DATE: *August 11, 2020*

TO: *Lee Momon – Seattle Public Utilities*

FROM: *Ellie Myers*
Justin Morgan, INCE

RE: ***DRAFT*** *North Transfer Station – 2020 Q2 Noise Monitoring Report*

Transmitted by: ☐ Mail ☐ Delivery ☐ Fax ☒ E-mail

INTRODUCTION

The intent of this memorandum is to present the results of staffed sound level measurements conducted on June 17, 2020 and June 27, 2020 to document daytime and nighttime sound levels from operations at the North Transfer Station and to determine compliance with applicable regulatory criteria.

NOMENCLATURE

The auditory response to sound is a complex process that occurs over a wide range of frequencies and intensities. Decibel levels, or "dB," are a form of shorthand that compresses this broad range of intensities with a convenient numerical scale. The decibel scale is logarithmic. For example, using the decibel scale, a doubling or halving of energy causes the sound level to change by 3 dB; it does not double or halve the sound loudness as might be expected.

The minimum sound level variation perceptible to a human observer is generally around 3 dB. A 5-dB change is clearly perceptible, and an 8 to 10 dB change is associated with a perceived doubling or halving of loudness. The human ear has a unique response to sound pressure. It is less sensitive to those sounds falling outside the speech frequency range. Sound level meters and monitors utilize a filtering system to approximate human perception of sound. Measurements made utilizing this filtering system are referred to as "A weighted" and are called "dBA".

Common sound pressure levels are presented in Table 1.

Table 1. A-weighted Levels of Common Sounds

Sound	Sound Level (dBA)	Approximate Relative Loudness[1]
Jet Plane @ 100 feet	130	128
Rock Music with Amplifier	120	64
Thunder, Danger of Permanent Hearing Loss	110	32
Power Mower	100	16
Food Blender at 3 feet	90	8
Busy Street	80	4
Interior of Department Store	70	2
Ordinary Conversation at 3 feet	60	1
Quiet Car at Low Speed	50	1/2
Average Office	40	1/4
City Residence, Interior	30	1/8
Quiet Country Residence, Interior	20	1/16
Rustle of Leaves	10	1/32
Threshold of Hearing	0	1/64

1. As compared to ordinary conversation at 3 feet.

Source: US Department of Housing and Urban Development, Aircraft Noise Impact Planning Guidelines for Local Agencies, November 1972., California Department of Transportation

Metrics

- **Equivalent Sound Level, L_{eq}**
  L_{eq} is the A-weighted level of a constant sound having the same energy content as the actual time-varying level during a specified interval. The L_{eq} is used to characterize complex, fluctuating sound levels with a single number. Typical intervals for L_{eq} are hourly, daily and annually.

- **Maximum Sound Level, L_{max}**
  L_{max} is the maximum recorded root mean square (rms) A-weighted sound level for a given time interval or event. L_{max} "fast" is defined as a 125-millisecond time-weighted maximum, while L_{max} "slow" corresponds to a 1-second time-weighted maximum. All values in this report are "fast" time-weighted, which corresponds closest to the typical response time of the human ear and are used in local regulatory criteria.

- **Sound Pressure Level, SPL**
  Sound pressure level correlates with what is heard by the human ear. SPL is defined as the squared ratio of the sound pressure with reference to 20 µPa. Sound pressure is affected by distance, path, barriers, directivity, etc.

REGULATORY CRITERIA

The Seattle Municipal Code (SMC) Section 25.08 specifies permissible sound levels within the City of Seattle. SMC 25.08.410 defines allowable exterior sound level limits based on land use zoning, as listed in Table 2 below.

Table 2. Exterior Sound Level Limits, L_{eq}[1] (L_{max}[2])

District of Sound Source	District of Receiving Property		
	Residential	Commercial	Industrial
Residential	55 (70)	57 (72)	60 (75)
Commercial	57 (72)	60 (75)	65 (80)
Industrial	60 (75)	65 (80)	70 (85)

1. Measurement time is 1-minute minimum for a constant sound source, 1-hour for a non-continuous sound source.
2. During measurement intervals, L_{max} may exceed L_{eq} limits by no more than 15 dBA.
Source: SMC 25.08.410 Exterior Sound Level Limits

Modifications to the exterior sound level limits set forth in Table 2 above are outlined in SMC 25.08.420. These modifications are for certain times of the day, classification of receiving properties, and the type of sound generated. These modifications to the exterior sound level limits include the following reductions:

- 10 dBA during the nighttime hours between the hours of 10:00 PM and 7:00 AM during weekdays and 10:00 PM and 9:00 AM on weekends and legal holidays when the receiving property is within a Residential district.
- 5 dBA for sources that carry a pure tone component.
- 5 dBA for impulsive sources not measured with an impulse sound level meter.

These modifications are cumulative and independent of one another. Therefore, the permissible nighttime exterior sound level in a Residential district for an impulsive, tonal source would be 20 dBA less than the exterior sound levels described in Table 2 above.

The area surrounding the Transfer Station is a mix of Residential (SF 5000) to the North and East, Commercial (C2) to the North, East and Southwest, and Industrial Commercial (IC-45) to the West and South. The Site is zoned Industrial Buffer, Industrial Commercial as well as Commercial, however the community agreement requires that for the evaluation of compliance with Noise Code, the entire site is considered a Commercial zone. The permissible daytime sound level limits for the Transfer Station at receiving property lines are summarized in Table 3 below.

Table 3. Transfer Station Sound Level Limits, L_{eq} (L_{max})

Time Period	Residential	Commercial	Industrial
Daytime	57 (72)	60 (75)	65 (80)
Nighttime	47 (62)	60 (75)	65 (80)

SOUND LEVEL MEASUREMENTS

Staffed sound level monitoring took place between 8:00 AM and 5:30 PM on Wednesday June 17, 2020 and from 8:00 AM to 9:00 AM on Saturday June 27, 2020. The measurements on June 17, 2020 were made for the duration of the North Transfer Station's operating hours and coincide with the facility's peak operating times based on information provided by Seattle Public Utilities (SPU). The measurements on June 27, 2020 were conducted to assess compliance with nighttime SMC sound level limits while the North Transfer Station operates between 8:00 AM and 9:00 AM on weekends, when nighttime sound level limits apply.
During both measurement periods, sound levels were monitored concurrently near two residential properties north and east of the Transfer Station. The average wind speed on June 17, 2020 was 2 MPH and temperatures ranged between 60-and 75-degrees Fahrenheit. On June 27, 2020 the average wind speed was 2 MPH and the temperature was 57-degrees-Fahrenheit. There was no precipitation accumulation during the measurements.

