NOISE ANALYSIS REPORT

LIC-16/37-14.24/15.72
Granville, Licking County, Ohio
PID 95445

VAR-D05/D10 Environmental Services, PID 107362;
Encumbrance Number 742780

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Authorization for Release

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The undersigned attest, to the best of their knowledge, that this document and the information contained herein is accurate and conforms to EnviroScience's internal Quality Assurance standards.

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EXECUTIVE SUMMARY

The Ohio Department of Transportation (ODOT) District 5 has proposed a project on SR 16/27 in Granville, Licking County, Ohio. The project is located along SR 16/37 from approximately 2000 ft west of the intersection of SR 37 with Columbus Road to the SR 16/37 Thornwood Crossing intersection. The project includes major reconstruction of pavement, replacement of composite pavement, and construction of additional general use lanes in the median. Bridge and culvert maintenance work will be completed within the project area. The construction of additional use lanes requires a Type I noise analysis. To support this project, EnviroScience completed a Noise Analysis for both the north and south sides of SR 16/37 in the City of Granville for receivers in noise sensitive areas within 500 ft of the edge of pavement including onramps and offramps. The noise analysis was completed in accordance with ODOT's Noise Manual for both the north and the south sides of SR 16/37.

Eight Noise Sensitive Areas (NSAs) were modeled using TNM 2.5. Six NSAs had receptors whose noise levels approached or exceeded federal Noise Abatement Criteria. Barriers were modeled for all NSAs whose noise levels approached or exceeded federal Noise Abatement Criteria. Barriers were evaluated for feasibility and reasonableness according to current ODOT guidelines.

Noise barriers were recommended for NSA 2. For all other NSAs, barriers were either acoustically infeasible or exceeded the ODOT cost threshold of $56,000 per benefited receptor.

1.0 INTRODUCTION

The Ohio Department of Transportation (ODOT) District 5 has proposed a project on SR 16/27 in Granville, Licking County, Ohio. The project is located along SR 16/37 from approximately 2000 ft west of the intersection of SR 37 with Columbus Road to the SR 16/37 Thornwood Crossing intersection (Figure 1, Appendix A). The project includes major reconstruction of pavement, replacement of composite pavement, and construction of additional general use lanes in the median. Bridge and culvert maintenance work will be completed within the project area. The construction of additional use lanes requires a Type I noise analysis. To support this project, EnviroScience completed a Noise Analysis for both the north and south sides of SR 16/37 in the City of Granville for receivers in noise sensitive areas within 500 ft of the edge of pavement including onramps and offramps (Figure 2, Appendix A). The noise analysis was completed in accordance with ODOT's Noise Manual for both the north and the south sides of SR 16/37.

The analysis was completed following procedures given in the current version of the ODOT Traffic Noise Analysis Manual and policy (ODOT, 2023). This document is ODOT's implementation of the Federal Highway Administration's (FHWA) rules found in Title 23 of the Code of Federal Regulations (CFR) Part 772 as modified on September 22, 2021, and the procedures contained in current FHWA guidance (FHWA, 2011).

Noise analysis is required for Type I projects to determine noise levels and to evaluate the feasibility and reasonableness of potential noise abatement strategies, including barriers. This report is organized as outlined in the ODOT Traffic Noise Analysis Manual. Appendices A through I contain maps with project features overlaid on aerial photos, field data and instrument calibration sheets, modeling inputs and outputs, plan views, traffic data, copies of notification letters for fieldwork, noise barrier design tables, addresses of benefited receptors, and digital TNM files.

2.0 NOISE ANALYSIS OVERVIEW

The noise analysis for this project was conducted following 23 CFR 772, and the U.S. Department of Transportation, FHWA's *Highway Traffic Noise Analysis and Abatement Policy and Guidance* (FHWA, 2011). The project was also conducted following ODOT's Traffic Noise Analysis Manual entitled *Standard Procedure for Analysis and Abatement of Highway Traffic Noise* (ODOT, 2019, as amended 2023). The 2024 noise levels, predicted noise levels, and evaluation of noise barrier walls were modeled using the FHWA Traffic Noise Model (TNM) Version 2.5 (FHWA, 1998). Specific data and assumptions used in this analysis are described as follows.

This noise analysis was performed under the policy that applies to Type I projects. A Type I project, as described by the 2021 ODOT Traffic Noise Analysis Manual document, is either construction of a highway on new location or physical alteration of an existing highway that has the potential to alter traffic noise levels.

The primary purpose of this Type I highway noise analysis is to determine noise levels within the project area and use them to evaluate where noise abatement is warranted. The following activities were completed to determine noise levels:

- Define the noise analysis area.
- Identify noise-sensitive areas (NSAs) within the noise analysis area based on land use and probable noise exposures.
- Measure current noise levels at locations representative of different NSAs.
- Model existing and future noise levels under the worst hourly traffic noise conditions.
- Compare noise modeling results against FHWA standards to identify impact areas where noise abatement must be considered.

Under FHWA rules and ODOT policy, noise abatement strategies must be considered wherever impacts are predicted. These strategies must be evaluated for feasibility and reasonableness. Strategies that meet both feasibility and reasonableness tests are recommended for the public involvement activities described in the ODOT Traffic Noise Analysis Manual. Abatement strategies that are determined to be both feasible and reasonable must also be desired by a majority of affected landowners and residents to be implemented.

From the 2023 ODOT Traffic Noise Analysis Manual, a feasible mitigation measure is defined as “A mitigation measure that is acoustically feasible and meets engineering requirements for constructability. A feasible noise barrier must provide a minimum of 5 dB(A) reduction for 40% of the impacted receptors.”

The ODOT Traffic Noise Analysis Manual defines reasonableness as follows: “Reasonableness involves considering the combination of social, economic, and environmental factors in the evaluation of a noise abatement measure. According to ODOT, “cost reasonable” barrier does not exceed the current cost per benefited receptor for noise abatement. The cost reasonableness criterion is not a design goal for noise abatement. Per ODOT’s Analysis and Abatement of Highway Traffic Noise Policy Statement dated October 4, 2023, reasonable cost per dwelling unit is presently considered to be $56,000 per benefited receptor, receiving a minimum reduction of 5 dB(A) in the predicted noise level. The noise reduction design goal is a 7 dB(A) reduction for at least one benefited receptor pursuant to 772.13(d)(2)(iii) and is a requirement. A benefited receptor is any receptor receiving at least a 5 dB(A) noise reduction. Other “benefited” receptors that receive a 5 or more dB(A) reduction in the average noise level shall be included in the cost/benefit calculation of each noise barrier regardless of whether or not the location is predicted to experience design year noise impacts.”

Evaluating potential noise abatement strategies focuses primarily on designing noise barriers between the highway and impacted NSAs. For clarity, the remainder of this section explains fundamental noise and acoustics principles that may be helpful to some readers. The following describes regulatory requirements and their applicability to this project; defines the criteria used to determine where noise impacts occur, and noise abatement is warranted; describes the noise analysis area and NSAs for this project; and discusses traffic parameters used for this project.

2.1 NOISE FUNDAMENTALS

The vibration of air molecules produces sound in the form of sound pressure waves, and noise is defined as any unwanted sound. The magnitudes of sound pressure waves, called sound pressure levels, determine the intensity or volume of the sound. Sound pressure levels are usually measured in logarithmic units called decibels, abbreviated dB. The dB expresses the ratio of the measured sound pressure level to a standard reference level that is defined at the typical threshold of human hearing.

An important aspect of sound is its duration or how long the sound lasts. Since sound levels can vary continuously or be intermittent, a standard method must be used to express variable sound levels. For this study, noise levels are expressed as one-hour equivalent sound levels, Leq(h). The Leq(h) is an average of the noise levels experienced over an hour. Highway noise studies like this one focus on Leq(h) values for the noisiest traffic hour of the day. Another important characteristic of sound is its frequency or pitch. Highway noise is composed of many frequencies, but the human ear does not respond to all frequencies equally. Sounds are measured using a frequency-weighting scheme known as the A-scale to represent highway noise as closely as possible to the noise levels experienced by people. The A-scale provides a weighted total sound level, where mid-range frequencies that people hear well are weighted more and high and low frequencies that people do not hear as well are weighted less. Sound pressure levels on the A-scale are expressed in units of A-weighted decibels (dBA). All noise levels reported in this study are Leq(h) in units of dBA unless stated otherwise. Sounds are produced by a variety of sources, some from nature and some from human activities.

Although all noise sources are considered in this analysis, the emphasis is on noise from highway traffic. Traffic noise is produced from tires rolling over the pavement, from vehicle engines, and from vehicle exhausts. The volume, frequencies, and duration of noise generated by traffic are determined by the type of vehicle (e.g., car, truck) as well as the vehicle's speed and acceleration. Sound travels or propagates from a source to a location of interest, called a receptor. The sound experienced at the receptor is dependent on the sound emitted from the source (intensity, frequency, and duration), the distance from the source, the presence of intervening terrain or structures between the source and receptor, the type of ground cover between the source and receptor, and meteorological conditions.

2.2 REGULATORY OVERVIEW

A noise analysis is required for any project that meets the description of a Type I project in 23 CFR 772.5. A Type I project, as described by the 2021 ODOT Traffic Noise Analysis Manual document, is either construction of a highway on new location or physical alteration of an existing highway that has the potential to alter traffic noise levels. Physical alterations to existing highway that require a Type I noise study include: substantial horizontal alteration; substantial vertical alteration; addition of a through-lane traffic lane; addition of an auxiliary lane; addition or relocation of interchange lanes, restriping to add additional lanes; the addition of a new weigh station, rest stop, ride share lot, or toll plaza, or the substantial alteration to existing weigh station, rest stop, ride share lot, or toll plaza.

2.3 FHWA NOISE ABATEMENT CRITERIA

The 2021 ODOT Traffic Noise Analysis Manual states that a traffic noise impact occurs, and noise abatement must be considered when either of the following conditions exist:

1. Predicted (design year) noise levels approach (within one dBA) or exceed applicable Noise Abatement Criteria (NAC) values shown in Table 2.1.
2. Predicted (design year) noise levels substantially exceed existing noise levels. (Substantial for this discussion is 10 dBA).

NAC are defined in 23 CFR 772 based on speech interference levels in different land use activity categories. The NAC values should not be considered federal standards or even desirable noise levels; they are used solely to determine when noise impacts occur, and when noise abatement is considered.

2.4 PROJECT LOCATION AND NOISE ANALYSIS AREA

The project is located along SR 16/37 from approximately 2000 ft west of the intersection of SR 37 with Columbus Road to the SR 16/37 Thornwood Crossing intersection. The noise analysis area includes all areas on both the north and south sides of SR 16/37 in the City of Granville within 500 ft of the edge of pavement including onramps and offramps (Figure 1, Appendix A).

2.5 NOISE SENSITIVE AREAS AND RECEPTORS

Eight Noise Sensitive Areas (NSAs) were identified within the Noise Study Area (Figure 2, Appendix A). The FHWA has established seven activity categories that must be considered for NAC. The Activity Categories are described in Table 2.1.

