Northgate Markets- Site at 2300-c Harbor Blvd.
Costa Mesa, CA

OUTDOOR AREA NOISE SIMULATIONS AND RECOMMENDATIONS

Report for: Le Architecture

February 10, 2023 V1.5

Report prepared by Gary Hardesty

Brief background and qualifications of Sound Media Fusion, LLC.:

Located in Van Nuys, California.

Facility includes:

1. Acoustic development and testing laboratory.
2. Electronic design development and testing laboratory.
3. Feature film motion picture augmented reality sound stage.
4. Acoustic and electronic simulation software systems of various kinds (NoisePlan, EASE, etc.).

SMF and its different generations, all founded by Gary Hardesty, have provided numerous services in the areas of acoustics, noise mitigation/monitoring, intellectual property creation and management (patents) and electronics, internationally, for more than 50 years.

We have provided the services of acoustic design, noise mitigation/monitoring, sound design and technical management for some of the largest events in the world, including:

-Olympic Opening and Closing Ceremonies and sports venues since the Los Angeles 1984 Olympics.

- Venue acoustic and sound system designs.
- Noise mitigation and monitoring design and management.
- Work includes all competition venues as well as Opening and Closing Ceremony.

-Continuous acoustic and mitigation work for the Vatican, including the large World Youth Day global events (the Toronto event featured a main site for the mass, which had more than 1.4 million people in attendance).

-24 years' work with the NFL on the Superbowl game, including acoustics, noise mitigation, sound design and management for the halftime shows.

-Academy Awards.

-Grammy Awards.

We have provided services for the Cities of Costa Mesa and Newport Beach, along with services for entities within those cities, including:

-20 years of acoustic design, noise monitoring/mitigation and technical management for the OC Fair, including reopening of Pacific Amphitheatre in 2003. In 2014, we redesigned the acoustics in Pac Amp, giving the Fair another 3.5 acres of usable land, while improving in-venue acoustics and out of venue noise mitigation- a $15 million project, also acting as project manager.

-Newport Dunes noise monitoring/mitigation and acoustic designs.

-Newport Beach pickleball courts acoustic designs and noise monitoring/mitigation.

-Balboa Bay Club noise mitigation.

-Various Costa Mesa venues.

-Acoustic design and noise mitigation/monitoring for large festivals in San Diego's Waterfront Park.

-Acoustic and sound system design for many international performing arts theaters, amphitheaters, and stadiums.

-Acoustic design for many large international theme parks, including Ocean Kingdom in China and EuroDisney in Paris.

A recent patent award was for a highly sophisticated type of high-power loudspeaker system (used for all Tokyo Olympic venues, including Opening and Closing Ceremony, as well as many fixed installations in theaters and stadiums in Japan, Korea, and Europe (licensed to one of our clients- Panasonic):

US010070217B2

(12) **United States Patent**
Hardesty

(10) **Patent No.: US 10,070,217 B2**
(45) **Date of Patent: Sep. 4, 2018**

(54) **SPEAKER APPARATUS**

(71) Applicant: **PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.**, Osaka (JP)

(72) Inventor: **Gary Allen Hardesty**, Northridge, CA (US)

(73) Assignee: **PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/439,392**

(22) Filed: **Feb. 22, 2017**

(65) **Prior Publication Data**

US 2018/0227663 A1 Aug. 9, 2018

(30) **Foreign Application Priority Data**

Feb. 3, 2017 (JP) 2017-019026

(51) **Int. Cl.**
H04R 1/02 (2006.01)
H04R 1/40 (2006.01)
H04R 3/14 (2006.01)

(52) **U.S. Cl.**
CPC ***H04R 1/403*** (2013.01); ***H04R 3/14*** (2013.01); *H04R 1/023* (2013.01)

(58) **Field of Classification Search**
CPC H04R 1/30; H04R 1/345; H04R 1/2861; G10K 11/02; G10K 11/025; G10K 9/00
USPC 181/152, 159, 177, 187; 381/339, 340
See application file for complete search history.

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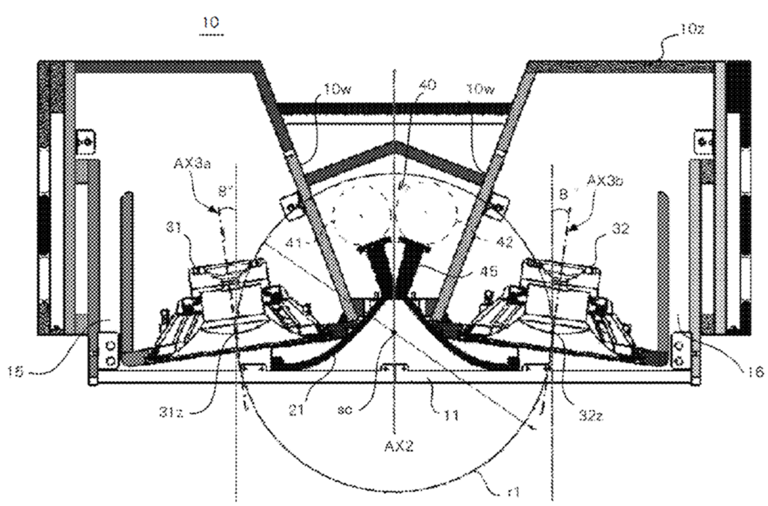
Primary Examiner — Sunita Joshi
(74) *Attorney, Agent, or Firm* — Greenblum & Bernstein, P.L.C.

(57) **ABSTRACT**

A speaker apparatus includes first acoustic drivers that respectively output first acoustic signals, and an acoustic coupler having acoustic passages. The acoustic passages respectively include inlets, and an outlet of the acoustic passages is common. The first acoustic signals output from the first acoustic drivers are respectively inlet into the inlets, the first acoustic signals inlet into the inlets are guided to the common outlet, the first acoustic signals are combined at the common outlet to generate a second acoustic signal, and the second acoustic signal is output. Lengths of the acoustic passages from the inlets to the common outlet are identical to each other.

