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Noise Impact Analysis for Proposed Tsunami Car Wash, Columbia Heights, Minnesota

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Executive Summary

The proposed Tsunami Car in Columbia Heights, Minnesota is planned to operate from 7:00 am and 8:00 pm daily. The Minnesota noise ordinance defines the daytime (7:00 am to 10:00 pm) noise limit for Residential zones at 60 dBA at the property lines. Our calculations indicate that the carwash-related noise levels with the planned layout will not exceed the residential limits with the addition of an 8’ sound barrier along the east and north property lines on top of the planned retaining wall (with the combined height extending 2’ above the top of the car wash entry doors).

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List of Abbreviated Terms

dB	Decibel
dBA	A-weighted Decibels
Leq	Equivalent Sound Level

1.0 Introduction

Soundscape Engineering has completed a sound study for a proposed Tsunami Express Carwash to be located at 999 50th Avenue NE, Columbia Heights, Minnesota. The proposed building will be a 5,000 SF car wash with 18 vacuums, a sales booth, and vacuum pump house. It is our understanding that the car wash will be open 7 days per week from 7:00 am to 8:00 pm.

We have collected sound data from past projects with Tsunami, specifically the Tsunami Car Wash in Waukesha, Wisconsin. The loudest noise sources are the blowers inside the car wash and the vacuums/pump house in the parking lot area. We assume that this location will use the same blowers as the Waukesha location.

The design is complete and you provided us with a copy of the city submitted design dated 08-05-2024. The Columbia Heights Tsunami Car Wash is bordered by an Aldi Grocery Store and single-family residences. The project plans to lower the grade of the building site. A new retaining wall will be installed on the east side of the site with a 6-foot fence on top of the wall.

According to the Waukesha car wash operation manager, a busy hour by industry standards would be 100+ cars per hour.

