Appendices

# F. Noise and Vibration Background and Modeling Data

## Appendices

*This page intentionally left blank.*

# Noise and Vibration Background and Modeling Data

## NOISE BACKGROUND

### Terminology and Noise Descriptors

The following are brief definitions of noise terminology.

- **Sound.** A vibratory disturbance that, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.

- **Noise**. Sound that is loud, unpleasant, unexpected, or otherwise undesirable.

- **Decibel (dB)**. A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micropascals (20 μPa).

- **Vibration Decibel (VdB).** A unitless measure of vibration, expressed on a logarithmic scale and with respect to a defined reference vibration velocity. In the U.S., the standard reference velocity is 1 micro-inch per second ($1x10^{-6}$ in/sec).

- **A-Weighted Decibel (dBA).** An overall frequency-weighted sound level in decibels which approximates the frequency response of the human ear.

- **Equivalent Continuous Noise Level (Leq); also called the Energy-Equivalent Noise Level.** The value of an equivalent, steady sound level which, in a stated time period (often over an hour) and at a stated location, has the same A-weighted sound energy as the time-varying sound. Thus, the $L_{eq}$ metric is a single numerical value that represents the equivalent amount of variable sound energy received by a receptor over the specified duration.

- **Statistical Sound Level ($L_n$).** The sound level that is exceeded "n" percent of time during a given sample period. For example, the $L_{50}$ level is the statistical indicator of the time-varying noise signal that is exceeded 50 percent of the time (during each sampling period); that is, half of the sampling time, the changing noise levels are above this value and half of the time they are below it. This is called the "median sound level." The $L_{10}$ level, likewise, is the value that is exceeded 10 percent of the time (i.e., near the maximum) and this is often known as the "intrusive sound level." The $L_{90}$ is the sound level exceeded 90 percent of the time and is often considered the "effective background level" or "residual noise level."

- **Day-Night Level ($L_{dn}$ or DNL).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring during the period from 10 PM to 7 AM.

- **Community Noise Equivalent Level (CNEL).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 5 dB added to the A-weighted sound levels occurring during the period from 7 PM to 10 PM and 10 dB added to the A-weighted sound levels occurring during the period from 10 PM to 7 AM. For general community/environmental noise, CNEL and $L_{dn}$ values rarely differ by more than 1 dB. As a matter of practice, $L_{dn}$ and CNEL values are interchangeable and are treated as being equivalent in this assessment.

- **Sensitive Receptor.** Noise- and vibration-sensitive receptors include land uses where quiet environments are necessary for enjoyment and public health and safety. Residences, schools, motels and hotels, libraries, religious institutions, hospitals, and nursing homes are examples.

## Characteristics of Sound

Sound is a pressure wave transmitted through the air. When an object vibrates, it radiates part of its energy as acoustical pressure in the form of a sound wave. Sound can be described in terms of amplitude (loudness), frequency (pitch), or duration (time). The standard unit of measurement of the loudness of sound is the decibel (dB). The human hearing system is not equally sensitive to sound at all frequencies. Sound waves below 16 Hz are not heard at all and are "felt" more as a vibration. Similarly, while people with extremely sensitive hearing can hear sounds as high as 20,000 Hz, most people cannot hear above 15,000 Hz. In all cases, hearing acuity falls off rapidly above about 10,000 Hz and below about 200 Hz. Since the human ear is not equally sensitive to sound at all frequencies, a special frequency-dependent rating scale is usually used to relate noise to human sensitivity. The A-weighted decibel scale (dBA) performs this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear.

Because of the physical characteristics of noise transmission and noise perception, the relative loudness of sound does not closely match the actual amounts of sound energy. Table 1 presents the subjective effect of changes in sound pressure levels. Typical human hearing can detect changes of approximately 3 dBA or greater under normal conditions. Changes of 1 to 3 dBA are detectable under quiet, controlled conditions and changes of less than 1 dBA are usually indiscernible. A change of 5 dBA or greater is typically noticeable to most people in an exterior environment and a change of 10 dBA is perceived as a doubling (or halving) of the noise.

**Table 1 Change in Sound Pressure Level, dB**

| Change in Apparent Loudness | |
|---|---|
| ± 3 dB | Threshold of human perceptibility |
| ± 5 dB | Clearly noticeable change in noise level |
| ± 10 dB | Half or twice as loud |
| ± 20 dB | Much quieter or louder |

Source: Bies and Hansen, Engineering Noise Control, 2009.

## Point and Line Sources

Noise may be generated from a point source, such as a piece of construction equipment, or from a line source, such as a road containing moving vehicles. Because noise spreads in an ever-widening pattern, the given amount of noise striking an object, such as an eardrum, is reduced with distance from the source. This is known as "spreading loss." The typical spreading loss for point source noise is 6 dBA per doubling of the distance from the noise source.

A line source of noise, such as vehicles proceeding down a roadway, would also be reduced with distance, but the rate of reduction is affected by of both distance and the type of terrain over which the noise passes. Hard sites, such as developed areas with paving, reduce noise at a rate of 3 dBA per doubling of the distance while soft sites, such as undeveloped areas, open space and vegetated areas reduce noise at a rate of 4.5 dBA per doubling of the distance.[1] These represent the extremes and most areas would actually contain a combination of hard and soft elements with the noise reduction placed somewhere in between these two factors. Unfortunately, the only way to actually determine the absolute amount of attenuation that an area provides is through field measurement under operating conditions with subsequent noise level measurements conducted at varying distances from a constant noise source.

Objects that block the line of sight attenuate the noise source if the receptor is located within the "shadow" of the blockage (such as behind a sound wall). If a receptor is located behind the wall, but has a view of the source, the wall would do little to reduce the noise. Additionally, a receptor located on the same side of the wall as the noise source may experience an increase in the perceived noise level, as the wall would reflect noise back to the receptor compounding the noise.

