



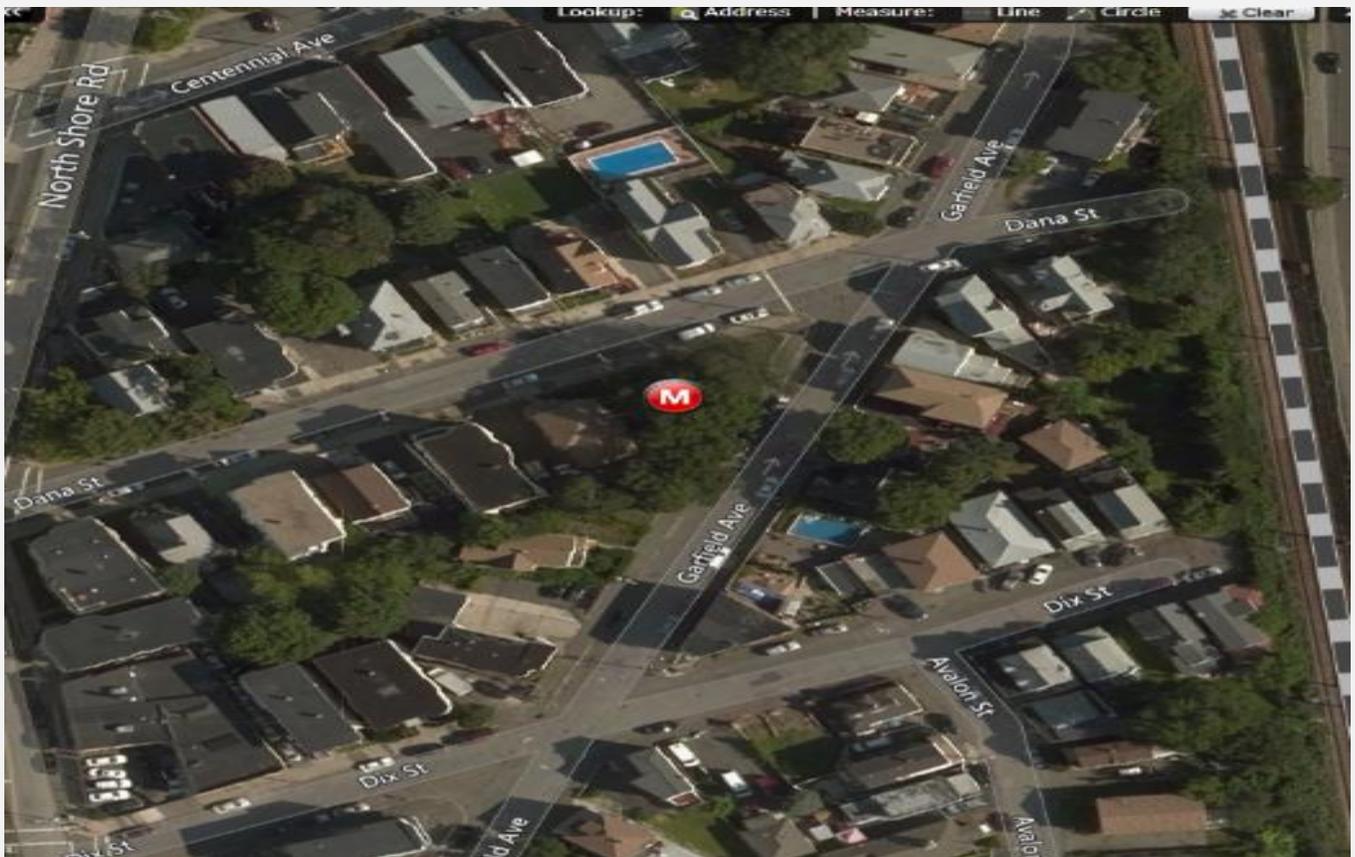
City	Metropolis, MA	Incident #	AFD232
Zone	MetropolisCityNorth	Docket/File #	232673324
Ref. Date	1/23/2015	Case Name	28700
Cust. Ref#	160114-013000	Report Date	2/2/2015

## DETAILED FORENSIC REPORT

### Shooting Description

At 02:08:03 (02:08:03 AM) hours on January 23, 2015 ShotSpotter detected a Multiple Gunshot incident in Metropolis, MA. ShotSpotter recorded the incident as Flex ID #1375 and located it at 27 Dana St.

