Noise Analysis

for

Callaway County Connector
Callaway County, Missouri

Prepared for
Ameren Missouri
and
Missouri Department of Transportation

July 2011

Prepared by

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SINCE 1898

NOISE ANALYSIS
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Project No. 51245

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PART 1

INTRODUCTION

Ameren Missouri, in cooperation with the Missouri Department of Transportation (MoDOT) and the Federal Highway Administration (FHWA) has proposed the construction of the Callaway County Connector—a route to connect Route 54 and Route CC across Callaway County, Missouri.

A noise assessment study, the subject of this report, was completed in order to investigate the potential traffic noise impacts caused by the construction and operation of the Callaway County Connector. Traffic noise impacts were determined using forecast future vehicle counts provided by HNTB for the Callaway County Connector.

The noise study consists of five main steps:

- Identification of existing sensitive receivers which may be affected by noise as a result of the proposed roadway improvements
- Determination of existing noise levels at the identified sensitive receivers
- Prediction of traffic noise levels for the build, no-build, and southern alternative scenarios for the design year 2037, using the Federal Highway Administration's Traffic Noise Model (TNM), Version 2.5.
- Determination of traffic noise impacts to sensitive receivers in comparison to the Federal Highway Administration's (FHWA) Noise Abatement Criteria (NAC) and existing noise levels

PART 2

TERMINOLOGY

Both existing and predicted noise levels are reported in hourly equivalent sound levels or $L_{eq}(h)$. $L_{eq}(h)$ is defined as the steady-state sound level that contains the same acoustic energy as a time-varying sound level during the same period. $L_{eq}(h)$ is the unit of sound measurement that is required to be used for all MoDOT projects. $L_{eq}(h)$ is given in units of "A-weighted" decibels (dBA). The A-weighted scale is used to approximate the response to noise by the human ear by compensating for high and low end frequencies to which the human ear is insensitive. The A-weighted decibel readings are based on perceptible sound energy and do not take into account those frequencies not audible by the human ear.

The human perception of sound is different from that of other types of perceptions. Sound is measured in decibels that are based on a logarithmic scale, instead of the more common linear units used in temperature measurements, for example. When adding two equivalent sound energy levels, the equivalent is only a 3 decibel increase (e.g., 60 dBA + 60 dBA = 63dBA). The human ear perceives a doubling of sound level at approximately a 10 decibel increase in sound. Most humans can start to detect a difference in sound level at 3 dB.

In the examination and analysis of noise from highway traffic, the level of highway traffic noise is dependent on the volume of the traffic, the speed of the traffic, and the number of trucks in the traffic mix. Heavier traffic volumes, traveling at higher speeds, with a greater number of trucks increase the loudness of traffic noise audible by the human ear.

PART 3

METHODOLOGY

This report examines the existing noise levels and compares them to the noise levels predicted to occur once the proposed roadway improvements are in place. The existing noise levels were measured using a noise meter; the projected noise levels were predicted using the FHWA's Traffic Noise Model (TNM), Version 2.5, for the build and no-build scenarios for the design year 2037. TNM uses roadway design, topographic information (elevations), receiver location, vehicle type, and traffic volume to predict the noise levels at each receiver. TNM is also used to determine the noise attenuation provided by barriers and other design measures, when required to mitigate noise impacts.

The predicted noise levels generated by TNM are compared to the FHWA's Noise Abatement Criteria (NAC), which include five different categories based on activities and land use, to determine the extent of the impacts of the proposed roadway improvements. The FHWA's NAC are presented in Table 3-1. According to MoDOT policy, a noise receiver is considered impacted if the predicted noise level approaches, equals, or exceeds the FHWA's NAC, or if the future predicted noise levels exceed existing noise levels by 15 dBA. The noise level is considered "approached" if it is one (1) dBA below the NAC. For the purposes of the project, noise abatement or mitigation measures were not evaluated; only the receivers that were predicted by the model to be impacted were identified.

TABLE 3-1
FHWA Noise Abatement Criteria (NAC)

Activity Category	L_{eq} Noise Level (dBA)	Description of Land Use Activity Areas
A	57 (exterior)	Lands on which serenity and quiet are of extra-ordinary 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 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (exterior)	Developed lands, properties, or activities not included in categories A or B above.
D	---	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

PART 4

TRAFFIC DATA

TNM was used to predict the worst hour of a typical day for noise. This worst-case condition normally occurs during evening or morning rush-hour when the highest volume of vehicles is combined with the highest speeds. Based on the traffic observed while conducting the existing noise measurements, this area experiences the highest traffic volumes between the hours of 6 a.m. and 7 a.m. and 6 p.m. and 7 p.m. which correspond to the morning and evening rush hours. The forecast traffic volumes for the design year 2037 were used to predict the future noise levels. This traffic data is presented in Appendix A.

Various vehicles produce different levels of noise. The CadnaA model segregates total traffic into the following vehicle types:

- Automobiles (all vehicles with two axles and four tires)
- Medium Trucks (all cargo vehicles with two axles and six tires)
- Heavy Trucks (all cargo vehicles with three or more axles)

Based on traffic analysis conducted for the Callaway County Connector, a traffic composition of four percent of trucks and ninety-six percent automobiles was used for the noise analysis in TNM. This percentage was used for all roads in the model.

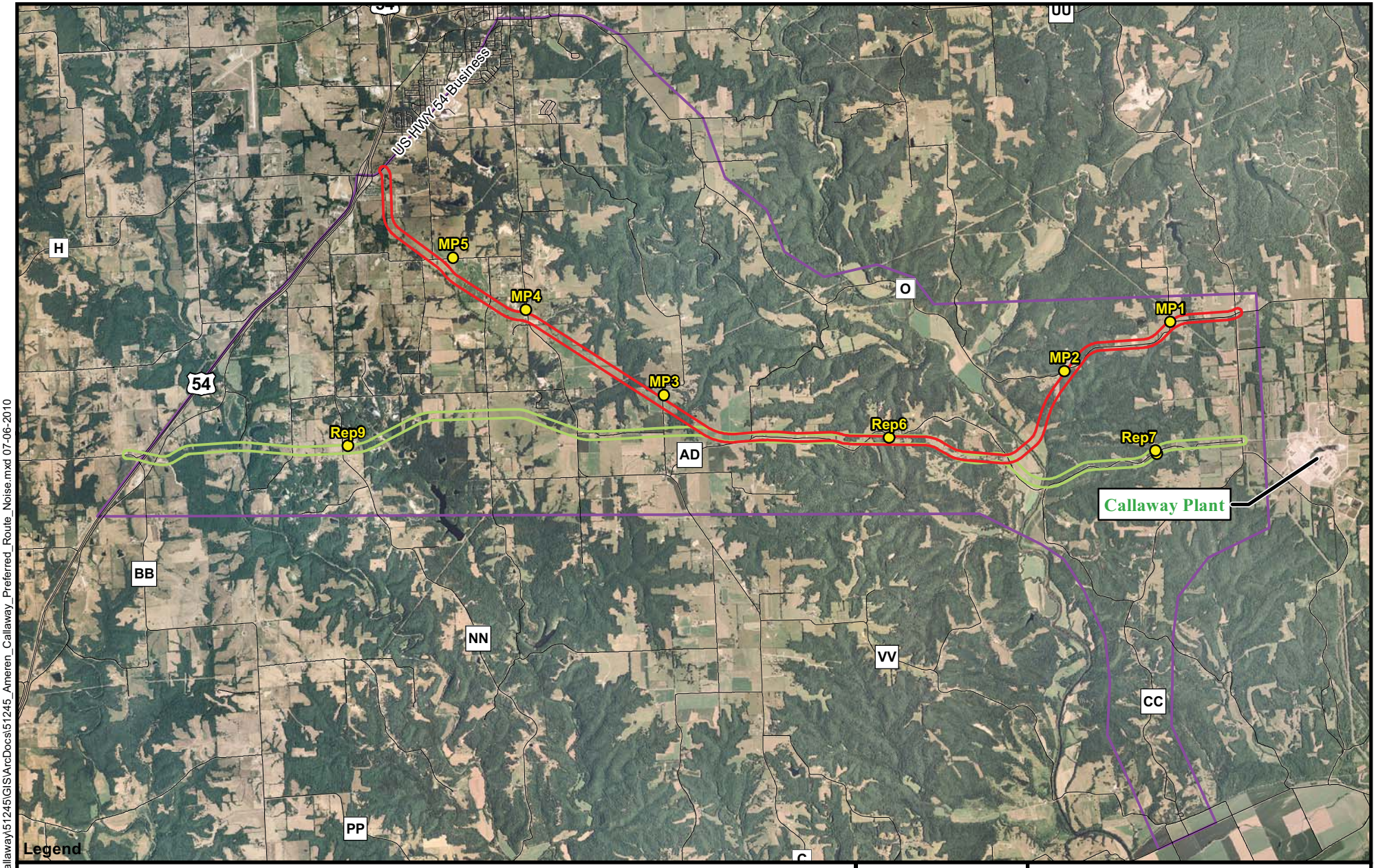
Traffic noise levels are also dependent on the speed of vehicles; which is a required input for the TNM model. Vehicle speeds of 60 miles per hour (mph) were used for each roadway segment. A 60 mph design speed is proposed for the roadway improvements.

PART 5

EXISTING NOISE LEVELS

Current land use along the proposed Callaway County Connector consists of scattered commercial, residential, and recreational areas. Single-family residential dwellings are most prevalent along County Road 428.

Existing noise levels were measured at five representative receivers within the Callaway County Connector study area (Figure 5-1). Locations were selected to be representative of sensitive receptors in the study area, such as residences and schools, where outdoor areas are frequently used by people. Measurements were taken using a Larson-Davis Model 824 Type I sound level meter. The sound level meter was calibrated before and after each set of measurements. None of the calibration level changes exceeded ± 0.3 dB. A windscreen was used at all times on the meter; the meter was mounted on a tripod, approximately five feet above the ground and was located near the property line of the sensitive receiver. The meter measured overall L_{eq} and L_{90} sound levels along with octave band and one-third octave band frequency sound levels.