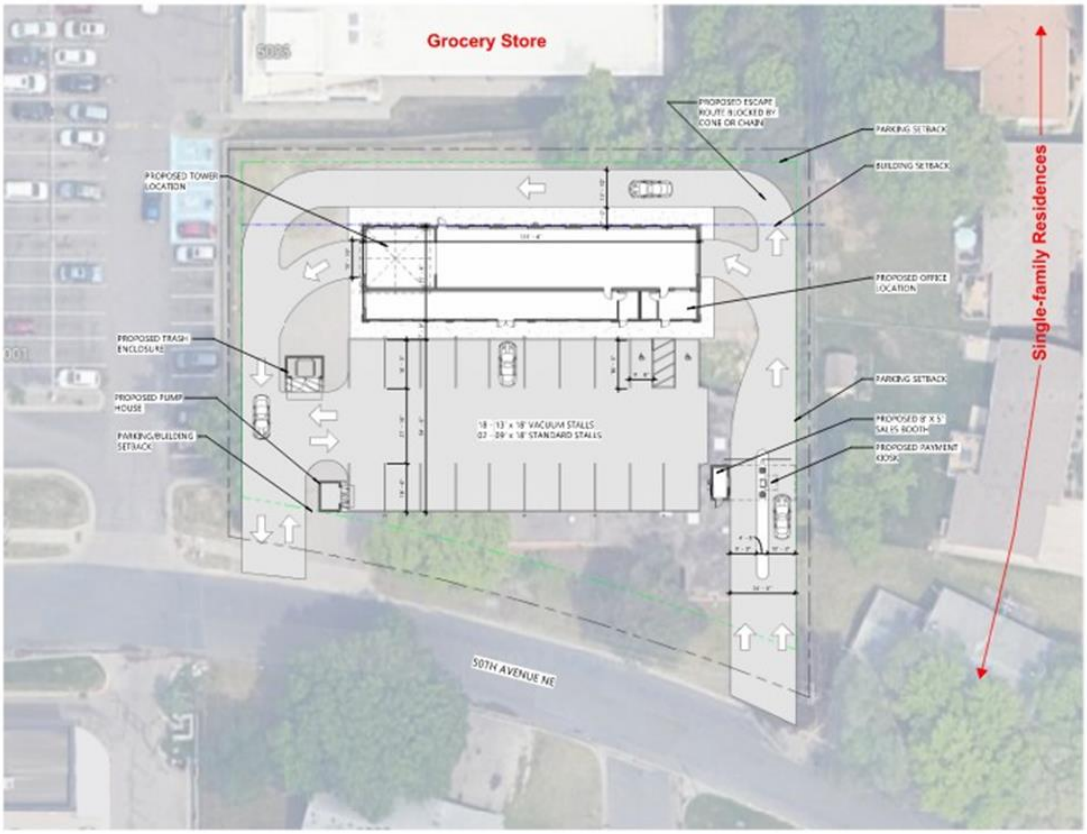

Figure 1: Proposed Tsunami Express Car Wash, Columbia Heights, Minnesota

For your reference, there is a brief glossary of pertinent acoustics terminology in Appendix A.

2.0 Measurements

The following describes the ambient measurements at the proposed Columbia Heights location and the existing equipment measurements at the Tsunami Car Wash in Waukesha, Wisconsin.

2.1 Instrumentation

An NTi Audio model XL2-TA acoustic analyzer with model MC230 microphone and model MA220 preamp was used for all measurements reported here. This system is Class 1 Type Approved, meeting the requirements of IEC 61672 and ANSI S1.4.

Table 1: Sound Measurement Equipment

Instrument - Location	Make	Model No.	Serial No.	Cal Date
Sound Level Meter (SLM) - Position 1	NTi	XL2-TA	A2A-11159-E0	8/10/2023
SLM Microphone	NTi	MC230	9538	8/10/2023
SLM Preamp	NTi	MA220 (M2230)	2923	8/10/2023
Sound Level Calibrator	Larsen Davis	CAL200	10152	03/23/2023

2.2 Ambient Measurements

Soundscape visited the proposed Tsunami Car Wash in Columbia Heights, Minnesota on Sunday, August 11th, 2024. A series of 15-minute spot measurements were taken around the proposed Columbia Heights property. Measurements were taken between 4:00 – 5:30 pm. The overall levels at each measurement location are shown in Figure 2. Photos of the onsite measurements are shown in Figure 3.

