# What about Noise?

## Mitigation of Traffic Noise on Federal Aid Highways

Federal Rule – Highway Traffic Noise Analysis & Abatement Policy & Guidance
FHWA – June 1996 (23 CFR 772)

This federal regulation resulted from the Noise Control Act of 1972 and the Federal Aid Highway Act of 1970. These regulations state the following:

> "The FHWA regulations for mitigation of highway traffic noise in the planning and design of **federally aided highways** are contained in 23 CFR 772. The regulations require the following during the planning and design of a highway project: (1) identification of traffic noise impacts; (2) examination of potential mitigation measures; (3) the incorporation of reasonable and feasible noise mitigation measures into the highway project; and (4) regulations contain noise abatement criteria which represent the upper limit of acceptable highway traffic noise for different types of land uses and human activities. The regulations do not require that the abatement criteria be met in every instance. Rather, they require that every reasonable and feasible effort be made to provide noise mitigation when the criteria are approached or exceeded. Compliance with the noise regulations is a prerequisite for the granting of **Federal-aid highway funds for construction or reconstruction of a highway**."

Note that these regulations require identification of traffic noise impacts and incorporation of "reasonable and feasible" noise mitigation measures into a highway project only when the project involves federal aid highway funds.

In the case of a federal aid project in order to decide whether the noise impacts warrant "examination of potential mitigation measures" the federal regulations states:

> "A traffic noise impact occurs when the predicted levels approach or exceed the noise abatement criteria (NAC) or when predicated traffic noise levels substantially exceed the existing noise level, even though the predicted levels may not exceed the NAC."

The Noise Abatement Criteria (NAC) that is used to establish impacts are described based different adjacent land uses in Table 5 (from the federal regulation) below:

Table 5: Noise Abatement Criteria (NAC)
Hourly A-Weighted Sound Level in Decibels (dBA)*

| Activity Category | $L_{eq}(h)$ | $L_{10}(h)$ | Description of Activity Category |
|---|---|---|---|
| A | 57 (Exterior) | 60 (Exterior) | Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. |
| B | 67 (Exterior) | 70 (Exterior) | Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, churches, libraries, and hospitals |
| C | 72 (Exterior) | 75 (Exterior) | Undeveloped lands. |
| D | | | Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums. |
| E | 52 (Exterior) | 55 (Exterior) | |

* Either $L_{eq}(h)$ or $L_{10}(h)$ (but not both) may be used on a project.

Note: These sound levels are only to be used to determine impact. These are the absolute levels where abatement must be considered. Noise abatement should be designed to achieve a substantial noise reduction – not the noise abatement criteria.

In Idaho the definition of "approach" that is used is "within 1dBA" for the given category and the criteria that is used for "substantially exceeding the existing noise level..." is +15 dBA. In that regard, a change of 3 dBA would be "barely perceptible" to the human ear; a change of 5 dBA would be "readily perceptible;" and a change of 10 dBA would be perceived as twice as loud.

The method utilized to determine whether any of the above criteria are met is based on a computer model called FHWA Traffic Noise Model (TNM). The model is run utilizing existing traffic and utilizing future predicted traffic with the project in place, usually twenty years out.

Even when the above criteria are met and the project is federally funded, this would not automatically result in specific mitigation measures. The only regulations require that mitigation measures be evaluated.

For specific measures such as sound walls to be required it has to be demonstrated that the measures are "reasonable and feasible." Whether this is the case is developed in the National Environmental Policy Act (NEPA) document that is prepared as part of the federal aid project. For most of ACHD sponsored projects which are built in an urbanized area the environmental document determines that specific mitigation measures are not required because none of the above criteria are met or for reasons described below are not "reasonable or feasible."

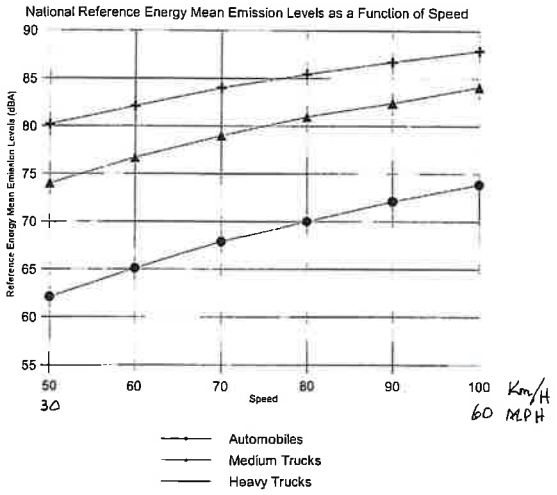
## State and Local Rules and Abatement Policy

In Idaho and Ada County there are no requirements for evaluation or mitigation of noise impacts due to traffic except when federal aid is involved in the project in which case the federal regulations are followed:

## Discussion of Noise Mitigation Measures and Issues in an Urbanized Environment

Speed – Maintaining speed limits at 35 mph or less in urbanized and residential areas is the primary mitigation measure that ACHD routinely utilizes. The reason for this can be readily recognized by viewing Figure 1.