Legend

- Study Area
- Preferred Route - 500 ft Corridor
- Southern Alternative - 500 ft Corridor
- Noise Measurement Locations

N

8,000 4,000 0 8,000 Feet

Figure 5-1
Representative Receiver Locations

\\espsrv\data\projects\Ameren-Callaway\51245\GIS\ArcDocs\51245_Ameren_Callaway_Preferred_Route_Noise.mxd 07-06-2010

Source: USDA NAIP Aerial Photograph for Callaway County, Missouri (2009); MODOT; Burns & McDonnell

PART 5

EXISTING NOISE LEVELS

Most of the residences within the study area are on acreages with large yards facing the roadway. Outdoor activity is predominately near driveways, the exterior of the house, swimming pools, and outbuildings. On February 16th and 17th, 2010, existing noise levels were measured and recorded at each of the five locations during four time periods: 1 p.m. to 3 p.m., 6 p.m. to 8 p.m., 12 a.m. to 2 a.m., and 6 a.m. to 8 a.m. Temperatures during the noise measurements ranged between 16.7 °F (during the 6 a.m. to 8 a.m. readings) and 30 °F (during the 1 p.m. to 3 p.m. readings). Winds generally varied between 0-3 mph, with winds not exceeding 9 mph during the 1 p.m. to 3 p.m. readings, and winds reaching 6 mph during the 6 p.m. to 8 p.m. readings. During the four sets of readings, the ground conditions were clear (e.g. no snow or water on the pavement). Existing noise measurements at representative receivers for each location are presented in Table 5-1.

TABLE 5-1
Existing Sound Levels

Representative Receiver	Time Period	Measured L_{eq} (dBA)	Extraneous Noises
MP1	1 P.M. to 3 P.M.	43.4	wind, no cars passed by
MP2	1 P.M. to 3 P.M.	55.9	wind, 3 cars passed by (about 35 dBA without traffic)
MP3	1 P.M. to 3 P.M.	46.7	wind, no cars passed by
MP4	1 P.M. to 3 P.M.	64.5	wind, 3 cars passed by
MP5	1 P.M. to 3 P.M.	64.3	distant low hum[1], wind, 1 car passed by (about 45 dBA without traffic)
MP1	6 P.M. to 8 P.M.	57.5	5 cars passed by (about 40 dBA without traffic), distant hum[1] audible without traffic noise
MP2	6 P.M. to 8 P.M.	60.1	5 cars passed by (about 33 dBA without traffic), dogs barking in distance, distant traffic audible
MP3	6 P.M. to 8 P.M.	41.9	no cars passed by, a few gunshots, snow/ice crackling
MP4	6 P.M. to 8 P.M.	61.0	9 cars passed by (about 41 dBA without traffic), plane overhead, distant hum[1]
MP5	6 P.M. to 8 P.M.	41.6	no cars passed by, distant traffic audible
MP1	12 A.M. to 2 A.M.	34.7	no cars passed by, dogs barking
MP2	12 A.M. to 2 A.M.	34.2	no cars passed by, dog barking, some distant traffic
MP3	12 A.M. to 2 A.M.	35.2	no cars passed by, dogs barking
MP4	12 A.M. to 2 A.M.	35.2	no cars passed by, dogs barking, distant traffic audible
MP5	12 A.M. to 2 A.M.	36.3	no cars passed by, dogs barking, distant traffic audible, faint hum audible[1]
MP1	6 A.M. to 8 A.M.	55.2	8 cars passed by
MP2	6 A.M. to 8 A.M.	60.2	11 cars passed by (about 35 dBA without traffic), distant traffic and distant humming[1] audible when no local traffic
MP3	6 A.M. to 8 A.M.	39.5	no cars passed by, birds chirping, grass blowing, distant hum[1], dog barking
MP4	6 A.M. to 8 A.M.	60.6	6 cars passed by (about 37-39 dBA without traffic), birds chirping and distant traffic audible without traffic, distant hum[1], dogs barking
MP5	6 A.M. to 8 A.M.	43.0	no cars passed by, distant traffic, distant hum[1], dog barking

[1]Distant hum may correlate to distant highway noise.

PART 6

PREDICTED IMPACTS

Several Representative Receivers (represented with "Rep" in Table 6-1) were added in addition to the measurement points where measurements of existing noise levels were taken to complete the representative receivers list. The future build, no-build, and southern alternative noise levels at each of the representative receivers were predicted using the TNM model. Because the individual homes fall under the NAC B (67 dBA threshold), an impact would occur when the predicted noise level would approach 67 dBA, (e.g., reach 66 dBA) or when the predicted noise level increases 15 dBA or more from the background value. Table 6-1 compares the existing measured, predicted No-Build 2037, predicted Build 2037, and Southern Alternative sound levels at the measurement points.

Table 6-1
Sound Level Results for Representative Receivers

Representative Receiver	Highest Measured Sound Level (L_{eq} dBA)	2037 Build Option Predicted Sound Level (L_{eq} dBA)	2037 No-Build Option Predicted Sound Level (L_{eq} dBA)	2037 Southern Alternative Predicted Sound Level (L_{eq} dBA)
MP1	57.5	64.8	**76.5**	38.6
MP2	60.2	58.7	**79.5**	41.5
MP3	46.7	**76.5**	31.1	46.8
MP4	64.5	58.4	33.2	39.5
MP5	64.3	**79.7**	34.6	37.3
Rep6	--	**68.5**	32.6	**70.7**
Rep7	--	35.3	36.9	**77.8**
Rep8	--	35.2	36.7	**67.8**
Rep9	--	30.2	20.9	64.0

***BOLD** numbers approach, meet, or exceed the NAC.

Three measurement points (MP3, MP5 and Rep6) would exceed the FHWA NAC under the Future Build Option and two measurement points (MP1 and MP2) would exceed the NAC for the Future No-Build Option. For the Southern Alternative, Rep6, Rep7, and Rep8 receivers were predicted to exceed the NAC. These exceedances are attributed to the closeness of each receiver to the proposed road (or the existing road under the no-build option).

For those representative receivers that are predicted to exceed the NAC for the year 2037, all receivers near those impacted representative receivers were modeled to determine how many receivers overall would be impacted by each option. The TNM model was used to determine the number and location of the sensitive receivers (homes) that would be impacted under both the No-Build, and Build options and

the Southern Alternative.

Table 6-2
Impacted Receivers for the Ameren-Callaway Route Options

Type of Impact	2037 Build Option (Number of Receivers)	2037 No-Build Option Predicted (Number of Receivers)	2037 Southern Alternative (Number of Receivers)
Over 66 dBA	7	4	7
15 dBA Increase	14	0	14
Over 66 dBA *and* 15 dBA Increase	16	5	20
Total Impacted Receivers	**37**	**9**	**41**

The impacts for the No-Build option occur on the eastern side of Route O where the sensitive receivers are significantly closer to Route O. Under the build alternative, measures used to reduce traffic noise levels may include scheduling large deliveries at times other than when peak traffic would occur (i.e. during shift changes). Appendix B lists the results for all of the sensitive receivers for the 2037 Build Option, the 2037 No-Build Option and the 2037 Southern Alternative.

PART 7

NOISE ABATEMENT

Noise levels for the 2037 Build Option and the 2037 Southern Alternative are predicted to exceed the NAC for 37 representative receivers and 41 sensitive receivers, respectively. The 2037 No-Build Option was not analyzed for noise abatement as traffic patterns would not change (except for increase in traffic) for this option. Various noise abatement options were considered for each receiver and are discussed in the following paragraphs.

Traffic Management

Lower speed limits or other speed control measures could be used on the ramps and highways to reduce the noise levels experienced by nearby receivers. However, major reductions in speed are required to achieve minor reductions in noise levels; for example, a 5-mph speed decrease yields approximately a 1 dB noise reduction. Lower speed limits would also cause adverse impacts due to increased congestion and air pollution. Therefore, traffic management is not considered to be reasonable as a noise abatement option.

Alteration of Horizontal and/or Vertical Alignments

The Project area consists of sections along an existing highway and some previously undisturbed areas. Due to the large scale of the Callaway County Connector Project, any horizontal and/or vertical realignment to the planned highway would be very costly and impractical. This noise abatement option is not considered reasonable for the Project.

Buffer Zone

Purchase of land for a buffer zone would involve the acquisition of additional real estate, which would likely be cost prohibitive. Due to the extensive nature of the impacted areas and the terrain, this noise abatement option is not considered reasonable for the Project.

Noise Barriers

Noise walls and earth berms are two types of noise barriers normally examined. Earth berms generally require a large area of right-of-way to meet the height required for noise abatement. The Project area is extremely large; therefore, the purchasing of enough additional land and residences would be cost prohibitive.

Noise barriers that are designed with sufficient height to break the line of sight from the receiver to the ramp or roadway will usually result in a noise level reduction of 5 dB or more. Because noise barriers

normally result in a cost effective method that may benefit many receivers, this noise abatement option was examined for those areas that are predicted to have noise impacts as a result of the proposed Project. TNM was used to design noise abatement barriers.

PART 8

NOISE BARRIER ANALYSIS

Noise walls were evaluated for each of the locations where sensitive noise receptors are projected to be adversely affected by traffic noise levels. The analyses were conducted in accordance with MoDOT policy by designing noise barriers that achieve the desired noise reduction for impacted receivers. The cost per benefited receiver was also determined.

Any receiver which could possibly benefit from the installation of a noise barrier was included in the noise abatement analysis in the area of the representative receiver being analyzed, regardless of whether or not it was considered impacted. Receivers were identified and positioned in the model by identifying residences on a topographic map, using GIS software.

- Guidance in the MoDOT EPG states that for a wall to be reasonable it must accomplish the following: provide 5 dBA reductions for all receivers closest to the highway
- must provide attenuation for more than one receiver
- must be less than or equal to 18 feet above normal grade
- must not interfere with normal access to the property
- must not pose a traffic safety hazard
- must not exceed a cost of $30,000 per benefited receiver (5 dBA reduction or more)
- the majority of residents (closest to highway and benefited) must desire a noise wall

The cost per benefited receiver was calculated using a cost of $25 per square foot. Factors such as aesthetics and line-of-site were considered in evaluating reasonableness. Given the elevation changes with some hills and valleys, drainage, utilities, constructability, and maintainability should be considered during the final design phase of the Project.

