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Report Addendum

To:	Terry Keller, SDDOT		
From:	HDR	Project:	Noise Study Technical Report I-29 from Tea Interchange to Skunk Creek Sioux Falls, South Dakota
cc:	file		
Date:	May 28, 2010; rev July 16, July 30, 2010	Job No:	140204

Re: I-29 Barrier Analysis Update

BACKGROUND

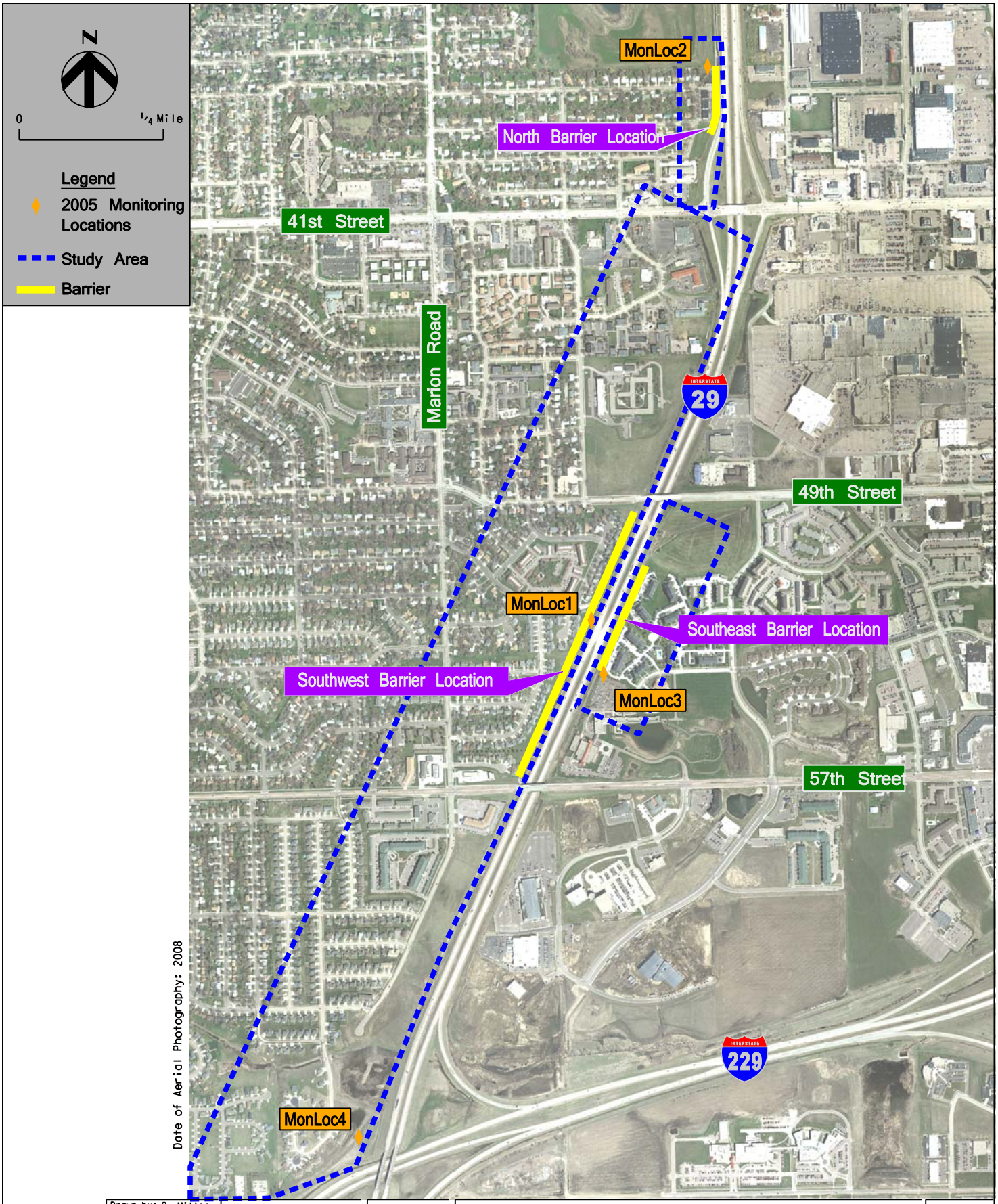
In November 2005, HDR conducted a noise study on the section of I-29 from the Tea Interchange to Skunk Creek in Sioux Falls, South Dakota. The study included two public meetings and a final Noise Study Technical Report[1]. Proposed construction of auxiliary lanes on I-29 precipitated the analysis. At the request of Federal Highway Administration (FHWA), the noise analysis is being revised with 2008 traffic volumes and year 2035 traffic projections from the City of Sioux Falls' updated Travel Demand Forecast Model. Noise wall costs are also being updated in the analysis. This memo serves as an update/addendum to the 2005 study. Figure 1 shows a site map of the noise study area.

[1] "Noise Study Technical Report, I-29 from Tea Interchange to Skunk Creek", HDR, 11/16/2005

SDDOT NOISE ABATEMENT POLICY

The SDDOT Noise Analysis and Abatement Policy (Policy), upon which this analysis is based, is intended to supplement FHWA traffic noise analysis and abatement regulations and guidance. The Policy provides procedures for noise studies and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria and to establish requirements for traffic noise information to be given to those officials who have planning and zoning authority in the Project area.

The Policy contains noise abatement criteria (NAC) that are based on the Leq(h) which is used to analyze traffic noise levels and identify noise impacts. The Leq(h) is defined as the equivalent steady-state sound level that, in a stated period of time, contains the same acoustic energy as the time-varying sound level during the same period. Therefore, for the purposes of this analysis, Leq can be considered the average sound level and Leq(h) can be considered the average sound level occurring over a one-hour period. It is representative of the overall (average) traffic generated noise level expressed on an hourly basis.



Drawn by: B. Miller
Date: 07/16/2010

Checked by: J. Unruh
Date: 07/16/2010

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I-29 Traffic Noise Study Site Map

I-29 Noise Analysis
Sioux Falls, South Dakota

Figure 1

Land uses are assigned to an activity category based on the type of activities occurring in each respective land use (i.e. picnic areas, churches, commercial land and undeveloped land). Activity categories are then ordered based on their sensitivity to traffic noise levels. NAC are assigned to each activity category. These NAC represent the maximum traffic noise levels that allow uninterrupted land use within each activity category. Table 1 lists the five land use categories included in the SDDOT NAC and the Leq(h) associated with each activity category. Traffic noise impacts are identified relative to the NAC and the Policy.

The federal (23 Code of Federal Regulations (CFR) 772) and SDDOT definition of a traffic noise impact contains three criteria of which only one has to be met. Traffic noise impacts are defined as impacts that occur when the predicted traffic noise levels:

- approach or equal the noise abatement criteria given on Table 1; or,
- exceed the noise abatement criteria given on Table 1; or,
- substantially exceed the existing noise levels.

Table 1
Noise Abatement Criteria

Activity Category	L_{eq} (h)	Description of Activity Category
A	57-dBA (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-dBA (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	72-dBA (Exterior)	Developed lands, properties or activities not included in Categories A or B above.
D	No Limit	Undeveloped Lands
E	52-dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

SOURCE: Federal-Aid Highway Program Manual 7-7-3, "Procedures for Abatement of Highway Traffic Noise and Construction Noise", dated August 1982.

The Policy states that a noise level of 66-dBA approaches the NAC (for category B), a noise level greater than 67-dBA exceeds the NAC (for category B) and a 15-dBA increase in existing noise levels is a substantial increase. Therefore, "approaches the NAC" is defined as within one decibel of the NAC.

METH0DOLOGY

The FHWA model "TNM" v2.5 was used to assess 2008 and predicted year 2035 traffic volumes for future "Build" traffic noise levels.

The Basic model inputs were:

- Preliminary project concept and geometry taken from the initial analysis.
- 2008 Traffic volumes for I-29 and area cross streets in the Study area updated from the original analysis from 2005
- 2035 Traffic volumes for I-29 and area cross streets in the Study area updated from the original analysis from 2025
- Operational speeds for I-29 of 60 miles per hour (mph) were based on drive-through observations. Operational speeds for area cross streets were based on the City's traffic model.

Once traffic counts were updated, HDR modeled various barrier lengths and heights within TNM to determine the effectiveness of the barriers against SDDOT's noise barrier cost/feasibility guidelines. The TNM model assists in determination of the optimum wall configuration to achieve a minimum 7 dBA of noise attenuation at a majority of impacted receptors per SDDOT policy. Receptors which achieve a 5 dBA or greater attenuation as a result of the barrier are included within the cost/benefit/reasonableness calculation.