1 Surface type or ground cover is defined as the "hardness" or "softness" of the surrounding area. "Hard site environment" is areas with acoustically hard ground (e.g., pavement or water). Distance attenuation from a line source (i.e., roadway or railway) with a hard site environment is 3 dB per doubling of distance (dB/DD). "Soft site environment" is areas with acoustically soft ground (e.g., lawn or loose dirt or agricultural uses). Ground cover can affect the sound propagation rate by as much as an additional 1.5 dB/DD. (Note that this rate occurs only when both the noise source and the receiver are close to the ground and the terrain between the two is flat and soft.) As a result of this additional attenuation, the line-source sound levels decrease at a rate of 4.5 dB/DD at soft sites.

## Noise Metrics

Several rating scales (or noise "metrics") exist to analyze adverse effects of noise, including traffic-generated noise, on a community. These scales include the equivalent noise level (Leq), the community noise equivalent level (CNEL) and the day/night noise level (Ldn). Leq is a measurement of the sound energy level averaged over a specified time period.

The CNEL noise metric is based on 24 hours of measurement. CNEL differs from Leq in that it applies a time-weighted factor designed to emphasize noise events that occur during the evening and nighttime hours (when quiet time and sleep disturbance is of particular concern). Noise occurring during the daytime period (7:00 AM to 7:00 PM) receives no penalty. Noise produced during the evening time period (7:00 to 10:00 PM) is penalized by 5 dB, while nighttime (10:00 PM to 7:00 AM) noise is penalized by 10 dB. The Ldn noise metric is similar to the CNEL metric except that the period from 7:00 to 10:00 PM receives no penalty. Both the CNEL and Ldn metrics yield approximately the same 24-hour value (within 1 dB) with the CNEL being the more restrictive (i.e., higher) of the two.[2]

## Psychological and Physiological Effects of Noise

Physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 dBA. Exposure to high noise levels affects the entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, thereby affecting blood pressure and functions of the heart and the nervous system. In comparison, extended periods of noise exposure above 90 dBA would result in permanent cell damage. When the noise level reaches 120 dBA, a tickling sensation occurs in the human ear even with short-term exposure. This level of noise is called the threshold of feeling. As the sound reaches 140 dBA, the tickling sensation is replaced by the feeling of pain in the ear. This is called the threshold of pain. A sound level of 160 to 165 dBA will result in dizziness or loss of equilibrium. The ambient or background noise is widespread and generally more concentrated in urban areas than in outlying, less-developed areas (see Table 2).

[2] Ldn and CNEL values rarely differ by more than 1 dB. As a matter of practice, Ldn and CNEL values are considered equivalent and are treated as such in this assessment.

**Table 2 Common Sound Levels and Their Sources**

| Noise Source | A-Weighted Sound Level in Decibels | Noise Environments | Subjective Evaluations Relative to 70 dB |
|---|---|---|---|
| Near Jet Engine | 140 | Deafening | 128 times as loud |
| Civil Defense Siren | 130 | Threshold of Pain | 64 times as loud |
| Hard Rock Band | 120 | Threshold of Feeling | 32 times as loud |
| Accelerating Motorcycle at a Few Feet Away | 110 | Very Loud | 16 times as loud |
| Pile Driver; Noisy Urban Street/Heavy City Traffic | 100 | Very Loud | 8 times as loud |
| Ambulance Siren; Food Blender | 95 | Very Loud | |
| Garbage Disposal | 90 | Very Loud | 4 times as loud |
| Freight Cars; Living Room Music | 85 | Loud | |
| Pneumatic Drill; Vacuum Cleaner | 80 | Loud | 2 times as loud |
| Busy Restaurant | 75 | Moderately Loud | |
| Near Freeway Auto Traffic | 70 | Moderately Loud | |
| Average Office | 60 | Quiet | One-half as loud |
| Suburban Street | 55 | Quiet | |
| Light Traffic; Soft Radio Music in Apartment | 50 | Quiet | One-quarter as loud |
| Large Transformer | 45 | Quiet | |
| Average Residence without Stereo Playing | 40 | Faint | One-eighth as loud |
| Soft Whisper | 30 | Faint | |
| Rustling Leaves | 20 | Very Faint | |
| Human Breathing | 10 | Very Faint | Threshold of Hearing |

Source: California Department of Transportation (Caltrans) 2006, October. Traffic Noise Analysis Protocol.

## Vibration

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Vibration is normally associated with activities such as railroads or vibration-intensive stationary sources, but can also be associated with construction equipment, such as jackhammers, pile drivers, and hydraulic hammers. Vibration displacement is the distance that a point on a surface moves away from its original static position. The instantaneous speed that a point on a surface moves is described as the velocity, and the rate of change of the speed is described as the acceleration. Each of these descriptors can be used to correlate vibration to human response, building damage, and acceptable equipment vibration levels. During the construction of a building, the operation of construction equipment could cause groundborne vibration. The three main wave types of concern in the propagation of groundborne vibrations are surface or Rayleigh waves, compression or P-waves, and shear or S-waves.

- Surface or Rayleigh waves travel along the ground surface. They carry most of their energy along an expanding cylindrical wave front, similar to the ripples produced by throwing a rock into a lake. The particle motion is more or less perpendicular to the direction of propagation (known as retrograde elliptical).

- Compression or P-waves are body waves that carry their energy along an expanding spherical wave front. The particle motion in these waves is longitudinal, in a push-pull motion. P-waves are analogous to airborne sound waves.

- Shear or S-waves are also body waves, carrying their energy along an expanding spherical wave front. Unlike P-waves, however, the particle motion is transverse, or perpendicular to the direction of propagation.

The peak particle velocity (PPV) or the root mean square (RMS) velocity is usually used to describe vibration amplitudes. PPV is defined as the maximum instantaneous peak of the vibration signal and RMS is defined as the square root of the average of the squared amplitude of the signal. PPV is more appropriate for evaluating potential building damage, whereas RMS is typically more suitable for evaluating human response.

The units for PPV and RMS velocity are normally inches per second (in/sec). Often, vibration is presented and discussed in dB units to compress the range of numbers required to describe the vibration. All PPV and RMS velocity are in in/sec and all vibration levels in this study are in dB relative to 1 micro-inch per second (abbreviated as VdB). The threshold of perception is approximately 65 VdB. Typically groundborne vibration generated by manmade activities attenuates rapidly with distance from the source of the vibration. Manmade vibration problems are usually confined to short distances (500 feet or less) from the source.