Table 2.1 Noise Abatement Criteria (NAC): Hourly A-Weighted Sound Level in Decibels (dBA)

Activity Category	Leq(h)	L10(h)	Description of Activity Category
A	57 (Exterior)	60 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	70 (Exterior)	Residential
C	67 (Exterior)	70 (Exterior)	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreational areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (Interior)	55 (Interior)	Auditoriums, daycare centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E	72 (Exterior)	75 (Exterior)	Hotels, motels, offices, restaurant/bars, and other developed lands, properties, or activities not included in A-D or F
F	N/A	N/A	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
G	N/A	N/A	Undeveloped lands that are not permitted

The noise-sensitive receptors identified as part of this project include the following land uses and activity categories: residential (Category B, Exterior Leq(h)= 67 dBA), park/playground (Category C, Exterior Leq(h)= 67 dBA), daycare centers/hospitals (Category C exterior/Category D, Interior Leq(h)= 52 dBA), or commercial (Category E, Exterior Leq(h)= 72 dBA). In TNM 2.5, the term “receiver” is used in place of receptor.

Table 2.2 Building Noise Reduction Factors

Building Type	Window Condition*	Reduction
All	Open	10 dB
Light Frame	Ordinary Sash (closed)	20 dB
Light Frame	Storm Windows	25 dB
Masonry	Single Glazed	25 dB
Masonry	Double Glazed	35 dB

* Consider the windows open unless there is firm knowledge that the windows are in fact kept closed almost every day of the year.

ODOT directed EnviroScience to use a building noise reduction factor of 25 dB for interior uses. The highest modeled exterior noise level in 2048 was 73.5 dB, so its interior noise level would be 48.5 dB (73.5 dB -25 dB). Therefore, none of the noise levels would approach of exceed the NAC for Category D land uses. Interior noise levels will not be discussed further in this report.

2.5.1 Equivalent Receptor Calculations for Nonresidential Land Uses

For nonresidential land uses such as parks, playgrounds, medical facilities, and restaurants with outdoor seating, the equivalent number of receptors must be calculated before determining the number of benefited receptors and cost per benefited receptor. The equivalent number of receptors is determined by using the following formula.

Equivalent # Receptors = # Occupants ÷ (# People / Receptor) x Usage

Where:

Occupants = # People (Students, Visitors, etc.).

3 = Average # of People / Residence (household size- Ohio Average)

Usage = # of Daily Hours Used Outdoors ÷ 24 Hours Per Day x Days Used Per Year ÷ Days Per Year (or Days Used Per Week ÷ Days Per Week)

Table 2.3 contains a summary of the calculations used to determine equivalent receptors for nonresidential land uses within the study area.

Table 2.3 Equivalent Receptor Calculations and NAC Category

Receiver No.	Land Use	NAC Use Category	# People	Hours/ day	Days/ week	Months/ year	Equivalent Receptor
1.01	Restaurant	E	24	9	4	8	1.1
1.02	Restaurant	E	24	9	4	8	1.1
2.15	Senior Living	B	9	24	7	12	3.0
2.16	Senior Living	B	9	24	7	12	3.0

Table 2.3 Equivalent Receptor Calculations and NAC Category (cont.)

Receiver No.	Land Use	NAC Use Category	# People	Hours/ day	Days/ week	Months/ year	Equivalent Receptor
2.17	Senior Living	B	9	24	7	12	3.0
2.18	Senior Living	B	9	24	7	12	3.0
2.19	Senior Living	B	9	24	7	12	3.0
2.20	Senior Living	B	9	24	7	12	3.0
2.21	Senior Living	B	9	24	7	12	3.0
2.22	Senior Living	B	9	24	7	12	3.0
2.23	Senior Living	B	9	24	7	12	3.0
2.24	Senior Living	B	9	24	7	12	3.0
2.25	Senior Living	B	9	24	7	12	3.0
2.26	Senior Living	B	9	24	7	12	3.0
2.27	Senior Living	B	9	24	7	12	3.0
2.28	Senior Living	B	9	24	7	12	3.0
2.29	Senior Living	B	9	24	7	12	3.0
2.30	Senior Living	B	9	24	7	12	3.0
2.45	Restaurant	E	20	9.5	6	8	1.5
2.46	Restaurant	E	20	9.5	6	8	1.5
2.47	Medical	C	12	2	5	8	0.2
2.49	Office	E	10	2	5	8	0.1
2.50	Senior Living	B	9	24	7	12	3.0
4.01	Medical	C	16	1	5	12	0.2
4.02	Restaurant	E	8	15	7	8	1.1
4.03	Restaurant	E	8	10	5	8	0.5
4.04	Restaurant	E	8	10	5	8	0.5
4.05	Medical	C	16	1	5	12	0.2
4.06	Medical	C	25	2	5.5	12	0.5
4.07	Sports	C	20	6	7	8	1.1
4.08	Playground	C	30	11	5	8	2.2
4.09	Playground	C	30	11	5	8	2.2
4.10	Playground	C	30	11	5	8	2.2
4.11	Office	E	8	2	5	12	0.2
4.14	Office	E	2	2	5	12	0.04

Table 2.3 Equivalent Receptor Calculations and NAC Category (cont.)

Receiver No.	Land Use	NAC Use Category	# People	Hours/ day	Days/ week	Months/ year	Equivalent Receptor
4.16	Playground	C	30	11	5	8	2.2
4.17	Playground	C	30	11	5	8	2.2
4.18	Playground	C	30	11	5	8	2.2
4.19	Playground	C	30	11	5	8	2.2
4.21	Sports	C	7	4	7	8	0.3
4.22	Sports	C	7	4	7	8	0.3
4.23	Sports	C	7	4	7	8	0.3
4.24	Sports	C	7	4	7	8	0.3
4.25	Sports	C	7	4	7	8	0.3
4.27	Playground	C	30	4	7	8	1.1
4.28	Sports	C	80	6	7	8	4.4
4.29	Sports	C	80	6	7	8	4.4
4.30	Restaurant	E	8	15	7	8	1.1
6.01	Bike Path	C	150	0.2	7	12	0.2
6.02	Bike Path	C	150	0.2	7	12	0.2
7.20	Playground	C	60	8	5	9	3.6
7.21	Sports	C	80	6	7	8	4.4
7.25	Sports	C	80	6	7	8	4.4
7.40	Medical	C	20	3	7	8	0.6
8.10	Convention Center	C	400	1	5	8	2.6
8.11	Convention Center	C	400	1	5	8	2.6
8.12	Hotel	E	60	2	7	8	1.1
8.13	Hotel	E	60	2	7	8	1.1
8.14	Hotel	E	60	2	7	8	1.1
8.15	Hotel	E	60	2	7	8	1.1
8.16	Hotel	E	60	2	7	8	1.1
8.17	Hotel	E	60	2	7	8	1.1
8.18	Hotel	E	60	2	7	8	1.1
8.19	Hotel	E	60	2	7	8	1.1
8.20	Hotel	E	60	2	7	8	1.1
8.21	Place of Worship	C	100	1	3	8	0.4
8.22	Hotel	E	35	1	7	8	0.3

2.6 ROADS AND TRAFFIC

Road lanes were digitized by tracing georeferenced aerial photomaps sourced from Ohio Statewide Imagery Program (OSIP) 2023 3-inch GeoTIFFs. Elevations for roadways, terrain, and structures such as bridge decks and buildings, were obtained from 2020 LiDAR obtained from OGRIP 3D Elevation Program (3DEP). Traffic data from ODOT's TMMS were used to generate Design Hour Volumes for US-16/37 and its ramps, S Main St/Lancaster Rd, Columbus Rd, Weaver Dr, River Rd, and Old River Rd. All other traffic data were generated using data collected during the field visit on August 12 and 13, 2024. Posted speed limits were used for all roads.

2.7 AMBIENT NOISE MEASUREMENTS

Ambient noise measurements were taken on August 12 and 13, 2024, using a TSI Quest™ SoundPro™ DL Type I sound level meter. Information regarding the sound level meter and calibration device are contained in Appendix B. Locations for each measurement are contained in the table below and shown on Figure 2 in Appendix A.

Table 2.4 Noise Measurement Locations

ID	Address	Lat/Long	Location Description
MP-1	1062 River Road Granville, OH 43023	40.057772, -82.515956	Daycare center
MP-2	6 Hannah Drive Granville OH 43023	40.061144, -82.527564	Single family homes
MP-3	1500 Weaver Drive Granville, OH 43023	40.061408, -82.525199	Assisted living facility
MP-4	1205 Weaver Drive Granville, OH 43023	40.060751, -82.526266	Single family homes
MP-5	1264 Weaver Drive Granville, OH 43023	40.060730, -82.522605	Medical center
MP-6	1100 River Rd Granville OH 43023	40.057887, -82.514099	Daycare center
MP-7	2098 Lancaster Road Granville OH 43023	40.057678, -82.522777	Single family home
MP-8	1020 River Road SE Granville OH, 43023	40.058552, -82.518281	Veterinary clinic
MP-9	1161 River Road SE Granville OH 43023	40.058491, -82.512168	Commercial
MP-10	221 W River Road Granville OH 43023	40.058199, -82.505684	Public park, baseball fields
MP-11	1264 River Road, Granville OH 43023	40.056676, -82.508171.	Single family home
MP-12	23 Mill Race Road, Granville OH 43023	40.056061, -82.507251	Single family home
MP-13	133 Wicklow Dr, Granville OH 430236	40.059089, -82.488560	Baseball field
MP-14	301 Clouse Lane, Granville, OH 43023	40.059414, -82.495883	Single family home
MP-15	201 Lansing Circle, Granville, OH 43023	40.060337, -82.491730	Single family home

Table 2.4 Noise Measurement Locations (cont.)

ID	Address	Lat/Long	Location Description
MP-16	317 Shannon Lane, Granville, OH 43023	40.057848, -82.485285	Apartments
MP-17	14 Westgate Dr NE, Newark, OH 43055	40.055833, -82.480608	Daycare center
MP-18	217 Wicklow Dr, Granville, OH 43023	40.059140, -82.486480	Single family home
MP-19	2299 Cherry Valley Road SE, Newark, OH 43055	40.052902, -82.476795	Hotel
MP-20	1067 Cherry Valley Road SE, Newark, OH 43055	40.054138, -82.481001	Single family home
MP-21	2299 Cherry Valley Road SE, Newark, OH 43055	40.052341, -82.477243	Hotel (interior courtyard)
MP-22	2299 Cherry Valley Road SE, Newark, OH 43055	40.052005, -82.475719	Hotel

2.8 ATMOSPHERIC MEASUREMENTS

Atmospheric data for the field measurements were taken from the Weather Underground station at John Glenn Columbus International Airport.

2.9 TRAFFIC COUNTS

Traffic data from ODOT's TMMS were used for the following roads: SR 16/37 and its ramps, Lancaster Rd, Columbus Rd, Weaver Dr, River Rd, and Old River Rd. All other traffic data for the exiting conditions model were generated using data collected during the field visit on August 12th-13th, 2024 or were estimated based on nearby traffic patterns. Table 3.1 contains a detailed summary of data sources.

For the proposed conditions model, planning-level design data from ODOT District 5 was used for 2028/2048 traffic loads on SR 16/37. For other roads, traffic was grown by applying the average growth factor used by District 5 for SR 16/37 between 2028 and 2048.

GoPro videos or drone videos of SR 16/37 were recorded by field personnel during each noise measurement at points near each sound meter setup. These videos were used to count traffic for validation of in-field noise measurements. Traffic on side roads was counted directly during each measurement when line of sight was possible.