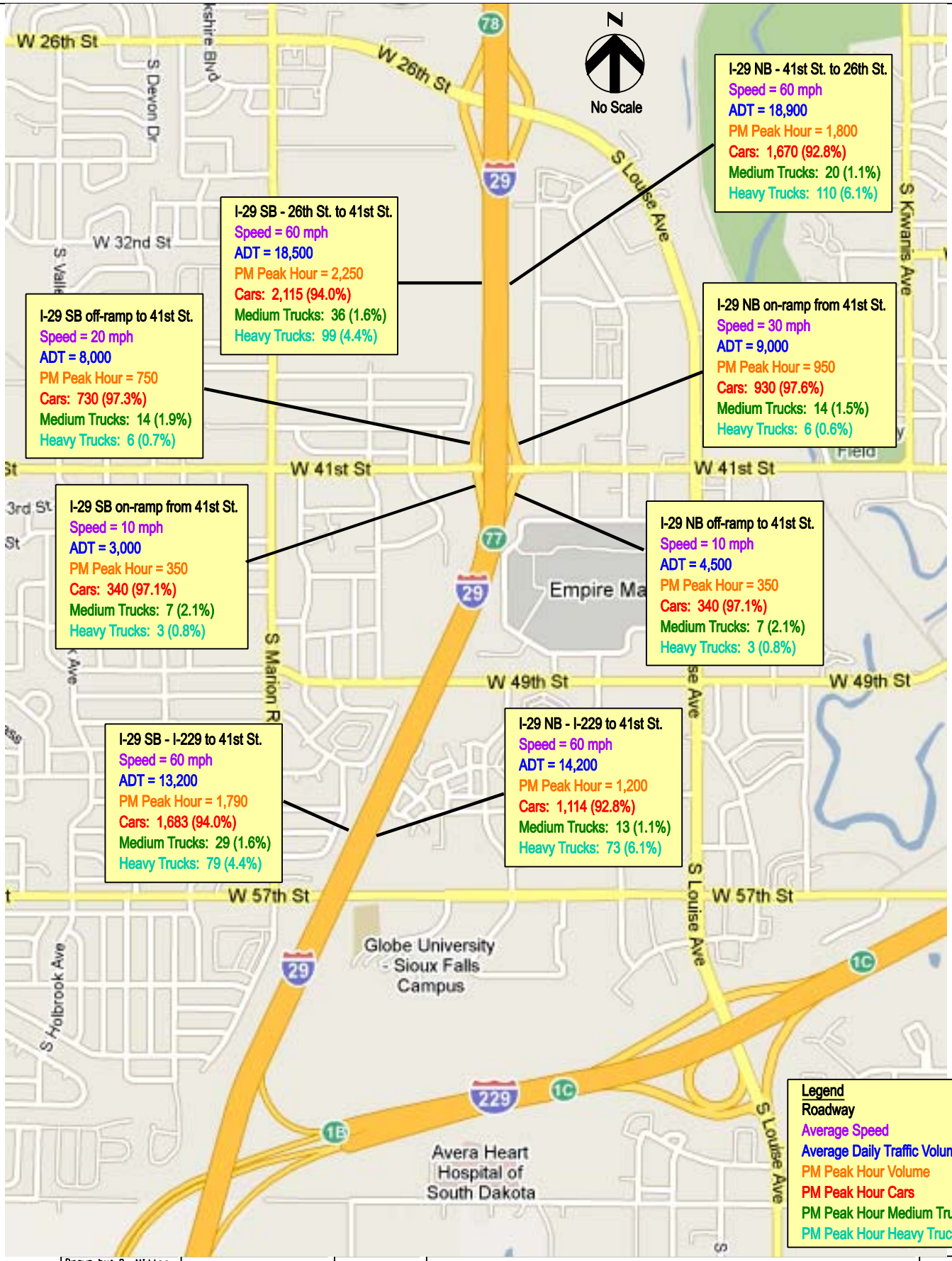
TRAFFIC VOLUMES

The traffic volumes used were the Peak Hourly Volume (PHV) traffic in the PM condition. This was determined to be the time period with the highest noise levels from the 24-hour monitoring conducted in 2005.

The traffic volumes on this Project were obtained from the following sources:

- I-29 peak hour volumes - City of Sioux Falls Office of Traffic Engineering/Transportation Planning
- I-29 vehicle classifications – Vehicle counts conducted by HDR on June 22, 2010.
- 41st Street interchange ramp volumes and vehicle mix - City of Sioux Falls Office of Traffic Engineering/Transportation Planning.
- 41st Street, 49th Street, and 57th Street peak hour volumes and vehicle mix - City of Sioux Falls Office of Traffic Engineering/Transportation Planning.

Figures 2, 2a, 3, and 3a show the traffic data used in the noise model.



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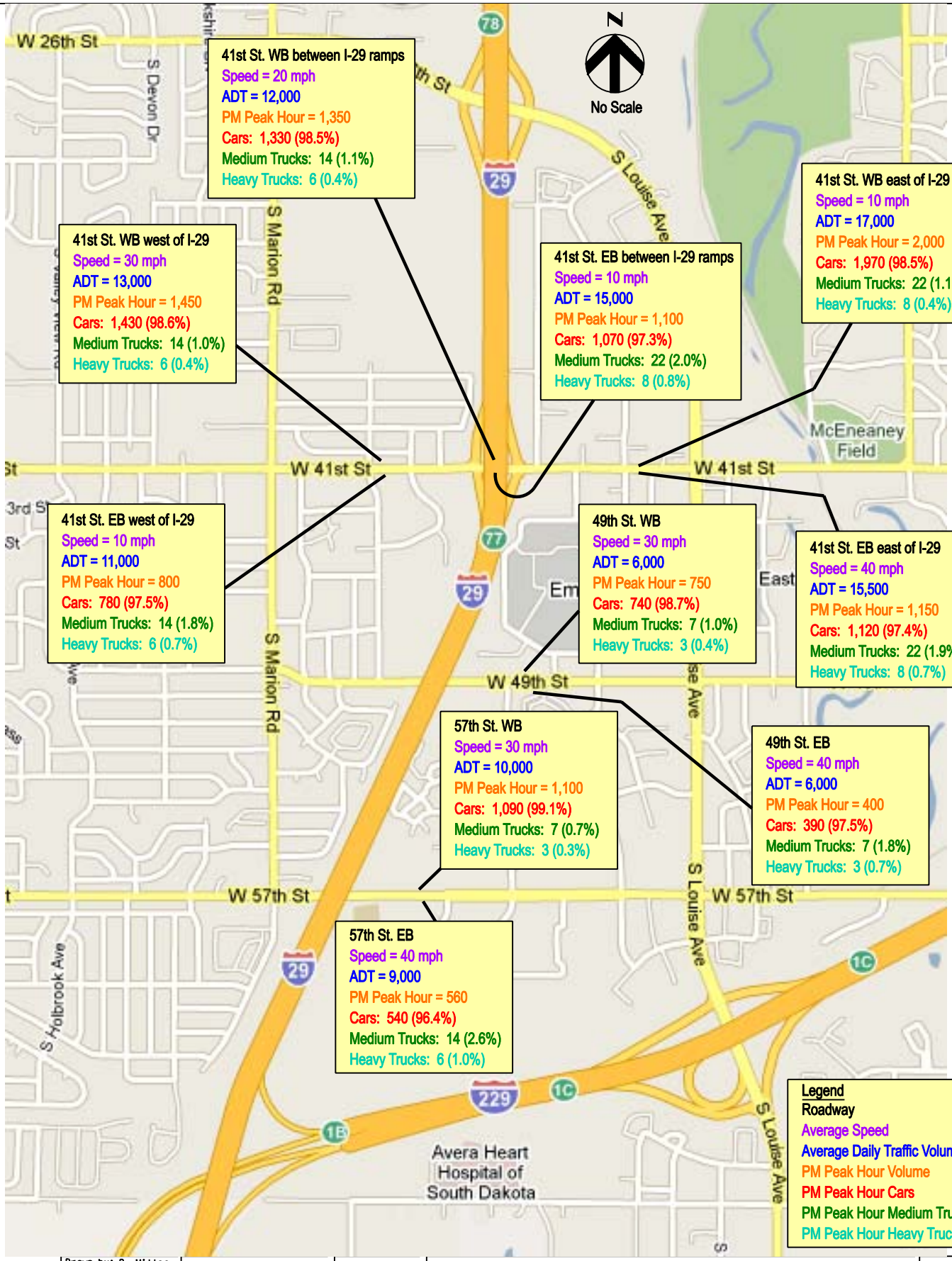
Year 2008 Traffic Volumes
I-29 and 41st Street Interchange Ramps
I-29 Noise Analysis
Sioux Falls, South Dakota

