Stationary Source Modeling Procedure and Example[1]

The modeling of constant stationary sources (Parked vehicles, power plants, etc.) can be done using the current TNM 2.5 model with a judicious choice of vehicle flow rates and speeds. Below is the explanation of the approach and its limitations.

Definitions:

A tier is a row of parking bays.

A bay is an allocated slot of a given width and length for the parking of a vehicle.

A tier length is equal to the sum of the widths of all the included bays.

The level prediction can be made by considering a tier as a roadway segment. The occupied bays can be thought of as individual sources. A working source vehicle density (ρ) is the number of occupied bays (N) divided by the total tier length (TL). $\rho = N/TL$

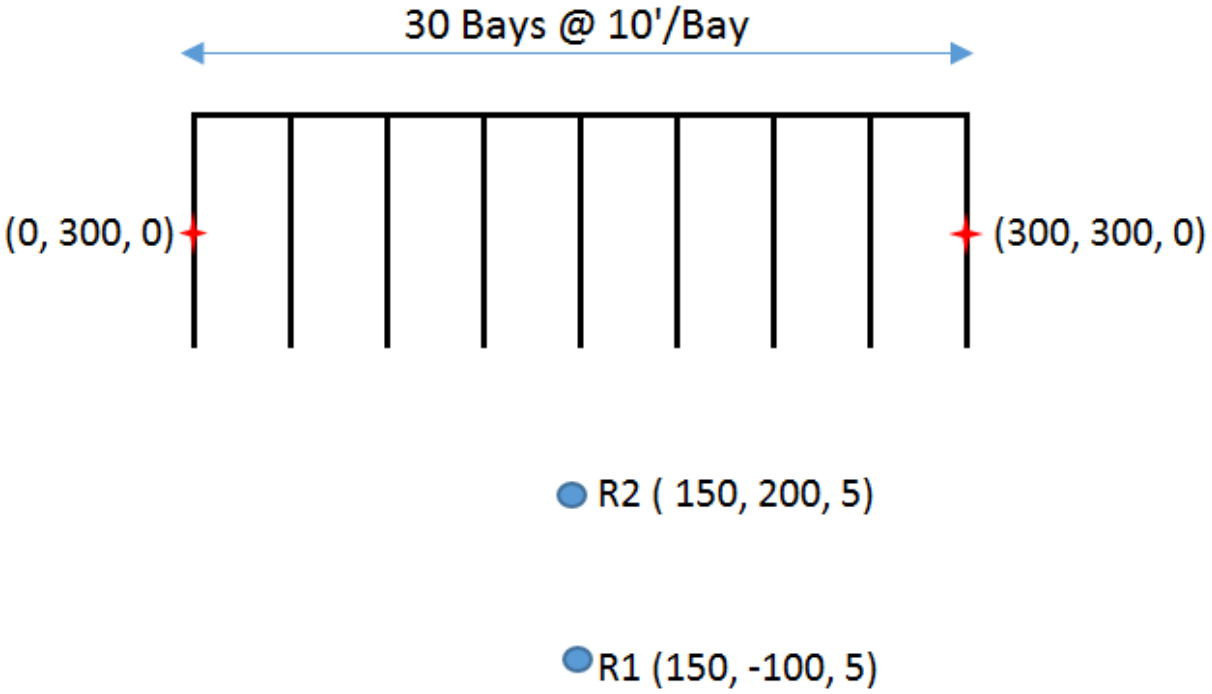
A limitation on this approach, of considering a tier as a roadway, is based on the Mean Integral Theorem. Any bays that have a width greater than the Line-of-sight distance from a considered Listener location, need to be addressed individually as a four foot roadway segment with ρ equal to 1.0 source per foot. Otherwise, modeling the tier as a roadway is quite adequate. This limitation shouldn't be a problem in most real evaluations.

Summary of the methodology for a prediction:

1) Idling Heavy Trucks are evaluated using the TNM 2.5 heavy truck with a speed of 1 MPH. It's necessary to have usage information available, such as percentage of bay usage, etc.
2) Generally the occupancy of a tier would be assumed to be 100% unless a lessor occupancy is anticipated. The bay width used to check the limitation referred to above should be equal to TL/N.
3) It should be understood that the example problem is a simplified, flat earth scenario so as to accentuate certain aspects of the problem. In reality, these sources would be modeled along with other roadways with flowing traffic.

[1] Note: This guidance is developed to address stationary source only. All other noise sources (local roads, ramps, mainlines etc.) will need to be modeled in the appropriate fashion.

