What Projects Are Eligible?

Only certain turnpike improvement projects are eligible for noise mitigation in Pennsylvania. These projects have the potential to alter the acoustical environment and are analyzed for noise impacts and the possibility of abatement. The scope of these projects include turnpike built on new locations and substantial changes to either the vertical and/or horizontal alignment on existing turnpike.

Applying The Process to Eligible Projects

There is a structured process that the Pennsylvania Turnpike Commission (PTC) uses to identify communities that will be considered for noise abatement and whether noise abatement measures can be implemented within state or federal guidelines. The first step in the process is to determine which land uses in the project could be affected by future turnpike noise. Locations such as residences, libraries, houses of worship, hospitals, schools, and parks are often the most common land uses that receive abatement consideration. The process continues through the following steps.

Monitor Noise Levels

After noise-sensitive locations that may be affected by the proposed turnpike project have been identified, existing traffic noise levels are monitored at locations that are representative of affected areas. The results of the monitoring sessions are used to ensure that the noise prediction model will provide accurate results. Just because a home or property was not monitored during this step does not mean it won't be considered during the noise study. The monitoring is used only to set and verify the prediction model and not as a basis for noise abatement decisions.

Noise Modeling

Computer modeling is performed with the FHWA TNM Model to assess future conditions in consideration of the proposed improvements. Noise projections are made for the maximum operating capacity of the future build condition and use forecasted traffic information for 20 years in the future. Turnpike design details and terrain modifications are included in the computer model. Additional modeling locations are added to clearly depict the impacted areas.

Noise Abatement Consideration

Noise abatement is considered for noise impacted locations. Whether you attend an in-person or virtual meeting or are directed to the project's website to learn more, you may hear or read the terms "warranted, feasible and reasonable". These terms describe the three steps PTC must take when considering noise abatement for noise-sensitive areas. To determine whether abatement is warranted, the project team compares the noise modeling projections to the noise impact criteria (per Federal Highway Administration (FHWA) guidelines) for the property. Abatement is "warranted" if the future noise levels approach or exceed the noise abatement criteria or are elevated by 10 decibels (dB(A)) above the existing conditions.

PTC defines an impact for residential areas as 66 dB(A). For communities where noise abatement consideration is warranted, the next step is to determine whether the noise abatement would be "feasible" for each affected community. Traffic noise abatement is typically provided by using noise walls. Feasible noise walls are those that provide at least 5 dB(A) of noise reduction to noise sensitive locations and pose no safety, engineering, or access restrictions. If a noise wall system is determined to be feasible, the next step is to determine if the wall is "reasonable" for construction. For a wall to be reasonable, it must be cost effective. Impacts to maintenance, constructability, drainage, and utility must be considered, as well as the desires of the affected residents.

The Resident or Property Owners' Role in the Process

The design of noise walls begins when a final alignment has been selected for the turnpike. During noise wall design process, residents and owners of noise-impacted properties will have the opportunity to have their concerns addressed by the project team. The PTC may engage with residents and owners through a variety of communication methods, including virtual or in-person meetings, one-on-one communication by phone or email, and/or via project questionnaires and ballots. Through this engagement, the decision for or against a sound wall, and the walls' texture and color, will be determined. If more than half of the affected residents and/or owners respond that they do not want the noise wall, the wall will not be constructed. Decisions on the noise wall and its texture and color are final.

Traffic Noise Generation

When a sound source is stationary, it is called a point source and it radiates sound equally in all directions like a pulsing sphere. When many sound sources are moving in a line, the sound radiates like a pulsing cylinder from the sources. Traffic noise is generated in this fashion. It is important to distinguish point sources from line sources because each has different characteristics.

Noise is rated on a decibel scale, designed to match our hearing mechanism. A sound that increases by 10 dB(A) will double in loudness. Therefore, a source will sound twice as loud if its level increases from 60 to 70 dB(A). The source will sound four times as loud if its level increases from 60 to 80 dB(A). Conversely, when the number of sound sources is doubled – such as two honking horns instead of one – the noise level increases by three decibels. A three-decibel change is barely noticeable to the average person.