**Figure 1: Reference Energy Mean Emission Levels** (taken from federal regulations)




Note:
Automobiles- All vehicles with two axles and four wheels
Medium trucks- All vehicles with two axles and six wheels
Heavy trucks- All vehicles with three or more axles

At speeds below 35 mph additional measures are not warranted, in fact, a review of the literature and federal regulations and studies demonstrate that the federal regulations are intended to apply to high speed facilities, not urban roads. To place these sound levels in perspective, please see the chart below:

**Figure 2: Lawn Mower Noise**

**Mower racket**

| | Brand | Type | Model | Price | Decibel noise level at 25 feet | Noise equivalent |
|---|---|---|---|---|---|---|
| Gas-powered | Husqvarna | Self-prop | 5521CHV | $350 | 82 | Snowmobile at 50 feet (80 decibels) |
| | Snapper | Push | MR216517B | $410 | 80 | |
| | Bolens | Push | 11A084C163 | $170 | 77 | |
| | Yard-Man | Push | 11A435D775 | $190 | 77 | |
| | Troy-Built | Self-prop | TuffCut 230 | $400 | 77 | |
| | Craftsman | Self-prop | 37894 | $280 | 77 | |
| | MTD | Push | Pro 11A588Q | $200 | 76 | |
| | Lawn-Boy | Self-prop | Gold Series 10655 | $400 | 76 | Garbage Disposal (75 decibels) |
| | Toro | Push | 20008 | $350 | 75 | |
| | Murray | Self-prop | 226111X92A | $215 | 75 | |
| | Honda | Self-prop | HRX217HXA | $700 | 74 | Jet plane interior (70 decibels) |
| | Ariens | Self-prop | 911097 | $470 | 72 | |
| Electric | Black & Decker | Cordless | CMM 1000 | $464 | 62 | Normal conversation (60 decibels) |
| | Yard Machines | Corded | 13 inch | $200 | 60 | |
| | Neuton | Cordless | EM 4.1 | $400 | 59 | |
| Reel | Brill/Sun Lawn | — | Luxus 38 | $200 | 55 | Bathroom Exhaust fan (50 decibels) |
| | McLane | — | Front Throw | $200 | 54 | |

Noisy ↑ Quiet

Sources: Noise Pollution Clearinghouse and Consumer Reports

SCOTT WALLACE STAFF



Automobiles moving at speed of 35 mph or less produce decibel levels on par with a normal conversation. Speeds of 45 to 50 mph produce noise levels on par with a garbage disposal or a relatively quiet lawn mower.

Another related factor is that,

> "Work done in Europe has indicated that there is a crossover speed for constant-speed driving of about 25 to 30 mph for cars and about 35 to 45 mph for trucks (2). At speeds less than 25 to 30 mph for cars or 35 to 45 mph for trucks; the power train noise dominates; however, at higher speeds the tire/pavement noise is more prevalent."

This will be explained further below in the discussion of pavement types.

### Noise Reduction by Use of Special Pavement Types

In Europe they have done extensive research on "Quiet Pavements" and in order to take advantage of this, FHWA sent a team of experts to Europe in 2004. The results of their trip are summarized below:

> "Quiet Pavements" Team
>
> In May 2004, a U.S. "quiet pavements" team of state, federal, academic and highway industry representatives toured five European countries for 17 days and, along with a comprehensive

study of research done on noise-reducing pavements, published a FHWA report on noise-reducing pavements in Europe.

The findings made by the team about quiet pavements systems in Europe were:

- Two-layer porous asphalt (TLPA) on high-speed highways produced exceptionally quiet pavements.
- Porous pavements should not be placed in urban areas where the operating speed drops below 45 miles per hour (mph) because highly porous mixes tend to clog under slow traffic.
- A reduction in aggregate size in the wearing surface mix will normally result in immediate noise-reducing properties of mixes.
- Aggregate sizes in Europe for quiet surface mixes are 0/4 millimeters to 0/10 millimeters. But most U.S. DOTs use Superpave aggregate gradings of 9 mm, 12.5 mm, and 9.5 mm [a reduction in aggregate size gradings to the next smallest size produces a noise reduction of 1 to 3 decibels.]
- Thin-textured surfaces using a small aggregate size worked well for urban or low-speed sections. To achieve noise reduction, the pavement was always negatively textured (containing holes or voids). Positively textured pavements such as chip seals increased noise.

In addition to the above this team concluded that the porous asphalt (TLPA) systems cost 10-25 percent more than traditional surfacing and that those types of surface should not be used in urban areas where speed was less than 45 mph. In those areas Europeans use smaller sized aggregate.