4 Claims, 24 Drawing Sheets
(3 of 24 Drawing Sheet(s) Filed in Color)



Loudspeaker acoustic design and development for several large international clients (JBL, Yamaha, Panasonic).

SMF/Gary Hardesty past/present clients include (examples):

Panasonic, US Army, The Scenic Route, Inc., OC Fair, City of Newport Beach, City of Costa Mesa, Newport Dunes, F1 Racing, Palmer Audio, Lucasfilm, Meyer Sound, Eastern Acoustic Works, JBL Professional, Yamaha Corporation, US Olympic committee, Ocean Kingdom Theme Park-China, EuroDisney-Paris, NFL Superbowl, Wheel of Fortune, Academy of Country Music Awards, Grammy Awards, Academy Awards, Vatican, Mexico 2010 Bicentennial Committee, World Cup Soccer, Hult Center for the Performing Arts, Asian Games- Korea- Thailand, China, Main Stadium-Japan.

More than 200 large venues/stadiums globally, including: Japan, Korea, Greece, China, Russia, USA, Italy, Germany.

While it is beyond the scope of this proposal to detail all the various acoustic parameters that makeup noise, noise monitoring and mitigation, it is important to highlight some of the theory, for the ideas as proposed in this study to make sense.

Some theory:

From a physics perspective, sound is nothing more than small pressure changes traveling through:

> *Any elastic medium. These pressure variances propagate in all directions from- Anything that vibrates mechanically in or on that medium or even just contacting that medium-- things like vocal cords, guitar strings, saxophone reeds, or loudspeakers.
>
> The word 'medium' -means any molecular substance that contacts the vibrating source. It could be almost anything-- air is the most common example; but water could be an example too. Even the wood that contacts a violin string is an example.
>
> *An elastic medium is one in which the molecules can be displaced slightly but where they tend to spring back to their original or rest position.
>
> In a gas like air, molecules can be compressed (pushed closer together) and rarefied (pulled further apart) but they will always spring back to normal pressure. Water, steel, and wood also have a springiness that makes them good conductors of sound waves.
>
> *The pressure changes don't have to be very big to be perceived as sound. In a typical conversation at 1 meter, the difference between highest compression to lowest is only 00.0001%, one ten thousandth of a percent.
>
> In sound, waves of compression are always followed by mirror image waves of rarefaction (decompression) so that overall, the pressure remains normal.
>
> Remember that in sound it's not the air molecules that travel from the source to your ear but

rather the waves of compression and rarefaction of those molecules.

Finally, sound waves are:

*Mechanical energy-- an actual physical disturbance.

They are not like radio waves or light waves. These are electromagnetic energy.

How fast does sound travel? Sound waves travel at approximately 1128 feet per second in air that is 68 degrees Fahrenheit.

In sustained sounds, molecular displacement is usually repetitive and it often occurs with high regularity. That means it repeats the same way at very evenly spaced time intervals-- say every thousandth of a second.

This regularity is called periodic vibration. When vibrations repeat like this, the sound they produce has an identifiable pitch-- a musical tone.

If there is no regularity, then the vibration is aperiodic and produces noise. The physical vibrations that make sound can be nearly any frequency.

Experiments have shown that sound at 10 billion cycles per second is possible.

However, human ears respond to only a relatively small range of between 20 cycles per second and 20,000 cycles per second.

Even this range is significantly shortened by age and other conditions.

Within this range of 20 to 20,000 cycles per second (cps) humans are most sensitive to the frequencies between 1,000 and 5,000 cycles per second.

Cycles per second are now more commonly referred to as Hertz. So, what was 1,000 cps, is now referred to as 1,000 Hertz (or 1 KHz- ‘K’ meaning 1,000).

There are four important attributes that we can manipulate to create or describe any sound.

And, we can work with these attributes in two different ways: we can measure them and we can hear them.

If we measure them, they're called physical attributes: if we hear them, they're called perceptual attributes.

The four physical attributes are frequency, amplitude, waveform, and duration.
Their perceptual counterparts are pitch, loudness, timbre, and time.

There is similarity between hearing and measuring these attributes; however, it is a complex correlation. The two are not exactly parallel.

Frequency refers to how often the vibration repeats a complete cycle from rest position through compression through rarefaction and back to rest position.

This is usually stated in cycles per second (cps) or in Hertz (Hz) after the 19th century physicist Heinrich Hertz. Cps and Hz are the same measurement.

Pitch refers to our perception of frequency on a continuum from low to high.

Amplitude refers to how much energy is contained in the displacement of molecules that make up sound waves.

It is usually measured in decibels.

Decibels is a logarithmic scale in which each ten-number increase represents a tenfold increase in energy.

On this scale a 10 decibel increase equals 10 times the energy, but a 20-decibel increase = 100 times the energy and a 30-decibel increase = 1000 times the energy; etc.- logarithmic scaling.

We need this logarithmic scale because the loudest sound humans can hear is about 1 trillion times as powerful as the softest.

Each doubling of sound energy can be represented by a 3-decibel change. Loudness refers to our perception of amplitude and is sometimes stated in phons.

The least amount of amplitude humans can perceive as sound, starts the decibel scale at 0 dB. This is about a trillionth of a watt per square meter.

TABLE 22-1
Units of sound intensity. Sound intensity is expressed as power per unit area (such as watts/cm²), or more commonly on a logarithmic scale called *decibels SPL*. As this table shows, human hearing is the most sensitive between 1 kHz and 4 kHz.

