

Noise Barrier Cost Reporting and Documentation

**Presentation by:
Harvey S. Knauer, P.E.
Environmental Acoustics, Inc.**

**TRB ADC40 Summer Meeting
Dayton, Ohio
July 29, 2009**

Purpose

To suggest a process for documenting and reporting the costs of a noise barrier:

- **During environmental evaluation & engineering design phases**
- **After construction of a noise barrier**

Note: While this presentation focuses on noise *barriers*, it could also be adapted to other types of noise abatement systems, including noise berms, combination barrier systems, and quiet pavement applications.

Noise Barrier Costs - “The 4 R’s”

- **R**easonableness Determination
- **R**eal Cost of Noise Barrier
- **R**eactions and Responses

Reasonableness Determination

- Usually applied during environmental process and design phases
- Statewide averages for in-place barrier cost (\$/sf) and cost per benefited receptor unit often utilized to account for factors such as:
 - Environmental justice issues
 - Variations in geographic areas
 - Union versus non-union labor forces
- Surface area often calculated from finished grade line to acoustical profile line
- May treat Type I and Type II differently
- May account for additional barrier-related costs

Real Cost of Noise Barrier

- Usually not known until project is bid or completed
- Influenced by a variety of factors, such as:
 - Panel type (full height. vs. stacked; reflective vs. absorptive; proprietary vs. non-proprietary)
 - Post spacing
 - Quantity of scale – large versus small projects
 - Front-end cost loading to establish cash flow (multiple bid analysis)
 - Life cycle cost
 - Type I versus Type II projects
 - Union versus non-union labor markets

Real Cost of Noise Barrier (cont.)

- **Can be calculated based on more detailed information such as:**
 - **Actual panel area produced**
 - **Number or linear feet of posts**
 - **Attachment material costs**
 - **Joint sealing materials**
 - **Anti-graffiti coatings**
 - **Transportation costs**
 - **Site preparation costs**
 - **Barrier component erection costs**
 - **Additional barrier-associated ROW and utility costs**

Reactions and Responses

- **Reactions** of States and organizations toward noise barriers may influence how barrier cost and reasonableness criteria are established.
- **Responses** in the form of policies may dictate what items are or are not included in barrier cost and reasonableness calculations.

Reactions and Responses (cont.)

- **Organizations often respond by developing standard noise barrier drawings. Such standard drawings may preclude more innovative, and possibly more cost effective, designs. In some instances, performance-based specifications may foster better barrier designs.**
- **Founded and unfounded perceptions exist related to factors such as:**
 - **Costs for aesthetics**
 - **Panel designs (stacked, full-height)**
 - **Reflective versus absorptive barriers**
 - **Proprietary versus non-proprietary barriers**

The Problem

- **Given the above presented factors associated with noise barrier costs and reporting processes, it is difficult to establish valid comparisons and make “apples to apples” comparisons.**
- **The problem may exist on an intrastate as well as an interstate basis**

A Solution

- **Establish a uniform cost-reporting process within each State/organization/agency that would:**
 - **Document all factors included and not included in the reported cost of a noise barrier**
 - **Account for factors unique to a particular noise barrier or barrier project**
 - **Enable apples-to-apples comparisons of selected noise barrier components/items/factors**

A Solution (cont.)

- **Provide a tool for comparing noise barrier costs with those of other States, even if States use factors differently in establishing noise barrier costs**
- **Assist FHWA in national noise cost reporting efforts**

