FDM 23-15-1 Description of Factors

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There are three major characteristics that will affect the sound level at any location. They are traffic conditions, roadway configuration, and attenuation parameters.

1.1 Traffic Conditions

1.1.1 Hourly Volumes

Traffic data used for existing and design year sound level predictions should represent the Design Hour Volume (DHV) or the maximum hourly volume under Level of Service "C", whichever creates the highest sound level. The DHV usually occurs during morning and/or evening peak traffic conditions between 7:00 - 9:00 am and 4:00 - 6:00 pm.

Whichever conditions are used, the intent is to define an hourly volume of traffic that is likely to occur on a regular basis, day after day. There are instances when the predominance of human habitation or activity does not occur during the traffic conditions defined above (such as at churches, schools, and resort areas). It may sometimes be more meaningful to predict sound levels for those locations for the off-peak hours during which they would normally be in use.

WisDOT uses a standardized format for reporting hourly volumes. The factor $K_{[30/100/200]}$ is the percent of Average Daily Traffic (ADT) that represents the DHV.

1.1.2 Directional Split

The directional split of traffic on roadways should be identified. The sound levels should be determined using the worst case directional split. When evaluating whether there is a noise impact on either side of a roadway, the highest percentage of traffic should be assigned to the lane(s) closest to the side being evaluated and the lower percentage to the lane(s) in the opposite direction farther away. The WisDOT format for directional split is D(%). This represents the percent of directional travel for the DHV.

1.1.3 Truck Percentage

The use of incorrect truck volumes or truck percentage factors is a common cause of error in sound level predictions. Truck factors normally provided by WisDOT are the percentage of trucks in the ADT and the percentage occurring in the DHV. Usually, the DHV truck factor ranges from one-half to two-thirds of the ADT truck factor. The DHV truck factor should be used when the input volume is either DHV or the maximum volume under Level of Service "C".

The T (% of DHV) is the WisDOT format for percent of DHV that represents trucks. Of that percent, medium trucks are classified as 2D (2 axle, 6 tire). All other classifications are heavy trucks (3 or more axles). If bus and motorcycle percentages are available, the traffic should also be split into these two categories. Vehicle Classification information is available on the WisDOT website in the following location: https://wisconsindot.gov/Pages/projects/data-plan/traf-fore/default.aspx.

1.1.4 Speed

The operating speed must be consistent with the volume being used. If the maximum Level of Service "C" volume is selected, use the corresponding operating speed as determined using the latest version of the Highway Capacity Manual. If the DHV is chosen, use the operating speed associated with that volume. Generally, the operating speed should not exceed the posted speed limit. Unless a speed study shows otherwise, assume the truck speed to be identical to the automobile speed.

1.2 Roadway Configuration

1.2.1 Grade and Vertical Alignment

The grades of the proposed roadway have an effect on the truck noise levels. For uphill grades, truck noise can be increased ranging from 1 dB for a two percent grade up to 5 dB for a seven or more percent grade. Changes in vertical alignment, particularly depressing the highway to form a cut section, can also be quite effective in reducing sound levels, since this creates a barrier (the back slope) between the source and the receiver.

1.2.2 Horizontal Alignment

Since noise from a linear source is reduced between 3 and 4.5 dB per doubling of distance (dB/DD) between

the source and receiver, shifting the alignment away from an affected area can be quite beneficial.[1] Sometimes, a roadway on a new location can be placed so that attenuation is provided by natural land forms such as hills. The same thing can be done with existing man-made features such as walls or other roadway embankments.

1.3 Attenuation Parameters

Given any combination of source characteristics and roadway characteristics, the sound level at a receiver is influenced by the path the sound must travel to each receiver.

1.3.1 Distance

The most obvious characteristic of the propagation path is the distance between the noise source and the receiver. The sound level decreases as the sound propagates away from the source at the rate of 3 to 4.5 dB (see Ground Cover Section below) per doubling of distance.

There are other propagation factors that further reduce sound levels.

1.3.2 Shielding

Shielding of the noise source occurs when the line-of-sight between the receiver and the roadway is obstructed by an object or objects, which interferes with the propagation of the sound. Shielding can be provided by rows of buildings. Common shielding adjustments for a row of buildings are: 3 dB for 40 to 65 percent coverage, 5 dB for 65 to 90 percent coverage, and 1.5 dB for each additional row, up to a maximum of 10 dB.

1.3.3 Ground Cover

Ground cover is defined as the "hardness" or "softness" of the surrounding ground. Hard sites are usually bituminous or concrete pavement, gravel and water. Distance attenuation on a hard site is 3 dB per doubling of distance (dB/DD).

Soft sites refer to grassy or agricultural areas. Ground cover can affect the sound propagation rate by as much as an additional 1.5 dB/DD. 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 equivalent sound levels decrease at a rate of 4.5 dB/DD at soft sites.

[1] "FHWA Highway Traffic Noise Prediction Model", T.M. Barry and J.A. Reagon, Federal Highway Administration, December 1978.