## F1.0 Noise Overview and Noise Standards

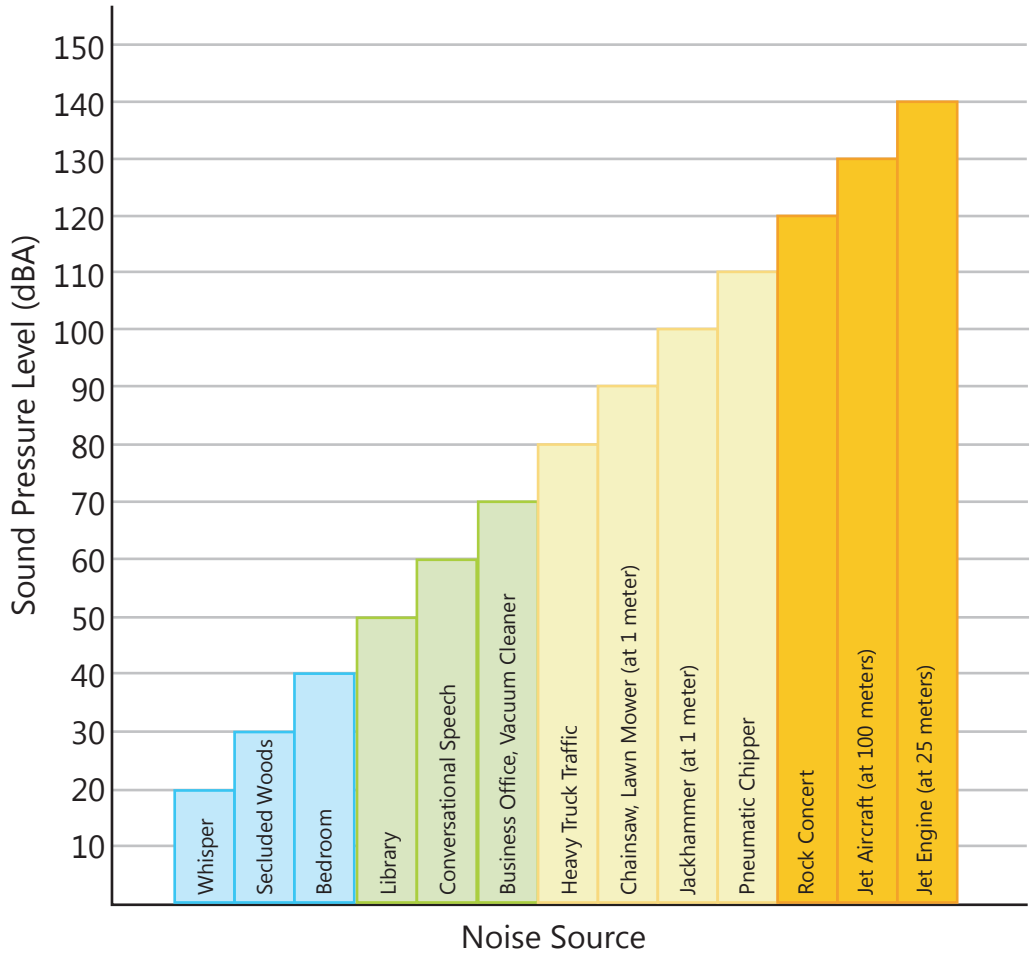
Noise is generally defined as unwanted sound. Sound travels in mechanical wave motion and produces a sound pressure level. Sound pressure level is commonly measured in decibels (dB), representing the logarithmic increase in sound energy relative to a reference energy level. Sound measurement is further refined by using an A-weighted decibel scale (dBA) to emphasize the range of sound frequencies that are most audible to the human ear (i.e., between 1,000 and 8,000 cycles per second). Decibel measurements discussed in this environmental impact statement (EIS) are presented using the dBA scale (Reference F1).

