



23 CFR 772 Streamlining, Analysis, and Outreach

Task 3

Examination of Noise Abatement Feasibility and Reasonableness Factors Permitted under 23 CFR 772

Presenter:

Darlene Reiter, Ph.D., P.E.
Senior Engineer
Bowlby & Associates, Inc.
Franklin, TN

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■ Purpose

- To examine the feasibility and reasonableness factors in 23 CFR 772 as implemented in the individual SHA noise policies individually and in combination with each other to identify optimized combinations of values.

■ Study Approach

- Examined SHA policies
- Qualitatively examined factors singularly and in combination
- Performed sensitivity analysis of combinations of reasonableness factors on hypothetical cases
- Tested factor combinations on four actual highway projects



Feasibility and Reasonableness Factors Studied

■ Feasibility

- **Feasibility Noise Reduction:** A noise reduction of at least 5 dB that must be achieved for a noise abatement measure to be feasible.
- **Feasibility Quantity:** The minimum number or percentage of impacted receptors that must achieve the feasibility noise reduction.

■ Reasonableness

- **Benefited Noise Reduction:** The minimum noise reduction for a receptor to be counted as benefited by a noise abatement measure.
- **Noise Reduction Design Goal (NRDG):** The noise reduction that must be achieved for a noise abatement measure to be reasonable.
- **NRDG Quantity:** The minimum number or percentage of benefited receptors that must achieve the NRDG.
- **Cost Effectiveness (CE):** The allowable cost per benefited receptor (CPBR) or the allowable barrier area per benefitted receptor (APBR).



Feasibility Reduction Design Goal and Quantity

Table 1: Combinations of Feasibility Quantity and Feasibility Noise Reduction³

Feasibility Quantity (Number or Percent of Impacted Receptors)	Number of SHAs by Feasibility Reduction
	5 dB
1	13
2	1
3	1
40%	1
50% of first-row impacted	3
50%	5
>50% of first-row impacted	3
>50%	10
60% of first-row impacted	2
67% of first-row impacted	2
67%	1
70%	1
75% of first-row impacted	4
75%	2
80% of first-row impacted	1
80% of first-row and 67% of all impacted	1
80%	1



Feasibility Reduction Design Goal and Quantity

- **Feasibility Generally Achievable**
 - Not very sensitive to changes in noise reduction or quantity factors
- **Feasibility Quantity**
 - two or more is an effective screen on the need to analyze abatement for isolated impacts
- **Is acoustic feasibility needed?**



Noise Reduction Design Goal and Quantity

Table 4: Combinations of NRDG and NRDG Quantity

NRDG Quantity (Number or Percent of Benefited Receptors)	Number of SHAs by NRDG			
	7 dB	8 dB	9 dB	10 dB
1	14 ¹	2 ²	2 ³	1
1 first-row	3 ⁴	--	--	1
1 at 10 dB and 50% of all at 7 dB	--	--	--	1 ⁵
10%	2	--	--	--
10% of first-row benefited	1	--	--	--
25%	1	--	1 ⁶	--
40% of first-row benefited	1	--	--	--
40%	2	--	--	--
50% of first-row benefited	3	--	--	--
50%	4 ⁵	--	--	1
>50% of first-row benefited	1	--	--	--
>50%	3	--	--	1
60% of first-row benefited	2	--	--	--
65%	--	--	--	1
67% of first-row benefited	1	--	--	--
67%	1	--	--	--
75% of first-row benefited	2	1	--	--
80% of first-row benefited	--	--	--	1
80%	--	1	--	--

¹ VDOT's policy says one *impacted* receptor.

² Illinois DOT's policy says one and as many others while staying within CE criterion.

³ AHTD's policy says 9 dB at 1 *impacted* receptor.

⁴ Idaho DOT's policy says at the one receptor that is closest to the road centerline.

⁵ MDOT's policy says 10 dB at one benefited receptor and 7 dB at 50% of all benefited receptors.

⁶ DelDOT's policy says 25% of *impacted* receptors.