Softer ↓ Louder ↑

Watts/cm²	Decibels SPL	Example sound
10^{-2}	140 dB	Pain
10^{-3}	130 dB	
10^{-4}	120 dB	Discomfort
10^{-5}	110 dB	Jack hammers and rock concerts
10^{-6}	100 dB	
10^{-7}	90 dB	OSHA limit for industrial noise
10^{-8}	80 dB	
10^{-9}	70 dB	
10^{-10}	60 dB	Normal conversation
10^{-11}	50 dB	
10^{-12}	40 dB	Weakest audible at 100 hertz
10^{-13}	30 dB	
10^{-14}	20 dB	Weakest audible at 10kHz
10^{-15}	10 dB	
10^{-16}	0 dB	Weakest audible at 3 kHz
10^{-17}	-10 dB	
10^{-18}	-20 dB	

We measure sound with a device called an 'SPL meter'.

Sound pressure level meters (SPL meters) incorporate ‘weighting filters’, which reduce the contribution of low and high frequencies to produce a reading that corresponds approximately to what we hear (‘curves’).

‘A weighting’, though originally intended only for the measurement of low-level sounds is now commonly used for the measurement of environmental noise and industrial noise, as well as when assessing potential hearing damage and other noise health effects at all sound levels; indeed, the use of A-frequency-weighting is now mandated for all these measurements.

History of A-weighting:

A-weighting began with work by Fletcher and Munson which resulted in their publication, in 1933, of a set of equal-loudness contours. Three years later these curves were used in the first American standard for sound level meters.

B-, C-, D- and Z-weightings:

A-frequency-weighting is mandated to be fitted to all sound level meters. The old B- and D-frequency-weightings have fallen into disuse, but many sound level meters provide for C frequency-weighting and its fitting is mandated — at least for testing purposes — to precision (Class one) sound level meters.

Sound Media Fusion uses a special laboratory calibrated meter made in Europe for our testing.

The meter can simultaneously show Z (flat frequency spectrum) measurements, as well as 'A', peak, LEQ, etc.

The meters also record the actual audio during a test, as well as all the raw data for later analysis.

We can hear what the sound was that was affecting a meter reading at a particular point in time.

While the A-weighting curve, as discussed previously, has been widely adopted for environmental noise measurement, and is standard in many sound level meters, it does not really give valid results for noise because of the way in which the human ear analyzes sound.

The distance of the measuring microphone from a sound source is often omitted when SPL measurements are quoted.

In the case of ambient environmental measurements of "background" noise, distance need not be quoted as no single source is present.

SPL meters are not smart- they present all the sound (noise) picked up by the meter at the meter's location, as a single SPL, or dB 'number'- be it traffic noise, whatever- it is all picked up and displayed as a number, representing the local environmental noise condition.

This local reading presents uncorrelated information, IE: it is not smart information, much as the human ears and brain- we can correlate and discriminate, a SPL meter cannot. The information obtained is ALL the local environment noise.

A trained human must make the measurements, as only this person can understand exactly what is taking place and how to solve it, as well as determine compliance, within the din of all the local background noise that may be present- another reason we record the actual audio, as well as the raw data- for later analysis.

Compliance monitoring is a very difficult science and requires sophisticated equipment and even more sophisticated operators, especially when the compliance monitoring involves noise buried in the overall ambient and local environmental noise.

The type of noise meter we use is called an 'integrating meter'. It can simultaneously record the actual audio taking place, as well as record and calculate the decibel reading- taking more than 16 samples every second.

As an example of our success, for 20 years we have provided noise monitoring and mitigation, acoustic design, sound system design, and video design services for the OC Fair and Events Center and Pacific Amphitheater in Costa Mesa.

The Costa Mesa Noise Ordinance, in brief:

TABLE N-2
CITY NOISE ORDINANCE STANDARDS-RESIDENTIAL

Exterior Noise Standards	Interior Noise Standards
55dBA-7:00 a.m. to 11:00 p.m.	55dBA-7:00 a.m. to 11:00 p.m.
50dBA-11:00 p.m. to 7:00 a.m.	45dBA-11:00 p.m. to 7:00 a.m.
NOTE: These represent the basic standards applicable for time periods exceeding 15 minutes each hour. Higher levels may be generated for specified shorter time periods.	

