Central Kitsap Middle School & High School Environmental Noise Report

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Abbreviations

Leq	Equivalent Noise Level
Lmax	Maximum Noise Level

Glossary

Equivalent Noise Level	The Leq noise descriptor is the Equivalent Noise Level, which is the dB level of a constant sound that has the same acoustical energy as the time-varying sound over the same period of time. The Leq is described by the Environmental Protection Agency as the "equivalent sound level is a single value of sound level for any desired duration, which includes all of the time-varying sound energy in the measurement period". Therefore, a source that produces a constant sound level of 60 dB for a ten-minute duration, and then produces a constant sound level of 70 dB for ten minutes would produce an Leq of 67 dB (the logarithmic average of 60 and 70) for the entire 20-minute duration. Note that the level in the Leq calculation is closer to the higher sound level because the higher level has more energy.
Maximum Noise Level	The Lmax noise descriptor is the maximum rms (root-mean-square) noise level within the duration of the measurement.

1.0 INTRODUCTION

This report describes the predicted noise impact to the community surrounding the Central Kitsap Middle School and High School project, located at 3700 NW Anderson Hill Road in Silverdale, WA. Also described is an analysis of existing noise levels on the school site to compare with WAC 246-366A-30 requirements for school sites.

1.1 APPLICABLE NOISE ORDINANCES

The site is governed by the provisions of Title 10.28 of the Kitsap County Code. The ordinance specifies the maximum noise levels allowable at receiving property lines for noise sources. The allowable noise levels depend on the zoning use of the source property and the zoning use of the receiving property. There are three possible classes of use; residential (Class A), commercial and light industrial (Class B), and manufacturing (Class C). Table 1 below documents the maximum allowable sound levels for any one hour based on the use of the source property and the use of the receiving property.

Table 1 Maximum permissible daytime environmental noise levels (Kitsap County Code, 10.28.040(a))

EDNA OF NOISE SOURCE	EDNA OF RECEIVING PROPERTY		
	Class A	Class B	Class C
Class A	55 dBA	57 dBA	60 dBA
Class B	57 dBA	60 dBA	65 dBA
Class C	60 dBA	65 dBA	70 dBA

For receiving properties classified as Class A EDNAs, the noise limitations shall be reduced by 10 dBA during the nighttime hours of 10 PM to 7 AM. This limits noise during nighttime hours for EDNA Class A properties to 45 dBA if the source property is a Class A EDNA, 47 dBA if the source property is a Class B EDNA, and 50 dBA if the source property is a Class C EDNA.

The ordinance allows noise levels to exceed those in Table 1 for short durations. These allowances are 5 dB above the limit for noise lasting up to 15 minutes out of every hour, 10 dB above the limit for noise lasting up to 5 minutes per hour, and 15 dB for noise lasting up to 90 seconds per hour (equivalent to the Lmax).

1.1.1 WAC 246-366A-30

The currently existing property is subject to WAC code section 246-366-030 (3) which states that:

"Noise from any source at a proposed site for a new school, an addition to an existing school, or a portable classroom shall not exceed an hourly average of 55 dBA (Leq 60 Minutes) and shall not exceed an hourly maximum of (Lmax) of 75 dBA during the time of the day that school is in

session; except sites exceeding these sound levels are acceptable if a plan for sound reduction is included in the new construction proposal and the plan for sound reduction is approved by the health officer."

To ensure the project meets the WAC code, ambient noise measurements were conducted at the existing Central Kitsap middle school and high school site located at 3700 NW Anderson Hill Road in Silverdale, WA.

1.2 PROJECT DESCRIPTION

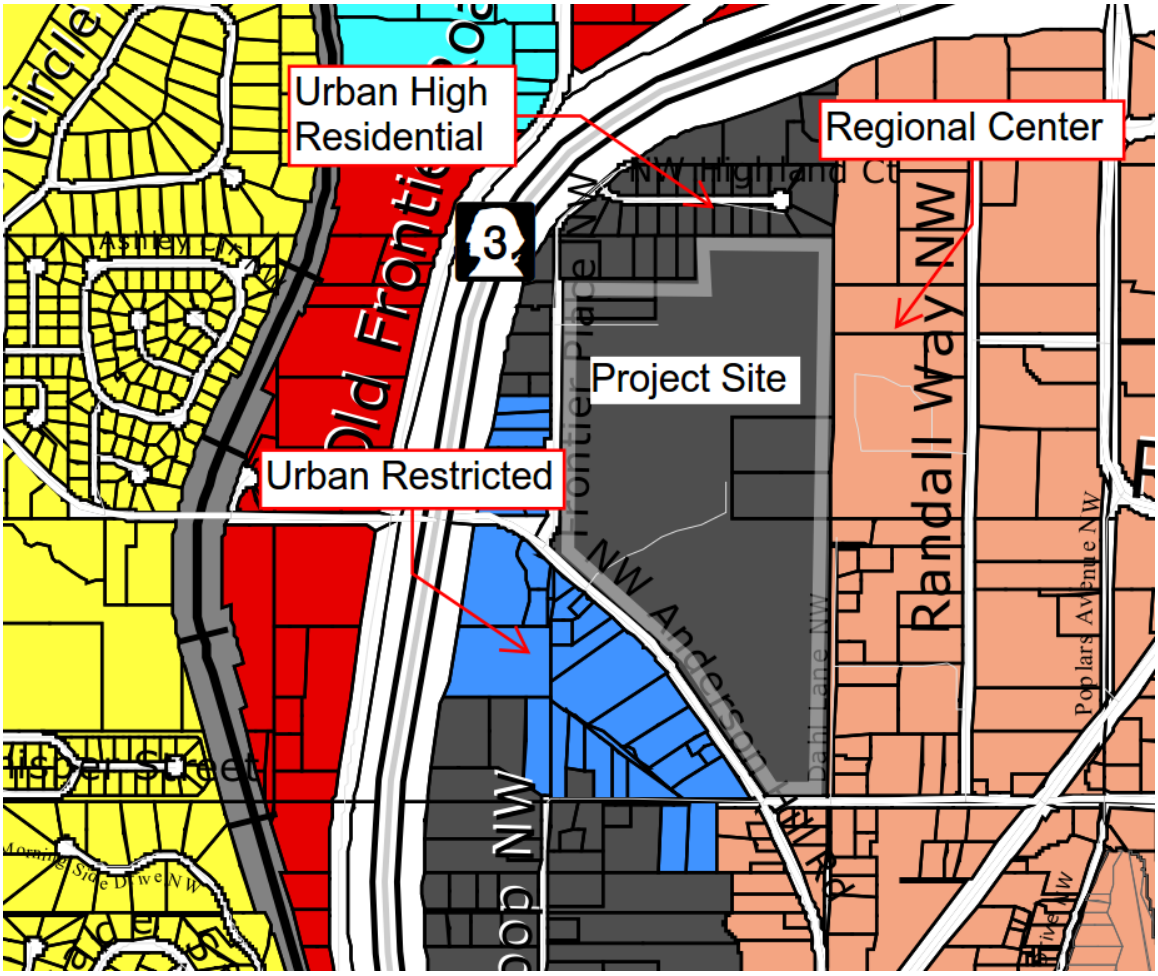
The project is a combined middle school and high school that will be going onto the existing middle school property located at 3700 NW Anderson Hill Road in Silverdale, WA. The currently existing Central Kitsap middle school and high school are separate buildings located at the north and south ends of the site. The proposed new building will be located on the center of the site. The primary noise impacts are expected to result from cars and buses maneuvering on the school grounds, building mechanical noise, sports events at the outdoor fields, and outdoor students noise.