Construction generally includes a wide range of activities that can generate groundborne vibration. In general, demolition of structures generates the highest vibrations. Vibratory compactors or rollers, pile drivers, and pavement breakers can generate perceptible amounts of vibration at distances within 200 feet of the vibration sources. Heavy trucks can also generate groundborne vibrations that vary, depending on vehicle type, weight, and pavement conditions. Potholes, pavement joints, discontinuities, differential settlement of pavement, etc., all increase the vibration levels from vehicles passing over a road surface. Construction vibration is normally of greater concern than vibration of normal traffic on streets and freeways with smooth pavement conditions. Trains generate substantial quantities of vibration due to their engines, steel wheels, and heavy loads.

## Sensitive Receptors

Certain land uses are particularly sensitive to noise and vibration. Noise- and vibration-sensitive uses include land uses where quiet environments are necessary for enjoyment and public health and safety. Residences, schools, guest lodging, libraries, religious institutions, hospitals, nursing homes, and passive recreation areas are generally more sensitive to noise than commercial and industrial land use.

## Noise Regulations and Guidelines

Compliance with State, City, and LAUSD noise requirements and guidelines is required for schools as described below.

## State

### California Code of Regulations, Title 24, Part 2

Current law states that every local agency enforcing building regulations, such as cities and counties, must adopt the provisions of the California Building Code (CBC) within 180 days of its publication. The publication date of the CBC is established by the California Building Standards Commission. The most recent building standard adopted by the legislature and used throughout the state is the 2016 version, often with local, more restrictive amendments that are based on local geographic, topographic, or climatic conditions.[5] The State of California's noise insulation standards are codified in the CBC. These noise standards are for new construction in California for the purposes of interior compatibility with exterior noise sources. The regulations specify that acoustical studies must be prepared when noise-sensitive structures, such as residential, schools, or hospitals, are near major transportation noises, and where such noise sources create an exterior noise level of 60 dBA CNEL or higher. Acoustical studies that accompany building plans must demonstrate that the structure has been designed to limit interior noise in habitable rooms to acceptable noise levels. For new residential buildings, schools, and hospitals, the acceptable interior noise limit for new construction is 45 dBA CNEL.

## City of Los Angeles

### Exterior

As specified in Sections 112.02 and 112.05 of the City of Los Angeles Municipal Code, noise attributable to mechanical equipment (such as heating, air conditioning, and ventilation equipment (HVAC) systems or any pumping, filtering, or heating equipment) cannot exceed the ambient noise level by more than 5 decibels. Ambient noise levels can be as-measured at the project site or established via Code-presumed levels. For the nearby residential neighborhood (Zone R1), the presumed ambient levels are 50 dBA (daytime, 7:00 AM to 10:00 PM) and 40 dBA (nighttime, 10:00 PM to 7:00 AM).

Further, power-equipment, including lawn mowers, backpack blowers, small lawn and garden tools, and riding tractors are restricted to no more than 65 dBA Leq at residential properties.

### Construction Activities

Section 41.40 of the Los Angeles Municipal Code prohibits construction or repair work between 9:00 PM and 7:00 AM the following morning, Monday through Friday; between 6:00 PM and 8:00 AM the following morning, Saturdays or federal holidays; and anytime on Sundays. Further, Section 112.05 specifies the maximum noise level from powered equipment[3] as 75 dBA at a distance of 50 feet from the source.[4]

---

[3] The specified equipment for this limitation includes: construction, industrial, and agricultural machinery including crawler-tractors, dozers, rotary drills and augers, loaders, power shovels, cranes, derricks, motor graders, paving machines, off-highway trucks, ditchers, trenchers, compactors, scrapers, wagons, pavement breakers, compressors, and pneumatic or other powered equipment.

[4] However, this noise limitation does not apply where compliance is technically infeasible. Technically infeasible means that the above noise limitation cannot be met despite the use of mufflers, shields, sound barriers and/or any other noise reduction device or techniques during the operation of equipment.

# REFERENCES

Bies, David A. and Colin H. Hansen. 2009. *Engineering Noise Control: Theory and Practice*. 4th ed. New York: Spon Press.

California Code of Regulations, Title 24, Part 2. 2016.

California Department of Transportation (Caltrans). 2006, *Traffic Noise Analysis Protocol.*

Federal Transit Administration (FTA). 2018, September. *Transit Noise and Vibration Impact Assessment*. U.S. Department of Transportation (DoT). FTA-VA-90-1003-06.

FHWA, 2006. *Construction Noise Handbook*. August.

Governor's Office of Planning and Research. 2003, October. *State of California General Plan Guidelines.*

Harris, Cyril M. *Handbook of Acoustical Measurements and Noise Control*, Third Edition. Acoustical Society of America. Woodbury, NY. 1998.

Thalheimer, E., 2000, *Construction Noise Control Program and Mitigation Strategy at the Central Artery/Tunnel Project*. Institute of Noise Control Engineering.