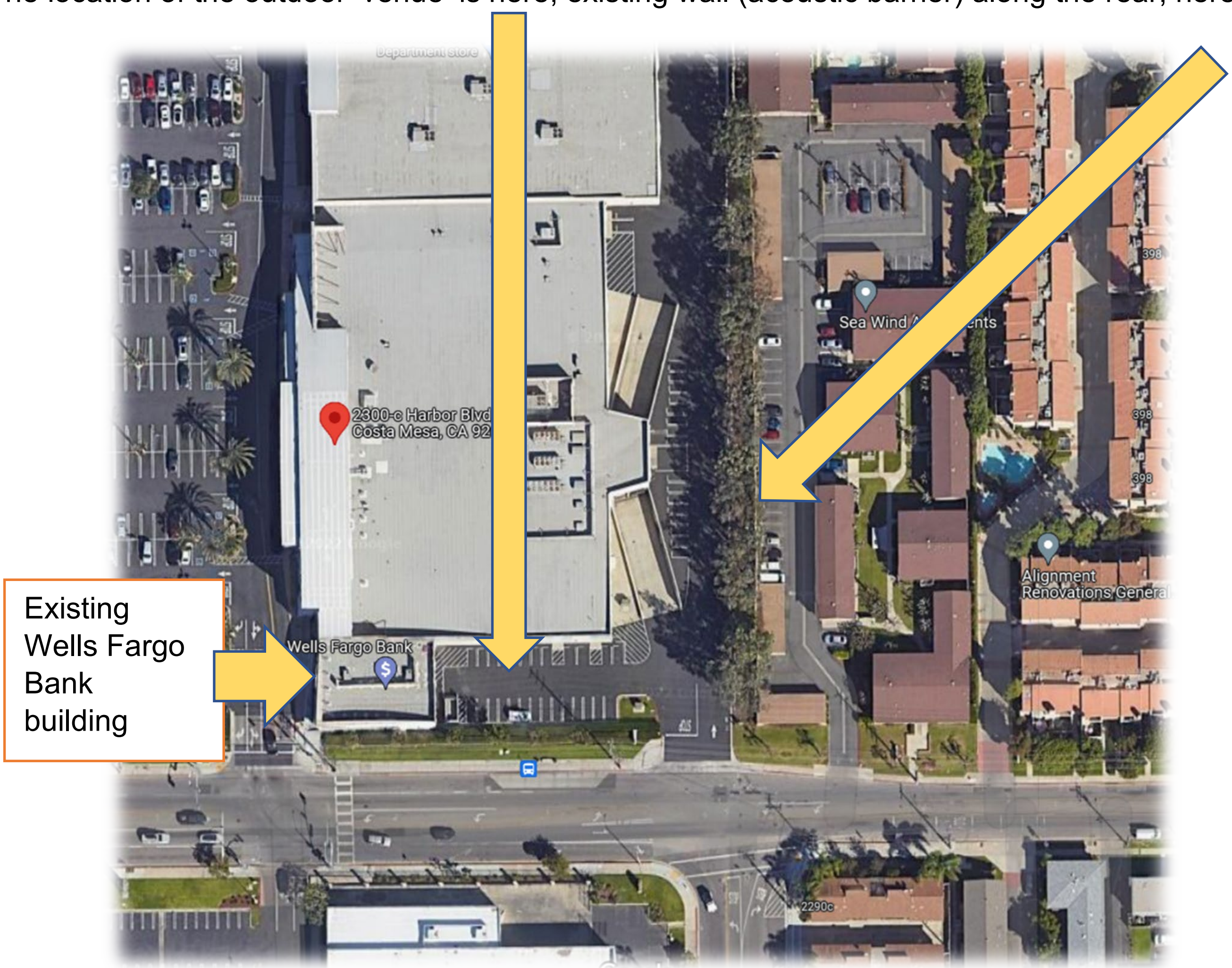
The Noise Ordinance prohibits stationary noise sources to exceed the following:

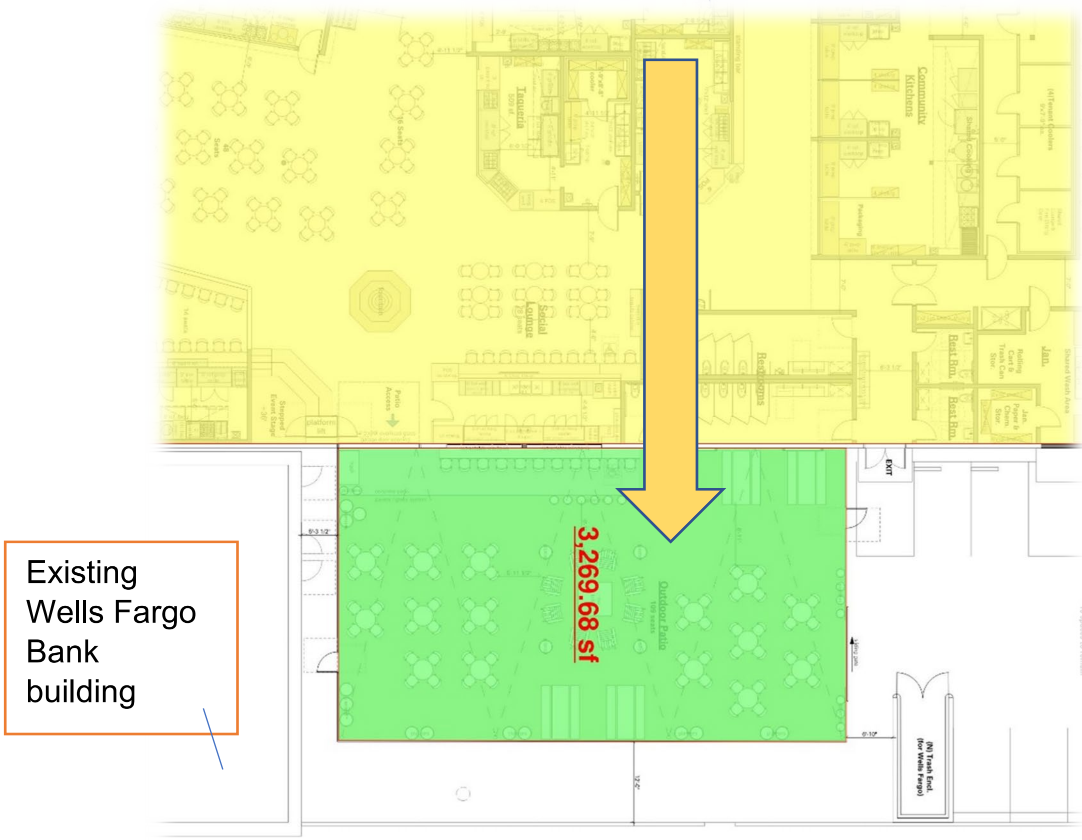
- ♦ The noise standard for a cumulative period of more than 30 minutes in any hour;
- ♦ The noise standard plus 5 dBA for a cumulative period of more than 15 minutes in any hour;
- ♦ The noise standard plus 10 dBA for a cumulative period of more than 5 minutes in any hour;
- ♦ The noise standard plus 15 dBA for a cumulative period of more than one minute in any hour; or
- ♦The noise standard plus 20 dBA for any period of time.

For the **Northgate Market- site at 2300-c Harbor Blvd., Costa Mesa**, we are discussing the following herein:

1. The proposed location of patron noise in an outdoor location;
2. Acoustic simulations which demonstrate likely noise levels based on several different scenarios;
3. Our recommendations for using the existing acoustic barrier, with the possible requirement of additional acoustic treatment if noise is a challenge;
4. Our recommendations for the acoustic barriers. The venue will have low level ambient music in the outdoor area, unobtrusive.