Noise walls were considered for three areas for each of the Build options: the 2037 Build Option and the 2037 Southern Alternative, as described in Table 8-1 and shown in Appendix C. Noise walls were designed to achieve a 5-dBA reduction at the maximum number of residences, when possible. All barriers were designed with the lay of the land. Table 8—1 lists physical and monetary characteristics of each designed barrier and lists whether building the wall is recommended according to the MoDOT Traffic Noise Policy. None of the designed barriers were reasonable per MoDOT traffic noise policy.

Table 8—1: Noise Wall Results

Barrier ID	Model	Location of Barrier	Number of Modeled Receivers	Number of Impacted Receivers	Number of Benefited Receivers	Min./Max. Barrier Height (ft)	Barrier Length (ft)	Total Barrier Square Feet	Est. Cost	Cost/ Benefitted Receiver	Min./Max. Reduction (dBA)	Likely to be Implemented?	If No, Reasons Why
Barrier 1	2037 Build Option	West side of route	7	7	7	9/18	989	13,824	$ 345,600	$ 49,371	5/8	No	Not reasonable. Cost per benefitted receiver exceeds $30,000.
Barrier 2	2037 Build Option	South side of route	6	2	2	3/9	1,036	6,335	$ 158,375	$ 79,188	5/10	No	Not reasonable. Cost per benefitted receiver exceeds $30,000.
Barrier 3	2037 Build Option	South side of route	24	2	18	6/18	14,662	241,878	$6,046,950	$ 335,942	5/14	No	Not reasonable. Cost per benefitted receiver exceeds $30,000.
Barrier 4	2037 Southern Alternative	North side of route	12	3	11	9/18	3,158	48,724	$1,218,100	$ 110,736	5/12	No	Not reasonable. Cost per benefitted receiver exceeds $30,000.
Barrier 5	2037 Southern Alternative	North side of route	11	3	7	6/18	2,816	39,267	$ 981,675	$ 140,239	5/18	No	Not reasonable. Cost per benefitted receiver exceeds $30,000.
Barrier 3	2037 Southern Alternative	South side of route	6	5	6	6/15	2,926	33,620	$ 840,500	$ 140,083	5/11	No	Not reasonable. Cost per benefitted receiver exceeds $30,000.

PART 9

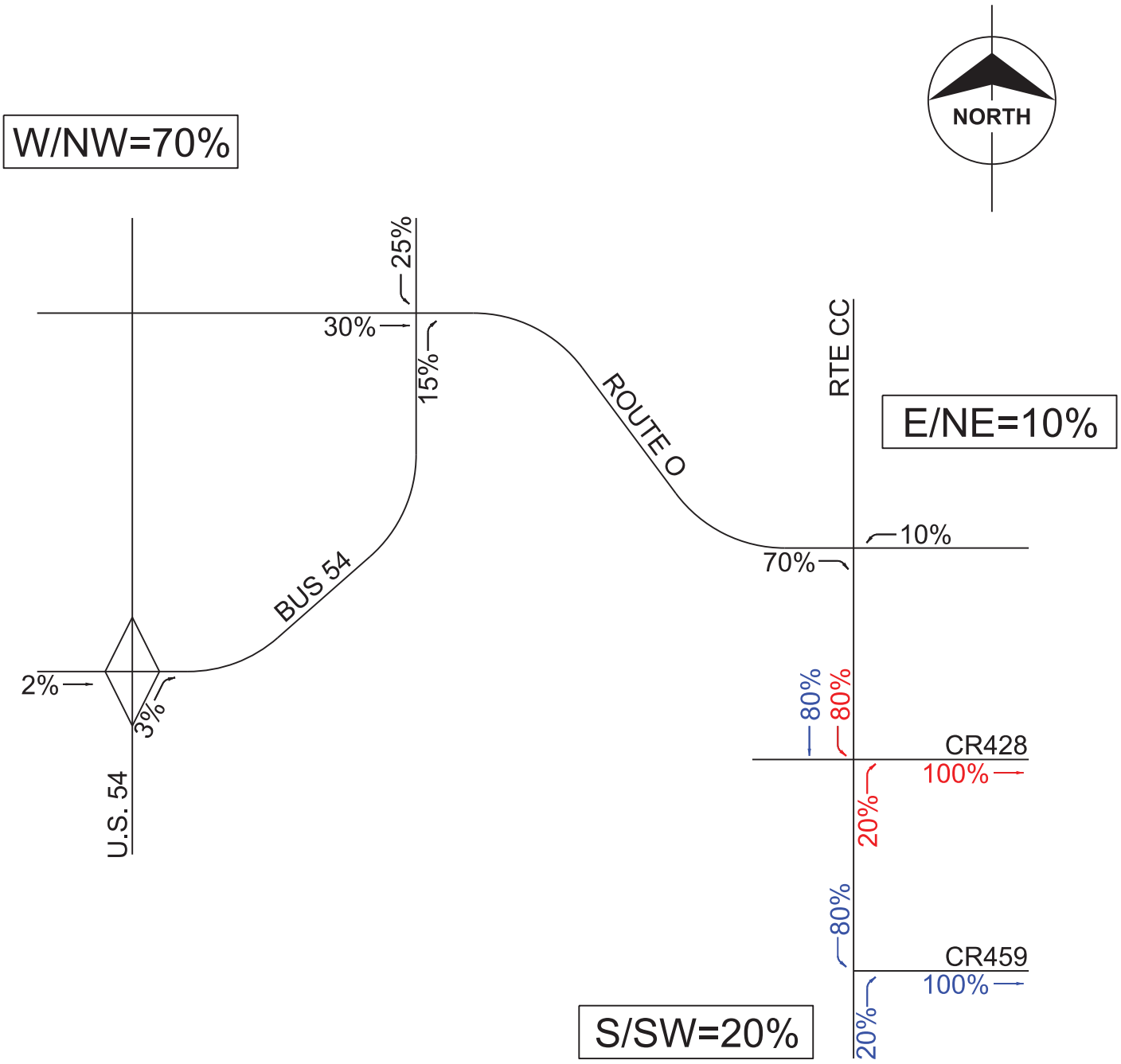
CONCLUSION

Existing noise levels were measured at five representative locations along the proposed Callaway County Connector. Using FHWA's TNM, the representative receivers, including measured points as well as other selected representative receivers, were then modeled to determine future noise impacts resulting from construction of the Callaway County Connector (Preferred Build Option), a Southern Alternative Route, and the No-Build condition in the design year 2037. Based on the results of the modeling, three representative receivers will be impacted under the 2037 Build Option, and two representative receivers each for the 2037 No-Build and the 2037 Southern Alternative scenario, though the location of the impacts differ depending on the scenario.

The representative receivers that were predicted to be impacted were modeled along with all receivers in the area to determine the number of actual receivers that would be impacted under each scenario. The 2037 Build scenario is predicted to impact 37 sensitive receivers: 7 that exceed the 66 dBA limit, 14 that exceed the 15 dBA increase, and 16 that exceed both the 66 dBA limit and the 15 dBA increase, while the 2037 Future No-Build scenario is predicted to impact 9 sensitive receivers—4 that exceed the 66 dBA limit and 5 that exceed both the 66 dBA limit and the 15 dBA increase limit. The Southern Alternative is predicted to impact 41 sensitive receivers: 7 that exceed the 66 dBA limit, 14 that exceed the 15 dBA increase, and 20 that exceed both the 66 dBA limit and the 15 dBA increase. The impacted receivers under both scenarios were located very close to existing roads or the proposed roadway alignment.

A noise barrier analysis was performed for those sensitive receivers that are expected to be impacted by the construction of both the Build Option and the Southern Alternative. Due to the rural nature of the project area, none of the designed barriers were determined to be reasonable per MoDOT's Traffic Noise Policy. As the design of the Callaway County Connector continues, some of the sensitive receivers that are expected to be impacted may be located within the proposed right-of-way required for the improvements, and therefore would be displaced by the project.