Spreadsheets

For Projects in Environmental Analysis and Design Phases

For Projects in Construction Phase or for Completed Projects

NOISE BARRIER COST DOCUMENTATION FOR FEASIBILITY AND DESIGN PHASES						
PROJECT INFORMATION						
PROJECT CLASSIFICATION	PROJECT CLASSIFICATION (Optional, Type 1, 2, Type III, Other) (See BARRIER TYPE cost appropriate type with an "X") (Ground-Mounted, (1) On Bridge, (2) On Retaining Wall, (3) OTHER, (4) BARRIER PROJECT (5) cost appropriate type with an "X") (Both Side, No Barrier, (1) Both Side Absorptive, (2) One Side Absorptive, One Side Absorptive, (3) Other, (4) PROPERLY BARRIER' cost with an "X") (1) No (2) Yes (3) No (4) Yes, indicate type here.					
PROPERLY BARRIER' cost with an "X") (1) No (2) Yes (3) No (4) Yes, indicate type here.	COSTS IN DOLLARS (\$), unless otherwise noted.					
NOISE ANALYSIS/ACCOUSTICAL DATA						
Receptor ID	Residential Units Represented by Receptor	Existing Noise Level (Leq/d)	Future Noise Levels Without a Barrier (Leq/d)	Barrier Length (ft)	Barrier Height (ft)	Average Barrier Height (ft)
RECEIVER 1	1	63	64			
RECEIVER 2	2	62	63			
RECEIVER 3	3	61	62			
RECEIVER 4	4	60	61			
RECEIVER 5	5	59	60			
RECEIVER 6	6	58	59			
RECEIVER 7	7	57	58			
RECEIVER 8	8	56	57			
RECEIVER 9	9	55	56			
RECEIVER 10	10	54	55			
RECEIVER 11	11	53	54			
RECEIVER 12	12	52	53			
RECEIVER 13	13	51	52			
RECEIVER 14	14	50	51			
RECEIVER 15	15	49	50			
RECEIVER 16	16	48	49			
RECEIVER 17	17	47	48			
RECEIVER 18	18	46	47			
RECEIVER 19	19	45	46			
RECEIVER 20	20	44	45			
RECEIVER 21	21	43	44			
RECEIVER 22	22	42	43			
RECEIVER 23	23	41	42			
RECEIVER 24	24	40	41			
RECEIVER 25	25	39	40			
RECEIVER 26	26	38	39			
RECEIVER 27	27	37	38			
RECEIVER 28	28	36	37			
RECEIVER 29	29	35	36			
RECEIVER 30	30	34	35			
RECEIVER 31	31	33	34			
RECEIVER 32	32	32	33			
RECEIVER 33	33	31	32			
RECEIVER 34	34	30	31			
RECEIVER 35	35	29	30			
RECEIVER 36	36	28	29			
RECEIVER 37	37	27	28			
RECEIVER 38	38	26	27			
RECEIVER 39	39	25	26			
RECEIVER 40	40	24	25			
RECEIVER 41	41	23	24			
RECEIVER 42	42	22	23			
RECEIVER 43	43	21	22			
RECEIVER 44	44	20	21			
RECEIVER 45	45	19	20			
RECEIVER 46	46	18	19			
RECEIVER 47	47	17	18			
RECEIVER 48	48	16	17			
RECEIVER 49	49	15	16			
RECEIVER 50	50	14	15			
RECEIVER 51	51	13	14			
RECEIVER 52	52	12	13			
RECEIVER 53	53	11	12			
RECEIVER 54	54	10	11			
RECEIVER 55	55	9	10			
RECEIVER 56	56	8	9			
RECEIVER 57	57	7	8			
RECEIVER 58	58	6	7			
RECEIVER 59	59	5	6			
RECEIVER 60	60	4	5			
RECEIVER 61	61	3	4			
RECEIVER 62	62	2	3			
RECEIVER 63	63	1	2			
RECEIVER 64	64	0	1			
RECEIVER 65	65	0	0			
RECEIVER 66	66	0	0			
RECEIVER 67	67	0	0			
RECEIVER 68	68	0	0			
RECEIVER 69	69	0	0			
RECEIVER 70	70	0	0			
RECEIVER 71	71	0	0			
RECEIVER 72	72	0	0			
RECEIVER 73	73	0	0			
RECEIVER 74	74	0	0			
RECEIVER 75	75	0	0			
RECEIVER 76	76	0	0			
RECEIVER 77	77	0	0			
RECEIVER 78	78	0	0			
RECEIVER 79	79	0	0			
RECEIVER 80	80	0	0			
RECEIVER 81	81	0	0			
RECEIVER 82	82	0	0			
RECEIVER 83	83	0	0			
RECEIVER 84	84	0	0			
RECEIVER 85	85	0	0			
RECEIVER 86	86	0	0			
RECEIVER 87	87	0	0			
RECEIVER 88	88	0	0			
RECEIVER 89	89	0	0			
RECEIVER 90	90	0	0			
RECEIVER 91	91	0	0			
RECEIVER 92	92	0	0			
RECEIVER 93	93	0	0			
RECEIVER 94	94	0	0			
RECEIVER 95	95	0	0			
RECEIVER 96	96	0	0			
RECEIVER 97	97	0	0			
RECEIVER 98	98	0	0			
RECEIVER 99	99	0	0			
RECEIVER 100	100	0	0			