Figure
2



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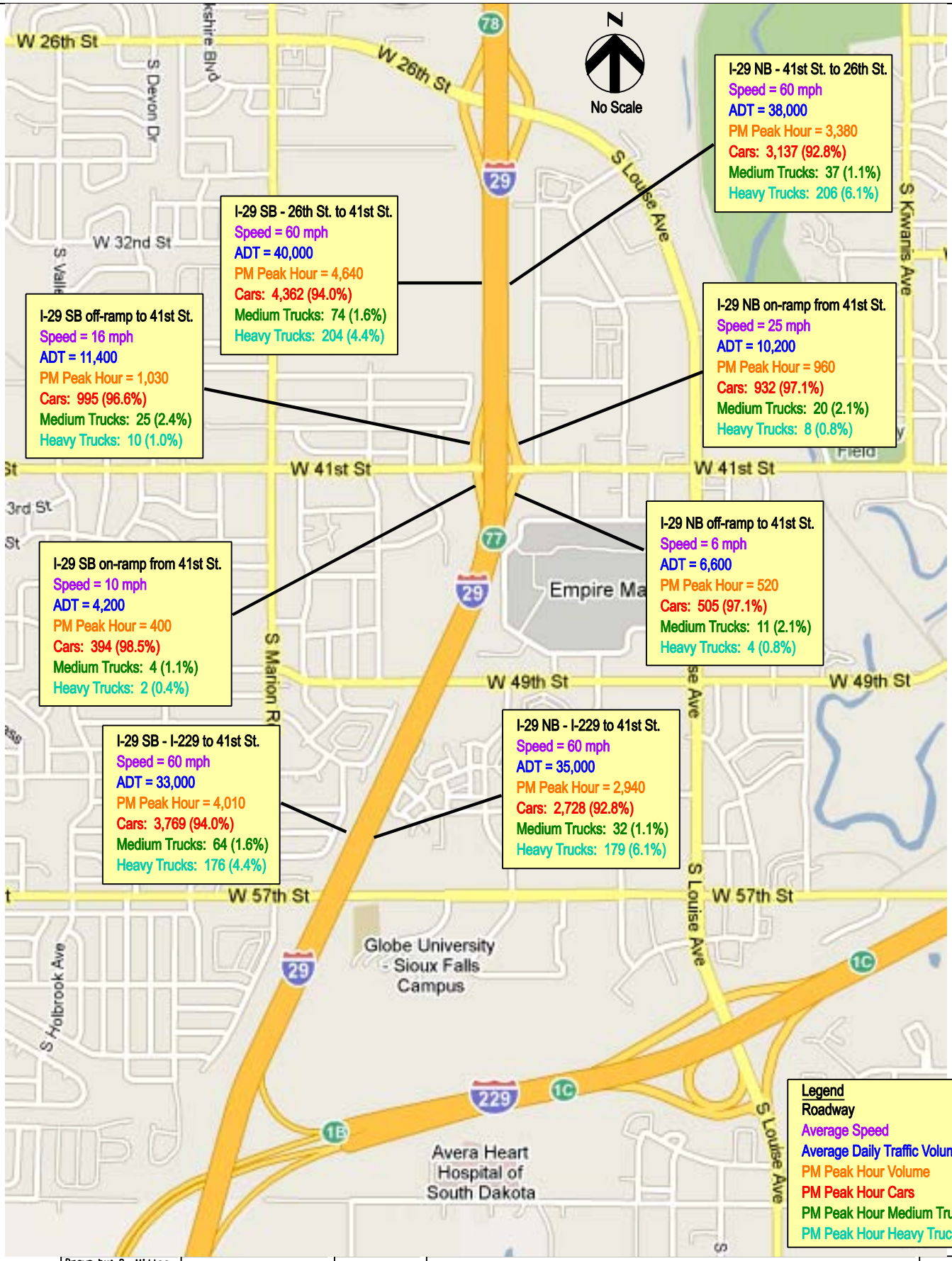
Year 2008 Traffic Volumes
I-29 Cross Streets
I-29 Noise Analysis
Sioux Falls, South Dakota

Figure
2a



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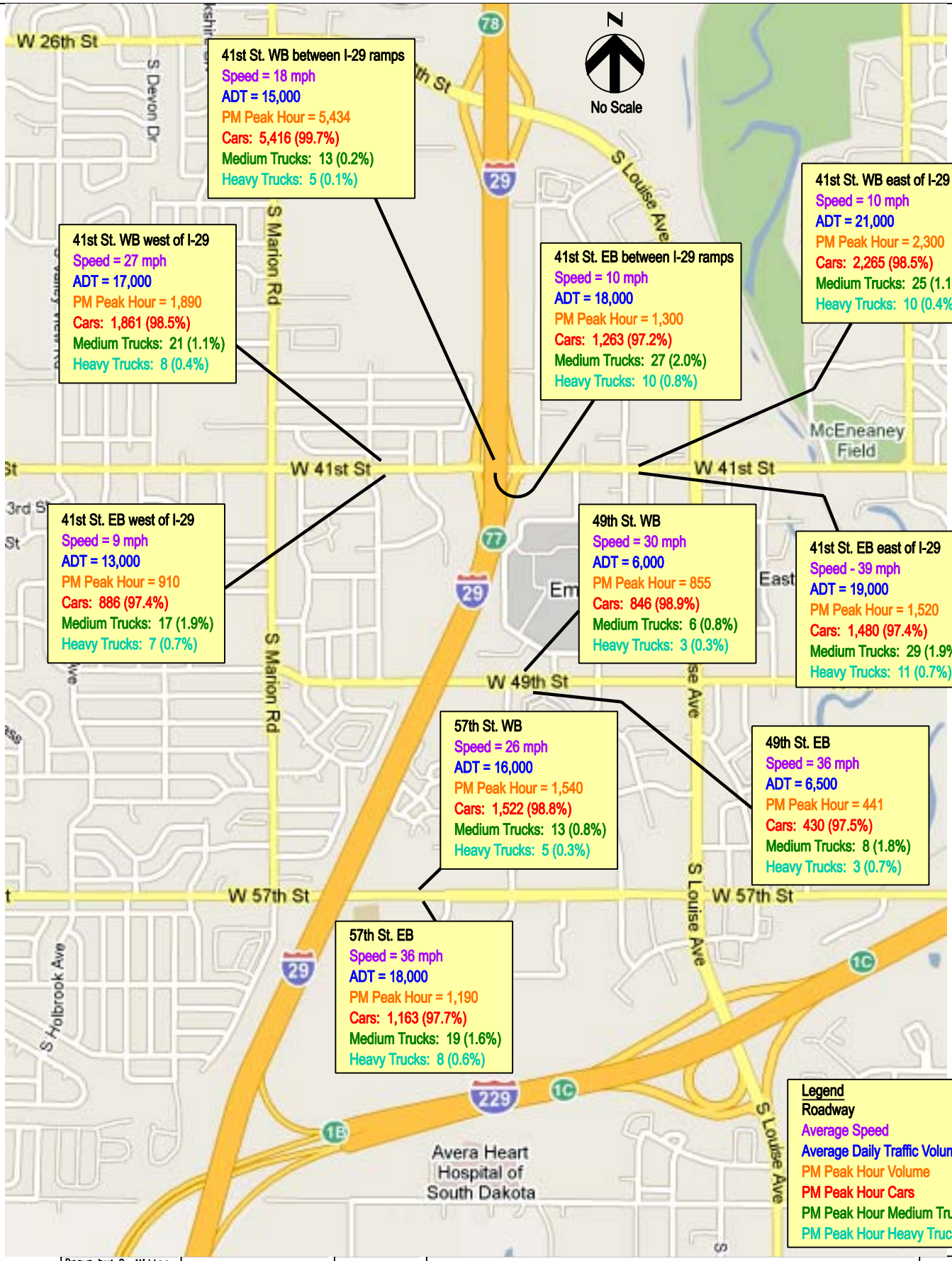
Year 2035 Traffic Volumes
I-29 and 41st Street Interchange Ramps
I-29 Noise Analysis
Sioux Falls, South Dakota

Figure
3



Drawn by: B. Miller
Date: 07/16/10

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Year 2035 Traffic Volumes
I-29 Cross Streets
I-29 Noise Analysis
Sioux Falls, South Dakota

Figure 3a

BARRIER LOCATIONS AND OPTIONS

Barriers analyzed were similar to that of the 2005 study with the exception of barrier cost. The barriers included a Southwest Barrier which was located along the west I-29 Right-of-way (ROW) and a west-side residential area north of 57th Street; a Southeast Barrier, which was located along the east I-29 ROW and an east-side apartment complex north of 57th Street; and a North Barrier, located along the west I-29 ROW and north of 41st St. and east of a residential area. In the 2005 analysis, SDDOT estimated the noise wall cost at $57.50 per square foot for colored, textured, pre-cast concrete walls. For this analysis, four less expensive barrier types were examined:

1. "Sound Fighter", a manufacturer of noise barriers for transportation and industry located in Shreveport, LA, was one option examined. The Sound Fighter barrier is a weatherized metal panel which has perforations on the side facing traffic with each panel filled with absorptive material. Noise from traffic is not only reduced due to the barrier itself, reflections are also mitigated due to the absorptive nature of the panel. A representation of the Sound Fighter panel is contained within Figure 1 below:

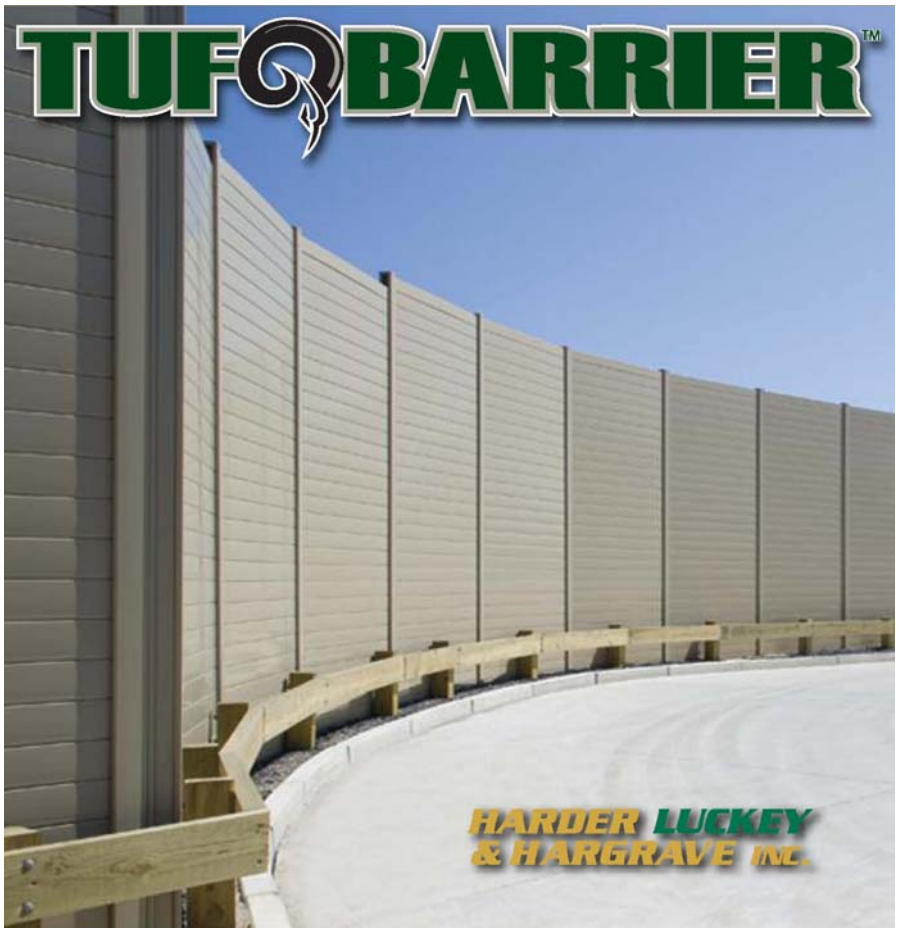
Figure 1, Sound Fighter Panels along a Roadside

Source: http://www.soundfighter.com/content.asp?page=11

The anticipated build price of the Sound Fighter panel was determined to be $30.00.