2.10 UTILITIES

Utility conflicts were obtained by examining the plan sheets and by visual inspection during the field survey. Several utilities were found to potentially interfere with noise barrier placement, including storm drains, buried electrical lines, buried gas lines, water lines, and overhead electrical lines. Table 2.5 shows the utility type, stationing for each potential conflict/crossing of SR 16-37, the nearest NSA, and any barrier that may conflict with the existing utility.

Table 2.5 Utilities

Utility Type	STA	NSA	Barrier
Water	672+45	2, 3	1, 2
Buried Electric	672-676	3	2
106"x 68" RCP	672+90	2, 3	1, 2
Storm Pipe	676+85	3	2
Overhead Electric	679+50	2, 3	1, 2
Storm Pipe	701+40	4	3
Storm Pipe	702+80	4	
Gas	706+00	4	3
Storm Pipe	706+25	4	3
Overhead Electric	710+70	4	3
Storm Pipe	711+30	4	
Storm Pipe	716+30	4	
Storm Pipe	726+30	4	3
Gas	726+60	4	3
Overhead Electric	728+00	4	4
Storm Pipe	731+30	5	
Storm Pipe	736+30	4, 5	4
Storm Pipe	737+25	5	
Storm Pipe	743+50	4	
Storm Pipe	765+00	6	
Tunnel	798+90	6	
48" CMP	776+85	7	5
Storm Pipe	777+25	7	
Overhead Electric	794+60	7	5
Overhead Electric	794+70	7	5
Overhead Electric	794+80	7	5
Overhead Electric	794+90	7	5
Gas	795+05	7	5
Structure	798+80	7	5, 6
Overhead Electric	800+00	7	6
Gas	806+25	7, 8	
Water	810+05	7, 8	7
Gas	810+70	7, 8	
Storm Pipe	810+60	7, 8	
Storm Pipe	812+30	7, 8	
Buried Electric	811-813	7, 8	7
Gas	811+80	7, 8	7
OHE	820+50	8	8
Gas	820+75	8	8
Storm Pipe	831+35	8	

3.0 NOISE MODELING METHODS

TNM 2.5 requires the input of various factors and model calibration, described in further detail below.

3.1 TNM INPUT DATA

TNM uses data on topographic features, ground zones, and traffic (volume, direction, and speed) in a spatial model to predict traffic noise levels. Data sources are described fully below.

3.1.1 Topography

OGRIP digital elevation model data were used to generate 1-ft contours. Obvious grade breaks were used as terrain lines. OGRIP data was then sampled using ArcGIS. Elevations were spot checked with Google Earth Pro.

3.1.2 Roads

Road lane segments were entered into TNM based upon GIS data created from aerial photographs. Elevations for roadway segments were derived from the OGRIP elevation model and digital terrain model data sampled using ArcGIS. Elevations were spot checked with Google Earth Pro.

3.1.3 Traffic

For current conditions, traffic information from ODOT's Transportation Data Management System was used for most roads within the study area, supplemented by traffic counts from in-field counts on minor roads. Annual average daily volume (AADT) from 2023 was multiplied by the K-factor to obtain the Design Hour Volume. Posted speed limits were used as the traffic speed for the model. For roads that did not have traffic data or counts, a conservative estimate of 30 cars and 2 medium trucks per hour was assumed.

Traffic for the Design Year (2048) was obtained from ODOT District 5.

3.1.4 Other Data Elements

Traffic signals and posted speed limits were identified during field measurements or in the office using Google Earth Street View.

3.1.5 Noise Abatement Costs

A cost of $40/sf was used for all barriers in the cost/benefit analysis below per the most recent ODOT guidance. A reasonable cost was $56,000 per benefited receiver.

Table 3.1 Traffic Data Sources

Road Name	Data Source	ODOT Location ID	Date of Data	AADT	K	PA	%A	BC	%BC	DHV-30	BC/hr	% Heavy	PA	Med Tr	Heavy Tr	Speed used in model
Onramp from Columbus Rd SW to SR37 WB	TCDS	26345	2023	1,130	13%	1,083	96%	47	4%	147	6	89%	141	1	5	10→55 mph
Offramp from SR 16 WB to Columbus Rd	TCDS	26445	2023	4,563	9%	4,325	95%	238	5%	411	21	76%	390	5	16	55→35 mph
Onramp from Columbus Rd SW to SR16 EB	TCDS	26645	2023	5,106	12%	4,821	94%	285	6%	613	34	89%	579	4	30	10→55 mph
Offramp from SR37 EB to Columbus Rd SW	TCDS	26545	2023	1,242	13%	1,199	97%	43	3%	161	6	89%	155	1	5	55→45 mph
Columbus Rd SW, north of interchange, EB	TCDS	40845	2023	3,530	11%	3,359	95%	171	5%	388	19	76%	369	5	14	35 mph
Columbus Rd SW, north of interchange, WB	TCDS	40845	2023	8,647	7%	8,226	95%	421	5%	605	29	76%	576	7	22	35 mph
Columbus Rd SW, south of interchange, EB	TCDS	28545	2023	6,029	11%	5,711	95%	318	5%	663	35	76%	628	8	27	45 mph
Columbus Rd SW, south of interchange, WB	TCDS	28545	2023	8,555	10%	8,032	94%	523	6%	856	52	76%	804	12	40	45 mph
Weaver Dr between Columbus Rd SW and Lancaster Rd, EB	TCDS	45845	2016	434	11%	412	95%	22	5%	48	2	70%	46	1	1	35 mph
Weaver Dr between Columbus Rd SW and Lancaster Rd, WB	TCDS	45845	2016	739	11%	702	95%	37	5%	81	4	70%	77	1	3	35 mph
SR 661 north of interchange, NB	TCDS	11045	2023	4,386	11%	4,084	93%	302	7%	482	33	76%	449	8	25	35 mph
SR 661 north of interchange, SB	TCDS	11045	2023	2,884	10%	2,696	93%	188	7%	288	19	76%	269	5	14	35 mph
River Rd east of Lancaster Rd	TCDS	1884598	2023	2,601	11%	2,471	95%	130	5%	286	14	70%	272	4	10	35 mph
Onramp from SR661 to SR16 WB	TCDS	26745	2023	1,185	19%	1,064	90%	121	10%	225	23	89%	202	3	20	10→55 mph
Offramp from SR37 EB to SR 661	TCDS	26845	2023	1,920	16%	1,687	88%	233	12%	307	37	76%	270	9	28	55→35 mph
Offramp from SR16WB to SR661	TCDS	26945	2023	4,358	9%	3,944	91%	414	9%	392	37	89%	355	4	33	55→35 mph
Onramp from SR 661 to SR16EB	TCDS	27045	2023	3,947	12%	3,636	92%	311	8%	474	37	89%	437	4	33	10→55 mph
Lancaster Rd south of SR16, NB	TCDS	45745	2016	5,375	11%	5,106	95%	269	5%	591	30	76%	561	7	23	45 mph
Lancaster Rd south of SR16, SB	TCDS	45745	2016	5,824	11%	5,533	95%	291	5%	641	32	76%	609	8	24	45 mph
SR661 north of interchange, NB	TCDS	11045	2023	4,386	11%	4,084	93%	302	7%	482	33	76%	449	8	25	35 mph
SR661 north of interchange, SB	TCDS	11045	2023	2,884	10%	2,696	93%	188	7%	288	19	76%	269	5	14	35 mph
Old River Rd	TCDS	440191	2023	99	18%	94	95%	5	5%	18	1	70%	17	0	1	35 mph
River Rd east of Canyon Rd, EB	TCDS	14354598	2020	1,389	11%	1,320	95%	69	5%	153	8	70%	145	2	6	35 mph
River Rd east of Canyon Rd, WB	TCDS	14354598	2020	441	11%	419	95%	22	5%	49	2	70%	47	1	1	35 mph
Canyon Rd south of River Rd	TCDS	13914598	2020	756	11%	718	95%	38	5%	83	4	74%	79	1	3	35 mph
Cherry Valley Rd North of Reddington Rd, NB	TCDS	12334598	2023	6,057	9%	5,754	95%	303	5%	545	27	80%	518	5	22	35 mph
Cherry Valley Rd North of Reddington Rd, SB	TCDS	12334598	2023	4,640	13%	4,408	95%	232	5%	603	30	80%	573	6	24	35 mph
Newark-Granville Rd east of Fern Hill Dr, 2-way	TCDS	14724598	2023	4,693	11%	4,458	95%	235	5%	516	26	76%	490	6	20	35 mph
Newark-Granville Rd east of Fern Hill Dr, EB	TCDS	38945	2023	1,375	13%	1,338	97%	37	3%	179	5	76%	174	1	4	35 mph
Newark-Granville Rd east of Fern Hill Dr, WB	TCDS	38945	2023	3,168	13%	3,026	96%	142	4%	412	18	76%	394	4	14	35 mph
Thornwood Xing NB, S of interchanges	Estimated	N/A	N/A	6,057	9%	3,027	95%	3,030	5%	545	27	80%	518	5	22	35 mph
Thornwood Xing NB, between interchanges	Estimated	N/A	N/A	4,935	9%	3,028	95%	1,907	5%	444	22	80%	422	4	18	35 mph
Thornwood Xing NB, N of interchanges	Estimated	N/A	N/A	4,879	9%	3,029	95%	1,850	5%	439	22	76%	417	5	17	35 mph
Thornwood Xing SB, S of interchanges	Estimated	N/A	N/A	4,640	13%	3,027	95%	1,613	5%	603	30	80%	573	6	24	35 mph

Table 3.1 Traffic Data Sources (cont.)