NOISE BARRIER COST DOCUMENTATION FOR PROJECTS IN CONSTRUCTION PHASE OR COMPLETED PROJECTS						
PROJECT TYPE AND LOCATION DATA						
PROJECT CLASSIFICATION (Optional, Type 1, 2, Type III, Other) (See BARRIER TYPE cost appropriate type with an "X") (Ground-Mounted, (1) On Bridge, (2) On Retaining Wall, (3) OTHER, (4) BARRIER PROJECT (5) cost appropriate type with an "X") (Both Side, No Barrier, (1) Both Side Absorptive, (2) One Side Absorptive, One Side Absorptive, (3) Other, (4) PROPERLY BARRIER' cost with an "X") (1) No (2) Yes (3) No (4) Yes, indicate type here.						
COSTS IN DOLLARS (\$), unless otherwise noted.						
NOISE ANALYSIS/ACCOUSTICAL DATA						
Receptor ID	Residential Units Represented by Receptor	Existing Noise Level (Leq/d)	Future Noise Levels Without a Barrier (Leq/d)	Barrier Length (ft)	Barrier Height (ft)	Average Barrier Height (ft)
RECEIVER 1	1	63	64			
RECEIVER 2	2	62	63			
RECEIVER 3	3	61	62			
RECEIVER 4	4	60	61			
RECEIVER 5	5	59	60			
RECEIVER 6	6	58	59			
RECEIVER 7	7	57	58			
RECEIVER 8	8	56	57			
RECEIVER 9	9	55	56			
RECEIVER 10	10	54	55			
RECEIVER 11	11	53	54			
RECEIVER 12	12	52	53			
RECEIVER 13	13	51	52			
RECEIVER 14	14	50	51			
RECEIVER 15	15	49	50			
RECEIVER 16	16	48	49			
RECEIVER 17	17	47	48			
RECEIVER 18	18	46	47			
RECEIVER 19	19	45	46			
RECEIVER 20	20	44	45			
RECEIVER 21	21	43	44			
RECEIVER 22	22	42	43			
RECEIVER 23	23	41	42			
RECEIVER 24	24	40	41			
RECEIVER 25	25	39	40			
RECEIVER 26	26	38	39			
RECEIVER 27	27	37	38			
RECEIVER 28	28	36	37			
RECEIVER 29	29	35	36			
RECEIVER 30	30	34	35			
RECEIVER 31	31	33	34			
RECEIVER 32	32	32	33			
RECEIVER 33	33	31	32			
RECEIVER 34	34	30	31			
RECEIVER 35	35	29	30			
RECEIVER 36	36	28	29			
RECEIVER 37	37	27	28			
RECEIVER 38	38	26	27			
RECEIVER 39	39	25	26			
RECEIVER 40	40	24	25			
RECEIVER 41	41	23	24			
RECEIVER 42	42	22	23			
RECEIVER 43	43	21	22			
RECEIVER 44	44	20	21			
RECEIVER 45	45	19	20			
RECEIVER 46	46	18	19			
RECEIVER 47	47	17	18			
RECEIVER 48	48	16	17			
RECEIVER 49	49	15	16			
RECEIVER 50	50	14	15			
RECEIVER 51	51	13	14			
RECEIVER 52	52	12	13			
RECEIVER 53	53	11	12			
RECEIVER 54	54	10	11			
RECEIVER 55	55	9	10			
RECEIVER 56	56	8	9			
RECEIVER 57	57	7	8			
RECEIVER 58	58	6	7			
RECEIVER 59	59	5	6			
RECEIVER 60	60	4	5			
RECEIVER 61	61	3	4			
RECEIVER 62	62	2	3			
RECEIVER 63	63	1	2			
RECEIVER 64	64	0	1			
RECEIVER 65	65	0	0			
RECEIVER 66	66	0	0			
RECEIVER 67	67	0	0			
RECEIVER 68	68	0	0			
RECEIVER 69	69	0	0			
RECEIVER 70	70	0	0			
RECEIVER 71	71	0	0			
RECEIVER 72	72	0	0			
RECEIVER 73	73	0	0			
RECEIVER 74	74	0	0			
RECEIVER 75	75	0	0			
RECEIVER 76	76	0	0			
RECEIVER 77	77	0	0			
RECEIVER 78	78	0	0			
RECEIVER 79	79	0	0			
RECEIVER 80	80	0	0			
RECEIVER 81	81	0	0			
RECEIVER 82	82	0	0			
RECEIVER 83	83	0	0			
RECEIVER 84	84	0	0			
RECEIVER 85	85	0	0			
RECEIVER 86	86	0	0			
RECEIVER 87	87	0	0			
RECEIVER 88	88	0	0			
RECEIVER 89	89	0	0			
RECEIVER 90	90	0	0			
RECEIVER 91	91	0	0			
RECEIVER 92	92	0	0			
RECEIVER 93	93	0	0			
RECEIVER 94	94	0	0			
RECEIVER 95	95	0	0			
RECEIVER 96	96	0	0			
RECEIVER 97	97	0	0			
RECEIVER 98	98	0	0			
RECEIVER 99	99	0	0			
RECEIVER 100	100	0	0			