### Position with Respect to the Coverage Area



**FIGURE 1**

*ShotSpotter Coverage Area: displays the ShotSpotter coverage in Metropolis, MA at the time of the incident. The red dot indicates the location of the shooting incident. M = multiple shots fired,*

### About ShotSpotter

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ShotSpotter was installed in Metropolis, MA in 2014. 5.78 Square Miles are covered within this Zone, with 101 sensors deployed across the coverage area. ShotSpotter has three primary components: acoustic sensors, a Location Server application, and the ShotSpotter Flex user interface. The ShotSpotter Location Server is operated by SHOTSPOTTER, Inc. and runs on a virtual server hosted at a remote facility, the ShotSpotter Flex user interface resides on the customers PC or mobile device. Acoustic sensors are deployed in geographic areas that are designated by the customer.

Each sensor is triggered by impulsive sounds in its environment. The acoustic measurements of these impulsive sounds and the exact time that they were detected are transmitted to the Location Server as possible gunshots. The Location Server analyses the data received and determines if the impulsive sound can be geographically located and classified as gunfire. If the impulsive sound can be located and classified as gunfire, Location Server reports the incident to the SHOTSPOTTER Service Operations Center where a human operator reviews the incident for classification accuracy. The reviewed incident is then published to the customer's user interface. The user interface, referred to as the Flex Alert Console, provides an actionable view of the incident with an emphasis on the time and location of the incident. Gunfire incidents are typically detected, located, classified, reviewed, and published to the customer in under 60 seconds.

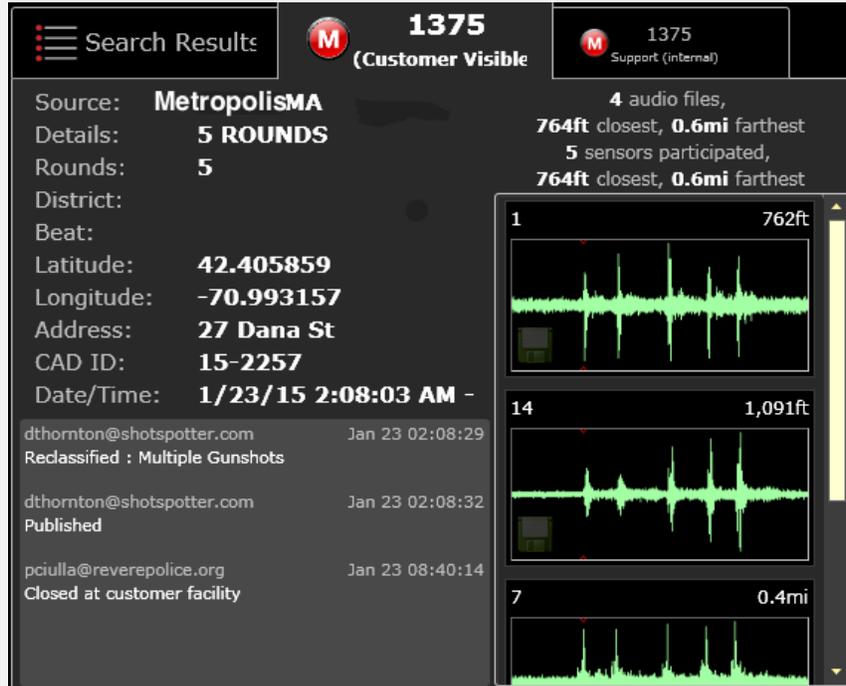
The firing of a gun or an explosive device creates a loud, impulsive sound that, under optimum environmental conditions, can be detected above urban background noise up to two miles away from the firing incident location. Thus, the operation of ShotSpotter is understandably subject to the laws of physics and acoustic propagation.

ShotSpotter detects and properly geo-locates (provides latitude and longitude) 90% of detectable outdoor incidents within the coverage area, accurate to within a circle whose radius is 25 meters (82ft). SHOTSPOTTER, Inc. does not guarantee 100% detection because real world environments may contain intervening buildings, topography, foliage, periods of increased traffic or construction noise, and other urban acoustic noises that may either prevent the sound of a gunshot from being detected by the sensor(s), or may change or modify the audio characteristics of the sound of a gunshot so that it no longer matches the sensor(s) detection parameters.

