

# **NORTH 33RD AND CORNHUSKER**

## **Traffic Noise Evaluation**

**February 2023**

**RTSD No. 5919  
City Project No. 702614  
State Control No. 13294  
Olsson Project No. A17-3604**



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## 1.0 Nature of Noise

Noise may be defined as unwanted sound. Sound is the sensation produced in the hearing organs when waves are created in the surrounding air by the vibration of some material body. The impact that sound waves have on the hearing organs is dependent on the pressure generated by the wave. The unit of measure of sound pressure level in common use is the decibel (dB), which can be simply defined as a logarithmic function of the actual sound pressure. The logarithmic function is used because the range of sound pressures is too great to be accommodated on a linear scale. The reference for sound pressure measurements is 0 decibels (dB) which corresponds to 0.0002 microbars. This represents the weakest sound that can be heard by a person with very good hearing in an extremely quiet place. A sound level of 100 decibels corresponds to a pressure of 20 microbars, or 100,000 times the pressure that corresponds with 0 decibels. The range of sound pressure levels most frequently encountered in evaluating traffic-generated noise on highways is 50 to 95 dB (American Association of State Highway and Transportation Officials).

## 2.0 Measurement of Sound

The sound-level meter is the basic instrument of noise measurement. The American Standard (ANSI S1.4-1971) specifies that sound level meters have the capability of measuring three alternate frequency response characteristics designated as A, B, and C. The Federal Highway Administration (FHWA) has specified that noise be predicted and evaluated in decibels weighted with the A-level frequency response; this unit of measure is referred to as dBA. Measurements in dBA incorporate the ear's reduced sensitivity to both low frequency and very-high frequency noises, thereby correlating well with our subjective impression of loudness. The following table displays noise levels (in dBA) common to our everyday activities.

<u>Common Noise Levels</u>	<u>Noise Level (dBA)</u>
Rock Band at 16 ft	110
Jet Flyover at 985 ft	105
Gas Lawn Mower at 3 ft	95
Diesel Truck at 50 ft	85
Same Truck at 110 ft	80
Gas Lawn Mower at 100 ft	70
Normal Speech at 3 ft	65
Birds Chirping	50
Leaves Rustling	40
Very Quiet Soft Whisper	30

### 3.0 Federal Highway Standards

23 Code of Federal Regulations (CFR) Part 772 was written by the Federal Highway Administration (FHWA). Its purpose is to provide procedures for noise studies, and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria, and to establish requirements for traffic noise information to be given to those officials who have planning and zoning authority in the project area.

23 CFR 772 contains the noise abatement criteria (NAC), which are based on the equivalent level (Leq), noise descriptor. Leq1h is the equivalent steady state sound level, which during the hour under consideration contains the same acoustic energy as the time-varying traffic sound level during that same hour. The upper limits of the hourly Leq desirable noise levels that are part of the NAC are listed below in Table 1. Any noise levels that approach or exceed the NAC for activity categories “A” through “E” are not desirable and are referred to as a noise impact. The Nebraska Department of Transportation - Noise Analysis and Abatement Policy (NDOT Noise Policy) issued January 2022 defines the approach level as “one decibel less than the NAC”.

**Table 1. Noise Abatement Criteria**

Activity Category	Hourly Noise Levels Leq1h dBA	Description of Activity Category
<b>A</b>	<b>57 (Exterior)</b>	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
<b>B</b>	<b>67 (Exterior)</b>	Residential
<b>C</b>	<b>67 (Exterior)</b>	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
<b>D</b>	<b>52 (Interior)</b>	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
<b>E</b>	<b>72 (Exterior)</b>	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A-D or F.
<b>F</b>	---	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
<b>G</b>	---	Undeveloped lands that are not permitted

The selection and analysis of individual noise sensitive receivers is based on the data included in the above table and guidance provided in the NDOT Noise Policy. All noise levels referred to in this study are exterior noise levels. Receiver locations are selected in accordance with the NDOT Noise Policy. For Activity Category “B” and “C” this is usually the side yard, backyard, or front porch and for Activity Category “E”, it is an area of frequent human use such as a hotel pool/lounge area, outdoor seating at a restaurant, designated break area, or the main public entrance.

## 4.0 Noise Prediction Method

The "Traffic Noise Model" (TNM) Version 2.5 is used in this study to predict the traffic noise levels. This model was developed and is approved for use by the FHWA. The procedures included in TNM permit an analysis of variations in traffic noise in terms of traffic parameters, roadway configuration, and receiver characteristics. These parameters are input into the model for the study area to generate the traffic noise level estimates. All traffic noise levels shown in this study are based on peak hourly traffic volume and are presented as the equivalent sound level for a 1-hour period (LAeq1h dBA).

## 5.0 Project Description

The Preferred Alternative would construct a new viaduct on a new alignment to create a direct connection over the railroad tracks near N. 33rd Street and Cornhusker Highway (US 6). The Preferred Alternative would close two at-grade railroad crossings: N. 33rd Street and Adams Street.

The Preferred Alternative includes the expansion of Cornhusker Highway (US 6) to six lanes with turn lanes from Deadmans Run to just east of N. 35th Street. North 33rd Street would be on a new alignment that includes two bridges over the Deadmans Run channel and the BNSF railroad tracks. The realigned N 33rd Street connects at an intersection with Cornhusker Highway (US 6) near the existing N 31st Street and Cornhusker intersection. Intersections at Cornhusker Highway (US 6) and State Fair Park Drive, a re-aligned N. 33rd Street and Cornhusker Highway (US 6), N. 33rd Street and Huntington Avenue, N 33rd Street and Adams Street, and N. 35th Street and Cornhusker Highway (US 6) would operate as full access intersections.

The Preferred Alternative also includes the realignment of Adams Street. Adams Street, no longer crossing the railroad tracks, would be extended southwest running roughly parallel to the railroad tracks, connecting to N. 33rd Street south of the railroad tracks and Cornhusker Highway (US 6). The new intersection would be located on the south end of the N. 33rd Street bridge and would be entirely elevated and supported by embankments, walls, or other structures.

The Preferred Alternative would maintain the present traffic flow on Cornhusker Highway (US 6) but would create a new access route for Adams Street via N 33rd Street, south of the BNSF railroad tracks.

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As a part of the Preferred Alternative, the existing at-grade crossing at N. 44th Street would remain open to vehicular and pedestrian traffic; however, improvements would be made to the crossing to bring it into compliance with ADA guidelines. Improvements would include the addition of detectable warning panels and ADA compliant slopes. The newly constructed grade separated viaduct at N. 33rd and Adams Streets would include an 8-foot-wide sidewalk separated from traffic for pedestrians and bicycles. The Preferred Alternative would provide upgrades and enhance connectivity to the existing trail network by providing a reroute of the existing trail network. The trail would proceed under the newly constructed N 33rd Street bridge over Deadmans Run, cross over Deadmans Run on a dedicated trail bridge, run adjacent to Baldwin Avenue and south along Griffith Street to reconnect to the existing trail near Fleming Fields and Huntington Avenue.

The Preferred Alternative would include the installation of fencing along the BNSF rail corridor from approximately Deadmans Run to approximately N 36th Street with final locations and dimensions to be determined during final design in coordination with BNSF.

Portions of the Preferred Alternative located west of 34th Street impact the regulatory floodplain and would require construction of flood storage mitigation areas. These flood storage areas would be located northwest of 33rd and Gladstone Streets and would provide the sufficient amount of storage necessary for the proposed project fill. The final configurations and locations of the flood storage mitigation areas would be determined as a part of the final design process.

Additional side streets would be reconstructed to tie into the primary project elements and to maintain local connectivity. Huntington Avenue would be reconstructed on either side of the intersection of N 33rd Street to connect back to the existing road. N 31st Street would be reconstructed on the north side of Cornhusker Highway (US 6) where the newly aligned N 33rd Street meets at an intersection. Existing N 33rd Street would be reconstructed on the north and south sides of Cornhusker Highway (US 6) as well to connect back to the existing road. Existing N 33rd Street on the south side of Cornhusker Highway (US 6) would also include the construction of a cul-de-sac just north of the BNSF railroad tracks to provide a turnaround for traffic near the closed at-grade railroad crossing. N 35th Street would also be reconstructed on the north side of Cornhusker Highway (US 6) to connect back to the existing road. N 36th Street would be reconstructed on the south side of Adams Street to connect back to the existing road. A new local roadway called 33rd Avenue would reconnect Madison Avenue to Saint Paul Avenue and Baldwin Avenue on the east side of the newly realigned N 33rd Street bridge. These streets would no longer have direct access onto N 33rd Street. Baldwin Avenue on the west side of N 33rd Street would also not reconnect with N 33rd Street and would include a new cul-de-sac for traffic to turnaround. Griffith Street would also be reconstructed between Huntington Avenue and Baldwin Avenue.

The project would also include sidewalk, and curb ramp improvements to meet ADA guidelines at the intersection of N 29th Street and Cornhusker Highway (US 6). The existing traffic signal at N 29th Street and Cornhusker Highway (US 6) would also be upgraded due to the addition of another westbound left turn lane and westbound outside through lane.



The project would also include reconstruction of the storm sewer system, sanitary sewer system, water main system as well as traffic signal and underground fiber-optic lines due to the impacts from the project. The project would also include impacts to private utility companies.

Construction of the project would require sections of N 33rd Street, Adams Street, and the intersection of N 33rd Street and Huntington Avenue to be closed to traffic. Detours would be required to reroute traffic due to the closure of N 33rd Street to construct the viaduct over Deadmans Run channel and the railroad tracks. The project would detour traffic onto roadways of the same functional roadway classification. No improvements would be made to detour routes as a part of the Preferred Alternative. Temporary detours would also be required along sections of the 33rd Street, Huntington Avenue, and Dietrich Trails. Trail detours would use existing local roadways and sidewalks. No improvements would be required along any designated trail detour route.

