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4.6 Noise and Vibration

An analysis of traffic noise and railroad noise/vibration was conducted to assess existing and future noise and vibration levels at properties near the project corridor. Some land uses, such as residences, schools and parks, are viewed by FHWA and CDOT as being more sensitive to traffic noise than other land uses. **Figure 4.6-1** shows the locations of these more noise-sensitive land uses in the project area. Existing conditions serve as a baseline for comparing any traffic noise impacts that may occur with the various alternatives, which includes System Alternatives 1, 2, 3, and the Preferred Alternative in the future.

This section provides basic noise and vibration information, applicable guiding policy, existing levels within the project corridor, and predicted future levels. More detailed information regarding the noise and vibration analysis can be found in the Noise and Vibration Impact Assessment Report and Addendum (FHU, 2005f; FHU, 2006e).

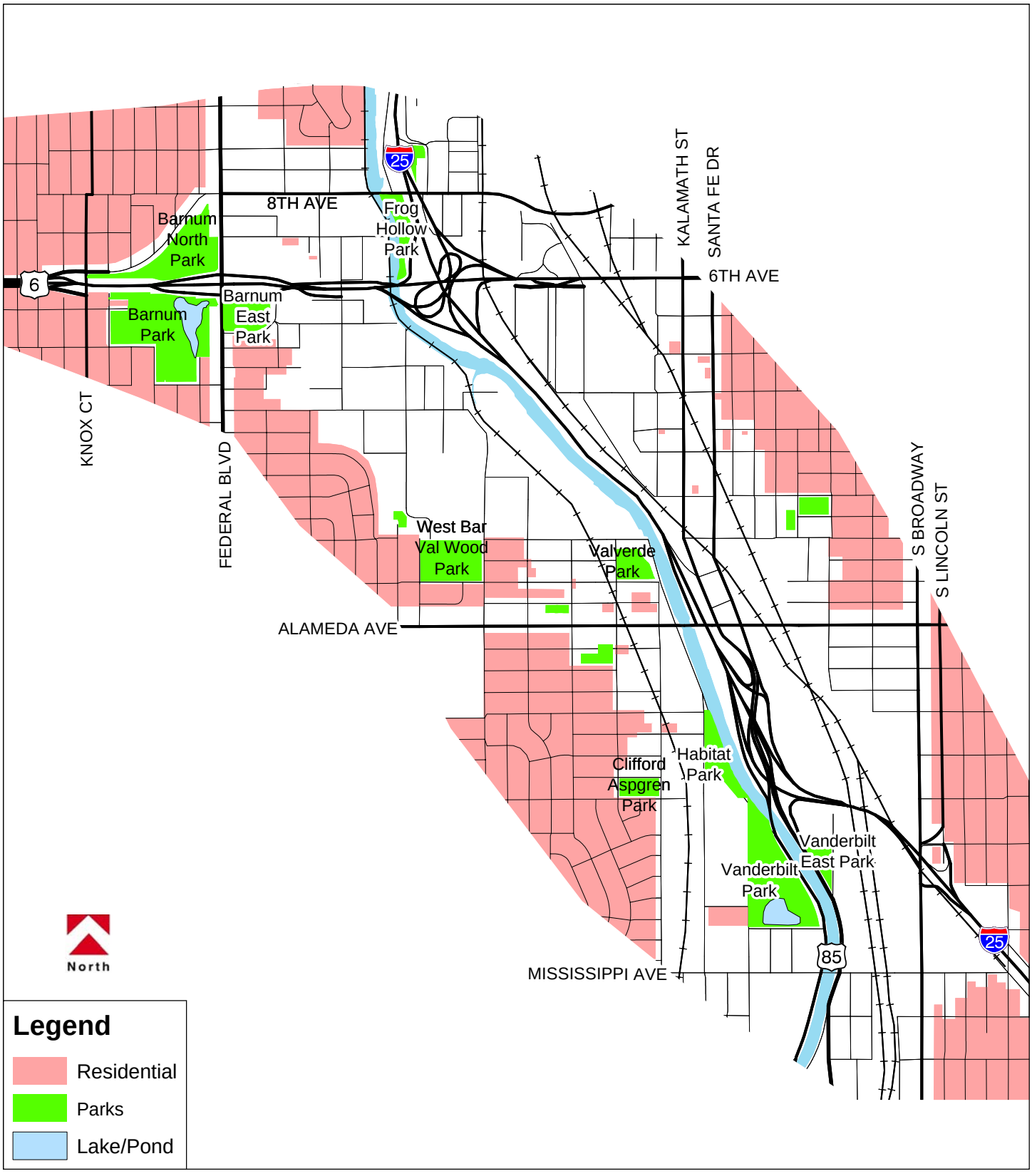
4.6.1 Current Conditions

Sound is created when an object vibrates and radiates part of that energy as acoustic pressure or waves through a medium, such as air, water, or a solid. Sound and noise are measured in units of decibels (dB). The dB scale is logarithmic, not linear. As an example, two identical noise sources, each producing 60 dB, will produce 63 dB when operated together. Likewise, a 10 dB increase in sound levels represents ten times as much sound energy. Some common noise levels are shown in **Figure 4.6-2.**

The human ear is receptive to a wide range of sound energy levels but is not equally receptive to all sound frequencies. A-weighting of sound frequency bands is a method used to approximate how the human ear perceives sound, mostly by reducing the contribution from lower frequencies by a specified amount (see **Figure 4.6-3**). A-weighted sound levels are reported in dBA. Most people will not notice a difference in loudness of sound levels of less than 3-dBA, which is a two-fold change in the sound energy. Most people relate a 10-dBA change in sound levels to a doubling of sound loudness.

Sound levels diminish with distance from the source because of spreading, atmospheric absorption, interference from other objects and ground effects. "Hard" ground (such as asphalt) and "soft" ground (such as grass) transmit sound differently. “Hard” ground is more reflective and will produce louder sound levels farther from the source. With traffic noise, a 3-dBA increase in noise could be caused by doubling the traffic volume or cutting the distance from the roadway in half (for “hard” ground).

Traffic noise tends to fluctuate over time in accordance with traffic volumes, vehicle types, and speeds. This fluctuation makes it difficult to describe the noise impact through a single value. FHWA and CDOT use the one-hour equivalent sound level (L_{eq}) as their metric for assessing traffic noise impacts. The L_{eq} is the “average” of the fluctuating noise levels over a time period, or the continuous noise level that would produce the same sound energy as the fluctuating noise levels over the time period. On congested highways like I-25, the loudest traffic noise generally occurs when the largest traffic volume can travel at the highest speed, which is usually outside periods when traffic becomes overly congested and slows. This condition generally describes LOS C for a highway.



Valley Highway, 02-069, 6/26/2006

0 0.25 0.5 1 Miles

Noise-Sensitive Areas

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-1

Figure 4.6-2 Typical Noise Levels

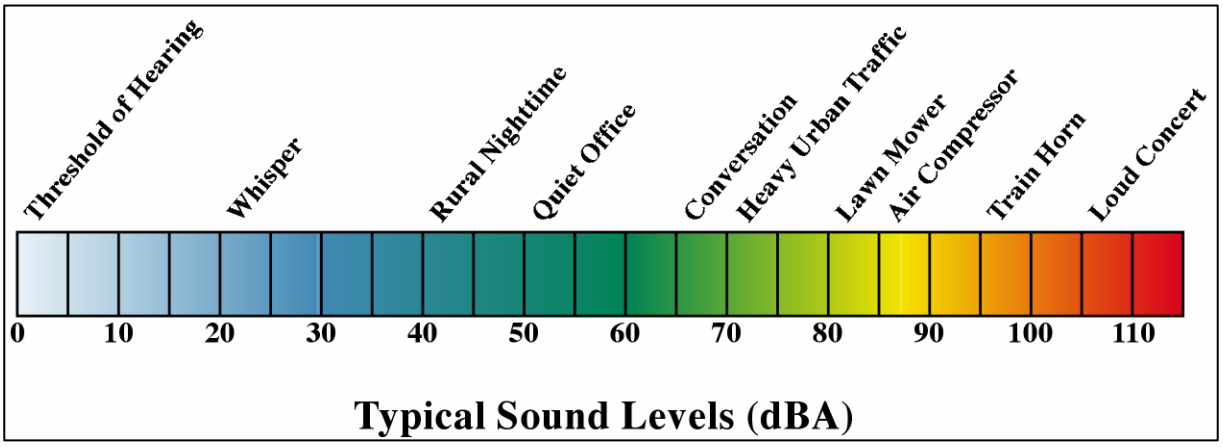
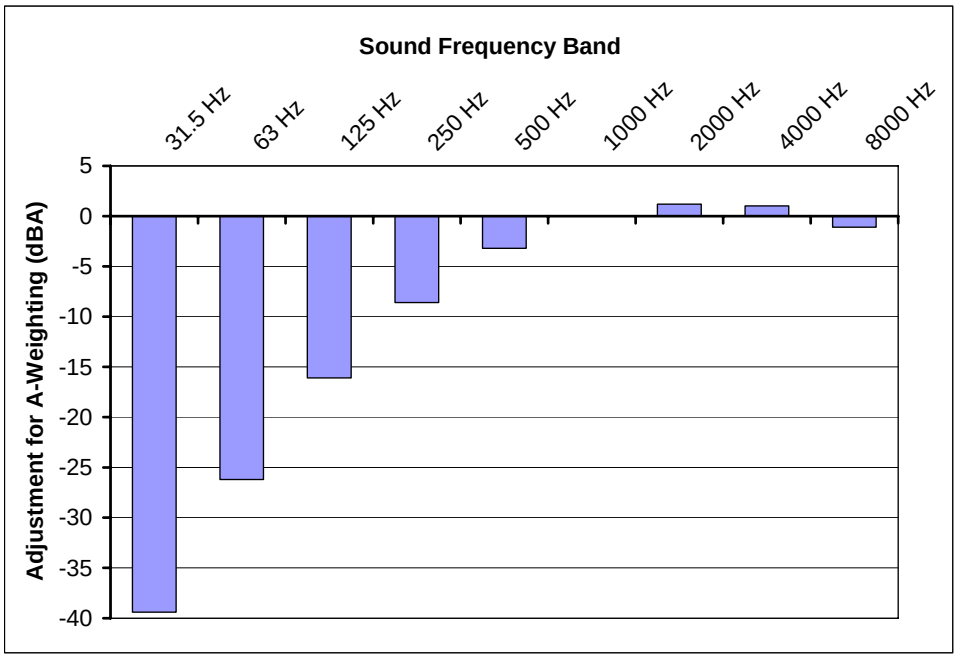


Figure 4.6-3 A-Weighting Adjustments



4.6.1.1 NOISE CRITERIA

Potential impacts from traffic noise were assessed on the basis of the predicted noise levels' relationship to CDOT's implementation of the FHWA Noise Abatement Criteria (NAC). The FHWA NAC for residences and other Category B receivers is a one-hour L_{eq} of 67 dBA, and for commercial areas (Category C) is an L_{eq} of 72 dBA for the peak hour (see **Table 4.6-1**). CDOT has determined that "approaching" the FHWA NACs is a concern that triggers an investigation of noise mitigation measures. "Approaching" the FHWA NACs has been specified by CDOT as noise 1 dBA below each FHWA NAC, which corresponds to 66 dBA for residential or other Category B land uses and 71 dBA for Category C areas. CDOT has established their own NACs

at these levels (see **Table 4.6-1**). CDOT NACs are the more restrictive of these criteria, and are the basis of comparison of impacts.

In addition to exceeding CDOT NACs, an impact from a "substantial" noise increase is indicated if the future noise level is expected to increase by 10 dBA or more over existing levels. This would also lead to evaluation of traffic noise mitigation actions.

4.6.1.2 EXISTING TRAFFIC NOISE LEVELS

Existing traffic noise conditions were evaluated through a combination of noise measurements and computer modeling. Modeling is used because day-to-day variations in traffic or weather conditions that affect noise levels can not be captured or quantified by brief noise measurements alone. The ultimate purpose of the modeling is to show whether future traffic noise levels caused by the proposed project would be high enough to impact neighboring properties, and whether noise mitigation should be considered for any such impacts within the study area. The measurements are helpful in evaluating noise model parameters.