Spreadsheets Document

- **Project Type and Location Data**
- **Noise Analysis Acoustical Data**
- **Barrier Cost and Physical Data**

For Projects in Environmental Analysis and Design Phases

**NOISE BARRIER COST DOCUMENTATION
FOR
FEASIBILITY AND REASONABLENESS DETERMINATIONS DURING ENVIRONMENTAL AND DESIGN PHASES**

PROJECT INFORMATION		PROJECT CLASSIFICATION (check) Type I () ; Type II () ; Other () List	
BARRIER ID/STATION:		BARRIER TYPE (mark appropriate type with an "x") : Ground-Mounted () ; On Bridge () ; On Retaining Wall () ; Other () List	
BARRIER SUBEACES (mark appropriate type with an "x") : Both Sides Reflective () ; Both Sides Absorptive () ; One Side Reflective, One Side Absorptive () ; Other () List		PROPRIETARY BARRIER? (mark with an "x") : Yes () ; No () ; If Yes, indicate type here	
COSTS IN 20xx DOLLARS (fill in appropriate year)		YEAR OF CONSTRUCTION COMPLETION: List if applicable	

NOISE ANALYSIS ACOUSTICAL DATA					Barrier Options			
Receptor ID.	Residential Units Represented by Receptor	Existing Noise Levels Leq(h)	Future Noise Levels Without a Barrier Leq(h)	Build 2030 Increase Over Existing Noise Levels (Without a Barrier) Leq(h)	Option 1		Option 2	
					Abated Noise Level Leq(h)	Insertion Loss Leq(h)	Abated Noise Level Leq(h)	Insertion Loss Leq(h)
Receiver 1	1	63	64	1	56	8	58	6
Receiver 2	1	61	62	1	55	8	58	5
Receiver 3	2	62	63	1	56	7	58	6
Receiver 4	6	68	69	1	61	9	59	10
Receiver 5	6	69	70	1	63	7	61	10
Receiver 6	6	70	71	1	65	6	62	9
Line-of-Sight Broken for All or Most Impacted Receptors?					Yes, LOS break for all receptors		Yes, for first floor of impacted residential units.	
Total Barrier Length (ft)					1399		1322	
Barrier Height Range (ft)					10-20		8-18	
Average Barrier Height (ft)					14.17		15.77	
PHWA TNM File					Orig Bar Rev HSK 6.7.09 - LOS All Sites		Smoothed Bar HSK 6.7.09	
Exist HSK 6.7.09					Fut No Bar HSK 6.7.09		Not feasible due to conflicts with utility pole access	
							Recommended Barrier	

All noise levels and insertion loss values are in dBA and represent exterior noise levels
 All values calculated to length of a dBA and then rounded
 Shaded values in table indicate future first floor exterior conditions with noise levels ≥ 66 dBA or with substantial increases over existing levels
 Shaded values in Insertion Loss columns indicate a benefit per XXDOT criteria