2. The second barrier type examined was cast in place concrete wall. The anticipated build cost was determined to be $30.00 per square foot.

3. A third noise barrier type examined was a recycled PVC/vinyl wall called "Tuf-Barrier Noise Wall System" manufactured by Harder, Luckey & Hargrave, Inc. (HLH, Inc.). Features of this wall type include:
    - Graffiti resistant
    - Designed for wind loads up to 110 mph
    - Fire retardant
    - Maintenance free
    - 40 year design life
    - Can be multi-colored for aesthetic purposes
    - Estimated cost is approximately $30 per square foot



Source: *WWW.HLHWALLS.COM*

4. A fourth noise barrier examined was a pre-cast wall panel system manufactured by AFTEC. Features of this product include durability, strength, pleasing aesthetics, etc. A verbal quote of $34.75 was supplied to SDDOT by the manufacturer.

Source: www.aftec.com

Within the updated modeling, a build cost of $30.00 per square foot was used for all analysis due to the similarity in costs of the various barriers. A discussion of each barrier, its respective location, and the cost analysis per benefited receptor follows.

It should be noted that this analysis used year 2035 predicted traffic volumes while the 2005 analysis used year 2025 predicted traffic volumes. The higher year 2035 traffic volumes resulted in higher predicted noise levels and a corresponding higher number of impacted receptors. Because of the higher predicted noise levels, the noise wall heights in this analysis were increased from the 2005 analysis to optimize the number of shielded and benefitted receptors in relationship to the wall cost.

BARRIER ANALYSIS RESULTS

Southwest Barrier

The southwest noise barrier is located along the west highway ROW between I-29 and the west-side residential area between 57th Street and 49th Street. The optimized barrier is 2,701-feet in length with an average height of 10.97 feet as shown in Figure 4. The barrier length and height were optimized to provide 7 dBA of noise reduction at the maximum number of receptors per SDDOT guidelines.

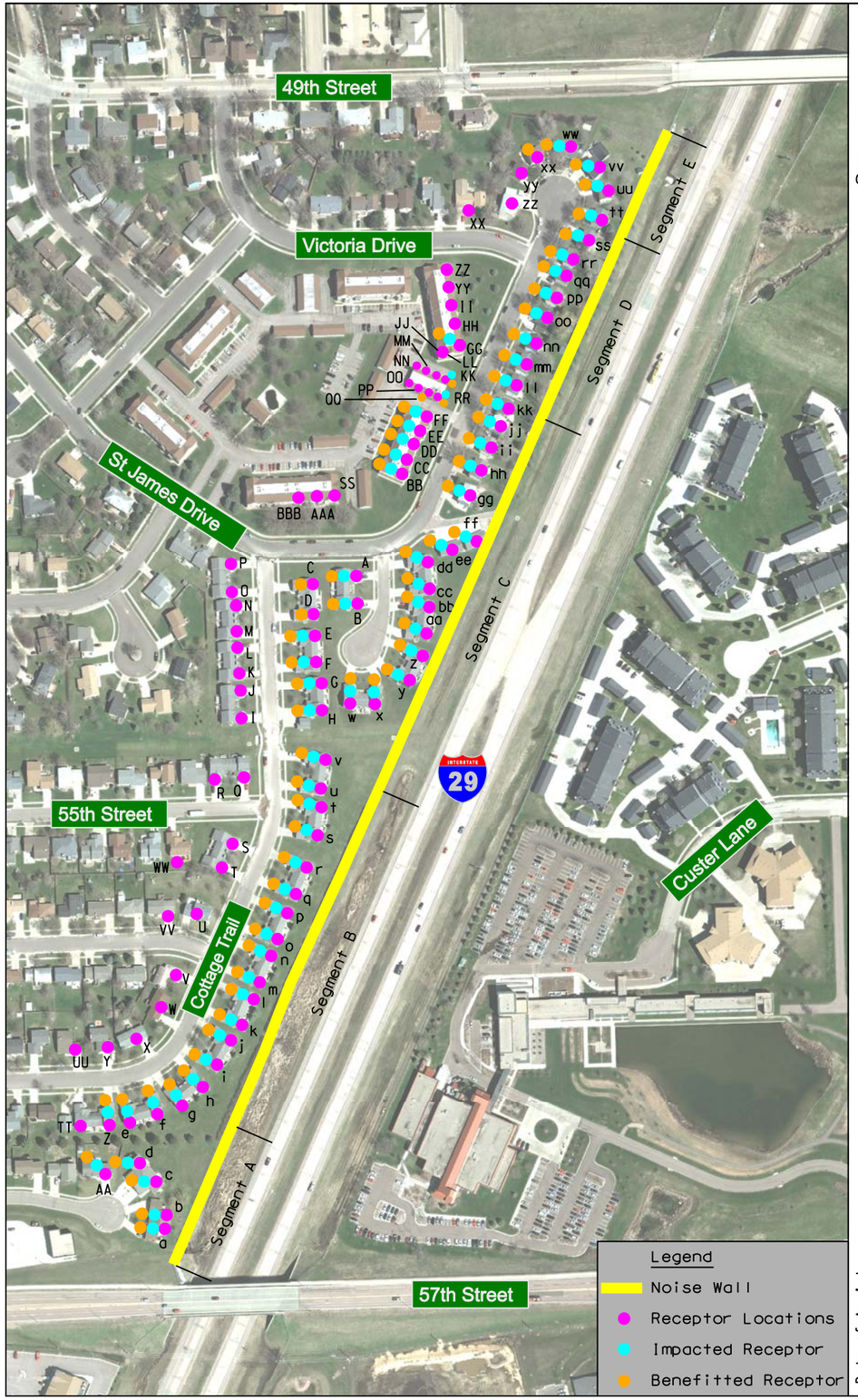
Table 2 summarizes the noise barrier modeled for this area, Figure 4 illustrates receptor and barrier locations, and Appendix A presents the predicted noise levels at each receptor with and without a noise barrier.

Given the calculated cost of the barrier ($888,540) and the number of benefited receptors (69), this barrier is considered cost reasonable based on SDDOT guidelines (less than $15,000 per benefited receptor).

Table 2
Southwest Barrier Noise Attenuation and Cost Results

Barrier	Barrier Length (ft)	Average Barrier Height (ft)	Barrier Area (sq ft)	Barrier Cost (@ $30/sq ft)	Total Number of Benefited Receptors[1]	Cost Reasonability
Southwest	2,701	10.97	29,618	$888,540	69	**$12,877/benefitted receptor Wall is cost-reasonable**

[1] Benefitted receptor: Noise barrier provides at least 5 dBA of noise level reduction.

