City	**Davies County, US**	**Incident #**	**163069**
Zone	**DaviesCountyUS**	**Docket/File #**	**21-CV-NUMBER**
Ref. Date	**08 DEC 2019**	**Case Name**	**US v John Doe**
Cust. Ref#	**N/A**	**Report Date**	**01 JAN 2024**	**Author**	**P. Greene**

DETAILED FORENSIC REPORT

Shooting Description

At 20:23:59 (8:23:59 PM) hours on December 08, 2019, ShotSpotter detected a Multiple Gunshot incident in Davies County, US. ShotSpotter recorded the event as Incident# 163069 and located it at 1234 Main St.

Position with Respect to the Coverage Area
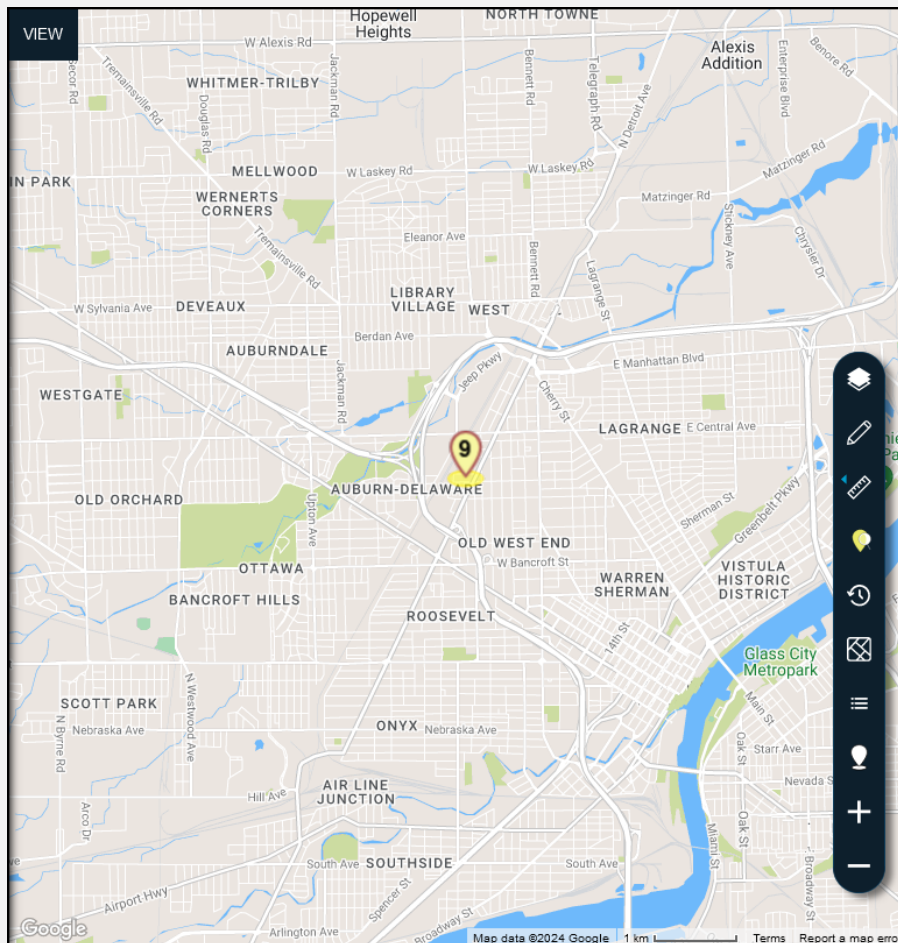
FIGURE 1.0
ShotSpotter City: displays Davies County, US at the time of the incident. The map pin indicates the location of the shooting incident.

City	Davies County, US	Incident #	163069		
Zone	DaviesCountyUS	Docket/File #	21-CV-NUMBER		
Ref. Date	08 DEC 2019	Case Name	US v John Doe		
Cust. Ref#	N/A	Report Date	01 JAN 2024	Author	S. Analyst

About ShotSpotter®

ShotSpotter was installed in Davies County, US (DaviesCountyUS) in 2020. This zone measures 5.78 Square Miles with ShotSpotter coverage provided by 101 sensors.

ShotSpotter has three primary components: acoustic sensors, a Location Server application, and a ShotSpotter user interface. Acoustic sensors are deployed in geographic areas that are designated by the customer. The ShotSpotter Location Server is operated by SoundThinking™, Inc. and runs on a virtual server hosted at a remote facility, the ShotSpotter user interface is run from a browser on the user's PC or from a mobile app.