Table 4.6-1 Noise Abatement Criteria

Land Use Category	FHWA NAC (L_{eq}) [1]	CDOT NAC (L_{eq}) [2]	Description of Land Use Category
A	57 dBA Exterior	56 dBA Exterior	Tracts of land in which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parks, or open spaces that are recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B	67 dBA Exterior	66 dBA Exterior	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, picnic areas, playgrounds, active sports areas, and parks.
C	72 dBA Exterior	71 dBA Exterior	Developed lands, properties, or activities not included in categories A and B above.
D	None	None	Undeveloped lands.
E	52 dBA Interior	51 dBA Interior	Residences, motels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Sources: [1] FHWA, 1995
[2] CDOT, 2002a

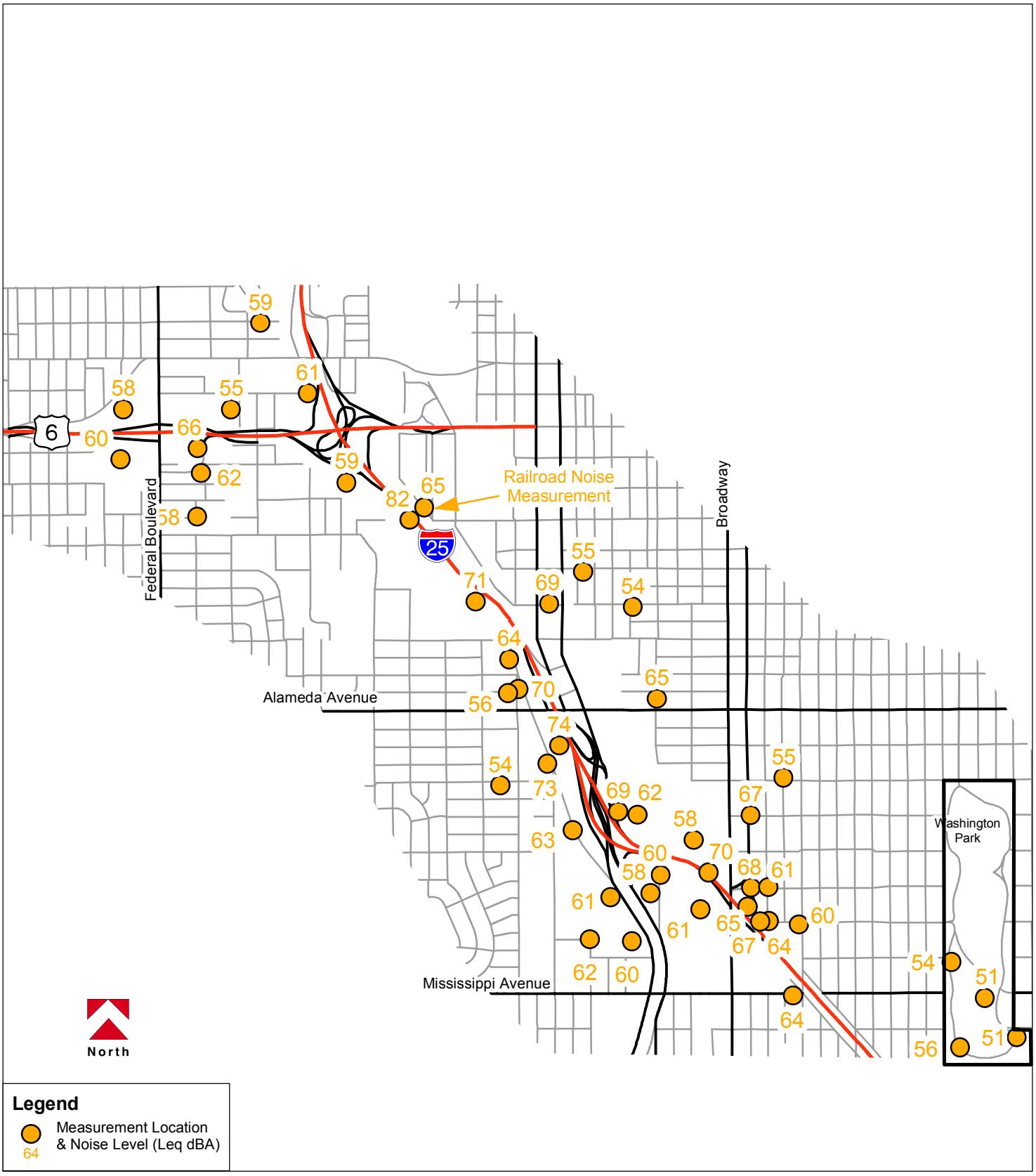
There were 46 short-term (20-minute) traffic noise measurements performed in the study area (see **Figure 4.6-4**) to document ambient conditions (FHU, 2005f; FHU, 2006e). These locations included residential, park, and commercial areas along the project corridor. Traffic counts, including the number of large trucks, were collected when possible during the noise measurement periods. One measurement targeting railroad noise was also made.

The traffic noise modeling software used for the assessment was the implementation of the FHWA-RD-77-108 (i.e., STAMINA) model contained in SoundPlan® Version 6.3 with CDOT vehicle noise emission values. Existing traffic conditions that were modeled included the current road configurations and traffic volumes. The computer noise models require a considerable amount of input data regarding the geometry of the roadways as well as traffic volumes, vehicle

mix, and speeds. Detailed traffic studies were completed for the project corridor (FHU, 2004c; FHU, 2006b) to provide traffic volumes. The existing road/street layout was mapped for existing conditions.

As a check on computer model parameters, the traffic conditions observed during some noise measurement episodes were used to construct a verification model, which was compared to the measured noise levels. Because of the large project area, the verification model consisted of a smaller piece of the project area near the I-25 and Broadway interchange. In general, the results were in close agreement, as the measured and modeled results for the noise measurement locations differed by 2 dBA or less.

Traffic noise levels during an average peak noise hour were modeled at 104 receiver points (see **Figure 4.6-5**) that represent locations within the project corridor. In addition, traffic noise levels were calculated at more than 28,500 grid nodes covering the project area to create detailed noise contours for a larger area than covered by the discrete receivers. The model results are illustrated in **Figure 4.6-6** and listed in **Table 4.6-2**. It should be noted that more receivers were added and the Preferred Alternative was remodeled to provide additional detail for this Final EIS. Those results are described in the noise report addendum (FHU, 2006e).