| Intersection | Direction | Segment | Existing No Project | Existing Plus Project | Future No Project | Future + Project | Project Traffic Noise | Cummulative Increase(Future) | Project Contribution Cumm Noise Increase |
|---|---|---|---|---|---|---|---|---|---|
| 1 | N | Normandie Ave - North of Beverly Blvd | 1535 | 1536 | 1682 | 1683 | 0.00 | 0.40 | 0.00 |
| | S | Normandie Ave - South of Beverly Blvd | 1573 | 1573 | 1742 | 1742 | 0.00 | 0.44 | 0.00 |
| | E | Beverly Blvd - East of Normandie Ave | 2449 | 2452 | 2656 | 2659 | 0.01 | 0.36 | 0.00 |
| | W | Beverly Blvd - West of Normandie Ave | 2485 | 2487 | 2690 | 2692 | 0.00 | 0.35 | 0.00 |
| 2 | N | Normandie Blvd - North of 3rd St | 1505 | 1505 | 1785 | 1785 | 0.00 | 0.74 | 0.00 |
| | S | Normandie Blvd - South of 3rd St | 1406 | 1406 | 1643 | 1643 | 0.00 | 0.68 | 0.00 |
| | E | 3rd St - East of Normandie Blvd | 1952 | 1955 | 2066 | 2069 | 0.01 | 0.25 | 0.01 |
| | W | 3rd St - West of Normandie Blvd | 2027 | 2030 | 2170 | 2173 | 0.01 | 0.30 | 0.01 |
| 3 | N | Normandie Blvd - North of 6th St | 1299 | 1299 | 1538 | 1538 | 0.00 | 0.73 | 0.00 |
| | S | Normandie Blvd - South of 6th St | 1255 | 1258 | 1484 | 1487 | 0.01 | 0.74 | 0.01 |
| | E | 6th St - East of Normandie Blvd | 2033 | 2039 | 2138 | 2144 | 0.01 | 0.23 | 0.01 |
| | W | 6th St - West of Normandie Blvd | 2027 | 2030 | 2166 | 2169 | 0.01 | 0.29 | 0.01 |
| 4 | S | Normandie Blvd - South of Wilshire Blvd | 1402 | 1402 | 1633 | 1633 | 0.00 | 0.66 | 0.00 |
| | E | Wilshire Blvd - East of Normandie Blvd | 2532 | 2534 | 3461 | 3463 | 0.00 | 1.36 | 0.00 |
| | W | Wilshire Blvd - West of Normandie Blvd | 2463 | 2465 | 3208 | 3210 | 0.00 | 1.15 | 0.00 |
| 5 | N | Vermont Ave - North of Beverly Blvd | 3616 | 3619 | 4215 | 4218 | 0.00 | 0.67 | 0.00 |
| | S | Vermont Ave - South of Beverly Blvd | 2901 | 2910 | 3525 | 3534 | 0.01 | 0.86 | 0.01 |
| | E | Beverly Blvd - East of Vermont Blvd | 2465 | 2465 | 2740 | 2740 | 0.00 | 0.46 | 0.00 |
| | W | Beverly Blvd - West of Vermont Blvd | 2316 | 2322 | 2604 | 2610 | 0.01 | 0.52 | 0.01 |
| 6 | N | Vermont Ave - North of 1st St | 2781 | 2790 | 3388 | 3397 | 0.01 | 0.87 | 0.01 |
| | W | 1st St - West of Vermont Ave | 1139 | 1139 | 1186 | 1186 | 0.00 | 0.18 | 0.00 |
| 7 | N | Vermont Ave - W 2nd St to 1st St | 2638 | 2659 | 3246 | 3267 | 0.03 | 0.93 | 0.03 |
| | E | W 2nd St - East of Vermont Ave | 130 | 130 | 136 | 136 | 0.00 | 0.20 | 0.00 |
| | W | W 2nd St - West of Vermont Ave | 76 | 76 | 79 | 79 | 0.00 | 0.17 | 0.00 |
| 8 | N | Vermont Ave - 3rd St to 2nd St | 2702 | 2723 | 3380 | 3401 | 0.03 | 1.00 | 0.03 |
| | S | Vermont Ave - South of 3rd St | 2669 | 2685 | 3385 | 3401 | 0.03 | 1.05 | 0.02 |
| | E | 3rd St - East of Vermont Ave | 2354 | 2354 | 2556 | 2556 | 0.00 | 0.36 | 0.00 |
| | W | 3rd St - West of Vermont Ave | 2283 | 2288 | 2495 | 2500 | 0.01 | 0.39 | 0.01 |
| 9 | N | Vermont Ave - North of 6th St | 2291 | 2307 | 2887 | 2903 | 0.03 | 1.03 | 0.02 |
| | E | 6th St - East of Vermont Ave | 2242 | 2242 | 2376 | 2376 | 0.00 | 0.25 | 0.00 |
| | W | 6th St - West of Vermont Ave | 2145 | 2153 | 2256 | 2264 | 0.02 | 0.23 | 0.02 |
| 10 | N | Vermont Ave - Wilshire Blvd to 6th St | 2373 | 2381 | 2977 | 2985 | 0.01 | 1.00 | 0.01 |
| | S | Vermont Ave - South of Wilshire Blvd | 2463 | 2466 | 3158 | 3161 | 0.01 | 1.08 | 0.00 |
| | E | Wilshire Blvd - East of Vermont Ave | 2366 | 2367 | 3120 | 3121 | 0.00 | 1.20 | 0.00 |
| | W | Wilshire Blvd - West of Vermont Ave | 2324 | 2328 | 3213 | 3217 | 0.01 | 1.41 | 0.01 |
| 11 | N | Bimini Pl - North of 1st St | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 |
| | S | Bimini Pl - South of 1st St | 185 | 185 | 193 | 193 | 0.00 | 0.18 | 0.00 |
| | W | 1st St - West of Bimini Pl | 1128 | 1158 | 1175 | 1205 | 0.11 | 0.29 | 0.11 |
| 12 | N | Madison Ave - North of 1st St | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 |
| | S | Madison Ave - South of 1st St | 55 | 115 | 58 | 118 | 3.20 | 3.32 | 3.08 |
| | W | 1st St - Madison Ave to Bimini Pl | 1224 | 1254 | 1297 | 1327 | 0.11 | 0.35 | 0.10 |
| 13 | N | Madison Ave - North of Project Driveway | 0 | 105 | 0 | 108 | 0.00 | 0.00 | 0.00 |
| | S | Madison Ave - South of Project Driveway | 0 | 45 | 0 | 48 | 0.00 | 0.00 | 0.00 |
| | E | Project Driveway - East of Madison Ave | 0 | 0 | 0 | 0 | - | 0.00 | 0.00 |
| | W | Project Driveway - West of Madison Ave | 0 | 60 | 0 | 60 | 0.00 | 0.00 | 0.00 |
| 14 | N | Westmoreland Ave - North of 1st St | 308 | 308 | 321 | 321 | 0.00 | 0.18 | 0.00 |
| | S | Westmoreland Ave - South of 1st St | 97 | 97 | 101 | 101 | 0.00 | 0.18 | 0.00 |
| | W | 1st St - Westmoreland to Madison Ave | 1187 | 1217 | 1236 | 1266 | 0.11 | 0.28 | 0.10 |
| 15 | N | Virgil Ave - North of 1st St | 1796 | 1797 | 2045 | 2046 | 0.00 | 0.57 | 0.00 |
| | S | Virgil Ave - South of 1st St | 1809 | 1827 | 2059 | 2077 | 0.04 | 0.60 | 0.04 |
| | W | 1st St - Virgil Ave to Westmoreland Ave | 929 | 959 | 967 | 997 | 0.14 | 0.31 | 0.13 |
| 16 | N | Virgil Ave - North of 3rd St | 1753 | 1771 | 2001 | 2019 | 0.04 | 0.61 | 0.04 |
| | S | Virigil Ave - South of 3rd St | 1692 | 1704 | 1939 | 1951 | 0.03 | 0.62 | 0.03 |
| | E | 3rd St - East of Virgil Ave | 2644 | 2650 | 2809 | 2815 | 0.01 | 0.27 | 0.01 |
| | W | 3rd St - West of Virgil Ave | 2641 | 2641 | 2803 | 2803 | 0.00 | 0.26 | 0.00 |
| 17 | N | Virigil Ave - North of 6th St | 1414 | 1426 | 1649 | 1661 | 0.04 | 0.70 | 0.03 |
| | S | Virgil Ave - South of 6th St | 1364 | 1372 | 1599 | 1607 | 0.03 | 0.71 | 0.02 |
| | E | 6th St - East of Virgil Ave | 2107 | 2111 | 2228 | 2232 | 0.01 | 0.25 | 0.01 |
| | W | 6th St - West of Virgil Ave | 2147 | 2147 | 2248 | 2248 | 0.00 | 0.20 | 0.00 |
| 18 | N | Commonwealth Ave - North of 1st St/Beverly Blvd | 72 | 72 | 127 | 127 | 0.00 | 2.46 | 0.00 |
| | S | Commonwealth Ave - South of 1st St/Beverly Blvd | 968 | 882 | 1087 | 637 | -0.40 | -1.82 | -2.32 |
| | E | 1st St/Beverly Blvd - East of Commonwealth Ave | 1742 | 1147 | 1980 | 1530 | -1.81 | -0.56 | -1.12 |
| | W | 1st St/Beverly Blvd - West of Commonwealth Ave | 1442 | 937 | 1672 | 1672 | -1.87 | 0.64 | 0.00 |
| 19 | N | Rampart Blvd - North of Beverly Blvd | 1889 | 1892 | 1972 | 1975 | 0.01 | 0.19 | 0.01 |
| | S | Rampart Blvd - South of Beverly Blvd | 2216 | 2217 | 2311 | 2312 | 0.00 | 0.18 | 0.00 |
| | E | Beverly Blvd - East of Rampart Blvd | 2511 | 2514 | 2676 | 2679 | 0.01 | 0.28 | 0.00 |
| | W | Beverly Blvd - West of Rampart Blvd | 2256 | 2263 | 2411 | 2418 | - | 0.30 | 0.01 |
| 20 | N | Rampart Blvd - North of 3rd St | 2191 | 2191 | 2292 | 2292 | 0.00 | 0.20 | 0.00 |
| | S | Rampart Blvd - South of 3rd St | 1959 | 1960 | 2065 | 2066 | 0.00 | 0.23 | 0.00 |
| | E | 3rd Street - East of Rampart Blvd | 2304 | 2306 | 2439 | 2441 | 0.00 | 0.25 | 0.00 |
| | W | 3rd Street - West of Rampart Blvd | 2348 | 2351 | 2484 | 2487 | 0.01 | 0.25 | 0.01 |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