The maximum permissible noise levels at the surrounding property lines is summarized in Table 2. The project site is zoned Urban High Residential. The properties located to the east of the site are zoned Regional Center which also allows high density residential. Property to the west is zoned either Urban High Residential and Urban Restricted. All surrounding property is considered EDNA Class A for the purposed of this report.

Table 2 Zoning description of the surrounding properties

Neighboring Property	Zoning Designation	EDNA Class	Max. Permissible Daytime Hourly Leq
North	Urban High Residential (19-30 DU/Ac)	Class A	55 dBA
East	Regional Center (10-30 DU/Ac)	Class A	55 dBA
South	Regional Center (10-30 DU/Ac)	Class A	55 dBA
Southwest	Urban Restricted (1-5 DU/Ac)	Class A	55 dBA
West	Urban High Residential (19-30 DU/Ac) and Urban Restricted (1-5 DU/Ac)	Class A	55 dBA

Figure 1 Zoning designations surrounding the school site (north is toward the top of page)

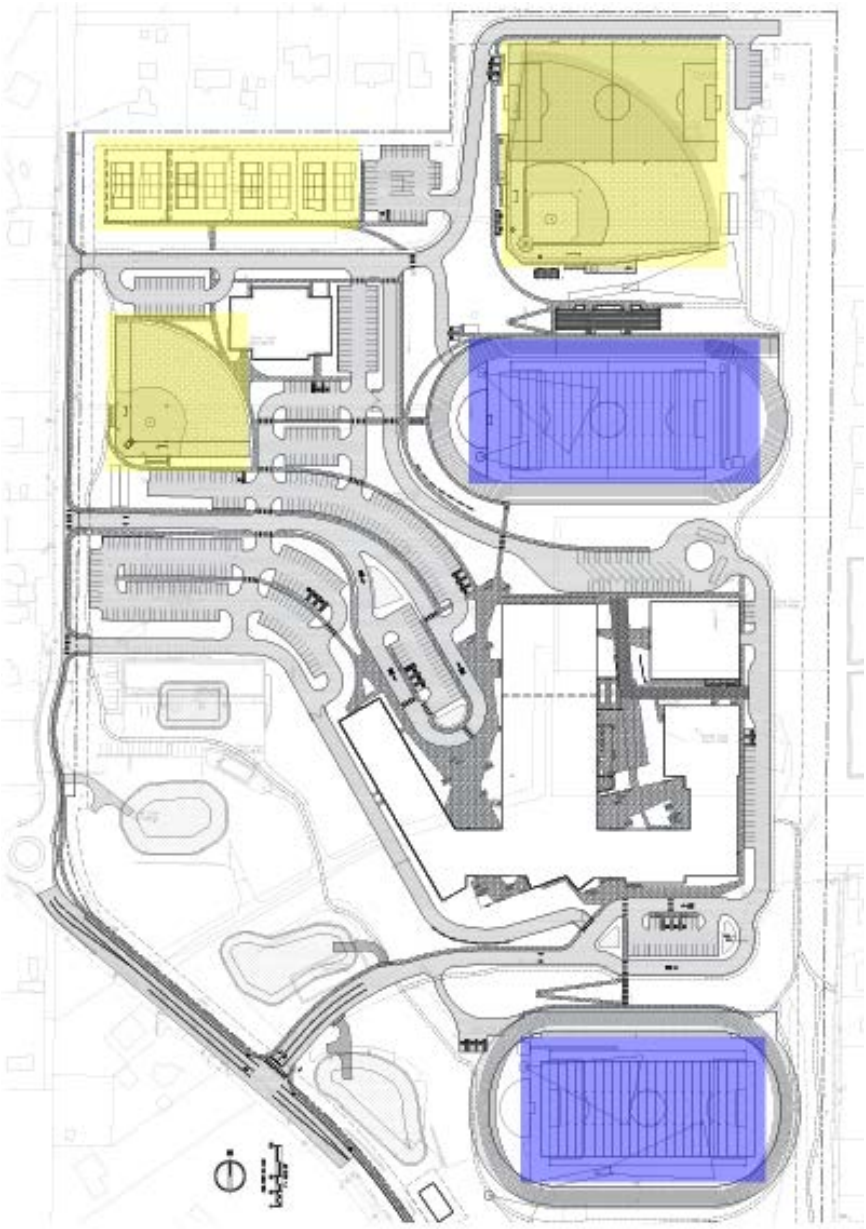


2.0 SITE NOISE TO NEIGHBORS

The noise sources generated by this project and included in this analysis are shown in Figure 2 and include the following:

- Cars and buses maneuvering on the school grounds.
- Building mechanical noise (fans, compressors, boilers)
- Sports events at the outdoor fields (football, soccer, baseball/softball, tennis) and outdoor student noise from PE classes, student loading and unloading and other activities

Figure 2 Noise sources including cars and buses (gray), building mechanical noise (school buildings) outdoor activities (yellow), and sporting events (blue) shown on the project site plan



The approach to assessing the noise impact of the project was as follows:

1. Compare the new site plan with the existing site plan, and assess for any changes in the program.
2. For locations where the program has changed on the school site and noise is generated, predict noise levels at the site property lines and compare to the allowable noise levels defined in the Kitsap County noise ordinance for the appropriate neighborhood zoning.

2.1 CAR AND BUS TRAFFIC ON SCHOOL GROUNDS

Existing car and bus traffic on school grounds currently runs along the edge of the property line. The proposed changes to car and bus traffic on the existing site either makes no significant changes to the traffic around the edge of the property line, or moves the traffic into the site interior. In addition, several traffic uses will be moving offsite, including the transportation facility. Noise levels to the surrounding property lines will therefore not change significantly on the existing property.

2.2 BUILDING MECHANICAL NOISE

There will be rooftop mechanical equipment for the new Central Kitsap Middle School and High School. This equipment is currently early in design, and will be designed as such to meet the noise code at the surrounding properties.

2.3 SPORTS EVENTS AND OUTDOOR STUDENT NOISE

2.3.1 Noise Types

The primary types of noise generated from sports events and outdoor students include the following:

- Whistles
- Crowds cheering and clapping
- Individual voices yelling
- PA Systems

The above noise sources can be further separated into short duration noise (Lmax) and long duration noise (Leq). Of these, only the whistles qualify for short duration.

2.3.1.1 PA System

The PA systems associated with the athletic fields are currently in design and will be designed to meet the noise code at the surrounding properties.

2.3.2 Sports Event Reference Levels

Measurements of a high school football game at Edmonds Woodway High School were used as reference levels for the noise to neighboring property predictions. The sound levels were measured by Sparling on October 6, 2006. Table 3 shows a description of the reference levels.

Table 3 Reference levels for noise to neighbors prediction

Noise Source	Noise Types	Measurement distance from Noise Source	Measured Level 120 minute Leq	Measured Lmax
Edmopnds Woodway HS Football Game	Crowds (Approximately 1000 in stands) Yelling voices Whistles, Marching band (in bleachers only), PA System	485 ft (from the end zone and 1/3rd point of bleachers, bleachers facing perpendicular to direction of measurement)	61 dBA	76 dBA

2.3.3 Predicted Levels at the Property Line

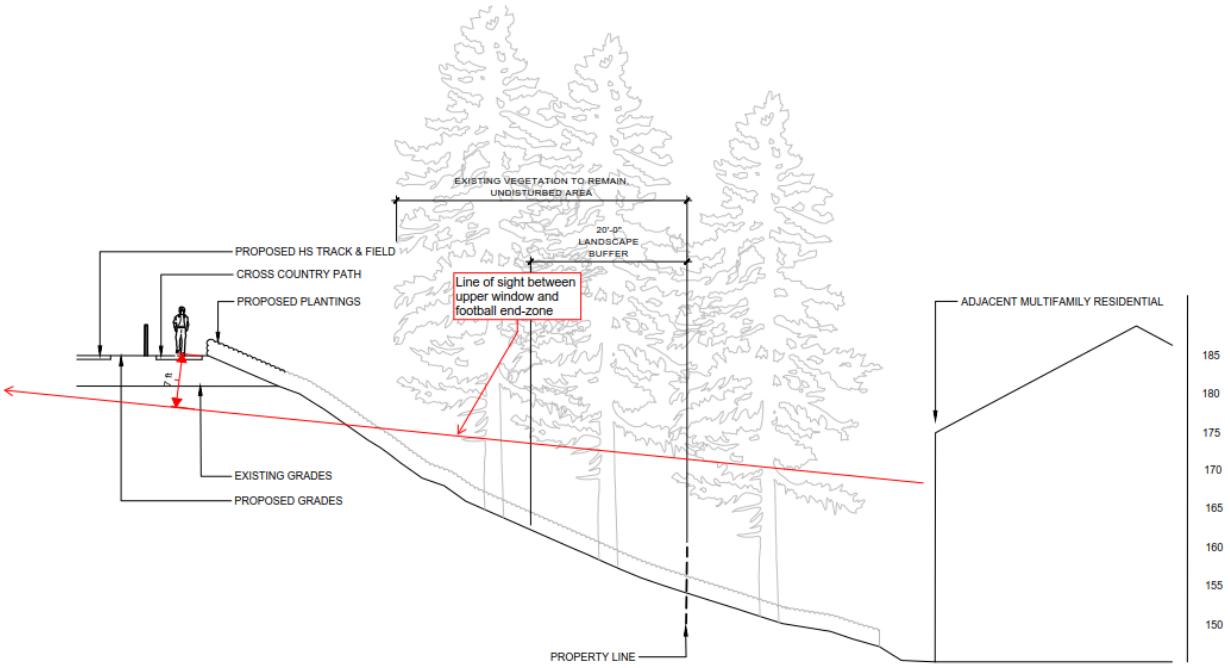
Of the locations shown in Figure 2, the two combined football/soccer fields would include all the above noise types. The remaining fields are expected to have significantly lower noise levels. The southernmost football/soccer field is already in its existing location and noise levels from this field are not expected to change unless a PA system is added. The northern field is new and is expected to have bleachers to seat as many as 1,500 people and a PA system.

