Traffic Noise Assessment

Brent Spence Bridge Corridor Project
Kentucky Southern Section
Kenton County
KYTC Item No. 6-17.00

BRENT SPENCE BRIDGE CORRIDOR

February 2023

Palmer ENGINEERING

Abstract

The Brent Spence Bridge Corridor Project is intended to improve the operational characteristics within the I-71/I-75 corridor for both local and through traffic. In the Greater Cincinnati/Northern Kentucky region, the I-71/I-75 corridor suffers from congestion and safety–related issues as a result of inadequate capacity to accommodate current traffic demand.

The objectives of this project are to:

- improve traffic flow and level of service,
- improve safety,
- correct geometric deficiencies, and
- maintain connections to key regional and national transportation corridors.

Concept I-W is a value engineering refinement to Alternative I from the 2012 EA/FONSI. It matches Alternative I for the I-71/I-75 alignment from Dixie Highway north to West 12th Street in Kentucky and north of Freeman Avenue in Ohio. It also includes the local C-D along both sides of I-75 in Ohio. Concept I-W also modifies the 5th Street intersection with Central Avenue in Ohio to include an additional eastbound through lane.

Concept I-W builds a new double decker companion bridge (with a width of 107 feet) just west of the existing BSB with all I-71 and I-75 traffic routed onto the new bridge and all local C-D traffic routed to the existing BSB. The new companion bridge carries five lanes of southbound I-71 and I-75 traffic on the lower deck and five lanes of northbound I-71 and I-75 traffic on the upper deck. The rehabilitated existing BSB carries three lanes of northbound local traffic on the lower deck and three lanes of southbound local traffic on the upper deck, as part of the C-D roadway system.

Existing noise levels were monitored at 16 field sites labeled M30-31 and M35-48 between June 23rd and July 12th of 2022. Readings were taken during AM and PM peak traffic periods (Appendix A). Road conditions at the time of the field readings were always clear and dry. The duration of measurements exceeded 15 minutes and were recorded at or near existing areas of human use.

Noise levels were determined at 325 locations (Exhibits 2A through 2H). Table 5 presents Concept I-W predicted noise levels by receiver. Table 6 presents a summary of Concept I-W impacts by activity category. TNM files are provided in Appendix C. The largest number of impacts by activity category is for Activity Category B residential uses where 119 receivers representing 175 equivalent residential units exceed impact thresholds during the PM peak period. The 175 equivalent receptor impacts represent a 22 percent increase over comparable existing (2022) conditions (144 equivalent residences).

Seven potential noise barriers at six locations were identified and evaluated for feasibility and reasonableness. Summaries of those findings are contained in Table 7 and Illustrations depicting the location of each analyzed noise barrier are shown on Exhibits 3 through 9. Results of traffic noise modelling for each proposed noise wall are contained in Appendix F.

The analysis concludes that five proposed noise barriers would satisfy the KYTC noise abatement feasibility and reasonableness requirements. The five recommended noise barriers provide abatement for four residential communities and two schools. The five recommended noise barriers consist of a total of 15,750 linear feet of barrier

wall ranging in height from 12 to 24 feet under Concept I-W. The recommended noise barriers are located between the following major road crossings or interchanges:

- I-71/75 northbound between Beechwood Road and Dixie Highway (Exhibit 6),
- I-71/75 northbound between Dixie Highway and Kyles Lane (see Exhibit 7),
- I-71/75 northbound between Kyle's Lane and West 12th Street (See Exhibit 8)
- I-71/75 southbound between West 12th Street and Kyles Lane (see Exhibit 9), and
- I-71/75 southbound between Kyle's Lane and Dixie Highway (See Exhibit 3)

The recommended barriers for Concept I-W would provide acoustic effectiveness for 527 noise receptors at a cost of approximately $10 million dollars. The final decision on the installation of any abatement measure will be determined in coordination with local officials and residents of the impacted properties during the public involvement process.

Table 8 presents design year sound levels for areas along I-75 where vacant and possibly developable lands exist. Noise predictions were made at intervals of 25 feet extending to 525 feet from the proposed edge of pavement for the 2050 Build condition. As indicated, sound levels of I-75 would exceed the NAC of 67 dB(A) for land use Categories B and C within 450 feet from edge of pavement (EOP). Sound levels exceed the NAC of 72 dB(A) for land use Category E up to 200 feet from EOP.

TABLE OF CONTENTS

TABLES

EXHIBITS

APPENDICES

1. INTRODUCTION

The analysis of the highway-generated noise impact of this project has been prepared in accordance with FHWA's Governing Document 23 Code of Federal Regulations (CFR) Part 772 Procedures for Abatement of Traffic Noise and Construction Noise, and the Kentucky Transportation Cabinet's *Noise Analysis and Abatement Policy*, July 1, 2022 (KYTC Noise Policy). The noise analysis involved:

- Determining noise-sensitive areas and representative receptors along the project;
- Measuring existing noise levels;
- Checking for validation of FHWA Traffic Noise Model (TNM2.5®) with measured traffic noise levels;
- Utilizing TNM2.5® to predict design year noise levels;
- Comparing predicted noise levels with noise level guidelines to determine impacts;
- Evaluating, where necessary, the feasibility and reasonableness of noise abatement options.

2. DEFINITIONS

Benefited Receptor - KYTC defines a benefited receptor as the recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dB(A).

Common Noise Environment - A group of receptors within the same Activity Category that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features.

dB(A) - Frequencies to which the human ear does not respond are filtered out when measuring and predicting highway noise levels resulting in the A-weighted scale.

Impacted Receptor - A receptor that has a traffic noise impact.

L_{Aeq1h} - The A-weighted equivalent steady state sound level which in one hour contains the same acoustic energy as the time varying sound level during one hour, shortened here to L_{eq}.

Noise Abatement Criteria (NAC) - Sound pressure levels established by the FHWA that act as a standard for noise abatement measures giving consideration to specific land uses.

Substantial Noise Increase - A 10 dB(A) or greater increase in noise levels in the design year compared to the existing noise level.

Traffic Noise Impacts - 23 CFR Part 772 defines traffic noise impacts as impacts which occur when the predicted traffic noise levels approach or exceed the Noise Abatement Criteria (NAC) or when the predicted traffic noise levels substantially exceed the existing noise levels.

Type 1 Project –

A. The construction of a highway on new location; or,

B. The physical alteration of an existing highway where there is either:

   1. Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,

2. Substantial Vertical Alteration. A project that removes shielding, therefore, exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or, the addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,

C. The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,

D. The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,

E. Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,

F. The addition of a new or substantial alteration of a weigh station, rest stop, rideshare lot, or toll plaza.

G. If a project is determined to be a Type I project under this definition, then the entire project area as defined in the environmental document is a Type I project.

3. PROJECT DESCRIPTION

3.1 PURPOSE OF THE PROJECT

The Brent Spence Bridge Corridor Project is intended to improve the operational characteristics within the I-71/I-75 corridor for both local and through traffic. In the Greater Cincinnati/Northern Kentucky region, the I-71/I-75 corridor suffers from congestion and safety–related issues as a result of inadequate capacity to accommodate current traffic demand.

The objectives of this project are to:

- improve traffic flow and level of service,
- improve safety,
- correct geometric deficiencies, and
- maintain connections to key regional and national transportation corridors.

3.2 STUDY CORRIDOR

The overall project corridor is located along a 7.8-mile segment of I-75 within the Commonwealth of Kentucky (state line mile 186.7) and the State of Ohio (state line mile 2.7). The southern limit of the project is 5,000 feet south of the midpoint of the Dixie Highway Interchange on I-71/I-75 in Fort Wright, south of Covington, Kentucky. The northern limit of the project is 1,500 feet north of the midpoint of the Western Hills Viaduct Interchange on I-75 in Cincinnati, Ohio. The eastern and western limits of the study area generally follow the existing alignment of I-75.

The Kentucky portion of the noise analysis was split into two sections, North and South with Palmer Engineering assessing the southern section and HMB Professional Engineers (HMB) assessing the northern section. To avoid overlap in the analyses, the southern section only includes assessment of areas west of the corridor between Kyle's Lane and 12th street near MP 189.2 while the northern section includes analysis of the areas east of the corridor. A depiction of the project study area is provided in Exhibit 1. The results of the analysis of traffic noise and abatement measures in the southern section are presented in this report.

3.3 BUILD ALTERNATIVE

The Brent Spence Bridge corridor consists of 7.8 total miles of I-71 and I-75 located within portions of Ohio and Kentucky. This corridor is located within the Greater Cincinnati/Northern Kentucky region and is a major route for local and regional mobility. Locally, it connects to I-74, I-275, and US 50. The Brent Spence Bridge (BSB) provides an interstate connection over the Ohio River and carries both I-71 and I-75 traffic. The bridge also facilitates local travel by providing access to downtown Cincinnati, Hamilton County, Ohio and Covington, Kenton County, Kentucky. This corridor is also one of the busiest trucking routes in the US, connecting Michigan to Florida via I-75.

The BSB opened in 1963 and was originally designed to carry 80,000 vehicles per day (VPD). Current traffic volumes on the BSB are 160,000 VPD. The BSB corridor exhibits congestion and safety–related issues due to inadequate capacity to accommodate current traffic demand, which are further exacerbated by design deficiencies along the corridor. The BSB project will improve the operational characteristics within the BSB corridor for both local and through traffic by improving traffic flow and level of service, improving safety, correcting geometric deficiencies, and maintaining connections to key regional and national transportation corridors.

The Kentucky Transportation Cabinet (KYTC) and the Ohio Department of Transportation (ODOT) developed a range of alternatives for improving the I-71/I-75 corridor in Kentucky and Ohio through a series of preliminary engineering and planning studies coupled with extensive public and stakeholder involvement. These activities were documented in the project's Environmental Assessment (March 2012). On August 9, 2012, the Federal Highway Administration (FHWA) issued a Finding of No Significant Impact (FONSI) identifying Alternative I as the preferred alternative for the BSB project.

Since the approval of the FONSI, KYTC and ODOT completed additional studies to update the preferred alternative to reflect current design standards, traffic counts, and traffic operations. KYTC and ODOT also conducted a value engineering analysis of the preferred alternative. These efforts resulted in refinements to Preferred Alternative I, which have been designated as Concept I-W.

Concept I-W is a value engineering refinement to Alternative I from the 2012 EA/FONSI. It matches Alternative I for the I-71/I-75 alignment from Dixie Highway north to West 12th Street in Kentucky and north of Freeman Avenue in Ohio. It also includes the local Collector-Distributor (C-D) along both sides of I-75 in Ohio. Concept I-W also modifies the 5th Street intersection with Central Avenue in Ohio to include an additional eastbound through lane.

Concept I-W builds a new double decker companion bridge (with a width of 107 feet) just west of the existing BSB with all I-71 and I-75 traffic routed onto the new bridge and all local C-D traffic routed to the existing BSB. The new companion bridge carries five lanes of southbound I-71 and I-75 traffic on the lower deck and five lanes of northbound I-71 and I-75 traffic on the upper deck. The rehabilitated existing BSB carries three lanes of northbound local traffic on the lower deck and three lanes of southbound local traffic on the upper deck, as part of the C-D roadway system.

KYTC and ODOT are currently developing a Supplemental Environmental Assessment to document any changes in impacts or effects that would result from the refined Preferred Alternative I (Concept I-W). These efforts also involve updating resource-specific studies to reflect any changes in conditions that have occurred since they were prepared for the Environmental Assessment.

Location Map

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
Kenton County, KY
KYTC Item No. 6-17

Exhibit 1

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

N

0 3,000 6,000

Feet

Palmer ENGINEERING

4. NOISE

Noise is unwanted sound that causes annoyance to listeners. On a physical molecular level, sound is the vibration of air molecules that propagate as waves through the air, which results in the stimulation of the nerve endings in the human ear creating the sensation of hearing. Sounds occur in the human and natural environment at all times. Some sounds are necessary or desirable for communication or pleasure, while other sounds are unwanted causing disturbance to the people living or working nearby. Noise varies from place to place and also in intensity as the cycle of human activity changes over the course of the day.

4.1 THE A-WEIGHTED NOISE LEVEL

While a variety of methods can be used to describe and quantify noise conditions, sound levels in decibels (dB) are presented in this report. Decibels are a unit of measure on a logarithmic scale used to quantify the amount of sound pressure at a given location from the general outdoor environment or specific sources. The most commonly used measure of noise level is the A-weighted sound level (dB(A)). From many experiments with human listeners, scientists have found that, unlike animals, the human ear is more sensitive to midrange frequencies than it is to either low or very high frequencies. At the same sound level, midrange frequencies are therefore heard as louder than other low or very high frequencies. These physical characteristics of the human ear are taken into account by adjusting or weighting the octave band spectrum of the measured or predicted sound for the sensitivity of human hearing range. The A-weighted sound scale is a measure of sound that corresponds well to human subjective response to noise. The A-weighted sound level is widely accepted by the Federal Highway Administration (FHWA) and Kentucky Transportation Cabinet (KYTC) as the preferred sound weighting method for assessing human exposure and annoyance from traffic noise. An understanding of the following relationships is helpful in providing a subjective impression of the human response to changes in the A-weighted sound level:

- an increase of only 1 dB(A) cannot be perceived,
- a 3 dB(A) increase is considered just at the threshold of a noticeable difference,
- a 5 dB(A) increase is considered readily perceived change in noise level, and
- a 10 dB(A) increase or decrease is subjectively heard as approximately a doubling (or halving) in loudness, independent of the existing noise level.

