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| Project Title | Eagle Gun Range, Farmers Branch, TX |
| Client | Eagle Gun Range Inc. |
| Report Title | Sound Mapping Summary |
| Report Number | DAS-10015-01 Rev B |
| Report Date | 1 st July 2016 |

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| Prepared by |  Principal Acoustical Engineer |
| Approved by |  President |

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1. Introduction

This report pertains to the proposed renovation of 14400 Midway Road, Farmers Branch, Texas, into a new state-of-the-art gun range, by Eagle Gun Range Inc.

It is specifically targeted at assessing the noise levels generated in the local area due to gun fire. This will be used to assess whether the gun fire will be audible, and compliance with the Farmers Branch zoning ordinance noise limits.

To this end, a 3D computer generated noise model has been created using SoundPlan v7.4, which aims to assess the peak noise levels generated in the areas surround the proposed Eagle Gun Range.

2. Brief Description of Modelled Conditions

The 3D model was generated in SoundPlan v7.4. Both the interior and exterior sound fields were modelled. Only the noise from gun fire specifically has been assessed in the model, all other noise sources have been excluded.

Two different models of the gun fire as a noise source were created.

The first model (henceforth referred to as “Impulse”), is specifically for assessment of absolute audibility using peak noise level (a 0.001 second measurement period).

The second model (henceforth referred to as “Community”), is specifically for assessment of compliance with local noise ordinance, *Farmers Branch Zoning Ordinances Article 8-601*, which defines limits for this type of zone.

The peak (or impulse) sound level data used when modelling the noise level of each gun being fired in the “Impulse” model, was based on a 0.38 calibre revolver (measurements taken by the National Research Council Canada⁽¹⁾).

The “Community” model requires assumptions for how often firing events occur. It is assumed that a firing event occurs once ever second, and the duration of the firing event lasts 0.125 seconds. The noise source level for this firing event is taken from “Impulse” model, but the 0.001 second level is kept constant throughout.

All models assume worse-case conditions;

All 24 lanes are in use and all shooters fire simultaneously. This will give the worse-case source peak sound level generated in the proposed Eagle Gun Range

All shooters fire once every second, without stoppage, for the full daytime period (sunrise to sunset), this will give the worse-case frequency of firing events and subsequently the worse-case noise level for assessment against the local noise ordinances.

The ground topography is modelled as perfectly flat. This will give the worse-case noise propagation model for the proposed Eagle Gun Range.

Where assumptions have had to be made, the most pessimistic assumption has been used.

The boundary noise measurement positions are approximately equally spaced along the property line, and can be seen on the sound maps denoted as white asterisks. These measurements are taken 5ft above ground level. The numbering system 1-18 starts relative to the northwest corner measurement position, and then continues clockwise around the perimeter (such that; the northeast corner is position 6, southeast corner is 10 etc.).

3. Technical Conclusions

3.1 Impulse Model

The areas of key interest for absolute audibility are The Westwood School situated to the south, and the commercial area directly to the north of the proposed Eagle Gun Range.

In a typical urban area the ambient (or background) noise level is typically 50-55dBA. After reviewing the resultant sound maps given in section 5, it can be seen that the levels in the vicinity of the Westwood School are 40-50dBA, and in the commercial area to the north approximately 50-55dBA.

When it is considered that to the north there are pre-existing light industry applications, such as an auto-repair shop, and these applications typically have an ambient noise level of 60-65dBA associated with them, the existing background noise level to the north is probably greater than the typical 50-55dBA of an urban area.

This means that the noise from gun fire alone will be barely audible above the ambient noise, if at all. Diagram 2 from EPA guidance is based on community studies conducted regarding noise intrusion from outdoor noise sources and the number of complaints received. It is based on an 8hr averaged noise level instead of peak/impulse level. However it can be seen that if the noise level is kept below 55dBA then the community's reaction is "No overt reaction" even if the noise is noticeable.

It can be seen that the "Impulse" sound level at the property boundary is at or below 65dB with one exception. The reason the north side levels are elevated is due to reflections from the parallel building to the north.

3.2 Community Model

The limitations set forth by Article 8-601 of the zoning noise ordinances are given in Table 1. Along with these limits, additional provisos are given.