Monitoring staff were stationed near the sound level meters to document specific on-site noise events. Measurements were conducted in general accordance with the most recent version of ASTM E1503.

Measurement Equipment

Sound level measurements were conducted using ANSI Type 1 instrumentation calibrated by a certified laboratory within one year of the measurement date. Equipment used during the measurements are identified in the Tables below.

Table 4. Measurement Equipment June 17, 2020

Make and Model	Description	Serial
Svantek 307	Sound level analyzer	78628
Svantek ST30	Microphone	82345
Larson Davis CAL200	Acoustic Calibrator	16826
Svantek 971	Sound level analyzer	68284
Aco Pacific 7052E	Microphone	68284
Svantek SV18	Preamp	72239
Larson Davis CAL200	Acoustic Calibrator	16827

Table 5. Measurement Equipment June 27, 2020

Make and Model	Description	Serial
Svantek 307	Sound level analyzer	78646
Svantek ST30	Microphone	82620
Larson Davis CAL200	Acoustic Calibrator	16826
Svantek 971	Sound level analyzer	68284
Aco Pacific 7052E	Microphone	68284
Svantek SV18	Preamp	72239
Larson Davis CAL200	Acoustic Calibrator	16827

Field calibrations of monitoring equipment were performed immediately before the measurements and verified after the measurements were completed. Audio recordings were made at both monitoring locations to allow for sound source identification after the

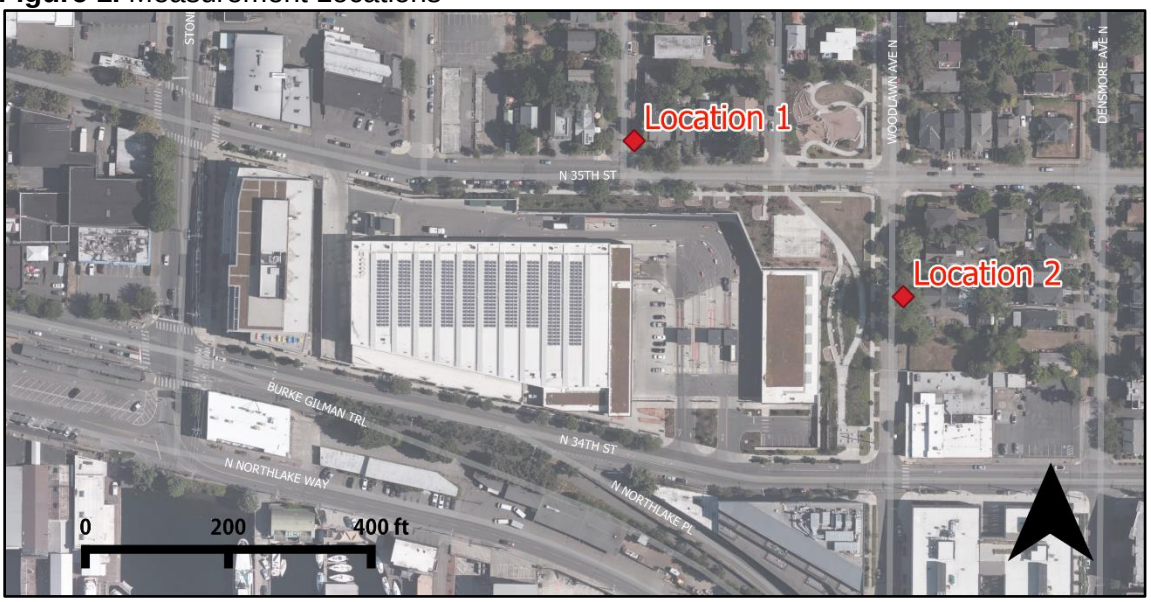
measurements were completed. One-second and hourly average (L_{eq}) and maximum (L_{max}) sound levels were collected during the monitoring.

Measurement Locations

Sound levels were measured at two residential properties near the Transfer Station. Microphones were positioned as close to residential property lines as feasible at approximately 10 feet above grade. A figure showing the measurement locations as well as the address closest to the monitoring locations are provided below.

- Location 1: 3512 Ashworth Avenue North (approximate)
- Location 2: 3420 Woodlawn Avenue North

Figure 1. Measurement Locations



Photos of the sound monitoring equipment at the two monitoring locations are provided in Photos 1 and 2 below.

Photo 1. Equipment at Location 1

Photo 2. Equipment at Location 2

RESULTS

After the measurements were completed, data was reviewed to identify noise events associated with SMC exceedances. Due to the high number of off-site sound sources at the monitoring locations, average sound levels (hourly L_{eq}) from the Transfer Station were not able to be determined, therefore the analysis was restricted to maximum sound levels (hourly L_{max}) only. Off-site sound sources included vehicle traffic, car horns, aircraft, pedestrians, and wildlife. Figures illustrating the measured L_{max} sound levels and all events above the SMC L_{max} sound level limit are provided in the Appendix.

Seattle Municipal Code Exceedances

During the measurements, a combined total of 667 seconds of data were above either the SMC daytime or nighttime L_{max} sound level limits, all resulted from off-site sound sources including vehicle traffic, car horns, aircraft, pedestrians, and wildlife. These off-site sound sources are summarized in Table 5 below and are presented graphically in the Appendix.

Table 5. Number of Seconds Sound Sources Exceeded SMC L_{max} Limits

Event	June 17, 2020		June 27, 2020		Total Events
	Location 1	Location 2	Location 1	Location 2	
Vehicle	55	91	181	47	374
Car Horn	2	0	0	0	2
Plane	5	0	11	0	16
Pedestrian	4	6	0	0	10
Car door	3	9	0	0	12
Misc	146	63	9	0	218

CONCLUSION

All operations at the North Transfer Station complied with daytime and nighttime Seattle Municipal Code L_{max} sound level limits during the measurement periods.