Noise Reduction Design Goal and Quantity

- Issues using all benefited residences versus
 - first-row benefited
 - impacted
 - first-row Impacted



NRDG	Number of Benefited Residences	Number of Benefited Residences Receiving Noise Reduction	Percentage of Benefited Residences Receiving Noise Reduction	NRDG Met?
<i>Neighborhood as shown on aerial photograph</i>				
7 dB at one benefited residence	115	40	n/a	Yes
7 dB at 60% or more of <i>first-row</i> benefited residences	115	40	35%	Yes
8 dB at 80% or more of <i>all</i> benefited residences	115	40	35%	No
<i>Hypothetical first-row only (2nd and 3rd rows do not exist)</i>				
7 dB at one benefited residence	39	39	n/a	Yes
7 dB at 60% or more of <i>first-row</i> benefited residences	39	39	100%	Yes
8 dB at 80% or more of <i>all</i> benefited residences	39	33	85%	Yes



- **Generally Achievable**
 - Any percentage (even high) of first-row benefited receptors
 - low percentage of all benefited receptors
- **Sometimes Achievable**
 - mid-range percentages of all benefited receptors
- **Rarely Achievable**
 - high percentages (> 50%) of all benefited receptors
- **Use of first-row or impacted receptors might be more appropriate for NRDG**



Is the NRDG a goal or a minimum?

- **Example: NRDG of 7 dB at one benefited receptor**
 - Issues:
 - What receptor(s) receives 7 dB?
 - residence with the highest sound level
 - closest receiver
 - “letter” of the regulation
 - Designs should consider the number and locations of impacts.
 - Whether designs provide adequate noise reduction depends on the SHAs design philosophy and not the NRDG
 - “Minimum Noise Reduction Criterion” may be better term

- **Future FHWA Guidance possible**



Cost Per Benefited Residence and Units Costs

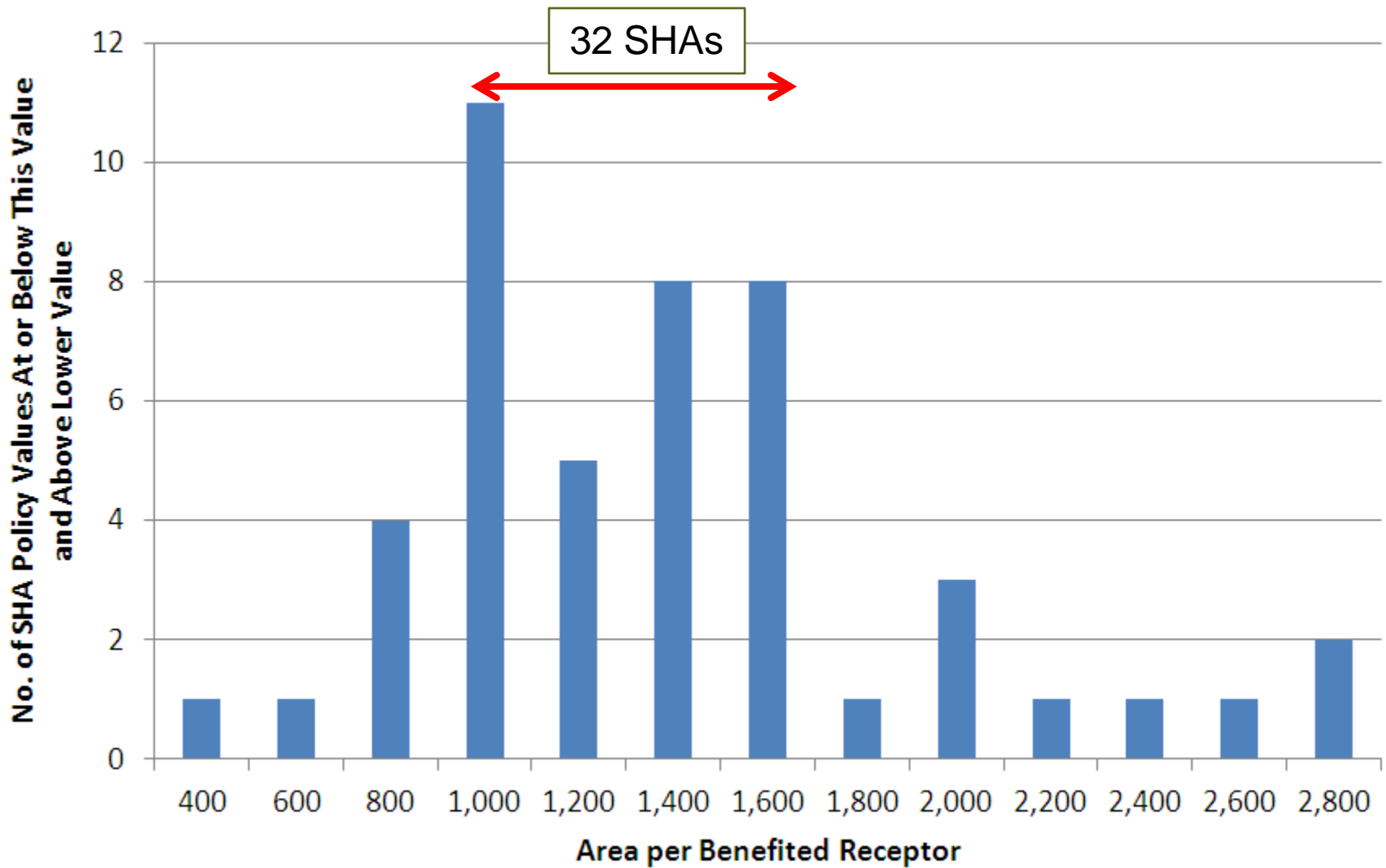
- **Wide ranges in values**
 - Cost per Benefited Residence
 - \$20,000 to \$60,000
 - Unit Costs
 - \$18/sf to \$70/sf
 - Area per Benefited Residence
 - Six states
 - 750 sf to 2,700 sf