APPENDIX A
TRAFFIC COUNTS



LEGEND

XX%	% OF TOTAL PLANT WORKERS
XX%	% OF UNIT 1 & 2 PLANT WORKERS
XX%	% OF UNIT 2 CONST. WORKERS

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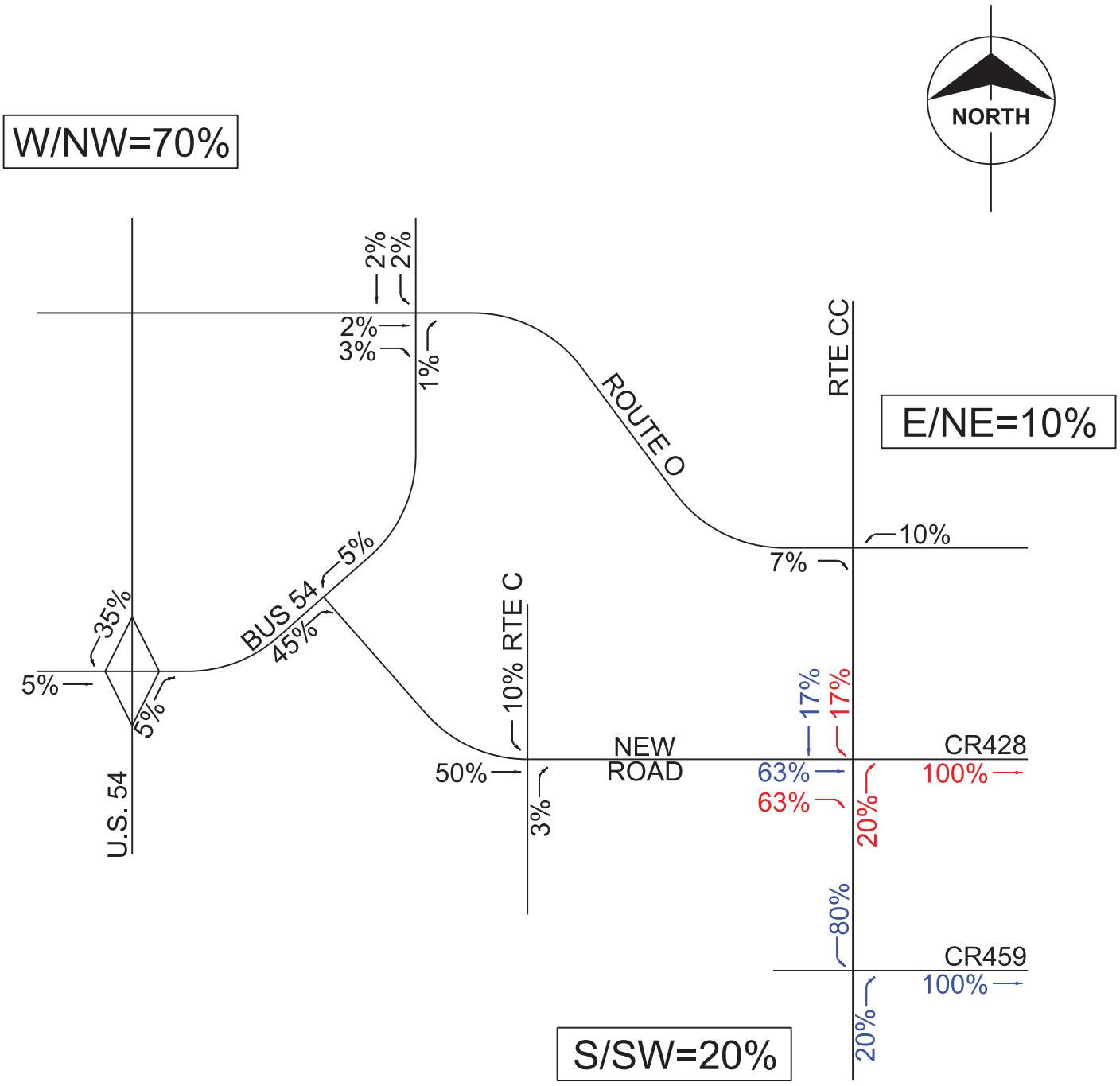
FIGURE 1

2017/2037 NO-BUILD SCENARIO DISTRIBUTION OF AMEREN PLANT WORKERS



LEGEND

XX%	% OF TOTAL PLANT WORKERS
XX%	% OF UNIT 1 & 2 PLANT WORKERS
XX%	% OF UNIT 2 CONST. WORKERS

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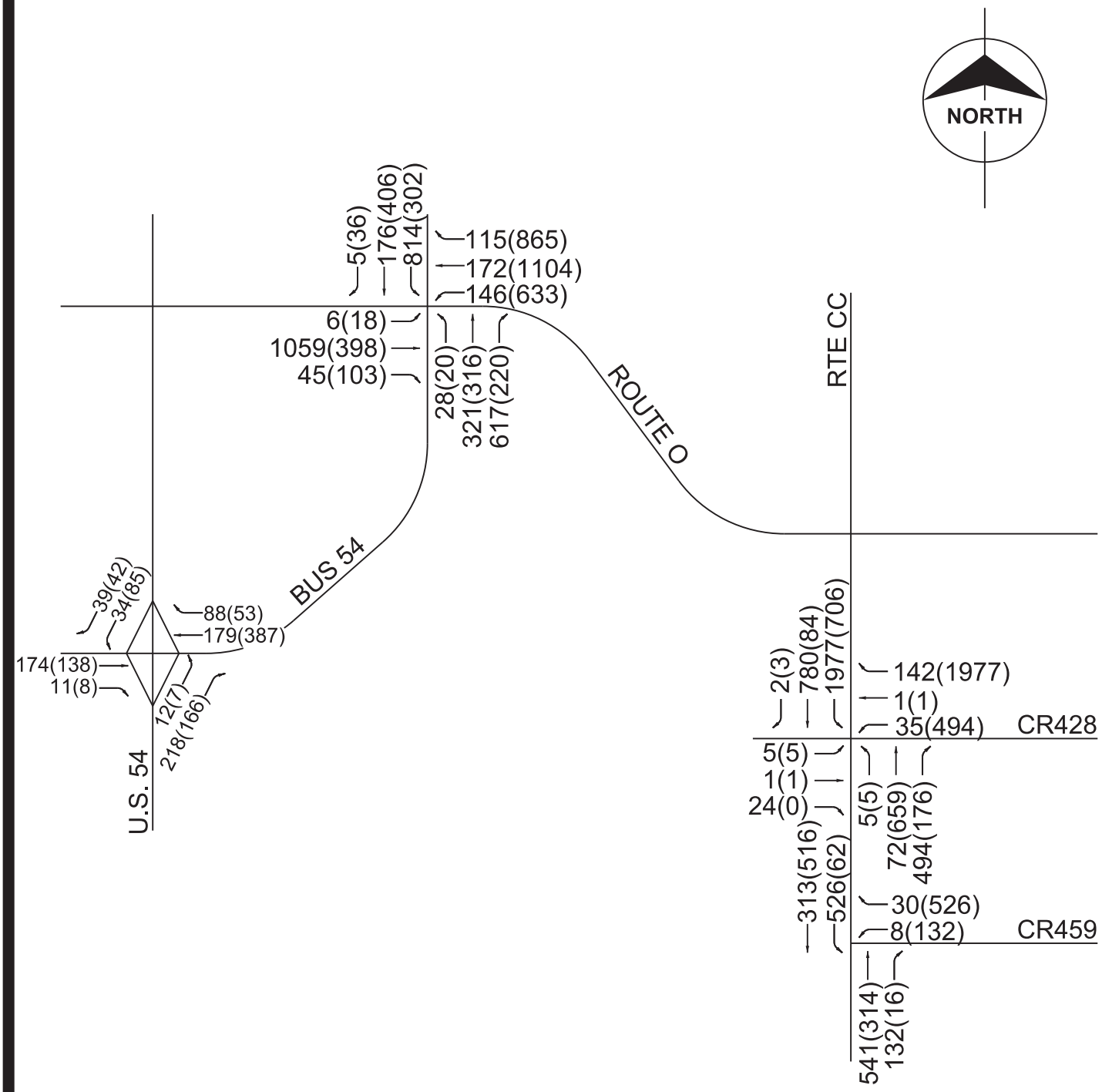
FIGURE 2

2017/2037 BUILD SCENARIO DISTRIBUTION OF AMEREN PLANT WORKERS



LEGEND

XX (XX) AM (PM) TRAFFIC VOL.

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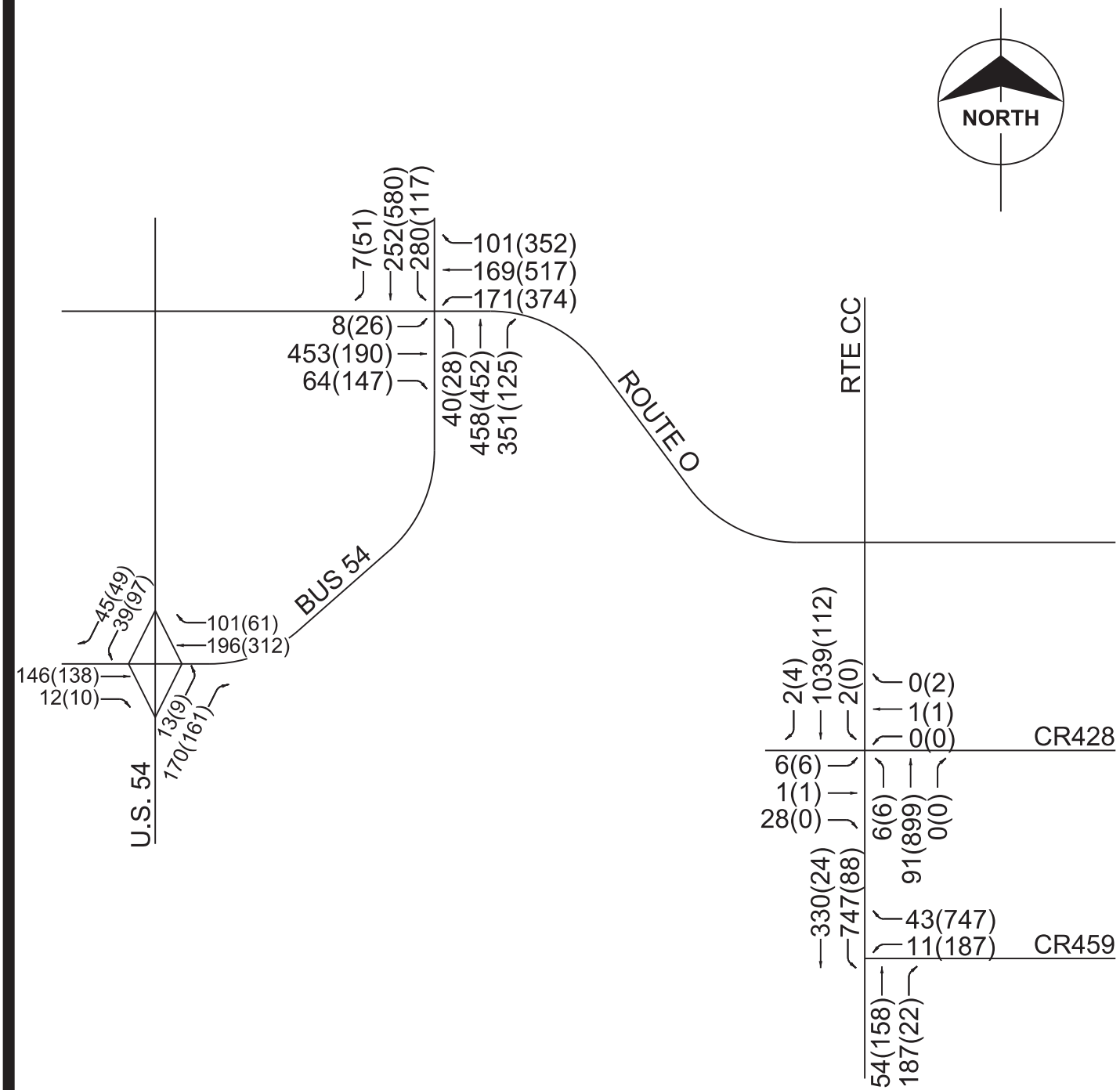
FIGURE 3

2017 NO-BUILD SCENARIO TRAFFIC VOLUMES



LEGEND

XX (XX) AM (PM) TRAFFIC VOL.