RECOMMENDED BARRIER COST AND PHYSICAL DATA				
ITEM	VALUE*	SOURCE	MARK (or fill in "x") IF COST IS INCLUDED IN ITEM F VALUE**	NOTES
A	Length of Barrier (feet)	1,322	PHWA TNM Run HSK	
B	Height Range (feet)	8-18	PHWA TNM Run HSK	
C	Average Barrier Height (feet)	15.77	PHWA TNM Run HSK	1
D	Surface Area of Barrier (sq. ft.)	20,848	PHWA TNM Run HSK	
E	State/Organization Barrier Value (cont/eq. ft.)	\$25.00	PHWA TNM Run HSK	
F	Barrier Cost Sub-Total	\$821,199	PHWA TNM Run HSK	2
Additional Costs Related to This Barrier Only				
G	Foundation Costs	\$0	List type (in on cut slab, caisson, Jersey barrier, retaining wall, etc.)	
H	Barrier Design Costs	\$10,000	List source	
I	Additional Right-of-Way Costs	\$20,000	List source	
J	Additional Utility Costs	\$25,000	List source	
K	Acoustic Treatment (sq. ft.)	\$0,000	Indicate type and whether one or both sides are coated	
	Acoustic Treatment (cont/sq. ft.)	\$2.00	List source	
L	Acoustic Treatment Cost	\$0,000		
	Surface or Anti-Graffiti Coating (sq. ft.)	\$0,000	Indicate type and whether one or both sides are coated	
M	Surface or Anti-Graffiti Coating (cont/sq. ft.)	\$1.00	List source	
	Surface or Anti-Graffiti Coating Cost	\$0,000		
N	Noise Barrier Protection Costs	\$0	List type (Jersey barrier, guardrail, etc.)	
O	Other Costs	\$0	List type	
TOTAL BARRIER COST		\$809,199		
TOTAL BARRIER COST/SQUARE FOOT		\$31.96		

NOTES:
 * Values in table are for illustrative purposes only.
 ** Do not mark shaded blocks.
 1. For ground-mounted barrier, suggest using height from finished grade at base of barrier to acoustical profile line; for structures mounted barrier, indicate base location and how costs for supporting structures are incorporated.
 2. Indicate Type I or Type II cost if applicable.

Source: Environmental Acoustics, Inc.

PROJECT TYPE AND LOCATION DATA

PROJECT INFORMATION:

BARRIER I.D./STATION: **PROJECT CLASSIFICATION (check) Type I (); Type II (); Other () List**

BARRIER TYPE (mark appropriate type with an "x"): Ground-Mounted (); On Bridge (); On Retaining Wall (); Other () List

BARRIER SURFACES (mark appropriate type with an "x"): Both Sides Reflective (); Both Sides Absorptive (); One Side Reflective, One Side Absorptive(); Other () List

PROPRIETARY BARRIER? (mark with an "x"): Yes (); No (). If Yes, indicate type here

COSTS IN 20xx DOLLARS (fill in appropriate year)

YEAR OF CONSTRUCTION COMPLETION: List if applicable

NOISE ANALYSIS ACOUSTICAL DATA

Receptor I.D.	Residential Units Represented by Receptor	Existing Noise Levels Leq(h)	Future Noise Levels Without a Barrier Leq(h)	Build 2030 Increase Over Existing Noise Levels (Without a Barrier) Leq(h)	Barrier Options			
					Option 1		Option 2	
					Abated Noise Level Leq(h)	Insertion Loss Leq(h)	Abated Noise Level Leq(h)	Insertion Loss Leq(h)
Receiver 1	1	63	64	1	56	8	58	6
Receiver 2	1	61	62	1	55	8	58	5
Receiver 3	2	62	63	1	56	7	58	6
Receiver 4	6	68	69	1	61	9	59	10
Receiver 5	6	69	70	1	63	7	61	10
Receiver 6	6	70	71	1	65	6	62	9

Line-of-Sight Broken for All or Most Impacted Receptors?	Yes, LOS break for all receptors	Yes, for first floor of impacted residential units
--	----------------------------------	--

Total Barrier Length (ft)	1399	1322
Barrier Height Range (ft)	10-20	8-18
Average Barrier Height (ft)	14.17	15.77