## 6.0 Traffic Parameters

The current and future traffic volumes used for this study are shown in Table 2. The traffic speeds used for this study are design speeds and are listed in Table 3. Traffic was allocated on the roadway based on lane direction. Olsson, Inc. completed a Corridor Traffic Study in 2019 for the project. Traffic volumes were calculated using turn movement counts during the AM and PM peak traffic volume hours. Design year 2040 traffic volumes, used for this noise study and for project design, were calculated from existing counts, the percentage of peak hour travel by direction, existing traffic counts and future ADTs as data input. Medium trucks include all vehicles having two axles and six wheels, generally having a gross vehicle weight greater than 10,000 lbs., but less than 26,000 lbs. Heavy trucks include all vehicles having three or more axles, generally having a gross vehicle weight greater than 26,000 lbs.

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**Table 2. Traffic Volume**

Roadway	Location	Existing Average Daily Traffic Volume	2040 Design Average Daily Traffic Volume	Vehicle Mix (Peak Hour)		
				Light Duty Vehicles (Percent)	Medium Trucks (Percent)	Heavy Trucks (Percent)
Cornhusker	W/O State Fair Park	27,744	31,300	95.0%	3.0%	1.5%
Cornhusker	W/O 33rd Street	36,117	46,500	95.0%	4.0%	1.0%
Cornhusker	W/O Adams	32,058	32,000	94.7%	3.8%	1.5%
Cornhusker	W/O 48th Street	22,450	29,400	92.8%	5.1%	2.1%
Adams	W/O 48th Street	12,159	8,300	98.0%	1.7%	0.3%
Adams	E/O Cornhusker	10,573	11,400	93.1%	5.4%	1.5%
Huntington	E/O 33rd Street	6,605	12,200	97.8%	2.1%	0.1%
33rd Street	S/O Cornhusker	10,510	23,200	97.3%	2.6%	0.1%
33rd Street	N/O Huntington	11,200	18,600	97.3%	2.6%	0.1%
33rd Street	S/O Huntington	11,059	13,900	96.7%	3.1%	0.2%

**Table 3. Traffic Speed**

Roadway Segment	Design Speed
Cornhusker Highway (US 6)	45 mph
Huntington Ave	40 mph
N. 33 <sup>rd</sup> Street	35 mph
Adams Street	35 mph
State Fair Park Drive	35 mph
Other Side Streets	25 mph

## 7.0 Adjacent Land Use

Olsson reviewed the City of Lincoln-Lancaster County, NE GIS Viewer to determine zoning districts. The properties along the project roadway are zoned Industrial District, Highway Commercial District, Public Use District, or Residential District. All existing development adjacent to the project is Activity Category B, C, E, or F (refer to Table 1). Olsson searched the residential and commercial building permits for new building permits issued from April 15, 2021 to February 15, 2022 for properties within the project area. No building permits for new construction were identified.



## 8.0 Traffic Noise Measurements

Traffic noise measurements were recorded on March 10, 2020 at three locations along the project roadway. These field readings are used as aids in identifying the existing noise environment within the project area. The noise measurement records are included in Appendix B.

During the measurement period, traffic was counted by vehicle type and any non-traffic noise source was noted. The ambient temperature ranged from 29° F to 37° F, the relative humidity ranged from 83 percent to 93 percent, and the winds averaged 1-4 mph.

The noise measurements were made using a Quest model 2200 sound level meter. This meter was set to collect continuous samples and compute the resultant A-weighted, equivalent sound level (LAeq) at one-second intervals. The field measurements are listed in Table 4. The model results are within plus/minus 3 dBA of the measured traffic noise, which verify the noise levels predicted by TNM.

**Table 4. Field Noise Measurements**

Location	Start Time	Duration	Distance to Centerline (feet)	Cars (per hour)	Medium Trucks (per hour)	Heavy Trucks (per hour)	Measured LAeq	Predicted LAeq
Site 1	08:53	13 mins	39.0	616	74	18	67.8	66.4
Site 2	12:20	15 mins	41.5	1,784	56	40	70.5	70.2
Site 3	13:01	15 mins	34.0	1,884	104	24	73.5	70.9

## 9.0 Traffic Noise Prediction

The 2040 Design and the noise sensitive receivers within the project area are depicted on Figures 2A – 2G in Appendix A and on Table 5. The table details the following:

- Predicted traffic noise levels for the project area under existing (2018 traffic) conditions,
- Predicted traffic noise levels for the 2040 Design alternative.

Also shown on Figures 2A – 2G is the 66 Leq1h dBA noise level contour depicting the “approach” noise level threshold for Activity Category B and C per the NDOT Noise Policy. This contour is an approximation as detailed surface topography, which affect noise propagation along the roadway, are not included in this analysis.

In accordance with the NDOT Noise Policy, a traffic noise impact occurs for receivers if:

- The design year (year 2040) noise levels approach (defined as 1 decibel less than the NAC) or exceed the NAC.
- The predicted future noise levels “substantially exceed” existing levels. The NDOT Noise Policy defines this as an increase in noise levels of 15 dBA or more in the design year above existing levels.

## 10.0 Traffic Noise Analysis

Table 5 displays traffic noise levels for receivers listed in Activity Category B, C, and E under current and future traffic conditions. Receivers that approach or exceed the Leq Noise Abatement Criteria (NAC) of 67 dBA, for Activity Category B and C, or 72 dBA for Activity Category E are shown in bold. There were no receivers impacted by traffic noise under 2018 traffic conditions or the 2040 Design Build scenario.

**Table 5. Predicted Traffic Noise Levels**

Receiver	Activity Category	Distance from Existing Centerline to Activity Area (feet)	Distance from 2040 Design Centerline to Activity Area (feet)	2018 Existing Traffic Noise Level (Leq1hr dBA)	2040 Design Traffic Noise Level (Leq1hr dBA)	Noise Abatement Criteria (Leq1hr dBA)	2040 Build Traffic Noise Level Approaches or Exceeds NAC
<b>Baldwin Avenue</b>							
3500 Baldwin	B	61	60	50	55	66	No
3501 Baldwin	B	87	89	50	54	66	No
3509 Baldwin	B	89	90	50	53	66	No
3517 Baldwin	B	89	90	49	53	66	No
<b>Cleveland Avenue</b>							
3517 Cleveland-1	C	627	278	52	54	66	No
3517 Cleveland-2	C	566	259	52	55	66	No
3517 Cleveland-3	C	519	249	53	55	66	No
3517 Cleveland-4	C	508	271	53	55	66	No
<b>Cornhusker Highway</b>							
2825 Cornhusker-1	E	99	99	67	68	71	No
2825 Cornhusker-2	E	112	112	66	68	71	No
3710 Cornhusker	B	139	139	63	64	66	No
<b>Huntington Avenue</b>							
3233 Huntington	C	223	223	46	49	66	No
3300 Huntington-1	B	64	75	63	64	66	No
3300 Huntington-2	B	64	75	63	65	66	No
3300 Huntington-3	B	64	75	63	65	66	No

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Receiver	Activity Category	Distance from Existing Centerline to Activity Area (feet)	Distance from 2040 Design Centerline to Activity Area (feet)	2018 Existing Traffic Noise Level (Leq1hr dBA)	2040 Design Traffic Noise Level (Leq1hr dBA)	Noise Abatement Criteria (Leq1hr dBA)	2040 Build Traffic Noise Level Approaches or Exceeds NAC
3500 Huntington	B	97	96	57	59	66	No
<b>Madison Avenue</b>							
3310 Madison	B	81	49	58	58	66	No
<b>North 33<sup>rd</sup> Street</b>							
2301 N 33 <sup>rd</sup>	C	45	46	59	59	71	No
33 <sup>rd</sup> _Mad-1	C	89	39	58	60	66	No
33 <sup>rd</sup> _Mad-2	C	90	77	57	58	66	No
33 <sup>rd</sup> _Mad-3	C	155	52	55	58	66	No
33 <sup>rd</sup> _Mad-4	C	156	100	55	57	66	No
33 <sup>rd</sup> _Mad-5	C	220	52	53	58	66	No
33 <sup>rd</sup> _Mad-6	C	222	100	53	56	66	No
33 <sup>rd</sup> _Mad-7	C	286	52	52	57	66	No
33 <sup>rd</sup> _Mad-8	C	287	100	52	56	66	No
33 <sup>rd</sup> _Mad-9	C	352	53	51	57	66	No
33 <sup>rd</sup> _Mad-10	C	353	100	51	55	66	No
<b>St Paul Avenue</b>							
3309 St Paul	B	81	34	58	61	66	No
3310 St Paul	B	108	40	56	59	66	No
3317 St Paul	B	122	44	55	59	66	No
3320 St Paul	B	148	40	54	59	66	No
3323 St Paul	B	175	46	54	58	66	No
3330 St Paul	B	197	45	53	58	66	No
3331 St Paul	B	225	51	52	58	66	No
3337 St Paul	B	274	48	51	57	66	No
3338 St Paul	B	256	40	51	58	66	No
3344 St Paul	B	298	39	50	58	66	No
3347 St Paul	B	324	50	50	57	66	No
3400 St Paul	B	354	39	50	57	66	No
3409 St Paul	B	328	46	50	57	66	No
3410 St Paul	B	405	38	50	57	66	No

## 11.0 Traffic Noise Abatement Measures

Noise abatement measures may be considered where predicted traffic noise levels approach or exceed the noise abatement criteria, or when the predicted traffic noise levels substantially exceed the existing noise levels. In this case, abatement measures were not considered because no impacts were identified.

When considering abatement measures, judgments are made in each area, weighing the costs and effects of each abatement measure against the amount of benefit. Even if a noise abatement measure is feasible, it might not be reasonable or warranted for a particular area.