The east property line is closest to the northern football/soccer field. Our predictions assumed the noise from a football game was produced at the portion of the field closest to the receiver. For property to the east, the source was located at the east goal line at a height of 6 feet above ground. Although the distance attenuation and topographical attenuation varied along the eastern property boundary receivers, the combination of the two remained relatively constant. Predicted noise levels given in Tables 4 and 5 represent the worst-case location along the boundaries of the project.

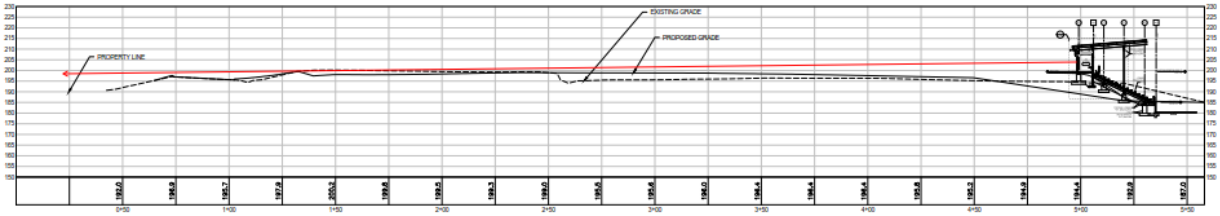
For property to the north, the source was located at the bleachers on the north side of the field at a height equal to half the height of the rear bleacher opening to the north. The receiver to the north was located just north of the parking lot to the east of the tennis courts.

The noise was modeled as a point source. The natural topography of the site will produce an acoustic barrier effect that attenuates sound traveling to the east. See Figure 3 below. Other cross sections were analyzed along the eastern and northern edge of the project site. The discussion that follows is valid for all receivers near the northern or eastern edges of the property.

Figure 3 Topographic section from the football field toward the east and north property lines



Section through the end zone toward the closest east property boundary



Section through the proposed bleachers toward the closest north property boundary

As can be seen in the figure, sound created on most of the football field and traveling east will be interrupted by the edge of the topographic plane prior to the ground sloping down to the property line. The red lines in the cross sections represent the line of sight between a receiver at the upper level of the residences and the pertinent sound source associated with the football field. The calculated topographical attenuation is 12 dBA between a source 6 feet above ground at the east goal line and the upper windows of the residences to the east. As the source of noise moves west from the east end zone, in addition to the increased distance attenuation, the topographic attenuation increases because the line of sight moves further into the ground.

Sound traveling north from the football field itself will also be attenuated by the topography near the field since the field is lower than the topography immediately to the north. Portions of the stadium seating will also be lower than the line of sight between the stadium and homes to the north. Homes to the north are a combination of one and two story homes. The cross section in

Figure 3 uses a single family home as an example. Although the topography near the stadium would not change, the line of sight to a two story home would be higher than is shown in the Figure.

Noise traveling to the north of the Central Kitsap High School stadium will be less than measured at Edmonds-Woodway for several reasons. First, the Edmonds-Woodway stadium had a solid rear wall so the sound was forced out toward the measurement location to the side, inflating the sound levels used for this noise study by as much as 3dBA. Second, the northerly direction at Central Kitsap is opposite the direction that the people and band are facing and projecting noise in the stands. Third, as mentioned earlier, a portion of the stands is depressed into the slope and blocked from direct view to the north. Finally, the slope of the bleacher roof will reflect sound to the south rather than the north. Combined with an absorptive audience (all audiences are absorptive), a reduced portion of the total energy will be emitted toward the north.

Predicted football game noise levels to the north incorporate the following attenuation factors in addition to the distance:

- 2 dBA for the solid wall behind the Edmonds-Woodway measurements.
- 2 dBA for the directionality of the audience and band at Central Kitsap compared to the orientation of the Edmonds-Woodway measurements.
- 5 dBA for the effect of the roof and the limited rear opening of the grandstand at Central Kitsap.

Single story homes and the first floor of two story homes to the north will receive additional attenuation from sound traveling at grazing incidence over the topography (mostly grass) between the stadium and their home. The additional attenuation is expected to be approximately 3 dBA. It has not been included in the predicted noise levels.

Tables 4 and 5 provide the predicted noise levels. Predictions accounted for daytime required sound levels, as competitive sporting events will take place after school and conclude by 10 PM. Predictions assumed an attendance of 1,000 people, which was assumed to be a common maximum attendance even though the capacity of the stadium is 1,500. Maximum capacity events are likely to occur at the most one time per year, too infrequent for evaluation.

The levels in the Ordinance are not given in terms of Leq. The Leq metric had not yet been implemented when the ordinance was written. Predicted noise levels are typically calculated in terms of Leq since it is seldom possible to calculate them in the terms given in the ordinance. There is typically a close correlation between Leq and the maximum permissible sound levels given in the Ordinance.

Table 4 Predicted average (Leq) levels from the northern football/soccer field

Receiving Property Line	Distance from source to Worst-Case Receiver	Predicted Average Level, Hourly Leq	Max. Permissible Daytime Limit per WAC
East	257 ft	55 dBA	55 dBA
North	450 ft	53 dBA	55 dBA

Table 5 Predicted maximum (Lmax) levels from the northern football/soccer field

Receiving Property Line	Distance from source to Property Line	Predicted Maximum Level, Lmax	Max. Permissible Daytime Lmax per WAC
East	257 ft	70 dBA	70 dBA
North	450 ft	68 dBA	70 dBA

The results show that the expected levels produced by a football game will meet the noise code limits at property surrounding the school site.

2.3.4 Potential Impact from Sports Events

The impact of a project is not directly correlated to compliance with local noise codes. Noise codes do not account for existing noise levels.

