Blue Water Bridge Plaza

Final Design Noise Analysis Addendum

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1 INTRODUCTION

This addendum summarizes the final design noise abatement analysis for the noise barriers proposed as part of the Blue Water Bridge (BWB) Plaza project located in St. Clair County, Michigan in conformance with corresponding Federal regulations and guidance, and the National Environmental Policy Act (NEPA). The determination of noise abatement measures and locations complies with the Federal Highway Administration's (FHWA's) *Procedures for Abatement of Highway Traffic Noise and Construction Noise* as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 722), and the Michigan Department of Transportation (MDOT) *Highway Noise Analysis and Abatement Handbook*, dated July 2011 (Handbook). The Handbook complies with the State Transportation Commission Policy 10136 Noise Abatement, dated October 17, 2019.

The February 2023 preliminary noise study[1] identified two locations along the project corridor where noise abatement was found to be feasible and reasonable. The two preliminary noise barriers, NB1 and NB2, have been evaluated in this final design noise abatement analysis with the latest project design in order to optimize the barrier design and confirm the feasibility and reasonableness determination.

1.1 Project Description

The Port Huron U.S. Customs and Border Protection (CBP) Land Port of Entry (LPOE) is commonly referred to as the BWB Plaza. The Port Huron facility is built on an elevated 11.5-acre plaza at the base of the United States side of the BWB, which connects Port Huron, Michigan with Sarnia, Ontario, across the St. Clair River. The existing plaza site is bordered by Elmwood Street on the north, Harker Street on the south, the M-25 connector on the west, and 10th Avenue on the east. Pine Grove Avenue (also known as M-25), one of Port Huron's major north-south connector streets, passes beneath the elevated plaza.

The existing facilities were constructed in 1996 and provide for the entry and exit between the United States and Canada. The U.S. BWB Plaza is owned by the Michigan Department of Transportation (MDOT) and partially leased to the General Services Administration (GSA). It is a major border crossing for cars and trucks between the United States - Canada, and Michigan - Ontario.

MDOT completed an Environmental Impact Statement (EIS) and obtained a Record of Decision (ROD) through the Federal Highway Administration on May 19, 2009. At that time, the project was divided into four separate phases, with real estate acquisition resulting in the purchase of 125 residences and 16 businesses by MDOT for the plaza and I-94/69 corridor expansion.

[1] Blue Water Bridge Plaza Project: Draft Traffic Noise Technical Report. February 2023.

The four phases include:

- Replacement of the I-94/69 Black River Bridge to provide dedicated lanes for traffic heading to Canada.
- Modernization of the Water Street and Lapeer Connector interchanges to separate local traffic from the international traffic and eliminate interaction with the frequent backups on the I-94/69 freeway.
- Construction of a new Michigan Welcome Center and rest area west of the Lapeer Connector interchange.
- The expansion of the BWB Plaza.