### 11.1 Buffer Zones

The purpose of a buffer zone is to provide enough distance between the noise source and any future developments to minimize future noise impacts. Buying substantial right-of-way in undeveloped areas adds that extra distance to allow for more noise reduction. Because the affected areas are already developed, this option would not be feasible.

### 11.2 Alteration of Horizontal and Vertical Alignment

This noise abatement measure can be incorporated into a project to reduce traffic noise impacts where the receptors are typically on one side of the project or where the elevation is relatively constant. Since sound intensity decreases with distance, shifting of the centerline away from the receptors may reduce noise levels.

### 11.3 Traffic Management Measures

These measures are examined and evaluated as alternative noise abatement measures for reducing or eliminating any noise impact.

The prohibition of certain vehicle types, mainly trucks, is an alternative noise abatement measure. Another measure might be to limit trucks to only daylight hours. However, these measures are not reasonable for this project because this is a major arterial, one of whose purposes is to move traffic including trucks, easily through the area.

### 11.4 Noise Barriers

The NDOT Noise Policy states “A noise barrier must block the “line of sight” between the noise source and the noise receiver”. To accomplish this, noise barriers must be continuous and have substantial length and height to be effective.

Noise barriers can consist of earth berms or structural barriers. An earth berm requires a wide area to be installed and due to the limited amount of right of way, this type of noise barrier would not be feasible for this project.

When considering noise barriers, the NDOT Noise Policy factors the cost and effects of the noise barrier against the amount of benefit. This assessment is conducted through analysis of the feasibility (acoustic and engineering) and reasonableness.

### **Feasibility**

A noise abatement device is considered acoustically feasible when 60% of the front-row impacted receptors located directly behind the noise wall achieves a 5 dB(A) noise reduction.

A noise abatement device is considered feasible if the device can be engineered to fit the topography and existing designed highway barriers and still be maintained; the exposed height of the device will be built at 25 feet high or less; and does not create safety concerns.

### **Reasonableness**

The NDOT Noise Policy establishes two factors that must be met for a noise barrier to be considered reasonable.

- A minimum of 50% of benefited front-row receptors directly behind the noise wall must achieve a 7 dB(A) noise reduction.
- The noise barrier must be cost effective. NDOT defines cost effectiveness as dollars per benefited receptor. NDOT will use a unit cost of \$52/ft<sup>2</sup> for barrier heights up to 16 feet. The unit cost increases 40% to \$73/ft<sup>2</sup> for barrier heights between 16 feet and 25 feet. The base value of allowable abatement costs for barriers up to 16 feet tall is \$41,600 per benefitted receptor; however, NDOT allows for adjustments based on the design year noise level and receptors experiencing a substantial increase receive an additional \$3,000 in allowable cost resulting in a potential maximum allowable cost of \$56,600 per benefitted receptor in extreme instances. The base value of allowable abatement costs for barriers 16 – 25 feet tall is \$58,400 with a maximum allowable cost of \$73,400 per benefitted receptor in extreme instances.

## **12.0 Construction Noise**

Construction noise can result in short-term impacts to sensitive land uses. Construction noise levels are typically a function of the scale of the project and the types and number of pieces of equipment operating concurrently. Appropriate measures to reduce construction noise impacts for this project may include the following:

### **12.1 Community Awareness**

Although this will not mitigate noise, it is important for people to be made aware of the possible inconvenience, and to know its approximate duration so they can plan their activities accordingly. This includes establishing and advertising a complaint mechanism so that construction operations can be responsive to community concerns. These provisions can be applied through contract requirements.

## 12.2 Source Control

This involves reducing noise impacts from construction by controlling the noise emissions at their source. This can be accomplished by specifying proper muffler systems and using wheeled equipment instead of tracked equipment when possible. Another method might be placing a temporary noise barrier in front of the equipment. Source control provisions can be applied through contract requirements.

## 12.3 Specifying the Allowable Time, Place, and Method of Operation

Reducing noise impacts at sensitive receivers can be accomplished by operating stationary equipment as far away from the sensitive receivers as possible. Employment of special work hour limitations is another option. These types of provisions can be applied through contract requirements.

## 13.0 Conclusion

A traffic noise study was completed for this project in accordance with the NDOT Noise Policy. The traffic noise level predicted for each noise sensitive receiver location does not approach or exceed the NAC for the future traffic conditions. The predicted future noise levels do not substantially exceed the existing levels.

In the event that any changes in the nature, design, or location of the project are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report are modified or verified in writing.

## 14.0 References

Nebraska Department of Transportation "Noise Analysis and Abatement Policy," January 2022.

American Association of State Highway and Transportation Officials, "Guide on Evaluation and Attenuation of Traffic Noise".

FHWA, Special Report - Highway Construction Noise: Measurement, Prediction and Mitigation.

AASHTO, A Policy on Geometric Design of Highways and Streets, 6th Edition – 2011.

Olsson, Transportation Alternative Traffic Analysis Report, December 2019.





## **Appendix A**

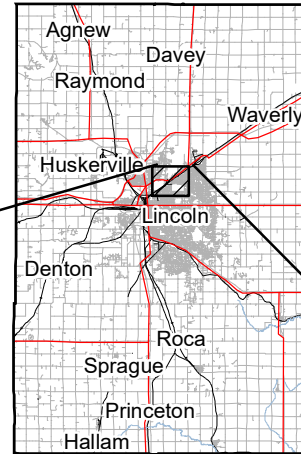
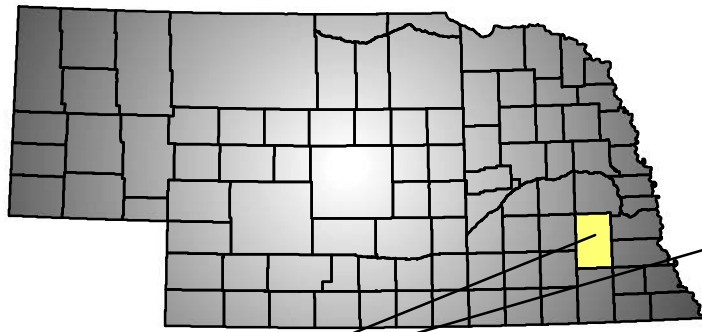
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### **Maps**

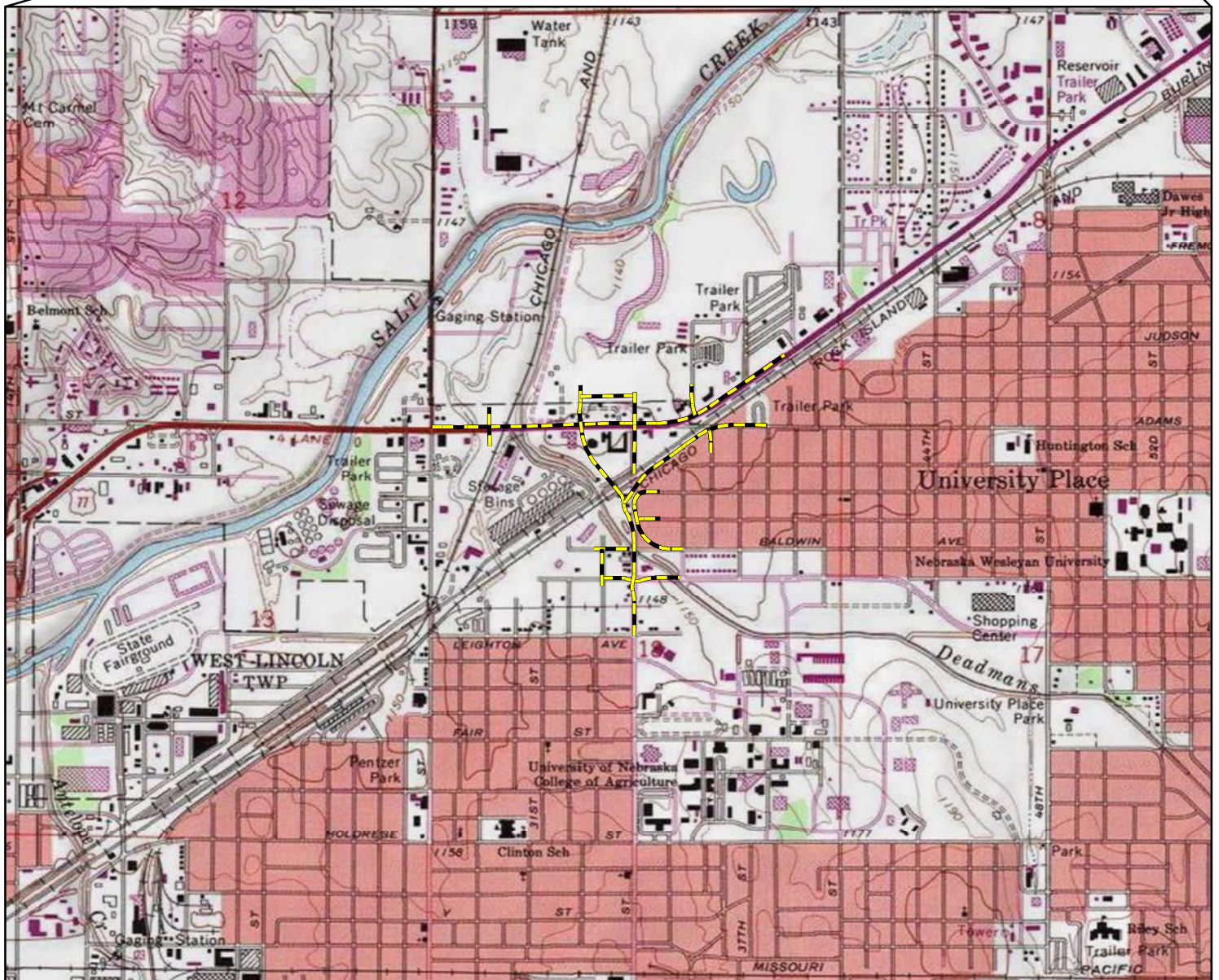
Project Location  
Receiver Location Map Index  
Receiver Location Map