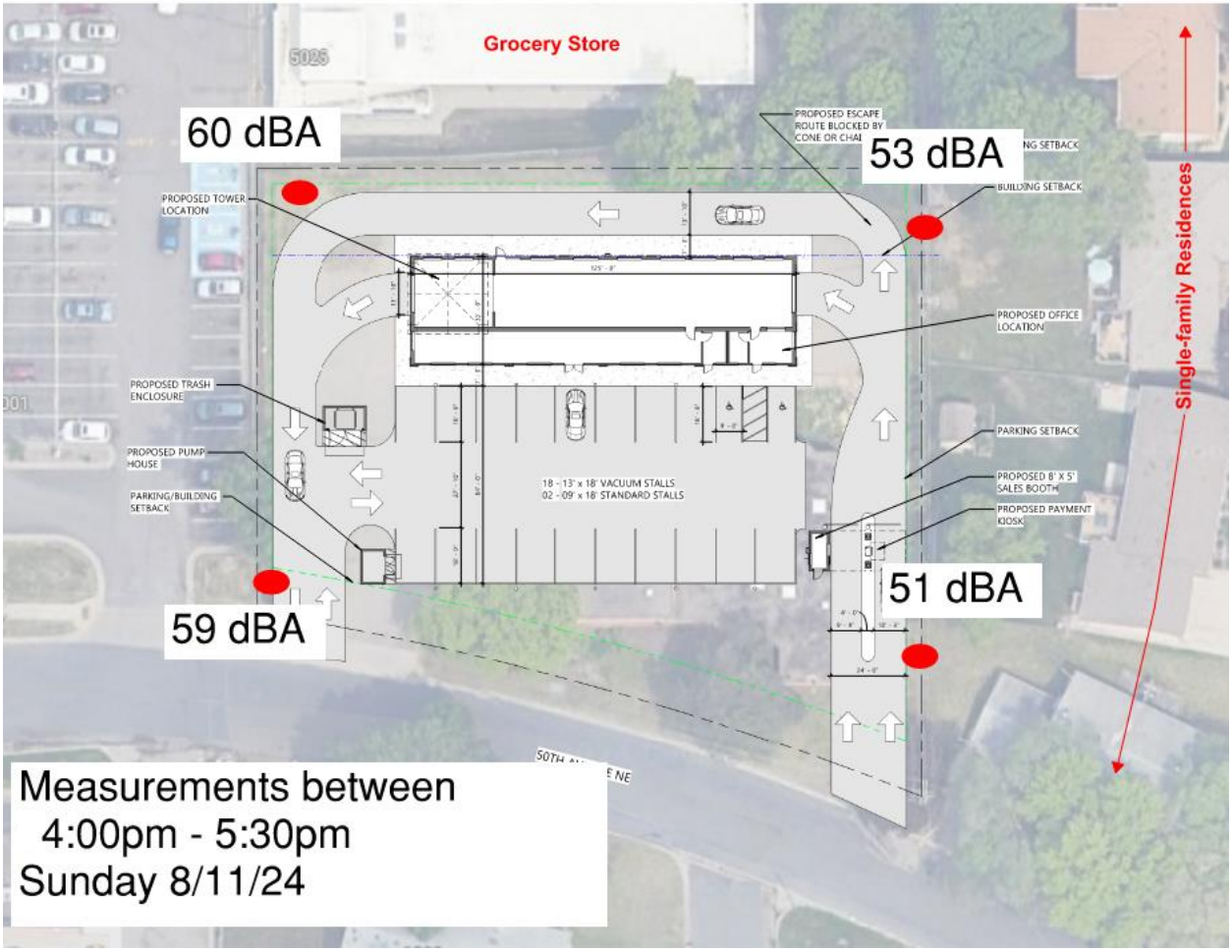

Figure 2: Ambient Sound Levels (dBA) Measured at Proposed Car Wash Site

Figure 3: Photos of Sound Level Meter at Two of the Measurement Locations On-Site

2.3 Equipment Measurements

To determine the equipment sound levels, we measured the sound level produced by equipment at the existing Tsunami Car Wash located at 300 W. Sunset Drive in Waukesha, Wisconsin. We understand that the Columbia Heights location will install the same blower system as the Waukesha location. The measured octave band sound levels at the car wash entry and exit are shown in Table 2.

Table 2: Sound levels Measured at a Waukesha Tsunami Carwash (dB)

	Sound Pressure Levels (dB at a 20-foot distance[1]) per Octave Band Center Frequency, Hz									Overall Level (dBA)
	31.5	63	125	250	500	1000	2000	4000	8000	
Wash Exit, Blowers On, Doors Open	78	80	80	81	89	88	86	82	74	93
Wash Exit, Blowers On, Doors Closed	74	79	77	77	79	73	69	63	53	79
Wash Entrance, Doors Open	73	74	72	69	71	72	71	66	56	76

1) These measurements were made directly in front of the entrance or exit, at a distance of 20 feet.

Figure 4: Waukesha Tsunami Car Wash Exit

Figure 5: Waukesha Tsunami Car Wash Layout

Measurements were also taken outside the vacuum pump house and near a car being vacuumed (Figure 6). The pump house is constructed of masonry block and has steel doors with perimeter seals. This construction is advantageous for noise control. We are not aware if the existing vacuum system has a muffler. These measured levels are presented in Table 3.

Table 3: Measured Vacuum Related Sound Levels at Waukesha Location

	Sound Pressure Levels (dB) per Octave Band Center Frequency, Hz									Overall level (dBA)
	31.5	63	125	250	500	1000	2000	4000	8000	
Vacuum Pump House at 3’ Distance	71	75	67	64	60	59	58	55	51	65
Car Vacuuming at Approx. 6’ Distance	70	72	70	66	64	64	68	69	62	74

Figure 6: Vacuum Pump House

3.0 Ordinance and Criteria

The project is required to meet the State of Minnesota's Administrative Rules Section 7030.0040 Noise Standards, which we understand to be the City of Columbia Heights' ordinance:

7030.0040 NOISE STANDARDS.

Subpart 1. **Scope.** These standards describe the limiting levels of sound established on the basis of present knowledge for the preservation of public health and welfare. These standards are consistent with speech, sleep, annoyance, and hearing conservation requirements for receivers within areas grouped according to land activities by the noise area classification (NAC) system established in part 7030.0050. However, these standards do not, by themselves, identify the limiting levels of impulsive noise needed for the preservation of public health and welfare. Noise standards in subpart 2 apply to all sources.