Respectfully submitted;

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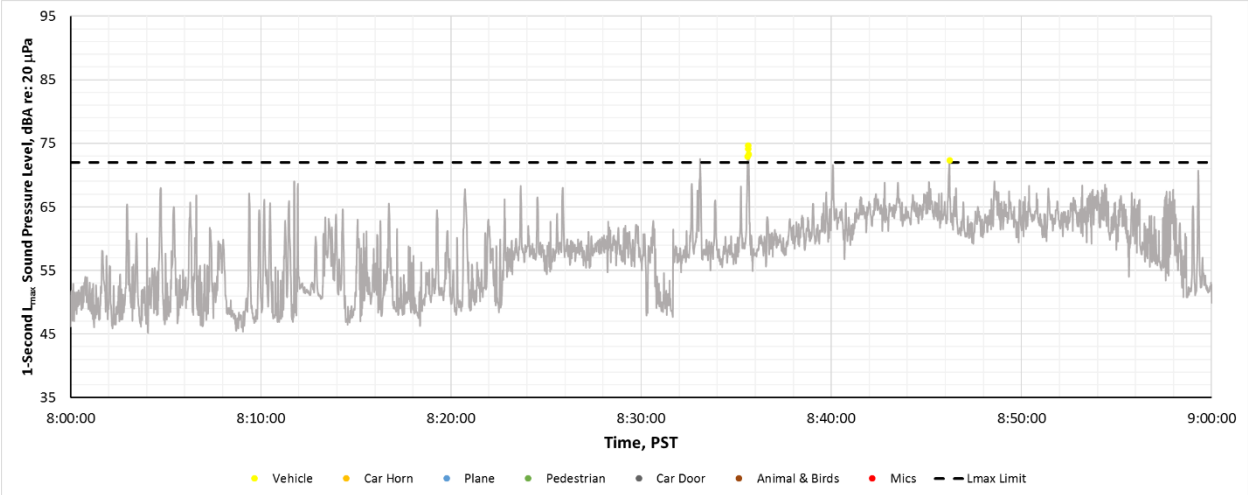
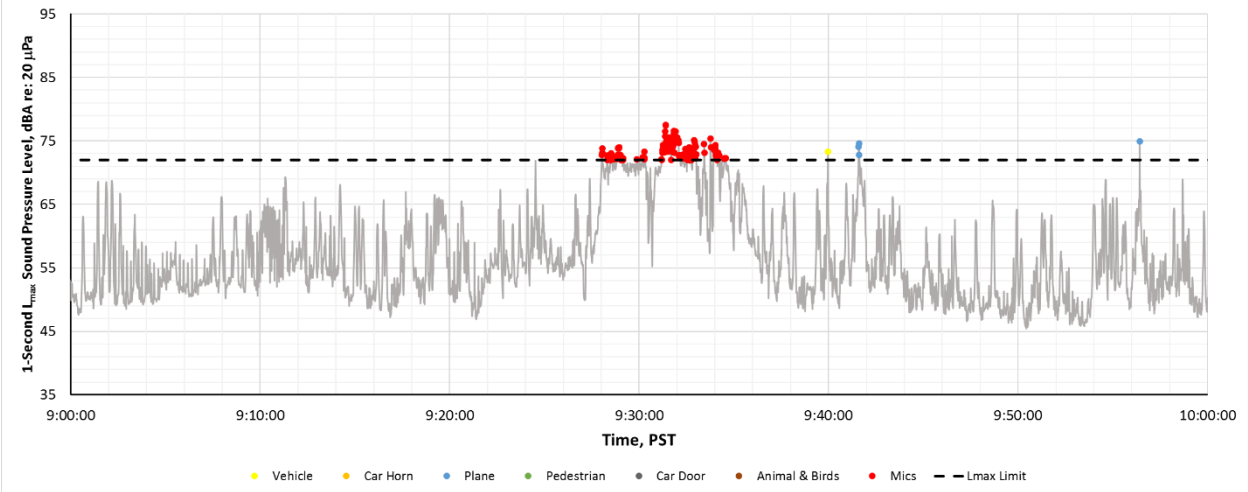
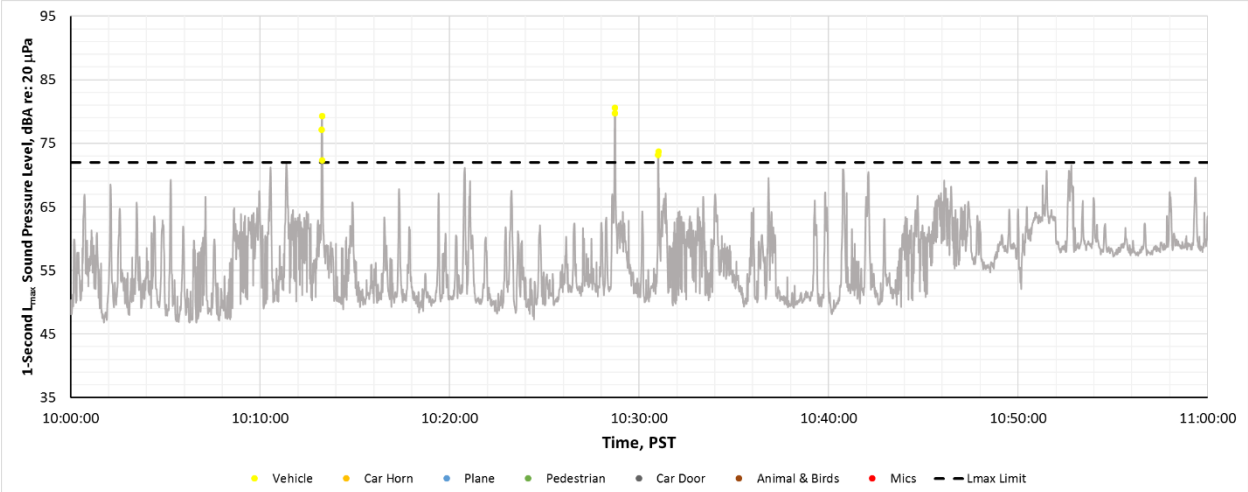
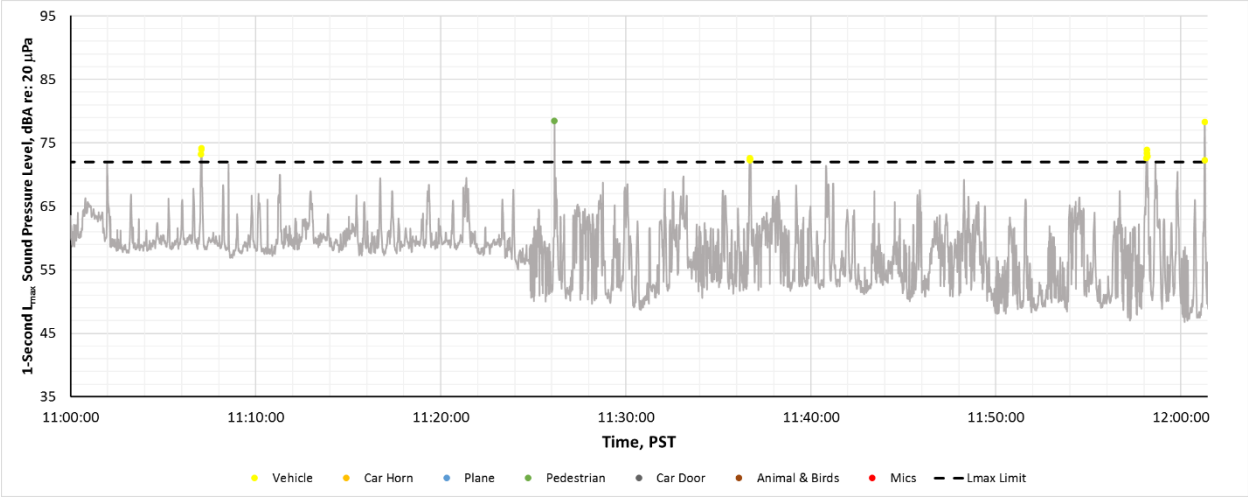
APPENDIX

