CREATE RAILROAD NOISE MODEL USER GUIDE

INTRODUCTION

The CREATE railroad noise model allows input of up to eight different types of noise sources, the activity of these noise sources and noise-sensitive receptor data to calculate hourly-equivalent (L_{eq}) or day-night (L_{dn}) noise levels. The model is based on the Federal Transit Administration (FTA) General Transit Noise Assessment spreadsheet including moving and stationary railroad and highway noise sources.

MODEL INPUT

The model allows input of the following noise sources, train activity and receptor data:

Moving Noise Sources

- Electric and diesel commuter locomotives
- Commuter passenger cars
- Light-rail transit (LRT) powered cars
- Automated-guideway transit (AGT) cars (steel-wheeled and rubber-tired)
- Monorail
- Magnetic-levitation (Maglev) trains
- Freight locomotives
- Freight cars (typical and empty hopper)
- Automobiles
- Buses (city and commuter)
- Commuter buses

Stationary Noise Sources

- Track crossovers (switches, turnouts, crossing diamonds)
- Rail yards or shops
- Layover tracks
- Bus storage yards
- Bus operating facilities
- Bus transit centers
- Parking garages
- Park and ride lots

Track Noise Sources

- Percentage of wheel flats for rail cars
- Jointed track
- Embedded track
- Aerial structure

Train Activity Data

- Number of trains per hour for:
  - Light-rail, commuter, AGT, monorail, Maglev, freight trains
  - Rail yards or shops and layover tracks
  - Track crossovers
- Number of vehicles per hour for:
  - Automobiles, city and commuter buses
  - Parking garages (automobiles) and park and ride lots (automobiles and buses)
  - Bus storage yards and bus transit center
  - Bus operating facilities (buses present and serviced)
  - Bus operating facility (buses serviced)
- Number of locomotives per train for:
  - Commuter trains (electric and diesel)
  - Freight trains
- Number of cars per train for:
  - Commuter, LRT, AGT, monorail and Maglev trains
  - Freight trains (length of cars)
- Duration of trains for:
  - Track crossovers
- Speed of vehicles for:
  - Trains and automobiles

Noise-Sensitive Receptor Data

- Land use type (FTA Category 1,2,3)
- Distance to noise sources
- Presence of noise barrier
- Intervening building rows

NOISE MODEL PROCESS

To calculate noise levels for sensitive receptors, perform the steps outlined in the flow diagram in Figure 1. Once the noise source number (one thru 23) is input, different metrics will appear in rows 26 to 38 that require input. Once all these variables are input, the noise model will automatically calculate the noise levels from each individual noise source (up to eight) as well as the cumulative noise levels from all noise sources together.

Figure 2 shows an example of typical input data into the CREATE railroad noise model.