The school district's bus transit center currently exists at the north end of the project site. It is scheduled to be relocated as part of the site requirements for this project, but currently it creates noise, primarily from bus traffic in its parking area as well as bus movements in and out of the facility. Figure 4 shows the existing facility and Figure 5 is a copy of Google Maps showing the bus facility and the surrounding property.

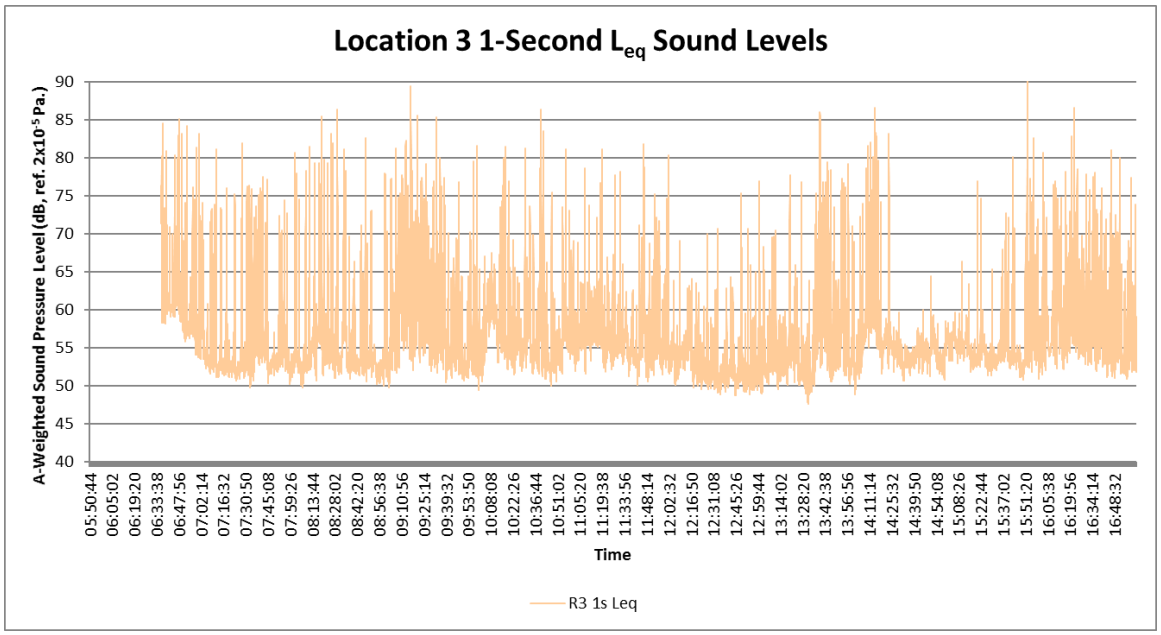
Figure 4 Existing district bus facility at north end of project site (from "Central Kitsap Consolidated Transportation, Food Service, and Warehouse Noise to Neighbors Report", Stantec, May, 2016)

As part of a previous noise study by Stantec for the Central Kitsap School District ("Central Kitsap Consolidated Transportation, Food Service, and Warehouse Noise to Neighbors Report", Stantec, May, 2016), measurements of existing noise levels were taken at locations pertinent to the present study. Those measurements locations are documented in Figure 4 and labeled R1 through R4. Location R3 is very close to the same location used to predict expected noise levels from a football game, documented in Tables 4 and 5 of this report.

Figure 5 Copy of Google Maps showing the project site and the existing district transportation center

Existing noise levels measured at R3 are significantly higher than the predicted noise levels due to a football game. Figure 6 is copied from the same previous Stantec report and document the existing noise levels at that locations.

Figure 6 Existing noise levels at location R1



As can be seen in Figure 6, existing sound levels north of the site are higher than expected maximum noise levels during an athletic event on the football/soccer field. In addition, the existing noise levels occur every school day, rather than occasionally, for a longer duration than is expected for an athletic event.

Overall, the noise impact from the new school project is not expected to be significant because the project noise levels will meet the Kitsap County Noise Ordinance and because the future sound levels will be less than current sound levels (property to the north).