Other factors, such as obstructed or attenuated muzzle blast, weapon discharge in an enclosed space, or if the weapon discharged is of .25 or smaller caliber, may also prevent the sensor(s) from not detecting all, or some shots fired.

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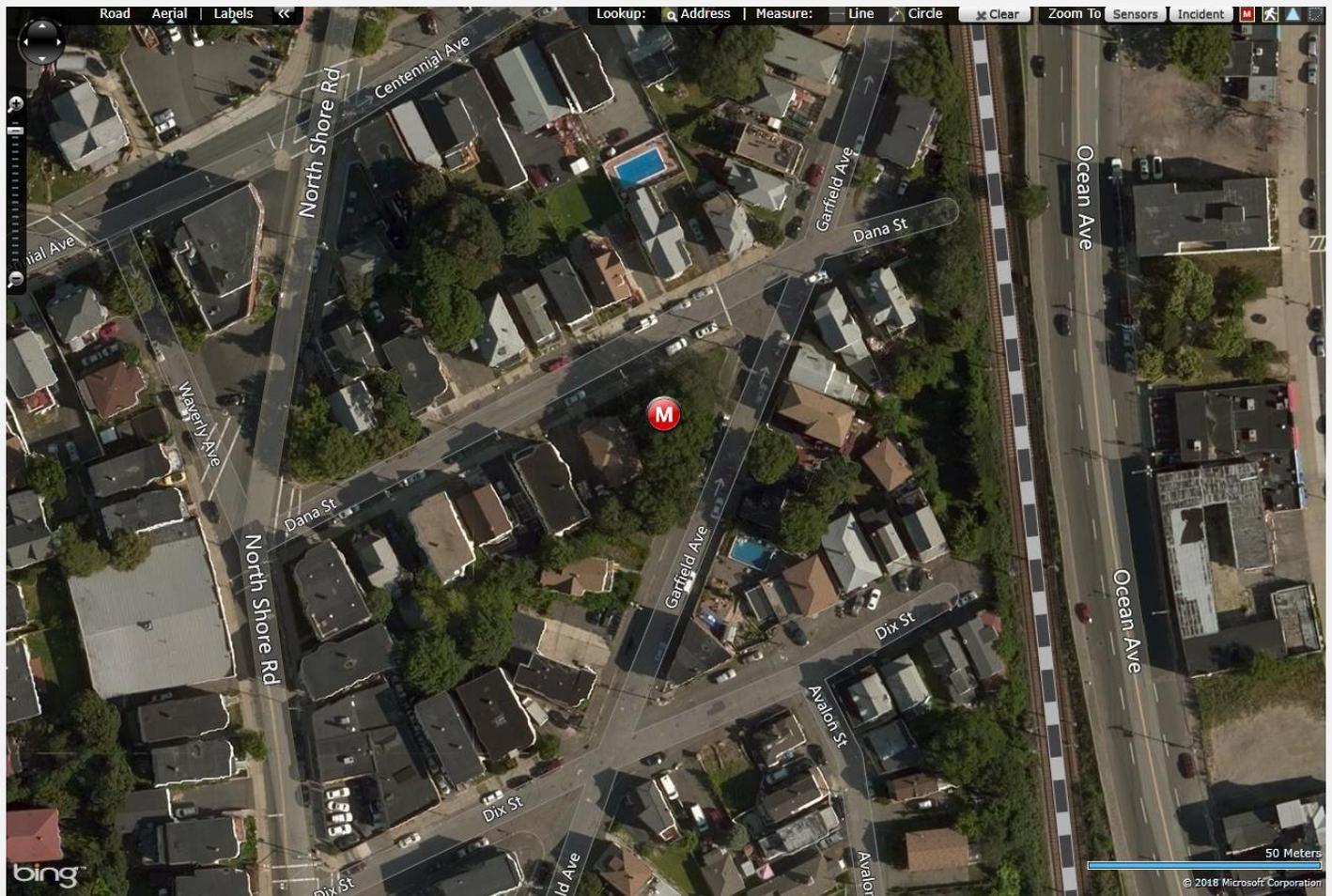
## Analysis



**FIGURE 2**

Incident review: At 02:08:03 on January 23, 2015, ShotSpotter detected and located a Multiple Gunshot incident in Metropolis, MA. Below is a table which shows the timeline of the incident being updated.