Example problem:



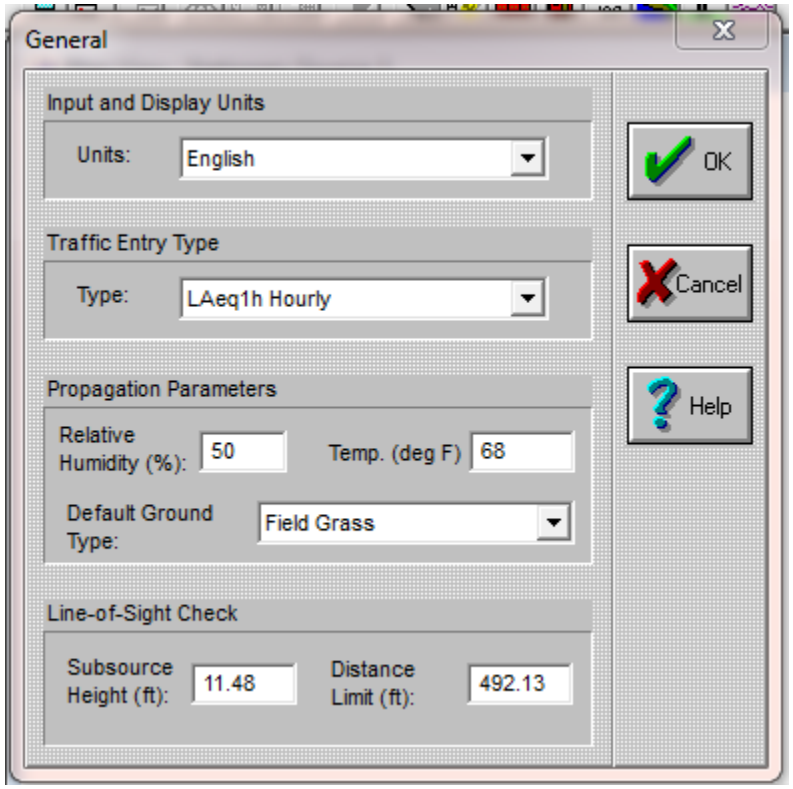
Assumptions:

1. The figure is not drawn to scale.
2. Since all heavy trucks are idling, speed should be 0 miles per hour (mph). However, the TNM model will err out with a speed of 0 mph. Therefore, a speed of 1 mph was assumed in this example.
3. Assumed a **Field Grass** ground type (Under real conditions actual ground types would need to be taken into account).
4. Assumed 80% of the bays will have idling heavy trucks in them at all times, therefore the total of occupancy = 30 bays × 80% = 24 bays.
5. Bay width for checking on the use of the tier as a roadway, BW = 300 feet ÷ 24 bays = 12.5 ft/bay which is < the line-of-sight distance from receptor locations R2 and R1. Thus, no bays need special attention.

6. ρ = 24 bays ÷ 300 feet = 0.08 H. Trks/foot
7. Using 1 mph, the vehicle count in vph to use is calculated as below:

$$vph = \rho \times 1\ mph \times \frac{5280\ ft}{mile} = \frac{0.08\ H.\ Trks}{foot} \times \frac{1\ mile}{hour} \times \frac{5280\ feet}{1\ mile} = 422\ vph$$

Example problem input:



INPUT: ROADWAYS <Project Name?>

<Organization?>
<Analysis By?>

27 March 2017
TNM 2.5

INPUT: ROADWAYS
PROJECT/CONTRACT: <Project Name?>
RUN: <Run Title?>

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	%		
Roadway1	12.0	point1	1	0.0	300.0	0.00				Average	
		point2	2	300.0	300.0	0.00					

INPUT: TRAFFIC FOR LAeq1h Volumes <Project Name?>

<Organization?>
<Analysis By?>

27 March 2017
TNM 2.5

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: <Project Name?>
RUN: <Run Title?>

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
Roadway1	point1	1	0	0	0	0	422	1	0	0	0	0
	point2	2										

INPUT: RECEIVERS <Project Name?>

<Organization?>
<Analysis By?>

27 March 2017
TNM 2.5

INPUT: RECEIVERS
PROJECT/CONTRACT: <Project Name?>
RUN: <Run Title?>

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria: Existing LAeq1h	Impact Criteria LAeq1h	Impact Criteria Sub'l	NR Goal	Active in Calc.
			ft	ft	ft	ft	dBA	dBA	dB	dB	
Receiver1	1	1	150.0	-100.0	0.00	5.00	0.00	66	10.0	7.0	Y
Receiver2	2	1	150.0	200.0	0.00	5.00	0.00	66	10.0	7.0	Y

Example problem output:

<Organization?> 27 March 2017
<Analysis By?> TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: <Project Name?>
RUN: <Run Title?>
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	With Barrier Noise Reduction Calculated	With Barrier Noise Reduction Goal	With Barrier Noise Reduction Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	65.5	66	65.5	10	—	65.5	0.0	7	-7.0
Receiver2	2	1	0.0	77.7	66	77.7	10	Snd Lvl	77.7	0.0	7	-7.0

Dwelling Units	# DUs	Noise Reduction Min	Noise Reduction Avg	Noise Reduction Max
		dB	dB	dB
All Selected	2	0.0	0.0	0.0
All Impacted	1	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0