Location 1 – June 17, 2020 L_{max} Sound Levels





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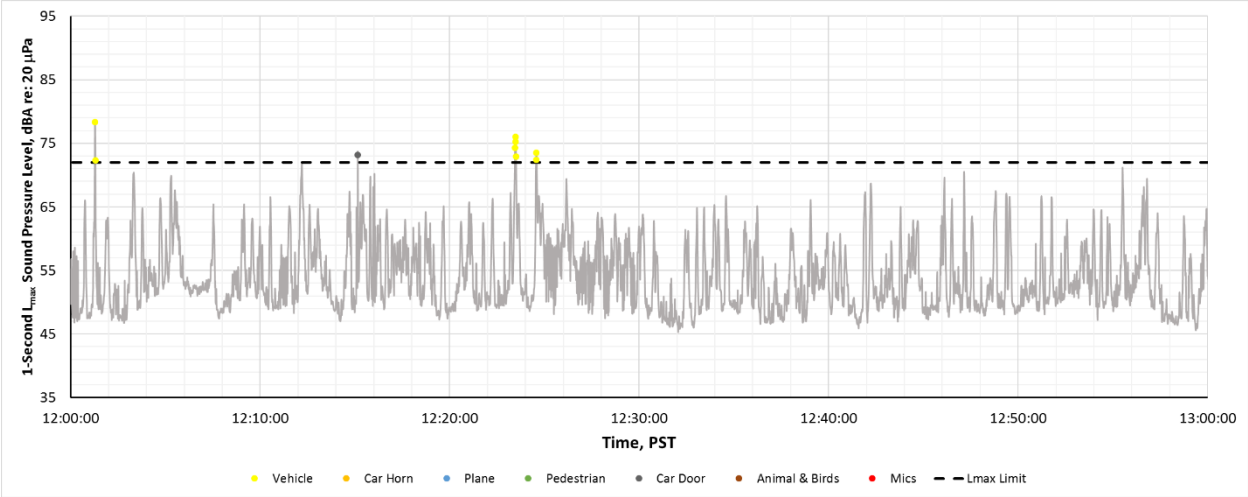
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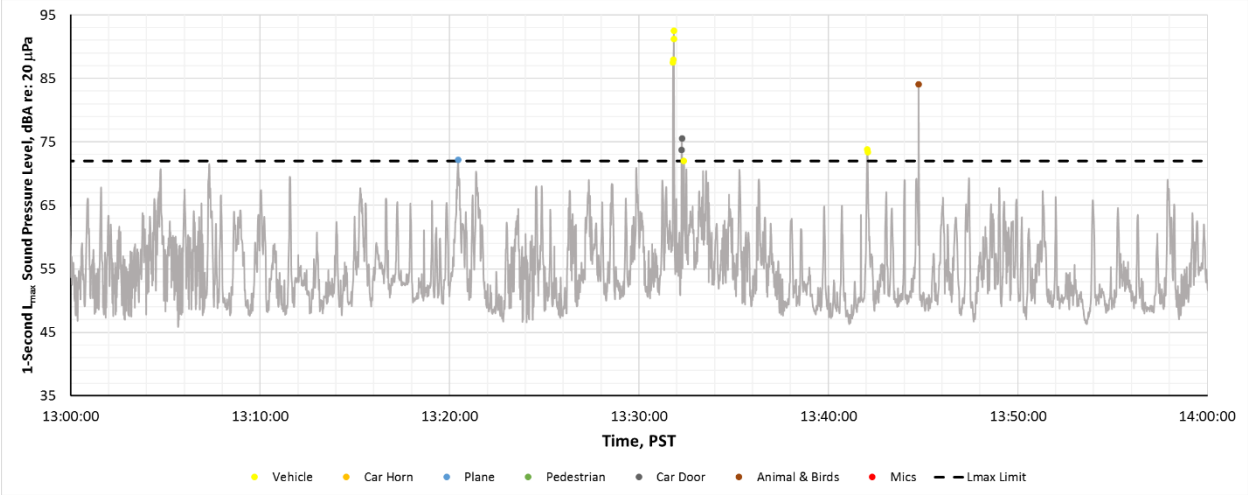
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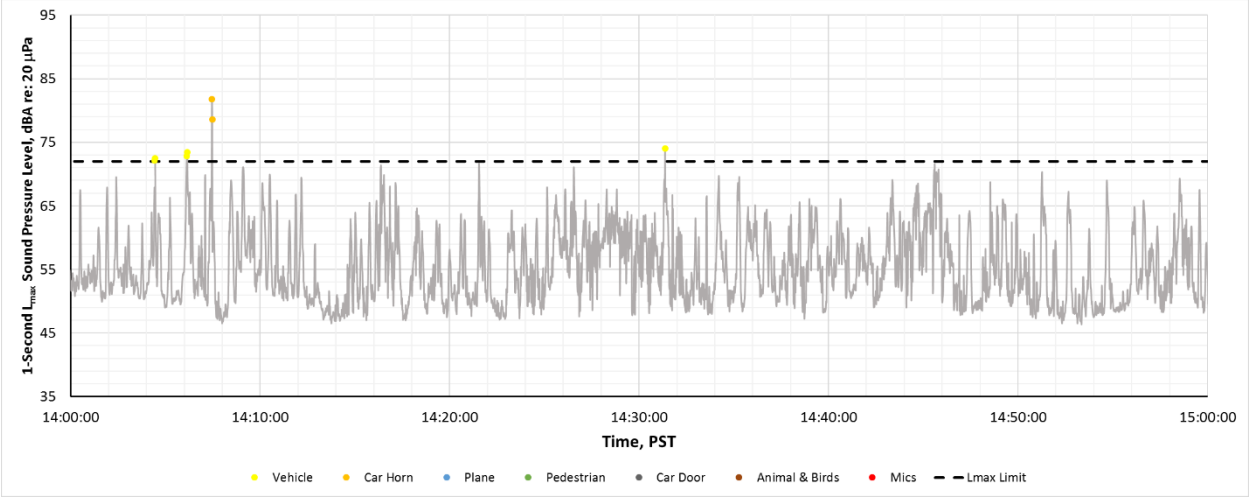