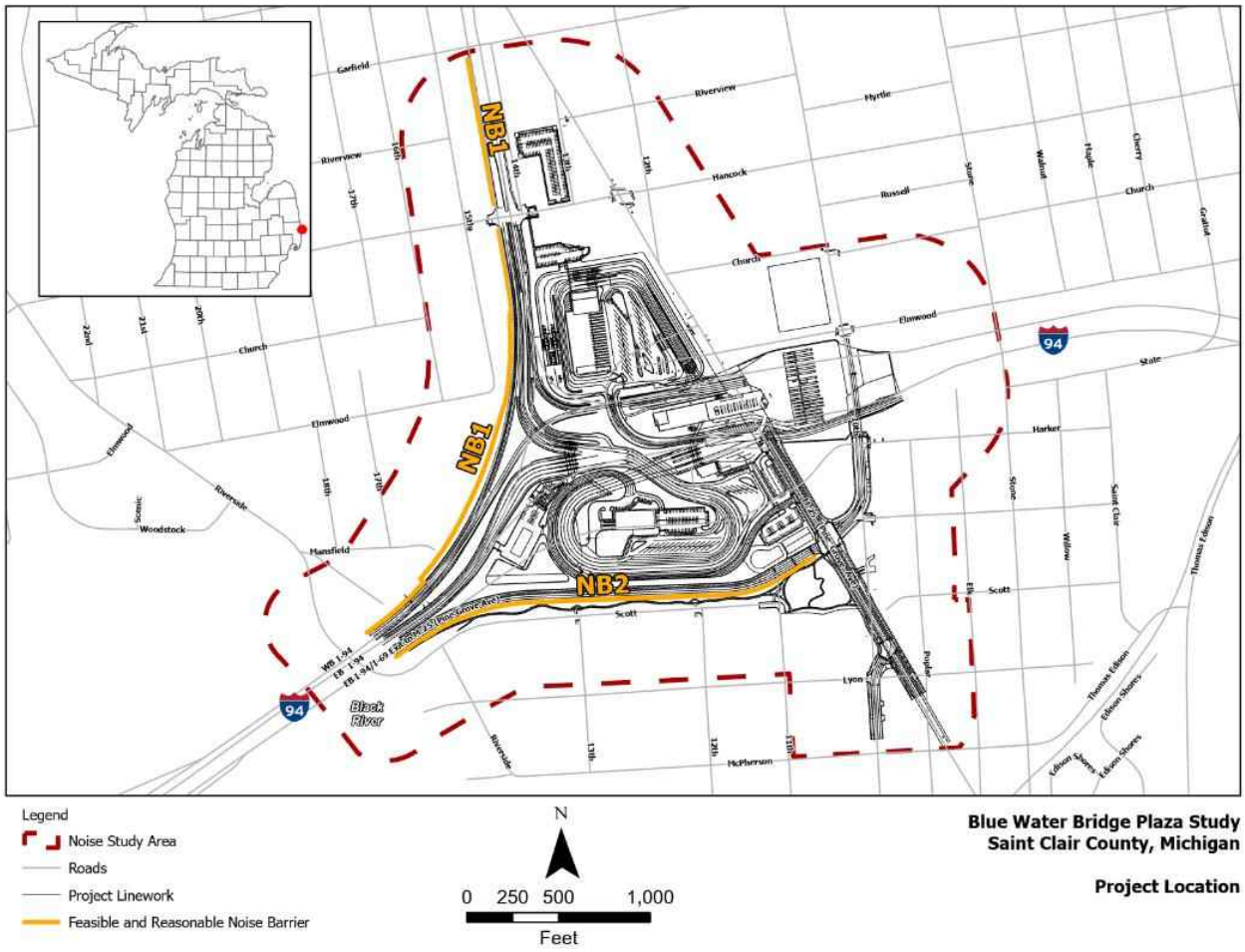
The first three phases of the project have been constructed. The last phase — the expansion of the BWB Plaza, required an environmental re-evaluation to review any changes in the project design, scope, affected environment or proposed mitigation, and provide updated analysis required by any new laws, regulations, or guidance established since the ROD. The environmental re-evaluation has been approved. The previous noise analysis was completed for the 2009 ROD Selected Alternative under the MDOT Commission Policy 10136 Noise Abatement, dated July 31, 2003. Noise barriers were analyzed at two locations; however, neither of the noise barriers met MDOT's reasonableness factors.

In 2021, MDOT started refining and updating the US BWB Plaza facilities from the 2009 ROD Selected Alternative to become the proposed 2022 Refined Alternative. The traffic noise analysis was updated for the 2022 Refined Alternative, and two noise barriers (NB) were found to meet MDOT's preliminary feasibility and reasonableness criteria including the allowable cost per benefited receptor unit (CPBU) of $52,248 in 2023 dollars (3 percent above results in a not to exceed cost of $53,815).

The 2022 Refined Alternative primarily consists of expanding the existing plaza to the south and to the north within the limits of the 2009 environmental clearance limits. The project limits for the noise analysis are along I-94 from approximately the Black River Bridge at the western terminus to Stone Street at the eastern terminus, and between Garfield Street at the northern terminus to McPherson Street at the southern terminus. As part of the Refined Alternative, MDOT has completed an environmental re-evaluation and feasibility study with GSA, CBP, and other federal partners.

Figure 1 shows the project location from the February 2023 preliminary noise study, including the locations of NB1 and NB2. The noise study area for the project included a 500-foot boundary around the project location.