Road Name	Data Source	ODOT Location ID	Date of Data	AADT	K	PA	%A	BC	%BC	DHV-30	BC/hr	% Heavy	PA	Med Tr	Heavy Tr	Speed used in model
Thornwood Xing SB, between interchanges	Estimated	N/A	N/A	3,518	13%	3,028	95%	490	5%	457	23	80%	434	5	18	35 mph
Thornwood Xing SB, N of interchanges	Estimated	N/A	N/A	3,462	13%	3,029	95%	433	5%	450	22	76%	428	5	17	35 mph
Onramp from Thornwood Crossing to SR16 WB	TCDS	46245	2023	2,991	11%	2,806	94%	185	6%	329	20	89%	309	2	18	10→55 mph
Offramp from SR16EB to Thornwood Crossing	TCDS	46345	2023	2,627	11%	2,432	93%	195	7%	289	21	89%	268	2	19	55→35 mph
Onramp from Thornwood Crossing to SR16 EB	TCDS	46445	2023	4,873	11%	4,656	96%	217	4%	536	24	89%	512	3	21	10→55 mph
Offramp from SR16 WB to Thornwood Crossing	TCDS	46145	2023	2,880	10%	2,711	94%	169	6%	288	17	89%	271	2	15	55→35 mph
SR37 E of C25 Morse Rd, S of Granville, EB	TCDS	5345	2023	19,067	12%	18,429	97%	638	3%	2,288	77	54%	2,211	35	42	55 mph
SR37 E of C25 Morse Rd, S of Granville, WB	TCDS	5345	2023	19,067	12%	18,501	97%	566	3%	2,288	68	54%	2,220	31	37	55 mph
SR 16/37 E of Columbus Rd SW, EB	TCDS	2645	2023	15,699	14%	14,650	93%	1,049	7%	2,198	147	54%	2,051	68	79	55 mph
SR 16/37 E of Columbus Rd SW, WB	TCDS	2645	2023	21,789	11%	20,713	95%	1,076	5%	2,397	118	54%	2,279	54	64	55 mph
SR16 between SR37 and Cherry Valley Rd, EB	TCDS	46045	2023	19,128	12%	17,716	93%	1,412	7%	2,295	169	54%	2,126	78	91	55 mph
SR16 between SR37 and Cherry Valley Rd, WB	TCDS	46045	2023	18,696	11%	17,487	94%	1,209	6%	2,057	133	54%	1,924	61	72	55 mph
SR 16 west of Thornwood Crossing, EB	TCDS	28645	2023	21,129	12%	19,797	94%	1,332	6%	2,535	160	54%	2,375	74	86	55 mph
SR 16 west of Thornwood Crossing, WB	TCDS	28645	2023	18,231	11%	17,152	94%	1,079	6%	2,005	119	54%	1,886	55	64	55 mph
SR37 between York Rd and Columbus Rd interchanges, EB	ODOT D5	N/A	2028 (design)	17,110	12%	15,570	91%	1,540	9%	2,053	185	54%	1,868	85	100	55 mph
SR37 between York Rd and Columbus Rd interchanges, WB	ODOT D5	N/A	2028 (design)	17,210	12%	15,661	91%	1,549	9%	2,065	186	54%	1,879	86	100	55 mph
SR16/37 between Columbus Rd and Lancaster Rd, EB	ODOT D5	N/A	2028 (design)	20,310	14%	18,482	91%	1,828	9%	2,843	256	54%	2,587	118	138	55 mph
SR16/37 between Columbus Rd and Lancaster Rd, WB	ODOT D5	N/A	2028 (design)	18,700	11%	17,017	91%	1,683	9%	2,057	185	54%	1,872	85	100	55 mph
SR16/37 between Lancaster Rd and Thornwood Xing, EB	ODOT D5	N/A	2028 (design)	24,290	12%	22,103	91%	2,187	9%	2,915	262	54%	2,653	121	141	55 mph
SR16/37 between Lancaster Rd and Thornwood Xing, WB	ODOT D5	N/A	2028 (design)	24,210	11%	22,031	91%	2,179	9%	2,663	240	54%	2,423	110	130	55 mph
Onramp from Columbus Rd SW to SR37 WB	TCDS	26345	2028 (grown)	1,202	13%	1,152	96%	47	4%	156	6	89%	150	1	5	10→55 mph
Offramp from SR 16 WB to Columbus Rd	TCDS	26445	2028 (grown)	4,854	9%	4,601	95%	238	5%	437	23	76%	414	6	17	55→35 mph
Onramp from Columbus Rd SW to SR16 EB	TCDS	26645	2028 (grown)	5,431	12%	5,128	94%	285	6%	652	36	89%	616	4	32	10→55 mph
Offramp from SR37 EB to Columbus Rd SW	TCDS	26545	2028 (grown)	1,321	13%	1,275	97%	43	3%	172	6	89%	166	1	5	55→45 mph
Columbus Rd SW, north of interchange, EB	TCDS	40845	2028 (grown)	3,755	11%	3,573	95%	171	5%	413	20	76%	393	5	15	35 mph
Columbus Rd SW, north of interchange, WB	TCDS	40845	2028 (grown)	9,198	7%	8,750	95%	421	5%	644	31	76%	613	7	24	35 mph
Columbus Rd SW, south of interchange, EB	TCDS	28545	2028 (grown)	6,413	11%	6,075	95%	318	5%	705	37	76%	668	9	28	45 mph
Columbus Rd SW, south of interchange, WB	TCDS	28545	2028 (grown)	9,100	10%	8,544	94%	523	6%	910	56	76%	854	13	43	45 mph
Weaver Dr between Columbus Rd SW and Lancaster Rd, EB	TCDS	45845	2028 (grown)	462	11%	439	95%	23	5%	51	3	70%	48	1	2	35 mph
Weaver Dr between Columbus Rd SW and Lancaster Rd, WB	TCDS	45845	2028 (grown)	786	11%	747	95%	39	5%	86	4	70%	82	1	3	35 mph
SR 661 north of interchange, NB	TCDS	11045	2028 (grown)	4,665	11%	4,344	93%	321	7%	513	35	76%	478	8	27	35 mph
SR 661 north of interchange, SB	TCDS	11045	2028 (grown)	3,068	10%	2,868	93%	200	7%	307	20	76%	287	5	15	35 mph
River Rd east of Lancaster Rd	TCDS	1884598	2028 (grown)	2,767	11%	2,629	95%	138	5%	304	15	70%	289	4	11	35 mph
Onramp from SR661 to SR16 WB	TCDS	26745	2028 (grown)	1,260	19%	1,131	90%	129	10%	239	24	89%	215	3	21	10→55 mph
Offramp from SR37 EB to SR 661	TCDS	26845	2028 (grown)	2,042	16%	1,794	88%	248	12%	327	40	76%	287	10	30	55→35 mph
Offramp from SR16WB to SR661	TCDS	26945	2028 (grown)	4,636	9%	4,196	91%	440	9%	417	40	89%	377	4	36	55→35 mph

Table 3.1 Traffic Data Sources (cont.)

Road Name	Data Source	ODOT Location ID	Date of Data	AADT	K	PA	%A	BC	%BC	DHV-30	BC/hr	% Heavy	PA	Med Tr	Heavy Tr	Speed used in model
Onramp from SR 661 to SR16EB	TCDS	27045	2028 (grown)	4,198	12%	3,867	92%	331	8%	504	40	89%	464	4	36	10→55 mph
Lancaster Rd south of SR16, NB	TCDS	45745	2028 (grown)	5,717	11%	5,431	95%	286	5%	629	31	76%	598	7	24	45 mph
Lancaster Rd south of SR16, SB	TCDS	45745	2028 (grown)	6,195	11%	5,885	95%	310	5%	681	34	76%	647	8	26	45 mph
SR661 north of interchange, NB	TCDS	11045	2028 (grown)	4,665	11%	4,344	93%	321	7%	513	35	76%	478	8	27	35 mph
SR661 north of interchange, SB	TCDS	11045	2028 (grown)	3,068	10%	2,868	93%	200	7%	307	20	76%	287	5	15	35 mph
Old River Rd	TCDS	440191	2028 (grown)	105	18%	100	95%	5	5%	19	1	70%	18	0	1	35 mph
River Rd east of Canyon Rd, EB	TCDS	14354598	2028 (grown)	1,477	11%	1,403	95%	74	5%	162	8	70%	154	2	6	35 mph
River Rd east of Canyon Rd, WB	TCDS	14354598	2028 (grown)	469	11%	446	95%	23	5%	52	3	70%	49	1	2	35 mph
Canyon Rd south of River Rd	TCDS	13914598	2028 (grown)	804	11%	764	95%	40	5%	88	4	74%	84	1	3	35 mph
Cherry Valley Rd North of Reddington Rd, NB	TCDS	12334598	2028 (grown)	6,443	9%	6,121	95%	322	5%	580	29	80%	551	6	23	35 mph
Cherry Valley Rd North of Reddington Rd, SB	TCDS	12334598	2028 (grown)	4,936	13%	4,689	95%	247	5%	642	32	80%	610	6	26	35 mph
Newark-Granville Rd east of Fern Hill Dr, 2-way	TCDS	14724598	2028 (grown)	4,992	11%	4,742	95%	250	5%	549	27	76%	522	6	21	35 mph
Newark-Granville Rd east of Fern Hill Dr, EB	TCDS	38945	2028 (grown)	1,463	13%	1,424	97%	39	3%	190	5	76%	185	1	4	35 mph
Newark-Granville Rd east of Fern Hill Dr, WB	TCDS	38945	2028 (grown)	3,370	13%	3,219	96%	151	4%	438	20	76%	418	5	15	35 mph
Thornwood Xing NB, S of interchanges	Estimated	N/A	2028 (grown)	6,443	9%	6,121	95%	322	5%	580	29	80%	551	6	23	35 mph
Thornwood Xing NB, between interchanges	Estimated	N/A	2028 (grown)	5,249	9%	4,987	95%	262	5%	472	24	80%	448	5	19	35 mph
Thornwood Xing NB, N of interchanges	Estimated	N/A	2028 (grown)	5,190	9%	4,931	95%	259	5%	467	23	76%	444	6	17	35 mph
Thornwood Xing SB, S of interchanges	Estimated	N/A	2028 (grown)	4,936	13%	4,689	95%	247	5%	642	32	80%	610	6	26	35 mph
Thornwood Xing SB, between interchanges	Estimated	N/A	2028 (grown)	3,742	13%	3,555	95%	187	5%	486	24	80%	462	5	19	35 mph
Thornwood Xing SB, N of interchanges	Estimated	N/A	2028 (grown)	3,683	13%	3,499	95%	184	5%	479	24	76%	455	6	18	35 mph
Onramp from Thornwood Crossing to SR16 WB	TCDS	46245	2028 (grown)	3,182	11%	2,985	94%	197	6%	350	22	89%	328	2	20	10→55 mph
Offramp from SR16EB to Thornwood Crossing	TCDS	46345	2028 (grown)	2,794	11%	2,587	93%	207	7%	307	23	89%	284	3	20	55→35 mph
Onramp from Thornwood Crossing to SR16 EB	TCDS	46445	2028 (grown)	5,183	11%	4,952	96%	231	4%	570	25	89%	545	3	22	10→55 mph
Offramp from SR16 WB to Thornwood Crossing	TCDS	46145	2028 (grown)	3,063	10%	2,883	94%	180	6%	306	18	89%	288	2	16	55→35 mph
SR37 between York Rd and Columbus Rd interchanges, EB	ODOT D5	N/A	2048 (design)	23,580	12%	21,457	91%	2,123	9%	2,830	255	54%	2,575	117	138	55 mph
SR37 between York Rd and Columbus Rd interchanges, WB	ODOT D5	N/A	2048 (design)	23,630	12%	21,503	91%	2,127	9%	2,836	255	54%	2,581	117	138	55 mph
SR16/37 between Columbus Rd and Lancaster Rd, EB	ODOT D5	N/A	2048 (design)	27,900	14%	25,389	91%	2,511	9%	3,906	352	54%	3,554	162	190	55 mph
SR16/37 between Columbus Rd and Lancaster Rd, WB	ODOT D5	N/A	2048 (design)	26,640	11%	24,242	91%	2,398	9%	2,930	264	54%	2,666	121	143	55 mph
SR16/37 between Lancaster Rd and Thornwood Xing, EB	ODOT D5	N/A	2048 (design)	32,240	12%	29,338	91%	2,902	9%	3,869	348	54%	3,521	160	188	55 mph
SR16/37 between Lancaster Rd and Thornwood Xing, WB	ODOT D5	N/A	2048 (design)	31,330	11%	28,510	91%	2,820	9%	3,446	310	54%	3,136	143	167	55 mph
Onramp from Columbus Rd SW to SR37 WB	TCDS	26345	2048 (grown)	1,539	13%	1,475	96%	47	4%	200	8	89%	192	1	7	10→55 mph
Offramp from SR 16 WB to Columbus Rd	TCDS	26445	2048 (grown)	6,214	9%	5,890	95%	238	5%	559	29	76%	530	7	22	55→35 mph
Onramp from Columbus Rd SW to SR16 EB	TCDS	26645	2048 (grown)	6,953	12%	6,565	94%	285	6%	834	47	89%	787	5	42	10→55 mph
Offramp from SR37 EB to Columbus Rd SW	TCDS	26545	2048 (grown)	1,691	13%	1,632	97%	43	3%	220	8	89%	212	1	7	55→45 mph
Columbus Rd SW, north of interchange, EB	TCDS	40845	2048 (grown)	4,807	11%	4,574	95%	171	5%	529	26	76%	503	6	20	35 mph
Columbus Rd SW, north of interchange, WB	TCDS	40845	2048 (grown)	11,776	7%	11,203	95%	421	5%	824	40	76%	784	10	30	35 mph

Table 3.1 Traffic Data Sources (cont.)