Based on this ACHD intends to try experimenting with 1/2-inch aggregate rather than 3/4-inch in the top lift of asphalt on some of its roads including the southside approaches to East ParkCenter Bridge in the vicinity of Bown Crossing.

Here in the US, studies have been done on the use of asphalt rubber friction courses as a noise mitigation measure and this type of asphalt has been used on the Beltway I-495 in the Washington D.C. area, in Arizona, and California with some success. However, all of these projects have been done on high speed highways (mostly freeways) and not on urban lower speed roads.

In addition, this type of asphalt is not available in the Boise area and if it were and we used it , ACHD would have to change its primary pavement maintenance method which is to seal the surface with chipseal. The way asphalt rubber friction courses are maintained is to rotomill them off every few years and relay new surface.

## Noise Barriers (Sound Walls) for Noise Mitigation

Below is an excerpt from the federal document cited above:

### Noise Barriers

1. **Technical Considerations and Barrier Effectiveness**

Noise barriers are solid obstructions built between the highway and the homes along the highway. Effective noise barriers can reduce noise levels by 10 to 15 decibels, cutting the loudness of traffic noise in half. Barriers can be formed from earth mounds along the road (usually called earthberms) or from high, vertical walls. Earthberms have a very natural appearance and are usually attractive. However, an earthberm can require quite a lot of land if it is very high. Walls take less space. They are usually limited to 8 meters in height because of

structural and aesthetic reasons. Noise walls can be built out of wood, stucco, concrete, masonry, metal and other materials. Many attempts are being made to construct noise barriers that are visually pleasing and that blend in with their surroundings.

There are no federal requirements or FHWA regulations related to the selection of material types to be used in the construction of highway traffic noise barriers. Individual State Highway Authorities (SHAs) select the material types to be used when building these barriers. The SHAs normally make this selection based on a number of factors such aesthetics, durability and maintenance, costs, public comments, etc. The FHWA does not specify the type of material that must be used for noise barrier construction, but the material type that is chosen must meet State specifications which have been approved by FHWA. The material chosen should be rigid and of sufficient density (approximately 20 kilograms/square meter minimum) to provide a transmission loss of 10 dBA greater than expected reduction in the noise diffracted over the top of the barrier.

Noise barriers do have limitations. For a noise barrier to work, it must be high enough and long enough to block the view of a road. Noise barriers do very little good for homes on a hillside overlooking a road or for buildings which rise above the barrier. A noise barrier can achieve a 5 dBA noise level reduction when it is tall enough to break the line-of-sight from the highway to the receiver and it can achieve an approximate 1.5 dBA additional noise level reduction for each meter of height after it breaks the line-of-sight (with a minimum theoretical total reduction of 20 dBA). To avoid undesirable and effects, a good rule-of-thumb is that the barrier should extend 4 times as far in each direction as the distance from the receiver to the barrier. Openings in noise walls for driveway connections or intersecting streets destroy the effectiveness of barriers. In some areas, homes are scattered too far apart to permit noise barriers to be built at a reasonable cost.

The last paragraph explains why in almost all cases noise barriers are not utilized or practical for use in an urbanized area.

The three figures (from federal publications) below further explain the limitations of noise barriers.