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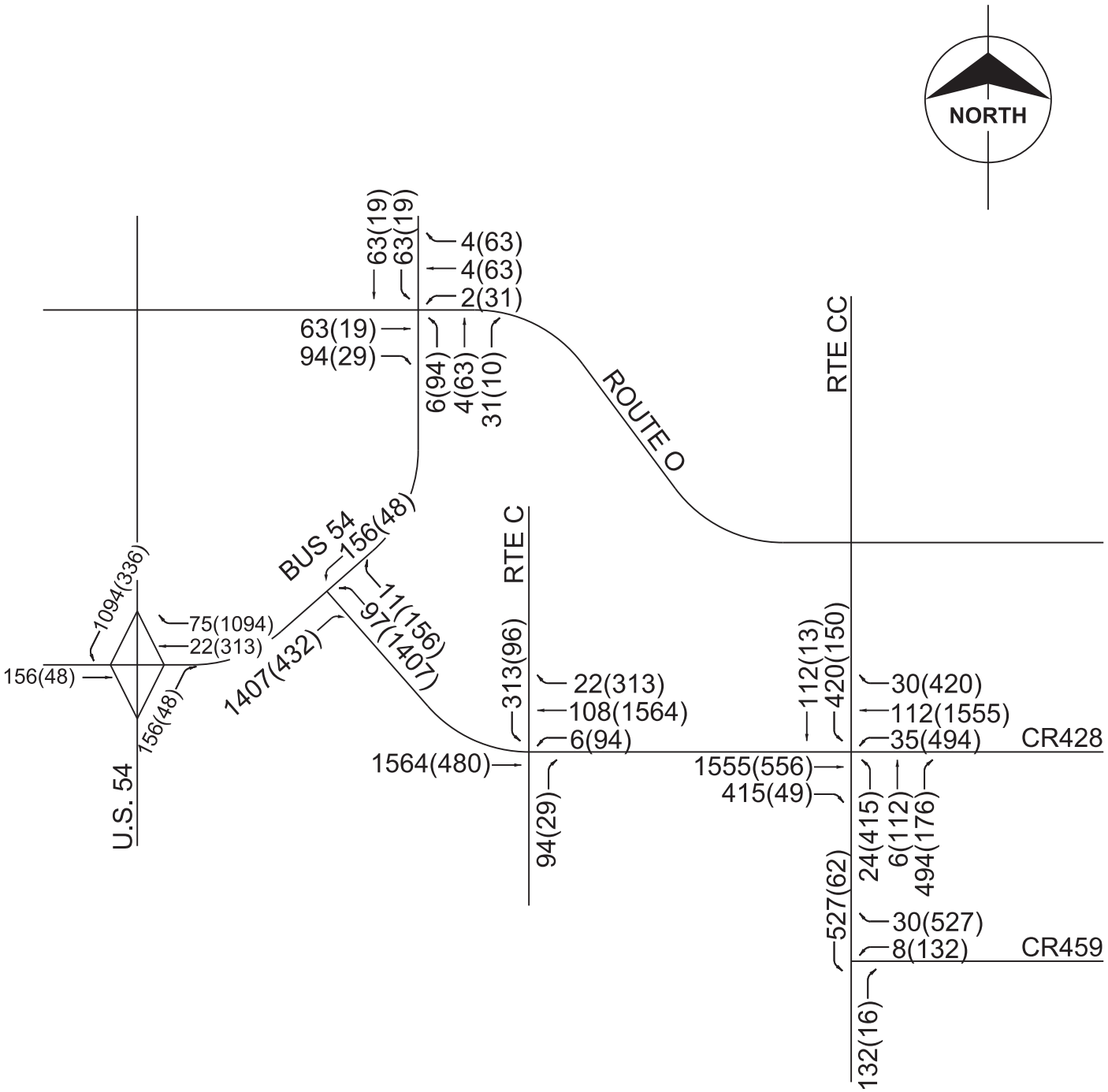
FIGURE 4

2037 NO-BUILD SCENARIO TRAFFIC VOLUMES



LEGEND

XX (XX) AM (PM) UNIT 1 PLANT & UNIT 2 CONST. WORKER TRAFFIC VOL.

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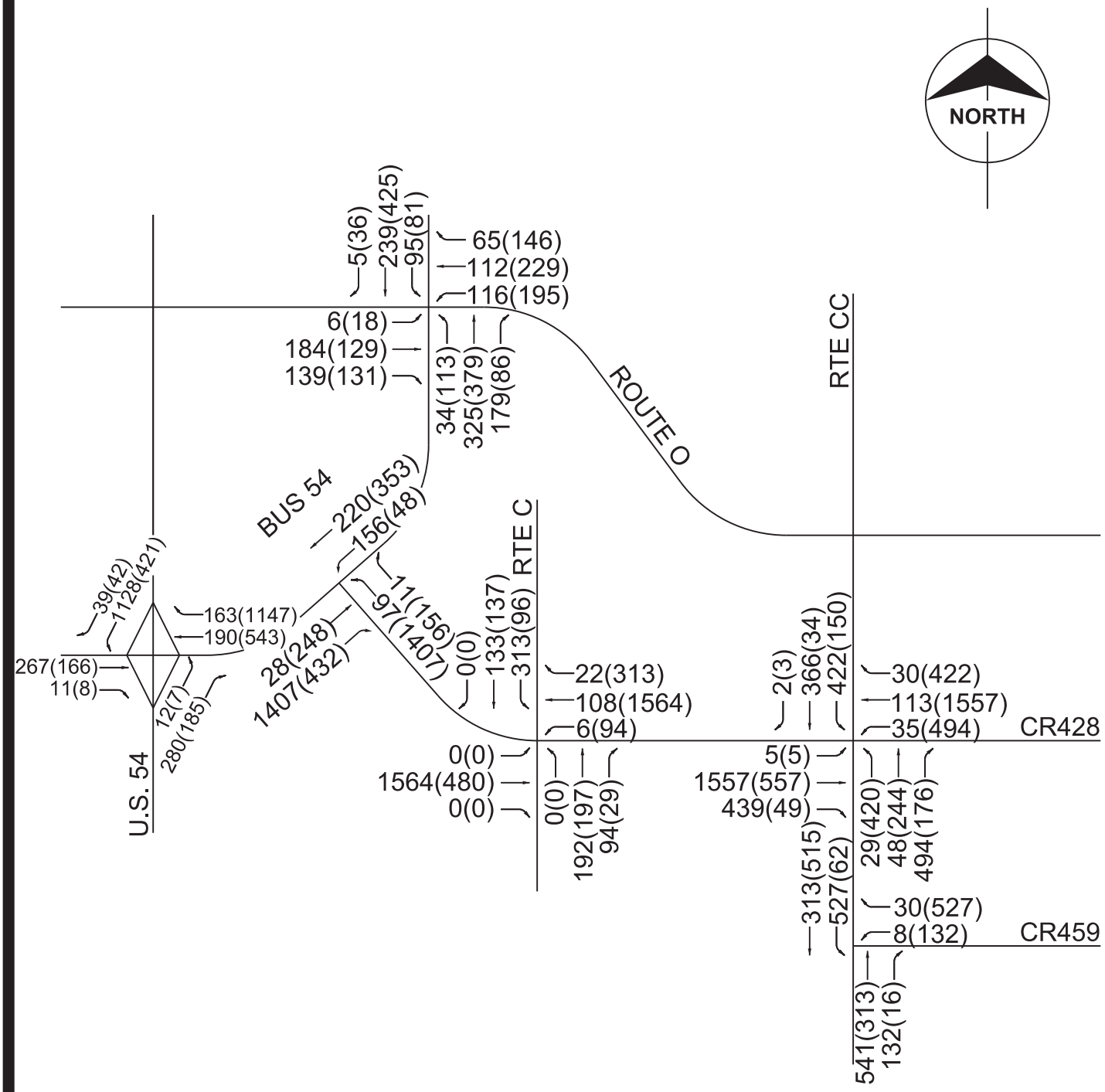
FIGURE 5

2017 PLANT AND CONST. WORKER TRAFFIC VOLUMES



LEGEND

XX (XX) AM (PM) TRAFFIC VOL.

