Is Train Horn Noise a Problem in your Town?

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September 2005

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Is Train Horn Noise a Problem in Your Town?

The locomotive horn is an effective deterrent to accidents at grade crossings. However, the sound level from the locomotive horn creates a significant noise that often depreciates the quality of life in communities where trains operate. On June 24, 2005, the Federal Railroad Administration (FRA) issued its Final Train Horn Rule that allows public authorities to establish quiet zones where locomotive horns are not routinely sounded at the public grade crossings. The result may be improved living conditions as loud train horns are silenced. However, a warning device (the loud train horn) that has successfully prevented many grade crossing accidents has been eliminated. So how can the silencing of train horns and grade crossing safety co-exist?

Let's review some basics about train horn noise. The following chart provides a comparison of noise levels from various common noise sources. Normal conversation occurs within a range of 60 and 70 dBA. A loud voice is between 70 and 80 dBA and a shout is between 80 and 90 dBA. This chart also indicates that audible communication usually ceases when background noise exceeds 90 dBA. It is noted that the noise from a train horn can have an impact greater than a siren.

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COMPARISON OF VARIOUS NOISE LEVELS						
Noise Level (dBA)	Extremes	Home Appliances	Speech at 3 ft.	Motor Vehicles at 50 ft.	Railroad Operations at 100 ft.	General Types of Community Environment
120	Air Craft at 500ft.					
110					Horns	
100				Sirens		
90				Diesel Truck (Not Muffled)	Locomotive	
80		Shop Tools	Shout	Diesel Truck (Muffled)	Rail Cars at 50 mph	
70		Blender	Loud Voice	Automobile at 70 mph	Loco Idling	Major Metropolis
60		Dishwasher	Normal Voice	Automobile at 40 mph		Urban (Daytime)
50		Air Conditioner	Normal Voice (Back to Listener)	Automobile at 20 mph		Suburban (Daytime)
40		Refridgerator				Rural (Daytime)
30						
20						
10						
0	Threshold of Hearing					

How Does Train Horn Noise Diminish as Distance from the Track Increases?
The FRA has modeled how the train horn sound propagates and dissipates from its source. The FRA model states that train horn noise is reduced by 4.5 dBA whenever the distance from the train is doubled. This horn noise dissipation is caused by divergence of sound and ground interference. The FRA model also considers shielding from buildings and includes a 3 dBA reduction at the first row of buildings, located 200 feet from the track, and additional 1.5 dBA reductions for each succeeding row at 400, 600, 800 and 1,000 feet. Assuming an average of 104 dBA of horn noise at 100 feet from the train, the following chart shows how the FRA models the dissipation of noise as distance from the grade crossing increases. This model shows that speech interference can begin to occur approximately 7,000 feet from the track when the train horn is sounding. People outside and closer than 1,500 feet from the track may have to shout to be heard. Outside

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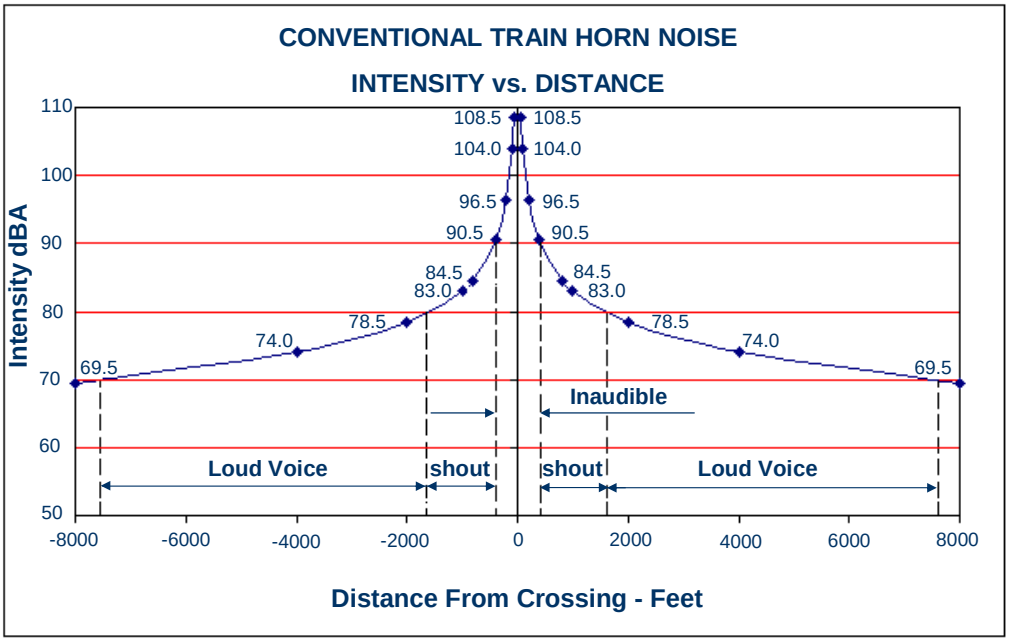
conversations, closer than 400 feet from the track, usually have to cease until the train passes by.