Figure 1. Project Location



2 NOISE ANALYSIS METHODOLOGY

The FHWA *Procedures for Abatement of Highway Traffic Noise and Construction Noise* presented in the Code of Federal Regulations (July 2010) and the MDOT *Highway Noise Analysis and Abatement Handbook* (July 2011) provide guidelines for assessing noise impacts and determining the need, feasibility, and reasonableness of noise abatement measures for proposed Type I highway construction and improvement projects. The project is being studied as a Type I project because of significant horizontal and vertical alterations to the overall plaza design, including ramp relocations closer to noise-sensitive receptors and additional truck parking in the plaza.

The FHWA Noise Abatement Criteria (NAC), which are presented in 23 CFR 772, establish the NAC for various land uses, and are presented in **Table 1**. The NAC are given in terms of the hourly, A-weighted, equivalent sound level in decibels (dB(A)). The A-weighted sound level is a single number measure of sound intensity with weighted frequency characteristics that corresponds to human subjective response to noise. Most environmental noise (and the A-weighted sound level) fluctuates from moment to moment, and it is common practice to characterize the fluctuating level by a single number called the equivalent sound level (L_{eq}). The L_{eq} is the value or level of a steady, non-fluctuating sound that represents the same sound energy as the actual time-varying sound evaluated over the same time period. For traffic noise assessment, L_{eq} is typically evaluated over a one-hour period and may be denoted as $L_{eq(1h)}$.

A traffic noise impact is defined as a future noise level that approaches or exceeds the NAC, or a future noise level that creates a substantial noise increase over existing noise levels. An approaching noise level is defined as being at least 1 dB(A) less than the noise level value listed in the NAC for Activity Category A through G. For Activity Category C/D land uses, NAC C is applied if an exterior use is present, and NAC D is applied if there is no exterior use or if abatement (e.g., a noise barrier) for NAC C is not feasible and reasonable. The FHWA allows states to define a substantial noise increase as an increase of anywhere between 5 and 15 dB(A).

Table 1. Noise Abatement Criteria (NAC)

Activity Category	Activity Criteria[a,b] $L_{eq(h)}$[c]	Activity Criteria[a,b] $L_{10(h)}$[d]	Evaluation Location	Activity Description
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[e]	67	70	Exterior	Residential
C[e]	67	70	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, daycare centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[e]	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	N/A	N/A	N/A	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	N/A	N/A	N/A	Undeveloped lands that are not permitted.

Source: Highway Noise Analysis and Abatement Handbook, Michigan Department of Transportation, 2011.

[a]) MDOT defines a noise impact as a 10 dB(A) increase between the existing noise level to the design year predicted noise level, OR a predicted design year noise level that is 1 dB(A) less than the levels Table 1 shows.

[b]) Either $L_{eq(h)}$ or $L_{10(h)}$ (but not both) may be used on a project. MDOT uses $L_{eq(h)}$. The $L_{eq(h)}$ and $L_{10(h)}$ Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.

[c]) L_{eq} is the equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with $L_{eq(h)}$ being the hourly value of L_{eq}.

[d]) L_{10} is the sound level that is exceeded 10 percent of the time (90^{th} percentile) for the period under consideration, with L_{10} being the hourly value of L_{10}.

[e]) Includes undeveloped lands permitted for this activity category.

The MDOT Handbook is the State's tool for implementing 23 CFR 772. The Handbook expands on 23 CFR 772 by refining definitions and establishing milestones within the design phase for the completion of noise impact analysis and mitigation development.

The Handbook includes the following definitions:

Noise Impact: A substantial noise increase or a predicted design year noise level that is one dB(A) less, equal to, or greater than the NAC level.

Common Noise Environment (CNE): 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. Generally, common noise environments occur between two secondary noise sources, such as interchanges, intersections, and cross-roads.

Substantial Noise Increase: A 10 dB(A) or greater increase between the existing noise level and the design year predicted noise level.

Feasible Noise Barrier: A barrier that has no construction impediments, meets safety requirements for the traveling public, and provides at least 5 dB(A) noise reduction at 75 percent of the impacted receptors.