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**FIGURE 3.0**

*Address Location: This image displays the shooting location as calculated by ShotSpotter. The address of 27 Dana St. was read from either a database of parcel information provided by the city or county and uploaded into ShotSpotter or is sourced from the satellite map provider. The red dot indicates the location of the shooting incident as calculated by ShotSpotter in real-time and reported to the ShotSpotter operator.*

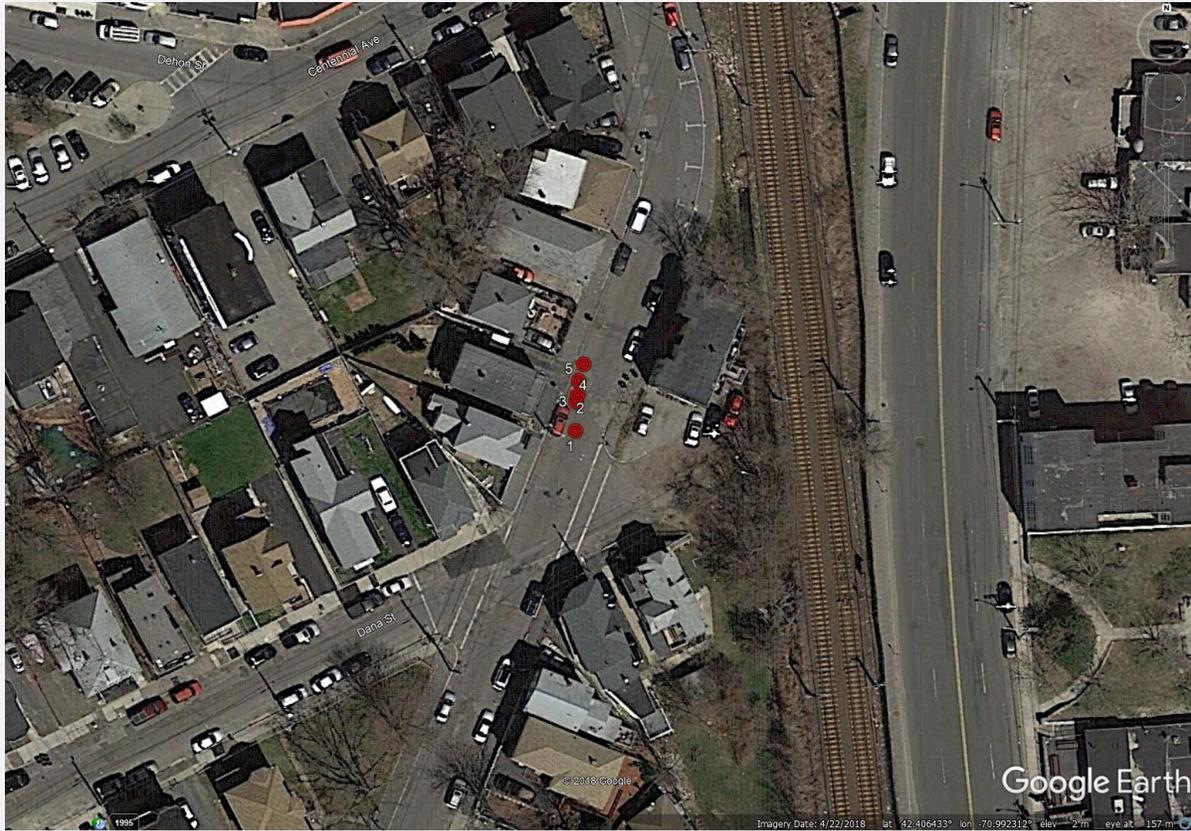
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Shot	Discharge Time
1	02:08:02.302
2	02:08:02.766
3	02:08:03.475
4	02:08:04.017
5	02:08:04.425

**TABLE 1.0**

*Timeline of Discharge of Shots: Above table shows the time of discharge for each of the shots which comprise this shooting event. The times listed below are the time the system calculated the trigger was pulled based on the environmental conditions at the time of the event. These times precede the time at which the system notified the ShotSpotter Operator listed because of small radio, computational, and network delays. All times are obtained from network, system, and sensor clocks that are synchronized to GPS time, which is in turn synchronized with the atomic clock at the National Institute of Standards and Technology in Boulder, CO.*