The location of the outdoor ‘venue’ is here, existing wall (acoustic barrier) along the rear, here





The venue will consist of outdoor seating for patrons who have purchased food in the marketplace and wish to dine outdoors.

We did several acoustic simulations to help us determine (from a purely simulated standpoint) what the expected housing area noise levels would be, based on several scenarios, and, considering the allowed noise levels based on the city noise standards.

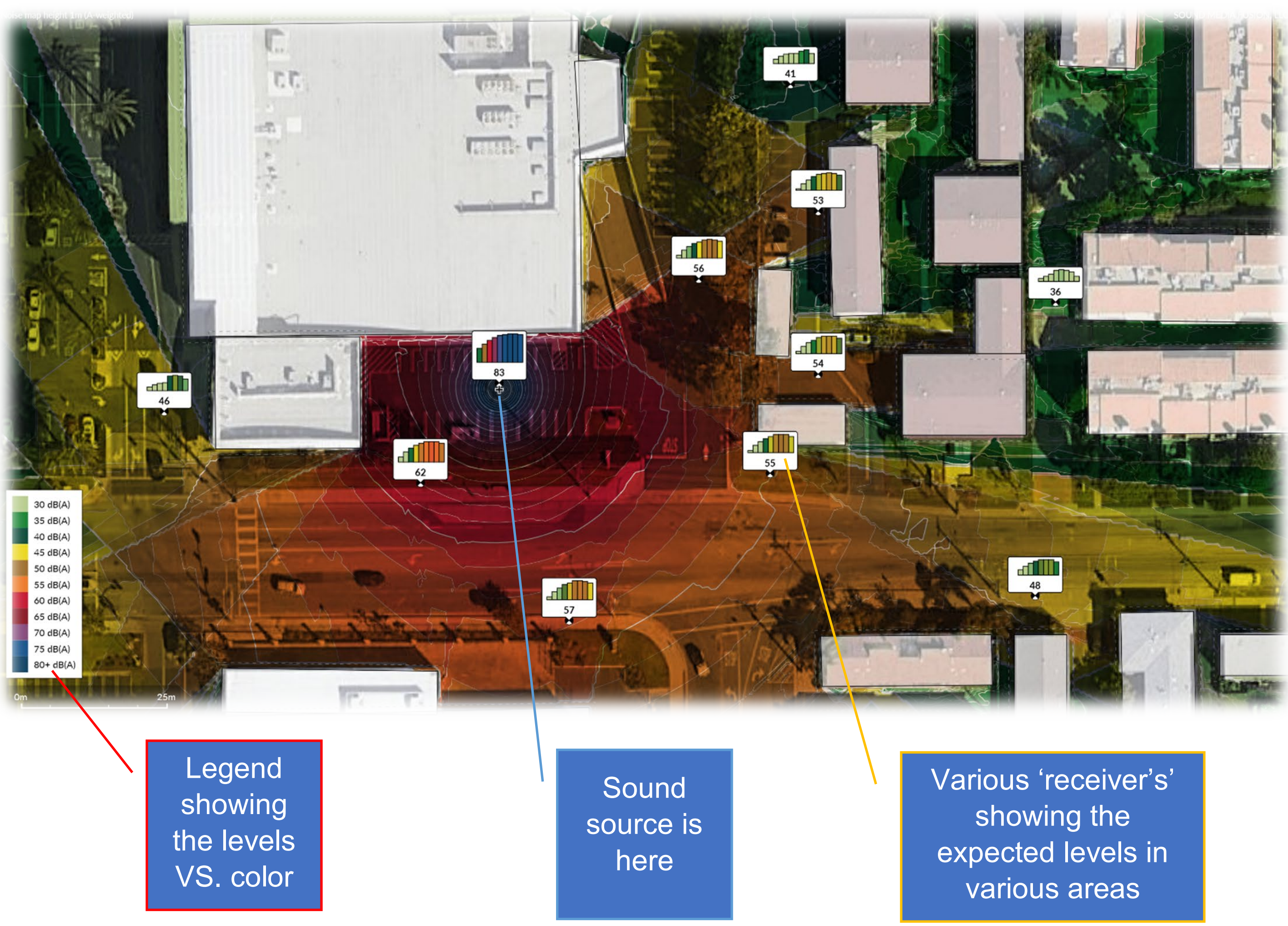
They follow on the next page.

Acoustic simulations are a good way to look at an area and study levels, reflections, barriers in order to 'see' what the likely sound levels will be in several different areas.

The simulations do not consider any local traffic noise, airplane noise or community noise- the displayed levels are based purely on the noise emanating from the location of the simulated sound source.

Likely, the addition of local ambient noise will help to mask noise from the venue, helping to put the venue noise into the overall acoustic landscape of the area.

The first simulation is showing expected noise levels, with no wall or other acoustic barrier around the outdoor venue, and, the sound source is located near the middle of the venue, closer to homes:



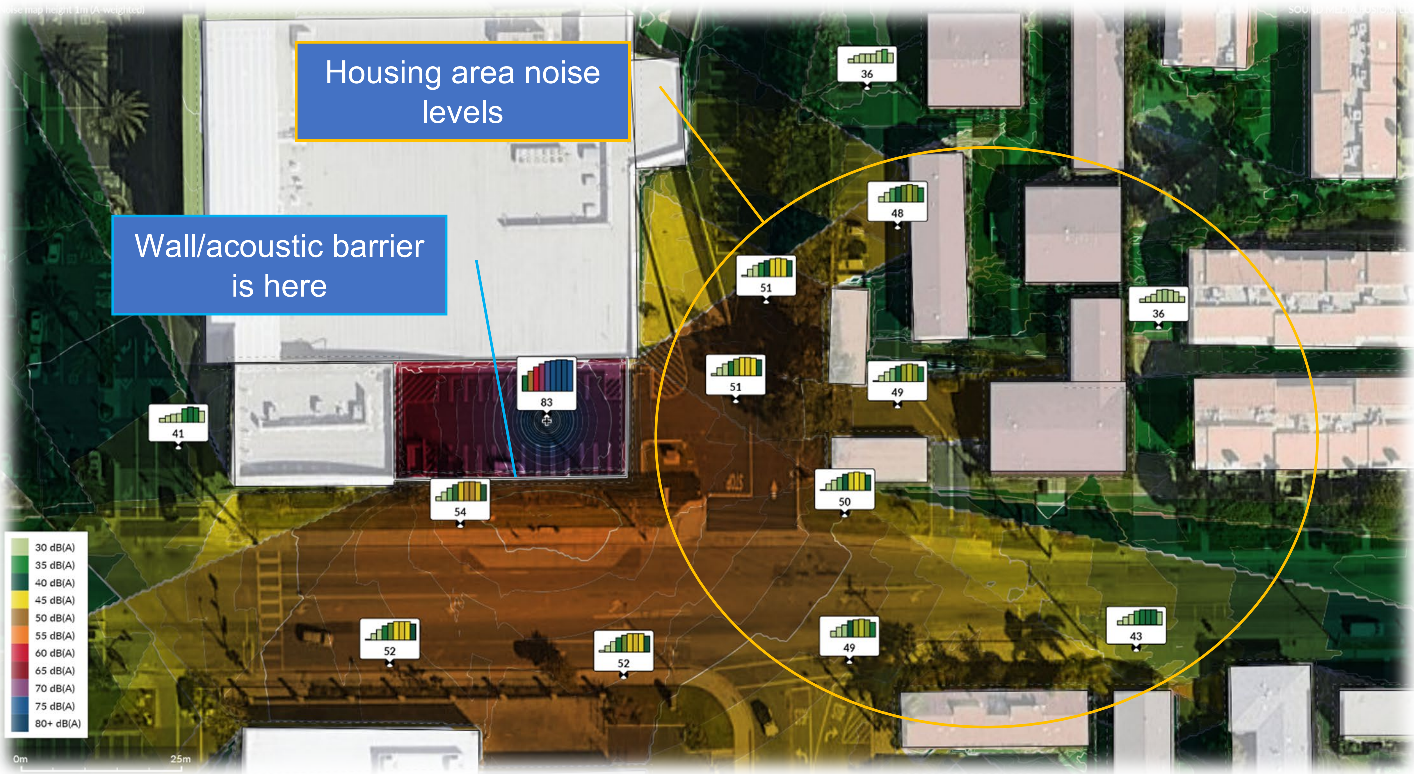
Conditions for the above are:

-No acoustic barrier;

-Sound source not in an optimum location;

-It shows that levels are marginally too high in housing areas.

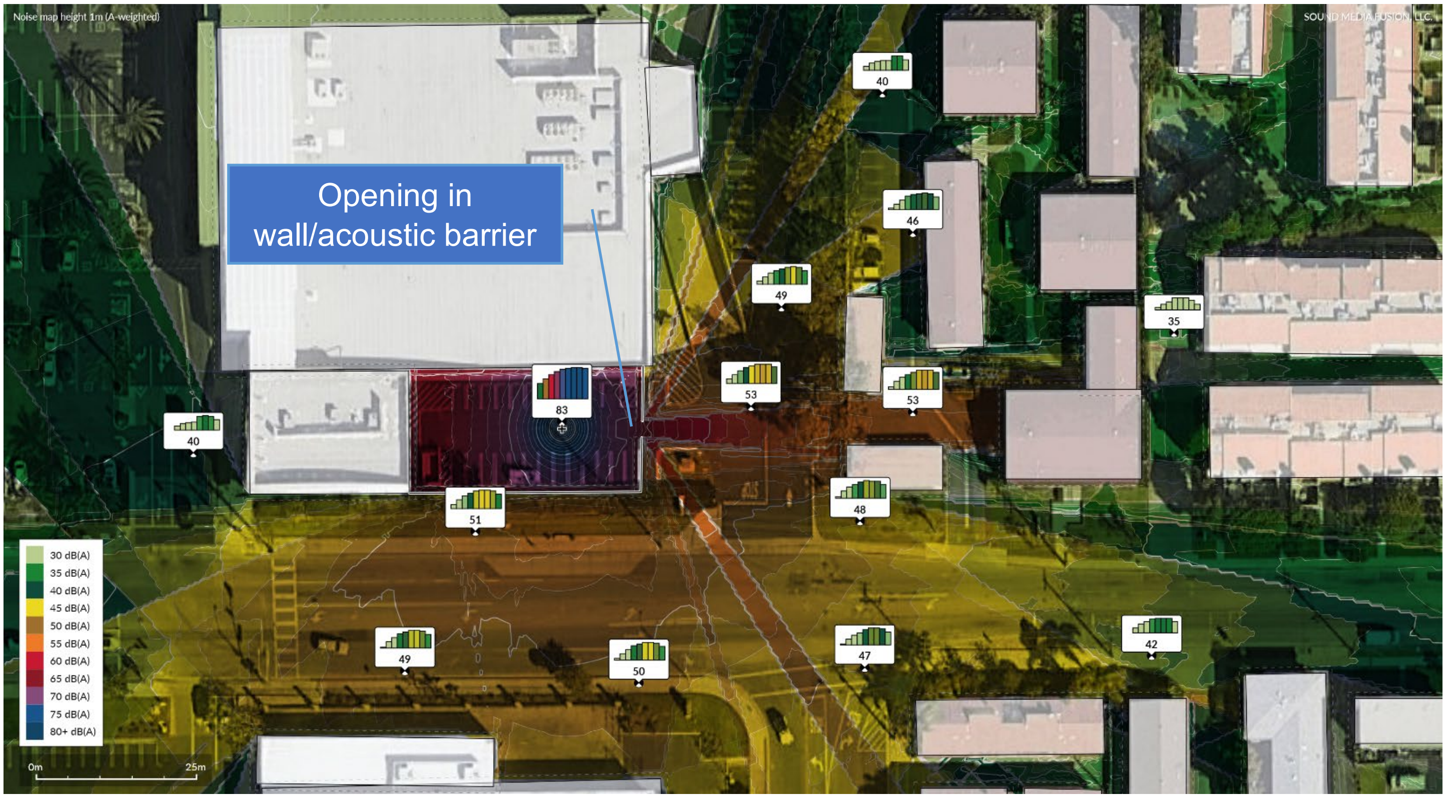
In the next simulation, we show the resulting sound levels using an **8-foot-tall acoustic barrier (wall)** around the venue, with no openings and the sound system not in an optimum location:



Note that housing area levels have dropped to around 50 dBA- the noise limit for after 11 PM usage.

Housing area levels are more acceptable, even though the sound system is not yet in an optimum location. You can clearly see, based on the color sound field display, how sound is more contained within the confines of the venue, via the acoustic barrier. Venue sound system is operated at a lower (much less ideal) sound level in this simulation- in order to try and meet noise compliance.

The next simulation is as above, with a 'door' (open) in the barrier, showing resulting noise higher in an area near the door, and past to door- indicating the importance of a relatively 'sealed' barrier:



The opening in the wall/acoustic barrier is allowing sound to propagate into housing areas- note the level increase (53 dBA) in the acoustic path of the open door, with the color field showing the acoustic path of the noise.

The following simulation is with a 10-foot wall/acoustic barrier surrounding the venue (no opening), and, the sound system is in a nearly ideal location (both in terms of housing area noise, and venue coverage).

The simulation shows the benefit of a higher wall/acoustic barrier (drop in level in housing areas) and the more ideal location of the sound system (near the market wall, facing left and right into the venue for better venue coverage). The in-venue sound level for this simulation was at 92 dBA near the speaker system, and, this level is a good level for the venue, and, as we can see in the simulation- using a 10-foot wall/acoustic barrier, this is the approximate maximum allowable level in order to meet compliance after 11 PM (compliance prior to 11 PM would allow a higher venue operating level- likely 94 dBA).

The final simulation is using a 12-foot-high wall/acoustic barrier:

The simulation is using the same sound level and location as in the previous simulation- note the levels have dropped to around 48 dBA in housing areas.

We have shown through our simulations that an acoustic barrier is important, and, the *venue does have a mitigation wall already installed, which is indicated earlier in this report.* The simulations herein serve to prove the benefits of various wall heights. We believe the existing wall will provide some benefit. How much is difficult to tell at this point.

Based on our past work for these types of venues, along with the noise ordinance and the simulations contained herein, we offer the following recommendations:

1. The venue has a wall near the east homes, as shown earlier in this report. This wall was installed per an earlier acoustic report and will help with noise mitigation, and, as stated in this report, a wall or barrier is required to mitigate noise. The potential challenge with this wall is that it may be too far away from the music source to properly mitigate. If it does not, a further wall may be required as stated below. We recommend monitoring the noise based on using the existing wall, and, if noise levels are too high, adjusting of sound levels and/or further acoustics barriers may be required.

2. If the venue does experience noise intrusion into the housing areas, a wall such as this (and as simulated herein) may be required: wall/acoustic barrier that is at minimum, 8 feet tall (the higher the better). The wall needs to be non-transparent to sound and of heavy construction (concrete block, etc., or construction which includes mass loaded vinyl:

https://acousticalsolutions.com/mass-loaded-vinyl-and-the-correct-uses-for-it within the wall structure):

a. The interior of the venue needs to have acoustic absorption placed at random areas on the walls (35% of the wall area), in order to absorb interior reflections and yield a better listening/talking environment.
b. The wall adjacent to the rear of the Wells Fargo bank building needs to be a separate wall, removed from the bank wall, in order to help prevent sound intrusion into the bank (assuming the venue is operating with music during bank hours). The interior of this wall should also use mass loaded vinyl, if the wall is not of heavy block or concrete type construction.
c. If the wall contains doors/emergency exits, these need to be well sealed, acoustically, when closed, and, ideally would be a double door (air lock type). Needs to be heavy construction, as doors can easily allow acoustic energy to escape into other areas.
d. The venue, outdoors, will have low level ambient music which will not increase noise levels outside of the venue.

3. The venue needs its own noise monitoring equipment (at least two devices), calibrated to the maximum allowed level, near the sound source and near the wall that is nearest to homes, such as:
   a. https://soundear.com/
4. Venue needs to understand that, always, noise compliance will be maintained. The actual venue sound system/band operating levels must be determined based on actual noise measurements at homes and within the venue, when venue is complete. In all cases, venue is to meet noise standards and ensure that sound outside the venue is non-disturbing.
5. Venue to employ a person to be responsible for maintaining proper venue noise levels, operate sound system and interface with performers.
6. Sound measurements by a professional sound monitor are to be made upon venue completion.

Addendum- February 10, 2023- Added concrete block wall, 4 feet high, topped by a 4 foot double pane glass barrier, parallel to Wilson Street, along with 8 foot tall block wall parallel to housing area:

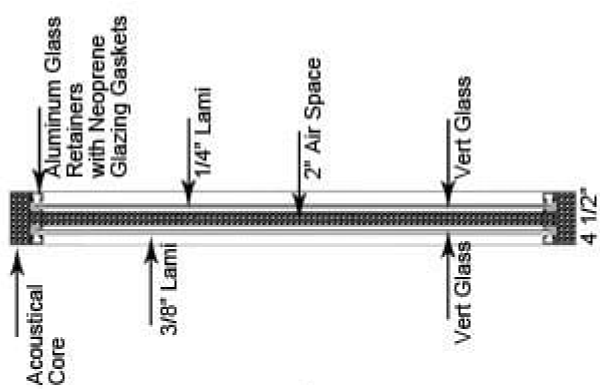
The architects have informed us that the venue will not have dedicated live music/DJ. The venue will have only low-level ambient music. This will allow the overall noise footprint to be significantly less. The ambient music will be no higher in volume than the patron noise in the venue- this will not impact exterior noise.