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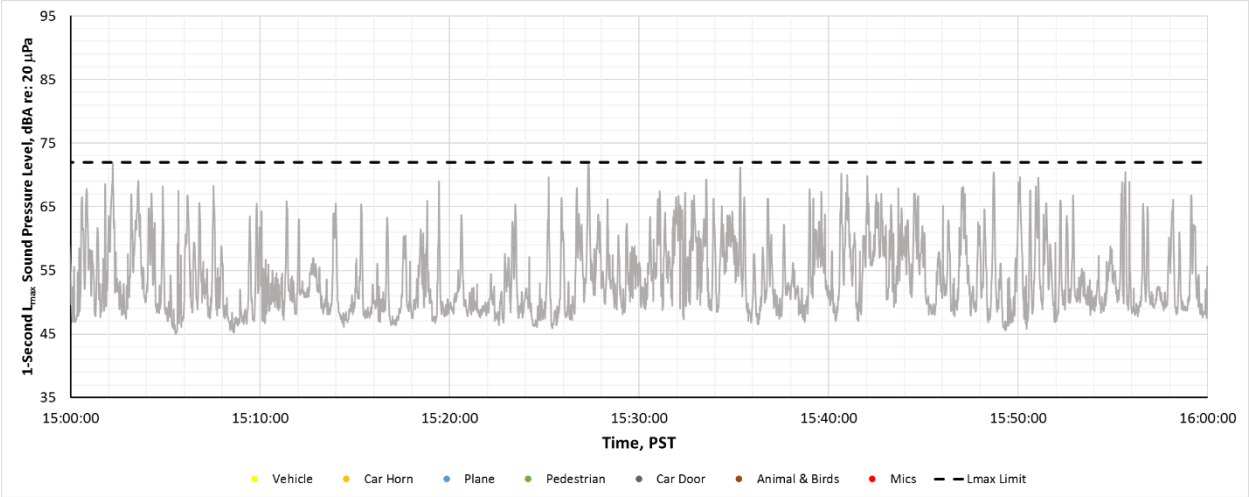
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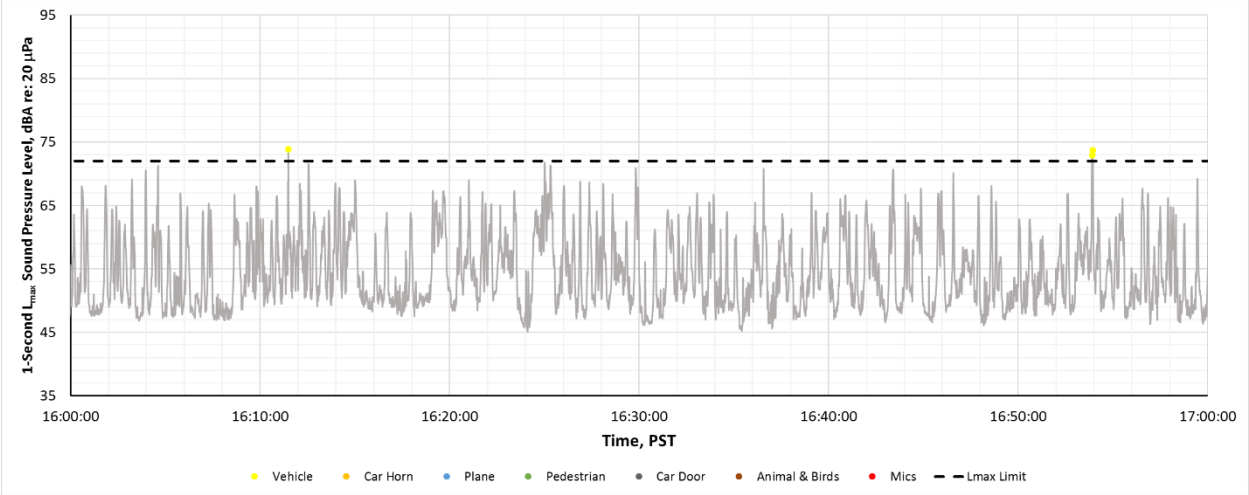
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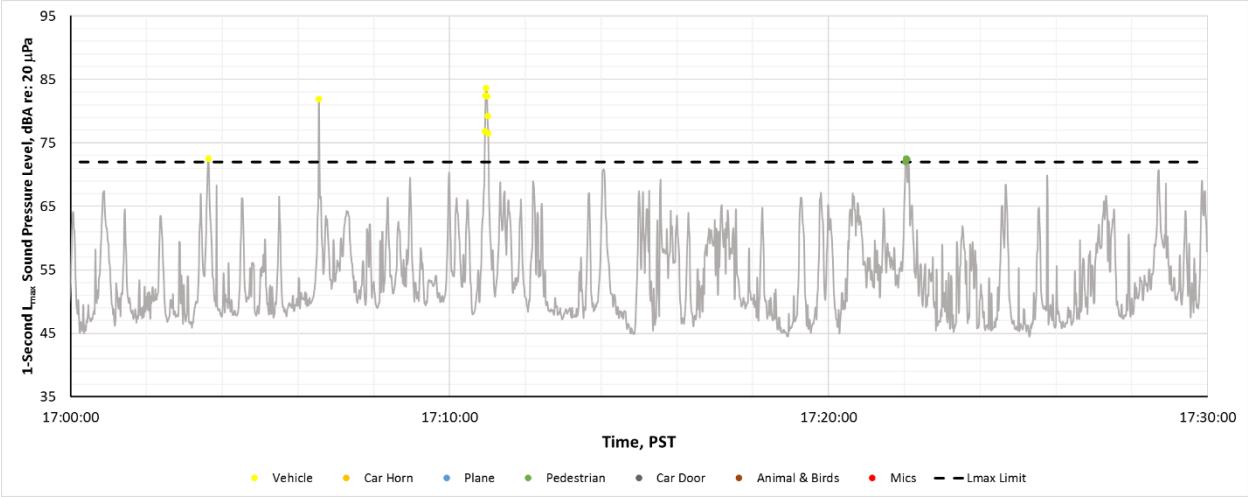
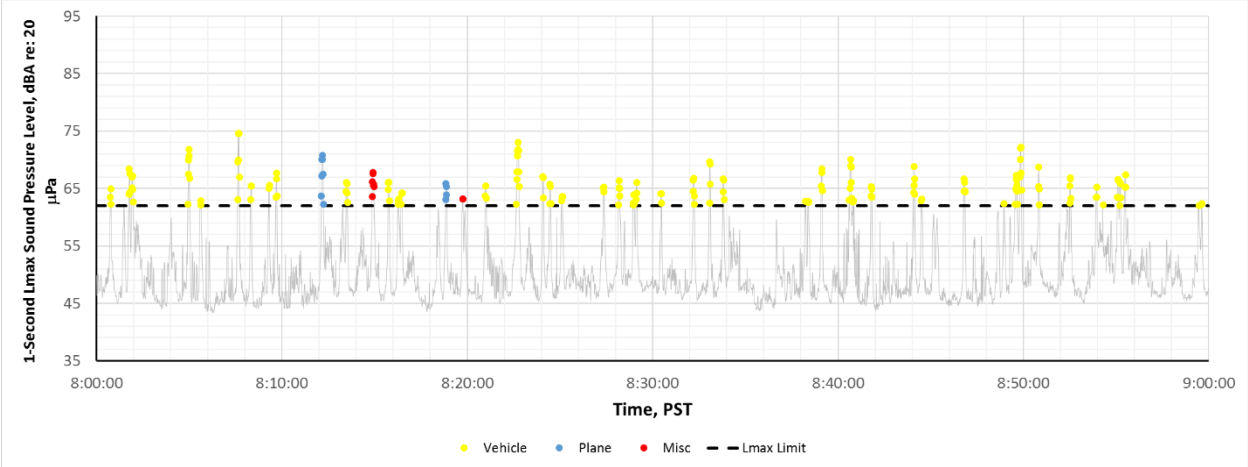