3.0 SITE NOISE MEASUREMENT

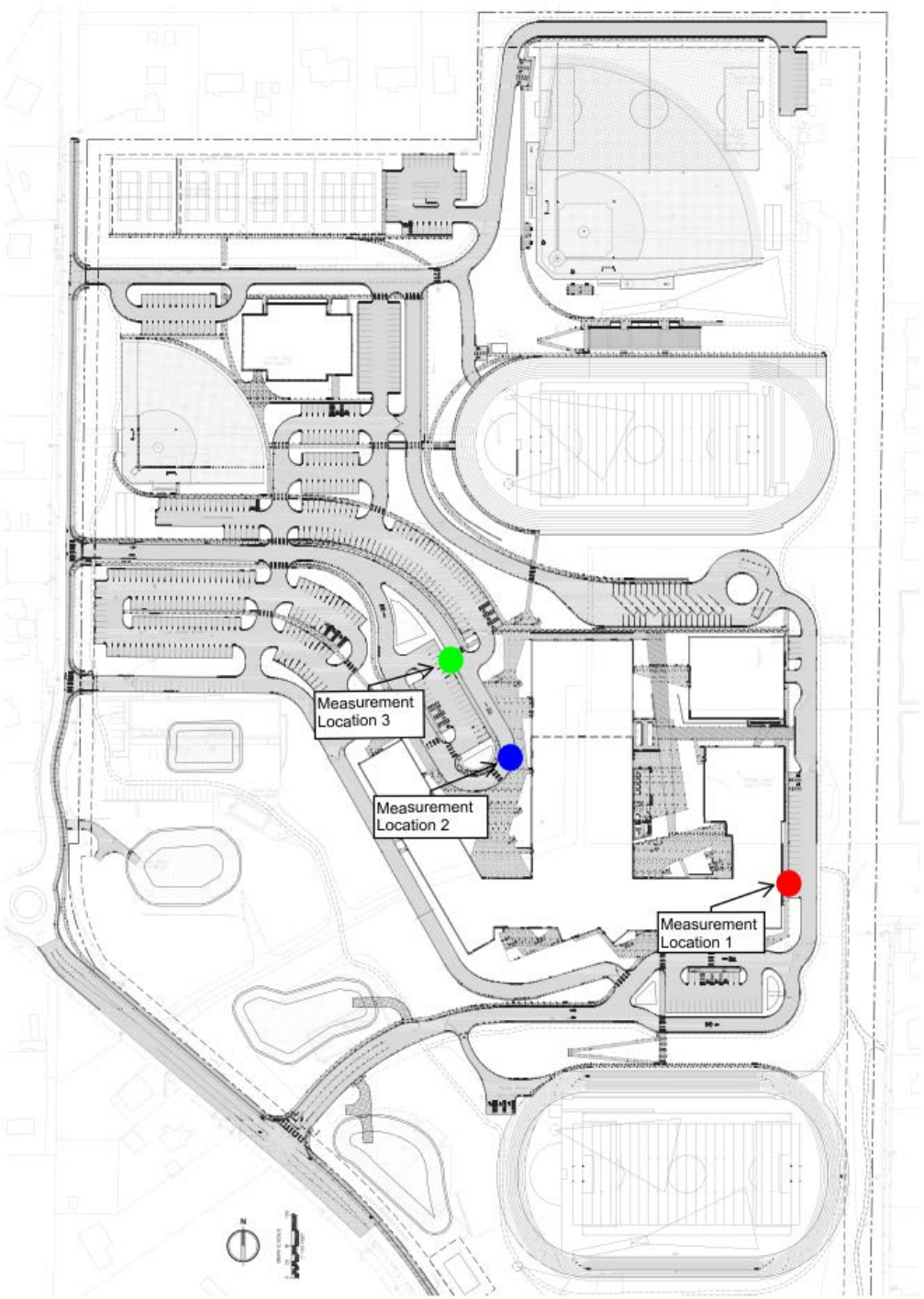
3.1 SITE NOISE COMPLIANCE WITH WAC 246-366-030

WAC 246-366-030 regulates noise levels on school sites created by sources external to the site. To check compliance with the code, sound level measurements were conducted on the existing school site on Wednesday, November 23, 2016. School was in session the day of the measurements with a full day for the high school and half day for the middle school. However, the outdoor fields were not in use this day.

Measurements were taken at three locations from roughly 8;00 a.m. to 3:00 p.m. Measurement equipment included Type 1 Larson Davis logging sound level meters that were field calibrated prior to and following the measurements. Measurement locations are shown in Figure 7.

The primary noise source during the measurements was from the nearby WA-3. There was additionally some student noise, but events were brief and did not contribute significantly to the

Figure 7 Measurement locations



3.2 MEASUREMENT RESULTS

Measurement results are documented in Figures 8 – 10. Each figure shows the measured one-minute Leq, the one-minute Lmax and a running hourly Leq for the duration of the measurement, starting at one hour into the measurement. The Leq represents an average noise level and the Lmax is the maximum noise level during the measurement period.