Road Name	Data Source	ODOT Location ID	Date of Data	AADT	K	PA	%A	BC	%BC	DHV-30	BC/hr	% Heavy	PA	Med Tr	Heavy Tr	Speed used in model
Columbus Rd SW, south of interchange, EB	TCDS	28545	2048 (grown)	8,210	11%	7,777	95%	318	5%	903	48	76%	855	12	36	45 mph
Columbus Rd SW, south of interchange, WB	TCDS	28545	2048 (grown)	11,650	10%	10,938	94%	523	6%	1,165	71	76%	1,094	17	54	45 mph
Weaver Dr between Columbus Rd SW and Lancaster Rd, EB	TCDS	45845	2048 (grown)	591	11%	561	95%	30	5%	65	3	70%	62	1	2	35 mph
Weaver Dr between Columbus Rd SW and Lancaster Rd, WB	TCDS	45845	2048 (grown)	1,006	11%	956	95%	50	5%	111	6	70%	105	2	4	35 mph
SR 661 north of interchange, NB	TCDS	11045	2048 (grown)	5,973	11%	5,562	93%	411	7%	657	45	76%	612	11	34	35 mph
SR 661 north of interchange, SB	TCDS	11045	2048 (grown)	3,927	10%	3,671	93%	256	7%	393	26	76%	367	6	20	35 mph
River Rd east of Lancaster Rd	TCDS	1884598	2048 (grown)	3,542	11%	3,365	95%	177	5%	390	19	70%	371	6	13	35 mph
Onramp from SR661 to SR16 WB	TCDS	26745	2048 (grown)	1,614	19%	1,449	90%	165	10%	307	31	89%	276	3	28	10→55 mph
Offramp from SR37 EB to SR 661	TCDS	26845	2048 (grown)	2,615	16%	2,298	88%	317	12%	418	51	76%	367	12	39	55→35 mph
Offramp from SR16WB to SR661	TCDS	26945	2048 (grown)	5,935	9%	5,371	91%	564	9%	534	51	89%	483	6	45	55→35 mph
Onramp from SR 661 to SR16EB	TCDS	27045	2048 (grown)	5,375	12%	4,951	92%	424	8%	645	51	89%	594	6	45	10→55 mph
Lancaster Rd south of SR16, NB	TCDS	45745	2048 (grown)	7,320	11%	6,954	95%	366	5%	805	40	76%	765	10	30	45 mph
Lancaster Rd south of SR16, SB	TCDS	45745	2048 (grown)	7,931	11%	7,534	95%	397	5%	872	44	76%	828	11	33	45 mph
SR661 north of interchange, NB	TCDS	11045	2048 (grown)	5,973	11%	5,562	93%	411	7%	657	45	76%	612	11	34	35 mph
SR661 north of interchange, SB	TCDS	11045	2048 (grown)	3,927	10%	3,671	93%	256	7%	393	26	76%	367	6	20	35 mph
Old River Rd	TCDS	440191	2048 (grown)	135	18%	128	95%	7	5%	24	1	70%	23	0	1	35 mph
River Rd east of Canyon Rd, EB	TCDS	14354598	2048 (grown)	1,892	11%	1,797	95%	95	5%	208	10	70%	198	3	7	35 mph
River Rd east of Canyon Rd, WB	TCDS	14354598	2048 (grown)	601	11%	571	95%	30	5%	66	3	70%	63	1	2	35 mph
Canyon Rd south of River Rd	TCDS	13914598	2048 (grown)	1,030	11%	979	95%	51	5%	113	6	74%	107	2	4	35 mph
Cherry Valley Rd North of Reddington Rd, NB	TCDS	12334598	2048 (grown)	8,248	9%	7,836	95%	412	5%	742	37	80%	705	7	30	35 mph
Cherry Valley Rd North of Reddington Rd, SB	TCDS	12334598	2048 (grown)	6,319	13%	6,003	95%	316	5%	821	41	80%	780	8	33	35 mph
Newark-Granville Rd east of Fern Hill Dr, 2-way	TCDS	14724598	2048 (grown)	6,391	11%	6,071	95%	320	5%	703	35	76%	668	8	27	35 mph
Newark-Granville Rd east of Fern Hill Dr, EB	TCDS	38945	2048 (grown)	1,872	13%	1,822	97%	50	3%	243	7	76%	236	2	5	35 mph
Newark-Granville Rd east of Fern Hill Dr, WB	TCDS	38945	2048 (grown)	4,314	13%	4,121	96%	193	4%	561	25	76%	536	6	19	35 mph
Thornwood Xing NB, S of interchanges	Estimated	N/A	2048 (grown)	8,248	9%	7,836	95%	412	5%	742	37	80%	705	7	30	35 mph
Thornwood Xing NB, between interchanges	Estimated	N/A	2048 (grown)	6,721	9%	6,385	95%	336	5%	605	30	80%	575	6	24	35 mph
Thornwood Xing NB, N of interchanges	Estimated	N/A	2048 (grown)	6,644	9%	6,312	95%	332	5%	598	30	76%	568	7	23	35 mph
Thornwood Xing SB, S of interchanges	Estimated	N/A	2048 (grown)	6,319	13%	6,003	95%	316	5%	821	41	80%	780	8	33	35 mph
Thornwood Xing SB, between interchanges	Estimated	N/A	2048 (grown)	4,791	13%	4,551	95%	240	5%	623	31	80%	592	6	25	35 mph
Thornwood Xing SB, N of interchanges	Estimated	N/A	2048 (grown)	4,715	13%	4,479	95%	236	5%	613	31	76%	582	7	24	35 mph
Onramp from Thornwood Crossing to SR16 WB	TCDS	46245	2048 (grown)	4,073	11%	3,821	94%	252	6%	448	28	89%	420	3	25	10→55 mph
Offramp from SR16EB to Thornwood Crossing	TCDS	46345	2048 (grown)	3,577	11%	3,311	93%	266	7%	393	29	89%	364	3	26	55→35 mph
Onramp from Thornwood Crossing to SR16 EB	TCDS	46445	2048 (grown)	6,636	11%	6,340	96%	296	4%	730	33	89%	697	4	29	10→55 mph
Offramp from SR16 WB to Thornwood Crossing	TCDS	46145	2048 (grown)	3,922	10%	3,692	94%	230	6%	392	23	89%	369	3	20	55→35 mph
All Other Roads, Each Direction	Assumed	N/A	N/A	N/A	N/A	N/A	94%	N/A	N/A	32	2	0%	30	2	0	35 mph

3.2 MODEL VALIDATION

Traffic data for side roads were collected in the field concurrently with field noise data collection. State Route 16/37 traffic data were collected using an EnviroScience tripod-mounted camera as well as a drone cameras. Actual traffic data were entered into the model for each noise measurement point, and model results were compared with measurements.

Field data from 14 of the 22 validation points were within 3 dB of the model results. The ones that were not in agreement were explainable due to a number of factors including construction noise or meter error. Validation results are summarized in Table 3.2, and validation input data are contained in Appendix C.

Table 3.2 Comparison of Measured and Modeled Noise Levels

Location	Measured Noise Level (Leq in dBA)	2024 Modeled Noise Level (Leq in dBA)	Comparison of Modeled Level to Measured Level (dB)	Comments
MP-1	69.4	*68.7*	-0.7	
MP-2	68.2	*66.3*	-1.9	
MP-3	59.6	*56.5*	-3.1	Model underpredicted noise levels by 3.1 dB
MP-4	67.2	*66.6*	-0.6	
MP-5	56.9	*57.6*	0.7	
MP-6	61.7	*61.2*	-0.5	
MP-7	59.5	*57.4*	-2.1	
MP-8	65.2	*64.3*	-0.9	
MP-9	57.1	*56.8*	-0.3	
MP-10	62.6	*66.4*	3.8	Model may overpredict noise because source heights are elevated
MP-11	64.4	*63.5*	-0.9	
MP-12	55.6	*55.4*	-0.2	
MP-13	60.1	*58.9*	-1.2	
MP-14	60.3	*63.7*	3.4	Model may overpredict noise because source heights are elevated
MP-15	52.2	*56*	3.8	Lanes were shifted at this point due to construction
MP-16	57.9	*59.7*	1.8	
MP-17	71.4	*67.7*	-3.7	Active construction nearby
MP-18	52.3	*51*	-1.3	
MP-19	36.9	*56.9*	20	Uknown meter issue during data collection
MP-20	56.1	*58.2*	2.1	
MP-21	37	*46.9*	9.9	Uknown meter issue during data collection
MP-22	48.5	*54.7*	6.2	Model adjusted as much as possible-discrepancy remains

4.0 IMPACT ASSESSMENT

To evaluate the significance of the changes in the predicted noise levels, FHWA has established Noise Abatement Criteria (NAC), as shown in Table 2.1, for various categories of land use, which represent the upper limits of acceptable traffic generated noise emissions. According to FHWA guidance, a project may have a traffic noise impact if either or both of the following conditions exist:

1. The predicted noise levels associated with the Build alternative approach, meet, or exceed the applicable NAC. According to the ODOT, noise levels "approach" the NAC when they are within 1 dB of the applicable NAC.

2. A substantial increase occurs in predicted noise levels between the future year build alternative and existing noise levels, even though the applicable NAC may not be approached or exceeded. An increase of 10 dB or greater is considered to be substantial.

The noise-sensitive receptors identified as part of this project include the following land uses and activity categories: residential (Category B, Exterior Leq(h)= 67 dBA), park/playground (Category C, Exterior Leq(h)= 67 dBA), daycare centers/hospitals (Category C exterior/Category D, Interior Leq(h)= 52 dBA), or restaurants/hotels/commercial areas (Category E, Exterior Leq(h)= 72 dBA).

4.1 NSA 1

NSA 1 is located west of Columbus Road and north of SR 16/37 (Figure 2.01, Appendix A). It contains one restaurant with two outdoor seating areas which were modeled as two separate receptors in Activity Category E. Elevations within NSA 1 were typically around 920 ft AMSL, while the elevation of SR 16/37 was approximately 918 ft along the mainline. Therefore, the difference in ground elevation between the highway and receptors was approximately 2 ft.

No receptors had modeled noise levels approaching or exceeding the NAC for activity Category E (Figure 3.01, Appendix A). Therefore, no further analysis is needed for this NSA.