FHWA TNM File			
Exist HSK 6.7.09	Fut No Bar HSK 6.7.09		Orig Bar Rev HSK 6.7.09 - LOS All Sites Barrier Analysis
			Smoothed Bar HSK 6.7.09
			Not feasible due to conflicts with utility pole access
			Recommended Barrier

RECOMMENDED BARRIER COST AND PHYSICAL DATA

ITEM		VALUE*	SOURCE	MARK (with an "x") IF COST IS INCLUDED IN ITEM F VALUE**	NOTES	
A	Length of Barrier (feet)	1,322	FHWA TNM Run ID#			
			List other source (Report table, spreadsheet, plan, etc.)			
B	Height Range (feet)	8-18	FHWA TNM Run ID#			
			List other source (Report table, spreadsheet, plan, etc.)			
C	Average Barrier Height (feet)	15.77	FHWA TNM Run ID#			1
			List other source (Report table, spreadsheet, plan, etc.)			
D	Surface Area of Barrier (sq. ft.)	20,848	FHWA TNM Run ID#			
			List other source (Report table, spreadsheet, plan, etc.)			
E	State/Organization Barrier Value (cost/sq. ft.)	\$25.00	List source			2
F	Barrier Cost Sub-Total	\$521,199				
	Additional Costs Related to This Barrier Only					
G	Foundation Costs	\$0	List type (moment slab, caisson, Jersey barrier, retaining wall, etc.)			
H	Barrier Design Costs	\$10,000	List source			
I	Additional Right-of-Way Costs	\$20,000	List source			
J	Additional Utility Costs	\$25,000	List source			
K	Aesthetic Treatment (sq. ft.)	30,000	Indicate type and whether one or both sides are coated			
	Aesthetic Treatment (cost/sq. ft.)	\$2.00	List source			
	Aesthetic Treatment Cost	\$60,000				
L	Surface or Anti-Graffiti Coating (sq. ft.)	30,000	Indicate type and whether one or both sides are coated			
	Surface or Anti-Graffiti Coating (cost/sq. ft.)	\$1.00	List source			
	Surface or Anti-Graffiti Coating Cost	\$30,000				
M	Noise Barrier Protection Costs	\$0	List type (Jersey barrier, guardrail, etc.)			
N	Other Cost	\$0	List type			
	TOTAL BARRIER COST	\$666,199				

**For Projects in Construction
Phase
or for Completed Projects**

**NOISE BARRIER COST DOCUMENTATION
FOR
PROJECTS IN CONSTRUCTION PHASE OR COMPLETED PROJECTS**

PROJECT INFORMATION:
BARRIER ID/STATION: PROJECT CLASSIFICATION (check) Type I () ; Type II () ; Other () *List*
BARRIER TYPE (mark appropriate type with an "x") : Ground-Mounted () ; On Bridge () ; On Retaining Wall () ; Other () *List*
BARRIER SURFACES (mark appropriate type with an "x") : Both Sides Reflective () ; Both Sides Absorptive () ; One Side Reflective, One Side Absorptive () ; Other ()
PROPRIETARY BARRIER? (mark with an "X") : Yes () ; No () ; If Yes, indicate type here
COSTS IN 20xx DOLLARS (fill in appropriate year) YEAR OF CONSTRUCTION COMPLETION: *List if applicable*

NOISE ANALYSIS ACOUSTICAL DATA							
Receptor I.D.	Residential Units Represented by Receptor	Existing Noise Levels Leq(dB)	Future Noise Levels Without a Barrier Leq(dB)		Build 2030 Increase Over Existing Noise Levels (Without a Barrier) Leq(dB)	Constructed Barrier	
						Abated Noise Level Leq(dB)	Insertion Loss Leq(dB)
Receiver 1	1	63		64	1	58	6
Receiver 2	1	61		62	1	58	5
Receiver 3	2	62		63	1	58	6
Receiver 4	6	68		69	1	59	10
Receiver 5	6	69		70	1	61	10
Receiver 6	6	70		71	1	62	9
Line-of-Sight Broken for All or Most Impacted Receptors?						Yes, for first floor of impacted residential units	
Total Barrier Length (ft)						1375	
Barrier Height Range (ft)						8.2 to 18.1	
Average Barrier Height (ft)						16.27	
FHWA TNM File							
Exist HSK			Put No Bar HSK			Constructed Bar HSK	
6.7,09			6.7,09			6.7,12	