Figure 8 Location 1 Measured Sound Levels

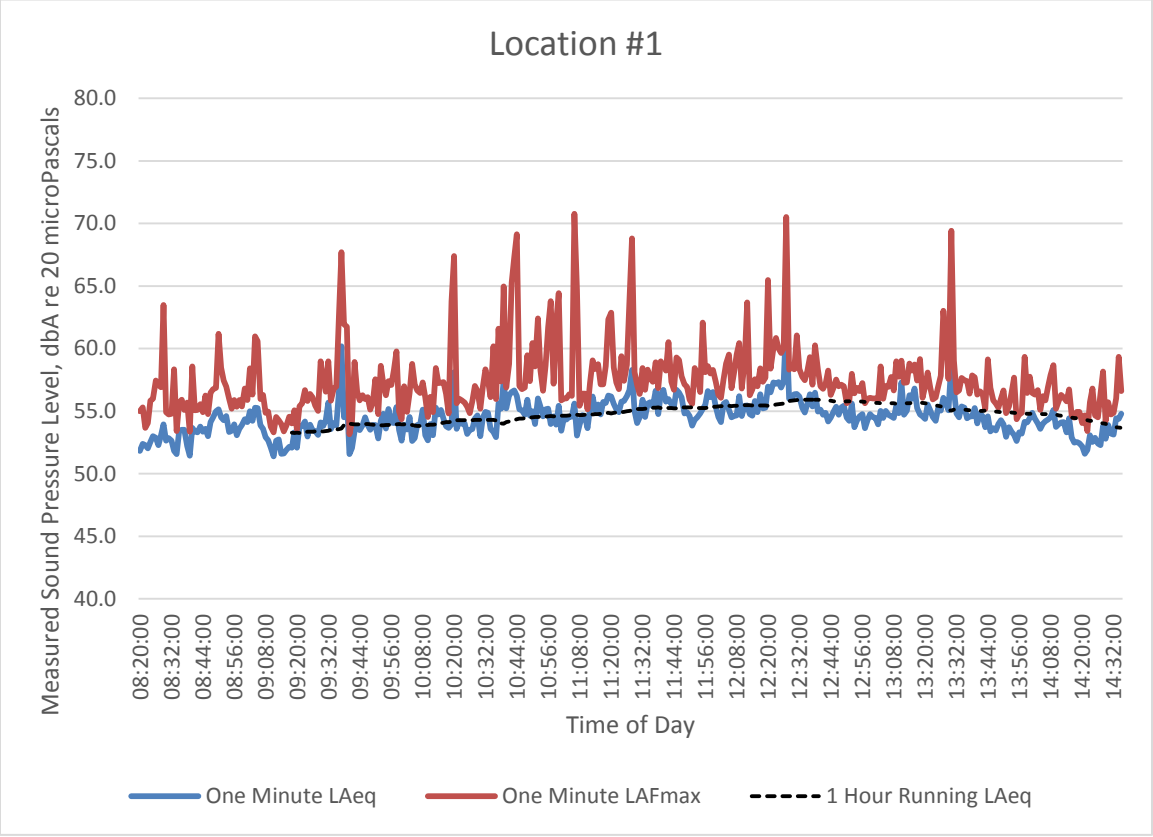


Figure 9 Location 2 Measured Sound Levels

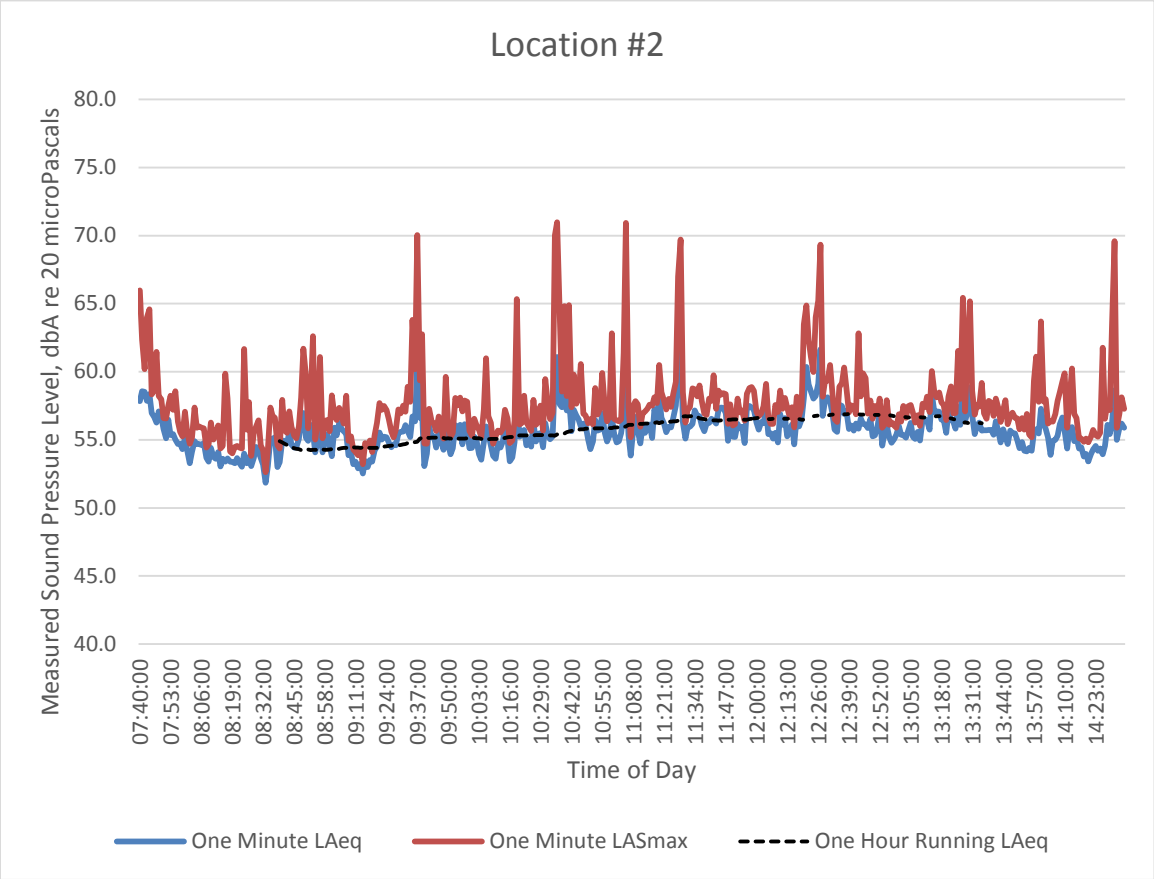
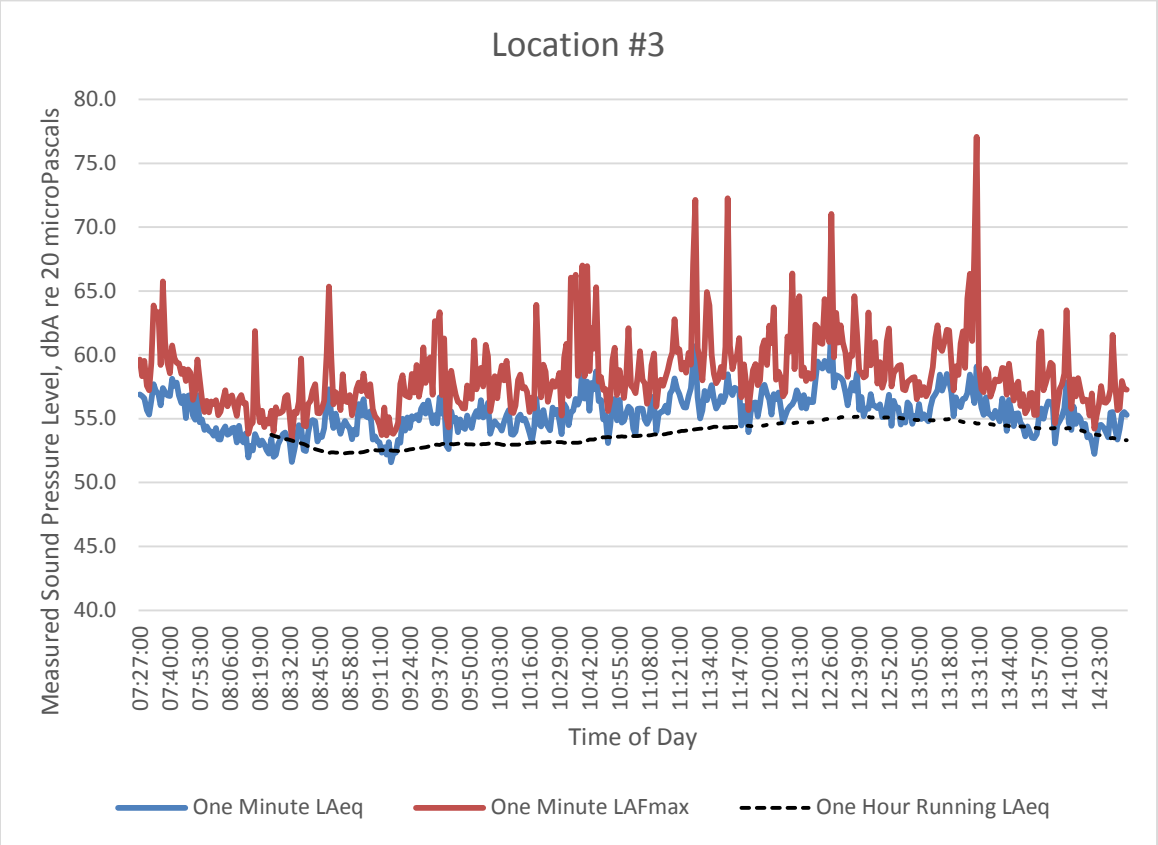