What are the Train Horn Sound Requirements in the New FRA Train Horn Rule?

- The locomotive horn must be sounded 15 to 20 seconds prior to and until the train arrives at the crossing,
- The locomotive horn should not be sounded greater than ¼ mile in advance of a grade crossing,
- The minimum sound level of the locomotive horn is 96 decibels (dBA) 100 feet in front of the train in its direction of travel, and
- The new maximum is 110 dBA at 100 feet in front of the train in its direction of travel.

Does the Train Horn Rule Provide a Method to Simultaneously Silence the Locomotive Horn and Promote Grade Crossing Safety?

The new FRA Rule sanctions the establishment of "quiet zones" where the conventional train horn may be silenced at the grade crossings. Flashing light signals with gates, as the minimum level of protection, are required at all grade crossings within new quiet zones. The grade crossing warning devices must be activated by constant warning circuitry. Each highway approach to every public and private grade crossing within a new quiet zone must have an advance warning sign that advises motorists that train horns are not sounded at the crossing. In addition, the installation of one of several FRA-approved

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Supplemental Safety Measures or Alternate Safety Measures may be required at all or some grade crossings within the quiet zone.

What is a Quiet Zone?
A quiet zone is a segment of rail line where locomotive horns are not routinely sounded while the train approaches the public highway/railroad grade crossings within the corridor. The minimum length of the quiet zone is ½ mile.

How can a Quiet Zone be Established?
The FRA Train Horn Rule permits a quiet zone to be established via the following avenues:

1. The calculated Quiet Zone Risk Index (QZRI) is determined to be less than the Nationwide Significant Risk Threshold (NSRT). In this situation, no further improvements or upgrades are necessary at the crossings within the proposed quiet zone.
2. One of several FRA-approved Supplemental Safety Measures is installed at all of the crossings in the proposed quiet zone. This is Hanson's recommended way to establish a quiet zone.
3. One of several FRA Supplemental Safety Measures or Alternate Safety Measures are installed at some of the crossings in the proposed quiet zone to reduce the Quiet Zone Risk Index (QZRI) below the Nationwide Significant Risk Threshold (NSRT).
4. One of several FRA Supplemental Safety Measures or Alternate Safety Measures are installed at some of the crossings in the proposed quiet zone to reduce the Quiet Zone Risk Index (QZRI) below the Corridor Risk Index with horns.

The FRA has a Quiet Zone Calculator Tool on its Web site to assist communities in determining the existing Corridor Risk Index with horns and the proposed Quiet Zone Risk Index using various safety enhancement options and crossing upgrade scenarios.

What is the Quiet Zone Risk Index?
The Quiet Zone Risk Index (QZRI) is a measure of risk to the motoring public in the quiet zone and reflects the increased risk due to silencing of the train horn and the reduced risk due to the implementation of Supplemental Safety Measures or Alternate Safety Measures.

What is the Nationwide Significant Risk Threshold?
The Nationwide Significant Risk Threshold (NSRT) is a measure of risk that reflects the average nationwide level of risk at public grade crossings equipped with flashers and gates and where train horns are sounded.

What is the Corridor Risk Index with Horns?
The Corridor Risk Index with horns is a measure of risk to the motoring public and reflects the risk if the train horn was sounded at each grade crossing in the quiet zone.

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Once a Quiet Zone has been created, can its Quiet Zone Status be Lost?
It depends. A quiet zone can remain in effect, without FRA annual monitoring, if it was created by installing one of the approved Supplemental Safety Measures at each and every grade crossing in the proposed quiet zone. However, if the quiet zone was established by reducing the QZRI to below the NSRT, then the quiet zone will be subject to annual review by the FRA. The QZRI will increase if there are accidents at the crossings within the quiet zone. The NSRT also can fluctuate. If the annual FRA review determines that the QZRI is above the NSRT then the public authority will have to take additional steps, and may incur additional costs to lower the QZRI sufficiently to maintain the quiet zone. In addition, the FRA may review the status of a quiet zone at anytime.