Location 1 – June 27, 2020, L_{max} Sound Levels



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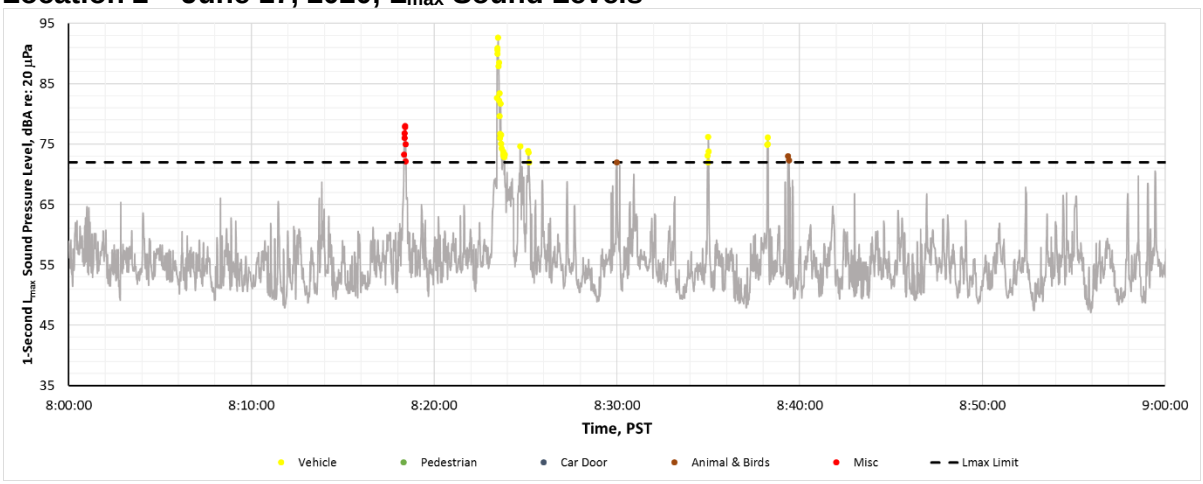