# NEBRASKA

# LANCASTER COUNTY

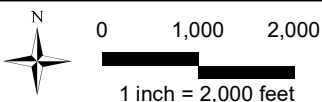


Project Location



— Preferred Alternative

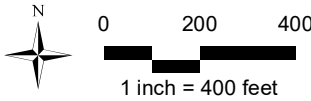
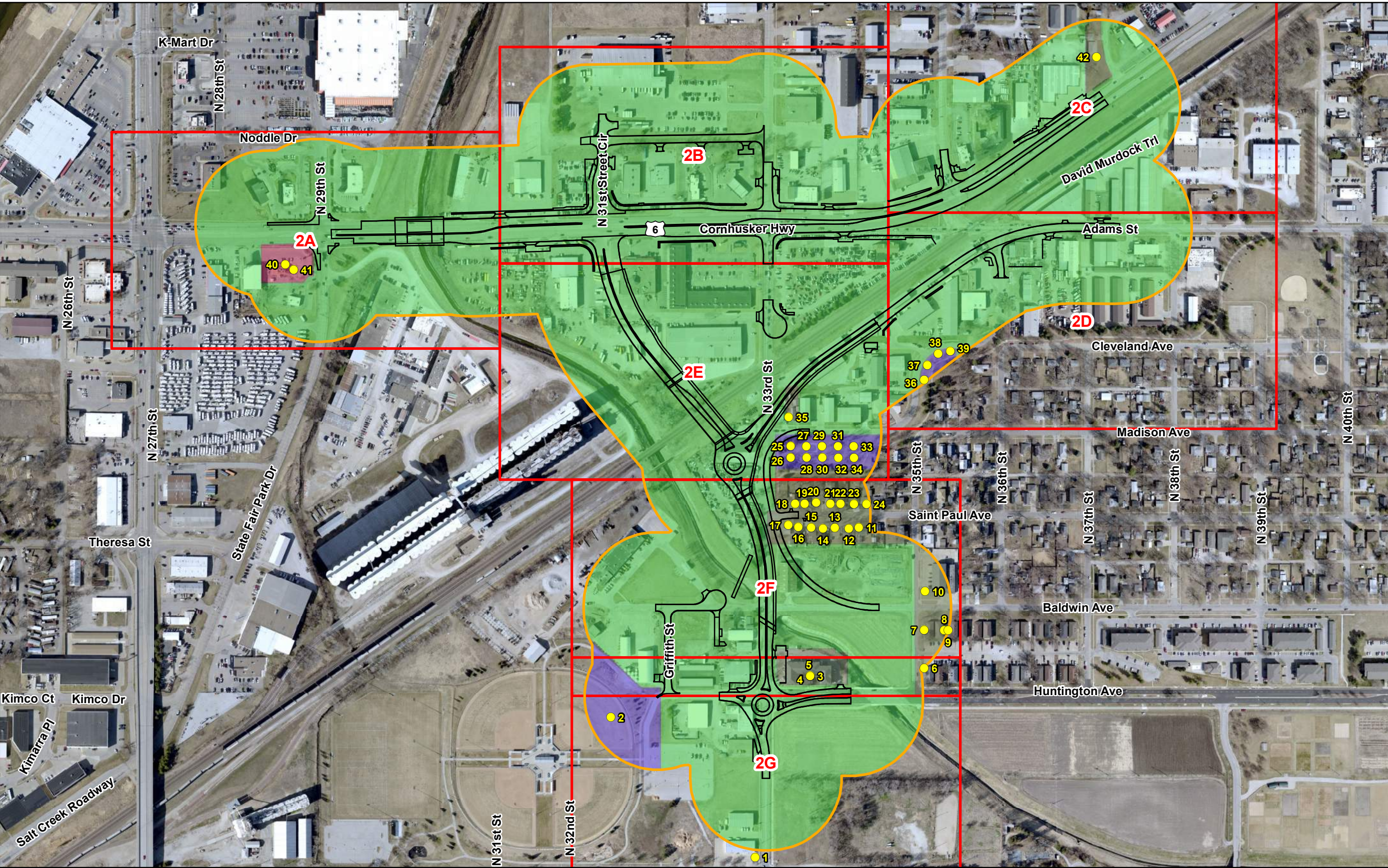
**33rd & Cornhusker**  
Lincoln, Nebraska  
Project No. A17-3604  
**Project Location Map**  
Figure 1





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Id	Receiver
1	2301 N 33rd
2	3233 Huntington
3	3300 Huntington-1
4	3300 Huntington-2
5	3300 Huntington-3
6	3500 Huntington
7	3501 Baldwin
8	3509 Baldwin
9	3517 Baldwin
10	3500 Baldwin
11	3409 St Paul
12	3347 St Paul
13	3337 St Paul
14	3331 St Paul
15	3323 St Paul
16	3317 St Paul
17	3309 St Paul
18	3310 St Paul
19	3320 St Paul
20	3330 St Paul
21	3338 St Paul
22	3344 St Paul
23	3400 St Paul
24	3410 St Paul
25	33rd_Mad-1
26	33rd_Mad-2
27	33rd_Mad-3
28	33rd_Mad-4
29	33rd_Mad-5
30	33rd_Mad-6
31	33rd_Mad-7
32	33rd_Mad-8
33	33rd_Mad-9
34	33rd_Mad-10
35	3310 Madison
36	3517 Cleveland-1
37	3517 Cleveland-2
38	3517 Cleveland-3
39	3517 Cleveland-4
40	2825 Cornhusker-1
41	2825 Cornhusker-2
42	3710 Cornhusker



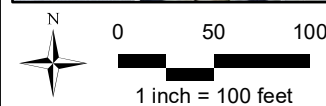
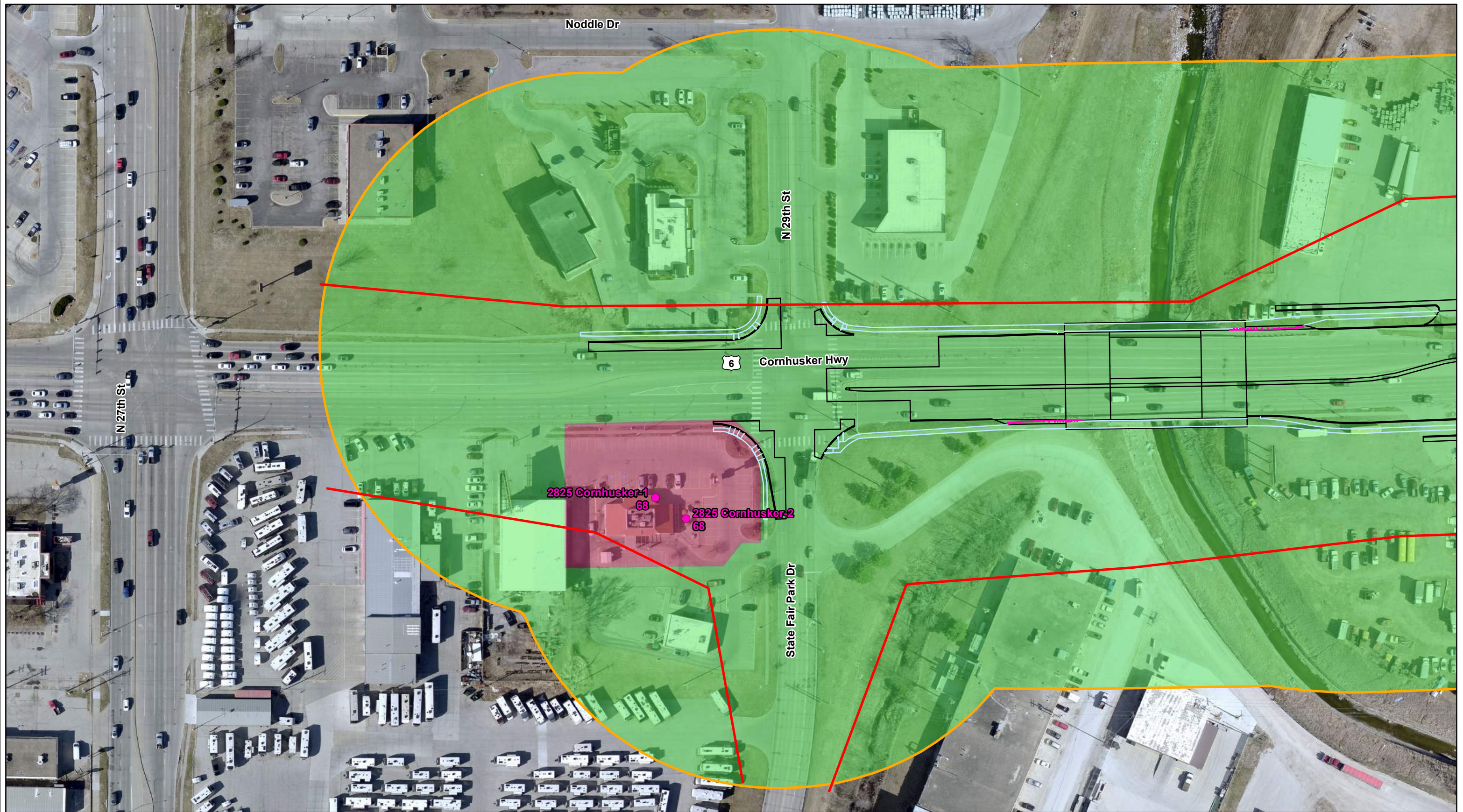
- Noise Receiver
- 300ft Noise Study Buffer
- Receiver Location Map Index
- Edge of Roadway

- Activity Category
- B
  - C
  - E
  - F

**33rd & Cornhusker**  
Lincoln, Nebraska  
Project No. 017-3604-A  
**Receiver Location Map Index**  
Figure 2



F:\2017\3501-4000\017-3604-A\40-Design\GIS\19-10-17\_NRPL\_Mod C Noise Figures.mxd User: rdcy