Table 4.1 NSA 1 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
1.01	1.1	59.3	60.4	71	No
1.02	1.1	57.3	58.5	71	No

4.2 NSA 2

NSA 2 is located north of SR 16/37 between Columbus Road and South Main Street (Figure 2.01, Appendix A). NSA 2 consists of an assisted living facility (Activity Category B) with multiple buildings, a restaurant/lounge (Activity Category E), and a health systems services provider (Activity Category C). Fifty receptor points were modeled in the area totaling 83.3 equivalent receptors. Ground surface elevations are fairly consistent throughout NSA 2, averaging 920 ft and range from 905 ft on the west side to 925 ft on the east side. SR-16/37 elevations ranged from

928-932 ft. The difference in ground surface elevations between receptors and the highway ranged from approximately 3-27 ft.

Seventeen receptor points totaling 17 equivalent receptors had modeled noise levels approaching or exceeding the NAC (Figure 3.01, Appendix B).

Table 4.2 NSA 2 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
2.01	1	64.5	65.3	66	No
2.02	1	64.9	66.5	66	Yes
2.03	1	**69.9**	71.2	66	Yes
2.04	1	**69.8**	71.1	66	Yes
2.05	1	**69.5**	70.7	66	Yes
2.06	1	65.2	66.4	66	Yes
2.07	1	65.4	66.3	66	Yes
2.08	1	**69.1**	69.9	66	Yes
2.09	1	**70.2**	70.6	66	Yes
2.10	1	**65.8**	66.3	66	Yes
2.11	1	**68.0**	69	66	Yes
2.12	1	**68.2**	69.2	66	Yes
2.13	1	**68.8**	69.6	66	Yes
2.14	1	**70.2**	70.2	66	Yes
2.15	3	58.9	60.1	66	No
2.16	3	59.5	60.7	66	No
2.17	3	60.5	61.6	66	No
2.18	3	61.0	62.1	66	No
2.19	3	60.5	61.7	66	No
2.20	3	60.6	61.9	66	No
2.21	3	59.9	61.3	66	No
2.22	3	62.6	63.2	66	No
2.23	3	62.9	63.6	66	No
2.24	3	64.8	65.4	66	No
2.25	3	62.7	63.8	66	No
2.26	3	63.3	64.4	66	No
2.27	3	61.8	62.9	66	No
2.28	3	59.6	61	66	No
2.29	3	59.1	60.5	66	No
2.30	3	58.3	59.9	66	No
2.31	1	65.1	66.6	66	Yes
2.32	1	62.7	64.1	66	No

Table 4.2 NSA 2 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
2.33	1	62.0	63.2	66	No
2.34	1	61.2	62.3	66	No
2.35	1	59.0	60.1	66	No
2.36	1	58.7	60	66	No
2.37	1	61.1	62.3	66	No
2.38	1	61.7	62.8	66	No
2.39	1	63.2	64.4	66	No
2.40	1	62.7	64.1	66	No
2.41	1	64.3	65.6	66	Yes
2.42	1	63.8	65.2	66	No
2.43	1	64.8	66.5	66	Yes
2.44	1	64.3	66	66	Yes
2.45	1.5	63.9	65.8	71	No
2.46	1.5	62.2	64.2	71	No
2.47	0.2	61.2	62.7	66	No
2.48	1	60.1	61.2	66	No
2.49	0.1	67.5	70.1	71	No
2.50	3	58.0	59.6	66	No
TOTAL	83.3	N/A	N/A	N/A	17

4.3 NSA 3

NSA 3 is located south of SR-16/37 between Columbus Road and Lancaster Road and includes residential housing (Figure 2.01, Appendix A). Five receptors were modeled in this location. All receptors were single-family homes (Activity Category B). Ground surface elevations were approximately 920-1,090 ft, while SR-16/37 elevations ranged from 928-932 ft. The difference in ground elevations between receivers and highway ranged from 8-160 ft.

One receptor totaling 1 dwelling unit had modeled noise levels approaching or exceeding the NAC (Figure 3.01, Appendix A).

Table 4.3 NSA 3 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
3.01	1	61.3	63.3	66	No
3.02	1	**69.1**	**71.4**	66	Yes
3.03	1	58.6	60.4	66	No
3.04	1	62.0	64.2	66	No
3.05	1	63.4	64.6	66	No

4.4 NSA 4

NSA 4 is located north of SR 16/37 between South Main Street and Raccoon Creek and includes residential and commercial properties along River Road/Raccoon Valley Parkway. (Figure 2.01, Appendix A). Thirty-one receptors were modeled in this location, including single family homes, commercial and professional services businesses, and childcare (Activity Categories B, C, C/D, and E). Ground surface elevations varied from 897 ft in the east and 921 in the west. SR 16/37 elevations varied from 907 ft in the east and 925 in the west. The difference in ground elevations between the receiver and highway was approximately 4-10 ft.

Twelve receptors totaling 16.5 equivalent receptors units had a modeled noise level exceeding the NAC (Figure 3.02-3.03, Appendix A).

Table 4.4 NSA 4 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
4.01	0.2	63.0	64.3	66	No
4.02	1.1	63.6	65.1	71	No
4.03	0.5	62.2	63.7	71	No
4.04	0.5	64.0	65.8	71	No
4.05	0.2	65.0	**66.7**	66	Yes
4.06	0.5	**68.9**	**70.5**	66	Yes
4.07	1.1	57.2	58.0	66	No
4.08	2.2	**66.6**	**67.9**	66	Yes
4.09	2.2	**71.7**	**72.6**	66	Yes
4.10	2.2	**66.1**	**67.4**	66	Yes
4.11	0.2	63.4	64.4	71	No
4.12	1	63.5	64.3	66	No
4.13	1	64.0	64.9	66	No
4.14	0.04	64.1	65.1	71	No
4.15	1	64.2	65.2	66	No
4.16	2.2	62.3	62.9	66	No
4.17	2.2	65.2	**66.0**	66	Yes
4.18	2.2	**68.2**	**68.9**	66	Yes
4.19	2.2	**70.7**	**71.4**	66	Yes
4.20	1	**73.1**	**73.0**	66	Yes
4.21	0.3	60.6	61.8	66	No
4.22	0.3	63.6	65.1	66	No
4.23	0.3	64.5	**66.3**	66	Yes
4.24	0.3	62.3	63.5	66	No
4.25	0.3	64.7	**65.8**	66	Yes
4.26	1	**68.3**	**68.7**	66	Yes
4.27	1.1	62.7	63.6	66	No

Table 4-4 NSA 4 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
4.28	4.4	58.4	59.3	66	No
4.29	4.4	61.1	61.5	66	No
4.30	0.2	62.0	63.6	66	No
4.31	0.2	63.4	64.9	66	No

4.5 NSA 5

NSA 5 is located south of SR-16/37 along River Road and Mill Race Road (Figure 2.01, Appendix A). Seven receptors were modeled in this location. All receptors were single-family homes (Activity Category B). Receptors had ground surface elevations ranging from 913 ft in the eastern portion to 919 ft in the western portion. SR 16/37 elevations ranged from 908 ft on the east side to 912 ft on the west side of the NSA. The difference between ground surface elevations of receptor and SR 16/27 were approximately 5-7 ft.

Zero receptors had modeled noise levels approaching or exceeding the NAC (Figure 3.02, Appendix A).

Table 4.5 NSA 5 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
5.01	1	63.8	64.8	66	No
5.02	1	63.2	64.3	66	No
5.03	1	63.6	64.9	66	No
5.04	1	63.3	64.7	66	No
5.05	1	63.4	64.7	66	No
5.06	1	57.4	58.7	66	No
5.07	1	58.3	59.3	66	No

4.6 NSA 6

NSA 6 bisects SR 16/37 following the alignment of the Thomas J Evans Trail (Figure 2.01, Appendix A). Two receptors were modeled in this location. Both receptors were on the bike path (Activity Category C). Receptors had a typical ground surface elevation of 900 ft, while SR 16/37 has an elevation of 932 ft in the NSA. The difference between ground surface elevations of receptors and SR 16/37 is therefore 32 ft.

Both receptors had modeled noise levels approaching or exceeding the NAC (Figure 3.04, Appendix A). Because of the difference in elevation between SR 16/37 and the bike path and the transient nature of the human use of the land, barriers were not modeled for this NSA per ODOT's direction.

Table 4.6 NSA 6 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
6.01	0.2	**66.1**	**66.4**	66	Yes
6.02	0.2	**66.6**	**67.6**	66	Yes

4.7 NSA 7

NSA 7 is located north of SR 16/37 between Clouse Lane and Westgate Drive Northeast (Figure 2.01, Appendix A). Forty receptors totaling 73 equivalent receptors were modeled in NSA 7. Receptors included single-family homes and 4-unit condominiums (Activity Category B), playgrounds and sports fields (Activity Category C), and Licking Memorial Urgent Care (Activity Category C/D). Receptor ground surface elevations varied from 886 ft in the central portion of the NSA to 912 ft in the western portion. SR 16/37 elevations ranged from 889 ft on the eastern side to 931 ft on the western side of the NSA. The difference between ground surface elevations of receptors and US-422 ranged from approximately 3-30 ft. **Ten receptors totaling 19 equivalent receptors had modeled noise levels approaching or exceeding the NAC (Figures 3.04-3.05, Appendix A).**

Table 4.7 NSA 7 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
7.01	1	**66.2**	**66.1**	66	Yes
7.02	1	63.4	63.9	66	No
7.03	1	61.0	61.6	66	No
7.04	1	60.4	60.8	66	No
7.05	1	61.9	62.3	66	No
7.06	1	61.8	62.2	66	No
7.07	1	63.0	63.1	66	No
7.08	1	64.0	64.3	66	No
7.09	1	64.7	65.2	66	No
7.10	1	62.8	63.2	66	No
7.11	1	60.9	61.0	66	No
7.12	1	65.4	**66.2**	66	Yes
7.13	1	**66.8**	**65.8**	66	Yes
7.14	1	**67.0**	**67.4**	66	Yes
7.15	1	**67.9**	**68.5**	66	Yes
7.16	1	**67.5**	**68.7**	66	Yes
7.17	1	61.6	61.8	66	No
7.18	1	62.1	62.3	66	No

Table 4.7 NSA 7 Model Results (cont.)