All noise levels and insertion loss values are in dBA and represent exterior noise levels
 All values calculated to tenth of a dBA and then rounded
 Shaded values in table indicate future first floor exterior conditions with noise levels ≥ 66 dBA or with substantial increases over existing levels
 Shaded values in Insertion Loss columns indicate a benefit per NADOT criteria

CONSTRUCTED BARRIER COST AND PHYSICAL DATA			
ITEM			
A	Length of Barrier (feet)	1,375	List source (PS&E documentation, bid documents, etc.)
B	Height Range (feet)	8.2 to 18.1	List source (PS&E documentation, bid documents, etc.)
C	Average Barrier Height (feet)	16.27	List source (PS&E documentation, bid documents, etc.)
D	Surface Area of Supplied Barrier Panels (sq. ft.)	21,929	List source (PS&E documentation, bid documents, etc.)
E	Unit Price of Supplied Panels (cost/sq. ft.)	\$14.20	List source
F	Cost of Supplied Noise Barrier Panels	\$311,464	
G	Total Length (ft.) or Number of Supplied Posts	102	List source (PS&E documentation, bid documents, etc.)
H	Unit Price of Supplied Posts (cost/ft. or cost/post)	\$100.00	List source; Also see Note 2
I	Bid Cost for Supplied Posts	\$10,200.00	
J	Barrier Cost Sub-Total	\$308,664	
Additional Costs Related to This Barrier Only			
K	Cost of Transportation of Materials to Site	\$20,000	
L	On-Site Panel Erection Costs	\$40,000	
M	On-Site Post Erection Costs	\$50,000	
N	Foundation Costs	\$100,000	List type (moment slab, caisson, jersey barrier, retaining wall, etc.)
O	Barrier Design Costs	\$10,000	List source
P	Additional Right-of-Way Costs	\$20,000	List source
Q	Additional Utility Costs	\$25,000	List source
R	Aesthetic Treatment (sq. ft.)	30,000	Indicate type and whether one or both sides are coated
	Aesthetic Treatment (cost/sq. ft.)	\$2.00	List source
	Aesthetic Treatment Cost	\$60,000	
S	Surface or Anti-Graffiti Coating (sq. ft.)	30,000	Indicate type and whether one or both sides are coated
	Surface or Anti-Graffiti Coating (cost/sq. ft.)	\$1.00	List source
	Surface or Anti-Graffiti Coating Cost	\$30,000	
T	Length of Noise Barrier Protection (ft.)	500	List type (jersey barrier, guardrail, etc.)
	Unit Cost of Noise Barrier Protection (cost/ft.)	\$10.00	List source
	Cost of Noise Barrier Protection	\$5,000	
U	Maintenance and Protection of Traffic Costs	\$0	List source
V	Mobilization Costs	\$5.00	List source
W	Insurance Costs	\$1,000	List source
X	Other Costs	\$0	List type and source
TOTAL BARRIER COST		\$670,184	
TOTAL BARRIER COST/SQUARE FOOT		\$31.88	

NOTES:
 - Values in table are for illustrative purposes only.
 - Do not mark shaded blocks
 1. For cast-in-place barrier or post less barrier, enter total surface area above foundation or supporting structure.
 2. For cast-in-place barrier or post less barrier, enter cost for total surface area above foundation or supporting structure. If the bid cost also includes the cost of both panels and posts in a lump sum, include the lump sum cost here and enter "50" for Item I.
 3. Values entered in this table are for number of posts.
 4. Prorate cost for this barrier only.

Source: Environmental Acoustics, Inc.