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

Each acoustic 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 analyzes the data received and determines if the impulsive sound can be geographically located and classified as characteristic of gunfire. If the impulsive sound can be located and classified as possible gunfire, Location Server reports the incident to the ShotSpotter Incident Review Center where a human operator reviews the incident to classify it as gunfire or dismiss it as not gunfire. If the reviewer determines it is a gunfire incident, it is then published to the customer's user interface. The user interface provides an actionable view of the incident with an emphasis on the time and location that the shooting occurred. Gunfire incidents are typically detected, located, classified, reviewed, and published to the customer in under 60 seconds.

SoundThinking guarantees that ShotSpotter will detect and accurately geo-locate (provide latitude and longitude) 90% of detectable outdoor incidents within the coverage area, accurate to within a 25-meter (82ft) radius of the actual shooting location. SoundThinking does not guarantee 100% detection because real world, urban environments may contain intervening structures, topography, foliage, periods of increased ambient noise, and other urban acoustic noises that may either prevent the sound of a gunshot from being detected by the sensors(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 into or from an enclosed space, or if the weapon discharged is of .25 or smaller caliber, can all affect whether ShotSpotter can detect and accurately geo-locate a given shooting incident, and may also prevent the sensor(s) from detecting all the shots fired during an incident.

City	Davies County, US	Incident #	163069		
Zone	DaviesCountyUS	Docket/File #	21-CV-NUMBER		
Ref. Date	08 DEC 2019	Case Name	US v John Doe		
Cust. Ref#	N/A	Report Date	01 JAN 2024	Author	S. Analyst

Analysis

Reported Incident Detail: *At 20:23:59 on December 08, 2019, ShotSpotter detected and located a Multiple Gunshot incident in Davies County, US. Below is a table containing additional details about the incident.*

Agency:	Davies County PD
Source:	DaviesCountyUS
Incident Id:	419-163069
Rounds:	9
Address:	1234 Main St
Latitude:	41.749975
Longitude:	-87.633666
District:	
Beat:	310
CAD ID:	
Date/Time:	12/08/2019 @ 20:23:59

City	Davies County, US	Incident #	163069		
Zone	DaviesCountyUS	Docket/File #	21-CV-NUMBER		
Ref. Date	08 DEC 2019	Case Name	US v John Doe		
Cust. Ref#	N/A	Report Date	01 JAN 2024	Author	S. Analyst
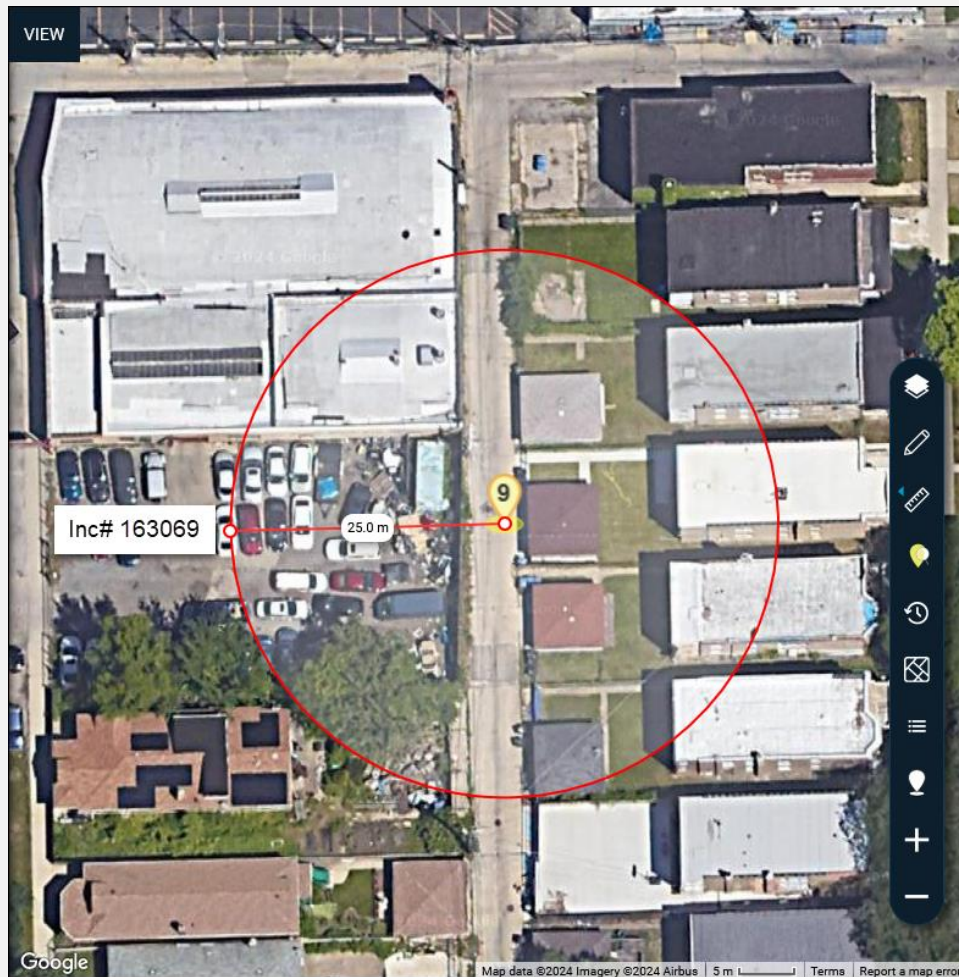
FIGURE 2.0