- Noise Receiver w/ Future Noise Level**
- Approaches or Exceeds NAC
  - Does Not Approach or Exceed NAC
  - 66 dBA Contour
  - 300ft Noise Study Buffer

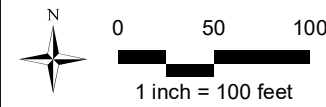
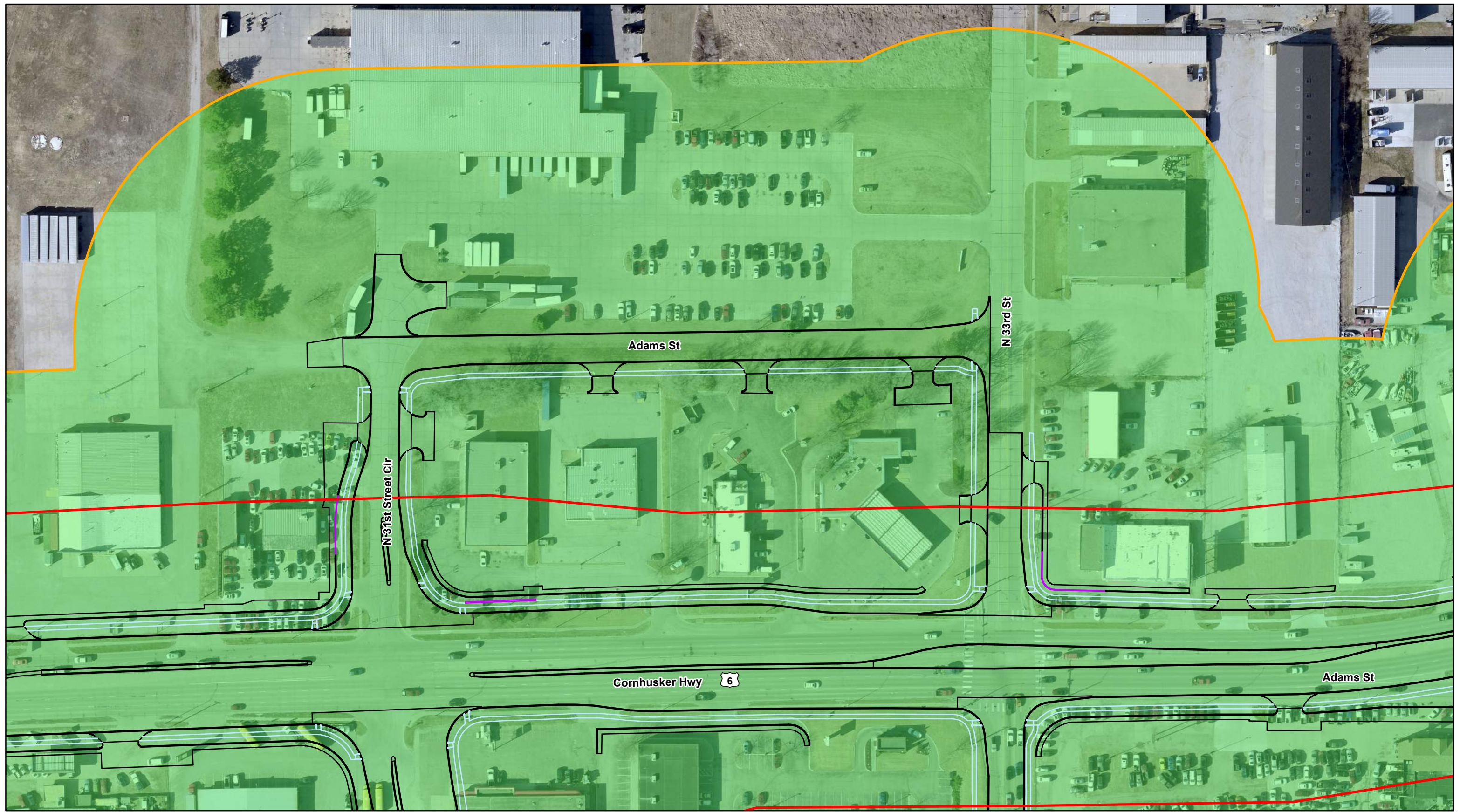
- Project Features**
- Edge of Roadway
  - Sidewalk
  - Guardrail
  - Retaining Wall

- Activity Category**
- B
  - C
  - E
  - F

**33rd & Cornhusker**  
Lincoln, Nebraska  
Project No. 017-3604-A  
**Receiver Location Map**  
Figure 2A



F:\2017\3501-4000\017-3604-A\40-Design\GIS\19-10-17\_NRPL\_Mod C Noise Figures.mxd User: rdcy

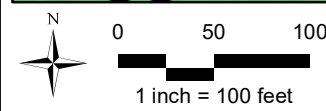
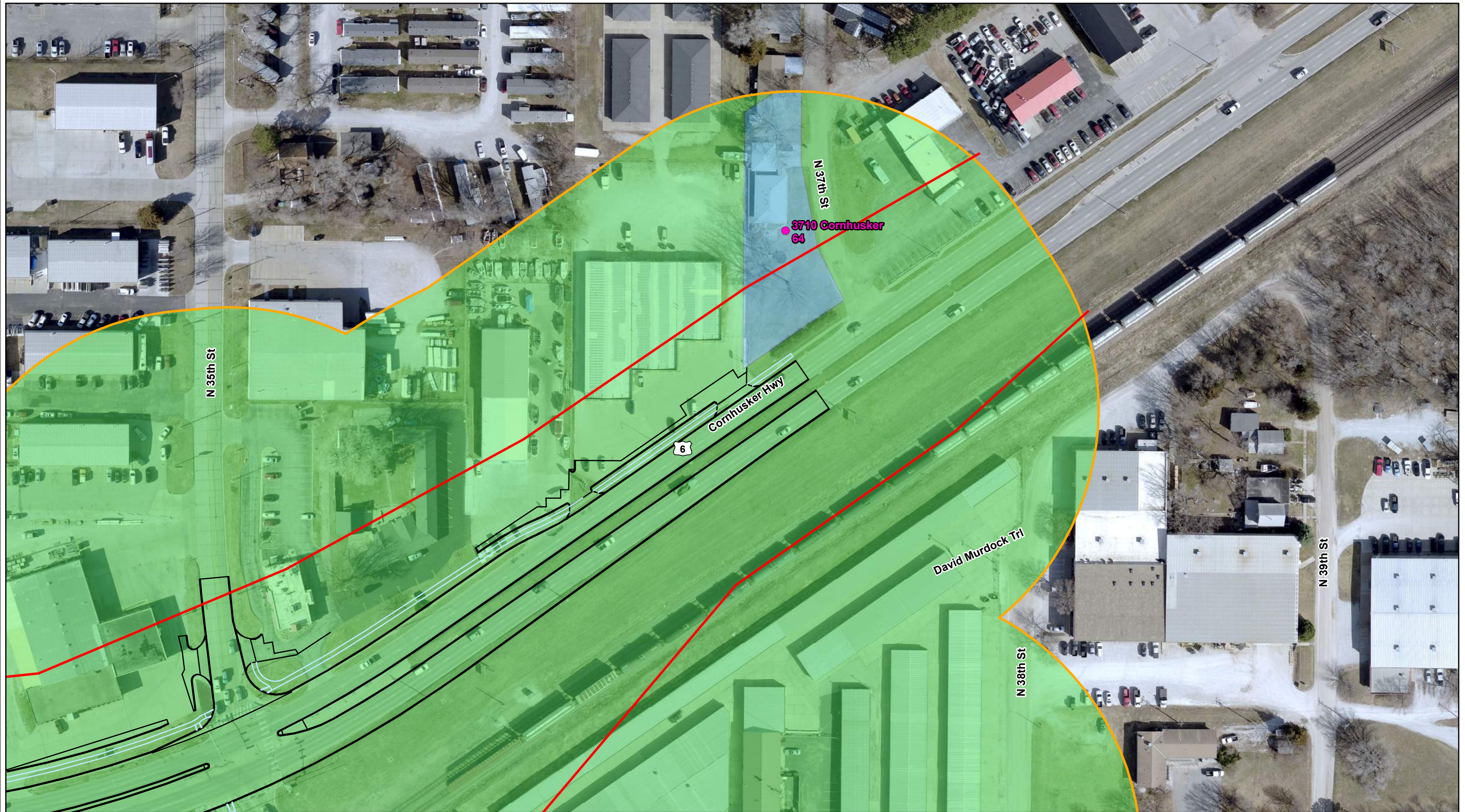


- | Noise Receiver w/ Future Noise Level   | Project Features                                     | Activity Category   |
|--|--|---|
| <span style="color: cyan;">●</span> Approaches or Exceeds NAC  | <span style="color: black;">—</span> Edge of Roadway | <span style="background-color: lightblue; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> B   |
| <span style="color: magenta;">●</span> Does Not Approach or Exceed NAC   | <span style="color: lightblue;">—</span> Sidewalk    | <span style="background-color: lightpurple; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> C |
| <span style="color: red;">—</span> 66 dBA Contour  | <span style="color: magenta;">—</span> Guardrail     | <span style="background-color: pink; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> E        |
| <span style="border: 2px solid orange; display: inline-block; width: 20px; height: 10px;"></span> 300ft Noise Study Buffer | <span style="color: purple;">—</span> Retaining Wall | <span style="background-color: lightgreen; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> F  |

**33rd & Cornhusker**  
Lincoln, Nebraska  
Project No. 017-3604-A  
**Receiver Location Map**  
Figure 2B



F:\2017\3501-4000\017-3604-A\40-Design\GIS\19-10-17\_NRPL\_Mod C Noise Figures.mxd User: rcdy