Reasonable Noise Barrier: A barrier that is cost effective, favorable to the majority of benefited receptors, and achieves noise reduction design goals by meeting or exceeding the reasonableness factor.

Cost Effective Noise Barrier: A noise barrier analyzed for environmental clearance with a preliminary construction cost that is not more than 3 percent above the allowable cost per benefited receptor unit (CPBU) of $52,248 in 2023 dollars[2] (3 percent above results in a not to exceed cost of $53,815), assuming a $45.00 per square foot noise barrier construction cost.

Benefited Receptor: A receptor that receives a 5 dB(A) or greater traffic noise reduction as a result of a proposed noise barrier.

Design Year Attenuation Requirement: Design year traffic noise reduction goal of 10 dB(A) for at least one benefited receptor and provide at least a 7 dB(A) reduction for 50 percent or more of the benefited receptor sites.

Permitted Development: Any presently undeveloped lands that have received a building permit from the local township or city.

Dwelling Unit Equivalent (DUE): The receptor count for public use areas such as parks, schools, libraries, and churches.

[2] Tom Zurburg, MDOT Noise Barrier Program Manager, email regarding "RE: MDOT 2023 CPBU", September 29, 2022.

Noise barriers were modeled with the FHWA's Traffic Noise Model (TNM)® 2.5 for the final design noise abatement analysis. This analysis presents optimized noise barrier designs based on the latest project design available at the time of the final design noise analysis. The noise model utilized 1-foot height increments and data points every 20 feet along the ground-mounted portions of the noise barrier alignment and every 25 feet for the precast concrete panels along the shoulder-mounted noise barrier alignment to provide detail for the noise barrier dimensions beyond that given in the preliminary noise study. The final structural plans for the proposed noise barriers (NB1 and NB2) will design the wall panels to stay above the minimum top elevation acoustical line identified for the noise barrier based on the parameters in the noise model.

2.1 Preliminary Noise Analysis

The preliminary noise analysis technical report, completed in February 2023, included a highway traffic noise analysis within the full project limits in accordance with federal and state regulations. The noise analysis methodology and determinations found in the preliminary noise analysis technical report serve as the basis for the final design noise abatement analysis and are further described in this section.

Following MDOT and FHWA policies and procedures, the preliminary noise analysis included receptors representing exterior activity areas at noise-sensitive land uses grouped into CNEs. Receptors in a CNE are exposed to similar noise sources and levels and generally occur between secondary sources of noise, such as traffic on cross-streets. Seven CNEs listed as A-G in the February 2023 Preliminary Noise Report were identified within the project limits. CNEs D and E have no impacted receptors with the future Design Year (2045) 2022 Refined Alternative and do not require abatement analysis. There are three isolated residential (NAC B) impacts in CNE F that are located between local road intersections and driveways. Because these impacts are isolated and would require various gaps in a noise barrier to allow for driveways and intersection sight distances, noise barrier abatement would not be an effective abatement strategy for these impacted locations. Residential receptors (NAC B) and two recreational outdoor seating areas (NAC C) were evaluated in CNEs A and C from the preliminary noise study, where noise abatement was found to be feasible and reasonable. Residential receptors (NAC B) and a commercial property with outdoor seating area (NAC E) were evaluated in CNEs B and G from the preliminary noise study, where noise abatement was found to be feasible and reasonable.

FHWA's TNM is the federally required computer program for highway traffic noise prediction and analysis. TNM® 2.5 was used in the preliminary noise analysis to compute noise levels throughout the study area for the Existing (2022) conditions and for the Design Year (2045) 2022 Refined Alternative. Traffic engineers determined the AM and PM peak traffic hours for the corridor occur from 7:15 a.m. to 8:15 a.m. and 4:30 p.m. to 5:30 p.m., respectively. The posted speed limits were used on I-94 and adjacent roadways in the noise model for the

existing and future conditions. Anticipated speeds were also used on new plaza roadways in the future condition model. Truck and automobile parking lots within the existing plaza and planned future plaza were modeled using the methods described in Chapter 4 of the National Cooperative Highway Research Program (NCHRP) Report 791 *Supplemental Guidance on the Application of FHWA's Traffic Noise Model (TNM)*.