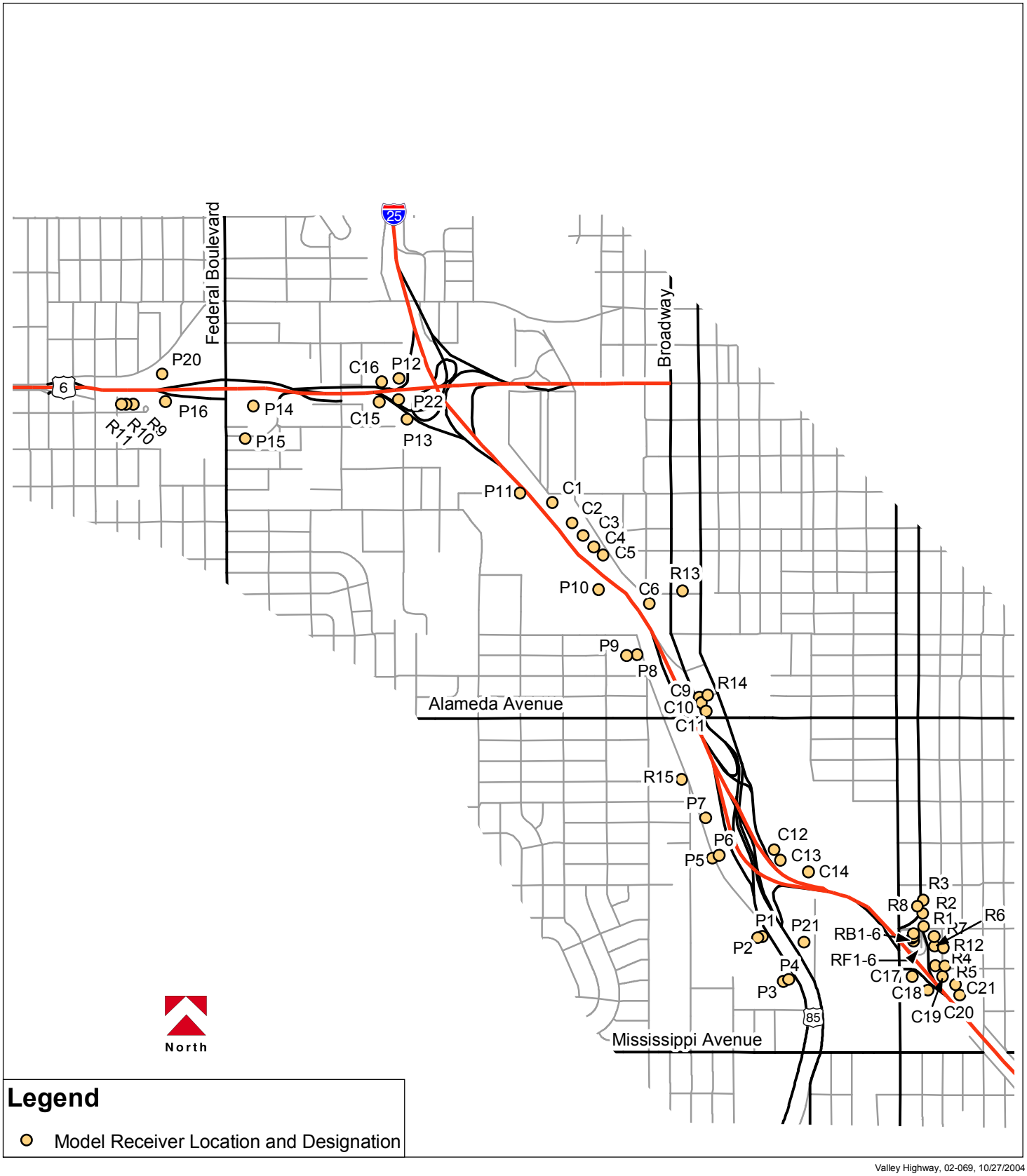
Valley Highway, 02-069, 10/27/2004

0 0.25 0.5 1 Miles

Noise Measurement Locations and Results

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-4

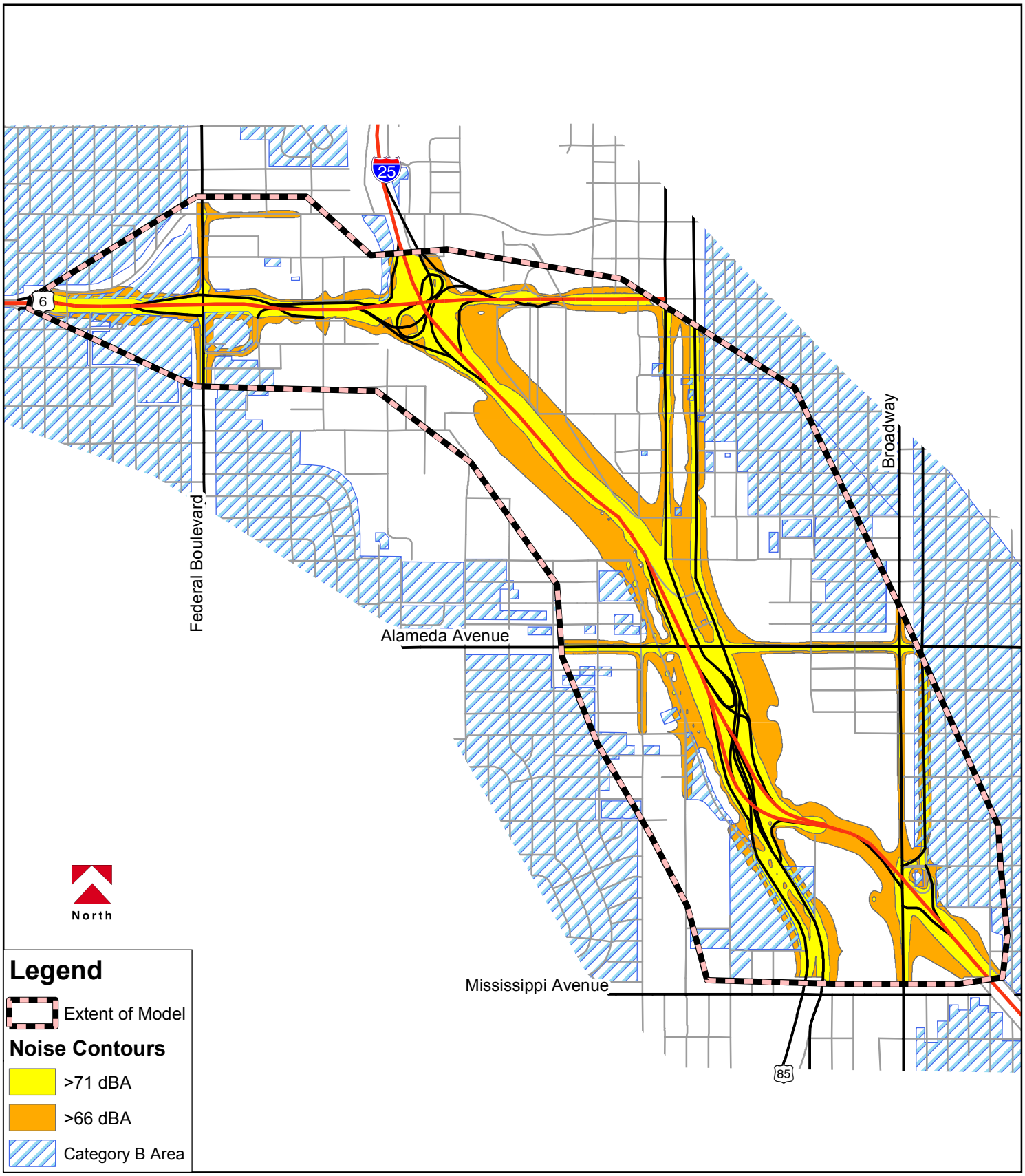


Valley Highway, 02-069, 10/27/2004

Noise Model Receiver Locations

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-5



Valley Highway, 02-069, 6/26/2006

0 0.25 0.5 1 Miles

Existing Conditions: Noise Contours

Table 4.6-2 Noise Model Results

Receiver	Predicted Noise Level (dBA)						Land Use[1]
	Existing	2025 No Action	2025 System 1	2025 System 2	2025 System 3	2025 Preferred Alt.	
C1	72	72	73	73	73	71	Com.—1500 W. 3rd
C2	71	71	72	72	72	70	Com.—1500 W. 2nd
C3	71	71	72	72	72	70	Com.—1400 W. 2nd
C4	71	71	72	72	72	70	Com.—1400 W. 1st
C5	71	71	72	72	72	70	Com.—1400 W. 1st
C6	72	72	73	73	73	70	Com.—1100 W. Ellsworth
C7	71	71	NA[2]	71	71	NA[2]	Com.—1100 W. Ellsworth
C8	71	72	NA[2]	74	70	NA[2]	Com.—100 S. Kalamath
C9	71	72	72	70	69	71	Com.—250 S. Kalamath
C10	72	73	73	71	71	72	Com.—250 S. Kalamath
C11	70	72	72	70	70	71	Com.—300 S. Kalamath
C12	70	71	72	73	72	73	Com.—300 W. Center
C13	70	71	73	73	73	74	Com.—300 W. Center
C14	67	68	71	72	71	72	Com.—300 W. Exposition
C15	74	76	76	76	76	76	Com.—2400 W. 6th
C16	70	72	72	72	72	70	Com.—2400 W. 6th
C17	71	73	74	73	73	72	Com.—900 S. Broadway
C18	73	74	75	74	74	72	Com.—900 S. Lincoln
C19	72	74	77	75	75	74	Com.—900 S. Sherman
C20	71	73	75	74	74	72	Com.—900 S. Grant
C21	69	70	73	71	71	69	Com.—1000 S. Grant
P1	69	70	70	70	68	69	Park—Vanderbilt
P2	64	65	65	65	64	64	Park—Vanderbilt
P3	65	66	66	66	66	63	Park—Vanderbilt
P4	70	71	71	71	71	69	Park—Vanderbilt
P5	65	66	67	67	67	66	Park—Habitat
P6	63	63	62	62	62	61	Park—Habitat
P7	65	65	66	66	66	66	Park—Habitat
P8	68	69	69	69	69	70	Park—Valverde
P9	64	64	65	65	65	65	Park—Valverde
P10	69	69	69	69	69	71	Park—Bike Path
P11	77	77	75	75	75	77	Park—Bike Path
P12	70	72	72	72	72	67	Park—Frog Hollow
P13	72	73	73	73	73	71	Park—Phil Milstein
P14	65	66	66	67	66	65	Park—Barnum East
P15	66	67	68	64	64	65	Res.—2900 block W. Short
P16	69	70	71	71	71	69	Park—Barnum
P20	66	68	68	68	68	67	Park—Barnum North
P21	65	66	67	67	67	66	Park—Vanderbilt East
P22	66	67	67	67	67	65	Trail— Platte/Milstein Grove
R1	69	70	71	71	67	66	Res.—700 block S. Lincoln
R2	69	70	71	71	69	69	Res.—700 block S. Lincoln
R3	69	70	70	70	70	69	Res.—700 block S. Lincoln

Table 4.6-2 Noise Model Results (continued)

Receiver	Predicted Noise Level (dBA)						Land Use[1]
	Existing	2025 No Action	2025 System 1	2025 System 2	2025 System 3	2025 Preferred Alt.	
R4	68	68	70	68	68	67	Res.—800 block S. Sherman
R5	63	64	66	64	64	64	Res.—800 block S. Sherman
R6	64	65	67	65	65	64	Res.—800 block S. Sherman
R7	60	61	62	61	61	59	Res.—800 block S. Sherman
R8	71	72	72	72	71	71	Res.—700 block S. Lincoln
R9	66	68	68	68	68	66	Res.—3300 block W. 5th
R10	65	67	67	67	67	64	Res.—3300 block W. 5th
R11	65	66	66	66	66	63	Res.—3300 block W. 5th
R12	58	59	61	59	59	59	Res.—800 block S. Sherman
R13	67	68	67	67	68	64	Res.—900 block W. Ellsworth
R14	68	69	69	71	68	67	Res.—900 block W. Byers
R15	68	68	68	68	68	68	Church—400 S. Platte River
RB1	67	68	72	NA[2]	NA[2]	NA[2]	Res.—800 block S. Lincoln
RB2	66	67	71	NA[2]	72	71	Res.—800 block S. Lincoln
RB3	65	66	70	NA[2]	73	72	Res.—800 block S. Lincoln
RB4	65	66	68	NA[2]	70	69	Res.—800 block S. Lincoln
RB5	67	68	69	NA[2]	71	70	Res.—800 block S. Lincoln
RB6	67	69	75	NA[2]	NA[2]	NA[2]	Res.—800 block S. Lincoln
RF1	65	66	69	NA[2]	NA[2]	NA[2]	Res.—800 block S. Lincoln
RF2	65	67	68	NA[2]	66	NA[3]	Res.—800 block S. Lincoln
RF3	65	67	68	NA[2]	65	NA[3]	Res.—800 block S. Lincoln
RF4	66	67	68	NA[2]	64	NA[3]	Res.—800 block S. Lincoln
RF5	67	69	68	NA[2]	64	NA[3]	Res.—800 block S. Lincoln
RF6	65	67	70	NA[2]	NA[2]	NA[2]	Res.—800 block S. Lincoln

[1] Com. = commercial; Res. = residential
[2] Receiver removed by alternative
[3] Properties were better modeled by receivers RB2-RB5
NA = Not Analyzed
Source: FHU 2006e – includes detailed map of receiver locations

A number of locations in both Categories B and C along the project corridor were either measured or predicted through modeling to equal or exceed their respective CDOT NACs under existing traffic conditions and therefore are impacted by traffic noise. These locations include residential areas, parks, two motels, a church and commercial areas (see **Figure 4.6-7**). The residential areas estimated to exceed the Category B NAC include:

- Three homes on the 800 block of S. Sherman Street
- Homes on the 500 to 800 blocks of S. Lincoln Street
- 900 block of W. Ellsworth Avenue
- 2900 block of W. Short Place
- 3300 block of W. 5th Avenue

- 900 block of W. Byers Place

Of these locations, a new replacement noise barrier has been completed for the 800 block of S. Sherman Street as part of the recently-completed T-REX project.

Essentially, all residential lots on Lincoln Street in the study area are estimated to have portions that exceed the NAC. However, the exceedences on Lincoln Street north of Ohio Avenue are due primarily to vehicles using Lincoln Street. For residences that are more than about 300 feet from I-25 or US 6, local traffic noise generally is louder than highway traffic noise.

It is estimated from the model results that overall approximately 65 residences within the study area are at or above the CDOT NAC. Of these, approximately 44 homes are either on Lincoln Street north of Ohio Avenue or on Sherman Street behind the existing noise barrier. These findings are presented in more detail in the Noise and Vibration Impact Assessment Report and Addendum (FHU, 2005f; FHU, 2006e) and are summarized in **Table 4.6-5**.

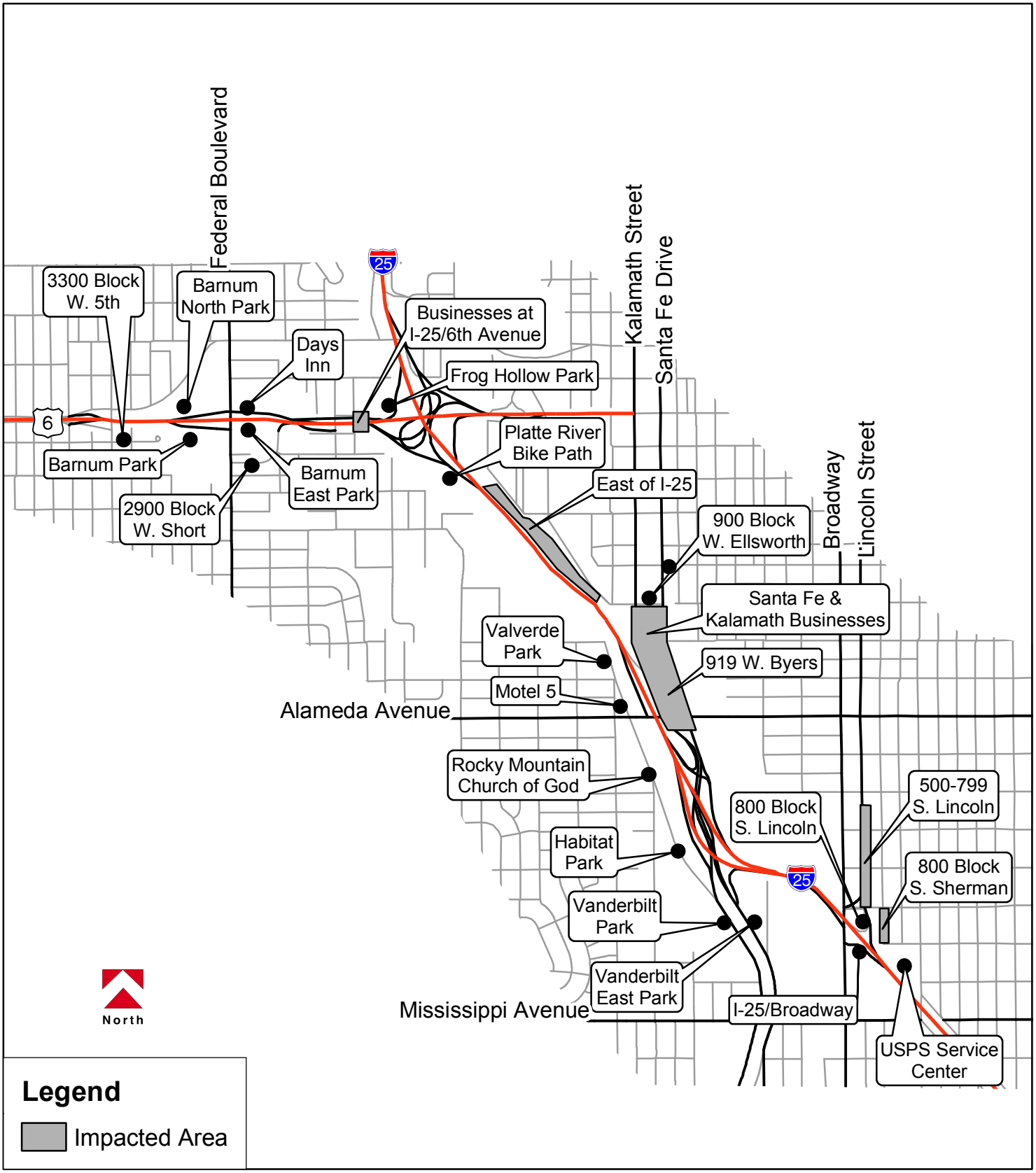
Portions of the following parks (see **Figure 4.6-7**) are estimated to have traffic noise levels above the CDOT NAC for Category B:

- Barnum Park
- Barnum East Park
- Barnum North Park
- Frog Hollow Park
- Valverde Park
- Habitat Park
- Vanderbilt Park
- Vanderbilt East Park
- South Platte River Trail (treated as a park for this evaluation)

Noise levels are also estimated to exceed the CDOT Category B NAC at:

- Motel 5 (1101 W. Alameda Avenue)
- Days Inn Motel (620 Federal Boulevard)
- Rocky Mountain Church of God (455 S. Platte River Drive)

However, none of these locations (see **Figure 4.6-7**) has any exterior facilities (e.g. yards or swimming pools). It should also be noted that all system alternatives, which include System Alternative 1, 2, 3, and the Preferred Alternative, will acquire Motel 5, so it is not a noise impact concern under any of the system alternatives.