Firstly that "A scale levels are provided for monitoring purposes only and are not applicable to detailed sound analysis". Hence the data will be reviewed in octave-band levels, in addition to the A-weighted total review. Secondly, "when Noise contains strong pure-tone components or is impulsive" subtract 7dB from the given limits. Gun fire by its nature is impulsive, hence this correction must be applied; these new limits are given in Table 1.

| Limit | Octave Band Centre Frequency (Hz) | | | | | | | dBA |
|-----------------|-----------------------------------|-----|-----|------|------|------|------|-----|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| As Given | 76 | 70 | 65 | 63 | 58 | 55 | 53 | 65 |
| With Correction | 69 | 63 | 58 | 56 | 51 | 48 | 46 | 58* |

Table 1 – Boundary noise limits from zoning noise ordinances

* - Ordinance expressly states "corrections shall be made to the table of octave band-decibel limits", but makes no provision for correcting "A Scale", however if new limits were summed this would be the result

After comparison of every measurement position in Table 4 to the corrected limits in Table 1, at each octave band, it can be seen that almost every measurement position complies in every octave band. The only exception is the 250Hz octave band of measurement position 4 which is 1dB over. This is well within the tolerance of measurement error, and this difference would be imperceptible. It should also be remembered that this is under a worse-case scenario which is almost unachievable in the real world.

It is concluded that, with these items held in mind, the proposed gun range will be in compliance with the limits as laid out in Farmers Branch noise related zoning ordinance.

4. Boundary Measurement Results

4.1 “Impulse” Model Results

| Measurement Position | Octave Band Centre Frequency (Hz) | | | | | | | dBA |
|----------------------|-----------------------------------|-----|-----|------|------|------|------|-----|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| 1 | 76 | 71 | 57 | 52 | 41 | 44 | 29 | 59 |
| 2 | 79 | 75 | 61 | 55 | 43 | 47 | 36 | 62 |
| 3 | 81 | 77 | 63 | 56 | 45 | 49 | 44 | 64 |
| 4 | 82 | 79 | 66 | 58 | 47 | 52 | 50 | 66 |
| 5 | 82 | 77 | 64 | 57 | 46 | 49 | 44 | 65 |
| 6 | 81 | 75 | 61 | 55 | 46 | 47 | 40 | 63 |
| 7 | 81 | 75 | 62 | 56 | 46 | 48 | 40 | 63 |
| 8 | 81 | 75 | 62 | 56 | 45 | 48 | 37 | 63 |
| 9 | 80 | 75 | 61 | 55 | 45 | 47 | 37 | 62 |
| 10 | 72 | 67 | 53 | 47 | 37 | 39 | 29 | 61 |
| 11 | 74 | 68 | 54 | 47 | 39 | 40 | 36 | 62 |
| 12 | 75 | 70 | 55 | 48 | 37 | 40 | 35 | 64 |
| 13 | 74 | 68 | 53 | 45 | 34 | 37 | 24 | 62 |
| 14 | 72 | 67 | 53 | 46 | 35 | 38 | 22 | 61 |
| 15 | 70 | 65 | 52 | 46 | 35 | 38 | 21 | 59 |
| 16 | 70 | 66 | 52 | 46 | 36 | 39 | 23 | 59 |
| 17 | 70 | 66 | 52 | 46 | 36 | 39 | 23 | 60 |
| 18 | 70 | 65 | 52 | 46 | 35 | 38 | 21 | 59 |

Table 3 – Sound level at measurement positions along the property boundary line, using “Impulse” model.