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**FIGURE 4.0**

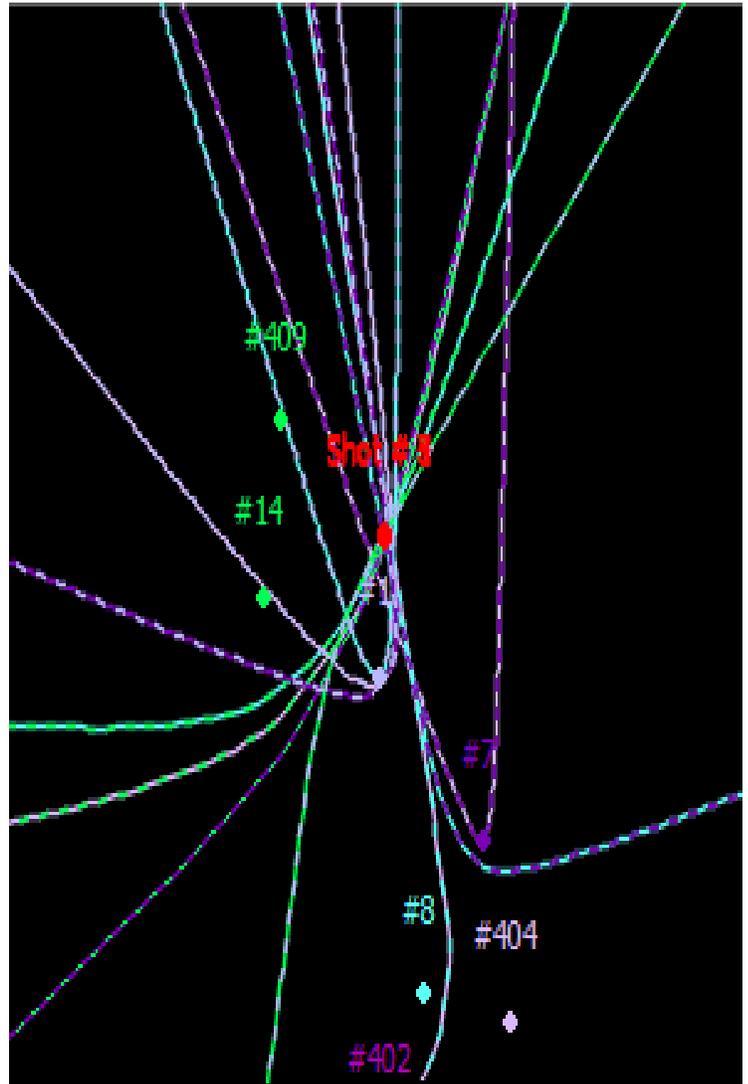
*Individual Shots Fired: The following image depicts the location of each shot onto a satellite image. The latitude and longitude of each shot is calculated by post-processing an incident's audio clips and archived data. Post-processing is a "manual" re-evaluation of incident data through software tools that duplicate the real-time location algorithms that are a resident part of the ShotSpotter Location Server. Post-processing can be selectively performed on subsets of the raw data so that noises from different sources can be isolated for analysis.*

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## Multilateration

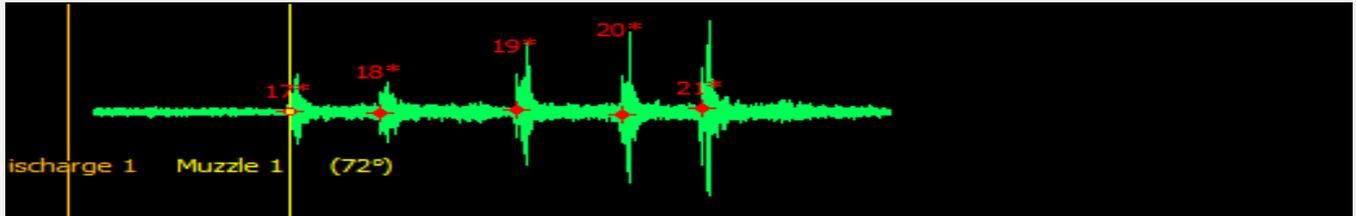
**FIG 5.0**

The source of an acoustic pulse (a sound that goes bang, boom, or pop) is located using a mathematical process called multilateration. Multilateration requires a minimum of three sensors that surround the source to accurately report the time that a pulse is detected. Each participating sensor will detect the same pulse at slightly different times. The Location Server calculates the time differences of detected pulses between unique pairs of sensors against the speed of sound (343 meters per second, or 768 mph) to generate a curve called a hyperbola. All the resulting hyperbolae are then plotted onto a map. The spot where the hyperbolae intersect is where ShotSpotter locates the shot. When more than three sensors participate in the detection, Location Server performs automatic calculations to find a solution that minimizes the error to the greatest extent possible. The image below is a pictorial representation of the hyperbolae calculated during the analysis of this shooting event. The map space depicts the shooting location at the intersection of the hyperbolae and the positions of the sensors used in the analysis relative to the shooting location.