This addendum is in response to the City requesting a change in the venue wall structure along the area parallel to Wilson Street, to consist of an 8 foot barrier- lower 4 feet block construction and the upper 4 feet double pane glass type construction for visibility.

The glass area will need to be laminated glass of a double pane type construction in metal framing suitable for an outdoor environment.

To allow for better sound blockage, it is recommended to use glass panels of dissimilar thickness. Each pane in a dissimilar glass unit blocks different sound frequencies. One pane targets lower-frequency sounds. The other pane targets higher-frequency sounds. The result is sound control over a greater range of frequencies and a significantly higher noise blocking compared to a window with standard dual-pane glass.

Construction such as this (example only- not for construction):



The glass area will have slightly less noise blocking ability compared to concrete block construction- however, the wall structures and the fact that only low-level ambient music is planned in the outdoor area, will allow for good noise compliance.

As most of the noise is speech, at those frequencies, the glass upper portion will provide good blockage of sound.

We expect that the local surrounding noise levels outside of the venue, using the added block/glass wall parallel to Wilson, and the full 8-foot block wall parallel to the housing areas, will provide adequate noise isolation and the venue will be able to meet or exceed local noise ordinances.

We expect that the total noise output from the outdoor venue to be less than local ambient noise.

This company may be able to provide resources:

https://www.acousticalsurfaces.com/

geo@acousticalsurfaces.com

The concrete block interior surfaces need absorption material on them in order to provide a more pleasant patron experience (less 'echo') and to help with overall noise mitigation. The above referenced company can provide such materials.

Regarding simulating the noise using a combination block/glass barrier- the simulations showed similar performance as shown earlier in this report- no additional simulation is required.

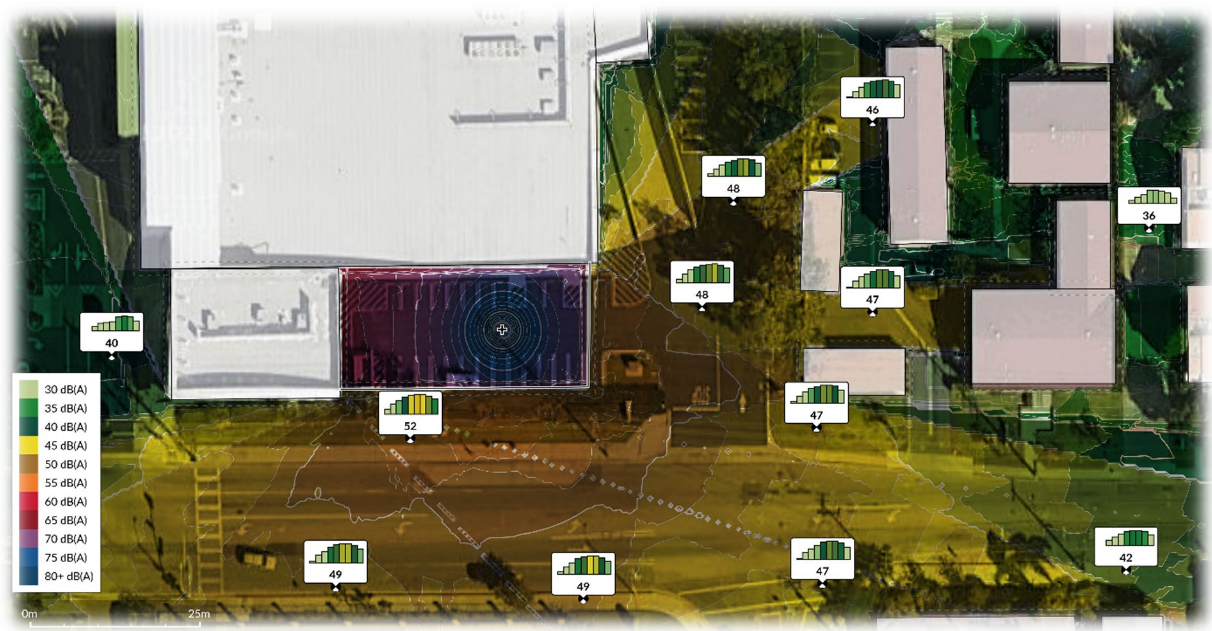
And, again, it is important to note that the venue will have only low-level ambient music outdoors (background music)- the noise is primarily people talking and this noise will be non-disturbing and will be relatively buried in the local ambient noise of traffic, etc.

Also note that block/glass portion of the wall is not facing a residential area.

Based on the primary facts:

1. The venue will be surrounded by a complete wall structure, as discussed in this addendum.
2. There will be only low-level ambient music.

3. The noise from the outdoor venue will blend into surrounding ambient noise, rendering it unobtrusive.
4. The venue combination of ambient music and patron noise (low level talking, etc.) should be limited to a level no higher than 82 dBA in the interior of the venue, as measured as an LEQ, based on the noise ordinance (time/level averaged according to the noise ordinance) which should allow the venue to easily meet or exceed the local noise ordinance.
5. The simulation below shows expected noise levels based on the block/glass wall, and ambient music (with interior venues noise averaging 82 dBA) and serves to indicate good noise compliance:



DISCLAIMER: information contained herein is based on simulations only and as such, levels and other details may need to be adjusted to comply with the noise ordinance. Information contained herein is believed to be correct and *usable as a guideline only*, to design acoustic barriers, sound system and such. Simulations approximate an acoustic situation, not an actual situation.

This document is not a design document- it is meant as a guide for further work by others, in order to meet compliance.

END of report.