Baselines (dBA)

| Description | Land Use | Daytime | Evening | Night |
|---|---|---|---|---|
| Building Demolition | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Usage (%) | Spec Lmax (dBA) | Actual Lmax (dBA) | Receptor Distance (feet) | Estimated Shielding (dBA) |
|---|---|---|---|---|---|---|
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |
| Dump Truck | No | 40 | | 76.5 | 220.0 | 0.0 |
| Dump Truck | No | 40 | | 76.5 | 220.0 | 0.0 |
| Tractor | No | 40 | 84.0 | | 220.0 | 0.0 |

Results

| | Calculated (dBA) | | Noise Limits (dBA) | | | | | | Noise Limit Exceedance (dBA) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Day | | Evening | | Night | | Day | | Evening | | Night | |
| Equipment | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Dump Truck | 63.6 | 59.6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Dump Truck | 63.6 | 59.6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Tractor | 71.1 | 67.2 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 71.1 | 69.4 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

| Description | Land Use | Baselines (dBA) Daytime | Evening | Night |
|---|---|---|---|---|
| Asphalt and Concretre Demo | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Spec Usage (%) | Actual Lmax (dBA) | Receptor Lmax (dBA) | Estimated Distance (feet) | Shielding (dBA) |
|---|---|---|---|---|---|---|
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |
| Dump Truck | No | 40 | | 76.5 | 220.0 | 0.0 |
| Dump Truck | No | 40 | | 76.5 | 220.0 | 0.0 |
| Tractor | No | 40 | 84.0 | | 220.0 | 0.0 |

Results

| | Calculated (dBA) | | Noise Limits (dBA) Day | | Evening | | Night | | Noise Limit Exceedance (dBA) Day | | Evening | | Night | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Dump Truck | 63.6 | 59.6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Dump Truck | 63.6 | 59.6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Tractor | 71.1 | 67.2 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 71.1 | 69.4 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

Baselines (dBA)

| Description | Land Use | Daytime | Evening | Night |
|---|---|---|---|---|
| Rough Grading | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Spec Usage (%) | Actual Lmax (dBA) | Receptor Lmax (dBA) | Estimated Distance (feet) | Shielding (dBA) |
|---|---|---|---|---|---|---|
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |
| Dump Truck | No | 40 | | 76.5 | 220.0 | 0.0 |
| Dump Truck | No | 40 | | 76.5 | 220.0 | 0.0 |