Subp. 2. **Noise standards.**

Noise Area Classification	Daytime		Nighttime	
	L_{50}	L_{10}	L_{50}	L_{10}
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

Statutory Authority: *MS s 116.07*

History: *11 SR 43; 18 SR 614*

Published Electronically: *December 12, 2003*

Figure 7: Minnesota Noise Ordinance

Residential properties fit into "Noise Area Classification 1" and commercial properties fall into the "Noise Area Classification 2". The L_{50} represents the level exceeded 50% of the time, or the median sound level. During peak business hours, the car wash is expected to be in nearly continuous operation, so the L_{50} is equivalent to the average sound level, or Leq. This means that the car wash measurement levels in Table 2 were used as source levels for Columbia Heights without applying a reduction for related to duration of use. Similarly, the L_{10} refers to the sound level during the loudest 10% of the time. Since the levels are nearly continuous, the L_{10} and the L_{50} are expected to be almost equal. Therefore, the L_{50} criterion is the most stringent for this project, and will be referred to in this assessment.

4.0 Computer Model Calculation of Sound Levels Around Carwash

We modeled the Columbia Heights site and surrounding area in the commercial environmental noise modeling software, SoundPLAN. Site topography, existing and proposed buildings, sound sources, and receiver locations were inputted as elements into the computer model. A 3D view of the propagation model is shown in Figure 8. The red-shaded areas represent sound area sources. We have modeled the worst-case scenario with all vacuum stations in use and the carwash entry door open. We understand that the car wash doors are planned to be open when cars are in the tunnel, which could be nearly continuous during the busiest hours of the week. Vacuum stations are indicated by the red asterisks below. Sources included in the model are based on measurements made at the Waukesha Tsunami and are as follows:

- Carwash Entry Door Open
- Carwash Exit Door Open and Closed – Blowers On
- Vacuum pump house with Sealed metal doors
- Car Vacuum Stations (red asterisks)

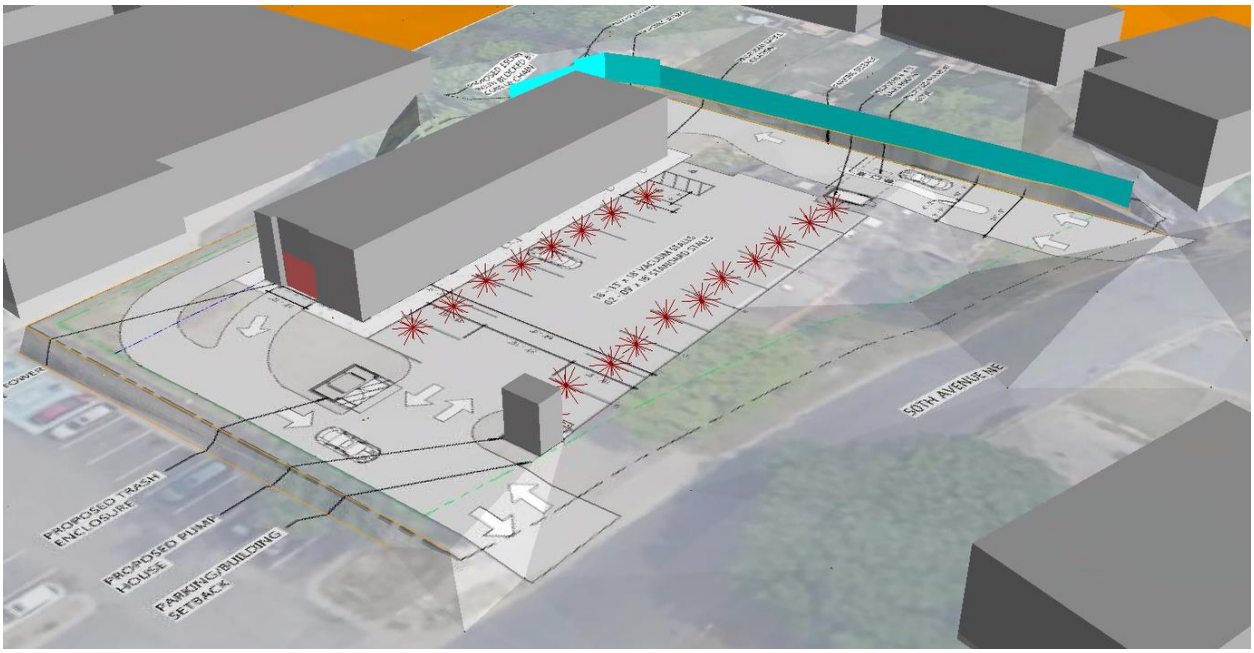

Figure 8: 3D Model View

Figure 9 presents the predicted radiated sound levels due to the Tsunami Car Wash. The darkest green shaded area represents areas where the sound levels are below the residential 60 dBA L50 noise ordinance limit.