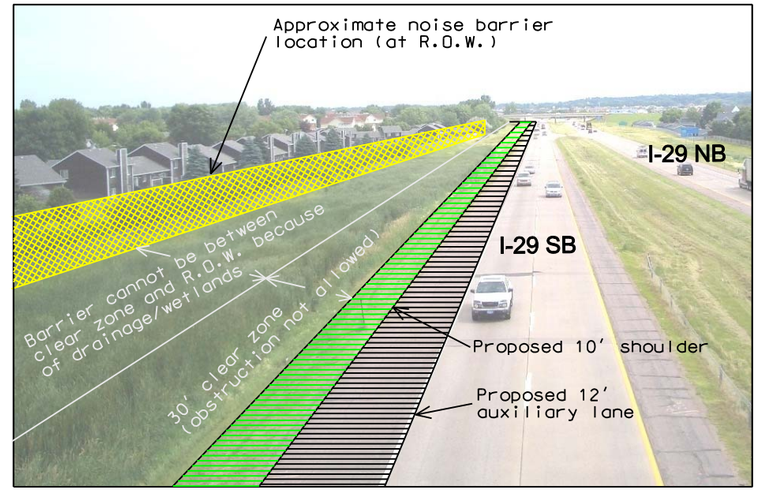


N

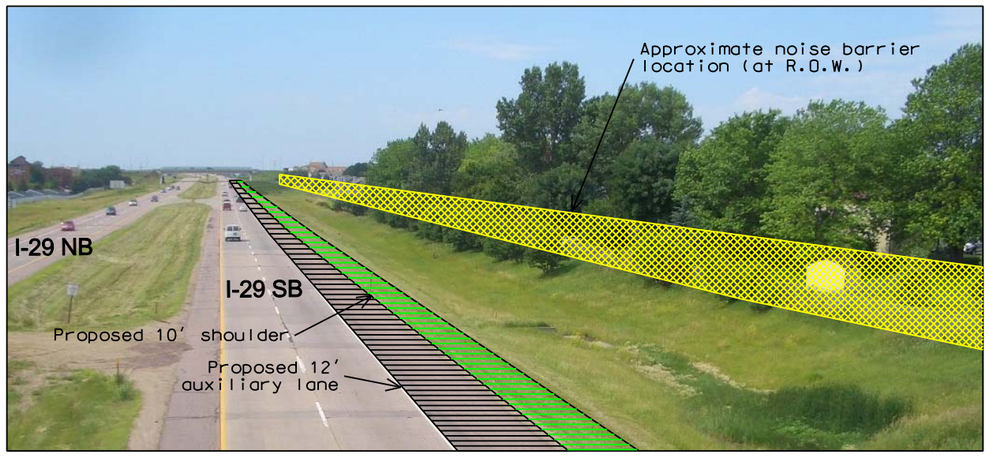
SCALE IN FEET

0 150 300

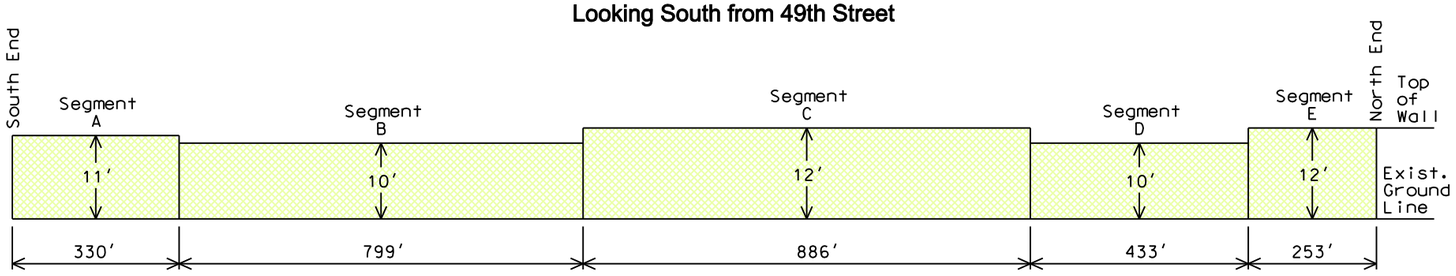
Wall Length = 2,701'
Average Wall Height = 10.97'
Wall Area = 29,618 sq.ft.
Wall Cost = $888,540 (@ $30 per sq.ft.)
Benefitted Receptors = 69
Cost Reasonability = $12,877 per benefitted receptor



Looking North from 57th Street



Looking South from 49th Street



Noise Barrier Profile

Date of Aerial Photography: 2008

Drawn by: B. Miller
Date: 07/16/2010

Checked by: J. Unruh
Date: 07/16/2010

Revision Date:
08/06/2010

South Dakota DOT Department of Transportation

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Southwest Barrier Layout

I-29 Noise Analysis
Sioux Falls, South Dakota

Figure 4

Southeast Barrier

The southeast noise barrier is located along the east highway ROW between I-29 and the east-side residential area between 57th Street and 49th Street at the Carrington House apartment complex. The optimized barrier is 1,074-feet in length with an average height of 13.87 feet as shown in Figure 5. The barrier length and height were optimized to provide 7 dBA of noise reduction at the maximum number of receptors per SDDOT guidelines.

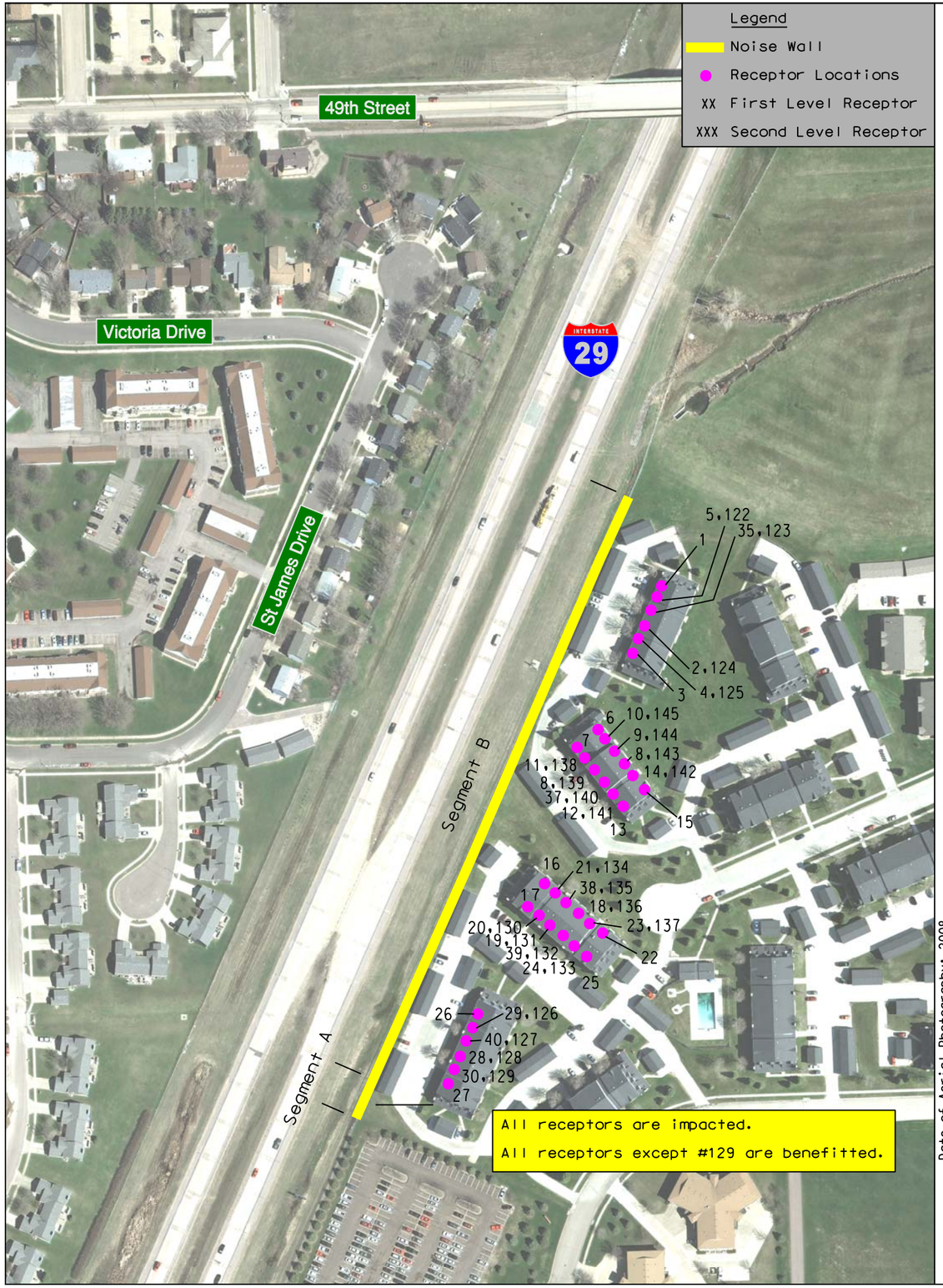
Table 3 summarizes the noise barrier modeled for this area, Figure 5 illustrates receptor and barrier locations, and Appendix B presents the predicted noise levels at each receptor with and without a noise barrier.

Given the calculated cost of the barrier ($447,000) and the number of benefited receptors (59), this barrier is considered cost reasonable based on SDDOT guidelines (less than $15,000 per benefited receptor).

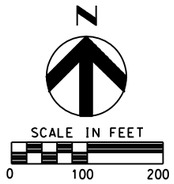
Table 3
Southwest Barrier Noise Attenuation and Cost Results

Barrier	Barrier Length (ft)	Average Barrier Height (ft)	Barrier Area (sq ft)	Barrier Cost (@ $30/sq ft)	Total Number of Benefited Receptors[1]	Cost Reasonability
Southeast	1,074	13.87	14,900	$447,000	59	**$7,576/benefitted receptor Wall is cost-reasonable**

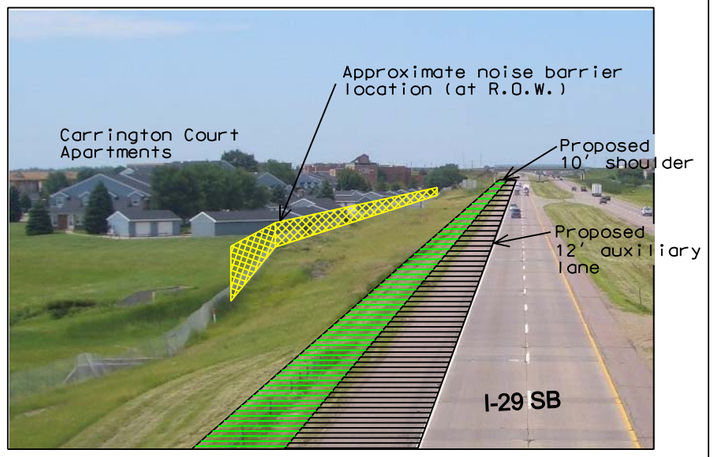
[1] Benefitted receptor: Noise barrier provides at least 5 dBA of noise level reduction.