Results

| | Calculated (dBA) | | Noise Limits (dBA) Day | | Evening | | Night | | Noise Limit Exceedance (dBA) Day | | Evening | | Night | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Dump Truck | 63.6 | 59.6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Dump Truck | 63.6 | 59.6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 66.2 | 68.4 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

| Description | Land Use | Baselines (dBA) Daytime | Evening | Night |
|---|---|---|---|---|
| Excavation | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Spec Usage (%) | Actual Lmax (dBA) | Receptor Lmax (dBA) | Estimated Distance (feet) | Shielding (dBA) |
|---|---|---|---|---|---|---|
| Auger Drill Rig | No | 20 | | 84.4 | 220.0 | 0.0 |
| Drum Mixer | No | 50 | | 80.0 | 220.0 | 0.0 |

Results

| | Calculated (dBA) | | Noise Limits (dBA) Day | | Evening | | Night | | Noise Limit Exceedance (dBA) Day | | Evening | | Night | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| Auger Drill Rig | 71.5 | 64.5 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Drum Mixer | 67.1 | 64.1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 71.5 | 67.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

Baselines (dBA)

| Description | Land Use | Daytime | Evening | Night |
|---|---|---|---|---|
| Utility Trenching | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Usage (%) | Spec Lmax (dBA) | Actual Lmax (dBA) | Receptor Distance (feet) | Estimated Shielding (dBA) |
|---|---|---|---|---|---|---|
| Backhoe | No | 40 | | 77.6 | 220.0 | 0.0 |

Results

| | Calculated (dBA) | | Noise Limits (dBA) | | | | | | Noise Limit Exceedance (dBA) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Day | | Evening | | Night | | Day | | Evening | | Night | |
| Equipment | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| Backhoe | 64.7 | 60.7 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 64.7 | 60.7 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

Baselines (dBA)

| Description | Land Use | Daytime | Evening | Night |
|---|---|---|---|---|
| Fine Grading | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Usage (%) | Spec Lmax (dBA) | Actual Lmax (dBA) | Receptor Distance (feet) | Estimated Shielding (dBA) |
|---|---|---|---|---|---|---|
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |

Results

| | Calculated (dBA) | | Noise Limits (dBA) Day | | Evening | | Night | | Noise Limit Exceedance (dBA) Day | | Evening | | Night | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 66.2 | 65.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

| Description | Land Use | Baselines (dBA) Daytime | Evening | Night |
|---|---|---|---|---|
| Building Construction | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Spec Usage (%) | Actual Lmax (dBA) | Receptor Lmax (dBA) | Estimated Distance (feet) | Shielding (dBA) |
|---|---|---|---|---|---|---|
| Concrete Mixer Truck | No | 40 | | 78.8 | 220.0 | 0.0 |
| Concrete Mixer Truck | No | 40 | | 78.8 | 220.0 | 0.0 |
| Drum Mixer | No | 50 | | 80.0 | 220.0 | 0.0 |
| Pumps | No | 50 | | 80.9 | 220.0 | 0.0 |
| Crane | No | 16 | | 80.6 | 220.0 | 0.0 |
| Man Lift | No | 20 | | 74.7 | 220.0 | 0.0 |

Results

| Equipment | Calculated (dBA) Lmax | Calculated (dBA) Leq | Noise Limits (dBA) Day Lmax | Day Leq | Evening Lmax | Evening Leq | Night Lmax | Night Leq | Noise Limit Exceedance (dBA) Day Lmax | Day Leq | Evening Lmax | Evening Leq | Night Lmax | Night Leq |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Concrete Mixer Truck | 65.9 | 62.0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Concrete Mixer Truck | 65.9 | 62.0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Drum Mixer | 67.1 | 64.1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Pumps | 68.1 | 65.1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Crane | 67.7 | 59.7 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Man Lift | 61.8 | 54.8 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 68.1 | 70.1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

Baselines (dBA)

| Description | Land Use | Daytime | Evening | Night |
|---|---|---|---|---|
| Paving | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Usage (%) | Spec Lmax (dBA) | Actual Lmax (dBA) | Receptor Distance (feet) | Estimated Shielding (dBA) |
|---|---|---|---|---|---|---|
| Dump Truck | No | 40 | | 76.5 | 220.0 | 0.0 |
| Dump Truck | No | 40 | | 76.5 | 220.0 | 0.0 |
| Pavement Scarafier | No | 20 | | 89.5 | 220.0 | 0.0 |
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |

Results

| | Calculated (dBA) | | Noise Limits (dBA) Day | | Evening | | Night | | Noise Limit Exceedance (dBA) Day | | Evening | | Night | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| Dump Truck | 63.6 | 59.6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Dump Truck | 63.6 | 59.6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Pavement Scarafier | 76.6 | 69.6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 76.6 | 71.0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

Baselines (dBA)

| Description | Land Use | Daytime | Evening | Night |
|---|---|---|---|---|
| Architectural Coating | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Spec Usage (%) | Actual Lmax (dBA) | Receptor Lmax (dBA) | Estimated Distance (feet) | Shielding (dBA) |
|---|---|---|---|---|---|---|
| Compressor (air) | No | 40 | | 77.7 | 220.0 | 0.0 |

Results

| | Calculated (dBA) | | Noise Limits (dBA) Day | | Evening | | Night | | Noise Limit Exceedance (dBA) Day | | Evening | | Night | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| Compressor (air) | 64.8 | 60.8 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 64.8 | 60.8 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 11/28/2018
Case Description: BSS-09

**** Receptor #1 ****

| Description | Land Use | Baselines (dBA) Daytime | Evening | Night |
|---|---|---|---|---|
| Finishing/Landscaping | Residential | 60.0 | 55.0 | 60.0 |

Equipment

| Description | Impact Device | Usage (%) | Spec Lmax (dBA) | Actual Lmax (dBA) | Receptor Distance (feet) | Estimated Shielding (dBA) |
|---|---|---|---|---|---|---|
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |
| Front End Loader | No | 40 | | 79.1 | 220.0 | 0.0 |

Results

| | Calculated (dBA) | | Noise Limits (dBA) Day | | Evening | | Night | | Noise Limit Exceedance (dBA) Day | | Evening | | Night | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Front End Loader | 66.2 | 62.3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Total | 66.2 | 67.0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