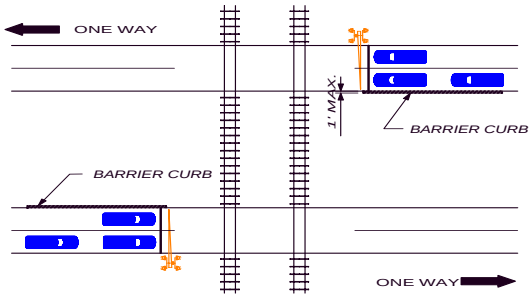
What are Supplemental Safety Measures?
A Supplemental Safety Measure (SSM) is a safety system that is provided by the public authority and determined by the FRA to be an effective substitute for the locomotive horn. The FRA Supplemental Safety Measures that will allow the silencing of the locomotive horn with the quiet zone include the following:

- Paired one-way streets with full closure gates,
- Median barriers in combination with two quadrant gates,
- Four quadrant gates,
- Permanent crossing closure, and
- Temporary crossing closure (during night hours).

Tell me more about Paired One-Way Streets.
The Paired One-Way Streets option involves full closure gates that completely block all approach lanes to the crossing. The gate arm, in the horizontal position, must extend across the road to within 1 foot of the far edge of pavement if one gate is used. In this situation, the edge of the road opposite the gate mechanism must have a barrier curb to prevent motorists from veering onto the shoulder and driving around the descended gate.

Paired One-Way Streets

Single Gate Option



If two gates are used, one on each side of the road as shown on this schematic, the ends

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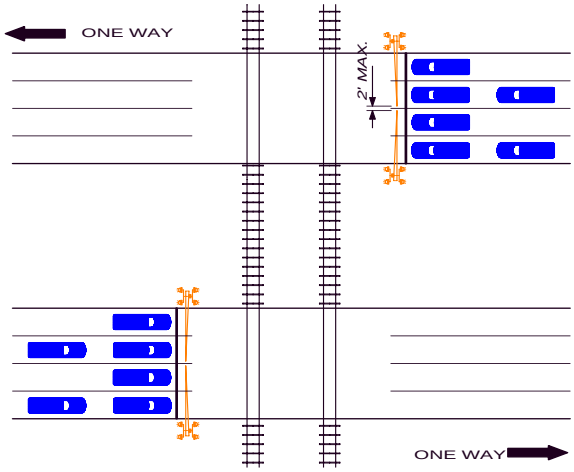
of the gate arms in the down position must leave a gap of no more than 2 feet from each other. The FRA also proposes that the Paired One-Way Street Option include constant warning time circuitry and signs alerting motorists that the train horn does not sound.

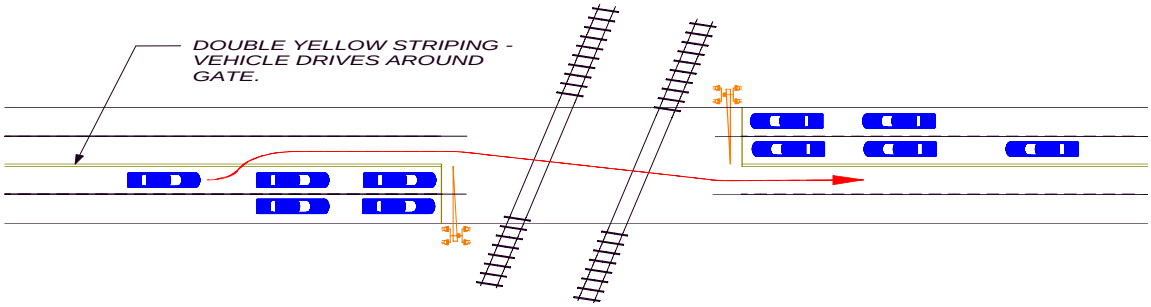
Paired One-Way Streets

Double Gate Option



Tell me more about Median Barriers.
Many grade crossing accidents occur when queued motorists pull out of their lane and attempt to drive around the lowered gates.