Address Location: *This image displays the shooting location as calculated by ShotSpotter's automated process. The map pin indicates the location of the shooting incident as calculated by ShotSpotter in real-time and reported to the ShotSpotter operator. All Street addresses were obtained by converting the calculated Latitude/Longitude of the incident detailed in **Table 1.0**, with either a database of parcel information provided by the city or county or by the satellite map provider.*

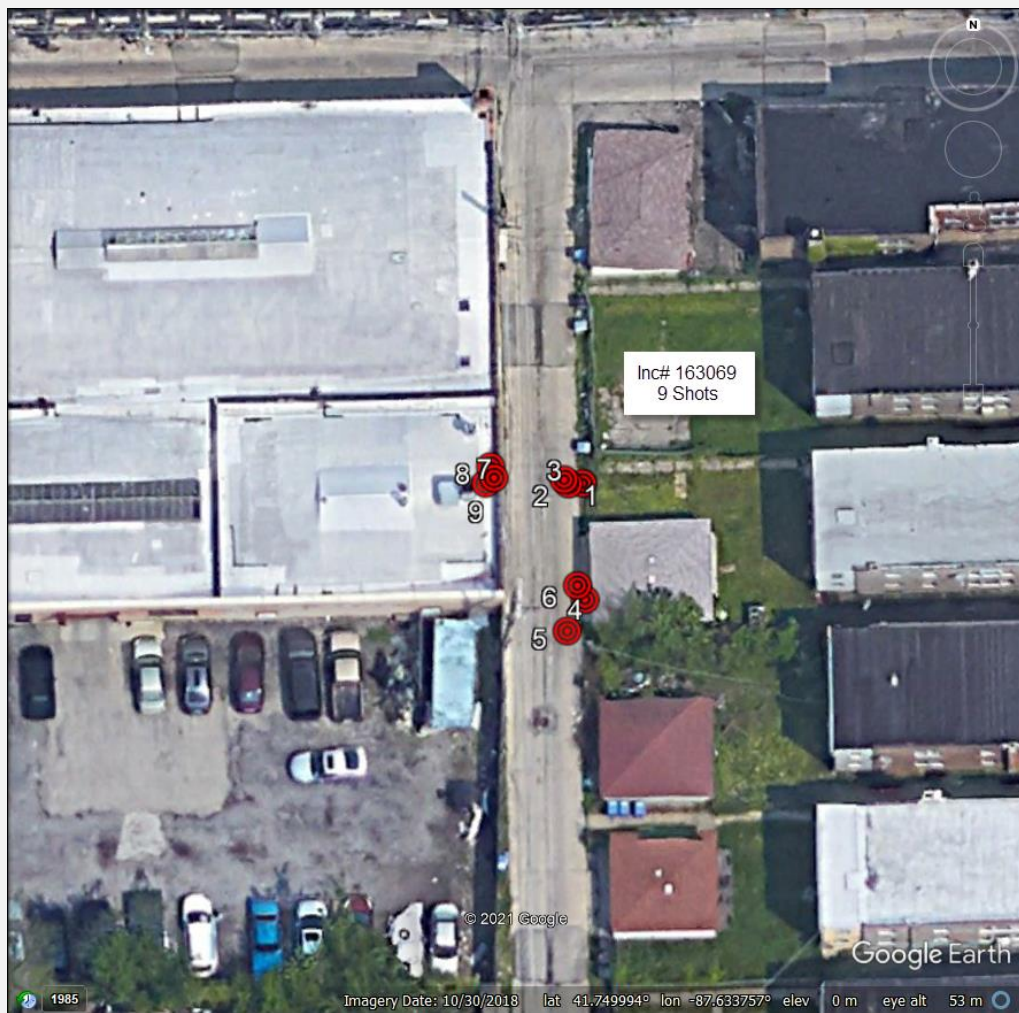| City	Davies County, US	Incident #	163069		
Zone	DaviesCountyUS	Docket/File #	21-CV-NUMBER		
Ref. Date	08 DEC 2019	Case Name	US v John Doe		
Cust. Ref#	N/A	Report Date	01 JAN 2024	Author	S. Analyst