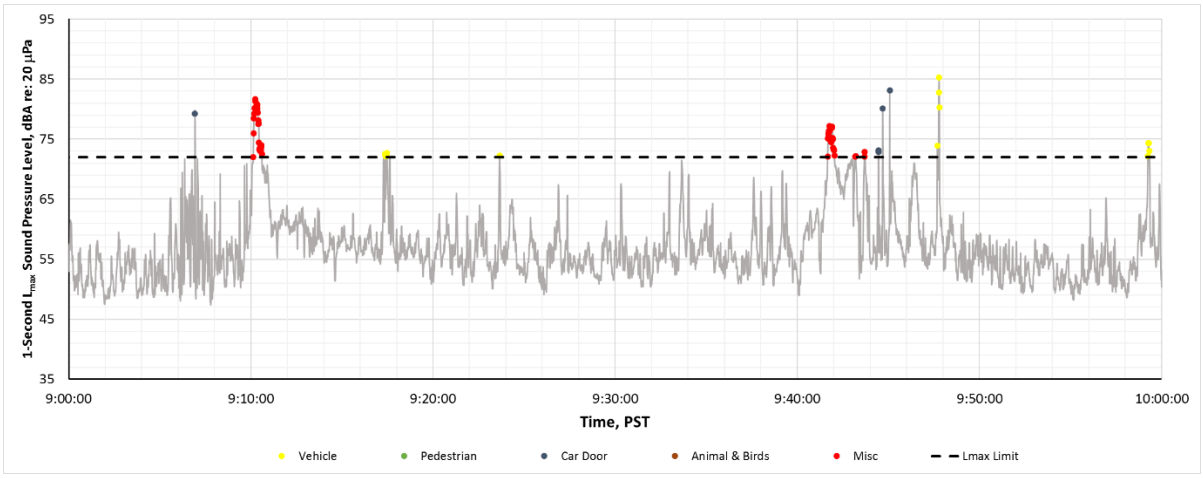

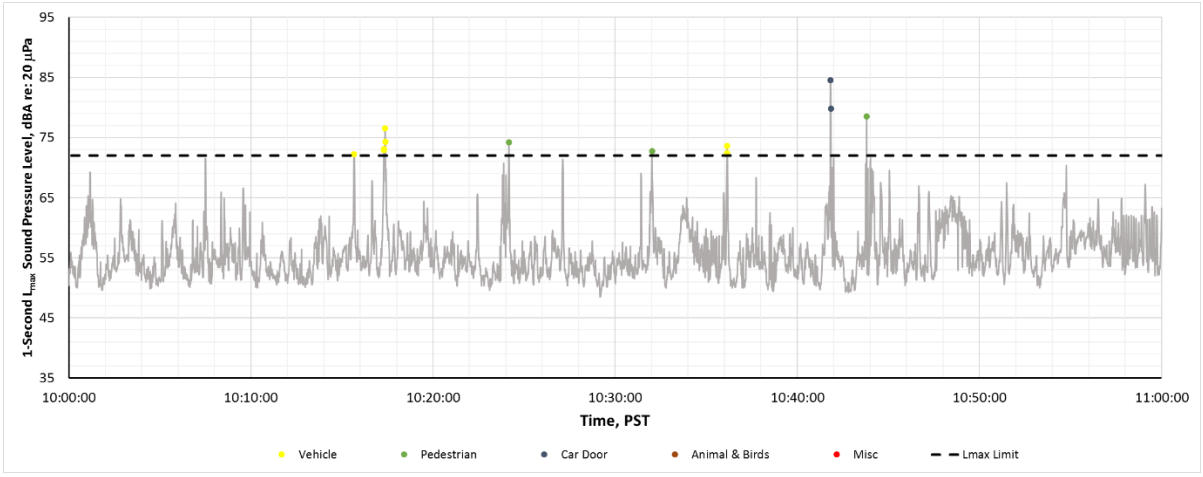

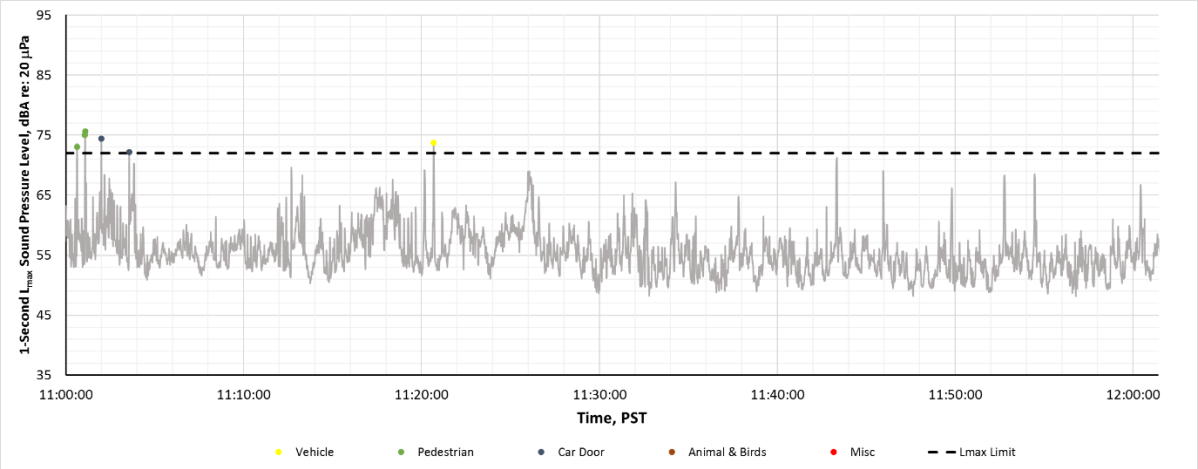
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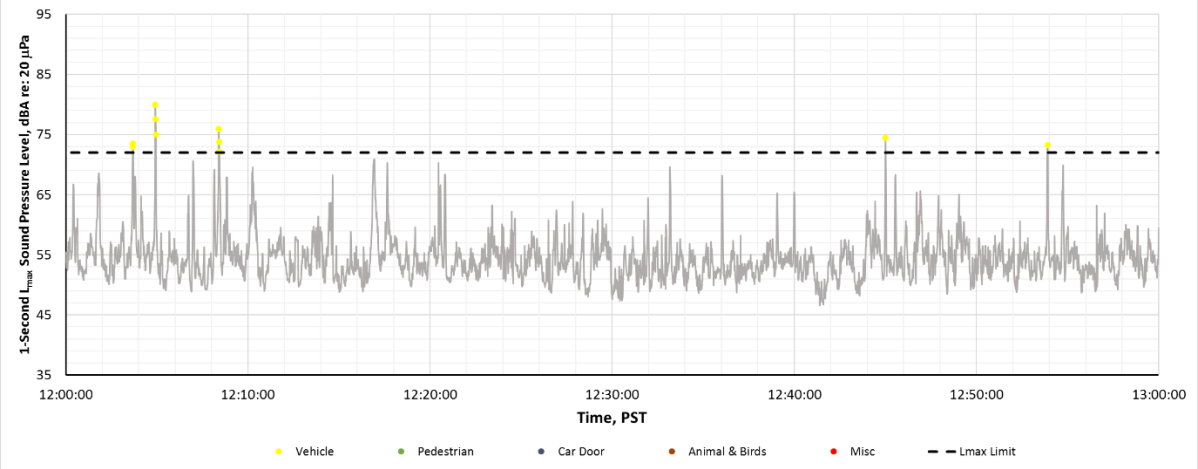
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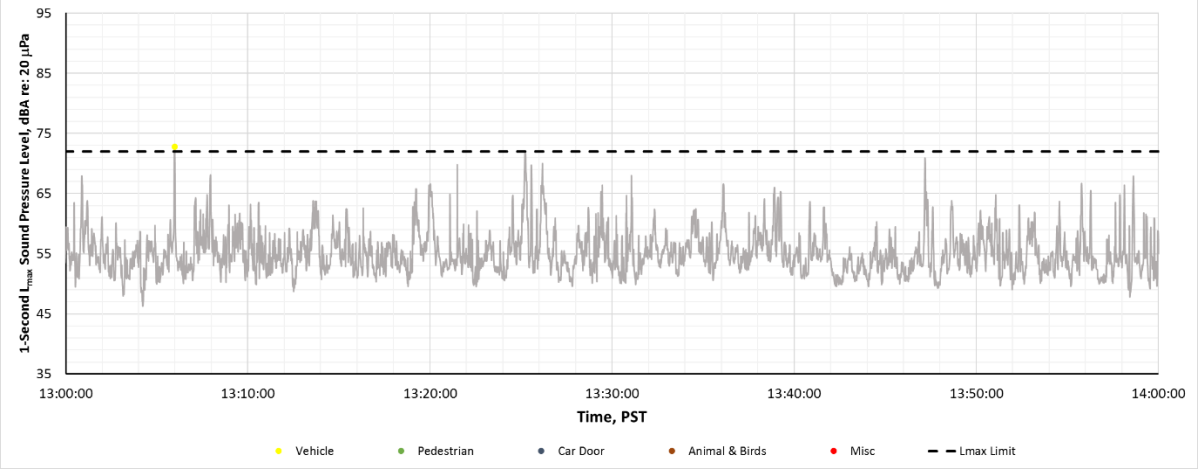
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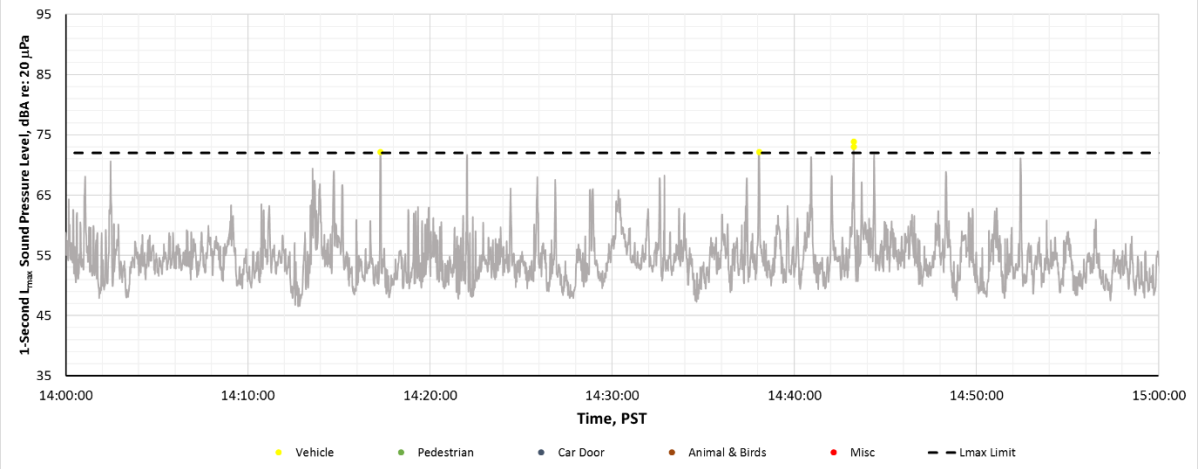