Without Median Barrier



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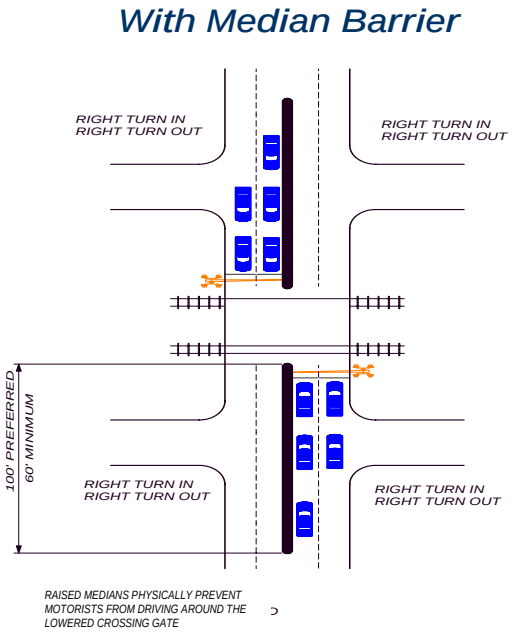
A "Channelization Device" or median barriers in combination with two quadrant gates are intended to constrain vehicles to wait in their lane until the train passes through the grade crossing. The line of median barriers begins at the end of the railroad gate when in its horizontal position, thus obstructing the gate runaround scenario. The FRA-recommended length of the line of median barriers is 100 feet, with 60 feet minimum. Therefore, median barriers will impact traffic maneuverability to and from business entrances or driveways if they are located in the near vicinity of the grade crossing. In order for median barriers to work, these entrances must be closed, relocated or converted to "right-in, right-out." Median barriers are relatively inexpensive as compared to other safety enhancement options.



This type of median barrier provides vehicular containment but allows emergency vehicles to drive over them and then spring back to the vertical position.

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Tell me more about Four Quadrant Gates.
Four quadrant gates are intended to completely block all road lanes on both sides of the tracks at the grade crossing and eliminate the gate runaround scenario. They are effective in preventing accidents by effectively sealing the crossing from vehicles. However, slow-moving vehicles could conceivably be trapped in the railroad zone after the gates descend. Vehicle Presence Detectors (VPD) are often installed that sense the presence of slow-moving vehicles to keep the "supplemental" exit gate arms in the vertical position until all vehicles have cleared the track crossing area. The FRA also requires that four quadrant gates include constant warning time circuitry and signs alerting motorists that the train horn does not sound. The cost for a four-quadrant gate system is relatively expensive compared with other SSM options. Furthermore, the railroads have issues regarding the additional maintenance costs, especially maintenance of the Vehicle Presence Detector system.

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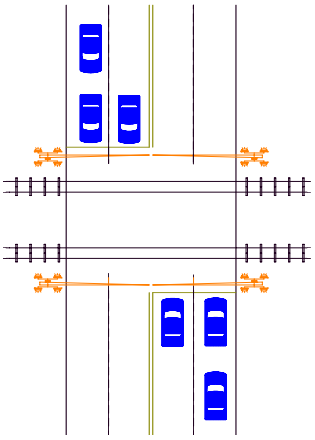
CROSSING WITH

FOUR QUADRANT GATES



Tell me more about Permanent Crossing Closure.
The grade crossing is permanently eliminated so that vehicles have to use other at-grade or grade-separated crossings.

Tell me more about Temporary Crossing Closure.
The temporary closing of the crossing during the same period every 24 hours will allow the locomotive engineer to silence the train horn during the period when the crossing is closed. When the crossing is physically closed by barriers, a relay automatically activates a "crossing closed" signal that confirms to the locomotive engineer that the crossing is closed. As long as the locomotive engineer can see the "crossing closed" confirmation signal, he will not be required to sound the train horn. This photo shows the locking gates and crossing closed signal used at a temporary closure crossing in Fort Leavenworth, Kansas. The Army is responsible for locking the gates at night. The trains are instructed to whistle unless they see the "crossing closed" confirmation signal activated. The confirmation signal does not require interconnection into the crossing signals or track wayside signals. This system was designed by *Railroads Controls Limited*.

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Temporary Crossing Closure

Fort Leavenworth, Kansas

Sound Level for a Motorist When Train is ¼ Mile From Crossing
Locomotive Horn vs Automated Train Horn

MOTORIST DISTANCE FROM CROSSING	LOCOMOTIVE HORN	AUTOMATED TRAIN HORN
50 FEET	78.0 dBA	98.9 dBA
100 FEET	73.6 dBA	93.7 dBA
200 FEET	75.0 dBA	84.9 dBA
300 FEET	67.8 dBA	79.5 dBA
400 FEET	64.0 dBA	73.7 dBA

What are Alternate Safety Measures?