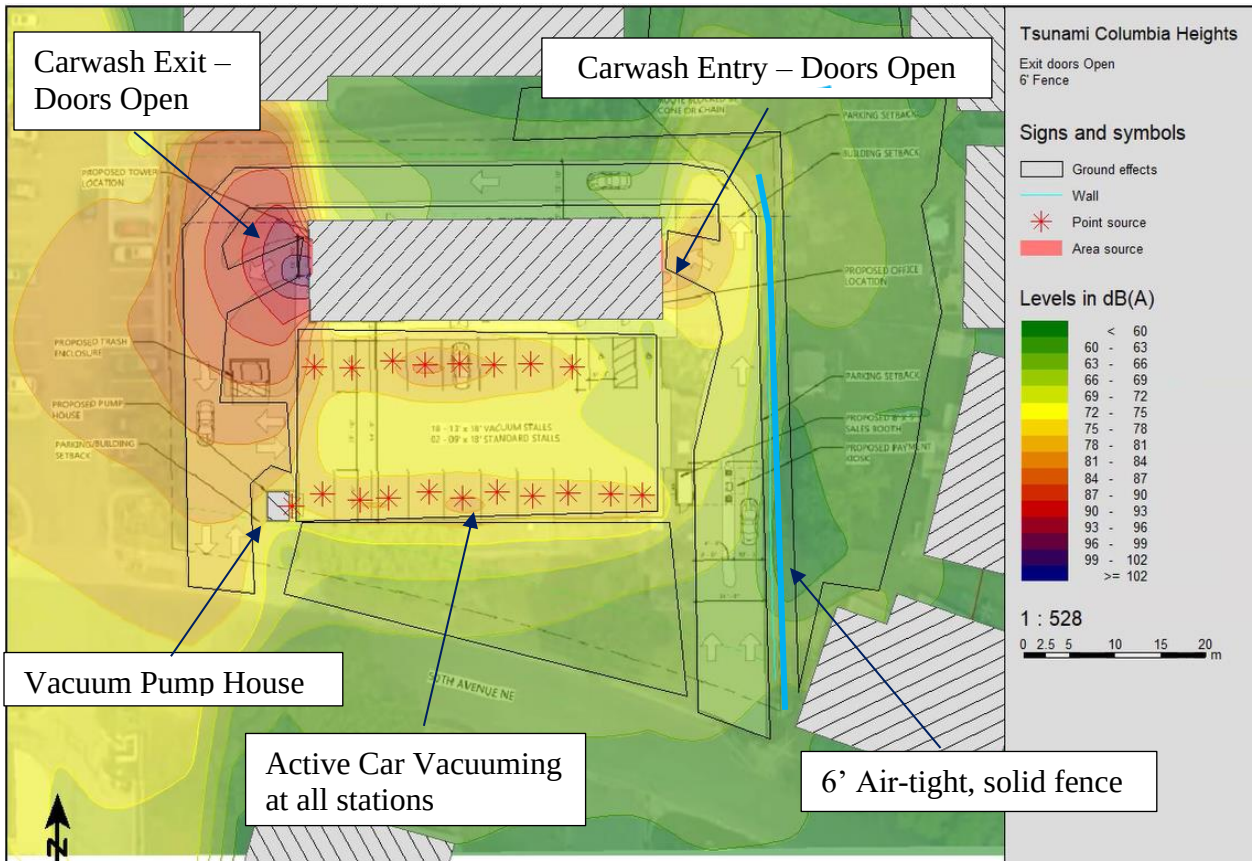

Figure 9: Sound Contour Map Predicted Sound Level Propagation – Current Design

5.0 Recommendations

To prevent the sound level from exceeding the 60 dBA noise ordinance at the residential property line, extend and increase the sound barrier fence height to an 8' sound barrier along the east border (approximately 2' above the top of the car wash entry door opening). The wall must extend around the northeast corner toward Aldi. Refer to Figure 10 and Figure 11 for barrier extent and predicted sound levels. Refer to Figure 11 for the modeled elevation height for the base of the sound barrier.