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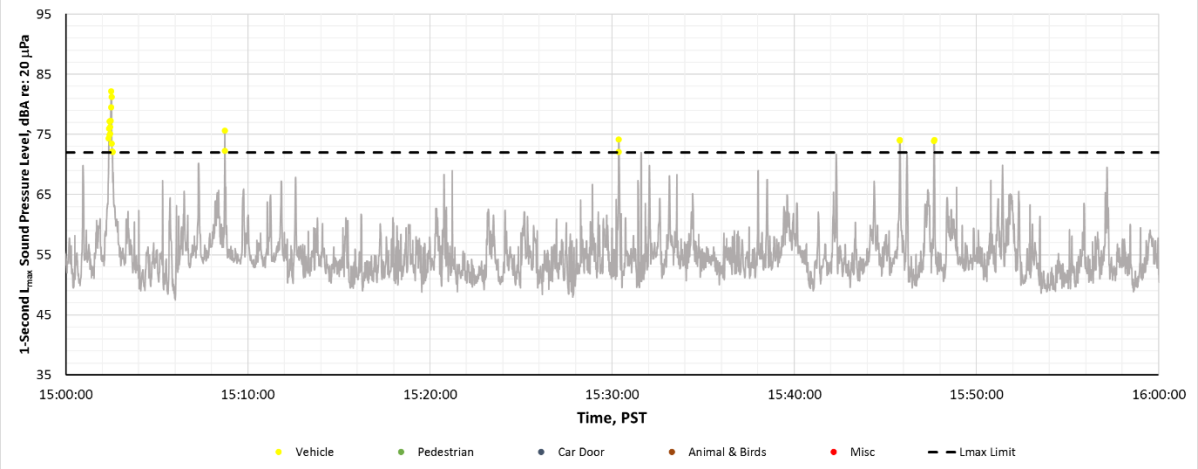
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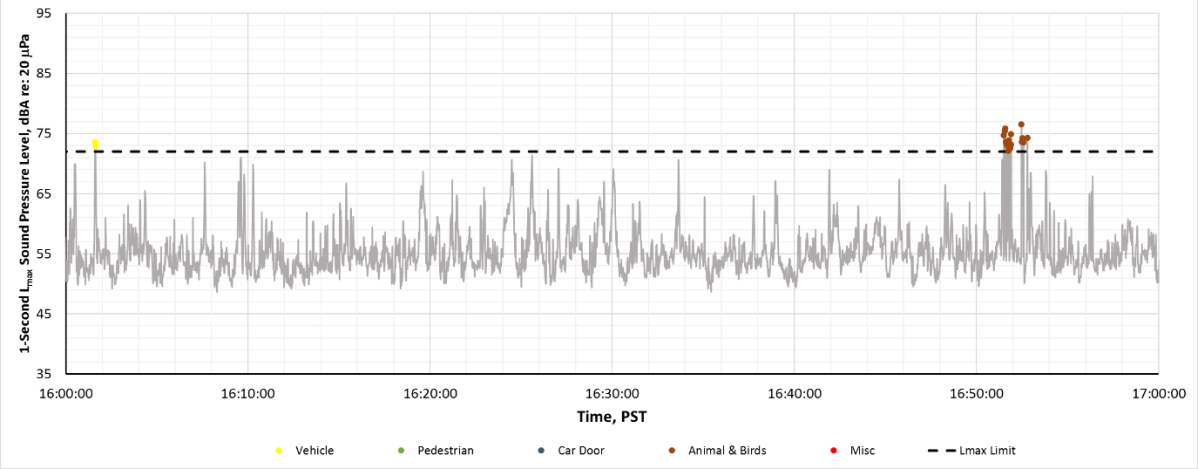
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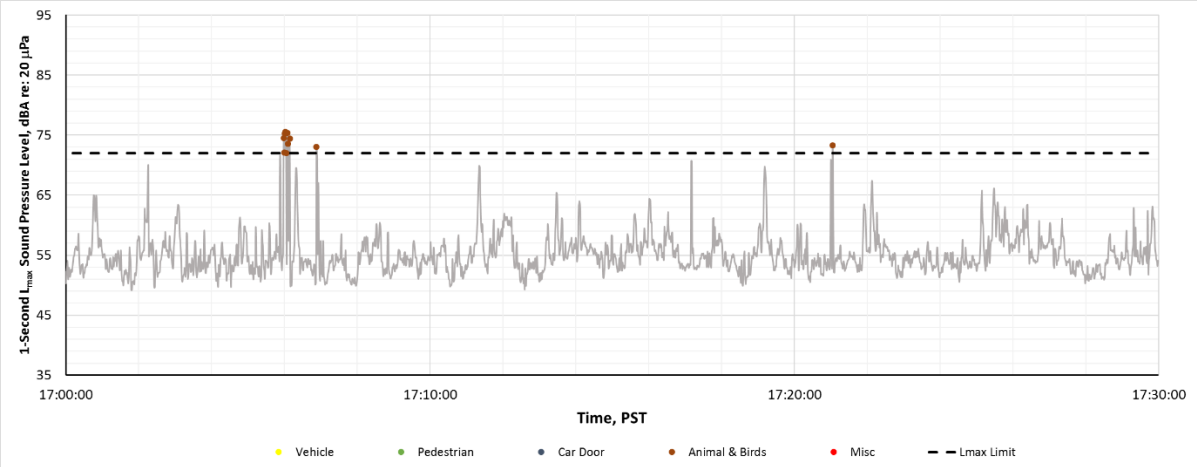

Location 2 – June 27, 2020, L_{max} Sound Levels