4.2 “Community” Model Results

| Measurement Position | Octave Band Centre Frequency (Hz) | | | | | | | dBA |
|----------------------|-----------------------------------|-----|-----|------|------|------|------|-----|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| 1 | 61 | 56 | 42 | 37 | 36 | 29 | 14 | 50 |
| 2 | 63 | 60 | 46 | 39 | 38 | 31 | 21 | 53 |
| 3 | 65 | 62 | 48 | 41 | 40 | 33 | 29 | 55 |
| 4 | 67 | 64 | 50 | 43 | 41 | 37 | 35 | 58 |
| 5 | 66 | 62 | 48 | 41 | 40 | 34 | 28 | 56 |
| 6 | 65 | 60 | 46 | 40 | 40 | 32 | 25 | 54 |
| 7 | 66 | 60 | 47 | 40 | 41 | 33 | 24 | 55 |
| 8 | 65 | 60 | 46 | 40 | 40 | 32 | 21 | 54 |
| 9 | 65 | 59 | 46 | 39 | 39 | 32 | 22 | 54 |
| 10 | 63 | 58 | 44 | 38 | 38 | 30 | 20 | 52 |
| 11 | 65 | 59 | 45 | 38 | 40 | 31 | 27 | 53 |
| 12 | 66 | 61 | 46 | 39 | 38 | 31 | 26 | 55 |
| 13 | 65 | 59 | 44 | 36 | 35 | 28 | 15 | 53 |
| 14 | 63 | 58 | 44 | 37 | 36 | 29 | 13 | 52 |
| 15 | 61 | 56 | 42 | 36 | 36 | 29 | 10 | 50 |
| 16 | 61 | 57 | 43 | 37 | 36 | 29 | 12 | 51 |

| | | | | | | | | |
|----|----|----|----|----|----|----|----|----|
| 17 | 61 | 57 | 43 | 37 | 37 | 30 | 14 | 51 |
| 18 | 61 | 56 | 43 | 37 | 36 | 29 | 12 | 51 |

Table 4 – Sound level at measurement positions along the property boundary line, using “Community” model.

5. Sound Level Comparison Chart & Sound Maps

Informational charts reproduced from United States Environmental Protection Agency’s, “Condensed Version of EPA Levels Document”, EPA 550/9-79-100, November 1978

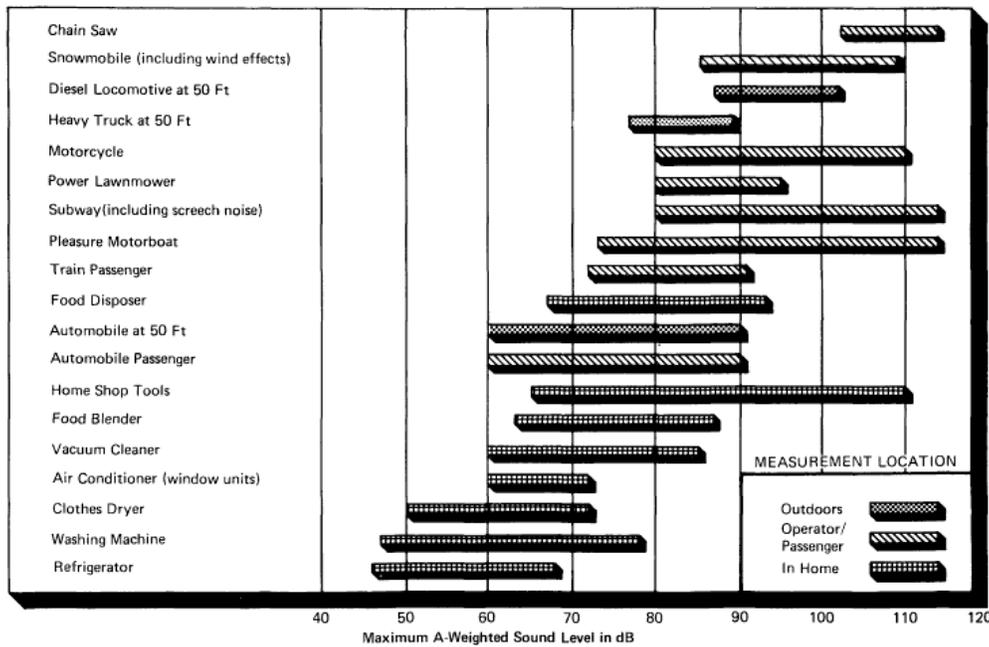


Diagram 1 – EPA’s “Figure 1. Typical Range of Common Sounds”