Valley Highway, 02-069, 6/26/2006

0 0.25 0.5 1 Miles

Existing Noise-Impacted Areas

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-7

Finally, there are several commercial properties estimated to reach or exceed the Category C NAC (**Figure 4.6-7**) including:

- One business near the I-25/US 6 interchange
- Several businesses along the east side of I-25 between 4th Avenue and Virginia Avenue
- The U.S. Postal Service vehicle maintenance facility
- Two businesses near the I-25/Broadway interchange
- Several businesses along Santa Fe Drive/Kalamath Street

These results are regarded as being less of a concern than the Category B results because Category C properties are less noise sensitive.

4.6.1.3 RAILROAD NOISE

One noise measurement was made specifically for train noise (see **Figure 4.6-4**). The location was the intersection of Lipan Street and Ellsworth Avenue, about 180 feet from the tracks. One freight train passed during the one-hour monitoring period and an L_{eq} of 65 dBA was measured. It should be noted that this included noise from nearby I-25 traffic as well.

Train noise was assessed using the Federal Transit Administration (FTA) process. FTA uses several noise metrics for assessing noise impacts, but for this analysis the one-hour L_{eq} was used. For the modeling, 2.5 freight trains per hour, consisting of three locomotives and 50 cars moving at 30 miles per hour, were assumed to use the railroad corridor. Pursuant to railroad safety regulations, the trains must sound their horn at crossings at Santa Fe Drive and Kalamath Street.

Most of the land adjacent to the railroad in the project corridor is commercial, so the distance from the railroad line to where an L_{eq} of 71 dBA occurs was used to assess impacts to commercial properties. This noise level corresponds to the CDOT Category C NAC. The distance to the 71 dBA L_{eq} line was calculated for trains with and without locomotive horns sounding. Using the FTA estimation methods, the distance to 71 dBA L_{eq} is 170 feet with train horns and 50 feet without train horns. Between Alameda Avenue and US 6, numerous commercial buildings are presently within the 170-ft zone, and eight commercial buildings appear to be within the 50-ft zone.

The home nearest the rail line in the project area is in the 900 block of W. Byers Place, at a distance of 330 feet. The distance from the railroad to an L_{eq} of 66 dBA was used to assess impacts to residential properties. This noise level corresponds to the CDOT Category B NAC. The distance to the 66 dBA L_{eq} line was calculated for trains with and without locomotive horns. Using the FTA estimation methods, the distance to 66 dBA L_{eq} is 330 feet with train horns (the distance to the nearest home) and 110 feet without train horns.

4.6.1.4 RAILROAD VIBRATION

Vibration from trains has the potential to be noticeable and intrusive. Highway traffic and maintenance facility activities do not generally cause vibration problems. There has been limited research of how people respond to vibration from trains. With greater densification of land use,

more knowledge is being gained on how communities react to various levels of building vibration. The impact criteria for people in buildings subjected to ground-borne vibration and noise from trains is shown in **Table 4.6-3** (FTA, 1995).

Vibration Category 3 includes schools, churches, other institutions and quiet offices that do not have vibration-sensitive equipment but still have the potential for interference of functions. While it is generally appropriate to include office buildings in this category, it is not appropriate to include all buildings that have any designated office space. For example, most industrial buildings contain office space, but buildings primarily industrial in nature are not intended to be included in this category. Industrial buildings are often categorized in the "International Organization for Standardization (ISO) Workshop" environment with a threshold of 90 vibration decibels (Vdb) for impact evaluation (ISO,1984). Although the impact thresholds given in **Table 4.6-3** are based on experience with vibration from rail transit systems, they can be applied to freight train vibrations as well.

Table 4.6-3 Vibration Impact Criteria

Land Use Category	Ground-Borne Vibration Impact Levels (Vdb relative to 1 micro inch/sec)	
	Frequent Events[1]	Infrequent Events[2]
Category 1: Buildings where low ambient vibration is essential for interior operations	65 Vdb[3]	65 Vdb[3]
Category 2: Residences and buildings where people normally sleep	72 Vdb	80 Vdb
Category 3: Institutional land uses with primarily daytime use.	75 Vdb	83 Vdb

Source: FTA, 1995

1 "Frequent" is defined as more than 70 vibrations per day. Most rapid transit falls into this category.

2 "Infrequent" is defined as less than 70 vibrations per day. This category includes most commuter rail systems.

3 This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research land uses will require detailed evaluation to define the acceptable vibration levels.

Vdb –Velocity decibels

The vibration analysis was carried out using FTA's preliminary screening and general assessment procedures (FTA, 1995). FTA's guidelines were followed because FHWA does not have specific standards or analytical procedures for addressing vibration from transportation or railroad sources. The vibration assessment focused on the area of track relocation of the CML railroad corridor that is directly east of and parallel to I-25 from Alameda Avenue to the US 6 interchange (see **Figure 4.6-8)**. **Table 4.6-4** lists the screening distances from a railroad where ground-borne vibration impacts are possible for various land uses. The buildings that are close enough to the railroad to warrant examination for vibration impact are numbered in **Figure 4.6-8**.

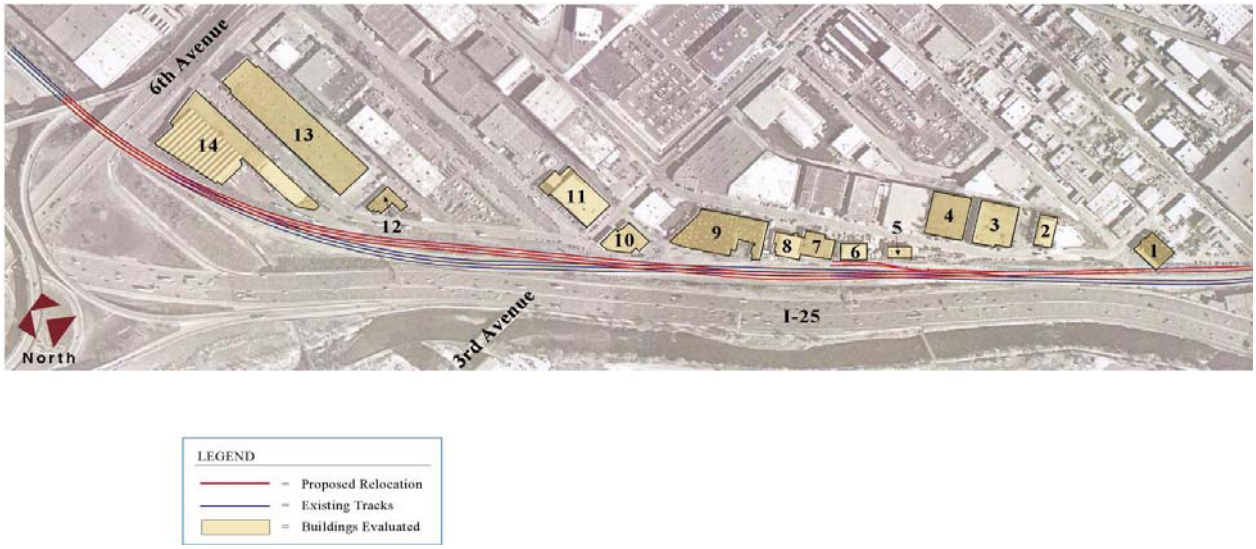
Table 4.6-4 FTA Screening Distances

Land Use Category	Distance to No Impacts
Category 1: Buildings where low ambient vibration is essential for interior operations	600 feet
Category 2: Residences and buildings where people normally sleep	200 feet
Category 3: Institutional land uses with primarily daytime use.	120 feet

Source: FTA, 1995

The 14 numbered buildings in **Figure 4.6-8** are all used as industrial facilities. As noted above, Category 3 does not typically include industrial buildings, but for this analysis, the Category 3 distance of 120 feet was used as the screening distance to be conservative. Three of these 14 buildings (4, 11, and 13) were eliminated from analysis because they were farther than 120 feet from the railroad.

Figure 4.6-8 Railroad Corridor Relocation Area



Following the preliminary screening, a general vibration impact analysis was performed. This general assessment procedure uses distance from the track to estimate vibration impacts. Adjustments were made for site-specific train speed, track structure, site geology, and building coupling according to FTA procedures to assess vibration levels at the 11 industrial buildings within 120 feet of the railroad. The overall finding was that none of the buildings appear to be impacted by railroad vibration.

4.6.2 Consequences of the Alternatives

The noise analysis was conducted to assess whether future noise levels near the project corridor would exceed the relevant CDOT NAC or cause a substantial noise increase. Either of these conditions would constitute a traffic noise impact. Noise models were constructed and run for I-25 and the other major project streets using predicted future (2025) traffic volumes and road layouts. Train noise impacts were assessed using the FTA process. The findings are presented in more detail in the Noise and Vibration Impact Assessment Report and Addendum (FHU, 2005f; FHU, 2006e) and are summarized in **Table 4.6-5**.

4.6.2.1 TRAFFIC NOISE

No Action Alternative

Model results for the No Action Alternative (see **Figure 4.6-9** and **Table 4.6-2**) are very similar to existing conditions results. Not surprisingly, the traffic noise patterns would be similar to existing noise contours pushed out a bit farther from the roads due to increased traffic volumes, so the impacted areas would be slightly larger overall. The impacts are summarized in **Table 4.6-5**. The model results show that for residences more than about 300 feet from I-25 or US 6, local traffic noise generally would be louder than highway traffic noise. The same Category B areas would be affected as under existing conditions (see **Figure 4.6-7**) with approximately 66 residences predicted to be at or above the CDOT Category B NAC. One additional residence on the 800-block of Sherman Street may be above the CDOT NAC. No noise-sensitive areas are expected to experience a 10-dBA increase as the largest increase is predicted to be 3 dBA.

There are several commercial properties with portions estimated to reach or exceed the Category C NAC including the U.S. Postal Service maintenance facility. In addition, two businesses near the I-25/US 6 interchange and many businesses along the east side of I-25 between 4th Avenue and Cherokee Street would exceed Category C NAC. Two businesses near the I-25/Broadway interchange and several businesses along Santa Fe Drive/Kalamath Street would also exceed Category C NAC. These results are similar to existing conditions.

Table 4.6-5 Noise Impact Summary

Location	Land Type	Number of Noise-Impacted Properties (without mitigation)					
		Existing Conditions	No Action	System 1	System 2	System 3	Preferred Alternative
Category B							
800 block S. Sherman Street	Residential	3	4	4	4	4	3
800 block S. Lincoln Street	Residential	9	9	9	0	6	6
500-799 S. Lincoln Street	Residential	41	41	41	41	41	41
900 block W. Ellsworth Avenue	Residential	3	3	3	3	3	3
2900 block W. Short Place	Residential	5	5	5	0	0	0
3300 block W. 5th Avenue	Residential	3	3	3	3	3	1
900 block Byers Place	Residential	1	1	1	1	1	1
Barnum Park	Park	1	1	1	1	1	1
Barnum East Park	Park	1	1	1	1	1	0*
Barnum North Park	Park	1	1	1	1	1	1
Frog Hollow Park	Park	1	1	1	1	1	1
Valverde Park	Park	1	1	1	1	1	1
Habitat Park	Park	1	1	1	1	1	1
Vanderbilt Park	Park	1	1	1	1	1	1
Vanderbilt East Park	Park	1	1	1	1	1	1
South Platte River bike path	Park	1	1	1	1	1	1
Motel 5	Motel	1	1	0	0	0	0
Days Inn	Motel	1	1	1	1	1	1
Rocky Mountain Church of God	Church	1	1	1	1	1	1
Category C							
6th Avenue	Commercial	1	2	2	2	2	1
I-25	Commercial	7	7	7	5	5	2
Post Office Service Center	Commercial	1	1	1	1	1	1
I-25/Broadway	Commercial	2	2	2	2	2	3
Santa Fe Drive/ Kalamath Street	Commercial	37	44	42	27	28	35

*braided ramp provides noise shielding from US 6

Valley Highway, 02-069, 6/26/2006

0 0.25 0.5 1 Miles

No Action Alternative: 2025 Noise Contours

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-9

System Alternative 1

Model results for System Alternative 1 (see **Figure 4.6-10** and **Table 4.6-2**) are similar to the No Action results, even with the proposed roadway changes. The impacts are summarized in **Table 4.6-5.** The same Category B areas would be affected (see **Figure 4.6-7**) and the same residences would be above the CDOT NAC. A small traffic noise benefit would be realized by grade separating Santa Fe Drive and Kalamath Street under the railroad. The fly-over ramps at I-25/Alameda Avenue and I-25/Santa Fe Drive would not impact any neighboring Category B areas, using CDOT/FHWA criteria.

The model results show that for residences more than about 300 feet from I-25 or US 6, local traffic noise generally would be louder than highway traffic noise. Approximately 66 residences are predicted to be at or above the CDOT Category B NAC for System Alternative 1. Of these 66 residences, 41 are located along Lincoln Street north of Ohio Avenue, in the area where noise from local streets predominates. No noise-sensitive areas are expected to experience a 10-dBA increase; the largest increase is predicted to be 5 dBA.