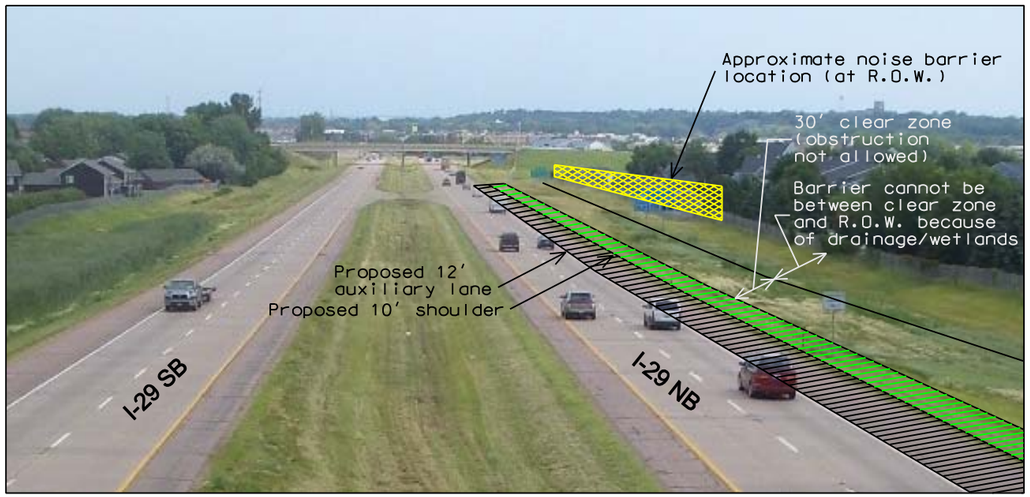
Date of Aerial Photography: 2008



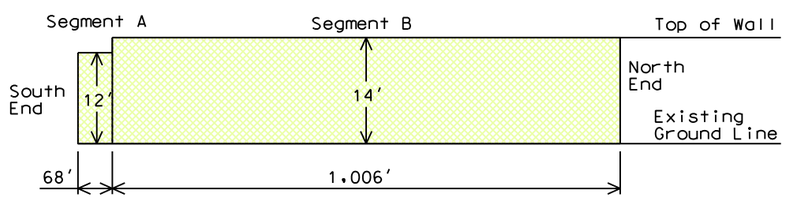
Wall Length = 1,074'
Average Wall Height = 13.87'
Wall Area = 14,900 sq.ft.
Wall Cost = $447,000 (@ $30 per sq.ft.)
Benefitted Receptors = 59
Cost Reasonability = $7,576 per benefitted receptor



Looking South from 49th Street Bridge



Looking North from 57th Street



Noise Barrier Profile

Drawn by: B. Miller
Date: 07/16/2010

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Date: 07/16/2010

Revision Date:
08/06/2010

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Southeast Barrier Layout

I-29 Noise Analysis
Sioux Falls, South Dakota

Figure 5

North Barrier

The north noise barrier is located along the west highway ROW north of 41st Street. A series of apartment complexes and single-family homes are in this area. The apartment complexes are three stories tall. Only the first and second stories were considered in this analysis. The optimized barrier is 606 feet in length with an average height of 16.61 feet as shown in Figure 6. The barrier length and height were optimized to provide 7 dBA of noise reduction at the maximum number of receptors per SDDOT guidelines.

Table 4 summarizes the noise barrier modeled for this area, Figure 4 illustrates receptor and barrier locations, and Appendix C presents the predicted noise levels at each receptor with and without a noise barrier.

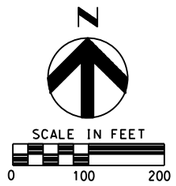
Given the calculated cost of the barrier ($301,980) and the number of benefited receptors (22), this barrier is considered cost reasonable based on SDDOT guidelines (less than $15,000 per benefited receptor).

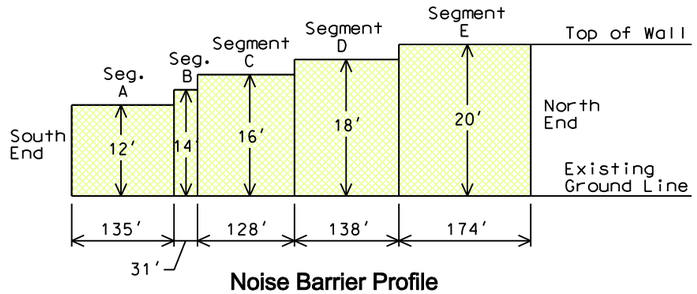
Table 4
Southwest Barrier Noise Attenuation and Cost Results

Barrier	Barrier Length (ft)	Average Barrier Height (ft)	Barrier Area (sq ft)	Barrier Cost (@ $30/sq ft)	Total Number of Benefited Receptors[1]	Cost Reasonability
North	606	16.61	10,066	$301,980	22	**$13,726/benefitted receptor Wall is cost-reasonable**

[1] Benefitted receptor: Noise barrier provides at least 5 dBA of noise level reduction.

Date of Aerial Photography: 2008

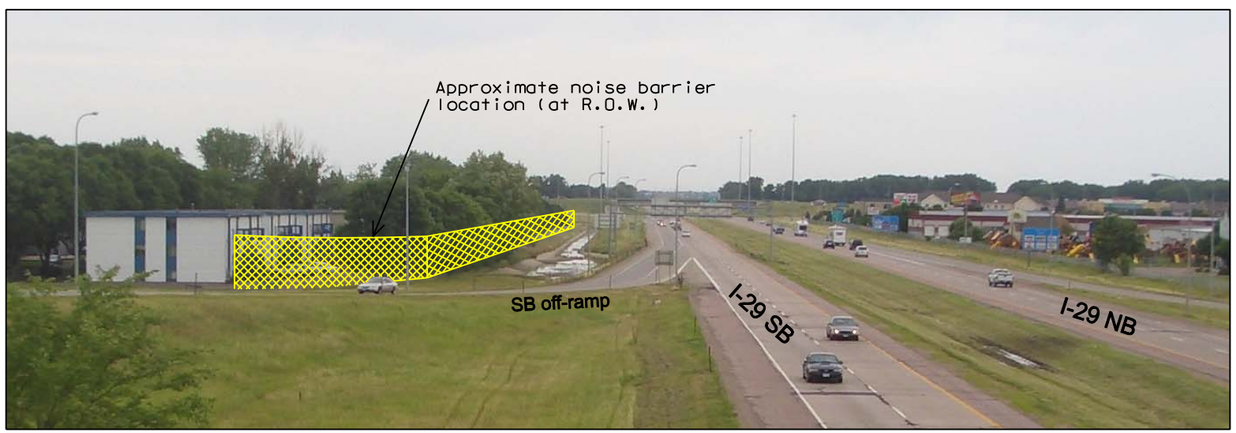




Noise Barrier Profile

Wall Length = 606'
Average Wall Height = 16.61'
Wall Area = 10,066 sq.ft.
Wall Cost = $301,980 (@ $30 per sq.ft.)
Benefitted Receptors = 22
Cost Reasonability = $13,726 per benefitted receptor

Looking South toward 41st Street



Looking North from 41st Street Bridge

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North Barrier Layout

I-29 Noise Analysis
Sioux Falls, South Dakota

Figure 6

CONCLUSIONS

HDR modeled 3 separate barrier locations for the I-29 expansion. The noise models were based on the noise analysis performed in 2005 with the exception of:

- Modified car and truck volumes which were updated to reflect current year volumes (2008) and Design Year (2035).
- An updated noise wall cost of $30.00 per square foot was used at the direction of SDDOT.
- Barrier height was optimized in relationship to the number of benefitted receptors and wall costs.

All three barrier locations were calculated to be cost "reasonable" based upon SDDOT's reasonableness factor of a build to benefit cost of less than $15,000 per benefited receptor.

PUBLIC INVOLVEMENT

Public involvement for the 2005 noise study included one public meeting before the study began and a second public meeting at the conclusion of the study.

One public meeting is proposed for the noise study update. All residents considered as noise receptors will be invited to attend. Apartment building owners will also be invited.

For the barriers determined to be cost reasonable by the analysis, residents will be provided with ballots to determine their preferences. Tabulation of the returned ballots will be weighted based on the proximity of the resident to the barrier location. The final decision on the wall installation will be based on a combination of the cost reasonability and the outcome of the voting.