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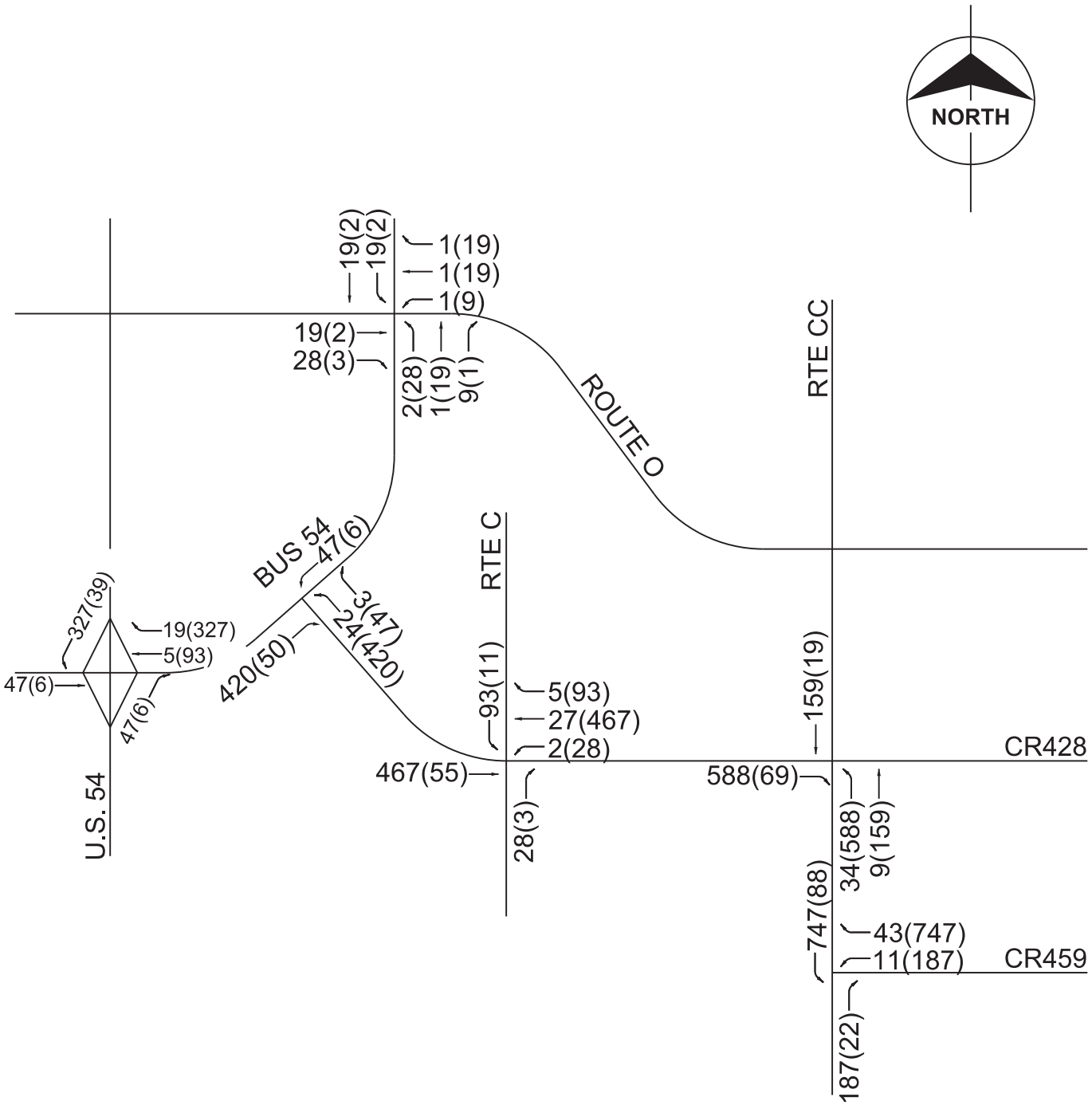
FIGURE 6

2017 BUILD SCENARIO TRAFFIC VOLUMES



LEGEND

XX (XX) AM (PM) UNIT 1 PLANT & UNIT 2 PLANT. WORKER TRAFFIC VOL.

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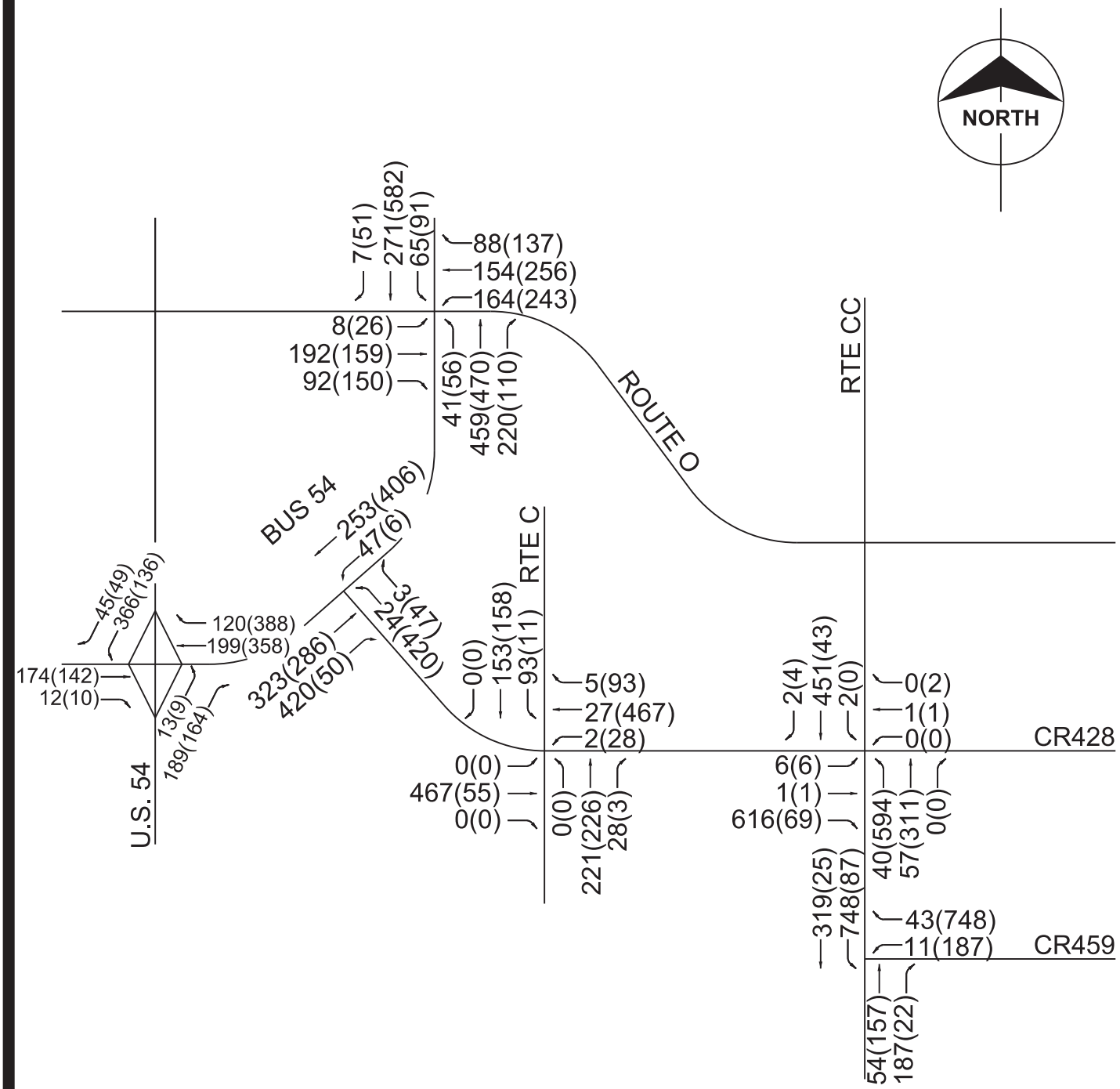
FIGURE 7

2037 PLANT WORKER TRAFFIC VOLUMES



LEGEND

XX (XX) AM (PM) TRAFFIC VOL.

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FIGURE 8

2037 BUILD SCENARIO TRAFFIC VOLUMES

APPENDIX B
NOISE MODELING RESULTS FOR SENSITIVE RECEIVERS

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver1	41.9	40.1	48.5
Receiver2	41.9	40.9	47.6
Receiver3	47.1	39.5	52.5
Receiver4	49.4	39.2	55.0
Receiver5	47.8	39.5	52.9
Receiver6	50.8	39.1	56.0
Receiver7	52.1	39.0	57.3
Receiver8	53.5	38.9	58.4
Receiver9	63.9	38.6	**68.7**
Receiver10	**68.9**	38.4	**67.4**
Receiver11	38.9	62.2	42.3
Receiver12	59.1	38.3	**75.2**
Receiver13	41.1	36.0	51.2
Receiver14	50.4	39.9	51.2
Receiver15	48.3	40.3	49.6
Receiver16	46.6	28.3	**62.7**
Receiver17	47.0	28.4	**58.8**
Receiver18	46.5	28.4	**65.9**
Receiver19	53.5	29.9	44.0
Receiver20	46.4	29.1	48.1
Receiver21	48.0	30.8	43.9
Receiver22	47.6	30.9	43.8
Receiver23	47.1	31.1	43.9
Receiver24	52.3	29.8	52.5
Receiver25	55.0	29.9	56.0
Receiver26	53.9	29.9	54.0
Receiver27	53.1	29.9	53.1
Receiver28	53.3	29.9	53.2
Receiver29	54.4	30.0	54.1
Receiver30	**58.4**	30.3	56.9
Receiver31	**63.1**	30.5	**60.1**
Receiver32	**61.3**	31.3	**61.3**
Receiver33	**74.6**	31.6	**68.0**
Receiver34	49.8	30.8	49.6
Receiver35	51.3	31.0	51.6
Receiver36	49.3	32.7	48.4
Receiver37	50.2	30.9	50.3
Receiver38	55.1	32.2	53.5
Receiver39	**66.4**	32.0	**60.7**
Receiver40	**64.6**	32.1	**59.7**

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver41	**62.7**	32.0	**63.6**
Receiver42	**67.5**	32.1	**69.0**
Receiver43	**75.2**	32.4	**68.2**
Receiver44	46.3	35.9	35.9
Receiver45	46.6	35.8	36.0
Receiver46	48.5	41.6	35.1
Receiver47	48.8	42.8	35.0
Receiver48	48.8	43.5	35.0
Receiver49	49.2	42.2	35.0
Receiver50	49.3	41.5	35.1
Receiver51	49.1	44.4	35.0
Receiver52	46.5	35.4	36.2
Receiver53	49.0	43.7	35.0
Receiver54	49.2	44.8	35.0
Receiver55	49.5	43.6	35.0
Receiver56	49.4	42.3	35.0
Receiver57	49.8	41.5	35.1
Receiver58	49.3	45.7	35.0
Receiver59	50.0	43.5	35.0
Receiver60	49.7	44.8	35.0
Receiver61	50.2	42.4	35.0
Receiver62	49.8	46.2	34.9
Receiver63	50.1	42.4	35.0
Receiver64	49.6	49.2	34.8
Receiver65	50.2	43.6	35.1
Receiver66	50.1	44.7	35.0
Receiver67	50.2	46.3	34.9
Receiver68	50.8	42.4	35.0
Receiver69	50.7	43.7	35.1
Receiver70	50.5	44.7	35.0
Receiver71	50.4	47.4	34.9
Receiver72	50.6	46.3	34.9
Receiver73	50.4	48.9	34.8
Receiver74	51.2	42.4	35.1
Receiver75	50.9	43.7	35.1
Receiver76	50.9	44.8	35.0
Receiver77	51.3	43.6	35.1
Receiver78	51.0	46.2	34.9
Receiver79	51.7	42.5	35.1
Receiver80	51.5	44.8	35.0
Receiver81	51.3	47.2	34.9