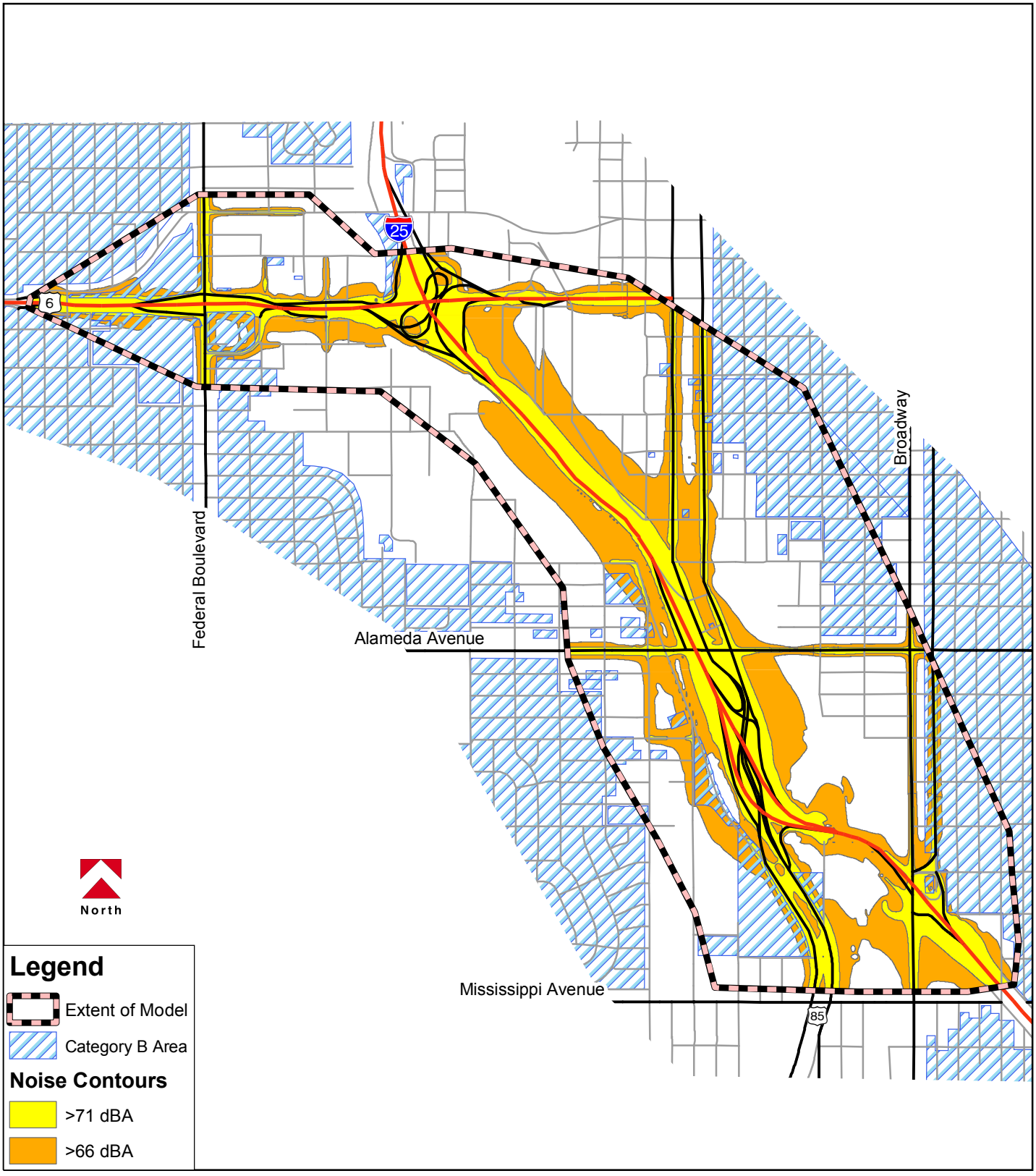
There are several commercial properties with portions estimated to reach or exceed the Category C NAC including the U.S. Postal Service vehicle maintenance facility. Two businesses near the I- 25/US 6 interchange and many businesses along the east side of I-25 between 4thAvenue and Cherokee Street would also reach or exceed the Category C NAC.
Two businesses near the I-25/Broadway interchange and several businesses along Santa Fe Drive/Kalamath Street would reach or exceed the Category C NAC. It should be noted that this alternative may remove two commercial buildings near I-25/Bayaud Avenue.

System Alternative 2

Model results for System Alternative 2 (see **Figure 4.6-11** and **Table 4.6-2**) are similar to the No Action model results, even with the proposed roadway changes. The impacts are summarized in **Table 4.6-5**. The same Category B areas would be affected (see **Figure 4.6-7**). A small noise benefit would be realized by grade separating Santa Fe Drive and Kalamath Street under the railroad. A small noise benefit would be realized by moving the Federal Boulevard-to-eastbound-US 6 ramp closer to US 6. The separation of Santa Fe Drive/Kalamath Street over Alameda Avenue would not impact any neighboring Category B areas, using CDOT/FHWA criteria. The fly-over ramp at I-25/Santa Fe would not impact any neighboring Category B areas, using CDOT/FHWA criteria.

The model results show that for residences more than about 300 feet from I-25 or US 6, local traffic noise generally is louder than highway traffic noise. Approximately 52 residences are predicted to be at or above the CDOT Category B NAC. Of these 52 residences, 41 are located along Lincoln Street north of Ohio Avenue, in the area where noise from local street predominates. No noise-sensitive areas are expected to experience a 10-dBA increase as the largest increase is predicted to be 4 dBA.

Several commercial properties have portions estimated to reach or exceed the Category C NAC including the U.S. Postal Service vehicle maintenance facility. Additionally, two businesses near the I-25/US 6 interchange and many businesses along the east side of I-25 between 4th Avenue and Bayaud Avenue would reach or exceed Category C NAC. Two businesses near the I-25/Broadway interchange and several businesses along Santa Fe Drive/Kalamath Street



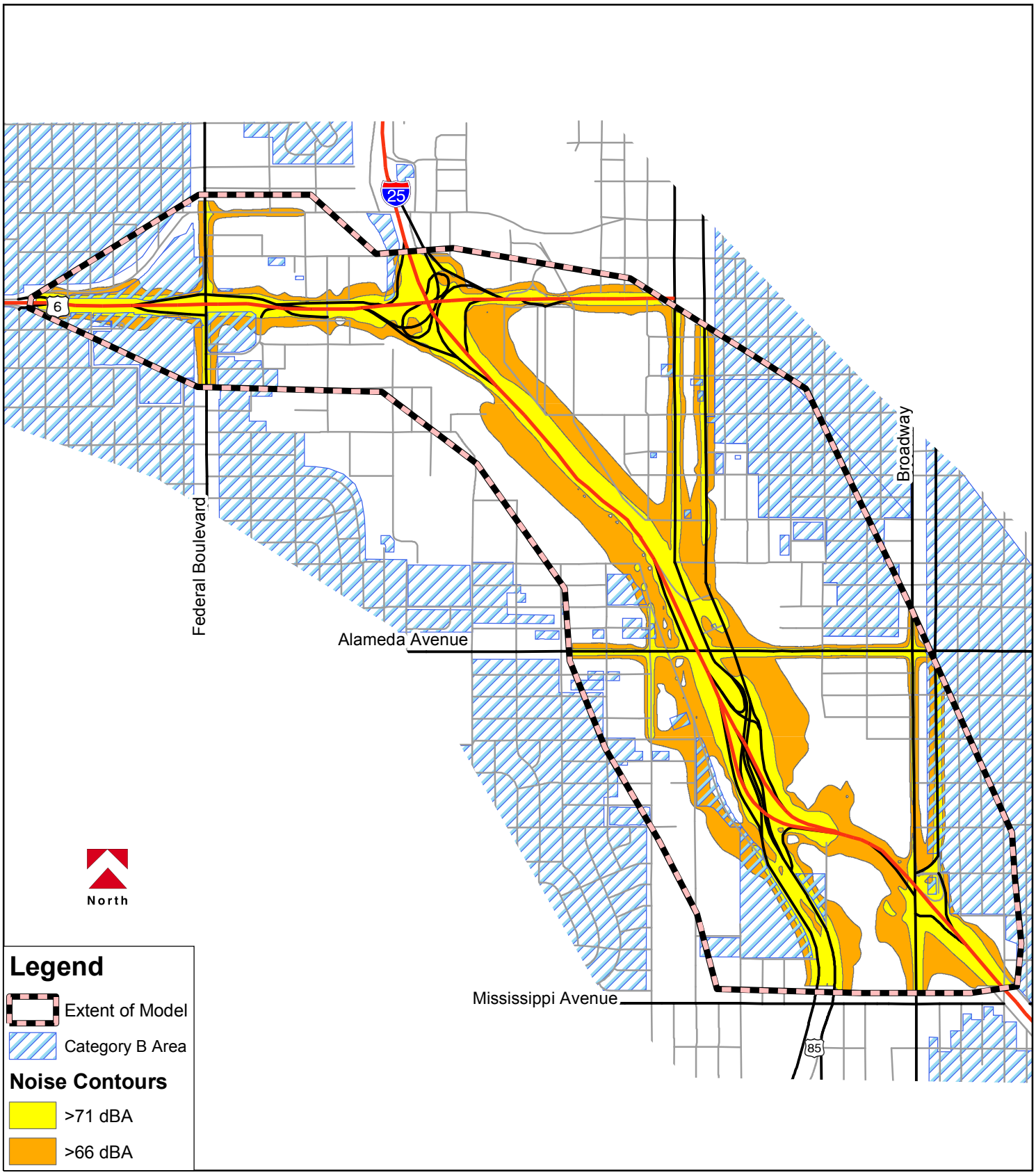
Valley Highway, 02-069, 6/26/2006

0 0.25 0.5 1 Miles

System Alternative 1: 2025 Noise Contours

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-10



Valley Highway, 02-069, 6/26/2006

0 0.25 0.5 1 Miles

System Alternative 2: 2025 Noise Contours

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-11

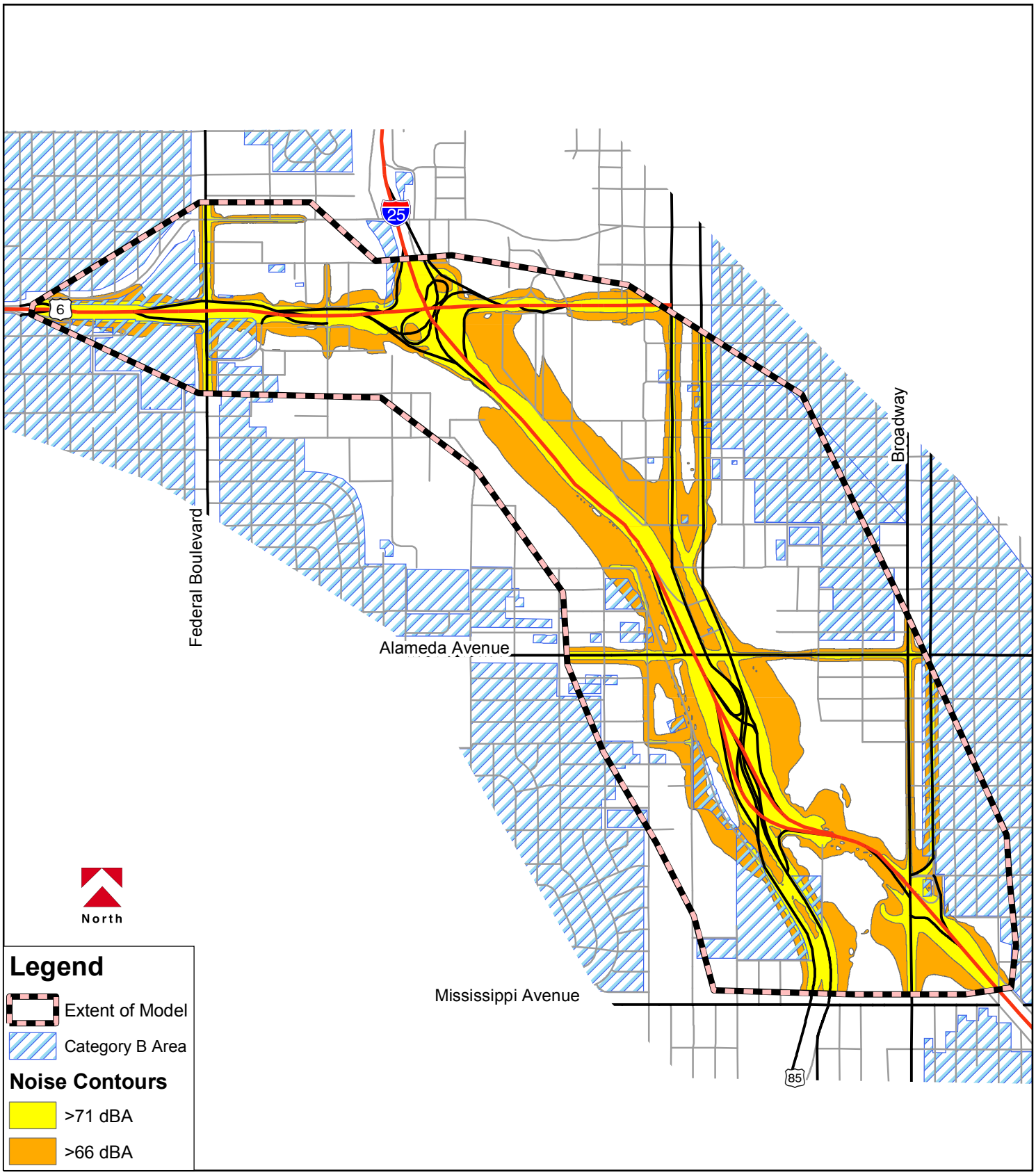
would reach or exceed Category C NAC. It should be noted that this alternative may remove two commercial buildings near I-25/Bayaud Avenue and the buildings between Santa Fe Drive, Kalamath Street, Bayaud Avenue and Dakota Avenue.