4.2 TRAFFIC NOISE DESCRIPTORS

Because environmental noise fluctuations vary from moment to moment, it is common practice to condense all of the information into a single number, called the “equivalent” sound level. Traffic noise levels applicable to transportation projects are often expressed in terms of an hourly equivalent noise level or Leq (1-hr) dB(A). The Leq is a measure of the average sound energy during a specified period of time (typically 1-hour duration) and is defined as the steady state sound level that typically, in a 1-hour period, contains the logarithmic sum of the acoustic energy generated by the time-varying sound during that hour. Studies have shown that the Leq (1-hr) descriptor correlates well with human response and annoyance to changes in noise levels. The Leq during the noisiest traffic hour, expressed as Leq (1-hr), is used by FHWA and KYTC as a descriptor for estimating traffic noise exposure.

5. FHWA NOISE IMPACT AND ABATEMENT CRITERIA

The National Environmental Policy Act (NEPA) of 1969 provides broad authority and responsibility for evaluating and mitigating adverse environmental effects including highway traffic noise. The NEPA directs federal agencies to use all practical means and measures to promote the general welfare and foster a healthy environment. The Federal-Aid

Highway Act of 1970 specifically mandates the Federal Highway Administration (FHWA) to develop noise standards for mitigating highway traffic noise.

In addition, Congress enacted standards and procedures for assessing the impact and abatement of highway traffic noise. These noise exposure standards and abatement procedures for establishing mitigation feasibility are covered under the United States Code of Federal Regulations Part 772 (23 CFR 772) *Procedures for Abatement of Highway Traffic Noise and Construction Noise.* The 23 CFR 772 regulations were updated in July 2011 in accordance with the FHWA 772 Final Rule and are described in detail in the document entitled *Highway Traffic Noise: Analysis and Abatement Guideline* (revised January 2011). The regulations establish traffic noise-level criteria for various land use activities and further provide that FHWA not approve plans and specifications for a federal-aid highway project unless adequate highway traffic noise abatement measures to implement the appropriate noise level standards are addressed.

The regulations contain noise abatement criteria, which represent the upper limit of acceptable highway traffic noise exposure levels for different types of land uses and human activities. The regulations do not require that the abatement criteria be met in every instance. Rather, they require that every reasonable and practicable effort be made to provide noise mitigation when the criteria are approached or exceeded. The FHWA guidelines apply to freeways and major arterial roads where traffic flows relatively freely. The regulations require the following during the planning and design of a highway project:

- Identification of traffic noise impacts.
- Examination and evaluation of potential mitigation measures.
- Incorporation of all identified reasonable and feasible noise mitigation measures into the highway project.
- Coordination with local officials and the affected residences to provide helpful information on compatible future land use planning, noise control, and the recommended noise abatement measures identified in this study.

For FHWA Type I improvements, such as the Brent Spence Bridge Corridor Project, substantial proposed changes to both the vertical and horizontal alignment require an analysis of traffic noise impacts and consideration of noise abatement, where appropriate, and in consideration of approved state DOT policies. Detailed noise modeling is required to a distance of 500 feet away from the proposed project edge of pavement for noise sensitive land uses. At a minimum, noise modeling must be completed at a distance that covers the extent of noise impacts identified from the proposed roadway improvements for each land use category.

To determine if noise levels near highways are compatible with various land uses, FHWA has developed noise abatement criteria (NAC) and procedures to be used in the planning and design of highways. The basic goals of the criteria, as they apply to highway projects, are to minimize potential adverse noise impacts on communities and, where necessary and appropriate, to provide feasible and reasonable abatement measures to either reduce or eliminate future noise impacts of proposed build alternatives.

The Kentucky Transportation Cabinet (KYTC) has developed procedures for assessing traffic noise impact and abatement feasibility and reasonableness, which comply with the FHWA requirements. These procedures are described in detail in the KYTC Noise Policy. A summary of the FHWA NAC for various land uses is presented in Table 1. These NAC levels represent the upper acceptable limit of traffic noise levels for exterior land uses and activities, and also for certain indoor activities. KYTC defines approach noise levels as being 1 decibel in A-weighted noise level

(dB(A)) less than the NAC levels shown in Table 1. For example, an "approach" exterior noise level threshold of 66 dB(A) Leq (1-hr) has been established as NAC for FHWA Category B and Category C sites.

Table 1: Activity Categories and Noise Abatement Criteria (NAC)

Activity Category	Description of Activity Category (Land Use)	Activity Criteria $L_{eq}(H)$	Evaluation Location
A	A 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 its intended purpose.	57	Exterior
B**	Residential	67	Exterior
C**	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.	67	Exterior
D	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.	52	Interior
E**	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.	72	Exterior
F	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	Undeveloped lands that are not permitted.	----------	----------

* The Leq(h) Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.

** Includes undeveloped lands permitted for this activity category

Independent of the impact thresholds shown in Table 1, KYTC also considers a noise impact to occur when a substantial increase in noise level is predicted. Current KYTC traffic noise policy guidelines define a substantial noise level change as an increase of 10 dB(A) or more in future build noise level over comparable existing noise levels. Predicted noise levels that either approach the NAC or are defined as a substantial noise increase constitute a noise impact.

5.1 DESCRIPTION OF EACH ACTIVITY CATEGORY

A description of each of the FHWA NAC activity categories is provided below.

Activity Category A: Includes 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. Some examples of lands that have been analyzed as Activity Category A include the Tomb of the Unknown Soldier, a monastery, an outdoor prayer area of a facility for nuns, and an amphitheater. KYTC will consider Category A sites on a case-by-case basis, as these land uses are not typically encountered. Documentation of the land use shall be submitted to the KYTC Noise Specialist, who will contact the FHWA to seek concurrence with the Category A designation.

Activity Category B: Includes exterior areas for residential use. Noise measurements are taken in exterior areas of frequent human use where traffic noise would interfere with normal conversation such as on balconies, patios or in the backyard of the residence. In the case of multifamily buildings balconies that have potential outdoor use should be modeled as frequent human receptor points and assessed for impact. In addition other receptor locations which should be modeled include shared common outdoor areas such as patios, club houses, and pools. For these shared uses the equivalent number of residences should be used to determine the total number of equivalent residences for each multifamily building. KYTC has a defined methodology to determine the equivalent number of receptors for these common shared outdoor areas based on usage factors and capacity limits for each type of activity area. The methodology used to estimate equivalent residences is described in Section 5.2.

Activity Category C: Includes exterior areas of non-residential lands as listed in Table 1 under Activity Category C such as schools, parks, cemeteries, etc. These land uses are analyzed for traffic noise impacts by taking exterior readings in areas of frequent human use such as in school playgrounds, sports fields and similar areas. KYTC has developed a standard method to establish the number of equivalent receptors for these non-residential land uses. The methodology used to estimate equivalent residences is described in Section 5.2.

Activity Category D: Includes certain land use facilities listed in Activity Category C that may have noise sensitivity to the interior spaces of these uses. These land uses shall be analyzed for traffic noise impacts per procedures found in FHWA's *Measurement of Highway Related Noise* (May 1996). Each structure is generally considered one receptor site for areas of frequent human use such as libraries, hospitals and public meeting rooms. Interior noise abatement measures are considered only after exhausting all outdoor mitigation options. Determining the interior noise level for Activity Category D land uses, can be achieved by subtracting the noise reduction factors contained in Table 2 from the predicted TNM2.5® exterior levels. In accordance with the KYTC Noise Policy, for buildings with windows that are fixed closed, interior noise readings are not required unless the predicted exterior noise levels exceed the interior NAC by more than 20 dB(A). Interior readings are also not required if exterior readings approach or exceed the NAC and thus abatement measures are already under consideration. The procedures to follow when collecting interior noise measurements are contained in the FHWA's*, Measurement of Highway Related Noise (May 1996)*.

Table 2: Building Noise Reduction Factors

Building Type	Window Condition *	Noise Reduction Due to Exterior of the Structure
All	Open	10 dB
Light Frame	Ordinary Sash (closed)	20 dB
	Storm Windows	25 dB
Masonry	Single Glazed	25 dB
	Double Glazed	35 dB

Source: *Highway Traffic Noise: Analysis and Abatement Guidance,* Revised January 2011

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

Activity Category E: Includes exterior areas of developed lands that are less sensitive to highway noise. These land uses include motels, hotels, offices and other developed lands not included in Activity Categories A-D or F. In the case of motels and hotels, outdoor pool areas or courtyards are considered shared exterior areas of frequent human use. The number of equivalent residences for Activity Category E land uses should be determined in a similar manner as that used for multi-family buildings. For example, balconies, outdoor pools or other areas of exterior frequent human use of motels and hotels should be identified, and usage factors or capacity limits for each activity should be calculated to estimate equivalent residential units. The methodology used to estimate equivalent residences is described in Section 5.2.

Activity Category F: Includes a number of land uses that are not sensitive to noise. No noise analysis is required for these locations.

Activity Category G: Includes undeveloped lands. Although consideration of mitigation is not required under 23 CFR 772, noise levels under the future build condition must be determined and documented. Furthermore, noise levels on undeveloped lands are to be made available to potential future land developers and local officials. Depending on the size of the undeveloped land, and if the vacant property has been issued permits, the minimum information to be provided under future build conditions consists of either the distance to the impact threshold of each land use category or noise level estimates at discrete receptor points on the vacant parcels.

For undeveloped lands without a permit, the FHWA TNM2.5® modeling should be completed for vacant parcels at 50 feet from the edge of pavement or the right-of-way line at 100 feet and at every additional 100 feet (not to exceed 800 feet) until an impact zone is established that would identify potential impact for all potential future development. If non-permitted vacant land is not permitted by the date of public knowledge, the noise level information will be provided to the appropriate local government office for planning purposes in accordance with 23 CFR 772.17(a).

For undeveloped lands with a permit the area should be analyzed for traffic noise impacts by collecting sound measurements and conducting modeling, as described in the previous section, using the activity category that best describes the future intended land use. Noise impacts and abatement consideration should be completed consistent with the permitted future intended land use for that particular activity category. In cases where the land is not permitted prior to the date of public knowledge, noise abatement is not required nor is abatement eligible for federal aid at a future date. The date of public knowledge is the date the NEPA document is approved.

5.2 ESTABLISHING EXTERIOR AREAS OF FREQUENT HUMAN USE AND DETERMINATION OF EQUIVALENT RECEPTORS

A noise receiver location is an area where noise is measured and/or determined. The receiver locations are normally restricted to "exterior areas of frequent human use." Exterior receivers are typically:

- at or near the highway right-of-way line,
- at or near a building in residential or commercial areas,
- at an area between the right-of-way line and a building where ground level frequent human activity occurs, such as a patio, pool or play area in the yard of a single family home,
- at public community facilities such as playgrounds, pools, parks, campgrounds, trails, picnic areas, active recreation areas such as basketball courts, baseball, and football fields,
- at multi-story multi-family apartment or condominium building's exterior balconies or decks, which are considered suitable elevated receiver locations of frequent human use. In addition ground floor exterior areas shared by residents of a multi-family building are also suitable modeling receiver locations, and
- at schools, day-care facilities, retirement homes, churches, cemeteries, hospitals and other types of medical facilities.

For areas other than single-family residences, an equivalent number of receptors is calculated based on the use of the area in question. The KYTC has developed a set of guidelines and procedures for determining the number of equivalent residences for various land uses. Determining the equivalent number of residences is necessary in establishing the feasibility and reasonableness of proposed noise abatement. The following formula is used in determining the equivalent number of residences:

Equivalent Residences = (# of Persons/2.5 Persons Per Average Household) x (Usage Factor)

Where:

Usage Factor = (Average Daily Hours of Use/24 hours per Day)

Or

Usage Factor = (Average Weekly Hours of Use/168 hours per Week)

"# of Persons" are those people who use the facility within 500 feet of the proposed edge of pavement. The numbers of persons is established through consultation with the school, church, daycare, etc. and based upon the greater of either the number enrolled or capacity of the facility. Where use involves a park, trail, or other exterior activity, the facility official is consulted to determine the use that occurs within 500 feet of the proposed edge of pavement for the Build Alternatives, and the extent of that use.

"Average Daily Hours of Use" or **"Average Weekly Hours of Use"** is the average number of hours during which the "# Persons" use the facility located within 500 feet of the proposed Build Alternative. The average should account for time that the facility is not in use such as nights and weekends.