A noise level change of three dBA is barely discernible to average human hearing. A five dBA change in noise level, however, is clearly noticeable. A ten dBA change in noise levels is perceived as a doubling or halving of noise loudness, while a 20 dBA change is considered a dramatic change in loudness. Cumulative noise increases occur on a logarithmic scale. If a noise source is doubled, there is a three dBA increase in noise, which is barely discernible to the human ear. For cumulative increases in noise resulting from sources of different magnitudes, the rule of thumb is that if there is a difference of greater than ten dBA between noise sources, there will be no additive effect to the overall noise level. Figure F-1 shows noise levels associated with common, everyday sources and provides a context for the magnitude of noise levels discussed here.

Typically, noise is evaluated according to two general criteria: the extent to which noise levels exceed federal, state, or (where applicable) local noise regulations; and the estimated degree of disturbance to people.

The Minnesota Pollution Control Agency (MPCA) has established standards for the regulation of noise levels. Land use activities associated with residential, commercial and industrial land have been grouped together into Noise Area Classifications (NAC; Minnesota Rules, part 7030.0050). Each NAC is then assigned daytime (7 a.m.to 10 p.m.) and nighttime

**Figure F-1 Noise Levels Associated with Common, Everyday Noise Sources**



(10 p.m. to 7 a.m.) limits for land use activities within the NAC.

Table F-1 shows the MPCA daytime and nighttime limits in dBA for each NAC. The limits are expressed as a range of permissible dBA within a one hour period. L50 is the dBA that may be exceeded 50 percent of the time within an hour, while L10 is the dBA that may be exceeded ten percent of the time within one hour. Residences, which are typically considered sensitive to noise, are classified as NAC-1 (Reference F1).

Minnesota's state noise level standards are more stringent than the U.S. Department of Housing and Urban Development standards; therefore, noise levels in the project area can conservatively be compared to state standards.

In addition to local, state and federal standards, the degree of disturbance becomes a key factor in evaluating noise conditions. Typically this includes a focus on residents in the vicinity of the area under evaluation. The concept of human disturbance varies with a number of interrelated factors, including changes in noise levels, the presence of other, non-project-related noise sources in the vicinity, people's attitudes toward the project, the number of people exposed, and the type of human activity affected (e.g., sleep or quiet conversation as compared to physical work or active recreation).

## F2.0 Project Noise

Noise associated with the project would be produced by construction of the transmission lines and substations, and by its operation.

As discussed in the Section 5.1.3 of this EIS, noise levels associated with construction will be highly localized and intermittent. Table F-2 provides additional detail regarding typical noise levels associated with a variety of types of construction equipment that may be used during construction of the proposed project (Reference F2). Receptors (people/residences), though perhaps nearby, would be located outside of the immediate construction area, so sound levels associated with construction equipment shown in Table F-2 are not indicative of noise levels experienced by sensitive receptors.

As discussed in Section 5.1.3 of this EIS, noise levels associated with transmission line operation are anticipated to be minimal and less than state noise standards, with the highest noise levels occurring in the immediate vicinity of the line during damp or rainy conditions. Table F-3 provides predicted noise levels associated with the transmission line configurations proposed for this project (Reference F2). During fair weather, predicted noise levels are less than 20 dBA for all transmission line configurations and operating voltages. This noise level is similar to that of a whisper. During rainy weather, predicted noise levels increase to nearly 40 dBA at the edge of the transmission line right-of-way. This noise level is similar to that of a bedroom. The increase in noise is due to the relatively greater ionization of air molecules near the line (corona effect) in rainy conditions. The relative impact of a 40 dBA noise level during rainy weather is anticipated to be mitigated, to some extent, by the sound of the rain itself. As discussed in Section 5.1.3 of this EIS, the primary means of mitigating noise impacts is by prudent routing and placement of the alignment within the route to avoid residences and other places that citizens congregate.