System Alternative 3

Model results for System Alternative 3 (see **Figure 4.6-12** and **Table 4.6-2**) are similar to the No Action Alternative model results, even with the proposed roadway changes. The impacts are summarized in **Table 4.6-5.** The same Category B areas are affected (see **Figure 4.6-7**). A larger local noise benefit than either System Alternatives 1 or 2 would be realized by grade separating Santa Fe Drive and Kalamath Street under both the railroad and Alameda Avenue. A small noise benefit would be realized by moving the Federal Boulevard-to-eastbound-US 6 ramp closer to US 6. A localized noise penalty would be realized from a realigned ramp at the I-25/Broadway interchange. The fly-over ramps at I-25/Alameda Avenue and I-25/Santa Fe Drive would not impact any neighboring Category B areas, using CDOT/FHWA criteria.

The model results show for residences more than about 300 feet from I-25 or US 6, local traffic noise generally would be louder than highway traffic noise. Approximately 58 residences are predicted to be at or above the CDOT Category B NAC. Of these 58 residences, 41 are located along Lincoln Street north of Ohio Avenue, in the area where noise from local streets predominates. No noise-sensitive areas are expected to experience a 10-dBA increase, as the largest increase is predicted to be 8 dBA. The maximum noise increase would be greater for System Alternative 3 because System Alternative 3 realigns an I-25 off-ramp closer to the remaining homes on the 800-block of Lincoln Street.

Several commercial properties have portions estimated to reach or exceed the Category C NAC, including the U.S. Postal Service vehicle maintenance facility. Two businesses near the I-25/US 6 interchange and many businesses along the east side of I-25 between 4th Avenue and Bayaud Avenue would reach or exceed Category C NAC. In addition, two businesses near the I-25/Broadway interchange and several businesses along Santa Fe Drive/Kalamath Street that would reach or exceed Category C NAC. It should be noted that this alternative may remove two commercial buildings near I-25/Bayaud Avenue and the buildings between Santa Fe Drive, Kalamath Street, Bayaud Avenue, and Dakota Avenue.



Valley Highway, 02-069, 6/26/2006

0 0.25 0.5 1 Miles

System Alternative 3: 2025 Noise Contours

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-12

Preferred Alternative

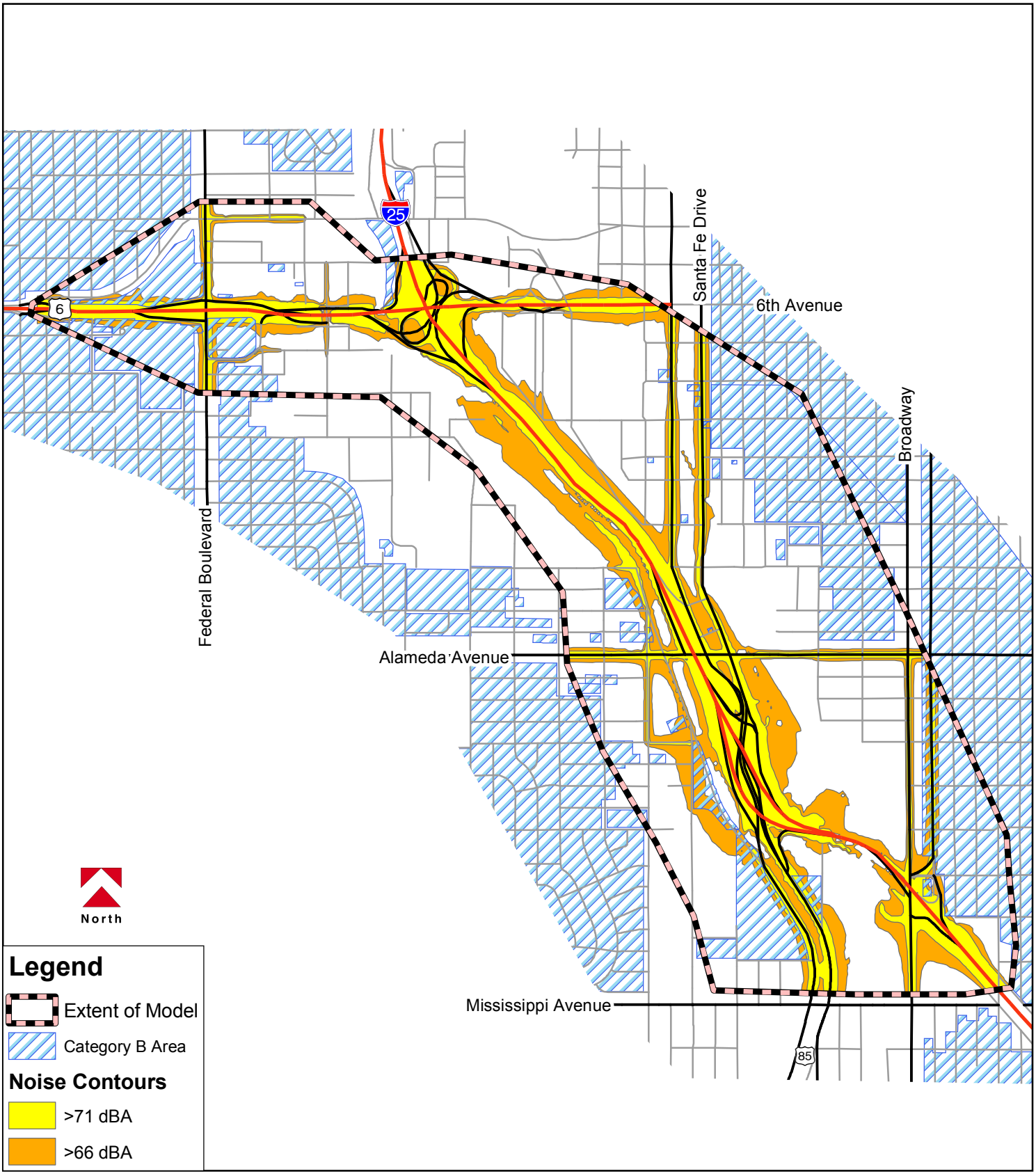
Model results for the Preferred Alternative (see **Figure 4.6-13** and **Table 4.6-2**) are similar to the No Action Alternative model results, even with the proposed roadway changes. The impacts are summarized in **Table 4.6-5.** Generally, the same Category B areas are affected (see **Figure 4.6-7**). A small traffic noise benefit would be realized by grade separating Santa Fe Drive and Kalamath Street under the railroad. A small noise benefit would be realized by moving the Federal Boulevard-to-eastbound-US 6 ramp closer to US 6. A localized noise penalty would be realized for four properties from a realigned ramp at the I-25/Broadway interchange. The fly-over ramps at I-25/Alameda Avenue and I-25/Santa Fe Drive would not impact any neighboring Category B areas, using CDOT/FHWA criteria. The model results show for residences more than about 300 feet from I-25 or US 6, local traffic noise generally would be louder than highway traffic noise. Approximately 55 residences are predicted to be at or above the CDOT Category B NAC. No noise-sensitive areas are expected to experience a 10-dBA increase, as the largest increase is predicted to be 7 dBA. This noise increase would be greater than for System Alternatives 1 or 2 because the Preferred Alternative realigns an I-25 off-ramp closer to the remaining homes on the 800-block of South Lincoln Street.

Several commercial properties have portions estimated to reach or exceed the Category C NAC, including the U.S. Postal Service vehicle maintenance facility. One business near the I-25/US 6 interchange and two businesses along I-25 between 4th Avenue and Bayaud Avenue would reach or exceed Category C NAC. In addition, three businesses near the I-25/Broadway interchange and 35 businesses along Santa Fe Drive/Kalamath Street that would reach or exceed Category C NAC. It should be noted that this alternative may remove two buildings near I-25/Bayaud Avenue and the buildings between Santa Fe Drive, Kalamath Street, Bayaud Avenue, and Dakota Avenue.

4.6.2.2 RAILROAD NOISE

Under all system alternatives, the railroad tracks would be grade-separated from Santa Fe Drive and Kalamath Street, which would eliminate the need for train horns in the project corridor and eliminate the impact zones from them. This would be a net noise benefit of the proposed project. The railroad tracks are also expected to be relocated as far as approximately 50 feet to the east between 4th Avenue and Ellsworth Avenue. These changes would bring the rails closer to some commercial buildings. This move would result in five to seven buildings within the 50-feet commercial impact zone, but the 170-feet zone would be eliminated along with the train horns. The rail relocation will not affect the distance (or the results) to the nearest homes in the corridor; however, the grade separation would eliminate the 330-feet zone along with the train horns, and would substantially reduce the train noise at homes in the larger area.

Overall, the changes in train noise due solely to the proposed relocation of the railroad would be minor because the relocation distance is not great. However, the proposed grade separation would markedly reduce train noise in the larger area through the elimination of locomotive horns. The proposed changes would provide a net noise benefit to the larger railroad corridor and no mitigation actions are necessary.



Valley Highway, 02-069, 6/19/2006

0 0.25 0.5 1 Miles

Preferred Alternative: 2025 Noise Contours

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-13

4.6.2.3 RAILROAD VIBRATION

As noted above, FTA's impact thresholds are based on experience with vibration from rail transit systems, but they can be applied to freight rail vibrations as well. These projected vibrations were adjusted for train speed and site geology.

The results of the vibration impact assessment are summarized in **Table 4.6-6**. This table lists the building number from **Figure 4.6-8**, the predicted vibration level and FTA criterion.

As **Table 4.6-6** shows, the predicted vibration for both locomotives and rail cars are less than the ISO 90 Vdb impact level for industrial buildings. In addition, all the buildings analyzed, except for Buildings 1 and 14, satisfy the more restrictive impact level requirements for FTA Category 3. Part of Building 1 must be demolished to accommodate the track relocation. Ballast mats could be used as mitigation near Buildings 1 and 14 to lower the vibration impact to fall within the Category 3 limits, but it is not necessary for these buildings to meet the Category 3 limits.

Table 4.6-6 Vibration Impact Projections without Mitigation

Building	Location	Distance from Near Track (feet)	Rail Car		Locomotive	
			Impact Criterion (Vdb)	Projected Vibration (Vdb)	Impact Criterion (Vdb)	Projected Vibration (Vdb)
1	1030 W. Ellsworth Avenue	25	75	73	83	86
2	50 Rio Grande Boulevard	103	75	63	83	75
3	70 Rio Grande Boulevard	108	75	63	83	74
5	95 Rio Grande Boulevard	55	75	69	83	80
6		52	75	69	83	81
7	123 Rio Grande Boulevard	59	75	68	83	79
8	201 Rio Grande Boulevard	58	75	68	83	79
9	275 Rio Grande Boulevard	54	75	69	83	80
10	1480/1490 W. 3rd Avenue	36	75	72	83	83
12	400 Raritan Way	104	75	63	83	75
14	401 Quivas Street	33	75	72	83	84

Notes:
Buildings 4, 11, and 13, were beyond the screening distance and are not included.
Buildings 5, 6, 7, 8, and 9 are at relatively greater distance from nearest track
Vdb – Velocity decibels

4.6.3 Mitigation Measures

The noise analysis was conducted to assess whether future noise levels near the project corridor would cause a noise impact. Impacted areas are not guaranteed mitigation measures, but mitigation measures must be evaluated. Traffic noise impacts are predicted in the project area (see **Section 4.6.2**); therefore, noise mitigation measures for the impacted areas were considered and evaluated following CDOT guidelines (CDOT, 2002a). The overall feasibility and reasonableness of each noise mitigation measure that provided an acceptable benefit for the impacted receivers were evaluated. Only mitigation measures that are found to be both reasonable and feasible are recommended for implementation (CDOT, 2002a).