TABLE 2.0

Timeline of Discharge of Shots and Calculated Shot Locations: *Below table shows the time of discharge, and the calculated Latitude and Longitude 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.*

IncidentID#	Shot#	Discharge Date	Discharge Time	Interval	Latitude	Longitude
163069	1	2019-12-08	20:23:56.533		41.750116	-87.633655
	2	2019-12-08	20:23:56.864	00:00:00.331	41.750115	-87.633665
	3	2019-12-08	20:23:57.109	00:00:00.245	41.750118	-87.633669
	4	2019-12-08	20:23:57.353	00:00:00.244	41.750053	-87.633654
	5	2019-12-08	20:23:57.932	00:00:00.579	41.750036	-87.633666
	6	2019-12-08	20:23:58.535	00:00:00.604	41.750061	-87.633659
	7	2019-12-08	20:23:59.287	00:00:00.752	41.750119	-87.633720
	8	2019-12-08	20:23:59.604	00:00:00.317	41.750125	-87.633722
	9	2019-12-08	20:23:59.831	00:00:00.227	41.750116	-87.633726
Total Elapsed Time			**00:00:03.298**			

FIGURE 3.0

Individual Shots Fired: *This 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.*

*In this image, the red dots indicate the calculated latitude and longitude locations of each of the shots as detailed in **Table 2.0**.*

City	Davies County, US	Incident #	163069		
Zone	DaviesCountyUS	Docket/File #	21-CV-NUMBER		
Ref. Date	08 DEC 2019	Case Name	US v John Doe		
Cust. Ref#	N/A	Report Date	01 JAN 2024	Author	S. Analyst