As discussed in Section 5.1.3 of this EIS, noise levels associated with substation operation would be limited, with noise levels below state standards at the receptors nearest to the proposed Huntley substation. Modeling was conducted by ITCM to predict noise levels at sensitive receptors near the proposed Huntley substation (Reference F2). At the Huntley substation, the 345kV/161 kV transformer is expected to be the dominant source of noise, although noise from the two 161kV/69kV transformers was also evaluated. Noise level

**Table F-1 Applicable Noise Standards for Different Land Uses in Minnesota**

| Noise Area Classification (NAC) | Noise Standard dBA | | | |
|---|---|---|---|---|
| | Daytime (7 a.m. to 10 p.m.) | | Nighttime (10 p.m. to 7 a.m.) | |
| | $L_{50}$ | $L_{10}$ | $L_{50}$ | $L_{10}$ |
| Residential (NAC-1) | 60 | 65 | 50 | 55 |
| Commercial (NAC-2) | 65 | 70 | 65 | 70 |
| Industrial (NAC-3) | 75 | 80 | 75 | 80 |
| Undeveloped (NAC-4) | None | None | None | None |

**Table F-2 Range of Typical Construction Equipment Noise Levels**

| Construction Equipment | Minimum Noise at 50 feet (dBA) | Maximum Noise at 50 feet (dBA) |
|---|---|---|
| Backhoe | 74 | 92 |
| Compactors (Rollers) | 73 | 76 |
| Compressors | 73 | 86 |
| Concrete Mixers | 76 | 88 |
| Cranes | 70 | 94 |
| Dozers | 65 | 95 |
| Front Loaders | 77 | 96 |
| Generators | 71 | 83 |
| Graders | 72 | 91 |
| Jackhammers and Rock Drills | 80 | 98 |
| Pavers | 85 | 87 |
| Pumps | 69 | 71 |
| Scrapers | 76 | 95 |
| Tractors | 77 | 95 |
| Trucks | 83 | 96 |

**Table F-3 Predicted Transmission Line Noise Levels**

| Configuration and Operating Voltage | $L_{50}$ Rain (dBA) | | $L_{50}$ Fair (dBA) | |
|---|---|---|---|---|
| | Distance from Transmission Line | | Distance from Transmission Line | |
| | 0 feet | 100 feet | 0 feet | 100 feet |
| 345 kV/161 kV | 41 | 38 | 16 | 13 |
| 345 kV/161 kV Low Profile | 43 | 39 | 18 | 14 |
| 345 kV/69 kV | 41 | 38 | 16 | 12 |
| 345 kV | 40 | 37 | 16 | 12 |
| 161 kV/161 kV | 30 | 23 | 5 | 0 |
| 161 kV/69 kV | 33 | 27 | 8 | 2 |
| 161 kV | 24 | 17 | 1 | 0 |

**Table F-4 Predicted Noise Levels Assuming Maximum Transformer Noise Output at Huntley Substation**

| Receiver | NAC | Sound Pressure Level (dBA) | Minnesota Noise Standard $L_{50}$ | Minnesota Noise Standard $L_{10}$ |
|---|---|---|---|---|
| Hunting Cabin (460 feet) | 3 | 51.1 | 75 | 80 |
| Residence (1,650 feet) | 1 | 34.7 | 50 | 55 |
| Residence (2,080 feet) | | 34.5 | | |
| Residence (2,420 feet) | | 34.2 | | |

modeling focused on the nearest receptors including the three nearest residences as well as the nearest structure (a seasonally occupied hunting cabin). Table F-4 shows predicted sound levels at these receptors. Since transformer noise does not vary over short periods of time, the predicted values in Table F-4 are directly comparable to the L50 and L10 Minnesota noise standards.

ITCM's modeling was based on the rating of the transformer equipment that they anticipate would be used for the project, however when ITCM orders transformers for this substation, they indicate that they will request that the transformers be tested for audible noise at the factory to ensure that actual audible noise will be within state noise standards.

## References

F1. MPCA, 2008. A Guide to Noise Control In Minnesota: Acoustical Properties, Measurement, Analysis and Regulation.

F2. ITCM, March 28, 2013. Application to the Minnesota Public Utilities Commission for a Route Permit, Minnesota – Iowa 345 kV Transmission Project and Associated Facilities in Jackson, Martin and Faribault Counties. Page 135.