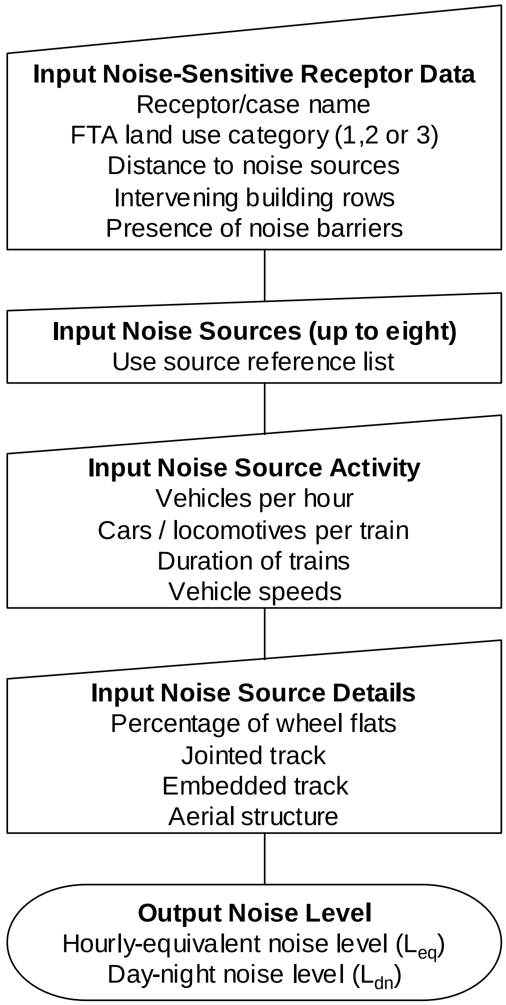

Figure 1. Flow diagram of noise modeling process

Parameter	Source 1	
Source Num.	Commuter Electric Locomotive	1
Distance (source to receiver)	distance (ft)	50
Daytime Hours	speed (mph)	25
(7 AM - 10 PM)	trains/hour	3
	locos/train	2
Nighttime Hours	speed (mph)	25
(10 PM - 7 AM)	trains/hour	1
	locos/train	2
Wheel Flats?		
Jointed Track?	Y/N	N
Embedded Track?	Y/N	N
Aerial Structure?	Y/N	N
Barrier Present?	Y/N	N
Intervening Rows of of Buildings	number of rows	0

Figure 2. Example of model input data

NOISE SOURCE AND RECEPTOR DETAILS

Summary of Noise Source Reference SELs

Reference SELs at 50 feet and speed coefficients are shown for all moving noise sources in Table 1. These reference SELs are per vehicle except for freight cars and hopper cars, which are based on 2000-feet of cars.

Table 2 shows the reference SELs at 50 feet and coefficients for all stationary noise sources. All of the stationary noise source coefficients are 10; however, the references are different (i.e. duration of pass-bys, trains per locomotive, buses per hour, etc.)

Table 1. Moving Noise Source Reference SELs and Speed Coefficients

Moving Noise Sources	SEL at 50 feet	Speed Coefficient	Reference Speed (mph)
Commuter Electric Locomotive	90	10.0	50
Commuter Diesel Locomotive	92	-10.0	50
Commuter Rail Car	82	20.0	50
RRT/LRT	82	20.0	50
AGT, Steel Wheel	80	20.0	50
AGT, Rubber Tire	78	20.0	50
Monorail	82	20.0	50
Maglev	72	20.0	50
Freight Locomotive	97	10.0	40
Freight Cars*	100	20.0	40
Hopper Cars (empty)*	104	20.0	40
Hopper Cars (full)*	100	20.0	40
Automobile	73	28.1	50
City Bus	84	23.9	50
Commuter Bus	88	14.6	50
* Freight and Hopper Cars+A51 SEL is based on 2000 feet of cars			

Table 2. Stationary Noise Source Reference SELs and Coefficients

Stationary Noise Sources	SEL at 50 feet	Reference Coefficient	Reference Value	Reference Metric
Track Crossover	100	10	3600	(seconds) duration of pass-bys
Rail Yard or Shop	118	10	20	(trains per hour)
Layover Tracks	109	10	1	(trains during hour)
Bus Storage Yard	111	10	100	(buses per hour)
Bus Oerations Facility	114	10	200	(buses per hour)
Bus Transit Center	101	10 / 10	20 / 60	(buses per hour) / (buses services per hour)
Parking Garage	92	10	1000	(autos per hour)
Park & Ride Lot	101	10 / 10	2000 / 24	(autos per hour) / (buses per hour)

Moving Noise Sources

Moving noise sources (listed in the Model Input section) are modeled to propagate noise as a line source over soft ground (grass, soft dirt). This results in a sound propagation rate of 4.5 decibels per distance doubling.