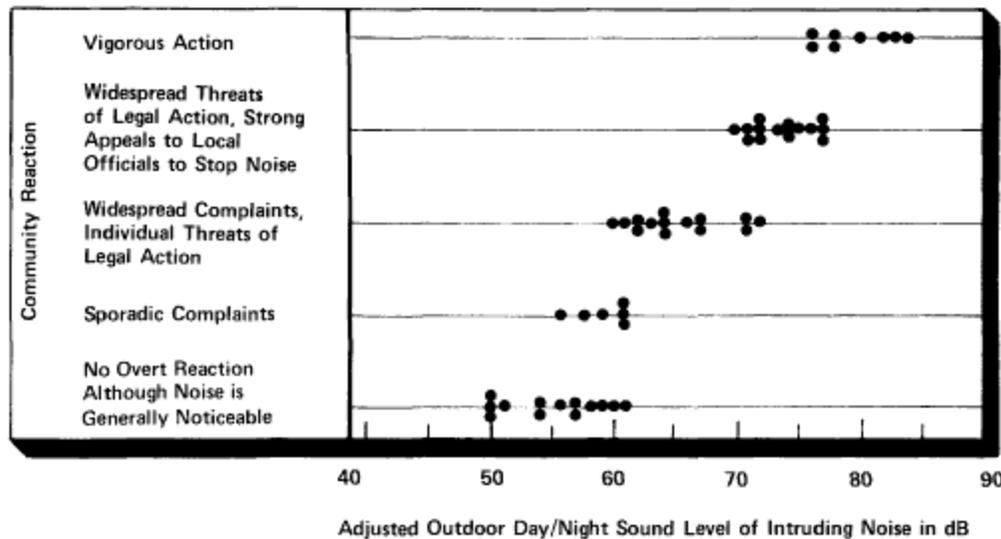
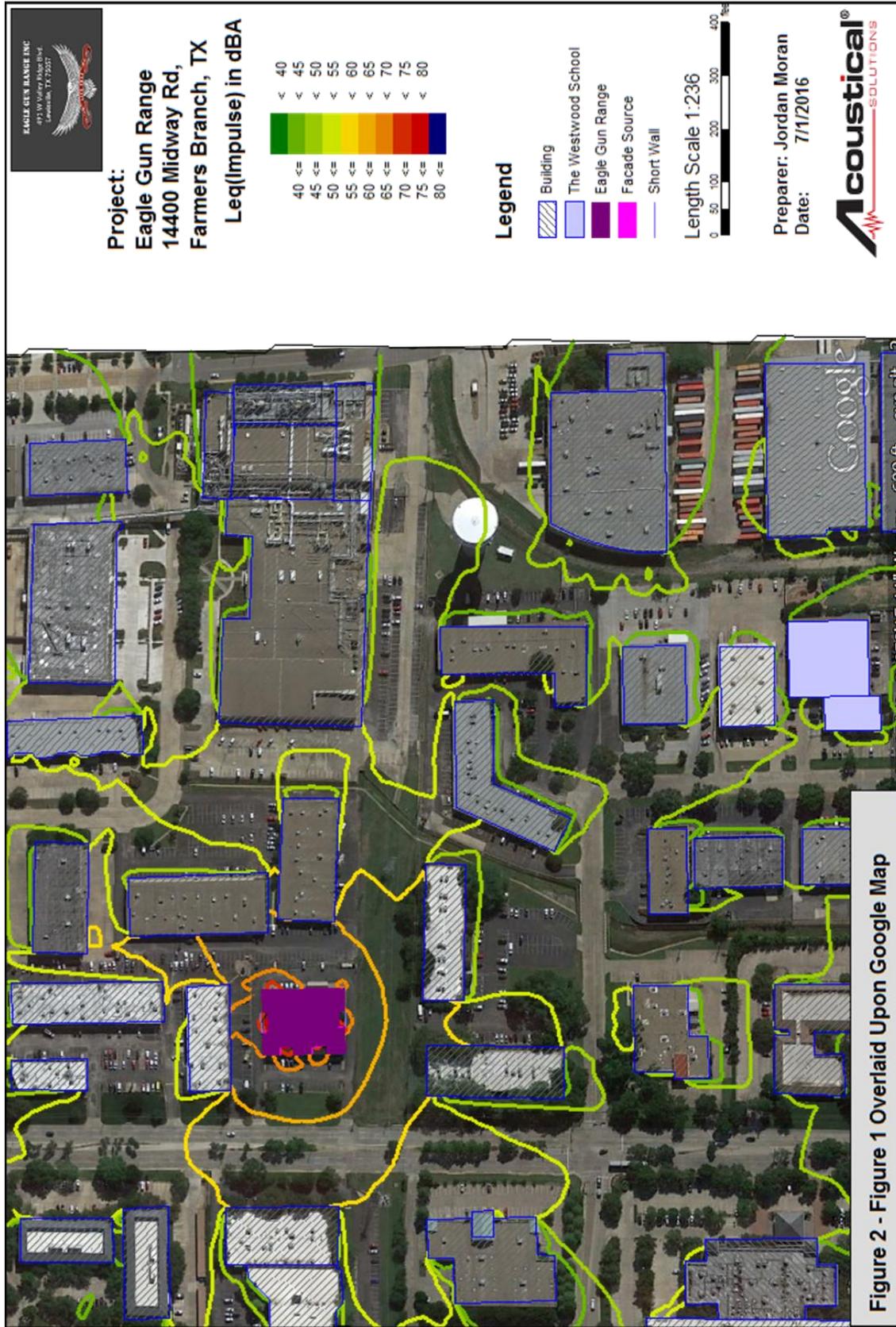