<Organization?>
PlaceWorks

10 December 2018
TNM 2.5

INPUT: ROADWAYS
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School

**Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA**

| Roadway | | Points | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Width | Name | No. | Coordinates (pavement) | | | Flow Control | | | Segment | |
| | | | | X | Y | Z | Control Device | Speed Constraint | Percent Vehicles Affected | Pvmt Type | On Struct? |
| | ft | | | ft | ft | ft | | mph | % | | |
| W 1st WB | 25.0 | point2 | 2 | 1,000.0 | 0.0 | 0.00 | | | | Average | |
| | | point1 | 1 | 0.0 | 0.0 | 0.00 | | | | | |
| W 1st EB | 25.0 | point3 | 3 | 0.0 | -25.0 | 0.00 | | | | Average | |
| | | point4 | 4 | 1,000.0 | -25.0 | 0.00 | | | | | |
| Madison SB | 12.0 | point5 | 5 | 488.0 | -51.0 | 0.00 | | | | Average | |
| | | point6 | 6 | 488.0 | -676.0 | 0.00 | | | | | |
| Madison NB | 12.0 | point8 | 8 | 512.0 | -676.0 | 0.00 | | | | Average | |
| | | point7 | 7 | 512.0 | -51.0 | 0.00 | | | | | |

<Organization?> 10 December 2018
PlaceWorks TNM 2.5

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School

| Roadway | Points | | Segment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Name | No. | Autos | | MTrucks | | HTrucks | | Buses | | Motorcycles | |
| | | | V | S | V | S | V | S | V | S | V | S |
| | | | veh/hr | mph | veh/hr | mph | veh/hr | mph | veh/hr | mph | veh/hr | mph |
| W 1st WB | point2 | 2 | 584 | 20 | 12 | 20 | 18 | 20 | 0 | 0 | 0 | 0 |
| | point1 | 1 | | | | | | | | | | |
| W 1st EB | point3 | 3 | 584 | 20 | 12 | 20 | 18 | 20 | 0 | 0 | 0 | 0 |
| | point4 | 4 | | | | | | | | | | |
| Madison SB | point5 | 5 | 28 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | point6 | 6 | | | | | | | | | | |
| Madison NB | point8 | 8 | 28 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | point7 | 7 | | | | | | | | | | |

<Organization?> 10 December 2018
PlaceWorks TNM 2.5

INPUT: RECEIVERS
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School

| Receiver | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | No. | #DUs | Coordinates (ground) | | | Height | Input Sound Levels and Criteria | | | | Active |
| | | | X | Y | Z | above | Existing | Impact Criteria | | NR | in |
| | | | | | | Ground | LAeq1h | LAeq1h | Sub'l | Goal | Calc. |
| | | | ft | ft | ft | ft | dBA | dBA | dB | dB | |
| Receiver1 | 1 | 1 | 575.0 | -250.0 | 0.00 | 4.92 | 0.00 | 66 | 10.0 | 8.0 | Y |

<Organization?>
PlaceWorks

10 December 2018
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School
BARRIER DESIGN: INPUT HEIGHTS

ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

| Receiver | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | No. | #DUs | Existing | No Barrier | | | | | | With Barrier | | | |
| | | | LAeq1h | LAeq1h | | Increase over existing | | Type | | Calculated | Noise Reduction | | |
| | | | | Calculated | Crit'n | Calculated | Crit'n Sub'l Inc | Impact | | LAeq1h | Calculated | Goal | Calculated minus Goal |
| | | | dBA | dBA | dBA | dB | dB | | | dBA | dB | dB | dB |
| Receiver1 | 1 | 1 | 0.0 | 52.1 | 66 | 52.1 | 10 | ---- | | 52.1 | 0.0 | 8 | -8.0 |

| Dwelling Units | # DUs | Noise Reduction | | |
|---|---|---|---|---|
| | | Min | Avg | Max |
| | | dB | dB | dB |
| All Selected | 1 | 0.0 | 0.0 | 0.0 |
| All Impacted | 0 | 0.0 | 0.0 | 0.0 |
| All that meet NR Goal | 0 | 0.0 | 0.0 | 0.0 |

<Organization?> 10 December 2018
PlaceWorks TNM 2.5

INPUT: ROADWAYS
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

| Roadway | | Points | | | | | Flow Control | | | Segment | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Width | Name | No. | Coordinates (pavement) | | | | | | | |
| | | | | X | Y | Z | Control Device | Speed Constraint | Percent Vehicles Affected | Pvmt Type | On Struct? |
| | ft | | | ft | ft | ft | | mph | % | | |
| W 1st WB | 25.0 | point2 | 2 | 1,000.0 | 0.0 | 0.00 | | | | Average | |
| | | point1 | 1 | 0.0 | 0.0 | 0.00 | | | | | |
| W 1st EB | 25.0 | point3 | 3 | 0.0 | -25.0 | 0.00 | | | | Average | |
| | | point4 | 4 | 1,000.0 | -25.0 | 0.00 | | | | | |
| Madison SB | 12.0 | point5 | 5 | 488.0 | -51.0 | 0.00 | | | | Average | |
| | | point6 | 6 | 488.0 | -676.0 | 0.00 | | | | | |
| Madison NB | 12.0 | point8 | 8 | 512.0 | -676.0 | 0.00 | | | | Average | |
| | | point7 | 7 | 512.0 | -51.0 | 0.00 | | | | | |

<Organization?> 10 December 2018
PlaceWorks TNM 2.5

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School

| Roadway | Points | | Segment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Name | No. | Autos | | MTrucks | | HTrucks | | Buses | | Motorcycles | |
| | | | V | S | V | S | V | S | V | S | V | S |
| | | | veh/hr | mph | veh/hr | mph | veh/hr | mph | veh/hr | mph | veh/hr | mph |
| W 1st WB | point2 | 2 | 599 | 20 | 12 | 20 | 18 | 20 | 0 | 0 | 0 | 0 |
| | point1 | 1 | | | | | | | | | | |
| W 1st EB | point3 | 3 | 599 | 20 | 12 | 20 | 18 | 20 | 0 | 0 | 0 | 0 |
| | point4 | 4 | | | | | | | | | | |
| Madison SB | point5 | 5 | 58 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | point6 | 6 | | | | | | | | | | |
| Madison NB | point8 | 8 | 58 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | point7 | 7 | | | | | | | | | | |