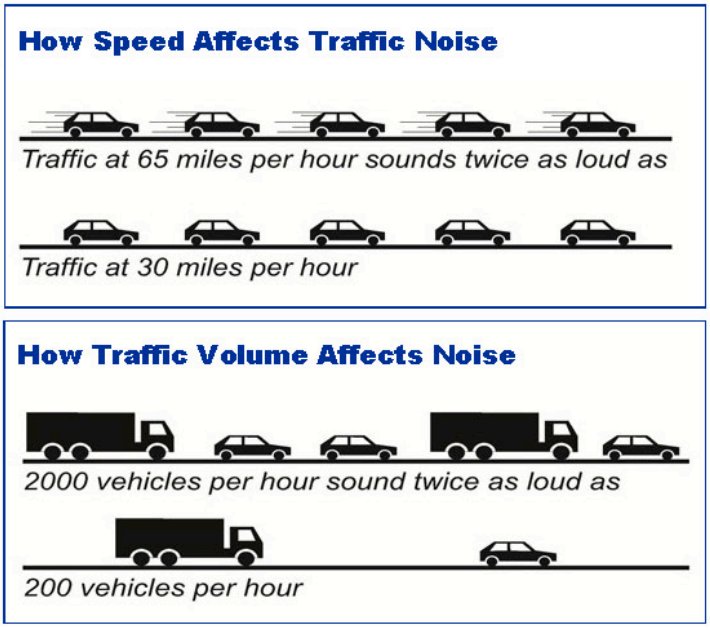
Traffic Noise Sources

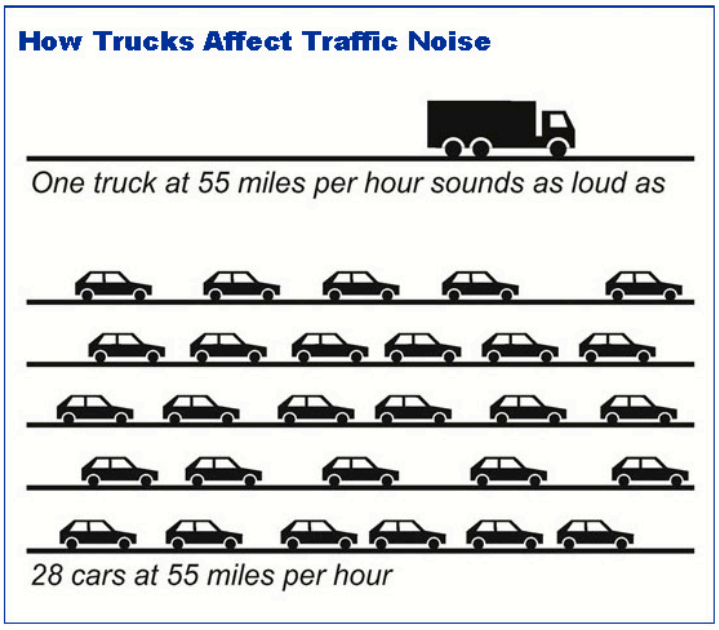
The principal noise sources of vehicles are the exhaust system, engine, and tires. Exhaust noise is typically controlled by mufflers, assuming they are used and are functioning properly. Engine noise is controlled by vehicle manufacturers and proper maintenance, factors that the PTC has no control over. Tire noise is generated by the interaction of each vehicle's tires with the road surface.

Engine and exhaust noise are usually louder than tire noise at vehicular speeds under 30 miles per hour. The reverse is normally true for vehicular speeds over 30 miles per hour. The turnpike is typically dominated by tire noise, while local streets are typically dominated by engine and exhaust noise. The overall noise level generated by vehicles on the turnpike depends on the number of vehicles, the speed of the vehicles, and the types of vehicles. The figures below show how these factors influence noise levels.

Traffic Noise Propagation

The travel, or propagation, of traffic noise depends mainly on three factors — atmospheric effects, ground effects, and spreading effects. Atmospheric conditions are constantly in flux and change the direction of sound travel. Ground conditions also affect sound travel. Sound will travel farther over a hard reflective surface than one covered with vegetation. Spreading effects diminish sound at a constant rate as the sound travels away from its source. For example, sound from a line source –such as the turnpike – decreases at a rate of approximately 3 dB(A) per doubling of distance from the source.