Alternate Safety Measures (ASMs) are safety systems or procedures, other than Supplemental Safety Measures, that are provided by the public authority and after review and analysis by the FRA are determined to be an effective substitute for the locomotive horn. Examples of Alternate Safety Measures are:

- Supplemental Safety Measures that do not fully comply with the FRA requirements,
- Programmed law enforcement,

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- Public education and awareness, and
- Video enforcement.

Programmed law enforcement involves the ongoing measurable monitoring and traffic law enforcement of the crossings within the quiet zone.

Public education and awareness is directed at the vehicle drivers and pedestrians within the community to emphasize the risks associated with grade crossings.

Video enforcement involves the installation of video equipment at the grade crossing that monitors the vehicle traffic flow and records traffic violations. The surveillance system is intended to be constant but the camera only activates and records an event when a violation is detected. Although video enforcement may discourage motorists who may consider driving around the railroad gates, it cannot physically prevent accidents at crossings because it does not provide any complimentary protection to compensate for the elimination of the train horn warning, which is what Supplemental Safety Measures provide.

Video enforcement is an "after the fact" safety enhancement option. Public awareness efforts are therefore critical to the success of video enforcement. The public must be informed that violations will result in penalties. Although local driver responsibility may improve because of the awareness of video enforcement, "out of town" vehicle behavior may be at risk. There is also the concern that a judge may not accept video enforcement to convict errant drivers. Without court enforcement, this alternative would fail to provide the intended safety enhancement. It is also noted that video equipment requires continuous monitoring and ongoing maintenance by the road authority.

How do Automated Train Horns fit into the mix?
The FRA Interim Train Horn Rule allows Automated Train Horns (wayside horns) to be used as a one-for-one substitute for the train horn at individual or multiple at-grade crossings, including those within quiet zones. The wayside horn is a stationary horn located at a highway-rail grade crossing, designed to provide audible warning to oncoming motorists of a train's approach. The crossing must be equipped with flashing lights and gates. The FHWA has granted wayside horns with interim approval as traffic control devices.

Tell me more about Wayside Horns.
Wayside horns are mounted on poles at the crossing and emit a louder, longer and more consistent audible alarm than the conventional train horn when the train is ¼ mile from the crossing. The following table developed by Railroad Controls Limited, the manufacturer of the ATH equipment, illustrates the sound levels for a motorist at varying distances from a grade crossing when the train is ¼ mile from the crossing.

The wayside horn sound is directed right toward motorists and pedestrians on the roadway. Wayside horns typically provide a minimum of 25 to 30 seconds of audible

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warning. The FRA requires that wayside horns provide a minimum of 92 and maximum of 110 dBA when measured 100 feet from the horn in the direction it is installed. Wayside horns are designed to sound like a train horn.

The circuit control board, upon receipt of the signal from the railroad's signal house, cycles through the standard railroad whistle pattern of two long blasts and one short blast followed by another long blast. This pattern continues until the train reaches the crossing and then the wayside horns stop sounding. When the train activates the crossing signal system, the wayside horns are activated. The horn confirmation signal is activated if the speaker located in the horn detects the alarm sound at the required decibel level.

As long as the locomotive engineer can see the horn confirmation signal, he will not be required to sound the train horn unless he detects some type of emergency. If the locomotive engineer cannot see the horn confirmation signal at the crossing, he is instructed to sound the train horn.

The following photos show the automated train horns, horn confirmation signal and master controller mounted on the same pole.

Mundelein, IL

Img16.jpg

Route 70 Grade Crossing
Note automated train horn, horn confirmation signal and master controller mounted on the same pole.