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
7.19	1	60.5	61.0	66	No
7.20	3.6	58.9	59.7	66	No
7.21	4.4	62.0	62.6	66	No
7.22	1	60.0	61.5	66	No
7.23	1	62.8	63.8	66	No
7.24	1	61.5	62.6	66	No
7.25	4.4	**66.3**	**66.4**	66	Yes
7.26	1	62.0	63.1	66	No
7.27	1	63.4	64.5	66	No
7.28	1	62.5	63.9	66	No
7.29	1	61.5	62.8	66	No
7.30	4	59.0	60.8	66	No
7.31	4	60.6	62.2	66	No
7.32	4	**65.6**	**66.0**	66	Yes
7.33	2	63.3	64.4	66	No
7.34	4	59.8	61.7	66	No
7.35	1	57.0	58.8	66	No
7.36	1	56.3	58.3	66	No
7.37	4	58.1	60.6	66	No
7.38	4	55.9	58.0	66	No
7.39	2	**71.9**	**72.8**	66	Yes
7.40	0.6	**72.5**	**73.6**	66	Yes

4.8 NSA 8

NSA 8 is located south of SR 16/37 and west of Thornwood Crossing (Figure 2.01, Appendix A). Twenty-two receptors totaling 28.6 equivalent receptors were modeled in this location. Receptors included single-family homes (Activity Category B), the Ohio Event Center (Activity Category C), a house of worship (Activity Category C/D), and the Cherry Valley Hotel (Activity Category E). Receptor ground surface elevations varied from 879 ft in the east portion to 889 ft in the central portion. SR 16/37 elevations ranged from 884 ft in the east and 890 ft in the west. The difference between ground surface elevations of receptor and SR 16/37 were approximately 1-10 ft. **Two receptors totaling 3.6 equivalent receptors had modeled noise levels approaching or exceeding the NAC (Figure 3.05, Appendix A).**

Table 4.8 NSA 8 Model Results

Receptor ID	Equivalent Receptor(s)	2028 Peak Hour Noise Level (dBA Leq)	2048 Peak Hour Noise Level (dBA Leq)	Noise Abatement Criteria Level (dBA Leq)	Noise Impact
8.01	1	60.6	61.9	66	No
8.02	1	64.4	**65.6**	66	Yes
8.03	1	60.7	62.1	66	No
8.04	1	60.4	61.6	66	No
8.05	1	61.7	63.1	66	No
8.06	1	60.6	61.9	66	No
8.07	1	59.7	61.4	66	No
8.08	1	57.6	58.9	66	No
8.09	1	56.5	58.0	66	No
8.10	2.6	**66.3**	**67.4**	66	Yes
8.11	2.6	57.3	58.4	71	No
8.12	1.1	61.9	62.7	71	No
8.13	1.1	60.1	61.2	71	No
8.14	1.1	57.5	58.8	71	No
8.15	1.1	59.3	60.5	71	No
8.16	1.1	58.4	59.5	71	No
8.17	1.1	57.9	59.0	71	No
8.18	1.1	55.6	56.8	71	No
8.19	1.1	55.5	56.7	71	No
8.20	1.1	49.1	50.4	71	No
8.21	0.4	46.2	47.6	66	No
8.22	0.3	49.9	51.2	71	No

5.0 NOISE ABATEMENT MEASURES

23 CFR 772.13(a) requires that noise abatement be considered and evaluated for feasibility and reasonableness when TNM predicts traffic noise levels that approach or exceed the applicable FHWA Noise Abatement Criteria. Feasibility is defined as the achievement of at least a 5 dBA noise reduction at 40 percent of impacted receptors (772.13(d)(1)(i)) and determination that it is possible to design and construct the noise abatement measure (772.13(d)(1)(ii)). Reasonableness is addressed by considering the viewpoints of the public (772.13(d)(2)(i)), achieving a reasonable cost per receptor (772.13(d)(2)(ii)), and achieving noise reduction design goal (772.13(d)(2)(iii)).

Abatement measures that were considered include traffic management, modifications to the vertical and horizontal roadway alignments, noise insulation, and construction of permanent noise barriers within or adjacent to the ROW. To be considered for implementation, a potential mitigation measure must be determined to be both feasible and reasonable.

Traffic management measures to reduce traffic noise can include restrictions on access to specific motor vehicle types, travel speed, traffic volumes, and time of operation. A reduction in the speed limit, while possibly generating some beneficial effects on noise level reduction, would affect the ability of SR 16/37 to accommodate current and future traffic volumes. Since SR 16/37 is the major highway in this location and nearby routes were not designed for large-volume, high-speed traffic, limiting truck traffic and time of truck traffic operation is not a feasible option. Time use limitations on traffic may result in an economic impact on commercial traffic and businesses within and beyond the project area. Traffic management measures would not be feasible for this location and are not considered further in this report.

Modifications to the vertical and horizontal roadway alignments of SR 16/37 would not be feasible or reasonable as a noise abatement measure for many reasons. The horizontal and vertical alignment of SR 16/37 in this location is dictated by ODOT design and safety criteria, as well as the elevations of nearby roads, bridges, offramps, and onramps. Altering the horizontal alignment of SR 16/37 would simply shift noise impacts to other receptors in this area, and acquisition of private property would be prohibitively expensive. It would cause economic and social impact due to numerous residential and commercial relocations and could impact public or institutional properties such as parks, churches, hospitals, libraries, and schools. For these reasons, vertical and horizontal alignment modifications to the proposed alignment are not considered to be feasible or reasonable noise abatement measures.

Buffer zones are undeveloped, open spaces bordering a highway that are purchased by a highway agency outside the standard ROW so that future dwellings cannot be constructed next to the highway. Much of the land adjacent to US-422 within the study area is already residential and commercial land use, or is occupied by Raccoon Creek and its floodplain, with houses and businesses located up to the ODOT ROW. Following ODOT guidelines, the amount of public funds considered reasonable for noise abatement purposes is $56,000 per benefited noise-sensitive receptor. The private residences adjacent to SR 16/37 would cost significantly more than $56,000 per residence; therefore, the purchase of buffer zones is not a reasonable noise abatement measure.

Noise insulation of structures applies only to public use or institutional structures where sound levels exceed the interior NAC. No public use structures in the study area had interior noise levels that exceeded the NAC; therefore, noise insulation was not considered for any structures impacted by SR 16/37.

Noise reduction by permanent noise barriers was modeled for each NSA where modeled sound levels approached or exceeded the NAC (see summary in Table 5.1). In locations where SR 16/37 is located below the elevations of the adjacent houses, noise walls were modeled at the top of the slope near the edge of the ROW. Per direction from ODOT, barriers were not modeled on structures such as overpasses. All barriers were modeled at 10ft, 12ft, and 14ft heights. Detailed sound level results for each modeled barrier scenario are contained in Appendix E.

5.1 NSA 1

No receptors in NSA 1 had modeled noise levels approaching or exceeding the NAC for activity Category E. Therefore, no further analysis was completed for this NSA. The noise barriers modeled for NSA 2 did not provide any benefit to the modeled receptors.

5.2 NSA 2

One noise barrier (Barrier 1) was modeled for NSA 2. Barrier 1 is located at the edge of shoulder, as NSA 2 is lower in elevation than the highway. Barriers were modeled at heights of 10ft, 12ft, and 14f and at three different lengths (Figures 4.01-4.03, Appendix A)t.

All modeled barrier scenarios were acoustically feasible, and all three of the barriers achieved the noise reduction design goal of 7 dB reduction for at least one receptor. The cost for the 14-ft wall was less than $56,000/benefited receptor and was determined to be reasonable. **Noise abatement in NSA 2 is recommended and Barrier 1 Medium is recommended (Figure 4.02, Appendix A).**

5.3 NSA 3

One noise barrier was modeled for NSA 3 at two lengths (Figures 5.01-5.02, Appendix A). Only the 14-ft tall barriers provided an acoustic benefit of at least 7 dB. None of the modeled barrier heights or lengths were reasonable due to high cost per benefited receivers. **Noise abatement in NSA 3 is not recommended.**

5.4 NSA 4

Two noise barriers (Barriers 3 and 4) were modeled for NSA 4 because of its intersection with River Road (Figures 6.01-6.03, Appendix A). Barriers were modeled together and individually at 10ft, 12ft, and 14ft heights. All of the modeled barriers for Barrier 3 and a combination of Barriers 3 and 4 were acoustically feasible and met the noise reduction design goals of 6.5 dB for at least one receptor, whereas none of the options with only Barrier 4 were acoustically feasible as they did not benefit a minimum of 40% of the receptors, and only the 14 ft wall provided benefit to one receptor. No barrier options are considered reasonable, as the costs for all scenarios were higher than $56,000 per benefited receptor. **Noise abatement in NSA 4 is not recommended.**

Table 5.1 State Route 16/37 Noise Analysis (PID 95445) Barrier Analysis Summary

Noise Sensitive Area	Barrier Name, Length, and Height	Barrier Location	Barrier Height (ft)	Total Barrier Length (ft)	Est. Cost	# Impacted Equivalent Receptors	Max Noise Reduction, dBA	# Benefited Equivalent Receptors	Cost per Benefited Equivalent Receptor	# Impacted and Benefited Receptors	# Receptors with >6.5dBA benefit	Benefited % of Impacted Receptors	Acoustically Feasible?	Meets Design Goal (>6.5 dBA reduction)?	Reasonable (<$56,000 per benefited receptor)?
2	1 Full 10 ft	EOS	10	2200	$879,951	17.0	6.8	9.1	$96,698	9.0	1.0	52.9%	Yes	Yes	No
2	1 Full 12 ft	EOS	12	2200	$1,055,942	17.0	7.9	13.6	$77,643	12.0	8.1	70.6%	Yes	Yes	No
2	1 Full 14 ft	EOS	14	2200	$1,231,932	17.0	8.6	26.1	$47,200	14.0	9.1	82.4%	Yes	Yes	Yes
2	1 Short 10 ft	EOS	10	1000	$399,986	17.0	6.8	9.0	$44,443	9.0	1.0	52.9%	Yes	Yes	Yes
2	1 Short 12 ft	EOS	12	1000	$479,983	17.0	7.9	10.0	$47,998	9.0	8.0	52.9%	Yes	Yes	Yes
2	1 Short 14 ft	EOS	14	1000	$559,980	17.0	8.5	11.0	$50,907	10.0	9.0	58.8%	Yes	Yes	Yes
2	1 Medium 10 ft	EOS	10	1600	$639,988	17.0	6.8	9.0	$71,110	9.0	1.0	52.9%	Yes	Yes	No
2	1 Medium 12 ft	EOS	12	1600	$767,986	17.0	7.9	10.0	$76,799	10.0	8.0	58.8%	Yes	Yes	No
2	**1 Medium 14 ft**	**EOS**	**14**	**1600**	**$895,984**	**17.0**	**8.5**	**23.0**	**$38,956**	**14.0**	**9.0**	**82.4%**	**Yes**	**Yes**	**Yes**
3	2 Full 10 ft	EOS	10	750	$299,984	1.0	3.6	0.0	no benefit	0.0	0.0	0.0%	No	No	No
3	2 Full 12 ft	EOS	12	750	$359,981	1.0	4.9	0.0	no benefit	0.0	0.0	0.0%	No	No	No
3	2 Full 14 ft	EOS	14	750	$419,978	1.0	7.1	1.0	$419,978	1.0	1.0	100.0%	Yes	Yes	No
3	2 Short 10 ft	EOS	10	550	$219,995	1.0	3.6	0.0	no benefit	0.0	0.0	0.0%	No	No	No
3	2 Short 12 ft	EOS	12	550	$263,994	1.0	4.9	0.0	no benefit	0.0	0.0	0.0%	No	No	No
3	2 Short 14 ft	EOS	14	550	$307,993	1.0	7.0	1.0	$307,993	1.0	1.0	100.0%	Yes	Yes	No
4	3 Full 10 ft	ROW	10	2800	$1,120,001	16.5	10.2	12.5	$89,600	8.1	8.1	49.1%	Yes	Yes	No
4	3 Full 12 ft	ROW	12	2800	$1,344,001	16.5	11.1	14.7	$91,429	14.7	8.1	89.1%	Yes	Yes	No
4	3 Full 14 ft	ROW	14	2800	$1,568,002	16.5	12.1	14.7	$106,667	14.7	14.7	89.1%	Yes	Yes	No
4	4 Full 10 ft	EOS	10	2000	$800,009	16.5	4.5	1.0	$800,009	1.0	0.0	6.1%	No	No	No
4	4 Full 12 ft	EOS	12	2000	$960,011	16.5	5.6	1.6	$600,007	1.6	0.0	9.7%	No	No	No
4	4 Full 14 ft	EOS	14	2000	$1,120,013	16.5	6.8	6.3	$177,780	1.9	1.3	11.5%	No	Yes	No
4	3&4 Full 10 ft	ROW + EOS	10	4800	$1,920,010	16.5	10.3	13.5	$142,223	13.5	8.1	81.8%	Yes	Yes	No
4	3&4 Full 12 ft	ROW + EOS	12	4800	$2,304,012	16.5	11.2	16.6	$138,796	16.3	8.1	98.8%	Yes	Yes	No
4	3&4 Full 14 ft	ROW + EOS	14	4800	$2,688,014	16.5	12.3	21.0	$128,001	16.3	8.1	98.8%	Yes	Yes	No
7	5&6 Full 10 ft	EOS + ROW	10	3700	$1,479,948	16.4	7.7	6.0	$246,658	5.0	5.0	30.5%	No	Yes	No
7	5&6 Full 12 ft	EOS + ROW	12	3700	$1,775,938	16.4	8.6	12.4	$143,221	9.4	5.0	57.3%	No	Yes	No
7	5&6 Full 14 ft	EOS + ROW	14	3700	$2,071,926	16.4	9.4	24.8	$83,545	11.4	11.4	69.5%	Yes	Yes	No
7	7 Full 10 ft	RPW	10	500	$199,986	0.6	8.2	0.6	$333,310	0.6	0.6	100.0%	Yes	Yes	No
7	7 Full 12 ft	ROW	12	500	$239,984	0.6	9.5	0.6	$399,973	0.6	0.6	100.0%	Yes	Yes	No
7	7 Full 14 ft	ROW	14	500	$279,981	0.6	10.4	0.6	$466,635	0.6	0.6	100.0%	Yes	Yes	No
7	7 Short 10ft	ROW	10	375	$150,001	0.6	8.1	0.6	$250,002	0.6	0.6	100.0%	Yes	Yes	No
7	7 Short 12ft	ROW	12	375	$180,002	0.6	9.3	0.6	$300,003	0.6	0.6	100.0%	Yes	Yes	No
7	7 Short 14ft	ROW	14	375	$210,002	0.6	10.1	0.6	$350,003	0.6	0.6	100.0%	Yes	Yes	No
8	8 Full 10 ft	EOS	10	1250	$499,974	3.6	5.5	2.6	$192,298	2.6	0.0	72.2%	Yes	No	No
8	8 Full 12 ft	EOS	12	1250	$599,968	3.6	6.7	6.7	$89,547	2.6	2.6	72.2%	Yes	Yes	No
8	8 Full 14 ft	EOS	14	1250	$695,965	3.6	7.5	9.7	$71,749	2.6	2.6	72.2%	Yes	Yes	No
8	8 Short 10 ft	EOS	10	850	$340,003	3.6	5.2	2.6	$130,770	2.6	0.0	72.2%	Yes	No	No
8	8 Short 12 ft	EOS	12	850	$408,004	3.6	6.4	3.6	$113,334	2.6	0.0	72.2%	Yes	No	No
8	8 Short 14 ft	EOS	14	850	$476,004	3.6	7.1	5.6	$85,001	2.6	2.6	72.2%	Yes	Yes	No

