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To: Joey Staubes / City of Smyrna  
From: Dustin Mullis / Zaxby's  
Subject: Drive-thru speaker relocation  
Date: April 3<sup>rd</sup>, 2014

Joey,

This letter is in response to City of Smyrna's request to have our speaker & menu board relocated. We believe shortening the drive-thru queue would have a big impact on our business. As it stands, we can fit 5 cars in the queue. That is the standard in our industry. If we move the speaker & menu board to the suggested location, it would take the queue down to 3 cars, and would increase our wait time for each order, and decrease our service level. As you can imagine, this will negatively impact our revenue. Based on our research, we expect this site to have a heavy drive-thru business, and the last thing we want is to not meet the expectation of the community.

I've provided some data below on the dB levels and how it would have no impact on the neighbors behind us. The data from 3M references "average traffic", and we believe this site is above average. Please note - this is not accounting for there being a car at the speaker (which would always be the case and help block the noise), and the **heavy** curb landscaping we added on the new plan. We also have the proposed line of trees that would also provide additional buffer. We think we will have no impact on the neighbors. I spoke to Cheryl (the HOA president) after our meeting and she and I were on the same page. Our drive-thru system has the ability to go on "night" mode as well, and we can set it to reduce the volume after a certain hour to complement the additional landscaping.

**Info from 3M about the system and the dB impact:**

***In an environment of average traffic noise, a 35 dB limit is virtually inaudible and should be considered the practical limit. This occurs at approximately 125 feet from the speaker post.***

**See table for reference:**

<b>Distance From Menu Post</b>	<b>3M Intercom SPL (dB)</b>
4'	65
8'	59
16'	53
32'	47
64'	41
128'	35

Table explaining decibel levels:

## Table of Sound Levels and Corresponding Sound Pressure and Sound Intensity

To get a feel for decibels, look at the table below which gives values for the sound pressure levels of common sounds in our environment. Also shown are the corresponding sound pressures and sound intensities. From these you can see that the decibel scale gives numbers in a much more manageable range.

Chart of sound levels $L$ and corresponding sound pressure and sound intensity			
Examples	Sound Pressure Level dB SPL	Sound Pressure $p$ $N/m^2 = Pa$	Sound Intensity $I$ watts/m <sup>2</sup>
Jet aircraft, 50 m away	140	200	100
Threshold of pain	130	63.2	10
Threshold of discomfort	120	20	1
Chainsaw 1m distance	110	6.3	0.1
Disco, 1 m from speaker	100	2	0.01
Diesel truck, 10 m away	90	0.63	0.001
Curbside of busy road, 5 m	80	0.2	0.0001
Vacuum cleaner, distance 1 m	70	0.063	0.00001
Conversational speech, 1m	60	0.02	0.000001
Average home	50	0.0063	1E-07
Quiet library	40	0.002	1E-08
Quiet bedroom at night	30	0.00063	1E-09
Background in TV studio	20	0.0002	1E-10
Rustling leaf	10	0.000063	1E-11
Threshold of hearing	0	0.00002	1E-12

A given sound pressure level  $L_p$  in dB SPL without the distance of the measurement to the specific sound source is useless.

The reference for 0 dB SPL sound pressure level is  $p = 20 \mu Pa = 2 \cdot 10^{-5}$  pascal, the threshold of hearing.

The sound pressure level decreases in the free field with 6dB per distance doubling. That is the  $1/r$  law.

Often it is argued the sound pressure would decrease after the  $1/r^2$  law (inverse square law). That's wrong.

The sound pressure in a free field is inversely proportional to the distance from the mic to the source.  $p \sim 1/r$ .