Moving noise sources also have a "speed coefficient" which represents the variability of the sound exposure level (SEL) of a vehicle pass-by as function of vehicle speed. The speed coefficients of each vehicle are a function of the potential increase or decrease in maximum noise level due to factors such as wheel/rail interaction, tire/pavement interaction or engine speed and the duration of the pass-by (a higher speed pass-by can actually result in a lower SEL due to the shorter duration of the event). For the moving noise sources in the CREATE model, speed coefficients range from –10 to 28.1.

Increasing the number of vehicles for moving sources relates to SEL on a 10 Log-basis. This results in a three-decibel increase in SEL for each doubling of the number of vehicles. For freight trains, the same relationship exists but is based on the length of cars rather than the specific number of cars.

Stationary Noise Sources

Stationary noise sources (listed in the Model Input section) are modeled to propagate noise as a point source over soft ground (grass, soft dirt). This results in a sound propagation rate of 7.5 decibels per distance doubling.

The SELs from noise sources such as rail yards, bus storage yards and parking lots, vary based on the number of vehicles present on a 10-Log basis. Similar to moving sources, a doubling in the number of vehicles results in an SEL increase of three decibels.

For the inclusion of idling locomotive noise sources, use layover tracks as a stationary source. This noise source will require the input of the number of trains during an hour. If one locomotive were to idle for 15 minutes, this is equivalent to 0.25 trains during an hour.

Track Noise Sources

For the inclusion of LRT, commuter or freight cars, the average percentage of wheel flats present should be input. The adjustment for wheel flats on cars could be as high as an additional five decibels; however, typically the actual percentage of cars with wheel flats is relatively low and noise levels typically increase by less than one decibel.

Jointed track produces an additional noise source at the wheel/rail interface as compared to continuous-welded rail (CWR). The presence of jointed track, therefore, will increase sound levels of commuter locomotives, commuter cars, LRT cars, freight locomotives and freight cars by five decibels.

For the operation of trains on embedded track, noise levels will be three decibels higher than on ballast and tie. This increase is due to the hard ground between the noise source and receptor allowing more efficient sound propagation.

Tracks that are elevated on an aerial structure will typically produce noise levels that are four decibels higher than tracks at grade. This increase in noise level is due to the radiation of the aerial structure as well as more efficient sound propagation from a source that is at a higher elevation.

The presence of a track crossover such as a switch, turnout or crossing diamond acts as a stationary noise source whenever the train travels over it. For this noise source, the duration and the number of trains per hour are required to determine the SEL from this source.

Noise-Sensitive Receptor Data

The FTA land use category must be input into the model. Land use category 1 and 3 correspond to locations where noise-sensitive receptors are present only during daytime hours and do not typically sleep (e.g. schools, churches and medical offices). Land use category 2 corresponds to locations where noise-sensitive receptors often sleep (e.g. hotel, motels, residences and hospitals). The hourly-equivalent (L_{eq}) noise level for the loudest-hour of train-related activity during hours of noise-sensitivity is used to assess potential impact at a category 1 or 3 receptor and the day-night (L_{dn}) noise level is used to assess potential impact at a category 2 receptor. The L_{dn} noise level includes a 10-decibel penalty for noise events that occur between 10pm and 7am; therefore, the input of both daytime and nighttime events is required for category 2 receptors

The presence of a noise barrier can be included in modeling noise levels. However, in a general assessment no details of the height or location of the noise barrier are input. It is assumed that the noise barrier would be effective in lowering noise levels a minimum of five decibels.

The model allows input of the number of intervening rows for receptors that are not adjacent to the noise source. For the first intervening building row, noise levels are modeled to decrease 4.5-decibels. For each additional intervening row (between two and five) an additional 1.5-decibel reduction is taken into account up to a maximum reduction of 10 decibels.

SPREADSHEET INFORMATION

To minimize the potential for error in modifying the CREATE railroad noise model, the spreadsheet has been password protected. The password protection disallows the deletion or modification to cells other than input or output cells (grey). Should modification of the spreadsheet be required for some reason, the spreadsheet can be unlocked with the password: "create".