**Figure 3: How Does a Noise Barrier Work?**

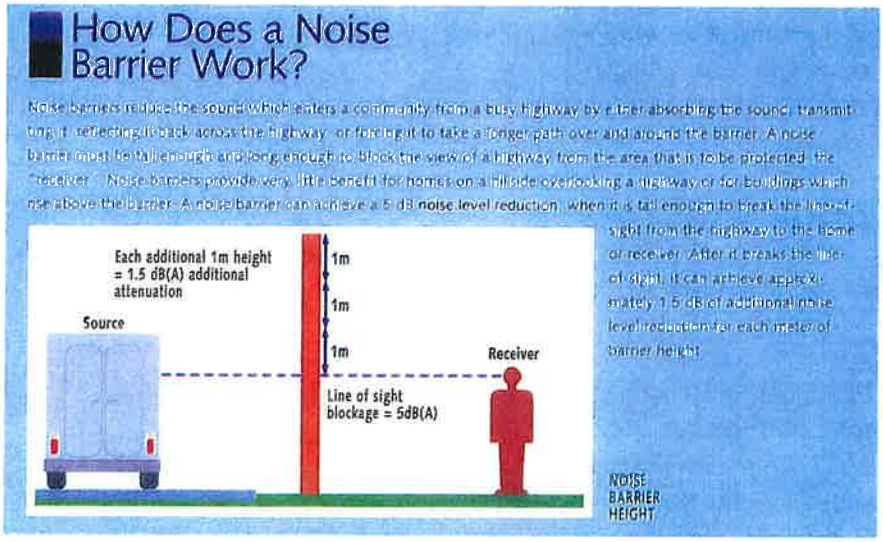
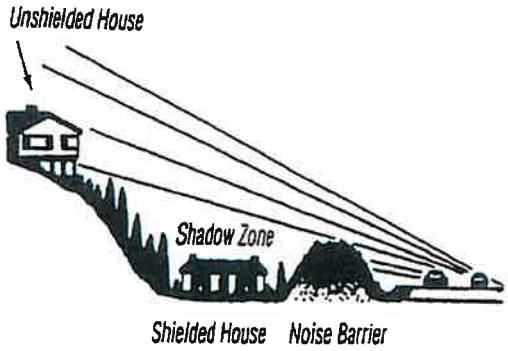
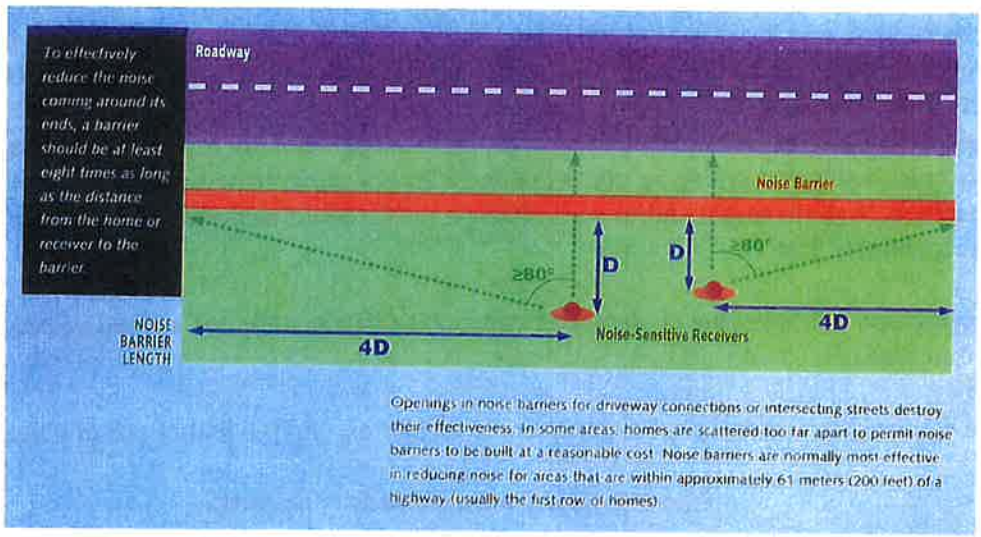


**Figure 4: Noise Barrier Shadow Zone**




Notes: Shadow effect of noise barrier.
The lower house is protected by the barrier, but the upper one is not.

**Figure 5: Noise Barrier Length**




The problem of openings for driveways and intersections that "destroy" the effectiveness of barriers is the primary reason why they are not practicable for use in an urban area. Also height problems and the fact that they cost $1-3 Million per mile to construct are other major reasons why they are not normally used on ACHD roads.

### The Use of Vegetation for Noise Reduction

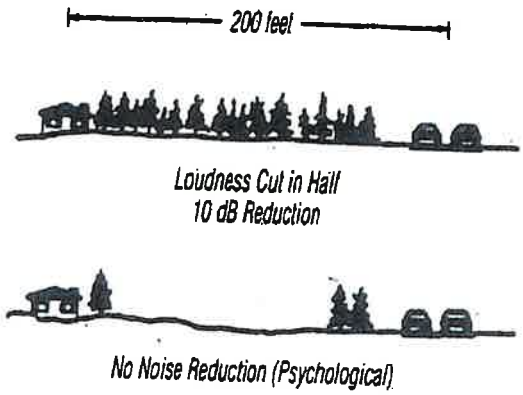
The following excerpt from the federal regulation cited above and drawing explain the limitations of using vegetation for noise mitigation:

> Vegetation
>
> Vegetation, if it is high enough, wide enough, and dense enough that it cannot be seen through, can decrease highway traffic noise. A 61-meter width of dense vegetation can reduce noise by 10 decibels, which cuts in half the loudness of traffic noise. It is usually impossible, however, to plant enough vegetation along a road to achieve such reductions.

Roadside vegetation can be planted to create a psychological relief, if not an actual lessening of traffic noise levels. Since a substantial noise reduction cannot be obtained for an extended period of time, the FHWA does not consider the planting of vegetation to be a noise abatement measure. The planting of trees and shrubs provides only psychological benefits and may be provided for visual, privacy, or aesthetic treatment, not noise abatement.

**Figure 6: Vegetation**

Vegetation & Noise Reduction




There are no places in Ada County where we have enough right-of-way available to plant a 200-feet wide strip of vegetation, consequently we do not use this as a method of mitigating for noise.