- **Normalized all CPBRs to APBRs**

CPBR: Cost in Dollars per Benefited Receptor
\$20,000
\$21,000
\$23,000
\$24,000 base, \$37,000 maximum
\$24,250 base, \$48,250 maximum
\$25,000
\$25,000 (residences post-date highway) / \$30,000 (residences pre-date)
\$30,000
\$30,000/\$37,500 (51% prior)
\$30,000/\$40,000 (severe impacts)
\$31,000
\$32,000
\$35,000
\$36,000
\$36,127 base / \$71,222 maximum (or 780 – 1380 SF)
\$40,000
\$42,509
\$42,244
\$43,500
\$45,000 or 1,500 SF
\$49,000
\$50,000/\$55,000 (severe impacts)
\$55,000
\$60,000



Normalized Area Per Benefited Residence



■ Issues with Cost per Benefited Residence

- Costs to include
- Type I versus Type II
- Economies of scale
- Variation in bid costs
- Type I projects awarded on the low bid for the entire project
- Inflation
- Cost variation based on geographical areas

■ Benefits of Area per Benefited Residence

- Eliminates issues with costs
- Consistent decisions based on characteristics of the community and the noise environment

■ APBRs below 1,400-1,500 may be too low



- Two tools developed to evaluate the effects of policy changes on the feasibility and reasonableness of noise abatement.

Noise Abatement Feasibility and Reasonableness Analysis Tool (NAFRAT)

- Worksheet with SHA feasibility and reasonableness criteria
- Individual case worksheets: Two designs from each of four real-world highway projects
- Individual case worksheets: 80 worksheets where TNM Sound Levels results tables for barrier designs can be pasted



Noise Abatement Reasonableness Sensitivity Analysis Tool (NARSAT)

- 108 cases derived from a set of hypothetical scenarios
 - One, two and three rows of receptors
 - Three different receptor densities
 - Two different setbacks from the barrier to the first row of receptors
 - Six different barrier heights