Multilateration

Multilateration Plot: *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.*

5 ShotSpotter sensors participated in automatically detecting and locating Incident# 163069. Post-process location analysis was performed using audio clips from 4 sensors.
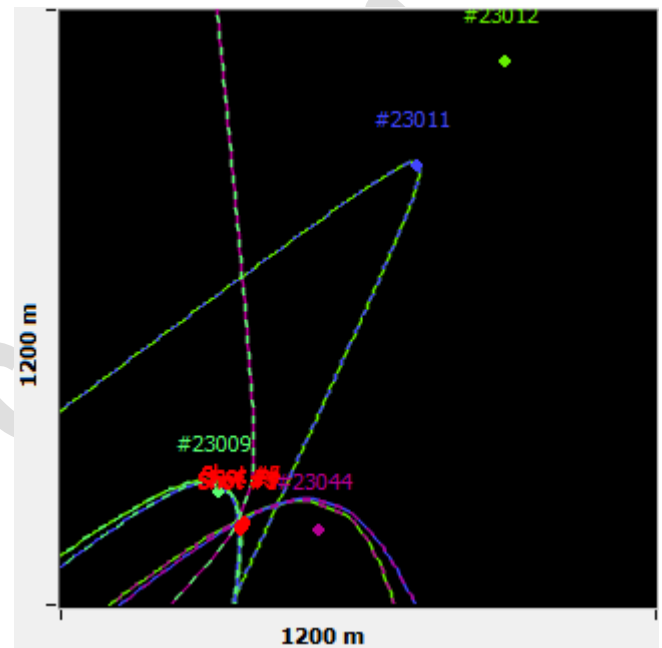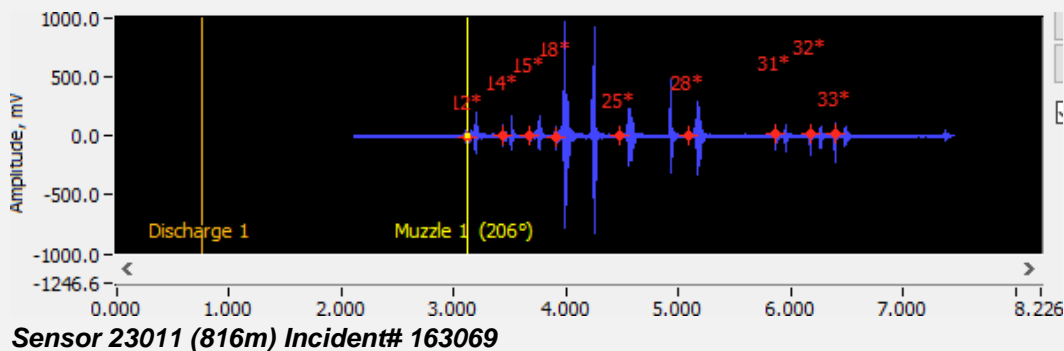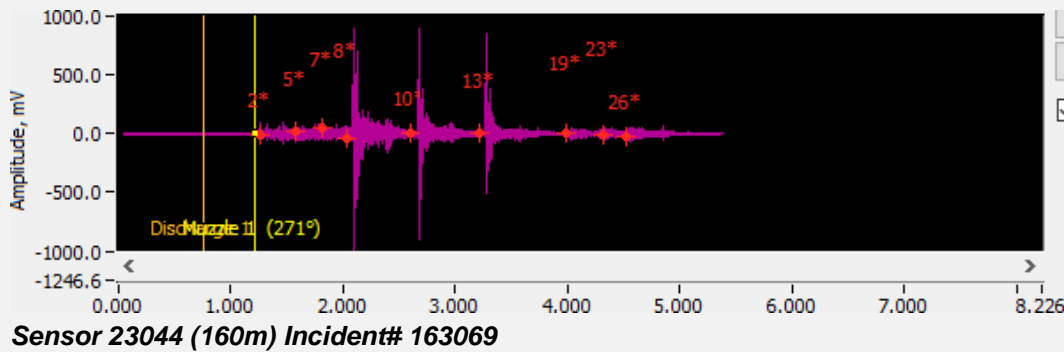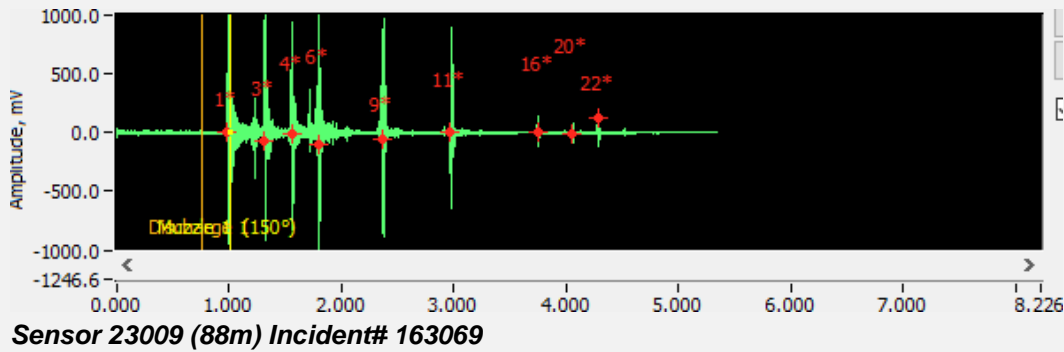

Fig 4.0

Site-specific Acoustics

The audio waveforms depicted below visually represent the incident audio that was recorded by, and downloaded from different sensors. Each sensor number also indicates the calculated distance from that sensor to the incident location.

Sensor 23009 (88m) Incident# 163069

Sensor 23044 (160m) Incident# 163069

Sensor 23011 (816m) Incident# 163069

City	Davies County, US	Incident #	163069		
Zone	DaviesCountyUS	Docket/File #	21-CV-NUMBER		
Ref. Date	08 DEC 2019	Case Name	US v John Doe		
Cust. Ref#	N/A	Report Date	01 JAN 2024	Author	S. Analyst

Conclusion

At 20:23:59 (8:23:59 PM) hours on December 08, 2019, ShotSpotter detected a Multiple Gunshot incident in Davies County, US. ShotSpotter recorded the event as Incident# 163069 and located it at 1234 Main St.

After review, the discharge times, and locations of 9 rounds fired were calculated and found to be within the 25m accuracy circle as described in the **About ShotSpotter** section. These results are listed in **Table 2.0** and depicted in **Figure 3.0** of this report.

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.

Davies County, US		Incident #	163069
DaviesCountyUS			

City	Davies County, US	Incident #	163069		
Zone	DaviesCountyUS	Docket/File #	21-CV-NUMBER		
Ref. Date	08 DEC 2019	Case Name	US v John Doe		
Cust. Ref#	N/A	Report Date	01 JAN 2024	Author	S. Analyst

Certification

I, Sam A. Analyst, declare that I am Forensic Services Manager at SoundThinking Inc., this report was prepared by me or is a true copy thereof. 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 date of_____

at _____, _____

Signature_____

Sam A. Analyst

SoundThinking, Inc.

39300 Civic Center Dr. Suite 300

Fremont, CA 94538

+1 (510) 794-3100

+1 (650) 887-2106 fax

forensics@soundthinking.com