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver82	51.7	43.6	35.1
Receiver83	51.5	46.2	34.9
Receiver84	51.5	50.6	34.8
Receiver85	52.3	42.5	35.1
Receiver86	52.1	44.6	35.0
Receiver87	52.2	43.7	35.1
Receiver88	51.9	49.9	34.8
Receiver89	52.8	42.5	35.1
Receiver90	52.6	43.6	35.1
Receiver91	52.5	46.2	34.9
Receiver92	52.3	54.9	34.7
Receiver93	52.5	49.2	34.8
Receiver94	53.2	42.5	35.1
Receiver95	53.1	43.7	35.1
Receiver96	52.8	47.1	34.9
Receiver97	53.6	42.5	35.1
Receiver98	53.5	44.6	35.0
Receiver99	53.7	43.6	35.1
Receiver100	53.4	46.0	34.9
Receiver101	54.2	42.4	35.2
Receiver102	54.3	43.6	35.1
Receiver103	54.3	44.6	35.0
Receiver104	54.1	45.9	34.9
Receiver105	54.2	51.2	34.8
Receiver106	55.1	44.6	35.0
Receiver107	55.2	43.6	35.1
Receiver108	54.9	46.0	34.9
Receiver109	55.5	42.5	35.2
Receiver110	55.7	43.6	35.1
Receiver111	55.7	44.6	35.0
Receiver112	55.8	45.9	34.9
Receiver113	56.4	42.5	35.2
Receiver114	56.3	43.6	35.1
Receiver115	48.4	47.7	34.2
Receiver116	56.5	44.5	35.0
Receiver117	56.8	42.4	35.2
Receiver118	56.9	43.5	35.1
Receiver119	56.8	45.8	34.9
Receiver120	57.4	42.4	35.2
Receiver121	57.4	44.4	35.0
Receiver122	57.5	43.5	35.1

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver123	57.9	42.4	35.2
Receiver124	57.6	45.7	34.9
Receiver125	45.6	34.2	36.9
Receiver126	58.0	43.5	35.1
Receiver127	58.2	44.4	35.0
Receiver128	58.5	42.3	35.2
Receiver129	58.7	43.4	35.1
Receiver130	58.6	45.6	34.9
Receiver131	59.0	44.3	35.0
Receiver132	59.2	42.3	35.2
Receiver133	59.4	43.4	35.1
Receiver134	59.5	45.5	34.9
Receiver135	46.7	34.5	36.8
Receiver136	59.9	44.3	35.0
Receiver137	60.3	42.3	35.2
Receiver138	60.4	43.3	35.1
Receiver139	60.3	45.4	34.9
Receiver140	61.2	44.3	35.0
Receiver141	61.7	42.2	35.1
Receiver142	61.3	45.3	34.9
Receiver143	61.7	43.3	35.1
Receiver144	62.8	42.2	35.1
Receiver145	62.6	44.1	35.0
Receiver146	62.9	43.2	35.1
Receiver147	62.6	45.2	34.9
Receiver148	48.2	34.8	36.7
Receiver149	64.3	42.2	35.1
Receiver150	64.5	**66.6**	34.5
Receiver151	**65.4**	43.1	35.1
Receiver152	**69.0**	42.2	35.1
Receiver153	**69.5**	43.2	35.0
Receiver154	**69.9**	46.9	34.9
Receiver155	55.9	**67.1**	34.4
Receiver156	42.2	44.2	33.8
Receiver157	**66.8**	40.3	35.3
Receiver158	41.2	44.7	33.8
Receiver159	61.8	37.9	35.7
Receiver160	51.1	**69.9**	34.4
Receiver161	60.5	38.6	35.5
Receiver162	42.1	45.3	33.8
Receiver163	49.0	**67.9**	34.3

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver164	41.4	46.3	33.8
Receiver165	45.2	61.4	34.3
Receiver166	50.0	57.8	34.5
Receiver167	41.0	47.1	33.8
Receiver168	54.2	41.6	35.2
Receiver169	53.6	39.8	35.4
Receiver170	40.8	48.0	33.8
Receiver171	53.2	37.8	35.7
Receiver172	52.6	39.2	35.5
Receiver173	52.5	38.1	35.6
Receiver174	40.7	48.6	33.9
Receiver175	40.7	49.6	33.9
Receiver176	40.5	51.3	33.9
Receiver177	46.0	33.5	37.9
Receiver178	49.3	40.7	35.2
Receiver179	41.3	64.2	34.0
Receiver180	45.2	33.3	38.1
Receiver181	45.4	33.3	38.1
Receiver182	51.9	34.3	37.3
Receiver183	47.9	33.8	37.7
Receiver184	47.0	40.5	35.1
Receiver185	52.6	34.3	37.4
Receiver186	49.6	33.8	37.7
Receiver187	48.9	33.7	37.8
Receiver188	49.0	33.7	37.9
Receiver189	48.5	33.6	38.0
Receiver190	50.7	33.8	37.8
Receiver191	51.6	35.6	36.6
Receiver192	51.3	34.6	37.4
Receiver193	48.1	32.8	39.5
Receiver194	49.0	34.4	37.6
Receiver195	46.0	32.3	40.5
Receiver196	57.5	33.1	39.2
Receiver197	45.7	32.2	40.7
Receiver198	46.5	34.5	37.5
Receiver199	46.6	34.4	37.7
Receiver200	47.1	34.3	37.8
Receiver201	46.9	32.3	40.7
Receiver202	46.7	32.2	40.8
Receiver203	46.2	34.6	37.5
Receiver204	55.7	32.9	39.7

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver205	61.7	33.0	39.4
Receiver206	46.8	34.4	37.8
Receiver207	46.4	34.5	37.6
Receiver208	63.7	33.3	39.0
Receiver209	65.9	33.0	39.4
Receiver210	57.8	33.4	39.0
Receiver211	47.2	34.1	38.1
Receiver212	46.7	34.3	37.9
Receiver213	46.8	34.2	38.0
Receiver214	48.2	33.9	38.4
Receiver215	52.5	33.6	38.7
Receiver216	49.2	33.8	38.4
Receiver217	47.3	34.0	38.2
Receiver218	48.7	33.8	38.4
Receiver219	51.3	33.6	38.7
Receiver220	46.3	34.2	38.1
Receiver221	46.6	34.1	38.2
Receiver222	46.4	32.1	41.5
Receiver223	47.3	32.2	41.2
Receiver224	49.9	32.5	40.6
Receiver225	51.9	32.6	40.4
Receiver226	46.6	34.1	38.2
Receiver227	58.0	32.8	40.1
Receiver228	47.6	34.0	38.3
Receiver229	50.6	32.5	40.7
Receiver230	52.4	32.6	40.5
Receiver231	58.2	32.8	40.1
Receiver232	46.4	34.1	38.2
Receiver233	48.1	33.9	38.5
Receiver234	47.6	32.2	41.4
Receiver235	46.7	34.1	38.3
Receiver236	62.6	32.9	40.0
Receiver237	55.0	32.7	40.3
Receiver238	61.4	32.8	40.0
Receiver239	54.6	32.7	40.4
Receiver240	48.0	32.2	41.4
Receiver241	46.1	34.2	38.2
Receiver242	48.4	32.2	41.3
Receiver243	52.1	33.4	39.1
Receiver244	56.5	33.3	39.4
Receiver245	61.6	32.8	40.1

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver246	55.2	32.7	40.4
Receiver247	**76.8**	33.0	39.9
Receiver248	51.4	33.5	39.2
Receiver249	58.2	33.2	39.6
Receiver250	60.9	33.2	39.7
Receiver251	**83.0**	32.9	40.1
Receiver252	65.0	33.0	40.1
Receiver253	53.1	33.3	39.6
Receiver254	49.4	32.0	42.0
Receiver255	55.5	32.4	41.2
Receiver256	49.1	32.0	42.2
Receiver257	56.0	32.4	41.2
Receiver258	50.6	32.1	41.9
Receiver259	51.4	32.2	41.6
Receiver260	48.9	31.9	42.5
Receiver261	50.9	33.4	39.5
Receiver262	49.1	31.9	42.4
Receiver263	48.2	31.9	42.6
Receiver264	49.2	33.5	39.4
Receiver265	49.7	32.0	42.3
Receiver266	54.5	33.1	40.1
Receiver267	47.7	33.6	39.3
Receiver268	49.4	31.9	42.4
Receiver269	52.6	32.1	42.0
Receiver270	46.7	33.7	39.3
Receiver271	49.5	33.4	39.6
Receiver272	**73.2**	32.4	**66.9**
Receiver273	52.3	31.7	52.5
Receiver274	**76.0**	32.5	**68.3**
Receiver275	**77.1**	32.5	**68.3**
Receiver276	**63.9**	32.9	**59.2**
Receiver277	**58.0**	32.3	**58.3**
Receiver278	**71.2**	32.6	**83.1**
Receiver279	**65.5**	32.5	**69.4**
Receiver280	54.0	32.1	53.8
Receiver281	**59.2**	32.3	57.6
Receiver282	**64.3**	32.4	**61.4**
Receiver283	57.7	32.2	56.1
Receiver284	52.1	31.9	51.1
Receiver285	55.7	32.1	54.3
Receiver286	**60.8**	32.9	**60.6**