APPENDIX A

SOUTHWEST BARRIER ANALYSIS RESULTS

July 16, 2010, rev. 7/30/10 **I-29 Noise Analysis Update** **by HDR**

I-229 to 26th Street

TNM 2.5 RUN: I-29 Noise Analysis Build Year 2035

BARRIER: Southwest (West side of I-29 from 57th Street to 49th Street)

ATMOSPHERICS: 75 deg F, 55% RH

Average pavement type used in analysis

Receiver Name	Dwelling Units	PM Peak hour noise levels						
		Without Barrier				With Barrier		
		Yr 2008 Leq dBA	Yr 2035 Leq dBA	Increase Yr 2008 to Yr 2035 dBA	Impacted (66 dBA) yes=1 no=0	Yr 2035 Leq dBA	Noise Reduction dBA	Benefitted (min. 5 dBA reduction) yes=1, no=0
P	1	54.6	60.8	6.2	0	57.1	3.7	0
O	1	54.7	60.9	6.2	0	57.0	3.9	0
N	1	54.9	60.9	6.0	0	57.0	3.9	0
M	1	55.0	60.8	5.8	0	57.0	3.8	0
L	1	55.3	61.1	5.8	0	57.3	3.8	0
K	1	55.7	61.6	5.9	0	57.9	3.7	0
J	1	56.3	62.1	5.8	0	58.3	3.8	0
I	1	56.9	62.6	5.7	0	58.9	3.7	0
BBB	1	56.4	62.8	6.4	0	58.7	4.1	0
AAA	1	57.1	63.6	6.5	0	59.3	4.3	0
SS	1	57.7	64.1	6.4	0	59.8	4.3	0
xx	1	58.2	64.9	6.7	0	59.9	5.0	1
yy	1	57.9	64.0	6.1	0	59.6	4.4	0
zz	1	58.3	64.8	6.5	0	60.1	4.7	0
XX	1	56.5	63.1	6.6	0	59.2	3.9	0
ZZ	1	57.6	64.1	6.5	0	60.0	4.1	0
YY	1	58.3	64.8	6.5	0	60.6	4.2	0
II	1	58.9	65.5	6.6	0	61.0	4.5	0
HH	1	59.2	65.9	6.7	0	61.1	4.8	0
GG	1	59.8	66.4	6.6	1	61.4	5.0	1
JJ	1	59.0	65.9	6.9	0	61.1	4.8	0
NN	1	58.2	65.2	7.0	0	60.7	4.5	0
MM	1	58.3	65.5	7.2	0	60.7	4.8	0
LL	1	59.0	65.9	6.9	0	61.1	4.8	0
KK	1	59.2	66.1	6.9	1	61.0	5.1	1
OO	1	58.1	65.3	7.2	0	60.7	4.6	0
PP	1	58.3	65.5	7.2	0	60.7	4.8	0
QQ	1	59.0	66.0	7.0	0	60.9	5.1	1
RR	1	59.5	66.3	6.8	1	61.0	5.3	1
FF	1	60.2	66.9	6.7	1	61.5	5.4	1
EE	1	60.3	67.0	6.7	1	61.7	5.3	1
DD	1	60.6	67.2	6.6	1	61.8	5.4	1
CC	1	60.8	67.5	6.7	1	62.0	5.5	1
BB	1	61.0	67.6	6.6	1	61.9	5.7	1
A	1	60.5	66.6	6.1	1	60.8	5.8	1
B	1	61.2	66.9	5.7	1	61.0	5.9	1
C	1	58.9	65.1	6.2	0	59.9	5.2	1
D	1	59.6	65.7	6.1	0	60.3	5.4	1
E	1	60.4	66.6	6.2	1	60.9	5.7	1
F	1	61.5	67.7	6.2	1	61.7	6.0	1

I-229 to 26th Street

TNM 2.5 RUN: I-29 Noise Analysis Build Year 2035
BARRIER: Southwest (West side of I-29 from 57th Street to 49th Street)
ATMOSPHERICS: 75 deg F, 55% RH
Average pavement type used in analysis

Receiver Name	Dwelling Units	PM Peak hour noise levels						
		Without Barrier				With Barrier		
		Yr 2008 Leq dBA	Yr 2035 Leq dBA	Increase Yr 2008 to Yr 2035 dBA	Impacted (66 dBA) yes=1 no=0	Yr 2035 Leq dBA	Noise Reduction dBA	Benefitted (min. 5 dBA reduction) yes=1, no=0
G	1	62.6	68.6	6.0	1	62.2	6.4	1
H	1	63.8	69.8	6.0	1	62.5	7.3	1
Q	1	57.8	63.7	5.9	0	60.3	3.4	0
R	1	56.3	61.9	5.6	0	59.2	2.7	0
S	1	57.6	63.1	5.5	0	60.6	2.5	0
T	1	57.2	62.7	5.5	0	60.2	2.5	0
WW	1	55.9	61.6	5.7	0	58.7	2.9	0
VV	1	56.3	61.8	5.5	0	58.4	3.4	0
U	1	58.1	63.9	5.8	0	59.7	4.2	0
V	1	58.1	63.8	5.7	0	59.3	4.5	0
W	1	58.2	63.9	5.7	0	59.0	4.9	0
X	1	57.7	63.4	5.7	0	58.6	4.8	0
Y	1	56.3	61.8	5.5	0	57.8	4.0	0
UU	1	55.0	60.3	5.3	0	56.9	3.4	0
AA	1	62.4	68.8	6.4	1	63.7	5.1	1
a	1	69.6	73.6	4.0	1	62.4	11.2	1
b	1	69.6	73.7	4.1	1	62.8	10.9	1
c	1	68.3	72.5	4.2	1	63.2	9.3	1
d	1	65.4	70.7	5.3	1	62.8	7.9	1
TT	1	59.1	64.5	5.4	0	59.8	4.7	0
Z	1	60.9	66.7	5.8	1	60.8	5.9	1
e	1	62.5	68.3	5.8	1	61.4	6.9	1
f	1	65.1	70.6	5.5	1	62.6	8.0	1
g	1	66.7	71.6	4.9	1	63.1	8.5	1
h	1	68.5	72.4	3.9	1	63.2	9.2	1
i	1	68.9	72.8	3.9	1	63.6	9.2	1
j	1	69.2	73.1	3.9	1	64.1	9.0	1
k	1	69.4	73.3	3.9	1	64.4	8.9	1
l	1	69.4	73.2	3.8	1	63.8	9.4	1
m	1	69.6	73.4	3.8	1	64.0	9.4	1
n	1	69.6	73.3	3.7	1	64.2	9.1	1
o	1	69.4	73.2	3.8	1	63.8	9.4	1
p	1	69.5	73.3	3.8	1	63.7	9.6	1
q	1	69.7	73.5	3.8	1	64.4	9.1	1
r	1	69.5	73.3	3.8	1	64.4	8.9	1
s	1	69.5	73.3	3.8	1	64.3	9.0	1
t	1	68.5	72.6	4.1	1	63.8	8.8	1
u	1	67.6	72.1	4.5	1	63.7	8.4	1
v	1	66.2	71.4	5.2	1	63.3	8.1	1
w	1	65.6	71.0	5.4	1	63.2	7.8	1

I-229 to 26th Street

TNM 2.5 RUN: I-29 Noise Analysis Build Year 2035
BARRIER: Southwest (West side of I-29 from 57th Street to 49th Street)
ATMOSPHERICS: 75 deg F, 55% RH
Average pavement type used in analysis

		PM Peak hour noise levels						
		Without Barrier				With Barrier		
Receiver Name	Dwelling Units	Yr 2008 Leq dBA	Yr 2035 Leq dBA	Increase Yr 2008 to Yr 2035 dBA	Impacted (66 dBA) yes=1 no=0	Yr 2035 Leq dBA	Noise Reduction dBA	Benefitted (min. 5 dBA reduction) yes=1, no=0
x	1	68.9	72.8	3.9	1	63.5	9.3	1
y	1	70.6	74.3	3.7	1	63.4	10.9	1
z	1	71.0	74.8	3.8	1	63.3	11.5	1
aa	1	70.6	74.4	3.8	1	64.0	10.4	1
bb	1	69.9	73.4	3.5	1	63.5	9.9	1
cc	1	69.3	72.8	3.5	1	63.7	9.1	1
dd	1	68.0	72.1	4.1	1	64.3	7.8	1
ee	1	69.4	73.2	3.8	1	64.4	8.8	1
ff	1	70.9	74.6	3.7	1	64.0	10.6	1
gg	1	69.1	72.8	3.7	1	64.6	8.2	1
hh	1	69.1	72.8	3.7	1	64.3	8.5	1
ii	1	69.2	72.9	3.7	1	64.0	8.9	1
jj	1	69.4	73.0	3.6	1	63.9	9.1	1
kk	1	69.7	73.2	3.5	1	63.9	9.3	1
ll	1	69.5	73.0	3.5	1	64.1	8.9	1
mm	1	69.5	73.0	3.5	1	64.1	8.9	1
nn	1	69.7	73.1	3.4	1	64.1	9.0	1
oo	1	69.3	72.8	3.5	1	64.2	8.6	1
pp	1	69.8	73.2	3.4	1	63.9	9.3	1
qq	1	69.6	72.9	3.3	1	64.1	8.8	1
rr	1	70.0	73.3	3.3	1	63.9	9.4	1
ss	1	70.3	73.5	3.2	1	63.7	9.8	1
tt	1	70.7	73.7	3.0	1	63.2	10.5	1
uu	1	70.0	73.0	3.0	1	63.2	9.8	1
vv	1	67.3	70.9	3.6	1	63.3	7.6	1
ww	1	62.5	67.0	4.5	1	61.6	5.4	1
Totals	106				65			69
Averages		63.2	68.3	5.2		61.7	6.7	

Optimized Barrier Length: **2,701** feet
Optimized Average Barrier Height: **10.97** feet
Optimized Barrier Area: **29,618** sq. ft.
Unit Barrier Cost: **$30** per sq. ft.
Total Barrier Cost: **$888,540**
Benefitted Receptors: **69**
Cost Reasonability: **$12,877** per benefitted receptor

(Cost Reasonability = Total Barrier Cost/receptors with 5 dBA or greater noise reduction)