Source:PennDOT

Principles of Outdoor Sound Control

When trying to solve a noise problem, the practical solution is a combination of treating the source of the noise and the path between the noise source and the listener. Since the source of traffic noise is the combination of vehicles on the turnpike, the efficient option is to try to reduce the noise along the path between the turnpike and the listeners. The most common outdoor noise reduction method is the construction of noise barriers. These barriers can take different forms and are designed to break the line-of-sight between the vehicles on the turnpike and affected residential communities.

Barriers can be in the form of walls or topographical changes. Topographical changes include building earth berms or hills between the turnpike and the community or by depressing the highway. To be effective, any noise barrier must be solid. Fences or vegetation have minimal effectiveness as noise barriers. Because noise walls are open to the air above and around them, sound bends over and around them through the principle of diffraction. Diffraction limits the effectiveness of any wall to a maximum noise reduction of 10 to 15 dB(A) regardless of the material used. Typical noise wall reductions can range from 5 to 10 dB(A).

Turnpike Design Options

Design options to minimize traffic noise include building roadways as far as possible from noise sensitive locations, depressing roadways, and avoiding steep inclines in roadways. Building the turnpike several hundred feet from noise-sensitive locations will minimize noise exposure. Where this is impractical, highways can be built closer to areas that are not noise-sensitive – such as industrial areas. Building the turnpike below ground level creates natural walls between the roadway and any noise sensitive locations. Steep inclines in roadways cause more noise to be generated by vehicles, especially trucks, as they accelerate uphill and decelerate downhill. A level roadway elevation avoids this extra noise generation.

Noise Walls & Other Available Abatement Options

In Pennsylvania, the noise abatement options considered most often are alternative highway design and noise wall construction. Designs that minimize noise without compromising safety and practicality are incorporated into turnpike plans. The PTC uses noise walls that have been rigorously evaluated to ensure safety, integrity, longevity, and preservation of aesthetics. The pictures on the back page of this brochure show some of the different types of noise abatement walls.

Sound Pressure Levels for Common Sources

dB(A)	Perception of Loudness	Sound Sources
10	1/6 as loud as 50 dB(A)	Normal breathing
20	1/8 as loud as 50 dB(A)	Broadcast studio
30	1/4 as loud as 50 dB(A)	Library
40	1/2 as loud as 50 dB(A)	Refrigerator
50	Reference level	Clothes dryer
60	2 times louder than 50 dB(A)	Air conditioning unit
70	4 times louder than 50 dB(A)	Pick-up truck @ 50mph, 50'
80	8 times louder than 50 dB(A)	Medium truck @ 50mph, 50'
90	16 times louder than 50 dB(A)	Motorcycle @ 50mph, 50'
100	32 times louder than 50 dB(A)	Jet flyover @ 1000'

Source:PennDOT

Construction of Noise Walls

The construction and installation of noise walls may involve acquiring right-of way to construct the wall along the back yard area or edge of a property. If there are trees growing in the area where the noise wall will be constructed, it is likely that they will have to be removed to accommodate the construction. However, efforts will be made to save as many trees as possible. Generally, it is most effective to locate noise walls as close as possible to either the turnpike or the impacted community. The walls will be built on the PTC owned right-of-way and will be the property of the turnpike.

Maintenance of Noise Walls

The maintenance of noise walls is the responsibility of PTC and access is required to the residential side of the wall to perform maintenance or replace damaged panels. There may be restrictions against building permanent structures in the area between the noise wall and the home or land property line to facilitate PTC access. The PTC does not typically provide landscaping on the residential side, However, if property owners wish to maintain the area between the wall and the property line, they are encouraged to discuss their plans with the PTC.

Examples of Noise Wall Abatement

GRAPE STAKE

FUZZY RAKE

ASHLAR STONE

FRACTURE FIN

SHIP LAP

Source:PennDOT

This noise wall guide includes information and content from PennDOT's noise abatement policy; read more at www.dot.state.pa.us. This brochure is neither representative of nor applicable to all PTC projects. For noise impact information specific to your county or region, contact the PTC Central Office at 877-736-6727.