There are minimum acoustical requirements for the sound barrier wall. It must be constructed from a material with a minimum acoustical rating of STC 22 or a mass no less than 2 pounds per square foot. An example of a suitable material would be overlapping, 1" (nominal thickness) cedar or pine planks, assembled such that the total, actual thickness of the wall is at least 1-½" along the entire length of the wall. They would need to be screwed together rather than nailed so that the natural warping of the planks over time does not cause them to pull apart and create gaps between them. Because this is a "sound barrier wall" rather than a "fence," there must not be any gaps and it must be constructed tight to the ground.

In addition to the sound barrier, the acoustic analysis for this project depends upon the following design elements:

a. The central vacuum will be located in a masonry building with sealed steel doors. If a vacuum pump exhaust muffler was used at the Waukesha location then the vacuum pump at this location should also be fit with a muffler.

b. The blowers must be set to turn off when the exit doors open. The entrance door is controlled by a separate set of photo-eye sensors placed at the tunnel entrance. Our analysis relies on the exit door being closed while the blowers are operating. We have assumed that the entry doors may be open while the blowers are operating. The sound level in the Aldi parking lot with the exit door closed will result in a sound level of approximately 71 dBA. We understand Tsunami does not want a wall that would block street view.

We must note that the sound level at the residential property to the south would exceed the 60 dBA residential limit when all vacuums are simultaneously active. We understand this situation to be a rare occurrence and typical use will not result in levels above the measured ambient (59 dBA SW corner).