6. TRAFFIC NOISE MODEL

Traffic conditions were obtained from the forecasted 2050 Concept I-W Build Condition volumes provided with the *Brent Spence Bridge Project Draft Traffic Operations Report* dated June 2022. According to the KYTC Noise Policy, analysis of Level of Service C (LOS C) conditions are required because increased congestion results in lower speeds,

and lower speeds result in a quieter condition. Therefore, LOS C conditions represent the highest amount and loudest traffic that is closest to free-flow speeds.

The forecast volumes were given in 15-minute intervals which were used to calculate hourly volumes. Density for each 15-minute interval was provided. LOS is based on density for freeways, so it was used to find the noisiest hour for the combination of northbound and southbound traffic. Mainline I-75 was used to determine the noisiest conditions since it carries the most significant amount of traffic. The average density for the northbound and southbound I-75 segments was calculated, and the 5:45 PM to 6:45 PM hour was selected for the noise analysis. This hour's average density fell the closest to LOS C conditions for all mainline segments in the study limits on the Kentucky portion. Density for LOS C ranges from 19 – 26 pcphpl (Passenger Cars Per Hour Per Lane), and this hour's density was 22.51 pcphpl, which is 0.01 above the midpoint of the LOS C range. It was also selected because it contained no LOS F intervals and only one LOS E interval while staying above the LOS C midrange point.

Existing and Build condition truck percentages and annual average daily traffic (AADTs) were not available. The forecast utilized the most recent KYTC traffic count data. Therefore, the most recent KYTC count data was utilized to determine existing and Build AADTs, design hour volumes (DHVs), and truck percentages. Historic traffic data from the mainline I-75 traffic count stations was used to forecast a linear growth rate of 0.50%, which was used to grow all existing counts to 2022.

6.1 EXISTING NOISE LEVELS

Existing noise levels were monitored at 16 field sites labeled M30-31 and M35-48 between June 23rd and July 12th of 2022. Readings were taken during AM and PM peak traffic periods (Appendix A). Road conditions at the time of the field readings were always clear and dry. The duration of measurements exceeded 15 minutes and were recorded at or near existing areas of human use. Typically, study sites are located in exterior areas of activity on the side of a building that faces the roadway being studied. To provide continuity with the 2011 Brent Spence Bridge Noise report, the naming convention of each receptor was maintained. In addition to the 2011 receptor locations, new receptors were added to provide adequate geographic coverage of the study area. A summary of the measured peak hour noise levels (Leq[1hr])dB(A) is provided in Table 3.

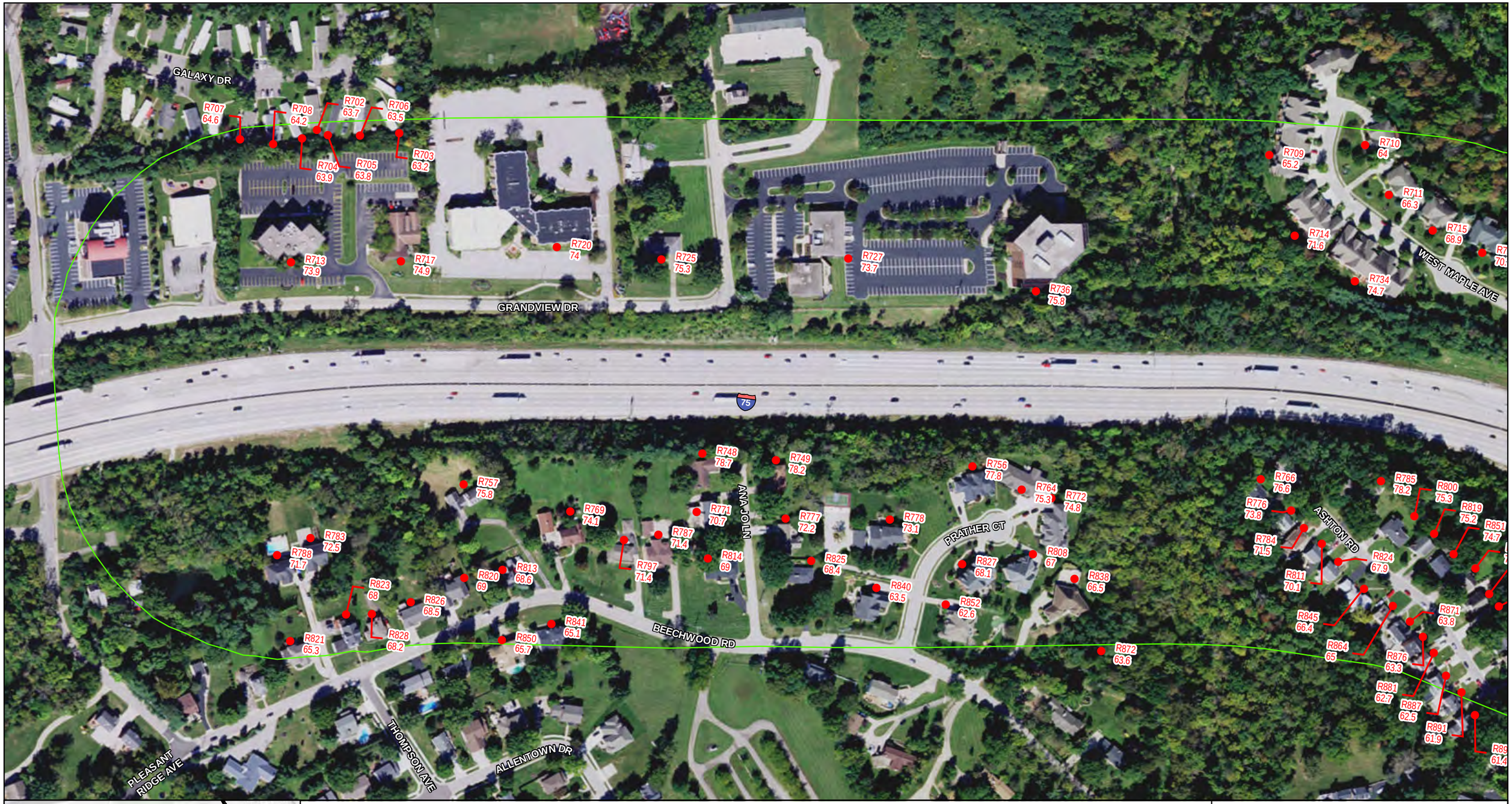
Equipment used for the existing sound level readings included:

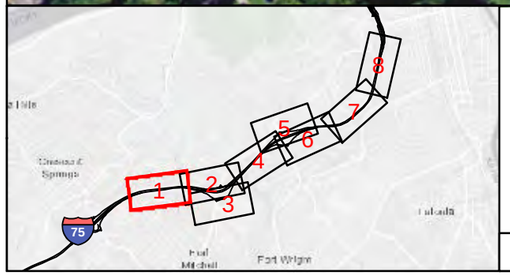
- Larson Davis Model 831 Type 1 Precision Integrating Sound Level Meter S. N. 2413
- Larson Davis Model 377C20 Precision Random High Incidence High Sensitivity Microphone S. N. 123355
- Larson Davis CA250 Precision Acoustic Calibrator S. N. 2742

Certificates of calibration for July 2021 are provided in Appendix B.

Traffic counts were conducted and existing sound level measurements collected foruse in the TNM2.5®to validate the model. The model results were considered for three scenarios:

- Validation using field observed traffic (2022)
- Existing conditions using 2022 traffic.
- Build future conditions using 2050 predicted traffic.





Legend

R# = Receptor Number
Current dB Reading

- Noise Prediction Site
- Noise Measurement Site
- 500' Buffer (Southern Study Area)
- 500' Buffer (Northern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Noise Measurement and Prediction Sites
Exhibit 2A

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2018 2 Feet

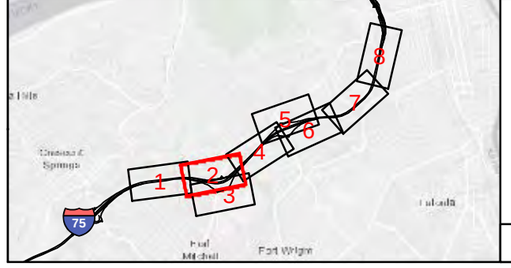
N

0 200 400

Feet

KENTUCKY TRANSPORTATION CABINET

Palmer ENGINEERING



Legend

R# = Receptor Number
Current dB Reading

- Noise Prediction Site
- Noise Measurement Site
- 500' Buffer (Southern Study Area)
- 500' Buffer (Northern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Noise Measurement and Prediction Sites
Exhibit 2B

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2018 2 Feet

N

0 200 400

Feet

Palmer ENGINEERING

R873
73
R879
72.7
R885
72.3
R890
71.9
R894
71.4
R897
70.9
R878
76.3
R888
67.7
R892
65.1
R895
59.2
R889
65.7
R893
65.7
R900
60.1
R898
64.9
R899
64.7
R901
63.8
M-47
62.6
75
25
PAGE RD
ASHTON RD
DIXIE HWY
EAST ORCHARD RD
UNNAMED RD 51
HIGHLAND CEM
BEECHWOOD
TIGERS

Legend

R# = Receptor Number
Current dB Reading

- Noise Prediction Site
- Noise Measurement Site
- 500' Buffer (Southern Study Area)
- 500' Buffer (Northern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Noise Measurement and Prediction Sites
Exhibit 2C

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

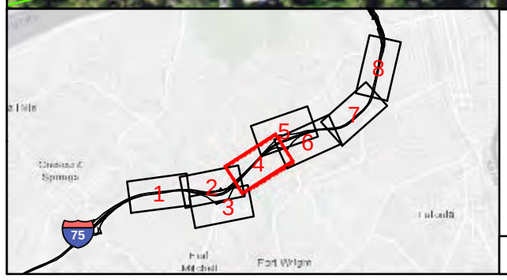
Imagery: KY NAIP 2018 2 Feet

N

0 200 400

Feet

Palmer ENGINEERING



Legend

R# = Receptor Number
Current dB Reading

- Noise Prediction Site
- Noise Measurement Site
- 500' Buffer (Southern Study Area)
- 500' Buffer (Northern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

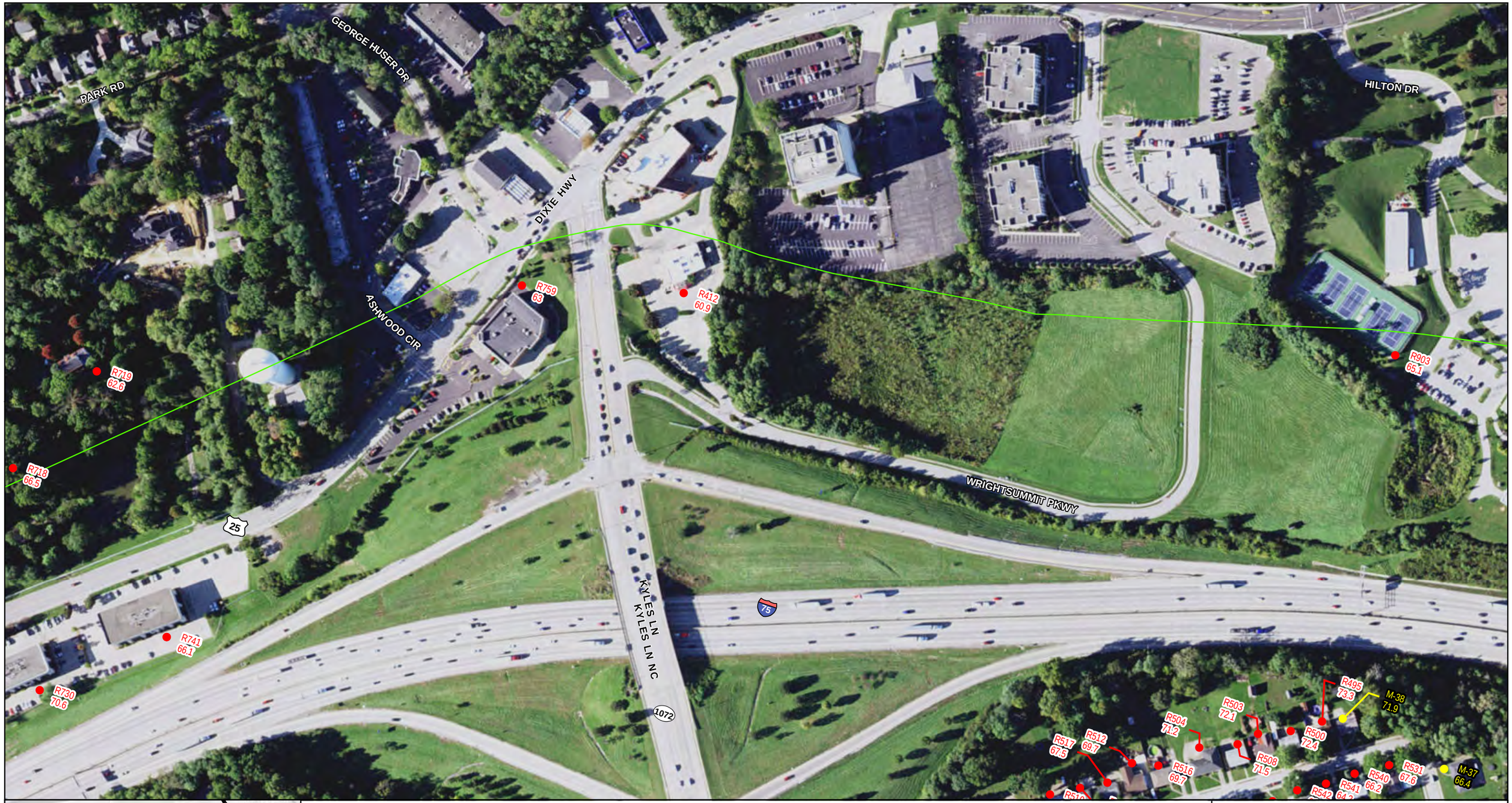
Noise Measurement and Prediction Sites
Exhibit 2D