5.5 NSA 5

No barriers were modeled for NSA 5, as none of the receptors were impacted. **Noise abatement is not recommended in NSA 5.**

5.6 NSA 6

Because of the difference in elevation between SR 16/37 and the bike path and the transient nature of the human use of the land, barriers were not modeled for NSA 6 per ODOT's direction. **Noise abatement is not recommended in NSA 6.**

5.7 NSA 7

Three barriers (Barriers 5, 6, and 7) were modeled for NSA 7 (Figures 7.01-7.03, Appendix A). Barriers 5 and 6 were modeled as a single unit at 10 ft, 12 ft, and 14 ft heights, and Barrier 7 was modeled at two lengths (500 ft and 375 ft) and three heights (10 ft, 12 ft, and 14 ft). For Barriers 5 and 6, only the 14 ft barrier was acoustically feasible, although all three heights achieved the noise reduction design goal of 6.5 dB reduction for at least one receptor. For Barrier 7 (500 ft length) the barrier is acoustically feasible at all heights, and all three heights achieved the noise reduction design goal of 6.5 dB reduction for at least one receptor. The 10ft, 375' long option for Barrier 7 was also acoustically feasible and achieved the noise reduction design goal of 6.5 dB reduction for at least one receptor. None of the options were considered reasonable, as costs for all scenarios exceeded $56,000 per benefited receptor. **Noise abatement in NSA 7 is not recommended.**

5.8 NSA 8

One barrier (Barrier 8) was modeled for NSA 8 (Figures 8.01-8.02, Appendix A). Barrier 8 was modeled at 10ft, 12ft, and 14ft heights and at two lengths, 1250 ft and 850 ft. All barriers were acoustically feasible, but several of the modeled barrier options did not meet the noise reduction design goal of 6.5 dB reduction for at least one receptor. The 12 ft and 14 ft tall walls at both lengths (1250 ft and 850 ft) were acoustically feasible and achieved the noise reduction design goal of 7 dB reduction for at least one receptor. However, none of the alternatives are considered reasonable, as costs for all scenarios were higher than $56,000 per benefited receptor. **Noise abatement in NSA 8 is not recommended.**

5.9 UTILITIES

Utility conflicts were obtained by examining the plan sheets and by visual inspection during the field survey. Several utilities were found to potentially interfere with the placement of Barrier 1. Table 5.1 shows the utility type and stationing for each potential conflict with Barrier 1, the only recommended barrier. A map of the potential conflicts is shown as Figure 9 in Appendix A. A 106" x 68" RCP culvert near the guardrail by Columbus Rd at the far western part of the proposed barrier travels under the highway. A water main also crosses the highway parallel to the culvert. An overhead electric line crosses the barrier near the eastern end of Middleton Assisted Living Facility. Vertical clearance between the electric line would need to be coordinated with AEP, the utility owner.

Table 5.2 Utilities that May Conflict with the Recomennded Barrier

Utility Type	STA	NSA	Barrier
Water	672+45	2	1
106"x 68" RCP	672+90	2	1
Overhead Electric	679+50	2	1

5.10 UNDEVELOPED LANDS

Per 23 CFR 772.17, to prevent future traffic noise impacts on currently undeveloped lands, highway agencies shall inform local officials within whose jurisdiction the highway project is located of the following:

(a) The best estimation of future noise levels (for various distances from the highway improvement) for both developed and undeveloped lands and other properties in the immediate vicinity of the project.

(b) Information that may be useful to local communities to protect future land development from becoming incompatible with anticipated highway noise levels.

Although the entire project corridor has been developed, there are several undeveloped parcels within the study area. Ten areas of undeveloped land were identified within the Noise Study Area (Figure 10, Appendix A). Sound levels were modeled at receivers spaced at 50-ft intervals or less to calculate the approximate distance from the current SR 16/37 edge of pavement to a distance where traffic noise impact would occur for Activity Categories B and C based on the current year traffic volumes. The dBA levels in the table below are measured in feet from the existing edge of pavement of SR 16/37 to points where 71 dBA (Activity Category E) would be expected, and to where 66 dBA (Activity Categories B and C) would be expected.

Table 5.3 Undeveloped Land Model Results - Distance from SR 16/37 EOP

Undeveloped Land ID	Location	Distance for 66 dB	Distance for 71 dB
1	Northwest of the ramp northwest of the intersection of SR 16/37 and Columbus Rd	230	90
2	Southeast of the intersection of SR 16/37 and Columbus Rd	225	175
3	South of SR 16/37 between Columbus Rd and Lancaster Rd	270	75
4	South of SR 16/37, west of Lancaster Rd to River Rd (approximately)	250	40
5	South of SR 16/37, west of River Rd to the Thomas J Evans Trail ROW	300	35
6	North of SR 16/37 from Raccoon Creek to the Thomas J Evans Trail ROW	275	50
7	North of SR 16/37 from the Thomas J Evans Trail ROW to Clouse Rd (approximately)	400	40
8	North of SR 16/37 southwest of the Spring Hills Baptist Church	200	40

Table 5.3 Undeveloped Land Model Results- Distance from SR 16/37 EOP (cont.)

Undeveloped Land ID	Location	Distance for 66 dB	Distance for 71 dB
9	South of SR 16/37 from the Thomas J Evans to Raccoon Creek (approximately) Trail ROW to	280	50
10	Northwest of the intersection of SR 16/37 and Cherry Valley Rd NW	95	40
11	Southeast of the intersection of SR 16/37 and Cherry Valley Rd NW	215	90

5.11 CONSTRUCTION NOISE

Noise sensitive receptors will be subjected to temporary noise impacts during the construction of the proposed noise walls. Construction noise will generate intermittent temporary adverse impacts on adjacent and nearby properties. Construction noise will be caused by a range of construction equipment at varying levels of intensity based on the types of operations being performed and the number of pieces of equipment in operation at the time. Available options to minimize temporary adverse noise impacts include the following: proper maintenance of equipment (particularly properly functioning mufflers and adequate lubrication of moving parts), restrictions on equipment use by location and time of day, controlling non-construction traffic by limiting heavy truck movements on residential streets, maximizing the distance between equipment and receptors whenever possible, and screening or enclosing stationary equipment or noisy activities.

6.0 CONCLUSIONS AND RECOMMENDATIONS

As a result of this analysis, one noise barrier option (Barrier 1 Medium) was recommended to provide feasible and reasonable noise abatement for NSA 2 within the SR 16/37 traffic noise study area. Barrier 1 Medium met all applicable criteria while protecting all impacted receptors.

Barriers 2-8 were not recommended, as they did not meet ODOT’s noise mitigation criteria for both feasibility and reasonableness. Factors contributing to this include the elevation of roadways above some of the impacted receivers, as well as the low density of receivers in impacted areas. These factors would require very high and/or long, continuous barriers to provide sufficient acoustic benefits.

7.0 LITERATURE CITED

23 CFR Part 772. 2010. "Procedures for Abatement of Highway Traffic Noise and Construction Noise."

Anderson, Grant S., Cynthia S. Y. Lee, Gregg O. Fleming, and Christopher W. Menge. 1998. FHWA Traffic Noise Model® Version 1.0 User's Guide, U.S. DOT, FHWA, Washington, DC.

ANSI. 1993. "Specification for Sound Level Meters." American National Standard, ANSI Standard S1.4-1993. New York: American National Standards Institute.

FHWA. 2011. Highway Traffic Noise: Analysis and Abatement Guidance, U.S. Department of Transportation Federal Highway Administration.

Lau, Michael C., Cynthia S. Y. Lee, Judith L. Rochat, Eric R. Boeker, and Gregg O. Fleming. 2004. FHWA Traffic Noise Model® User's Guide (Version 2.5 Addendum), U.S. DOT, FHWA, Washington, DC.

Lee, Cynthia S. Y., and Gregg O. Fleming. 1996. Measurement of Highway-Related Noise,

ODOT. 2021. ODOT Highway Traffic Noise Analysis Manual: Analysis and Abatement of Highway Traffic Noise, Ohio Department of Transportation, Office of Environmental Services.