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver287	**60.4**	32.9	**60.4**
Receiver288	50.7	33.5	50.7
Receiver289	**68.5**	32.6	**70.7**
Receiver290	54.1	33.1	54.1
Receiver291	**83.8**	32.5	**79.2**
Receiver292	61.5	32.7	62.0
Receiver293	53.4	33.1	53.1
Receiver294	59.0	32.8	59.3
Receiver295	56.1	32.9	56.4
Receiver296	**68.2**	32.5	**69.7**
Receiver297	49.8	33.4	49.8
Receiver298	54.9	32.9	55.2
Receiver299	**70.2**	32.4	**73.2**
Receiver300	60.8	32.5	61.0
Receiver301	52.9	32.8	53.2
Receiver302	48.2	38.4	49.1
Receiver303	52.1	32.8	52.4
Receiver304	46.4	39.0	47.4
Receiver305	47.6	38.8	48.8
Receiver306	45.9	39.6	47.8
Receiver307	47.9	39.0	50.0
Receiver308	41.1	36.1	52.0
Receiver309	40.1	35.9	50.3
Receiver310	40.3	60.0	42.7
Receiver311	40.4	36.0	51.6
Receiver312	39.5	56.4	41.9
Receiver313	40.6	57.4	41.9
Receiver314	48.0	53.0	42.8
Receiver315	46.6	63.6	42.3
Receiver316	38.1	36.7	64.4
Receiver317	54.6	62.2	42.2
Receiver318	**66.2**	54.6	42.4
Receiver319	**70.9**	51.4	42.7
Receiver320	55.3	48.5	43.0
Receiver321	55.6	**69.4**	41.8
Receiver322	41.0	38.4	52.8
Receiver323	51.9	60.8	41.3
Receiver324	60.2	**66.0**	41.7
Receiver325	54.3	61.7	41.3
Receiver326	59.8	65.2	41.3
Receiver327	37.6	37.5	**73.8**

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver328	53.6	60.9	41.1
Receiver329	36.3	36.6	55.7
Receiver330	36.2	36.7	57.3
Receiver331	37.0	37.4	60.1
Receiver332	65.1	63.5	40.1
Receiver333	36.2	37.1	62.1
Receiver334	36.1	37.0	63.4
Receiver335	35.5	36.6	**68.4**
Receiver336	35.3	36.5	**67.8**
Receiver337	35.2	36.5	**66.6**
Receiver338	46.7	33.4	39.9
Receiver339	58.3	58.8	39.9
Receiver340	35.5	36.8	**66.7**
Receiver341	50.1	33.3	39.9
Receiver342	35.1	36.4	63.9
Receiver343	46.3	33.5	39.8
Receiver344	56.0	61.3	40.3
Receiver345	36.1	37.7	53.9
Receiver346	35.7	37.1	60.8
Receiver347	50.7	52.5	39.5
Receiver348	51.5	55.9	40.5
Receiver349	35.8	37.4	56.5
Receiver350	35.8	37.4	56.9
Receiver351	36.0	37.7	53.8
Receiver352	49.9	51.8	39.3
Receiver353	35.7	37.3	59.3
Receiver354	35.3	36.9	**77.8**
Receiver355	47.2	49.4	39.0
Receiver356	35.2	36.7	**67.8**
Receiver357	35.4	37.0	**72.8**
Receiver358	46.6	49.6	38.8
Receiver359	43.8	46.9	38.3
Receiver360	59.2	**66.6**	39.7
Receiver361	34.8	36.7	**70.3**
Receiver362	35.4	37.4	55.1
Receiver363	35.2	37.2	58.2
Receiver364	34.7	36.6	**70.3**
Receiver365	39.0	42.3	37.2
Receiver366	34.2	36.1	55.0
Receiver367	34.0	35.9	52.6
Receiver368	34.1	36.0	53.6

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver369	34.3	36.1	56.3
Receiver370	42.0	45.4	37.6
Receiver371	**67.8**	**81.7**	38.6
Receiver372	41.0	44.1	37.3
Receiver373	60.5	60.9	38.2
Receiver374	47.9	50.0	37.6
Receiver375	52.7	54.4	37.8
Receiver376	**67.5**	**66.7**	38.0
Receiver377	40.1	42.9	36.6
Receiver378	39.9	42.5	36.5
Receiver379	40.6	42.8	36.5
Receiver380	32.8	35.0	**75.2**
Receiver381	32.2	34.3	49.6
Receiver382	53.3	53.9	37.1
Receiver383	56.6	52.8	37.0
Receiver384	40.9	42.3	36.4
Receiver385	44.8	30.1	56.4
Receiver386	42.0	30.0	**61.3**
Receiver387	42.0	30.1	**76.3**
Receiver388	41.8	30.3	60.1
Receiver389	40.7	30.3	57.6
Receiver390	42.8	30.6	49.9
Receiver391	39.1	29.8	50.8
Receiver392	41.1	30.7	49.7
Receiver393	40.8	30.7	50.1
Receiver394	40.3	30.6	52.8
Receiver395	40.0	30.6	54.2
Receiver396	40.6	30.7	50.8
Receiver397	40.4	30.7	52.1
Receiver398	41.1	30.7	48.5
Receiver399	42.7	31.1	45.7
Receiver400	42.6	31.0	46.0
Receiver401	42.9	31.1	45.5
Receiver402	42.4	31.0	46.2
Receiver403	41.9	30.9	47.1
Receiver404	41.0	30.8	48.7
Receiver405	42.1	31.0	46.3
Receiver406	42.3	31.0	46.2
Receiver407	41.9	31.1	45.9
Receiver408	41.4	31.0	46.2
Receiver409	41.2	31.0	46.1

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver410	39.8	30.7	48.3
Receiver411	40.4	30.8	47.0
Receiver412	38.8	30.4	54.8
Receiver413	38.7	30.3	52.6
Receiver414	38.3	30.2	56.9
Receiver415	38.1	30.1	60.2
Receiver416	38.9	30.4	49.6
Receiver417	37.9	30.0	55.1
Receiver418	37.8	30.1	52.5
Receiver419	38.8	30.5	48.0
Receiver420	37.8	30.1	52.4
Receiver421	33.2	28.1	53.3
Receiver422	33.3	28.2	60.3
Receiver423	33.6	28.3	64.0
Receiver424	33.3	28.2	57.3
Receiver425	33.7	28.4	51.4
Receiver426	33.9	28.5	49.9
Receiver427	34.0	28.6	46.8
Receiver428	32.9	27.9	51.6
Receiver429	32.6	27.7	47.4
Receiver430	32.7	27.7	45.7
Receiver431	33.5	28.2	46.5
Receiver432	33.1	28.0	60.9
Receiver433	32.9	27.9	62.5
Receiver434	32.4	27.7	52.1
Receiver435	32.4	27.7	53.3
Receiver436	32.5	27.8	50.3
Receiver437	32.7	27.9	46.4
Receiver438	32.8	28.0	46.4
Receiver439	31.2	27.0	48.9
Receiver440	31.9	27.4	50.1
Receiver441	28.5	24.8	57.7
Receiver442	29.1	25.6	54.2
Receiver443	28.6	25.2	54.5
Receiver444	32.4	27.8	56.7
Receiver445	29.6	26.0	47.1
Receiver446	30.1	26.4	51.8
Receiver447	29.6	25.9	47.1
Receiver448	29.7	26.0	46.6
Receiver449	32.5	27.8	52.1
Receiver450	28.8	25.0	54.2

**Bold values indicate an exceedance of the NAC

Reciever Name	2037 Build Option Predicted Sound Level (dBA)	2037 No Build Option Predicted Sound Level (dBA)	2037 Southern Alternative Predicted Sound Level (dBA)
Receiver451	29.2	25.8	57.2
Receiver452	29.3	25.8	53.8
Receiver453	28.8	25.0	56.3

**Bold values indicate an exceedance of the NAC

Legend

- No Build Route
- Modeled Receiver
- Over 66 dBA
- Over 66 dBA and over 15 dBA increase

3,500 1,750 0 3,500 Feet

NORTH

Burns & McDonnell SINCE 1898

Future No-Build (2037)
Expected Noise Impacts
Callaway County Connector
Ameren UE
Callaway County, Missouri

Source: USDA NAIP Aerial Photography for Callaway County, Missouri (2007); Burns & McDonnell

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Legend

Preferred Route
Modeled Receiver
Over 66dBA
Over 15 dBA Increase
Over 66 dBA and over 15 dBA increase

3,500 1,750 0 3,500 Feet

NORTH

Burns & McDonnell SINCE 1898

Future Build (2037)
Expected Noise Impacts
Callaway County Connector
Ameren UE
Callaway County, Missouri

Source: USDA NAIP Aerial Photography for Callaway County, Missouri (2007); Burns & McDonnell

Legend

- Southern Alternative
- 15 dBA Increase
- Modeled Receiver
- Over 66 dBA and 15 dBA Increase
- Over 66 dBA

3,500 1,750 0 3,500 Feet

NORTH

Burns & McDonnell SINCE 1898

Southern Alternative (2037)
Expected Noise Impacts
Callaway County Connector
Ameren UE
Callaway County, Missouri

Source: USDA NAIP Aerial Photography for Callaway County, Missouri (2007); Burns & McDonnell

APPENDIX C
NOISE BARRIER LOCATIONS

Legend

- Modeled Receivers
- Preferred Route
- Barrier 1
- Barrier 2
- Barrier 3

3,500 1,750 0 3,500 Feet

NORTH

Burns & McDonnell SINCE 1898

Future Build (2037)
Barrier Analysis Locations
Callaway County Connector
Ameren UE
Callaway County, Missouri

Source: USDA NAIP Aerial Photography for Callaway County, Missouri (2007); Burns & McDonnell

Legend

- Modeled Receivers
- Barrier 4
- Barrier 6
- Southern Alternative
- Barrier 5

3,500 1,750 0 3,500 Feet

NORTH

Burns & McDonnell SINCE 1898

Southern Alternative (2037)
Barrier Analysis Locations
Callaway County Connector
Ameren UE
Callaway County, Missouri

Source: USDA NAIP Aerial Photography for Callaway County, Missouri (2007); Burns & McDonnell