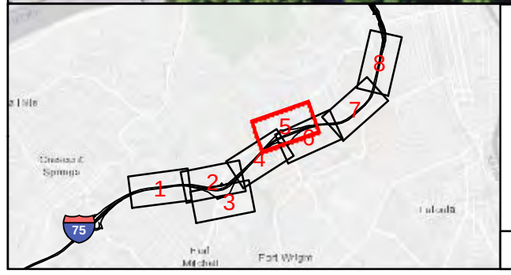
Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2018 2 Feet

0 200 400
Feet

Palmer ENGINEERING





Legend

R# = Receptor Number
Current dB Reading

- Noise Prediction Site
- Noise Measurement Site
- 500' Buffer (Southern Study Area)
- 500' Buffer (Northern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Noise Measurement and Prediction Sites
Exhibit 2E

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

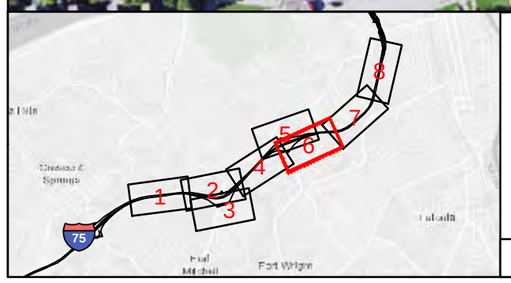
Imagery: KY NAIP 2018 2 Feet

N

0 200 400

Feet

Palmer ENGINEERING



Legend

R# = Receptor Number
Current dB Reading

- Noise Prediction Site
- Noise Measurement Site
- 500' Buffer (Southern Study Area)
- 500' Buffer (Northern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Noise Measurement and Prediction Sites
Exhibit 2F

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

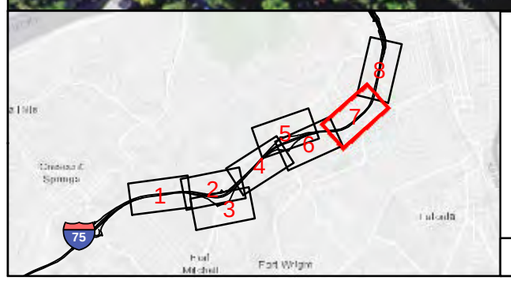
Imagery: KY NAIP 2018 2 Feet

0 200 400
Feet

Palmer ENGINEERING

R904 54.4
R460 47
R468 49.1
R477 49.1
R494 53.5
R493 53.2
R523 59.7
R307 63
R515 65.1
R525 70.3
M-35 70.8
R509 60.4
UNNAMED RD 25
UNNAMED RD 26
ELBERTA CIRLCE
R465 40.5
R476 48.7
R473 48.7
R481 54.4
R487 54.4
UNNAMED RD 23
R492 45.1
R491 34.1
R530 52.9
CEDAR RIDGE LN
R496 47.1
R484 42.6
M-31 70
EMERY PL
UNNAMED RD 28
EMERY DR
UNNAMED RD 24
RAY LN
HIGHLAND AVE

"See Brent Spence Bridge Corridor Project Noise Study: Kentucky - Northern Section
for Assessment South of the 12th Street Interchange to Ohio River



Legend

R# = Receptor Number
Current dB Reading

- Noise Prediction Site
- Noise Measurement Site
- 500' Buffer (Southern Study Area)
- 500' Buffer (Northern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Noise Measurement and Prediction Sites
Exhibit 2G

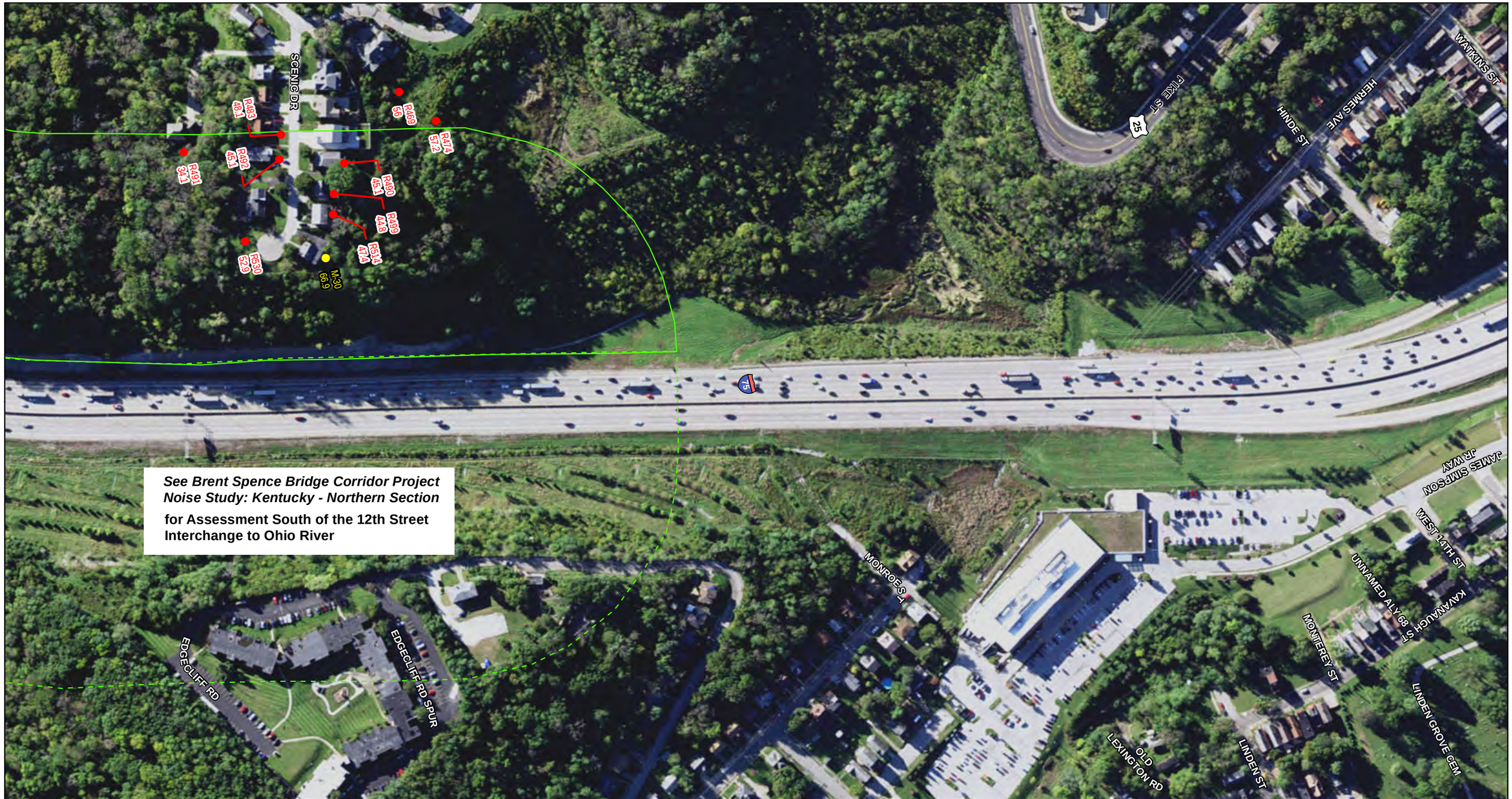
Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

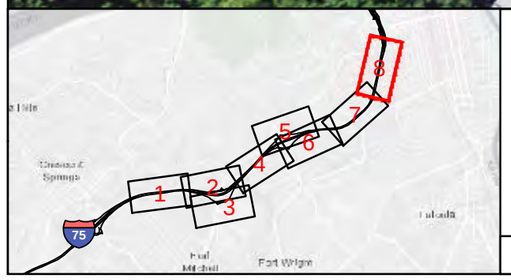
Imagery: KY NAIP 2018 2 Feet

0 200 400
Feet

KENTUCKY TRANSPORTATION CABINET

Palmer ENGINEERING





Legend

R# = Receptor Number
Current dB Reading

- Noise Prediction Site
- Noise Measurement Site
- 500' Buffer (Southern Study Area)
- 500' Buffer (Northern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Noise Measurement and Prediction Sites
Exhibit 2H

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2018 2 Feet

0 200 400
Feet

KENTUCKY TRANSPORTATION CABINET

Palmer ENGINEERING

Table 3: Summary of Measured Peak Hour Noise Levels (Leq[1hr])dB(A)

Site Number	Address of Measurement Site	Land Use	NAC Category	AM	PM
				Leq (1hr) dB(A)	Leq (1hr) dB(A)
M-30	506 Scenic Drive, Park Hills	Residential	Category B	62.8	59.4
M-31	1132 Cedar Ridge Lane, Park Hills	Residential	Category B	59.6	59.1
M-35	502 St Joseph Lane, Park Hills	Residential	Category B	63.2	61.7
M-36	Notre Dame Academy, 1699 Hilton Drive, Park Hills	School	Category D	69.7	59.4
M-37	1565 Saint Anthony Street, Fort Wright	Residential	Category B	65.8	62.9
M-38	1586 Marcella Drive, Fort Wright	Residential	Category B	72	73.6
M-39	101 Kyles Lane, Fort Wright	Residential	Category B	66.8	67.2
M-40	1 Lake Street, Fort Wright	Residential	Category B	58.4	59
M-41	15 Highview Drive, Fort Wright	Residential	Category B	69.4	68.7
M-42	1 Highview Drive, Fort Wright	Residential	Category B	70.9	71.1
M-43	Infiniti Dealership, 1945 Dixie Highway, Fort Wright	Commercial	Category E	67.7	68.6
M-44	1971 Pieck Drive, Fort Mitchell	Residential	Category B	68.2	66.7
M-45	Central Church of Nazarene, 2006 Pieck Drive, Fort Wright	Church	Category D	67.2	70.4
M-46	15 Leslie Avenue, Fort Mitchell	Residential	Category B	64.8	63.2
M-47	Beechwood Elementary and High schools, 54 Beechwood Road, Fort Mitchell	School	Category C	65.7	57.4
M-48	102 West Maple Avenue, Fort Mitchell	Residential	Category B	65.1	65.7

6.2 TNM2.5® MODEL VALIDATION

Field-measured Leq values were compared to model-generated Leq noise values to validate the model. For validation, the difference between measured noise levels and the modeled levels is within ±3 dB(A) Leq. The measured noise levels and the model-predicted noise levels are shown in Table 4. The modeled levels were within ±3 dB(A) Leq of the measured AM and PM levels at all three validation sites, therefore, validating the model.

Table 4: TNM Validation: Summary of Ambient Noise Measurements and TNM Predicted Existing Noise Levels

Site Number	Address of Measurement Site	Land Use	NAC Category	Date of Noise Reading	Noise Measurement Leq (1-hr) dB(A)	TNM Model Leq (1-hr) dB(A)	Delta Leq (1-hr) dB(A)
M-38	1586 Marcella Drive, Fort Wright	Residential	Category B	7/5/2022 AM	72	71.5	0.5
				7/7/2022 PM	73.6	72.3	1.3
M-40	1 Lake Street, Fort Wright	Residential	Category B	7/8/2022 AM	58.4	61.1	-2.7
				7/11/2022 PM	59	61.9	-2.9
M-45	Central Church of Nazarene, 2006 Pieck Drive, Fort Wright	Church	Category D	7/6/2022 AM	67.2	69.6	-2.4
				7/7/2022 PM	70.4	70	0.4

6.3 ANTICIPATED NOISE LEVELS FOR THE DESIGN YEAR (2050)

Noise levels were determined at 325 locations (Exhibits 2A through 2H). Table 5 presents Concept I-W predicted noise levels for each receiver. Table 6 presents a summary of Concept I-W impacts by activity category. TNM2.5® files are provided in Appendix C.