NOISE ANALYSIS ACOUSTICAL DATA

Receiver I.D.	Residential Units Represented by Receptor	Existing Noise Levels $L_{eq}(h)$	Future Noise Levels Without a Barrier $L_{eq}(h)$	Build 2030 Increase Over Existing Noise Levels (Without a Barrier) $L_{eq}(h)$	Constructed Barrier	
					Abated Noise Level $L_{eq}(h)$	Insertion Loss $L_{eq}(h)$
Receiver 1	1	63	64	1	58	6
Receiver 2	1	61	62	1	58	5
Receiver 3	2	62	63	1	58	6
Receiver 4	6	68	69	1	59	10
Receiver 5	6	69	70	1	61	10
Receiver 6	6	70	71	1	62	9
Line-of-Sight Broken for All or Most Impacted Receptors?					Yes, for first floor of impacted residential units	
Total Barrier Length (ft)					1375	
Barrier Height Range (ft)					8.2 to 18.1	
Average Barrier Height (ft)					16.27	
FHWA TNM File						
		Exist HSK 6.7.09	Fut No Bar HSK 6.7.09			Constructed Bar HSK 6.7.12

CONSTRUCTED BARRIER COST AND PHYSICAL DATA

ITEM					
A	Length of Barrier (feet)	1,375	<i>List source (PS&E documentation, bid documents, etc.)</i>		
B	Height Range (feet)	8.2 to 18.1	<i>List source (PS&E documentation, bid documents, etc.)</i>		
C	Average Barrier Height (feet)	16.27	<i>List source (PS&E documentation, bid documents, etc.)</i>		
D	Surface Area of Supplied Barrier Panels (sq. ft.)	21,020	<i>List source (PS&E documentation, bid documents, etc.)</i>		1
E	Unit Price of Supplied Panels (cost/sq. ft.)	\$14.20	<i>List source</i>		2
F	Cost of Supplied Noise Barrier Panels	\$298,484			
G	Total Length (ft.) or Number of Supplied Posts	102	<i>List source (PS&E documentation, bid documents, etc.)</i>		3
H	Unit Price of Supplied Posts (cost/ft. or cost/post)	\$100.00	<i>List source; Also see Note 2</i>		3
I	Bid Cost for Supplied Posts	\$10,200.00			
J	Barrier Cost Sub-Total	\$308,684			
Additional Costs Related to This Barrier Only					
K	Cost of Transportation of Materials to Site	\$20,000			
L	On-Site Panel Erection Costs	\$40,000			
M	On-Site Post Erection Costs	\$50,000			
N	Foundation Costs	\$100,000	<i>List type (moment slab, caisson, Jersey barrier, retaining wall, etc.)</i>		
O	Barrier Design Costs	\$10,000	<i>List source</i>		4
P	Additional Right-of-Way Costs	\$20,000	<i>List source</i>		4
Q	Additional Utility Costs	\$25,000	<i>List source</i>		4
R	Aesthetic Treatment (sq. ft.)	30,000	<i>Indicate type and whether one or both sides are coated</i>		
	Aesthetic Treatment (cost/sq. ft.)	\$2.00	<i>List source</i>		
	Aesthetic Treatment Cost	\$60,000			
S	Surface or Anti-Graffiti Coating (sq. ft.)	30,000	<i>Indicate type and whether one or both sides are coated</i>		
	Surface or Anti-Graffiti Coating (cost/sq. ft.)	\$1.00	<i>List source</i>		
	Surface or Anti-Graffiti Coating Cost	\$30,000			
T	Length of Noise Barrier Protection (ft.)	500	<i>List type (Jersey barrier, guardrail, etc.)</i>		
	Unit Cost of Noise Barrier Protection (cost/ft.)	\$10.00	<i>List source</i>		
	Cost of Noise Barrier Protection	\$5,000			
U	Maintenance and Protection of Traffic Costs	\$0	<i>List source</i>		4
V	Mobilization Costs	\$500	<i>List source</i>		4
W	Insurance Costs	\$1,000	<i>List source</i>		4
X	Other Costs	\$0	<i>List type and source</i>		
TOTAL BARRIER COST		\$670,184			
TOTAL BARRIER COST/SQUARE FOOT		\$31.88			

Some Additional References on Factors Affecting Noise Barrier Costs

- **FHWA Noise Barrier Design Handbook, Final Report; February 2000 – Chapter 13**
- **Highway Traffic Noise Barriers in the U.S. – Construction Trends and Cost Analysis; Ken Polcak, MDSHA; September 2003**
- **Current FHWA Noise Barrier Inventory: “Summary of Noise Barriers Constructed By December 31, 2004”; May 2006**