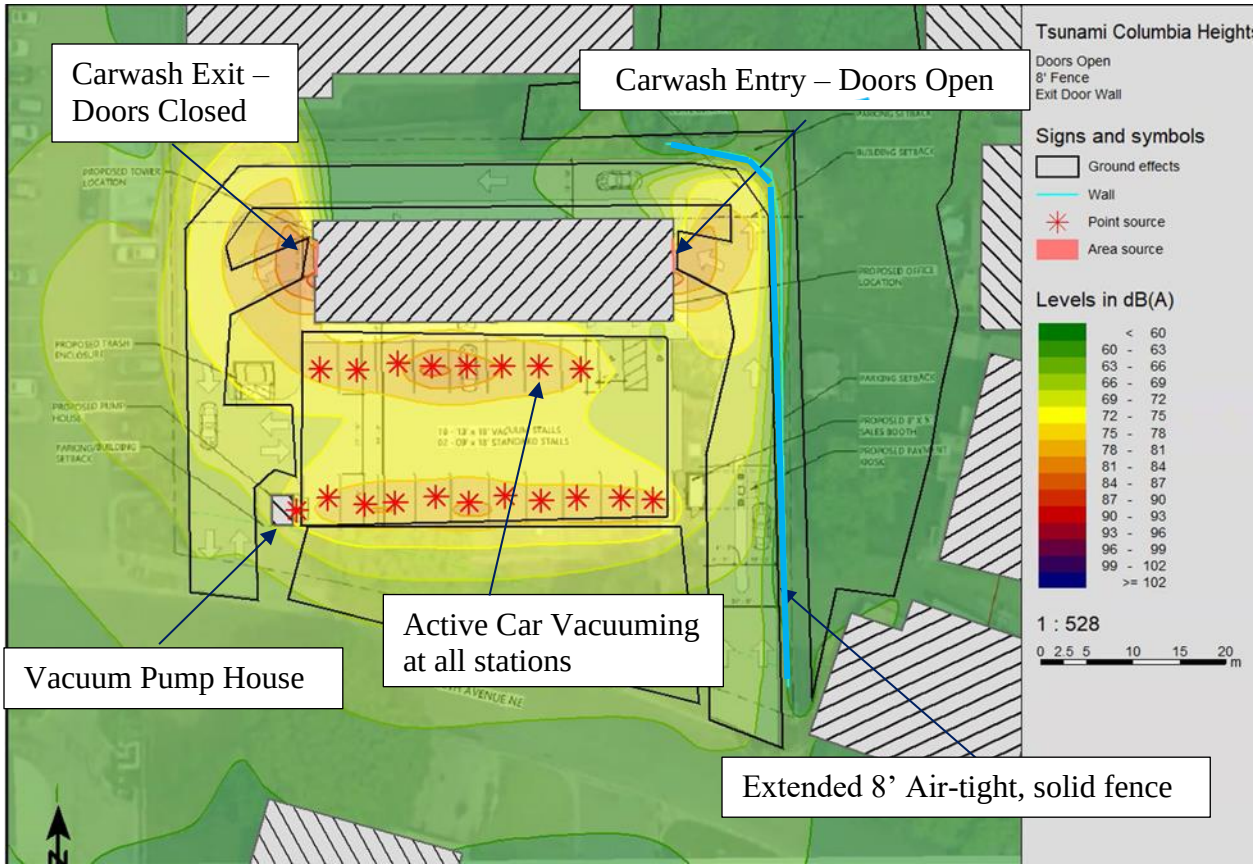

Figure 10: Sound Contour Map – Tsunami Car Wash Exit Doors Closed with 8-ft Property Line Barrier

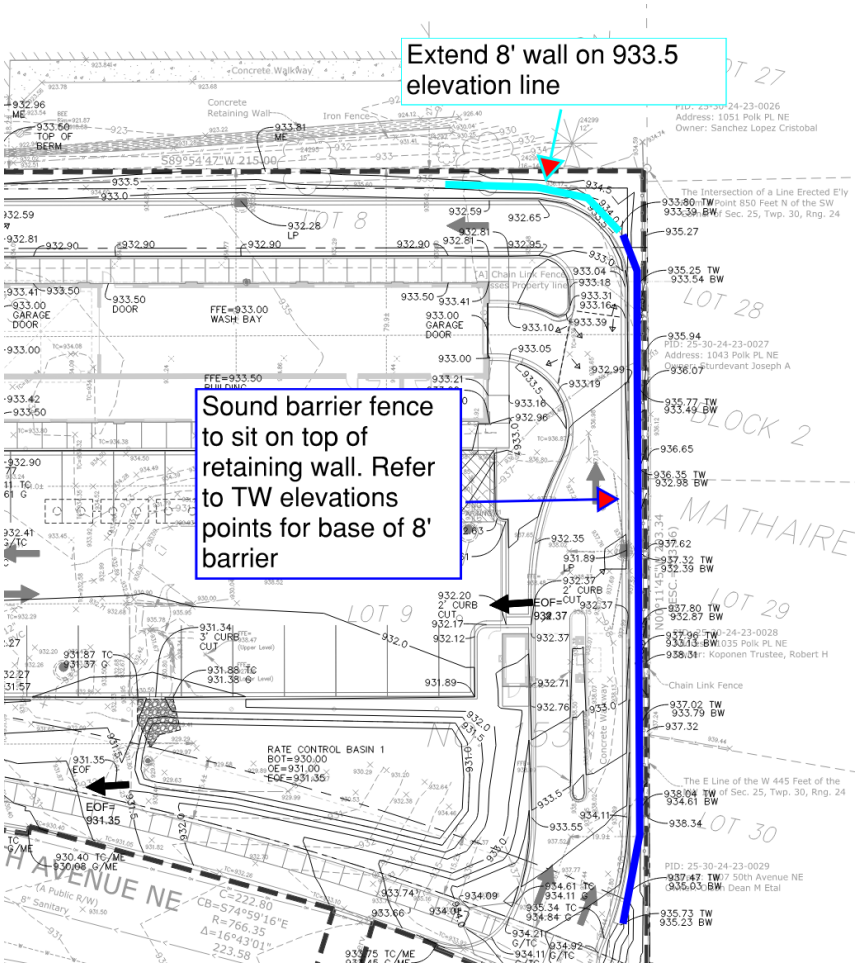

Figure 11: Sound Barrier Fence Location

6.0 Conclusion

The proposed carwash design includes several elements that are beneficial in terms of noise transmission to the residential neighborhood. The carwash is oriented so that the loudest part of the building (the exit) is pointed away from residences. Airlift doors will be installed and the exit door will be kept closed while the blowers are operating. The central vacuums will be located within a masonry building with sealed steel doors. Finally, the addition of a solid, 8' tall, air-tight fence (2' above the top of the car wash entry door) will serve as a sound barrier along the eastern border on top of the planned retaining wall, allowing the carwash-related sound levels at the residential property lines to meet the Minnesota noise ordinance's residential threshold of 60 dBA.