Under Concept I-W, the number of impacted receptors in the 2050 PM peak hour increase by approximately 25 percent (136 versus 109 impacts) when compared to the existing (2022) noise levels. When considering equivalent residential unit impacts, there is a 25 percent increase (294 versus 248) compared to the existing (2022) conditions. The largest number of impacts by activity category is for Activity Category B (residential), where 119 receivers representing 175 equivalent residential units exceed impact thresholds during the PM peak period. The 175 equivalent receptor impacts represent a 22 percent increase over comparable existing (2022) conditions (144 equivalent residences). In addition, a fairly large number of Category D noise impacts were identified within the project corridor due to the presence of schools within the project study area, which generally equate to a significant number of equivalent receptors.

Table 5: Concept I-W Noise Levels

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
M-30	Single-Family	66.9	67.6	0.7	**Yes**	**Yes**	B
M-31	Multi-Family	70	68.7	-1.3	**Yes**	**Yes**	B
M-35	Multi-Family	70.8	70.6	-0.2	**Yes**	**Yes**	B
M-36	School	70.8	74.7	3.9	**Yes**	**Yes**	D
M-37	Single-Family	66.4	69.1	2.7	**Yes**	**Yes**	B
M-38	Single-Family	71.9	74	2.1	**Yes**	**Yes**	B

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
M-39	Multi-Family	71.2	68.9	-2.3	**Yes**	**Yes**	B
M-40	Single-Family	61.9	62.7	0.8	No	No	B
M-41	Single-Family	69.9	75.2	5.3	**Yes**	**Yes**	B
M-42	Single-Family	63.9	68.9	5	No	**Yes**	B
M-43	Car Dealership	75.7	78.6	2.9	**Yes**	**Yes**	E
M-44	Multi-Family	70.7	73	2.3	**Yes**	**Yes**	B
M-44a	Multi-Family	72.5	73.5	1	**Yes**	**Yes**	B
M-45	Church	72.3	75.4	3.1	**Yes**	**Yes**	D
M-46	Single-Family	65	67	2	No	**Yes**	B
M-47	School	60	62.6	2.6	No	No	C
M-48	Single-Family	60.9	62.9	2	No	No	B
R412	Restaurant/Bar	60.9	61.4	0.5	No	No	E
R460	Single-Family	47	48.4	1.4	No	No	B
R465	Multi-Family	40.5	41.7	1.2	No	No	B
R468	Multi-Family	49.1	49.6	0.5	No	No	B
R469	Vacant	56	58.2	2.2	No	No	B
R473	Multi-Family	48.7	47.2	-1.5	No	No	B
R474	Vacant	57.2	59.5	2.3	No	No	B
R476	Multi-Family	48.7	49.9	1.2	No	No	B
R477	Multi-Family	49.1	49.8	0.7	No	No	B
R479	Office	67.7	65.7	-2	No	No	E
R481	Multi-Family	54.4	54.3	-0.1	No	No	B
R483	Single-Family	48.1	50.6	2.5	No	No	B
R484	Office	42.6	43.1	0.5	No	No	C
R486	Multi-Family	47.7	48.3	0.6	No	No	B
R487	Multi-Family	54.4	52.1	-2.3	No	No	B
R490	Single-Family	45.1	46.8	1.7	No	No	B
R491	Single-Family	34.1	37.2	3.1	No	No	B
R492	Single-Family	45.1	46	0.9	No	No	B
R493	Multi-Family	53.2	52.9	-0.3	No	No	B
R494	Multi-Family	53.5	53.5	0	No	No	B
R495	Single-Family	73.3	75.6	2.3	**Yes**	**Yes**	B
R496	Single-Family	62.4	65.4	3	No	No	B
R499	Single-Family	44.8	45.7	0.9	No	No	B
R500	Single-Family	72.4	75.1	2.7	**Yes**	**Yes**	B
R501	Single-Family	64.7	68.4	3.7	No	**Yes**	B
R502	Single-Family	64	67.9	3.9	No	**Yes**	B
R503	Single-Family	72.1	75	2.9	**Yes**	**Yes**	B
R504	Single-Family	71.2	74.1	2.9	**Yes**	**Yes**	B

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
R505	Single-Family	66.1	70	3.9	**Yes**	**Yes**	B
R507	Multi-Family	63	61.7	-1.3	No	No	B
R508	Single-Family	71.5	74.4	2.9	**Yes**	**Yes**	B
R509	School	69.4	70.4	1	**Yes**	**Yes**	C
R510	Multi-Family	67.2	71.1	3.9	**Yes**	**Yes**	B
R512	Single-Family	69.7	73.2	3.5	**Yes**	**Yes**	B
R514	Single-Family	47.4	48	0.6	No	No	B
R515	Multi-Family	65.1	63.8	-1.3	No	No	B
R516	Single-Family	69.7	73	3.3	**Yes**	**Yes**	B
R517	Single-Family	67.5	71.2	3.7	**Yes**	**Yes**	B
R518	Single-Family	67.6	71.4	3.8	**Yes**	**Yes**	B
R519	Multi-Family	58.9	58.8	-0.1	No	No	B
R520	Multi-Family	61.9	60.9	-1	No	No	B
R523	Multi-Family	59.7	58.8	-0.9	No	No	B
R525	Multi-Family	70.3	69.6	-0.7	**Yes**	**Yes**	B
R526	Multi-Family	56.7	57.9	1.2	No	No	B
R527	Multi-Family	57.5	58.3	0.8	No	No	B
R530	Single-Family	52.9	53.7	0.8	No	No	B
R531	Single-Family	67.6	70.5	2.9	**Yes**	**Yes**	B
R532	Multi-Family	56.2	57.7	1.5	No	No	B
R533	Multi-Family	56.8	58.8	2	No	No	B
R535	Multi-Family	56.5	59.7	3.2	No	No	B
R536	Multi-Family	64.1	62.9	-1.2	No	No	B
R537	Single-Family	66.3	67.6	1.3	**Yes**	**Yes**	B
R538	Single-Family	69.4	70.2	0.8	**Yes**	**Yes**	B
R539	Single-Family	63.8	65.2	1.4	No	No	B
R540	Single-Family	66.2	69	2.8	**Yes**	**Yes**	B
R541	Single-Family	64.2	67.2	3	No	**Yes**	B
R542	Single-Family	62.1	65.3	3.2	No	No	B
R545	Single-Family	72.1	73.1	1	**Yes**	**Yes**	B
R546	Single-Family	61.1	63.5	2.4	No	No	B
R547	Single-Family	60.7	64.1	3.4	No	No	B
R548	Multi-Family	57.1	60.5	3.4	No	No	B
R550	Multi-Family	58.4	61.8	3.4	No	No	B
R551	Single-Family	56	56	0	No	No	B
R552	Single-Family	58.4	58.1	-0.3	No	No	B
R553	Single Family	61.2	60.6	-0.6	No	No	B
R554	Single-Family	59	62.3	3.3	No	No	B
R555	Single Family	58.8	62	3.2	No	No	B

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
R556	Single-Family	54.3	54.9	0.6	No	No	B
R557	Single Family	69.4	69	-0.4	**Yes**	**Yes**	B
R558	Single-Family	58.5	61.6	3.1	No	No	B
R559	Single-Family	59.6	63.2	3.6	No	No	B
R560	Single-Family	59.2	62.8	3.6	No	No	B
R561	Single-Family	59.4	62.8	3.4	No	No	B
R562	Single-Family	52.2	53.7	1.5	No	No	B
R563	Single-Family	53	54.6	1.6	No	No	B
R565	Single-Family	52.4	53.5	1.1	No	No	B
R566	Single-Family	64.7	61.2	-3.5	No	No	B
R569	Single-Family	52.7	53.9	1.2	No	No	B
R570	Multi-Family	60	59.3	-0.7	No	No	B
R572	Single-Family	55.5	58.9	3.4	No	No	B
R573	Single-Family	68	69.2	1.2	**Yes**	**Yes**	B
R577	Single-Family	65.5	67	1.5	No	**Yes**	B
R578	Single-Family	58.4	61.1	2.7	No	No	B
R579	Single-Family	53.3	55.1	1.8	No	No	B
R580	Multi-Family	55.1	55.6	0.5	No	No	B
R581	Single-Family	53.1	55.4	2.3	No	No	B
R583	Single-Family	63.3	65	1.7	No	No	B
R584	Single-Family	56.4	58.9	2.5	No	No	B
R585	Single-Family	53.6	56.2	2.6	No	No	B
R586	Multi-Family	53.1	53.8	0.7	No	No	B
R587	Single-Family	54.2	57.4	3.2	No	No	B
R589	Single-Family	61.9	63.6	1.7	No	No	B
R590	Single-Family	56.3	59.5	3.2	No	No	B
R591	Single-Family	55.9	59.2	3.3	No	No	B
R592	Single-Family	56.1	59.2	3.1	No	No	B
R593	Single-Family	55.4	58.8	3.4	No	No	B
R594	Single-Family	54.2	57.4	3.2	No	No	B
R597	Single-Family	61.4	63.3	1.9	No	No	B
R598	Single-Family	54.4	57.8	3.4	No	No	B
R599	Multi-Family	53.3	54.4	1.1	No	No	B
R600	Multi-Family	53.3	54.4	1.1	No	No	B
R604	Single-Family	61.6	63.6	2	No	No	B
R605	Multi-Family	53.5	54.5	1	No	No	B
R607	Multi-Family	53.5	54.4	0.9	No	No	B
R612	Single-Family	54.1	55	0.9	No	No	B
R637	Single-Family	67	67.6	0.6	**Yes**	**Yes**	B

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
R702	Single-Family	62	63.7	1.7	No	No	B
R703	Single-Family	61.4	63.2	1.8	No	No	B
R704	Single-Family	62.3	63.9	1.6	No	No	B
R705	Single-Family	62.2	63.8	1.6	No	No	B
R706	Single-Family	61.8	63.5	1.7	No	No	B
R707	Single-Family	62.7	64.6	1.9	No	No	B
R708	Single-Family	62.6	64.2	1.6	No	No	B
R709	Multi-Family	63.5	65.2	1.7	No	No	B
R710	Single-Family	61.7	64	2.3	No	No	B
R711	Single-Family	63.9	66.3	2.4	No	**Yes**	B
R712	Single-Family	65.7	68.4	2.7	No	**Yes**	B
R713	Office	71.8	73.9	2.1	**Yes**	**Yes**	E
R714	Multi-Family	68.9	71.6	2.7	**Yes**	**Yes**	B
R715	Single Family	65.8	68.9	3.1	No	**Yes**	B
R716	Single-Family	65.6	68.4	2.8	No	**Yes**	B
R717	Office	72.9	74.9	2	**Yes**	**Yes**	E
R718	Single-Family	64.1	66.5	2.4	No	**Yes**	B
R719	Single-Family	60.9	62.6	1.7	No	No	B
R720	Office	72.2	74	1.8	**Yes**	**Yes**	E
R721	Retail	58.6	61.7	3.1	No	No	E
R722	Office	58.3	60.8	2.5	No	No	E
R723	Medical Facility	58.4	60.8	2.4	No	No	C
R724	Single-Family	53.9	56	2.1	No	No	B
R725	Vacant	73.6	75.3	1.7	**Yes**	**Yes**	B
R726	Single-Family	67.6	70.7	3.1	**Yes**	**Yes**	B
R727	Office	71.9	73.7	1.8	**Yes**	**Yes**	E
R728	Single-Family	58.2	60.2	2	No	No	B
R729	Single-Family	58.1	60.4	2.3	No	No	B
R730	Office	69.8	70.6	0.8	No	No	E
R731	Single-Family	58.2	60.8	2.6	No	No	B
R732	Single-Family	58.9	61.1	2.2	No	No	B
R733	Hotel	71.1	75.1	4	**Yes**	**Yes**	E
R734	Multi-Family	72	74.7	2.7	**Yes**	**Yes**	B
R735	Hotel	65.9	70.2	4.3	No	No	E
R736	Office	75.2	75.8	0.6	**Yes**	**Yes**	E
R737	Office	73.5	77.1	3.6	**Yes**	**Yes**	E
R738	Single-Family	60.6	62.8	2.2	No	No	B
R739	Single-Family	58.7	60.7	2	No	No	B
R740	Single-Family	60.6	62.6	2	No	No	B