APPENDIX B

SOUTHEAST BARRIER ANALYSIS RESULTS

July 16, 2010, rev. 7/30/10 **I-29 Noise Analysis Update** **by HDR**

I-229 to 26th Street

TNM 2.5 RUN: I-29 Noise Analysis Build Year 2035

BARRIER: Southeast (East side of I-29 from 57th Street to 49th Street)

ATMOSPHERICS: 75 deg F, 55% RH

Average pavement type used in analysis

		PM Peak hour noise levels						
		Without Barrier				With Barrier		
Receiver Name	Dwelling Units	Yr 2008 Leq dBA	Yr 2035 Leq dBA	Increase Yr 2008 to Yr 2035 dBA	Impacted (66 dBA) yes=1 no=0	Yr 2035 Leq dBA	Noise Reduction dBA	Benefitted (min. 5 dBA reduction) yes=1, no=0
1	1	66.8	69.8	3.0	1	63.6	6.2	1
2	1	66.8	70.1	3.3	1	62.4	7.7	1
3	1	67.1	70.3	3.2	1	61.6	8.7	1
4	1	66.9	70.3	3.4	1	61.9	8.4	1
5	1	66.8	69.9	3.1	1	62.9	7.0	1
6	1	66.8	71.8	5.0	1	61.5	10.3	1
7	1	68.4	73.3	4.9	1	61.3	12.0	1
8	1	65.8	71.0	5.2	1	61.3	9.7	1
9	1	64.4	69.4	5.0	1	61.2	8.2	1
10	1	65.7	70.7	5.0	1	61.5	9.2	1
11	1	67.2	72.1	4.9	1	61.3	10.8	1
12	1	64.3	69.4	5.1	1	61.1	8.3	1
13	1	63.3	68.4	5.1	1	60.9	7.5	1
14	1	63.4	68.4	5.0	1	60.9	7.5	1
15	1	62.2	67.2	5.0	1	60.6	6.6	1
16	1	66.6	72.1	5.5	1	61.7	10.4	1
17	1	67.3	72.4	5.1	1	61.5	10.9	1
18	1	63.3	68.9	5.6	1	61.2	7.7	1
19	1	64.0	69.7	5.7	1	61.6	8.1	1
20	1	65.7	71.2	5.5	1	61.5	9.7	1
21	1	64.9	70.6	5.7	1	61.5	9.1	1
22	1	61.2	66.7	5.5	1	60.9	5.8	1
23	1	62.2	67.9	5.7	1	61.1	6.8	1
24	1	62.7	68.4	5.7	1	61.5	6.9	1
25	1	61.8	67.3	5.5	1	61.1	6.2	1
26	1	66.5	71.4	4.9	1	61.8	9.6	1
27	1	66.6	71.2	4.6	1	64.6	6.6	1
28	1	66.8	71.5	4.7	1	62.5	9.0	1
29	1	66.5	71.4	4.9	1	62.2	9.2	1
30	1	66.5	71.3	4.8	1	63.9	7.4	1
35	1	66.8	70.2	3.4	1	62.2	8.0	1
36	1	65.0	70.0	5.0	1	61.3	8.7	1
37	1	65.0	70.2	5.2	1	61.2	9.0	1
38	1	64.0	69.7	5.7	1	61.4	8.3	1
39	1	64.9	70.5	5.6	1	61.5	9.0	1
40	1	66.6	71.4	4.8	1	62.3	9.1	1
122	1	69.2	73.5	4.3	1	66.6	6.9	1
123	1	69.2	73.5	4.3	1	66.1	7.4	1

I-29 Noise Analysis Update

I-229 to 26th Street

TNM 2.5 RUN: I-29 Noise Analysis Build Year 2035

BARRIER: Southeast (East side of I-29 from 57th Street to 49th Street)

ATMOSPHERICS: 75 deg F, 55% RH

Average pavement type used in analysis

		PM Peak hour noise levels						
		Without Barrier				With Barrier		
Receiver Name	Dwelling Units	Yr 2008 Leq dBA	Yr 2035 Leq dBA	Increase Yr 2008 to Yr 2035 dBA	Impacted (66 dBA) yes=1 no=0	Yr 2035 Leq dBA	Noise Reduction dBA	Benefitted (min. 5 dBA reduction) yes=1, no=0
124	1	69.2	73.5	4.3	1	65.9	7.6	1
125	1	69.3	73.6	4.3	1	65.5	8.1	1
126	1	69.3	73.6	4.3	1	67.8	5.8	1
127	1	69.3	73.6	4.3	1	68	5.6	1
128	1	69.4	73.7	4.3	1	68.4	5.3	1
129	1	69.4	73.7	4.3	1	69.2	4.5	0
130	1	68.4	72.7	4.3	1	66.4	6.3	1
131	1	67.9	72.2	4.3	1	65.9	6.3	1
132	1	67.5	71.8	4.3	1	65.6	6.2	1
133	1	66.8	71.1	4.3	1	65.1	6.0	1
134	1	67.9	72.2	4.3	1	65.6	6.6	1
135	1	67.5	71.8	4.3	1	65.2	6.6	1
136	1	67.0	71.3	4.3	1	65	6.3	1
137	1	66.6	70.9	4.3	1	64.7	6.2	1
138	1	69.1	73.4	4.3	1	65	8.4	1
139	1	68.5	72.8	4.3	1	64.8	8.0	1
140	1	68.1	72.4	4.3	1	64.6	7.8	1
141	1	67.7	72.0	4.3	1	64.5	7.5	1
142	1	67.1	71.4	4.3	1	64.4	7.0	1
143	1	67.6	71.9	4.3	1	64.6	7.3	1
144	1	68.0	72.3	4.3	1	64.7	7.6	1
145	1	68.3	72.6	4.3	1	64.9	7.7	1
Totals	60				60			59
Averages		66.5	71.1	4.6		63.4	7.8	

Note: Receptors 31 to 34 are not included in the above list because they represent a different land use.

Optimized Barrier Length: **1,074** feet

Optimized Average Barrier Height: **13.87** feet

Optimized Barrier Area: **14,900** sq. ft.

Unit Barrier Cost: **$30** per sq. ft.

Total Barrier Cost: **$447,000**

Benefitted Receptors: **59**

Cost Reasonability: **$7,576** per benefitted receptor

(Cost Reasonability = Total Barrier Cost/receptors with 5 dBA or greater noise reduction)

APPENDIX C

NORTH BARRIER ANALYSIS RESULTS

July 16, 2010, rev. 7/30/10 **I-29 Noise Analysis Update** **by HDR**

I-229 to 26th Street

TNM 2.5 RUN: I-29 Noise Analysis Build Year 2035

BARRIER: North (West side of I-29 north of 41st Street)

ATMOSPHERICS: 75 deg F, 55% RH

Average pavement type used in analysis

		PM Peak hour noise levels						
		Without Barrier				With Barrier		
Receiver Name	Dwelling Units	Yr 2008 Leq dBA	Yr 2035 Leq dBA	Increase Yr 2008 to Yr 2035 dBA	Impacted (66 dBA) yes=1 no=0	Yr 2035 Leq dBA	Noise Reduction dBA	Benefitted (min. 5 dBA reduction) yes=1, no=0
210	1	69.8	74.2	4.4	1	69.1	5.1	1
29	1	70.0	74.1	4.1	1	67.9	6.2	1
28	1	70.5	74.2	3.7	1	66.5	7.7	1
27	1	70.6	74.1	3.5	1	66.1	8.0	1
26	1	70.7	74.0	3.3	1	65.7	8.3	1
25	1	70.9	74.1	3.2	1	65.7	8.4	1
24	1	71.2	74.3	3.1	1	66.1	8.2	1
23	1	71.3	74.3	3.0	1	67.7	6.6	1
22	1	72.6	75.6	3.0	1	64.3	11.3	1
21	1	72.3	75.3	3.0	1	66.2	9.1	1
17	1	58.2	64.6	6.4	0	62.7	1.9	0
16	1	58.9	65.8	6.9	0	62.7	3.1	0
15	1	59.8	67.0	7.2	1	62.2	4.8	0
14	1	61.0	66.9	5.9	1	61.1	5.8	1
13	1	60.5	66.3	5.8	1	61.0	5.3	1
12	1	61.4	66.9	5.5	1	62.4	4.5	0
11	1	64.1	69.6	5.5	1	64.9	4.7	0
10	1	67.3	73.4	6.1	1	62.7	10.7	1
9	1	67.8	73.4	5.6	1	62.8	10.6	1
8	1	68.8	73.6	4.8	1	62.6	11.0	1
7	1	69.0	73.6	4.6	1	62.6	11.0	1
6	1	69.2	73.6	4.4	1	63.0	10.6	1
5	1	69.2	73.5	4.3	1	63.4	10.1	1
4	1	69.8	73.6	3.8	1	64.5	9.1	1
3	1	71.4	75.1	3.7	1	62.3	12.8	1
2	1	71.2	74.8	3.6	1	64.8	10.0	1
1	1	69.8	73.5	3.7	1	66.5	7.0	1
Totals	27				25			22
Averages		67.7	72.2	4.5		64.4	7.8	

Note: Third level receptors were not considered in this analysis.

Optimized Barrier Length: **606** feet

Optimized Average Barrier Height: **16.61** feet

Optimized Barrier Area: **10,066** sq. ft.

Unit Barrier Cost: **$30** per sq. ft.

Total Barrier Cost: **$301,980**

Benefitted Receptors: **22**

Cost Reasonability: **$13,726** per benefitted receptor

(Cost Reasonability = Total Barrier Cost/receptors with 5 dBA or greater noise reduction)