This concludes our assessment and recommendations. We will be happy to elaborate on anything contained within this report.

Appendix A: Acoustical Terminology

Sound level is measured in units called decibels (abbreviated dB). Decibels are logarithmic rather than linear quantities and thus a doubling of the sound level does not translate to a doubling of decibels. Also, the human ear does not interpret a doubling of sound energy as a doubling of loudness. For these reasons, the following approximate relationships should be kept in mind when reading this report.

The logarithmic nature of dB and the human subjective perception of relative sound levels result in the following approximate rules for judging increases in noise. A 3 dB sound level increase (or decrease) typically cannot be heard or is barely perceptible. A 5 dB sound level increase is perceptible and is often considered significant. A sound level which increases by 10 dB will be perceived as twice as loud. These perceived changes in the noise level are mostly independent of the absolute noise level. That is, a 35 dB noise will be perceived as twice as loud as a 25 dB noise, and a 60 dB noise will be perceived as twice as loud as a 50 dB noise.

Audible sound occurs over a wide frequency range, from low-pitched sounds at approximately 20 Hertz (Hz) to high-pitched sounds at 20,000 Hz. These frequencies are commonly grouped into octave bands or 1/3 octave bands. Building mechanical systems generally produce noise in the 63 Hz to 1000 Hz octave bands, with the lower frequency noise generated by large fans. Human speech is predominantly contained in the 250 Hz to 2000 Hz octave bands.

Humans do not hear equally well at all frequencies. We are especially poor at hearing low frequency sound and are best at hearing sound in the frequency range of human speech. A microphone does not have these same characteristics. Therefore, when sound is being measured to determine how well people will be able to hear it, a "weighting" is applied to the sound level measured using a microphone. The most common weighting is the "A-weighting" and the resulting sound level is expressed in A-weighted decibels (dBA). This weighting reduces the low frequency sound, slightly increases the sound at the dominant frequencies of human speech, and slightly lowers the sound level at high frequencies.

The ambient noise level is the existing level of noise in a space or at a specific location in the environment.

Direct Sound Level or Direct Noise Level is the result of sound that travels directly from the sound source to the listener’s ears, without reflecting off of any surfaces.

Equivalent Sound Level (L_{eq}) is the average sound level in an environment where the sound level changes. However, the L_{eq} is not a simple arithmetic average of the sound level over time, but is a logarithmic average. L_{eq} is the “energy” average noise level over a period of time. L_{eq} can be measured for any time period, but is typically measured for some increment or fraction of an hour such as 15 minutes, 1 hour or 24-hours.

Sound Power and Sound Pressure Levels - Sound pressure can be directly measured by a microphone. Outdoor sound pressure levels are influenced by the distance and orientation of the receiver, obstructions and ground absorption between the source and receiver, the temperature, and wind gradients. Sound power is a physical property of the source alone and is not influenced by the external environment. It is an important parameter which is used for rating and comparing sound sources. The sound power is calculated by taking sound pressure or sound intensity measurements according to strict standards and calculation procedures. Conversely, the Sound Pressure Level at a particular location can be calculated

from the Sound Power Level for a given source and the environmental factors affecting the sound propagation path between the source and receiver.

The statistical sound levels, as they are most often called, quantify the sound level exceeded during a period of time. For example, the L_{90} sound level is the sound level exceeded during 90% of the measurement period. If the measurement period is 60 minutes long, then the L_{90} is the sound level exceeded during 54 minutes. The L_{90} is generally considered to be the "background" sound level, the baseline level that is present most of the time. Another commonly used statistical level is the L_{10}. The L_{10} is the sound level exceeded during only 10% of the measurement period. If the measurement period is 60 minutes long, then L_{10} is the sound level exceeded during only 6 minutes of the measurement period. L_{10} can be used to quantify the fluctuating sound levels in an environment. L_1 and L_5 are also sometimes used for this purpose.