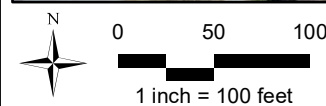
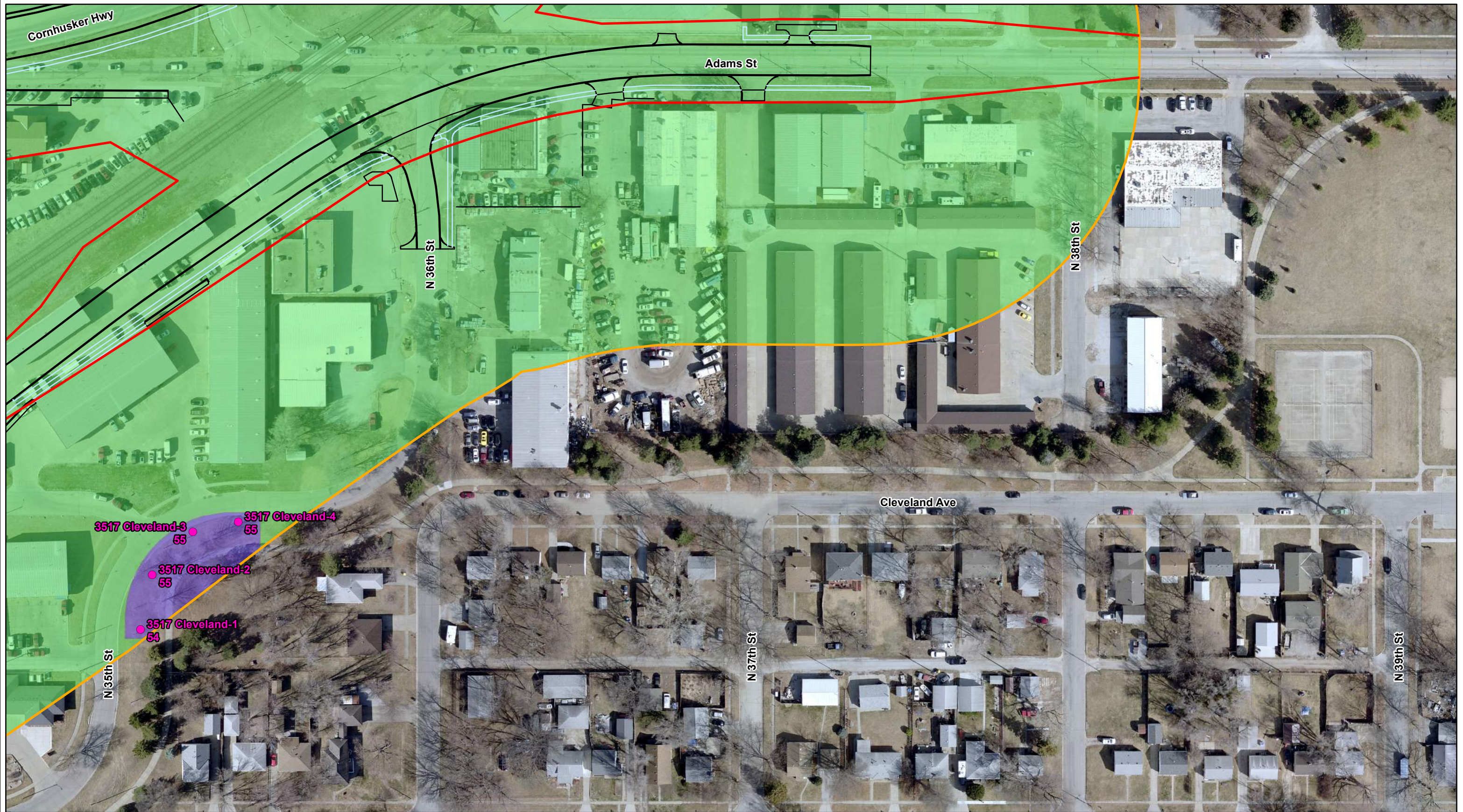


- | Noise Receiver w/ Future Noise Level                                   | Project Features                                     | Activity Category                          |
|--|--|--|
| <span style="color: cyan;">●</span> Approaches or Exceeds NAC          | <span style="color: black;">—</span> Edge of Roadway | <span style="color: lightblue;">■</span> B |
| <span style="color: magenta;">●</span> Does Not Approach or Exceed NAC | <span style="color: lightblue;">—</span> Sidewalk    | <span style="color: purple;">■</span> C    |
| <span style="color: red;">—</span> 66 dBA Contour                      | <span style="color: magenta;">—</span> Guardrail     | <span style="color: pink;">■</span> E      |
| <span style="color: orange;">—</span> 300ft Noise Study Buffer         | <span style="color: purple;">—</span> Retaining Wall | <span style="color: green;">■</span> F     |

**33rd & Cornhusker**  
Lincoln, Nebraska  
Project No. 017-3604-A  
**Receiver Location Map**  
Figure 2C



F:\2017\3501-4000\017-3604-A\40-Design\GIS\19-10-17\_NRPL\_Mod C Noise Figures.mxd User: rdcy

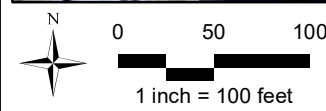


Noise Receiver w/ Future Noise Level	Project Features	Activity Category
<span style="color: cyan;">●</span> Approaches or Exceeds NAC	<span style="color: black;">—</span> Edge of Roadway	<span style="background-color: lightblue;"> </span> B
<span style="color: magenta;">●</span> Does Not Approach or Exceed NAC	<span style="color: lightblue;">—</span> Sidewalk	<span style="background-color: lightpurple;"> </span> C
<span style="color: red;">—</span> 66 dBA Contour	<span style="color: magenta;">—</span> Guardrail	<span style="background-color: pink;"> </span> E
<span style="border: 2px solid orange; display: inline-block; width: 20px; height: 10px;"></span> 300ft Noise Study Buffer	<span style="color: red;">—</span> Retaining Wall	<span style="background-color: lightgreen;"> </span> F

**33rd & Cornhusker**  
Lincoln, Nebraska  
Project No. 017-3604-A  
**Receiver Location Map**  
Figure 2D



F:\2017\3501-4000\017-3604-A\40-Design\GIS\19-10-17\_NRPL\_Mod C Noise Figures.mxd User: rcdy

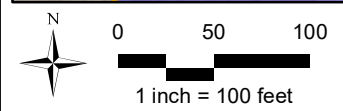
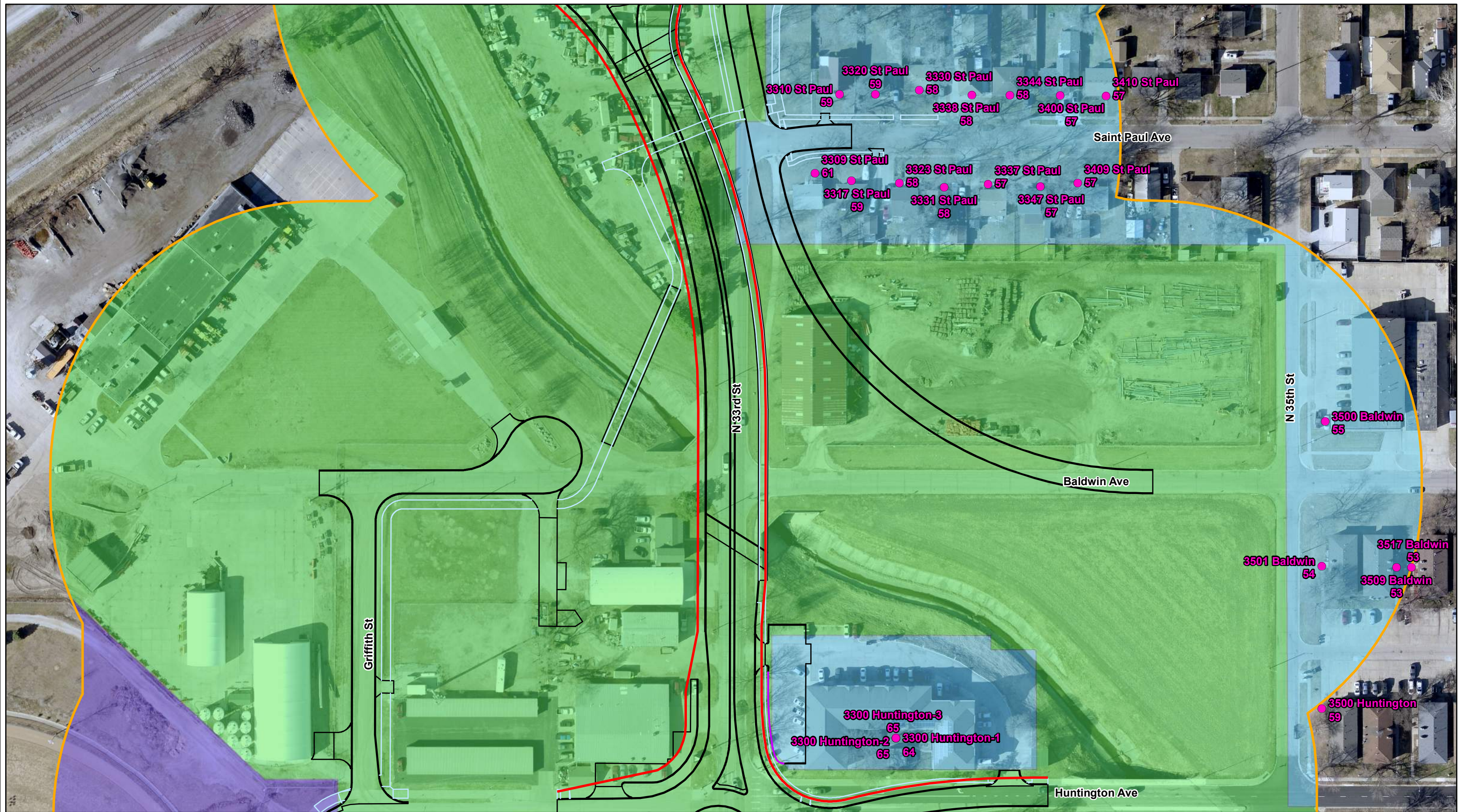