Diagram 2 – EPA “Figure 11. Combined Data from Community Case Studies Adjusted for Conditions of Exposure”

[1] - "Acoustical Characteristics of Guns as Impulse Sources", M.J.R. Lamothe and J.S. Bradley, National Research Council Canada, *Journal of the Canadian Acoustical Association Vol 13 - No. 2*, April 1985





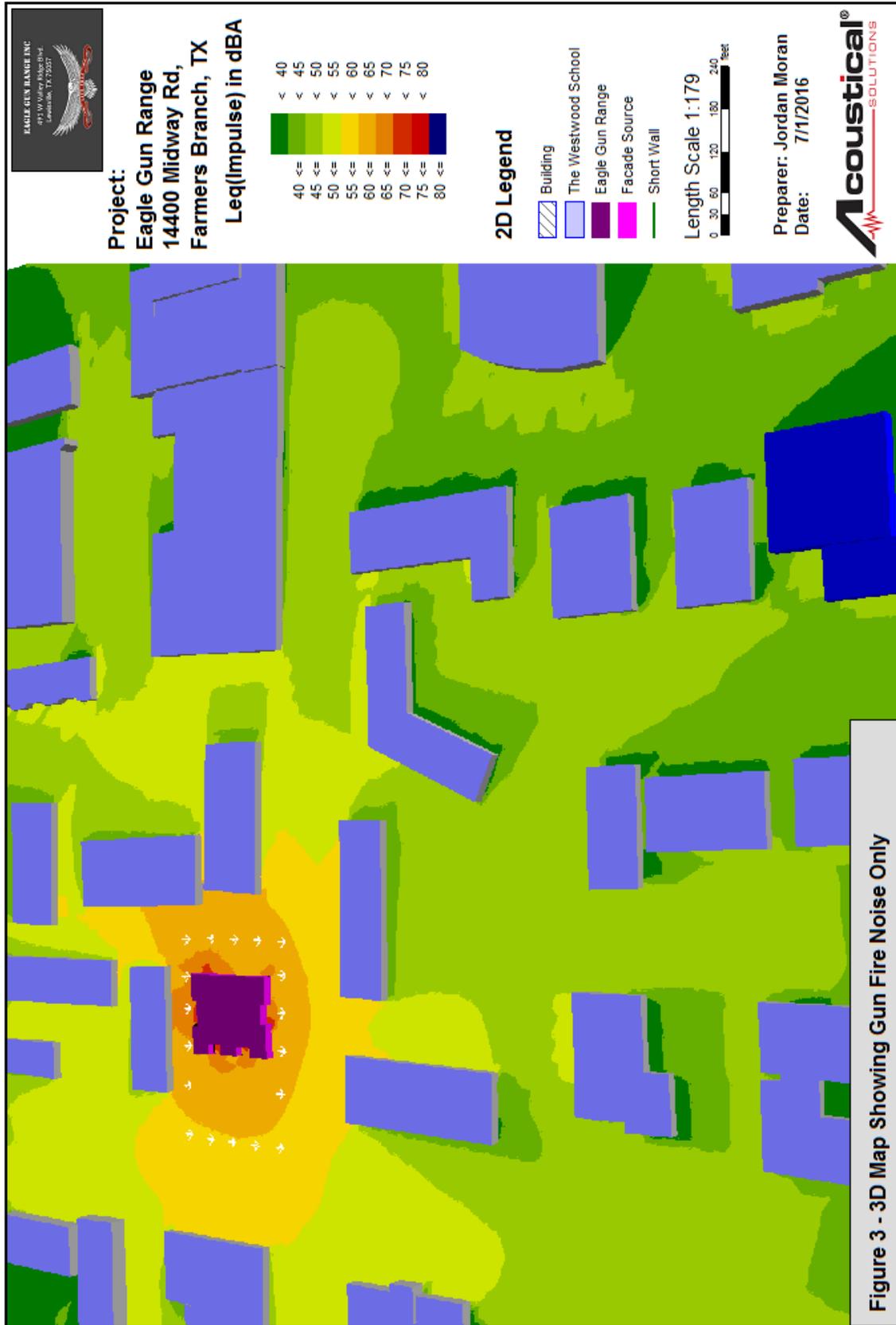
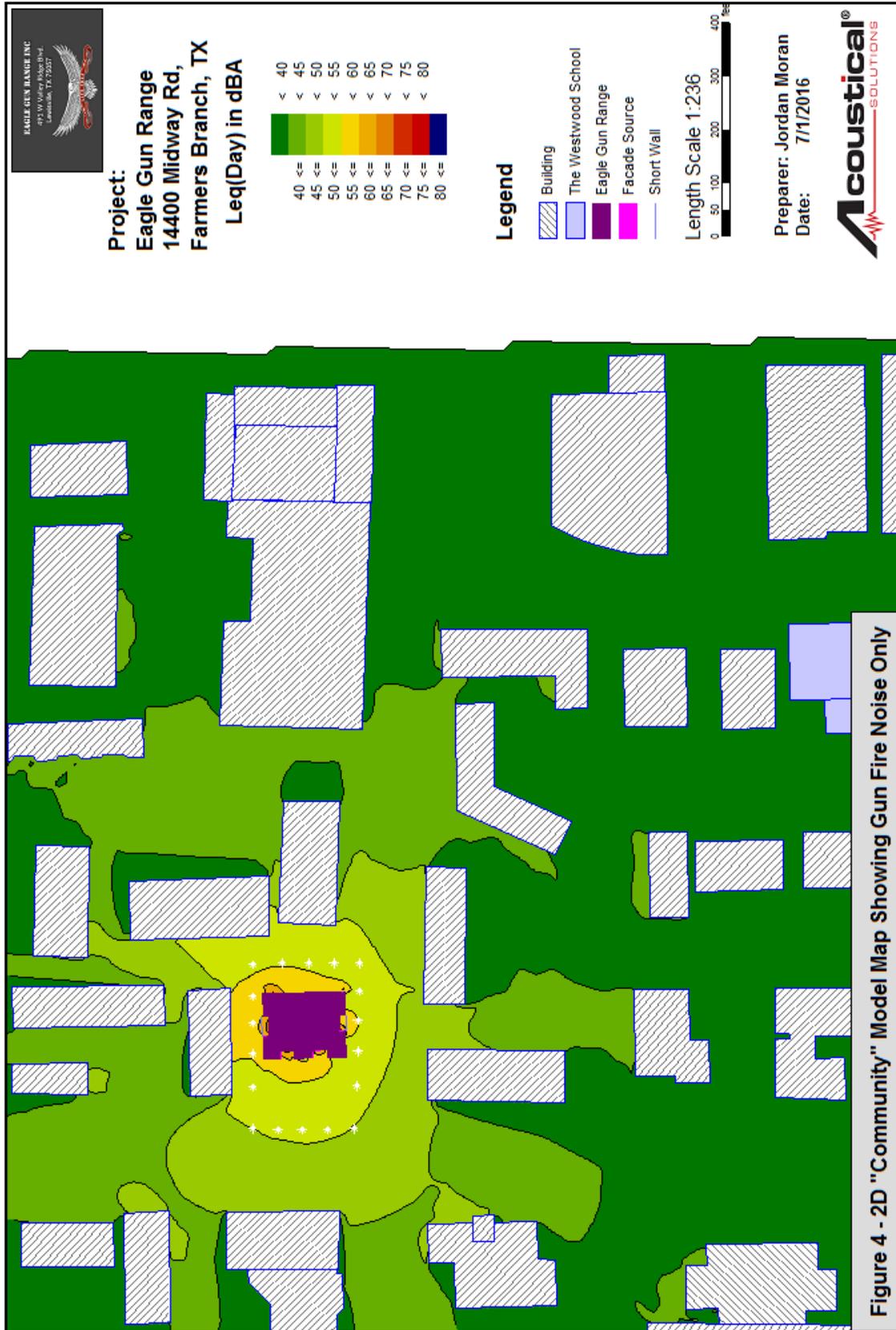
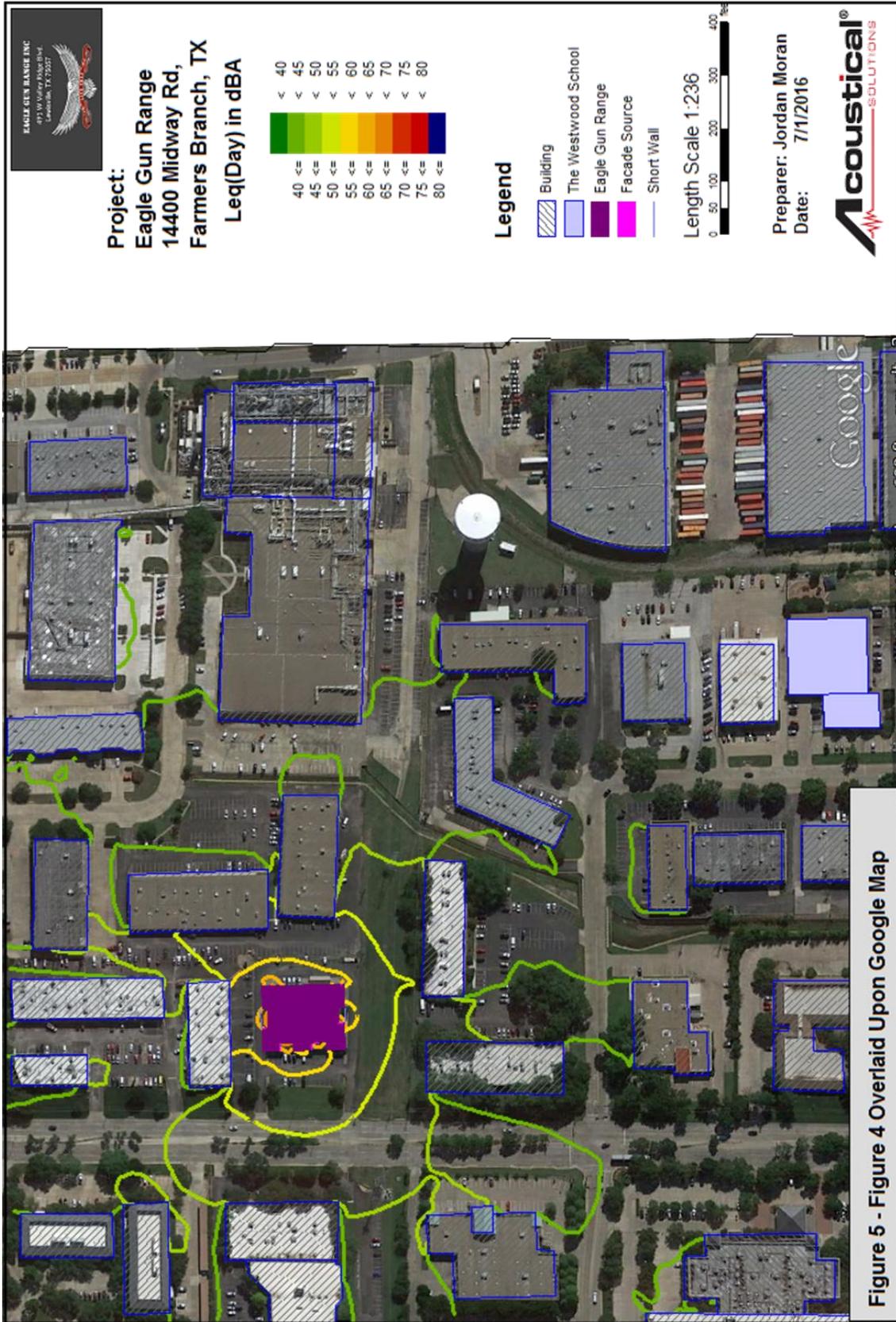