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
R741	Office	67.8	66.1	-1.7	No	No	E
R742	Office	58.7	61	2.3	No	No	E
R743	Single-Family	55.9	58	2.1	No	No	B
R744	Single-Family	70	72.9	2.9	**Yes**	**Yes**	B
R745	Single-Family	55.2	58	2.8	No	No	B
R746	Single-Family	63.1	65	1.9	No	No	B
R747	Single-Family	53.9	56.9	3	No	No	B
R748	Single-Family	78	78.7	0.7	**Yes**	**Yes**	B
R749	Single-Family	77.4	78.2	0.8	**Yes**	**Yes**	B
R750	Single-Family	60	61.8	1.8	No	No	B
R751	Single-Family	61.4	63.1	1.7	No	No	B
R752	Single-Family	60.6	62	1.4	No	No	B
R753	Restaurant/Bar	62.7	64.7	2	No	No	E
R754	Single-Family	56.2	58.9	2.7	No	No	B
R755	Single-Family	69.6	72.5	2.9	**Yes**	**Yes**	B
R756	Single-Family	77.1	77.8	0.7	**Yes**	**Yes**	B
R757	Single-Family	74.7	75.8	1.1	**Yes**	**Yes**	B
R758	Single-Family	61.7	64.4	2.7	No	No	B
R759	Commercial	63.1	63	-0.1	No	No	E
R760	Single-Family	61.7	62.9	1.2	No	No	B
R761	Single-Family	57.3	59.7	2.4	No	No	B
R762	Single-Family	63.2	64	0.8	No	No	B
R763	Single-Family	58.6	61	2.4	No	No	B
R764	Single-Family	74.5	75.3	0.8	**Yes**	**Yes**	B
R765	Single-Family	63.2	64.6	1.4	No	No	B
R766	Single-Family	75.2	76.6	1.4	**Yes**	**Yes**	B
R767	Single-Family	54.6	58	3.4	No	No	B
R768	Single-Family	61.5	63.2	1.7	No	No	B
R769	Single-Family	72.8	74.1	1.3	**Yes**	**Yes**	B
R770	Single-Family	59.9	61.8	1.9	No	No	B
R771	Single-Family	69.6	70.7	1.1	**Yes**	**Yes**	B
R772	Single-Family	73.5	74.8	1.3	**Yes**	**Yes**	B
R773	Vacant	62.7	64.7	2	No	No	B
R774	Single-Family	70.7	72	1.3	**Yes**	**Yes**	B
R775	Single-Family	55.7	59.1	3.4	No	No	B
R776	Single-Family	72	73.8	1.8	**Yes**	**Yes**	B
R777	Single-Family	71	72.2	1.2	**Yes**	**Yes**	B
R778	Single-Family	71.9	73.1	1.2	**Yes**	**Yes**	B
R779	Single-Family	69.2	72.2	3	**Yes**	**Yes**	B

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
R780	Single-Family	71.1	72.5	1.4	**Yes**	**Yes**	B
R781	Single-Family	62.5	64.1	1.6	No	No	B
R782	Single Family	62.6	64.4	1.8	No	No	B
R783	Single-Family	70.8	72.5	1.7	**Yes**	**Yes**	B
R784	Single-Family	69.1	71.5	2.4	**Yes**	**Yes**	B
R785	Single-Family	76.4	78.2	1.8	**Yes**	**Yes**	B
R786	Single Family	59	61.4	2.4	No	No	B
R787	Single-Family	69.7	71.4	1.7	**Yes**	**Yes**	B
R788	Single-Family	70	71.7	1.7	**Yes**	**Yes**	B
R789	Single-Family	63.7	64.2	0.5	No	No	B
R790	Single-Family	70.6	73.7	3.1	**Yes**	**Yes**	B
R791	Single-Family	69.1	71	1.9	**Yes**	**Yes**	B
R792	Single-Family	73.9	76.7	2.8	**Yes**	**Yes**	B
R793	Vacant	62.4	63.7	1.3	No	No	B
R794	Vacant	65.9	70.8	4.9	No	**Yes**	B
R795	Single Family	69	69.6	0.6	**Yes**	**Yes**	B
R796	Single-Family	70.6	74.4	3.8	**Yes**	**Yes**	B
R797	Single-Family	69.8	71.4	1.6	**Yes**	**Yes**	B
R798	Single-Family	61.9	63.1	1.2	No	No	B
R799	Single-Family	67.5	69.6	2.1	**Yes**	**Yes**	B
R800	Single-Family	72.5	75.3	2.8	**Yes**	**Yes**	B
R801	Single-Family	67.1	69.7	2.6	**Yes**	**Yes**	B
R802	Single-Family	68.2	72.7	4.5	**Yes**	**Yes**	B
R803	Single-Family	65.7	66.1	0.4	No	**Yes**	B
R804	Single-Family	63.5	64.8	1.3	No	No	B
R805	Single-Family	69.5	73.3	3.8	**Yes**	**Yes**	B
R806	Single-Family	63.6	63.9	0.3	No	No	B
R807	Single-Family	68.4	72.6	4.2	**Yes**	**Yes**	B
R808	Single-Family	65.4	67	1.6	No	**Yes**	B
R809	Multi-Family	65.9	67.4	1.5	No	**Yes**	B
R810	Single-Family	67.1	65.7	-1.4	**Yes**	No	B
R811	Single-Family	67.4	70.1	2.7	**Yes**	**Yes**	B
R812	Single-Family	63.1	65.8	2.7	No	No	B
R813	Single-Family	67.3	68.6	1.3	**Yes**	**Yes**	B
R814	Single-Family	67.3	69	1.7	**Yes**	**Yes**	B
R815	Multi-Family	64.1	65.5	1.4	No	No	B
R816	Single-Family	61	64.4	3.4	No	No	B
R817	Single-Family	67.3	69.5	2.2	**Yes**	**Yes**	B
R818	Multi-Family	55.4	54.7	-0.7	No	No	B

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
R819	Single-Family	72.5	75.2	2.7	**Yes**	**Yes**	B
R820	Single-Family	67.5	69	1.5	**Yes**	**Yes**	B
R821	Single-Family	63.9	65.3	1.4	No	No	B
R822	Single-Family	65.4	67.5	2.1	No	**Yes**	B
R823	Single-Family	66.2	68	1.8	**Yes**	**Yes**	B
R824	Single-Family	65.1	67.9	2.8	No	**Yes**	B
R825	Single-Family	66.9	68.4	1.5	**Yes**	**Yes**	B
R826	Single-Family	66.8	68.5	1.7	**Yes**	**Yes**	B
R827	Single-Family	66.6	68.1	1.5	**Yes**	**Yes**	B
R828	Single-Family	66.4	68.2	1.8	**Yes**	**Yes**	B
R829	Single-Family	68.3	66.3	-2	**Yes**	**Yes**	B
R830	Multi-Family	65.7	67.7	2	No	**Yes**	B
R831	Single-Family	63.2	63.9	0.7	No	No	B
R832	Single-Family	59.2	61.5	2.3	No	No	B
R833	Single-Family	60.4	63.4	3	No	No	B
R834	Single-Family	65.9	67.9	2	No	**Yes**	B
R835	Single-Family	68.1	70.9	2.8	**Yes**	**Yes**	B
R836	Multi-Family	65.3	67.4	2.1	No	**Yes**	B
R837	Single-Family	55.4	54.9	-0.5	No	No	B
R838	Single-Family	65.2	66.5	1.3	No	**Yes**	B
R839	Single-Family	61.9	63.2	1.3	No	No	B
R840	Single-Family	62.2	63.5	1.3	No	No	B
R841	Single-Family	63.9	65.1	1.2	No	No	B
R842	Day Care	57.3	60.9	3.6	No	No	C
R843	Single-Family	62.8	64.7	1.9	No	No	B
R844	Single-Family	68.2	66.1	-2.1	**Yes**	**Yes**	B
R845	Single-Family	63.7	66.4	2.7	No	**Yes**	B
R846	Single-Family	60.1	62.7	2.6	No	No	B
R847	Single-Family	61.7	64	2.3	No	No	B
R848	Multi-Family	54.8	53.7	-1.1	No	No	B
R849	Single-Family	58.6	61.5	2.9	No	No	B
R850	Single-Family	64.8	65.7	0.9	No	No	B
R851	Single-Family	72	74.7	2.7	**Yes**	**Yes**	B
R852	Single-Family	61.7	62.6	0.9	No	No	B
R853	Car Dealership	60.5	63.1	2.6	No	No	E
R854	Single-Family	62.7	64.7	2	No	No	B
R855	Single-Family	57.7	61.2	3.5	No	No	B
R856	Single-Family	58.2	60.7	2.5	No	No	B
R857	Single-Family	69.6	72.4	2.8	**Yes**	**Yes**	B

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
R858	Single-Family	56.9	59.9	3	No	No	B
R859	Single-Family	56.1	59.2	3.1	No	No	B
R860	Single-Family	71.6	74.3	2.7	**Yes**	**Yes**	B
R861	Single-Family	55.4	58.2	2.8	No	No	B
R862	Single-Family	63.8	65.3	1.5	No	No	B
R863	Single-Family	54.2	53.3	-0.9	No	No	B
R864	Single-Family	62.4	65	2.6	No	No	B
R865	Commercial	68.8	71.3	2.5	No	**Yes**	E
R866	Car Dealership	64.3	67.7	3.4	No	No	E
R867	Single-Family	67	70	3	**Yes**	**Yes**	B
R869	Single Family	61.8	64.8	3	No	No	B
R870	Single-Family	70.6	73.3	2.7	**Yes**	**Yes**	B
R871	Single-Family	61.4	63.8	2.4	No	No	B
R872	Vacant	61.8	63.6	1.8	No	No	B
R873	Single-Family	70.3	73	2.7	**Yes**	**Yes**	B
R874	Single-Family	51.7	54.4	2.7	No	No	B
R875	Single-Family	64.9	68.3	3.4	No	**Yes**	B
R876	Single-Family	61	63.3	2.3	No	No	B
R877	Single-Family	61.5	64.5	3	No	No	B
R878	School	73.9	76.3	2.4	**Yes**	**Yes**	E
R879	Single-Family	69.9	72.7	2.8	**Yes**	**Yes**	B
R880	Single-Family	61.3	64.8	3.5	No	No	B
R881	Single-Family	60.8	62.7	1.9	No	No	B
R882	Single-Family	69.2	71.4	2.2	**Yes**	**Yes**	B
R883	Single-Family	63	66.8	3.8	No	**Yes**	B
R884	Single-Family	65.6	69.4	3.8	No	**Yes**	B
R885	Single-Family	69.8	72.3	2.5	**Yes**	**Yes**	B
R886	Single-Family	61.6	64.9	3.3	No	No	B
R887	Single-Family	60.4	62.5	2.1	No	No	B
R888	Single-Family	63.9	67.7	3.8	No	**Yes**	B
R889	Single-Family	61.9	65.7	3.8	No	No	B
R890	Single-Family	69.2	71.9	2.7	**Yes**	**Yes**	B
R891	Single-Family	59.9	61.9	2	No	No	B
R892	Single-Family	62.1	65.1	3	No	No	B
R893	Single-Family	62.1	65.7	3.6	No	No	B
R894	Single-Family	68.7	71.4	2.7	**Yes**	**Yes**	B
R895	Single-Family	55.8	59.2	3.4	No	No	B
R896	Single-Family	59.6	61.4	1.8	No	No	B
R897	Single-Family	68.2	70.9	2.7	**Yes**	**Yes**	B

Receptor Number	Land Use	PM Peak Hour			2022 Approach/ Exceed NAC (Yes/No)	2050 Approach/ Exceed NAC (Yes/No)	Activity Category
		2022 Existing Leq (1-Hr) dB(A)	2050 Build Leq (1-Hr) dB(A)	Build Minus Existing (dB(A))			
R898	Single-Family	61.2	64.9	3.7	No	No	B
R899	Single-Family	61.2	64.7	3.5	No	No	B
R900	Single-Family	56.9	60.1	3.2	No	No	B
R901	Cemetery	60.8	63.8	3	No	No	C
R902	School Auditorium	74.5	77.1	2.6	**Yes**	**Yes**	D
R903	Tennis Courts	65.1	69.1	4	No	**Yes**	C
R904	Track/Soccer Field	54.4	56.4	2	No	No	C

Table 6: Summary of Impacts by FHWA Activity Category

Alternative	NAC A	NAC B	NAC C	NAC D	NAC E	NAC G	Totals
2022 Existing	0	94 (144)	2 (14)	3 (84)	10 (6)	0	109 (248)
2050 I-W Build	0	119 (175)	2 (14)	3 (84)	12 (21)	0	136 (294)

Numbers not in parentheses represent the total number of receivers with impacts for each FHWA Activity Category evaluated for each scenario.

Numbers shown in parentheses represent the total impacted number of equivalent receptors for each FHWA Activity Category for each scenario evaluated. The last column on the extreme right provides a summary of the total corridor-wide impacts.

7. NOISE ABATEMENT

The Kentucky Transportation Cabinet (KYTC) requires that noise abatement measures be considered where traffic related noise impacts are predicted. Federal funds may be used for noise abatement measures when:

- traffic noise impacts have been identified, and
- abatement measures have been determined to be feasible and reasonable pursuant to Section 772.13(d) and KYTC policy.

In conformance with these requirements, abatement measures were evaluated in terms of their effectiveness to substantially reduce predicted design year noise levels at locations where impacts occur. Potential abatement measures include:

- Traffic management measures.
- Alteration of roadway horizontal or vertical alignments.
- Acquisition of real property or land to serve as a buffer zone to preempt development that would be adversely impacted from traffic noise.

- Noise insulation of Activity Category D land use facilities listed in Table 1.
- Construction of noise barriers, including acquisition of property rights, either within or outside the highway right of way (ROW).