Figure 10 Location 3 Measured Sound Levels



3.3 MEASUREMENT FINDINGS

The WAC code limits the allowable site noise to an hourly Leq of 55 and an Lmax of 75 dBA during school hours. All three measurement locations exceeded the allowable noise levels.

The code exceedance requires the construction of the exterior envelope of the school buildings to be reviewed by the Kitsap County health officer to confirm that exterior noise, by the time it travels through the building exterior, will meet allowable interior sound levels governed by WAC 246-366-110, Sound Control.

APPENDIX

Appendix A GENERAL DISCUSSION OF ENVIRONMENTAL NOISE

Environmental noise typically refers to the total acoustic environment as measured or heard by humans. This acoustic environment is made up of background noise caused by distant traffic, airplanes, etc., and higher-level noise dominated by nearby sources such as car pass-bys, airplane flyovers, or close construction activity. The most commonly used measure of sound is the sound pressure level (SPL), which represents the magnitude of the sound pressure in the air.

The human ear responds differently to sounds at different frequencies (pitch). This is demonstrated by the fact that we hear higher pitched sounds easier than lower ones of the same magnitude. To compensate for the different "loudness" as perceived by humans at different pitches, a standard weighting curve is applied to measured levels. This weighting curve represents the human ear's sensitivity, and is labeled "A" weighting. The Units of magnitude of the sound are written dBA ("A" weighted decibels), which is a logarithmic scale. Regulatory agencies use the dBA scale as one measure of evaluating noise impacts.

The nature of dB scales means that individual dB ratings for different noise sources cannot be added directly to give the dB rating of the combination of these sources. Two noise sources producing equal dB rating at a given location will produce a composite noise that is 3 dB greater than the individual levels. Similarly, the loudness of sounds does not vary arithmetically. A difference of 3 dB is marginally detectable to the untrained ear. A 5 dB difference is easily detectable, and a sound that is 10 dB more than another sounds twice as loud.

The following table presents examples of common noise levels:

SPL(dBA)	Example
0	Threshold of audibility
20	Quiet rural area (no traffic)
40	Suburban neighborhood (distant traffic)
60	Normal conversation
70	Busy freeway
100	Jackhammer
130	Threshold of pain

Statistical descriptors are commonly used to describe noise levels that fluctuate. Examples of statistical descriptors are L(1), L(10), L(50), L(90), and L(99), and represent the sound that is exceeded the percentage of time in parentheses. For example, L(50) is the sound level exceed 50% of the time in a given time interval. L(1) levels generally represent maximum levels, L(50) average levels, and L(99) background levels.

Another noise descriptor is the Equivalent Noise Level (Leq), which is the dBA level of a constant sound that has the same acoustical energy as the time-varying noise. The EPA describes it: "The equivalent sound level is a single value of sound level for any desired duration, which includes all of the time-varying sound energy in the measurement period". Therefore, a sound that was 60 dBA for ten minutes, and 70 dBA for ten minutes would have an Leq for the total time period of 67 dBA (remember, logarithms do not add together directly). It can be seen that the higher

level sounds are weighted heavier in the calculation, because they have more energy. Maximum noise levels are therefore accounted for in the Leq descriptor.

Another important noise descriptor is Lmax, which represents the highest root-mean-square level for all samples during the sample interval. A 60-minute Lmax is the highest level recorded during the 60 minute measurement period.

The Ldn, or day-night equivalent sound level, is the Leq measured over a 24 hour period, with a 10 dBA penalty applied to night-time levels (10:00pm to 7:00am).

Noise levels at locations removed from the source are affected by several factors:

1. The distance between the noise source and receiver and size of the noise source. Noise resulting from a large noise source (such as a football game) will fall off at a slower rate than noise from a point source (such as a loudspeaker), with increasing distance.

Depending on the above factors, distance attenuation will vary from 3 to 6 dB per doubling of distance from the source to the receiver. The following factors may provide additional reduction of noise levels at the receiver:

1. Intervening topography. Topography which blocks the line of sight from the receiver to the noise source will typically result in a 5-15 dB reduction in noise levels at the receiver.
2. Intervening vegetation. Vegetation that blocks the line of sight from the source to the receiver, such as trees or shrubs, acts as barrier to sound. Vegetation is porous, however, and makes a poor barrier. 3 dB of attenuation per 100 ft. of distance is typical for very dense vegetation and trees. Depending on several factors, vegetation can produce as much as 15 dB reduction at long distances (greater than 300 ft).