<Organization?> 10 December 2018
PlaceWorks TNM 2.5

INPUT: RECEIVERS
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School

| Receiver | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | No. | #DUs | Coordinates (ground) | | | Height above Ground | Input Sound Levels and Criteria | | | | Active in Calc. |
| | | | X | Y | Z | | Existing LAeq1h | Impact Criteria LAeq1h | Sub'l | NR Goal | |
| | | | ft | ft | ft | ft | dBA | dBA | dB | dB | |
| Receiver1 | 1 | 1 | 575.0 | -250.0 | 0.00 | 4.92 | 0.00 | 66 | 10.0 | 8.0 | Y |

<Organization?>
PlaceWorks

10 December 2018
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School
BARRIER DESIGN: INPUT HEIGHTS

ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

| Receiver Name | No. | #DUs | Existing LAeq1h | No Barrier LAeq1h Calculated | No Barrier LAeq1h Crit'n | Increase over existing Calculated | Increase over existing Crit'n Sub'l Inc | Type Impact | With Barrier Calculated LAeq1h | Noise Reduction Calculated | Noise Reduction Goal | Calculated minus Goal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | dBA | dBA | dBA | dB | dB | | dBA | dB | dB | dB |
| Receiver1 | 1 | 1 | 0.0 | 52.3 | 66 | 52.3 | 10 | ---- | 52.3 | 0.0 | 8 | -8.0 |

| Dwelling Units | # DUs | Noise Reduction Min | Avg | Max |
|---|---|---|---|---|
| | | dB | dB | dB |
| All Selected | 1 | 0.0 | 0.0 | 0.0 |
| All Impacted | 0 | 0.0 | 0.0 | 0.0 |
| All that meet NR Goal | 0 | 0.0 | 0.0 | 0.0 |

<Organization?>
PlaceWorks

10 December 2018
TNM 2.5

INPUT: ROADWAYS
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

| Roadway | | Points | | | | | Flow Control | | | Segment | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Width | Name | No. | Coordinates (pavement) | | | | | | | |
| | | | | X | Y | Z | Control Device | Speed Constraint | Percent Vehicles Affected | Pvmt Type | On Struct? |
| | ft | | | ft | ft | ft | | mph | % | | |
| W 1st WB | 25.0 | point2 | 2 | 1,000.0 | 0.0 | 0.00 | | | | Average | |
| | | point1 | 1 | 0.0 | 0.0 | 0.00 | | | | | |
| W 1st EB | 25.0 | point3 | 3 | 0.0 | -25.0 | 0.00 | | | | Average | |
| | | point4 | 4 | 1,000.0 | -25.0 | 0.00 | | | | | |
| Madison SB | 12.0 | point5 | 5 | 488.0 | -51.0 | 0.00 | | | | Average | |
| | | point6 | 6 | 488.0 | -676.0 | 0.00 | | | | | |
| Madison NB | 12.0 | point8 | 8 | 512.0 | -676.0 | 0.00 | | | | Average | |
| | | point7 | 7 | 512.0 | -51.0 | 0.00 | | | | | |

<Organization?> 10 December 2018
PlaceWorks TNM 2.5

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School

| Roadway | Points | | Segment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Name | No. | Autos | | MTrucks | | HTrucks | | Buses | | Motorcycles | |
| | | | V | S | V | S | V | S | V | S | V | S |
| | | | veh/hr | mph | veh/hr | mph | veh/hr | mph | veh/hr | mph | veh/hr | mph |
| W 1st WB | point2 | 2 | 634 | 20 | 13 | 20 | 20 | 20 | 0 | 0 | 0 | 0 |
| | point1 | 1 | | | | | | | | | | |
| W 1st EB | point3 | 3 | 634 | 20 | 13 | 20 | 20 | 20 | 0 | 0 | 0 | 0 |
| | point4 | 4 | | | | | | | | | | |
| Madison SB | point5 | 5 | 59 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | point6 | 6 | | | | | | | | | | |
| Madison NB | point8 | 8 | 59 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | point7 | 7 | | | | | | | | | | |

<Organization?> 10 December 2018
PlaceWorks TNM 2.5

INPUT: RECEIVERS
PROJECT/CONTRACT: BSS-09
RUN: Bright Star Charter School

| Receiver | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | No. | #DUs | Coordinates (ground) | | | Height above Ground | Input Sound Levels and Criteria | | | | Active in Calc. |
| | | | X | Y | Z | | Existing LAeq1h | Impact Criteria LAeq1h | Sub'l | NR Goal | |
| | | | ft | ft | ft | ft | dBA | dBA | dB | dB | |
| Receiver1 | 1 | 1 | 575.0 | -250.0 | 0.00 | 4.92 | 0.00 | 66 | 10.0 | 8.0 | Y |

<Organization?>
PlaceWorks

10 December 2018
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

| | |
|---|---|
| PROJECT/CONTRACT: | BSS-09 |
| RUN: | Bright Star Charter School |
| BARRIER DESIGN: | INPUT HEIGHTS |
| ATMOSPHERICS: | 68 deg F, 50% RH |

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

| Receiver | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | No. | #DUs | Existing LAeq1h | No Barrier | | | | | With Barrier | | | |
| | | | | LAeq1h | | Increase over existing | | Type | Calculated | Noise Reduction | | |
| | | | | Calculated | Crit'n | Calculated | Crit'n Sub'l Inc | Impact | LAeq1h | Calculated | Goal | Calculated minus Goal |
| | | | dBA | dBA | dBA | dB | dB | | dBA | dB | dB | dB |
| Receiver1 | 1 | 1 | 0.0 | 52.7 | 66 | 52.7 | 10 | ---- | 52.7 | 0.0 | 8 | -8.0 |

| Dwelling Units | # DUs | Noise Reduction | | |
|---|---|---|---|---|
| | | Min | Avg | Max |
| | | dB | dB | dB |
| All Selected | 1 | 0.0 | 0.0 | 0.0 |
| All Impacted | 0 | 0.0 | 0.0 | 0.0 |
| All that meet NR Goal | 0 | 0.0 | 0.0 | 0.0 |