Traffic management measures involve restrictions on the speed and type of vehicles permitted to use a particular roadway. Traffic management measures such as placing restrictions on heavy truck movements and lowering operating speeds are not compatible with the purpose of interstate roadways. Alteration of horizontal and vertical alignments beyond what is presently proposed for Concept I-W is constrained by existing terrain, location of the existing transportation facilities and land uses, underlying geology, and other considerations. Due to the densely developed urban environment of the study area, acquisition of land to serve as a noise buffer zone is not a practical option. The insulation of Category D facilities has been considered in accordance with KYTC's Noise Policy where interior noise impacts are predicted to approach or exceed the NAC. At any such locations, noise barriers are being recommended and further consideration of interior insulation is not required. Therefore, the only remaining potentially effective abatement measure is noise barriers.

7.1 KYTC NOISE BARRIER FEASIBILILTY AND REASONABLENESS FACTORS

Noise barriers reduce noise by blocking the path of sound between the source of the noise and the receiver. To be effective, a noise barrier should be located adjacent to either the source or the receiver. The noise wall must also be long, continuous, and break the line-of-sight from the highway to the receiver. When determining the acoustic feasibility of a proposed abatement measure, the KYTC Noise Policy requires that abatement measures provide a substantial noise reduction (>5 dB(A)) for a reasonable percentage of impacted receptors. Furthermore, the objective of the proposed abatement is to achieve the noise reduction design goal of 7 dB(A) for a minimum of 50 percent of front row benefited receptors. A proposed barrier will not be considered acoustically feasible if it does not provide a minimum 5 dB(A) reduction for three or more impacted receptors.

Engineering or constructability issues may render an abatement measure infeasible. In determining if site characteristics are suitable for noise barrier construction, KYTC considers numerous factors including safety, maintenance, drainage, and access. Engineering judgment may dictate that a barrier is not feasible if the barrier would pose overriding safety (visibility issues) or maintenance (drainage and right of way access) problems as is dictated by the current versions of KYTC's *Highway Design Guidance Manual*, the American Association of State Highway Transportation Officials' (AASHTO) *A Policy on Geometric Design of Highways and Streets* (the Green Book), AASHTO's *Roadside Design Guide* or FHWA's *Manual of Uniform Traffic Control Devices* (MUTCD).

The determination of reasonableness of a proposed abatement measure is based upon three primary factors: cost effectiveness, the noise reduction design goal, and the desires of the benefited receptors. The noise barrier determination of reasonableness is defined as follows:

To be cost effective, the KYTC Noise Policy has established $40,000 as a reasonable maximum threshold for the Cost per Benefited Receptor (CBR). The CBR is defined as follows:

CBR = (Cost of Noise Barrier ($)/Number of Benefited Receptors)

Where:

1. Cost of noise barrier is the total anticipated cost of the noise barrier including design, ROW, utilities, and construction. For this analysis, an average cost of $32 per square foot of barrier wall is assumed.

2. The number of benefited receptors is the total number of receptors receiving a noise reduction of at least 5 dB(A).

Once a proposed noise barrier satisfies the physical feasibility and reasonableness requirements described above, the solicitation of views of the affected property owners (benefited receptors) is the final step in determining if a proposed noise barrier will be constructed. The final decision on the installation of any abatement measure is determined in coordination with residents and owners of the impacted properties during the public involvement process. When the majority of benefited receptors and property owners are opposed to construction of a noise barrier, KYTC will give great deference to these opinions in making a final determination regarding the reasonableness of the measure. Similarly, where the majority of the benefited receptors and property owners are in support of noise barrier construction, and the proposal satisfies all other criteria for consideration outlined in the KYTC Noise Policy, KYTC will incorporate the abatement measures into the project.

7.2 NOISE BARRIER ANALYSIS FINDINGS

A noise barrier analysis was completed utilizing the TNM2.5® for adjacent residential communities and other noise sensitive areas where noise impacts are predicted to occur should Concept I-W be constructed. Seven noise barrier configurations at six locations were identified and evaluated for feasibility and reasonableness. Summaries of those findings are contained in Table 7. Illustrations depicting the location of each proposed noise barrier are shown on Exhibits 3 through 9. The abatement analysis concludes that five of the six noise walls considered satisfy KYTC feasibility and reasonableness requirements for the Build Alternative. Walls in similar locations to the previous 2011 report kept the same naming convention. Barrier B20/NSA D is a variation of an earlier design (B20) that extends the previously analyzed barrier approximately 3,265 feet northward to near the 12th Street interchange. Barrier B23 is an additional location and, therefore, has been named with the next available ascending number.

The recommended noise barriers for the Concept I-W are illustrated on Exhibits 3, 6, 7, 8, and 9 The optimized barrier heights at B16 is 24’; B18, & B19 are consistent throughout at 20’ while B23 has barrier heights that vary from 18’-22’. All recommended noise barriers achieve a 5 dB(A) or greater noise reduction for at least 50 percent of the impacted receptors. In addition, each recommended barrier satisfies the 7 dB(A) minimum noise reduction goal for 50 percent or more of the front row benefited receptors.

B16: As was done with the 2011 Noise Report, this existing 24’ wall was evaluated under future traffic conditions in its current configuration. The CBR of $38,057 is below the allowable maximum of $40,000, so this wall is recommended to be rebuilt in-kind.

B17A&B: This wall was broken down into two design recommendations.

B17A: This design is the same as the previous report’s design, spanning the same distance and being a consistent 20’ in height throughout the span. This design has a CBR of $58,119, well above the limit established by the KYTC Noise Policy.

B17B: This design has been optimized by shortening its length by 300’ on the north end, and varies in height from 18’-22’ throughout. The wall has been shortened to take advantage of an existing berm in the area that will not be impacted by the construction. Shortening the length of the wall to the north, does not change the number of benefited properties and will reduce the CBR from ~$58k to ~$46k. Though the optimized design lowers the CBR, it still exceeds the limit prescribed by the KYTC Noise Policy.

B18: This design has a constant height of 20' spanning 4,487'. Though it is the longest proposed wall and the most costly at over $2.8 million, it has the lowest CBR among those considered ($13,611) due to the high number of benefited receptors.

B20/NSA D The area southeast of the Kyles Lane interchange was previously evaluated as Barrier B20 but was not recommended for inclusion in the project. The barrier was reanalyzed in light of updates to the KYTC Noise Policy and was again found not to meet KYTC's feasibility criteria. However, when extended northward and combined with the proposed barrier west of the 12th Street interchange (see barrier NSA D of the *Traffic Noise Impact Analysis: Kentucky – Northern Section (2023)*), this barrier system meets the feasibility criteria.

The combined barrier system, totaling 5,255 feet in length and ranging in height from 12-24 feet, is predicted to benefit 132 receptors and achieve a 5 dB(A) reduction at three or more impacted receptors, meeting KYTC's feasibility criteria. The cost of the barrier system is estimated to be $3,149,580 resulting in a CBR of $23,860 per benefited receptor. This value is below KYTC's cost–effectiveness criterion of $40,000 per benefited receptor; therefore, the modeled barriers meet KYTC's reasonableness threshold. The barriers would provide 7 dB(A) of attenuation for 31 of the 51 front-row receptors (58.8 percent). This is greater than the 50 percent design goal established in the KYTC Noise Policy; therefore, the barriers would meet this reasonableness criterion.

B23: This design was developed primarily to address the noise levels at the Notre Dame Academy, both for interior levels in its auditorium and classrooms as well as exterior levels at its sports complexes. There are also five full-time residents on-site. The wall was extended eastward to also address several noise impacted apartment buildings at the end of St. Joseph Lane. By extending the wall to shield these properties, the three apartment buildings closest to the interstate become benefited receptors. Even with the extended length of the wall, the CBR is well within the KYTC Noise Policy limit at $14,356.

One thing to note regarding the design of this wall is its location. There are two retaining walls north of the corridor in this area. The proposed barrier was analyzed to be just on the backside (north) of these retaining walls. Additional geotechnical studies or considerations may be appropriate to account for the additional loads of these noise barriers atop or immediately behind the retaining walls. With the relatively low CBR calculated for the barrier, it is not expected that any associated additional costs would affect the conclusions that this barrier meets cost effectiveness criteria.

Total construction cost of all recommended noise barriers for Concept I-W in the project southern section, including barrier B20/NSA D extending into the northern analysis section, is estimated to be $9,955,590 providing abatement to 527 equivalent benefiting receptors.

Table 7: Summary of Noise Abatement Findings

Barrier #	Location	Percentage of Front Row Benefited Receptors which Receive 7 dB(A) or Greater Noise Reduction (%)	Percentage of Impacted Receptors which Receive 5 dB(A) or Greater Noise Reduction (%)	Barrier Description					Number of Benefited Properties	Estimated Cost Per Benefiting Receptor (CBR) ($)	Noise Barrier Effectiveness			KYTC Noise Abatement Criteria Satisfied (Yes/No)
				Length (feet)	Beginning Point and Highway Direction	Ending Point and Highway Direction	Noise Barrier Height (ft)	Estimated Cost ($)			Design Goal Achieved	Acoustic Feasibility Achieved (Yes/No)	Cost Effective Achieved (Yes/No)	
B16	SB between Kyle's Lane and Dixie Highway	55	100	1,041	SB 413+81	SB 403+29	24	$799,187	21	$38,057	Yes	Yes	Yes	Yes
B17A	SB between Dixie Highway and Buttermilk Pike	67	89	1,453	SB 384+82	SB 370+60	20	$929,896	16	$58,119	Yes	Yes	No	No
B17B		67	89	1,153	SB 381+82	SB 370+60	18-22	$736,360	16	$46,023	Yes	Yes	No	No
B18	NB between Buttermilk Pike and Dixie Highway	90	89	4,487	NB 347+62	NB 391+74	20	$2,871,936	211	$13,611	Yes	Yes	Yes	Yes
B19	NB between Dixie Highway and Kyle's Lane	88	97	2,617	NB 405+57	NB 431+88	20	$1,670,599	61	$27,387	Yes	Yes	Yes	Yes
B20/NSA D	NB between Kyle's Lane and 12th St	59	55	5,255	NB 446+15	NB 496+00	12-24	$3,149,580	132	$23,860	Yes	Yes	Yes	Yes
B23	SB between 12th St and Kyle's Lane	76	99	2,350	SB 477+00	SB 453+50	18-22	$1,464,284	102	$14,356	Yes	Yes	Yes	Yes
			Total Cost and Number of Benefited Properties for Recommended Noise					**$9,955,590**	**527**					

DIXIE HWY

25

R724
55.9
(3.3)

R723
59.9
(3.6)

R722
60.2
(2.6)

R721
63
(-0.6)

R732
59.5
(4.3)

R731
58.9
(3.4)

R729
58.9
(3.7)

R728
58.3
(3.8)

R746
63.9
(5.4)

R740
61.1
(5.6)

R742
59.5
(5.2)

R739
59.2
(8.1)

R738
60.7
(6.6)

R753
63.6
(5.3)

R752
59.7
(11.6)

R750
59.1
(11.4)

R758
60.7
(11.7)

R751
60.2
(10.3)

R762
61.6
(12.4)

R765
61.9
(13.5)

R760
61
(10.1)

LESLIE AVE

R768
61.3
(12.1)

BARRIER WALL B16

M-46
62.1
(16.9)

R773
62.5
(13)

R781
61.5
(16.1)

2967

EAST ORCHARD RD

Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Recommended Noise Wall
- 500' Buffer (Southern Study Area)

DEPARTMENT OF TRANSPORTATION · UNITED STATES OF AMERICA

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Concept I-W Barrier B16 (24 feet)

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

KENTUCKY TRANSPORTATION CABINET

0 100 200
Feet

Palmer ENGINEERING

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2020 2 Feet

R709
63.7
(2.2)

R710
60.7
(3.6)

R711
62.6
(4.1)

R715
61.8
(7.6)

R726
62.8
(8.5)

R744
65.6
(7.8)

R755
65.5
(7.4)

R779
65.3
(7.1)

R801
64.7
(5.2)

R822
64.3
(3.2)

M-48
61.5
(1.5)

R714
66.7
(5.8)

R734
66.9
(8.3)

BARRIER WALL B17A

WEST MAPLE AVE

75

Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Recommended Noise Wall
- 500' Buffer (Southern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Concept I-W Barrier B17A (20 feet)

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2020 2 Feet

N

0 100 200

Feet

Palmer ENGINEERING

R709
64
(1.2)

R710
61.2
(2.8)

R711
62.9
(3.4)

R715
62.4
(7)

R726
63.7
(7)

R744
66.1
(7.3)

R755
65.7
(7.2)

R779
65.3
(7.1)

R801
64.9
(5)

R822
65.3
(2.2)

M-48
61.3
(1.6)

R714
67.3
(5.2)

R734
67.5
(7.2)

WEST MAPLE AVE

18 ft

22 ft

20 ft

18 ft

75

ASHTON RD

Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Analyzed Noise Barrier
- 500' Noise Buffer

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Concept I-W Barrier B17B (18 to 22 feet)
Exhibit 5