- | Noise Receiver w/ Future Noise Level   | Project Features                                     | Activity Category  |
|--|--|--|
| <span style="color: cyan;">●</span> Approaches or Exceeds NAC  | <span style="color: black;">—</span> Edge of Roadway | <span style="background-color: lightblue; border: 1px solid black;"> </span> B   |
| <span style="color: magenta;">●</span> Does Not Approach or Exceed NAC   | <span style="color: lightblue;">—</span> Sidewalk    | <span style="background-color: lightpurple; border: 1px solid black;"> </span> C |
| <span style="color: red;">—</span> 66 dBA Contour  | <span style="color: magenta;">—</span> Guardrail     | <span style="background-color: pink; border: 1px solid black;"> </span> E        |
| <span style="border: 2px solid orange; display: inline-block; width: 20px; height: 10px;"></span> 300ft Noise Study Buffer | <span style="color: purple;">—</span> Retaining Wall | <span style="background-color: lightgreen; border: 1px solid black;"> </span> F  |

**33rd & Cornhusker**  
Lincoln, Nebraska  
Project No. 017-3604-A  
**Receiver Location Map**  
Figure 2E



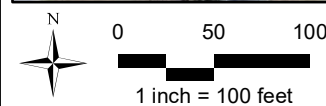
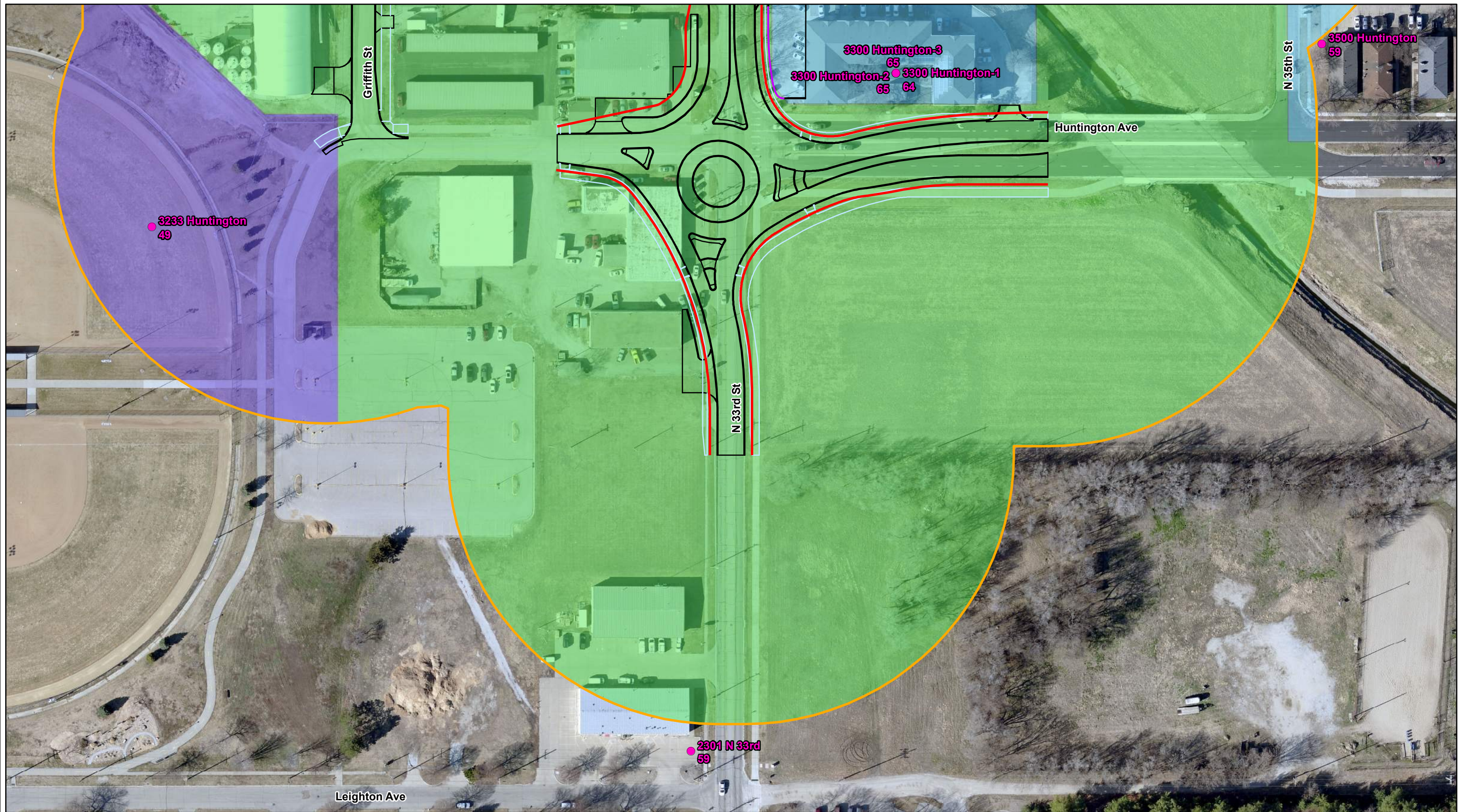
F:\2017\3501-4000\017-3604-A\40-Design\GIS\19-10-17\_NRPL\_Mod C Noise Figures.mxd User: rcdy



**33rd & Cornhusker**  
Lincoln, Nebraska  
Project No. 017-3604-A  
**Receiver Location Map**  
Figure 2F



F:\2017\3501-4000\017-3604-A\40-Design\GIS\19-10-17\_NRPL\_Mod C Noise Figures.mxd User: rcdy



Noise Receiver w/ Future Noise Level	Project Features	Activity Category
<span style="color: cyan;">●</span> Approaches or Exceeds NAC	<span style="color: black;">—</span> Edge of Roadway	<span style="background-color: lightblue;"> </span> B
<span style="color: magenta;">●</span> Does Not Approach or Exceed NAC	<span style="color: blue;">—</span> Sidewalk	<span style="background-color: purple;"> </span> C
<span style="color: red;">—</span> 66 dBA Contour	<span style="color: magenta;">—</span> Guardrail	<span style="background-color: pink;"> </span> E
<span style="border: 2px solid orange; display: inline-block; width: 20px; height: 10px;"></span> 300ft Noise Study Buffer	<span style="color: purple;">—</span> Retaining Wall	<span style="background-color: lightgreen;"> </span> F

**33rd & Cornhusker**  
Lincoln, Nebraska  
Project No. 017-3604-A  
**Receiver Location Map**  
Figure 2G





## **Appendix B**

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### Noise Measurement Records

## Noise Measurement Record

Project Name: 33rd & Cornhusker		Project No.: A17-3604
Site ID: Site 1		Measurement No.: 1
Conducted by: Ryan Doty		Date: 3/10/2020
Start Time: 0853	Stop Time: 0906	Leq Range: 50-120
Length of Measurement: 13 minutes		Microphone Height: 5 ft

Site Address: SE corner 33rd & Madison Ave

	Sound Level Meter	Microphone	Calibrator
Model:	Quest 2200	—	Quest CA-12B
Serial No.:	K0A 100010	—	45100063

Calibration Check: Calibrated to 110 dB, checked at 110 dB

Winds	Temperature	Humidity	Precipitation
~ / mph	29°	93%	None

### Noticeable Events

Source	dBA	Source	dBA
Train @ 13 minutes Stopped measurement			

### Optional

Leq at 5 minutes: — dBA	L1: dBA
Leq at 10 minutes: — dBA	L10: dBA
Leq at 15 minutes: — dBA	L50: dBA
Leq at 20 minutes: dBA	L90: dBA

Overall Leq: 67.8

TNM predicted 66.4

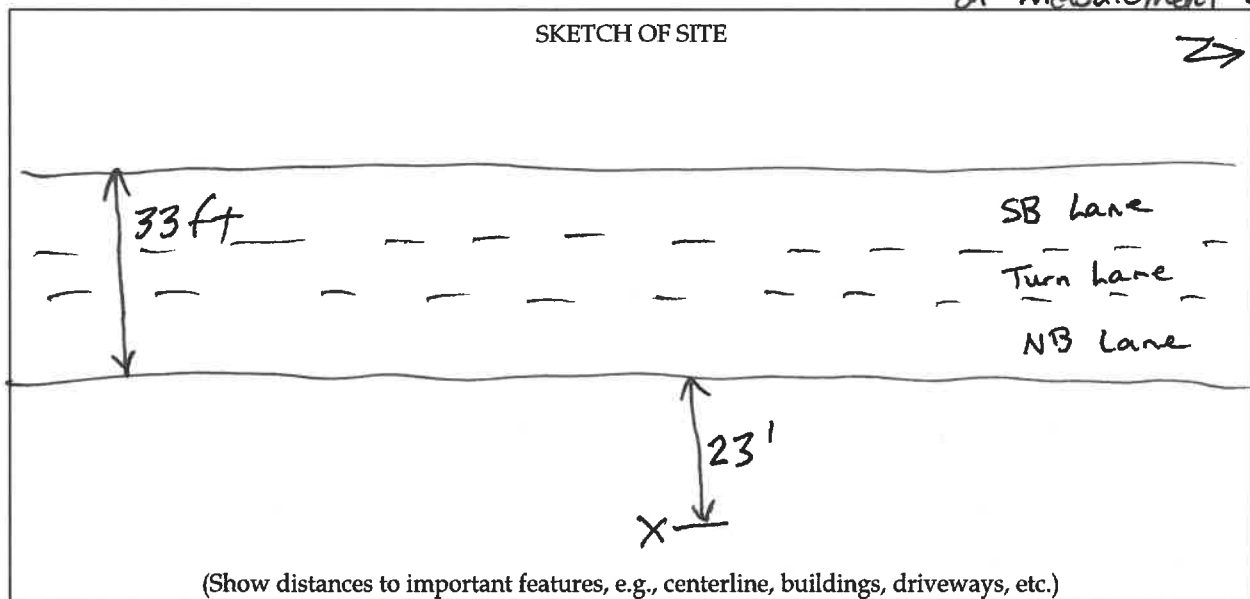


**Traffic (Optional)**

	Roadway: <u>33rd</u>		Roadway:		Roadway:	
	Counted	Hr. Equiv.	Counted	Hr. Equiv.	Counted	Hr. Equiv.
Autos	$134 \times 4 = 536$		$134 \times 4.6 = 616$		=	
Medium Trucks	$16 = 64$		$16 = 74$		=	
Heavy Trucks	$4 = 16$		$4 = 18$		=	
Speed	$35 \text{ mph}$					