Typically, noise barriers are the mitigation action evaluated, but avoidance and non-barrier mitigation were also considered. These findings are presented in the Noise and Vibration Impact Assessment Report and Addendum (FHU, 2005f; FHU, 2006e).

Barriers are the only viable mitigation for providing the required noise reduction in the space available and were the only mitigation considered in detail. To permit evaluation, barriers protecting each impacted area (see **Figure 4.6-14**) were developed for the system alternatives and the models were re-run to assess barrier effectiveness. Following CDOT guidelines, barriers providing 10 dBA and 5 dBA of noise reduction were both evaluated for feasibility and reasonableness. After the minimum barrier parameters were established in a given area for a feasible barrier (if possible) from the model runs, each barrier was processed through a reasonability assessment according to CDOT guidance (CDOT, 2002a). Barriers that were found to be both feasible and reasonable were recommended for implementation (see **Table 4.6-7**).

The impacted areas include multiple geographic areas and multiple land uses. The impacted areas and mitigation evaluations included:

- 800 Block of S. Sherman Street
- 500-899 South Lincoln Street
- 900 Block of W. Ellsworth Avenue
- 2900 Block of W. Short Place
- 3300 Block of W. 5th Avenue
- Barnum Park
- Barnum East Park
- Barnum North Park
- Frog Hollow Park
- Valverde Park
- Habitat Park
- Vanderbilt Park
- Vanderbilt East Park
- Days Inn Motel
- Rocky Mountain Church of God
- South Platte River Bike Path
- 900 block of W. Byers Place
- Various Commercial Areas

Valley Highway, 02-069, 6/19/2006

Mitigation Barriers Evaluated

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-14

Table 4.6-7 Noise Mitigation Barrier Summary

Noise Impacted Area	Barrier For 5 dBA Noise Reduction						Barrier For 10 dBA Noise Reduction				
	Barrier Length (feet)	Barrier Height (feet)	Feasible?[1]	Reasonable?[1]	Recommended?	Comment	Barrier Height (feet)	Feasible?[1]	Reasonable?[1]	Recommended?	Comment
Category B											
800 block S. Sherman Street	NA	NA	NA	NA	NA	This area is covered by a new T-REX barrier.	NA	NA	NA	NA	This area is covered by a new T-REX barrier.
800 block S. Lincoln Street-Alternative 1	840	6-8	Yes	Yes	Yes	Cost/benefit is reasonable.		No		No	10 dBA reduction could not be achieved.
800 block S. Lincoln Street-Alternative 3 and Preferred Alternative	360	12	Yes	Yes	Yes	Cost/benefit is high but still recommended.		No		No	10 dBA reduction could not be achieved.
500-799 S. Lincoln Street	NA	NA	No		No	A noise barrier would prohibit access to the homes.		No		No	A noise barrier would prohibit access to the homes.
900 block W. Ellsworth Avenue	NA	NA	No		No	A noise barrier would prohibit access to the homes.		No		No	A noise barrier would prohibit access to the homes.
2900 block W. Short Place-Alternative 1	260	8	Yes	Yes	Yes	For Alternative 1 only.	25	Yes	No	No	This barrier needed to be 420 feet long.
3300 block W. 5th Avenue	300	10	Yes	No	No	Barrier provides relatively little benefit..		No		No	10 dBA reduction could not be achieved.
900 block W. Byers Place	NA	NA	No		No	A noise barrier would prohibit access to the home.		No		No	A noise barrier would prohibit access to the home.
Barnum Park	1200	10-11	Yes	No	No	Barrier provides relatively little benefit.					Not analyzed.
Barnum East Park	NA	NA	No		No	Could not achieve 5-dBA reduction.					Not analyzed.
Barnum North Park	1350	14	Yes	No	No	Barrier provides relatively little benefit.					Not analyzed.
Frog Hollow Park	1500	8	Yes	No	No	Barrier provides relatively little benefit.					Not analyzed.

Table 4.6-7 Noise Mitigation Barrier Summary (Continued)

Noise Impacted Area	Barrier For 5 dBA Noise Reduction						Barrier For 10 dBA Noise Reduction				
	Barrier Length (feet)	Barrier Height (feet)	Feasible?[1]	Reasonable?[1]	Recommended?	Comment	Barrier Height (feet)	Feasible?[1]	Reasonable?[1]	Recommended?	Comment
Valverde Park	550	10	Yes	No	No	Barrier provides relatively little benefit.					Not analyzed.
Habitat Park	NA	NA	No		No	A noise barrier would prohibit access to the park.					Not analyzed.
Vanderbilt Park	2100	6-7	Yes	No	No	Barrier provides relatively little benefit.					Not analyzed.
Days Inn	NA	NA	No		No	No exterior uses in the impacted area.					Not analyzed.
Vanderbilt East Park	1050	14	Yes	No	No	Barrier provides relatively little benefit.					Not analyzed.
Platte River bike path	2100	12	Yes	No	No	Barrier provides relatively little benefit.					Not analyzed.
Platte River bike path at 3rd Avenue	500	9	Yes	No	Yes	Cost/benefit is high but still recommended	13	Yes	No	No	Cost/benefit is too high
Motel 5	NA	NA	NA	NA	NA	All System Alternatives remove this motel					Not analyzed.
Rocky Mountain Church of God	NA	NA	No		No	Barrier conflicts with access; no exterior uses.					Not analyzed.
Category C											
I-25/6th Avenue	750	6-9	Yes	No	No	Cost/benefit is too high.					Not analyzed.
East of I-25	2200	10	Yes	No	No	Cost/benefit is too high.					Not analyzed.
Post Office Service Center	580	9	Yes	No	No	Cost/benefit is too high.					Not analyzed.
I-25/Broadway	725	11-14	Yes	No	No	Cost/benefit is too high.					Not analyzed.
Santa Fe Drive/Kalamath Street	NA	NA	No			Could not get 5 dBA reduction. Barrier blocking noise also blocks property access.					Not analyzed.
S. Santa Fe/I-25	1300	5-12	Yes	No	No	Cost/benefit is too high.					Not analyzed.

[1]According to CDOT guidelines (CDOT, 2002a).
NA - not applicable

The feasibility and reasonableness evaluations for the noise barriers resulted in the recommendation of certain mitigation actions (see **Table 4.6-7**) to be further considered and refined during final design. The barriers for the other traffic noise impacted areas were found to be either infeasible or unreasonable and were not recommended. For brevity, only the recommended noise barriers are described below. More detailed information on the other barriers evaluated can be found in the Noise and Vibration Impact Assessment and Addendum (FHU, 2005f; FHU, 2006e) and **Table 4.6-7**.

4.6.3.1 TRAFFIC NOISE

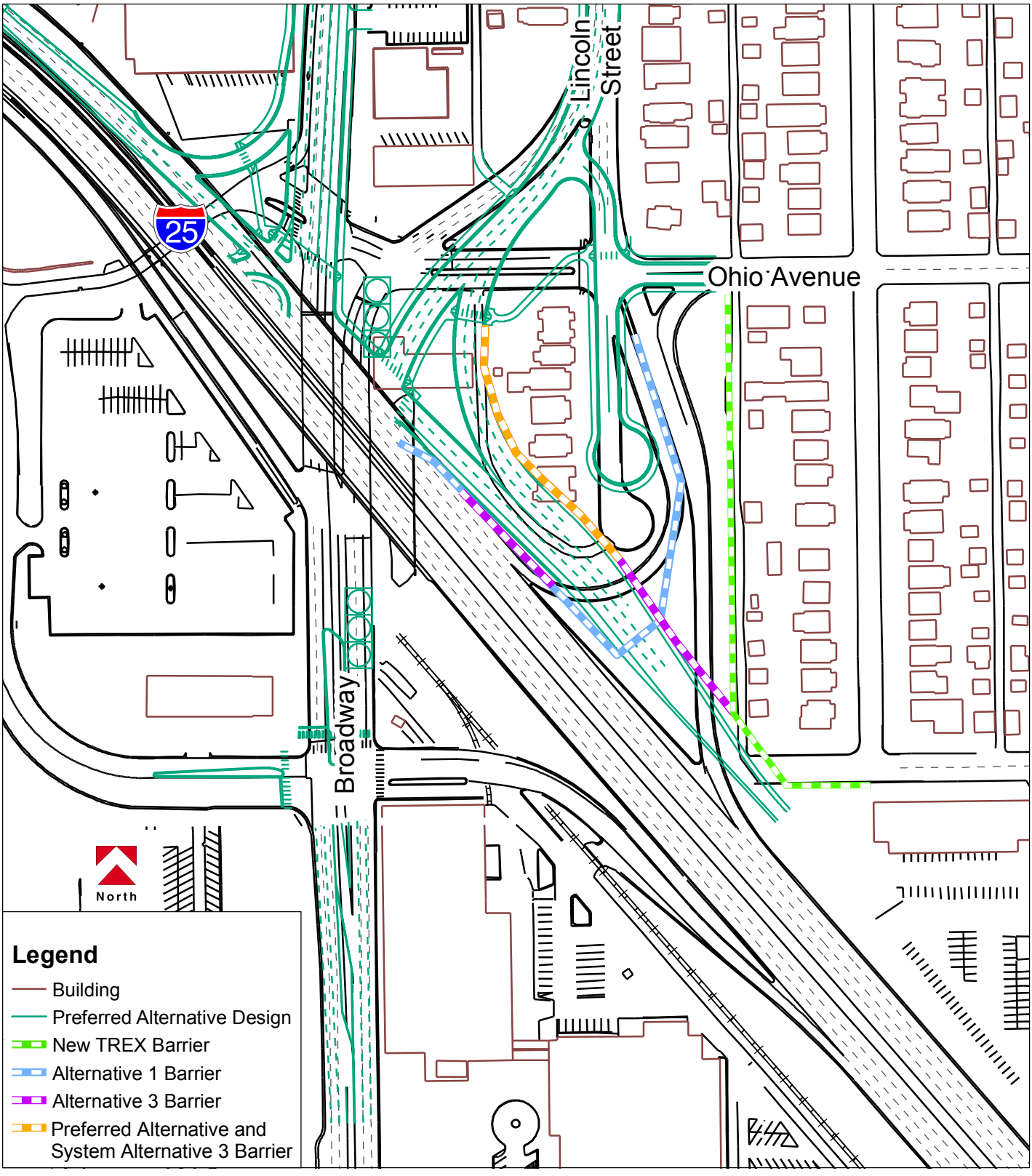
Lincoln Street South of Ohio Avenue

Lincoln Street south of Ohio Avenue in the study area consists solely of the homes on the 800 block. Along with the homes on Sherman Street, these homes are the closest residences to I-25 in the entire project corridor. With the complex traffic noise situation in this area, a 10-dBA noise reduction could not be achieved short of encircling the homes with barriers, which is not feasible. Therefore, mitigation for a 10-dBA noise reduction is not discussed further.

Under System Alternative 1, none of the homes on this block would be physically disturbed. This alternative will leave the future roads similar to the current roads. A barrier was modeled between the homes and both I-25 and the future off-ramp (see **Figure 4.6-15**). With the current understanding of future ground elevations, a continuous barrier varying in height from 6 to 8 feet and 840 feet long would provide a 5-dBA noise reduction for most of the homes on the block. The cost/benefit calculation for this barrier was in the reasonable category following CDOT guidelines. Therefore, the barrier is recommended, especially with these houses being closely surrounded by busy roads.

Under System Alternative 2, all of the homes on this block would be removed. Therefore, no mitigation for this block is necessary under this alternative.

For System Alternative 3 and the Preferred Alternative, the two southernmost homes on this block would be removed; the other homes on the block would remain. The I-25 off-ramp would be relocated from the east to west sides of the homes. With the current understanding of future ground elevations, the barrier would be 12 feet tall and 360 feet long. The cost/benefit calculation for these barriers was in the unreasonable category of CDOT guidelines. However, the noise abatement barriers are still recommended, given the unusual circumstance of these houses being closely surrounded by busy roads.