Figure 3 - 3D Map Showing Gun Fire Noise Only





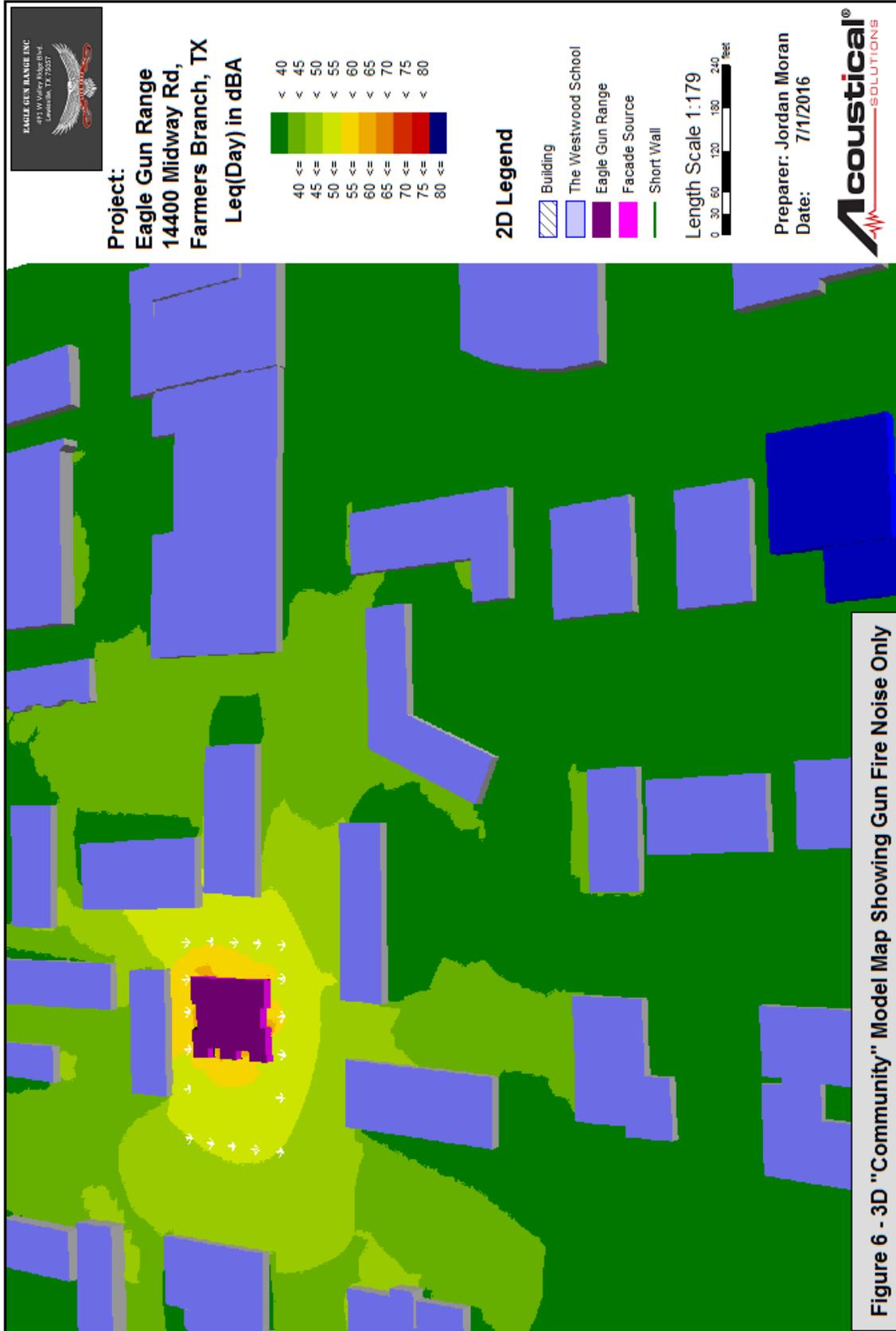


Figure 6 - 3D "Community" Model Map Showing Gun Fire Noise Only