TEAM KENTUCKY TRANSPORTATION CABINET

N

0 125 250

Feet

Palmer ENGINEERING

Credit: KYFromAbove Partners; Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

GRANDVIEW DR

75

BARRIER WALL B18

R748
76.6
(2.4)

R757
64.1
(11.7)

R769
62.9
(11.2)

R771
61.9
(8.8)

R787
61.4
(10.2)

R797
60.9
(10.7)

R814
61.2
(8.3)

ANA JO LN

R783
64.8
(7.7)

R788
65.3
(6.5)

R813
60
(8.6)

R820
61.5
(7.7)

R826
61.5
(7.3)

R841
57.6
(7.4)

R823
62.5
(5.8)

R828
62.4
(6.1)

R850
58.2
(7.6)

R821
62.5
(2.9)

ROYAL DR

BEECHWOOD RD

THOMPSON AVE

Legend

- Receptor #
  Predicted Abated Noise Level
  (Noise Reduction)
- Noise Measurement Site
- Recommended Noise Wall
- 500' Buffer (Southern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Concept I-W Barrier B18 (20 feet)

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2020 2 Feet

N

0 100 200

Feet

Palmer ENGINEERING

BARRIER WALL B18

R749 74.8 (3.5)
R756 75.9 (2.1)
R764 69.6 (6.3)
R772 66.3 (8.9)
R766 68.8 (8.1)
R776 68.2 (5.9)
R784 64.7 (7.1)
R785 72.2 (6.1)
R800 66.5 (8.6)
R819 66.5 (8.5)
R851 66.3 (8.3)
R860 65.2 (9)
R811 63 (7.3)
R824 61.4 (6.9)
R778 70.1 (3.5)
R777 68.8 (3.9)
R808 60.8 (7.4)
R827 62.7 (6.6)
R838 58.7 (8.4)
R845 60.8 (5.9)
R864 59.6 (5.6)
R871 57.5 (6.6)
R825 64.7 (5)
R840 57.9 (6.4)
R852 57.3 (6)
R876 57.2 (6.1)
R881 56.7 (6.1)
R887 56.6 (5.8)
R891 55.8 (6)
R872 55.5 (8.1)

PRATHER CT
ASHTON RD
ANAJO LN
BEECHWOOD RD

Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Recommended Noise Wall
- 500' Buffer (Southern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Concept I-W Barrier B18 (20 feet)

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2020 2 Feet

N

0 100 200

Feet

Palmer ENGINEERING

BARRIER WALL B18

R851
66.3
(8.3)

R860
65.2
(9)

R870
63.3
(9.9)

R873
62.4
(10.4)

R878
69.3
(7.1)

R879
63.5
(9)

R885
63.7
(8.5)

R881
56.7
(6.1)

R890
62.8
(9)

R894
62.1
(9.2)

R887
56.6
(5.8)

R897
61.5
(9.3)

R891
55.8
(6)

R896
55.4
(5.9)

M-47
57.5
(5.1)

ASHTON RD

PAGE RD

DIXIE HWY

BEECHWOOD

75

25

Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Recommended Noise Wall
- 500' Buffer (Southern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Concept I-W Barrier B18 (20 feet)

N

0 100 200

Feet

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2020 2 Feet

Palmer ENGINEERING

Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Recommended Noise Wall
- 500' Buffer (Southern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

Concept I-W Barrier B19 (20 feet)

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2020 2 Feet

0 100 200
Feet

Palmer ENGINEERING

Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Recommended Noise Wall
- 500' Buffer (Southern Study Area)

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17

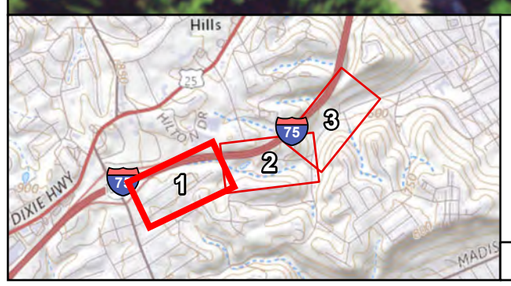
Concept I-W Barrier B19 (20 feet)

0 100 200
Feet

Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

Imagery: KY NAIP 2020 2 Feet

Palmer ENGINEERING



Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Analyzed Noise Barrier
- 500' Noise Buffer

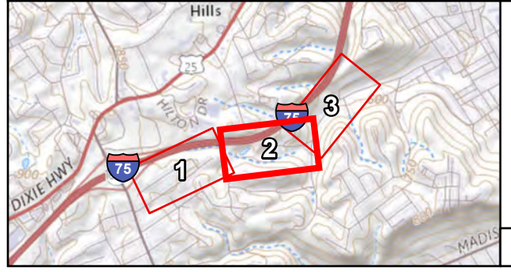
Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17
Page 1 of 3
Concept I-W Barrier B20 / NSA D (12 to 24 feet)
Exhibit 8A

Credit: KYFromAbove Partners; Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

0 125 250
Feet

TEAM KENTUCKY TRANSPORTATION CABINET

Palmer ENGINEERING



Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Analyzed Noise Barrier
- 500' Noise Buffer

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17
Page 2 of 3
Concept I-W Barrier B20 / NSA D (12 to 24 feet)
Exhibit 8B

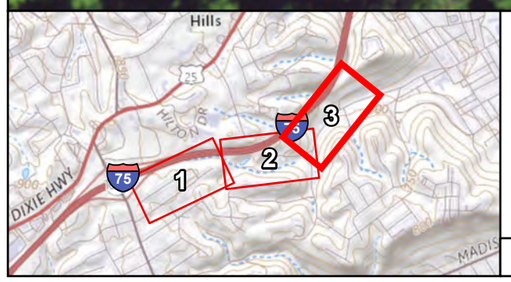
N

0 125 250

Feet

Credit: KYFromAbove Partners; Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

20 ft
16 ft
12 ft
75
UNNAMED RD 28
HIGHLAND AVE
EMERY DR
RAYS LN
UNNAMED RD 24
62.2 (9.4)
55.6 (5.7)
55.2 (5.7)
55.6 (5.7)
55.5 (5.6)
54.1 (6.3)
53.5 (6.3)
53.8 (6.2)
52.3 (6.9)
52.4 (7)
52.7 (7.3)
52.2 (6.9)
52.7 (7.3)
52.9 (7.8)
53.1 (7.9)
53.3 (7.8)
53.5 (7.7)
53.5 (7.7)
53.6 (7.6)
53.7 (7.6)
53.7 (7.5)
53.6 (7.6)
53.8 (7.3)
54.5 (6.4)
54.1 (6)
54.2 (3.9)
53.9 (3.9)
55.9 (3)
53.5 (3.8)
53.2 (3.7)
52.9 (3.7)
52.4 (3.6)
52.5 (3.6)
52 (3.6)
52.1 (3.6)
50.4 (3.7)
52.6 (6)
52.6 (7.1)
54.5 (6.3)
54.2 (6.6)
54.3 (7)
54.6 (7)
53.7 (5.5)
53.6 (5.1)
53.9 (5.6)
53.5 (5.1)
54 (5.7)
54.1 (5.8)
53.4 (5)



Legend

- Receptor # Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Analyzed Noise Barrier
- 500' Noise Buffer

DEPARTMENT OF TRANSPORTATION UNITED STATES OF AMERICA

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17
Page 3 of 3
Concept I-W Barrier B20 / NSA D (12 to 24 feet)
Exhibit 8C

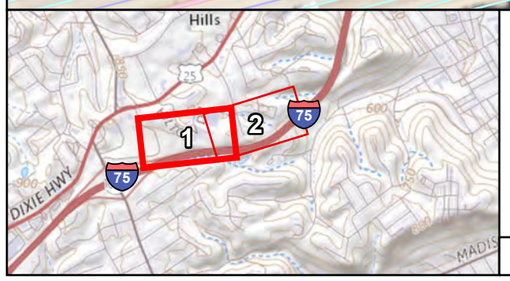
STATE OF OHIO DEPARTMENT OF TRANSPORTATION

TEAM KENTUCKY TRANSPORTATION CABINET

0 125 250
Feet

Palmer ENGINEERING

Credit: KYFromAbove Partners; Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet



Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Analyzed Noise Barrier
- 500' Noise Buffer

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17
Page 1 of 2
Concept I-W Barrier B23 (18 to 22 feet)
Exhibit 9A

Credit: KYFromAbove Partners; Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

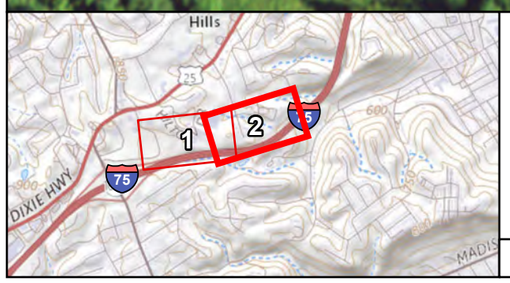
N

0 125 250

Feet

TEAM KENTUCKY TRANSPORTATION CABINET

Palmer ENGINEERING



Legend

- Receptor # / Predicted Abated Noise Level (Noise Reduction)
- Noise Measurement Site
- Analyzed Noise Barrier
- 500' Noise Buffer

Brent Spence Bridge Corridor Project
Noise Study: Kentucky - Southern Section
KYTC Item No. 6-17
Page 2 of 2
Concept I-W Barrier B23 (18 to 22 feet)
Exhibit 9B

Credit: KYFromAbove Partners; Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet

N

0 125 250

Feet

TEAM KENTUCKY TRANSPORTATION CABINET

Palmer ENGINEERING

7.3 PARALLEL BARRIER CONSIDERATION

The *FHWA Highway Noise Barrier Design Handbook* defines parallel barriers as two barriers which face each other on opposite sides of a roadway. Sound reflected between reflective parallel barriers may cause degradations in each barrier's performance due to multiple reflections that diffract over the individual barriers. To categorize parallel noise barriers and the insertion-loss degradation values, a width-to-height ratio is used. The separation distance width-to-barrier-height ratio (w/h) is the ratio of the total distance between parallel barriers and the average height of the two barriers. Significant insertion loss degradation of greater than 3 dB(A) will occur when width-to-height ratios are less than 10:1. Within the study area there are no parallel barrier configurations with width-to-height ratios of less than 10:1 which would warrant further TNM2.5® modeling to quantify sound barrier performance degradation and require adjustments to the recommended sound barrier configurations outlined in this report.

8. COORDINATION WITH LOCAL OFFICIALS

Coordination with and providing information to local officials is critical to developing a comprehensive approach to creating livable communities adjacent to highways. Impacts of highway traffic noise can be reduced through a program of shared responsibility. Requests to approve land use changes adjacent to highways should consider the current and predicted traffic noise.

Table 8 presents design year sound levels for areas along I-75 where vacant and possibly developable lands exist. Noise predictions were made for distances of 100 feet to 525 feet from the edge of pavement (EOP) of Concept I-W for the Build condition in 2050. As indicated, sound levels exceed the NAC of 67 dB(A) for land use Categories B and C to a distance of 450 feet of EOP. Sound levels exceed the NAC of 72 dB(A) for land use Category E up to 200 feet from EOP.

The values in Table 8, while calculated at a particular location, do not represent predicted levels at a particular location along the roadway. Sound levels will vary with changes in terrain and will be affected by the shielding of objects such as buildings. This information is being included to make local officials and planners aware of anticipated highway noise levels so that future development will be compatible with these levels.

9. CONSTRUCTION NOISE

The contractor may be required to provide such equipment as sound-deadening devices, shields, and physical barriers and take such noise-abatement measures, which may be necessary to restrict or reduce the transmission of noise in the immediate vicinity of noise-sensitive sites. These measures may include, but not necessarily be limited to the following:

- Providing soundproof housing or enclosures for stationary noise-producing machinery, such as drills, augers, cranes, derricks, compactors, pile drivers, etc.
- Providing efficient silencers on air intakes of equipment.
- Providing efficient intake and exhaust mufflers on internal combustion engines.
- Performing proper maintenance on all noise-producing equipment to prevent excessive rattling and vibration of metal surfaces.

- Restricting construction operations near noise-sensitive locations to periods of the day when excessive noise would be least harmful
- Taking other measures as necessary to prevent construction noise from becoming a public nuisance or detriment to human health.

Table 8: Design Year 2050 Sound Level for Undeveloped Lands

Distance from I-75 (1)	dB(A) Leq (2)
100 Feet	76.8
125 Feet	75.9
150 Feet	74.0
175 Feet	72.5
200 Feet	71.7
225 Feet	70.8
250 Feet	70.2
275 Feet	69.7
300 Feet	69.3
325 Feet	68.8
350 Feet	68.4
375 Feet	68.0
400 Feet	67.7
425 Feet	67.3
450 Feet	66.9
475 Feet	66.5
500 Feet	66.2
525 Feet	65.9

(1) Distance is measured perpendicular to edge of pavement of I-75 near Sta. 467+00 RT
(2) Modeled at elevation of outside lane