Noise Sources Other than Traffic Noise: Train at 13 minutes, stopped reading

Elevation of Roadway in Relation to Elevation of Ground at Measurement Site: Roadway is 1 ft lower than ground at measurement site

**Supplementary Information**

Comments:

Cars	Med. Trucks	Heavy Trucks

## Noise Measurement Record

Project Name: 33 <sup>rd</sup> & Cornhusker		Project No.: A12-3604	
Site ID: Site 2		Measurement No.: 1	
Conducted by: Ryan Doty		Date: 3/10/2020	
Start Time: 1220	Stop Time: 1235	Leq Range: 50-120	
Length of Measurement: 15 minutes		Microphone Height: 5 ft	

Site Address: Sunset Storage

	Sound Level Meter	Microphone	Calibrator
Model:	Quest 2200	—	Quest CA-12B
Serial No.:	K0A10010	—	45100063

Calibration Check: 110 dB

Winds	Temperature	Humidity	Precipitation
2-3 mph	37°	83%	None

### Noticeable Events

Source	dBA	Source	dBA
Train @ 12:05 minutes			

### Optional

Leq at 5 minutes: 69.6 dBA	L1: dBA
Leq at 10 minutes: 69.0 dBA	L10: dBA
Leq at 15 minutes: 70.5 dBA	L50: dBA
Leq at 20 minutes: dBA	L90: dBA

Overall Leq: 70.5

TNM predicted 70.2

**Traffic (Optional)**

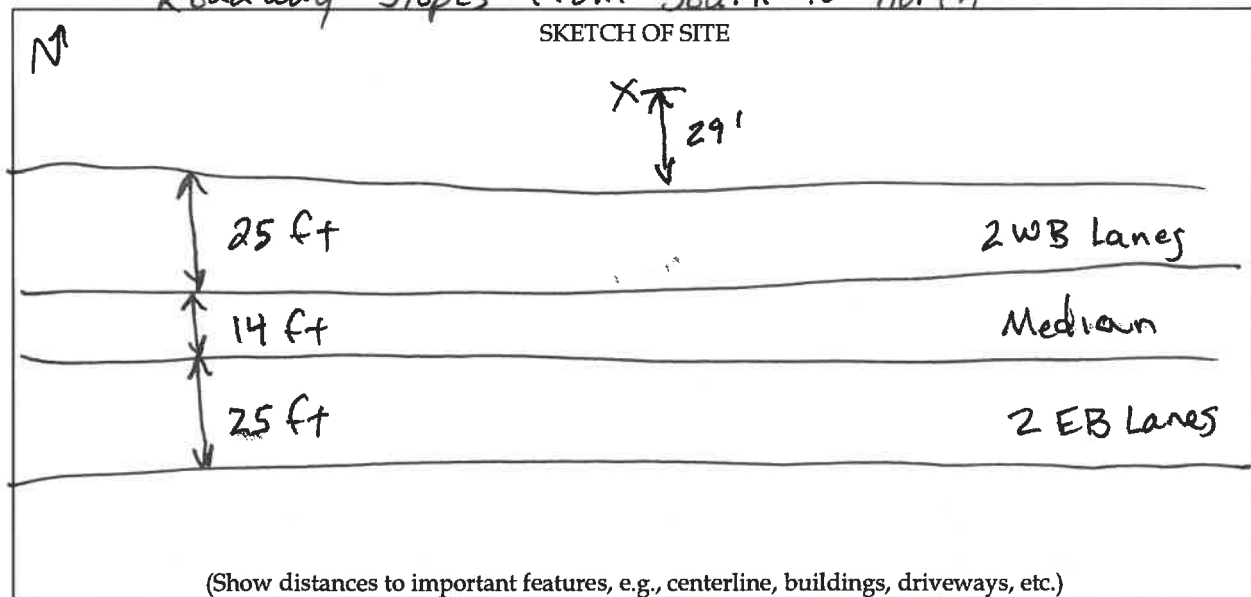
	Roadway: <u>Cornhusker</u>		Roadway:		Roadway:	
	Counted	Hr. Equiv.	Counted	Hr. Equiv.	Counted	Hr. Equiv.
Autos	446	= 1784	=		=	
Medium Trucks	14	= 56	=		=	
Heavy Trucks	10	= 40	=		=	
Speed	45 mph					

Noise Sources Other than Traffic Noise: Railroad tracks south of road

Elevation of Roadway in Relation to Elevation of Ground at Measurement Site: \_\_\_\_\_

Monitoring point is ~ 2 ft lower than roadway

Roadway slopes from south to north

**Supplementary Information**

Comments:

Traffic recorded for count

## Noise Measurement Record

Project Name: 33 <sup>rd</sup> + Cornhusker	Project No.: A17-3604
Site ID: Site 3	Measurement No.: 1
Conducted by: Ryan Doty	Date: 3/10/2020
Start Time: 1301	Stop Time: 1316
Length of Measurement: 15 minutes	L <sub>eq</sub> Range: 50-120
	Microphone Height: 5 ft

Site Address: Window World

	Sound Level Meter	Microphone	Calibrator
Model:	Quest 2200	—	Quest CA-12B
Serial No.:	K0A 10010	—	45100063

Calibration Check: 110 dB

Winds	Temperature	Humidity	Precipitation
2-3 mph	36°	85%	None

## Noticeable Events

Source	dBA	Source	dBA
None			

## Optional

L <sub>eq</sub> at 5 minutes: 73.9 dBA	L <sub>1</sub> : dBA
L <sub>eq</sub> at 10 minutes: 73.6 dBA	L <sub>10</sub> : dBA
L <sub>eq</sub> at 15 minutes: 73.5 dBA	L <sub>50</sub> : dBA
L <sub>eq</sub> at 20 minutes: dBA	L <sub>90</sub> : dBA

Overall L<sub>eq</sub>: 73.5

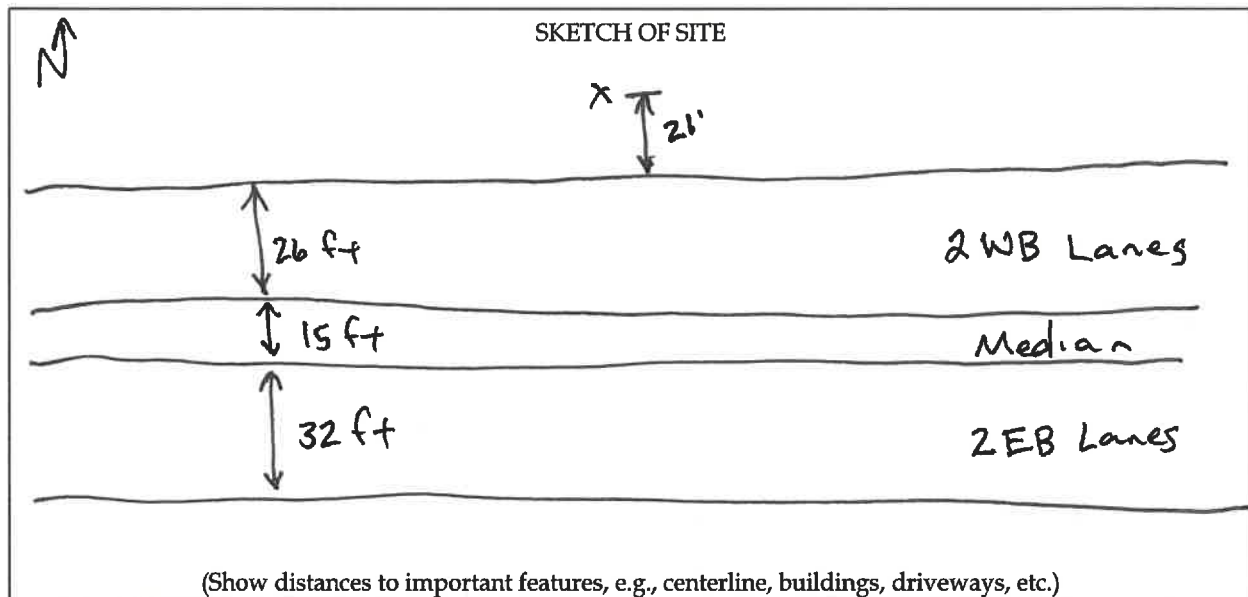
TNM predicted 70.9

**Traffic (Optional)**

	Roadway: <u>Cornhusker</u>		Roadway:		Roadway:	
	Counted	Hr. Equiv.	Counted	Hr. Equiv.	Counted	Hr. Equiv.
Autos	471	= 1884	=		=	
Medium Trucks	26	= 104	=		=	
Heavy Trucks	6	= 24	=		=	
Speed	45 mph					

Noise Sources Other than Traffic Noise: N/A

Elevation of Roadway in Relation to Elevation of Ground at Measurement Site: < 1 ft difference

**Supplementary Information**

Comments:

Traffic recorded for count

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_