Img15.jpg

Route 70 Grade Crossing
Automated train horns

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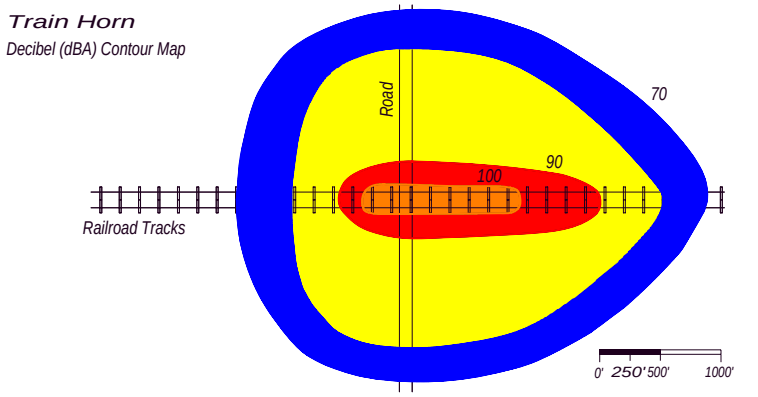
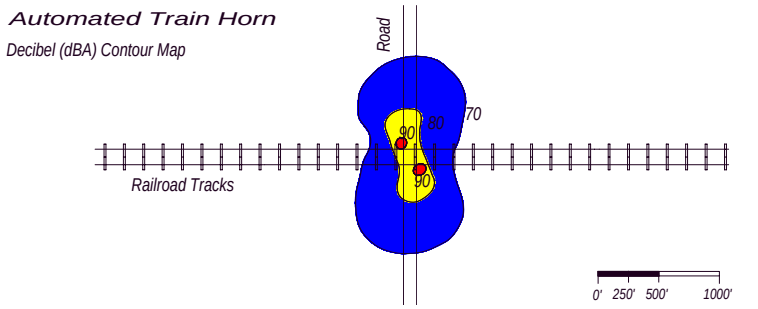
What is the Comparative Noise Footprint of the Conventional Locomotive Horn versus Wayside Horns?

It is estimated the noise from ATHs affect less than 10 percent of the area impacted by the noise from a conventional locomotive horn. The following schematics, developed by Railroad Controls Limited, indicate the comparative noise footprint of the area impacted by the sound of the conventional locomotive horn versus the ATH.





The noise intensity of wayside horns does not ramp up as the train approaches the crossing and the "Doppler Effect" of the conventional locomotive horn is missing. Therefore, the public is not able to conclude from which direction the train is approaching upon hearing the train alarm. However, safety experts acknowledge that often the public does not know from which direction the train is approaching with the conventional locomotive horn because either the vehicle windows are up, the car radio is on, or people are not paying that close of attention.

What other steps must the community take to achieve a quiet zone that satisfies the requirements of the FRA Rule?

The establishment of a quiet zone is not an "overnight" event. It may be an odyssey requiring careful strategy and perseverance followed by enormous quality of life rewards. A community wishing to create a quiet zone must judiciously evaluate and then select the optimal safety treatments that provide maximum benefit at minimum cost without compromising public safety at the grade crossings in the quiet zone. A field "Diagnostic Team Meeting" at the various crossings in the proposed quiet zone involving the

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appropriate agencies is also a typical step in the process. Grade crossing inventory forms also must be updated for submittal purposes. After the quiet zone "game plan" has been crafted, the FRA requires the community to prepare and distribute a Notice of Intent to Create a Quiet Zone to the appropriate agencies. After the grade crossing safety improvements have been installed, the FRA requires the community to prepare and distribute a Notice of Quiet Zone Establishment to the appropriate agencies. The requirements for these documents are found in the FRA Train Horn Rule.

Summary

The FRA has provided various safety enhancement options to silence or mitigate train horn noise. Each of these options will be more or less appropriate based on the unique situation in each specific community. Communities wishing to silence the train horn while maintaining grade crossing safety should understand the FRA Train Horn Rule and the quality of life and safety implications for both communities and railroads.

Communities should also understand the advantages and disadvantages of the various Supplemental Safety Measures and Wayside Horns for the specific crossing in their town. A community may benefit from having an engineering consultant experienced with railroad crossing safety and the FRA Quiet Zone Rule to analyze the various grade crossings in their town, perform a cost-benefit analysis and recommend the optimal arrangement of FRA-approved safety options that will achieve train horn relief, without compromising grade crossing safety, based on the town's objectives, priorities and budget. The engineering consultant should also be able to:

- Represent the community during the Diagnostic Team Meeting process,
- Navigate the project through the regulatory approval process including Notice of Intent and Notice of Quiet Zone Establishment preparation and submittals,
- Prepare design drawings and specifications for construction purposes, and
- Provide construction support services to ensure that the safety options are properly installed.

About the Author

John P. Redden, P.E., is a senior railroad engineer at Hanson Professional Services Inc. in Kansas City, Missouri. Redden spent 19 years in the Design and Construction Department of Conrail in Philadelphia, where he served in the Civil Engineering and Public Improvements offices. He is a member of the American Railway Engineering and Maintenance-of-Way Association and participates in Committee 1, Roadway and Ballast. He can be reached at (816) 941-2178 or at jredden@hanson-inc.com.

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