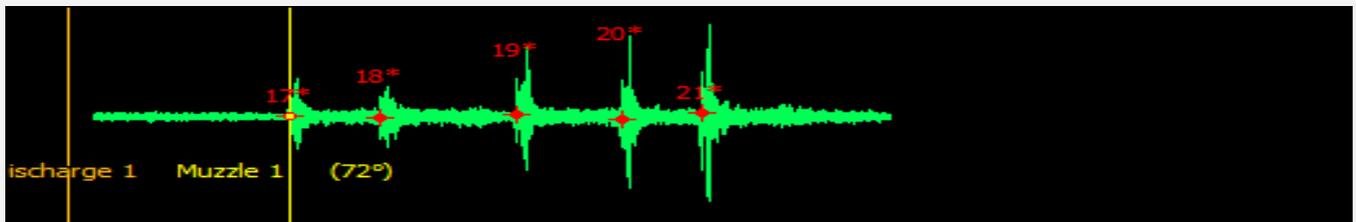


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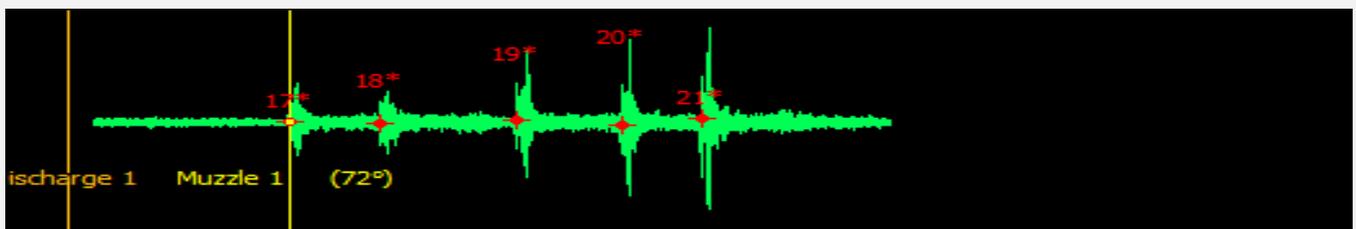
## Site-specific Acoustics



Sensor 1 (280m)



Sensor 1 (280m)



Sensor 1 (280m)

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## Conclusion

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At 02:08:03 (02:08:03 AM) hours on January 23, 2015 ShotSpotter detected a Multiple Gunshot incident in Metropolis, MA. ShotSpotter recorded the incident as Flex ID #1375 and located it at 27 Dana St. After review, the locations and times of 5 rounds fired were calculated. Acoustical data analysis of a gunfire incident is complex and not comprehensive. The conclusions above should be corroborated with other evidentiary sources such as recovered shell casings, and witness statements.

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## Certification

I, Jane Smith, declare that I am the Technical Support Engineer IV at ShotSpotter Inc. I have personal knowledge of the matter referred to in this report, and, if called as a witness, could and would testify thereto.

I declare that the above is true and correct.

Executed this \_\_\_\_\_ of \_\_\_\_\_, 2018, at Newark, CA.

\_\_\_\_\_

\_\_\_\_\_

Jane Smith

ShotSpotter, Inc. 7979 Gateway Blvd. Suite 210 Newark, CA 94560-1156 +1 (510) 794- 3114 +1 (650) 887-2106 fax rcayabyab@shotspotter.com

## California All-Purpose Certificate of Acknowledgement

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document

State of California / County of Alameda

On before me \_\_\_\_\_,

, Notary Public personally appeared Ronald B Cayabyab Jr who provided to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify UNDER PENALTY OF PERJURY, under the laws of the State of California that the foregoing paragraph is true and correct. Witness my hand and official seal.

\_\_\_\_\_

Name