Valley Highway, 02-069, 6/19/2006

0 125 250 Feet

South Lincoln Street Mitigation Barriers

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-15

2900 Block of W. Short Place

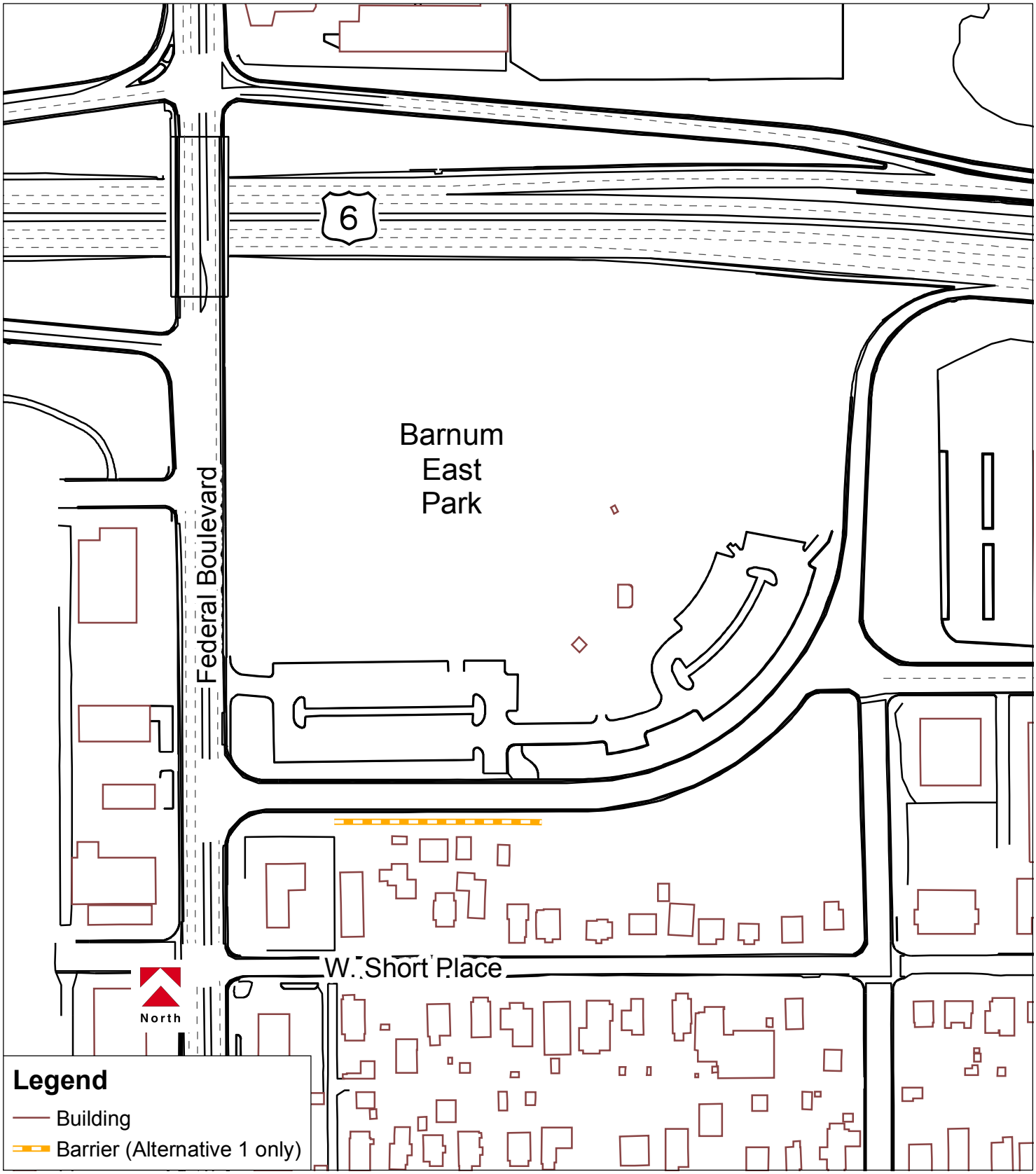
Four residences on Short Place would have noise levels above the NAC due to traffic on the ramp from Federal Boulevard to eastbound US 6. Replacing the rear property fences with a barrier (see **Figure 4.6-16**) approximately 8 feet by 260 feet would provide a 5-dBA noise abatement for these properties and this barrier was found to be both feasible and reasonable. To achieve a 10 dBA noise reduction at this position, a barrier 25 feet tall and 420 feet long was necessary, which was found to be unreasonable according to CDOT guidelines. The 8-feet barrier is being recommended only for System Alternative 1. System Alternatives 2 and 3, and the Preferred Alternative would relocate this ramp closer to US 6 and remove the traffic noise impact from these homes, so this barrier would not be needed for System Alternatives 2, 3, or the Preferred Alternative.

South Platte River Trail

Parts of the South Platte River Trail are predicted to have noise levels that would exceed the Category B NAC. The portion of the trail covered by this evaluation is the section between 6th Avenue and Alameda Avenue. There is a subsegment of the trail at 3rd Avenue (see **Figure 4.6-17**) where the path is at the same elevation as I-25 and as little as 10 feet from I-25 pavement. This segment is very noisy and its current arrangement raises some safety concerns. For this segment of the trail, a barrier 9 feet high by 500 feet long could provide more than 5 dBA of noise reduction and could provide a safety benefit to bicyclists. (A 13-feet barrier could provide 10 dBA of noise reduction on the bike path.) The 9-foot high barrier is recommended. Barriers for other portions of the trail are not recommended (FHU, 2005f; FHU, 2006e).

4.6.3.2 RAILROAD VIBRATION

Neither the applicable FTA nor ISO vibration criteria were exceeded at the buildings analyzed along the rail relocation corridor, so no vibration mitigation is necessary.



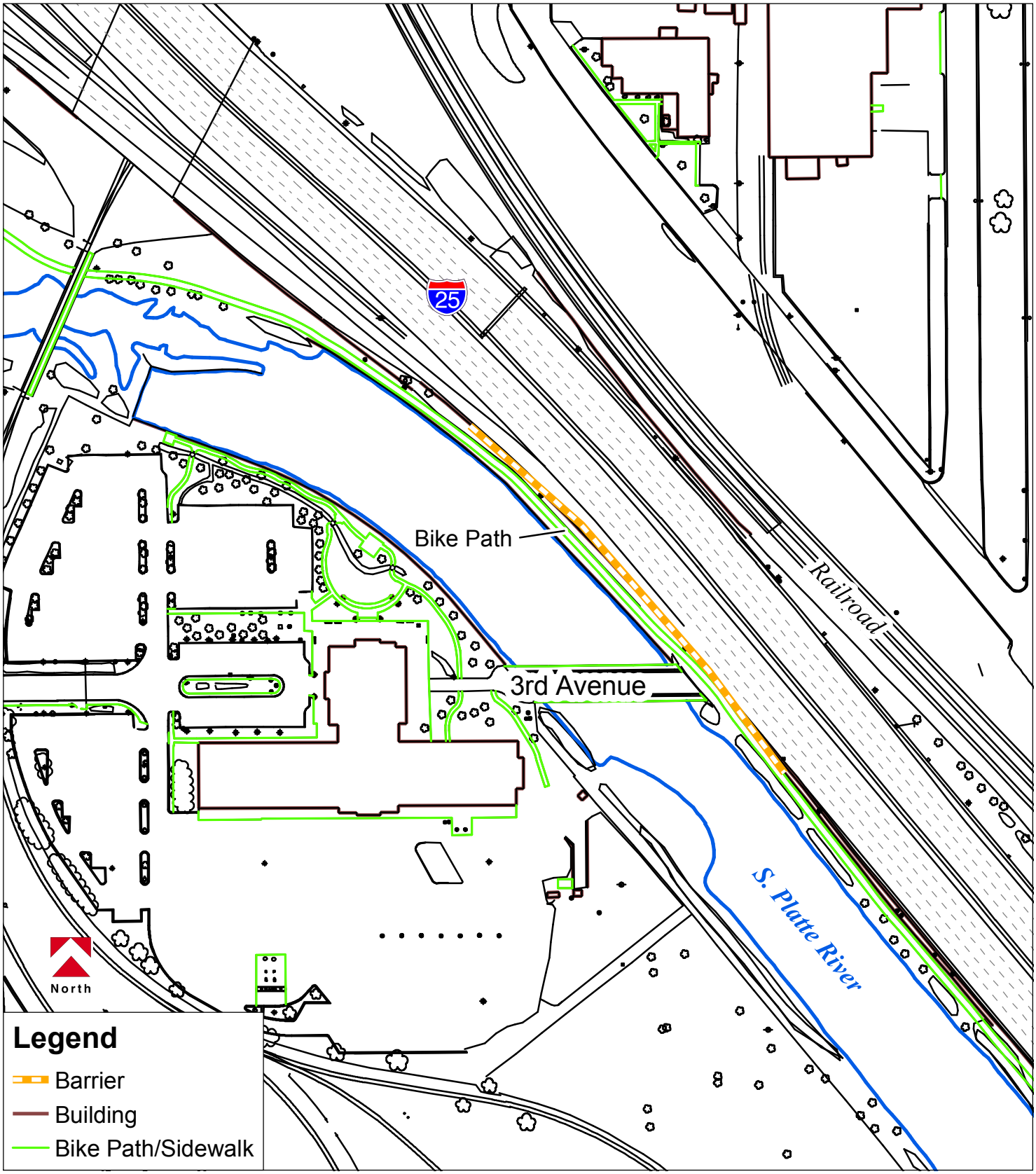
Valley Highway, 02-069, 10/27/2004

0 125 250 Feet

West Short Place Mitigation Barrier

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-16



Valley Highway, 02-069, 6/19/2006

0 125 250 Feet

South Platte Trail Mitigation Barrier

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.6-17

4.6.4 Nuisance Noise Considerations

The Citizen Working Group for noise provided a means for neighbors of the project corridor and interested citizens to express issues and concerns to CDOT. The members of the Citizen Working Group made it clear that noise from the project corridor is a major concern to them.

Noise impacts were examined as a standard part of the EIS in accordance with CDOT/FHWA guidelines. These guidelines specify that a noise impact occurs when a property approaches or exceeds the NAC specific to the property use, or when a property will experience a noise increase of 10 dBA or more. The guidelines further specify that impacted properties are evaluated for noise mitigation measures on the basis of feasibility and reasonableness of the mitigation measure. Specific noise mitigation measures (i.e., barriers) for impacted properties may or may not be recommended based on this mitigation evaluation. Properties that are not predicted to experience a noise impact typically are not considered for noise mitigation.

Members of the Citizen Working Group made it clear that they are bothered by traffic noise from the existing highway corridor, even if the sound levels are less than those specified in the CDOT/FHWA guidance. Working Group members were very interested in trying to reduce this "nuisance noise" that is not captured by the typical CDOT/FHWA noise analysis process. For purposes of this discussion, the "nuisance noise" of interest includes the following characteristics:

- Encompasses noise from traffic
- Is below CDOT/FHWA NAC levels
- Bothers/annoys people
- Interferes with quality of life
- Includes low-frequency sounds not adequately covered by A-weighted sound levels (i.e., C-weighted sound levels)
- Impacts property values

In light of this, the Citizen Working Group developed the following suggestions to be considered to reduce "nuisance noise" and improve the quality of life for neighbors of the project corridor.

- **Alternative Selection –** Consider the alternative or improvement that has the least impacts from a noise perspective as evaluation criteria. (Note: the Preferred Alternative includes the least noise element alternatives for the interchanges at I-25/ Broadway and US 6 /Federal where residential areas are closest to the project highway corridors.)
- **Pavement Type –** Consider the quietest pavement type throughout the corridor that can meet the safety and durability requirements. Stone matrix asphalt, which has been used on the new I-25/Broadway viaduct, was an example cited of a way to implement nuisance noise considerations. CDOT has recently initiated a study to evaluate the long-term relationship between different pavement types/surface textures and traffic noise, and this information may be used in the future to help minimize traffic noise.
- **Taller Barriers –** Use the taller Type 7 barriers or similar in the corridor to maximize noise reduction benefits from these necessary project components.

- **Absorptive Material –** Use sound-absorptive material wherever possible in the project corridor. This includes pavement type and vegetation.
- **Aesthetic Treatment/Landscaping –** Use aesthetic treatments and landscaping in the project to reduce traffic noise where possible. Combine visual treatments with noise-reducing properties, such as rough/uneven surfaces that reflect less sound rather than flat surfaces. Use earthen berms where possible. Use multi-purpose barriers (traffic control and noise reduction) wherever possible. Coordinate planning and design so that noise reduction actions are considered throughout the corridor.
- **Focused Actions –** Focus noise reduction actions to provide the most benefit to the most sensitive noise receptors.

In response to these concerns and suggestions, CDOT has agreed to consider additional noise reduction measures through project design. These are not mitigation actions and are not directed toward the traffic noise impacted properties. These are project enhancements that may be implemented as feasible to address concerns that are beyond the project impacts and project mitigation actions. Therefore, for project enhancement and betterment purposes, CDOT will evaluate the technological and economic feasibility of the following actions in final design of each construction phase of the project:

- Adopt traffic noise reduction as a goal in project development
- Evaluate noise barriers and other noise reduction techniques
- Examine noise impacts from a broader perspective
- Plan for noise reduction actions comprehensively throughout design
- Include noise-reducing technologies systematically

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