For the preliminary noise study, existing noise level measurements were conducted on April 5, 2022, at seven representative sites in the project corridor. The measurement results at the four representative sites within CNEs A, B, C and G where noise barriers are proposed are reproduced in this addendum. The existing noise measurements were conducted in order to validate use of FHWA's TNM to predict future noise levels. Fifteen-minute measurements were taken at each site. The measurements were made in accordance with MDOT guidelines using an integrating sound level analyzer meeting American National Standards Institute (ANSI) and International Electrotechnical Commission (IEC) Type 1 specifications. Vehicle speeds were determined from field observation. Traffic counts were taken concurrently with the noise measurements at the sites and classified by vehicle type: cars, medium trucks (two axles) and heavy trucks (three or more axles).

Comparing the modeled noise levels to the measured noise levels validates TNM for use on the specific project. The validation process compares the measured sound levels at each field site (FS) to the noise levels calculated with TNM using the existing site geometry and traffic counts taken during each measurement as input to the model. All the modeled data compared within 3 dB(A) of the measured levels, which satisfies the MDOT requirement for validating noise measurements.

Within CNE A, the measured L_{eq} at FS-1 was 74 dB(A), while the corresponding TNM calculated noise level was 72 dB(A) (difference of -2 dB). Within CNE B, the measured L_{eq} at FS-2 was 62 dB(A), while the corresponding TNM calculated noise level was 62 dB(A) (difference of 0 dB). Within CNE C, the measured L_{eq} at FS-3 was 66 dB(A), while the corresponding TNM calculated noise level was 65 dB(A) (difference of -1 dB). Within CNE G, the measured L_{eq} at FS-7 was 55 dB(A), while the corresponding TNM calculated noise level was 55 dB(A) (difference of -1 dB due to rounding). The validation results for these sites are shown in **Table 2** and the site locations are shown on **Figures A-1** and **A-2** in **Appendix A**. The preliminary noise report contains further details on the noise measurements conducted in the study area and noise model validation.

Table 2. Comparison of Measured and Modeled Noise Levels

Field Site #	Site Location	Noise Level, dB(A) $L_{eq(1h)}$		Difference in Noise Level, dB(A) $L_{eq(1h)}$ (Modeled Minus Measured)[a]
		Measured	Modeled	
FS-1	CNE A	74	72	-2
FS-2	CNE B	62	62	0
FS-3	CNE C	66	65	-1
FS-7	CNE G	55	55	-1

[a]) Difference may appear incorrect due to rounding.

When the predicted Design Year (2045) Build condition noise levels equal or exceed the NAC during the loudest hour of the day or cause a substantial increase in existing noise, consideration of traffic noise reduction measures is necessary. If it is found that such abatement measures will cause adverse social, economic, or environmental effects that outweigh the benefits received, they may be dismissed from consideration. The preliminary noise study identified two locations along the project corridor where noise abatement was found to be feasible and reasonable (CNEs A and C and CNEs B and G). The preliminary noise barriers have been evaluated in this final design noise abatement analysis with the latest project design in order to optimize the barrier design and confirm the feasibility and reasonableness determination.

Table 3 provides a summary of the barriers that were analyzed in the preliminary noise study, including whether the barrier meets the design goals, total estimated cost, the number of benefited receptors, the cost per benefited receptor, feasibility determination, and reasonableness determination.

Table 3. Preliminary Noise Study Noise Barrier Designs Analyzed

Barrier ID	Number of Attenuated Locations					Cost	Cost/Benefit	Feasible[a]	Reasonable[b]
	≥ 10 dB(A)	≥ 7 dB(A)		≥ 5 dB(A) (Benefited Receivers)					
		#	% of Benefited	#	% of Impacted			(Y/N)	(Y/N)
NB1	15	29	52%	56	83%	$2,407,185	$42,985	Y	Y
NB2	3	26	53%	49	88%	$1,897,425	$38,723	Y	Y

[a]) MDOT requires that noise barriers achieve a 5 dB(A) reduction at 75 percent of the impacted receptors. If a barrier cannot achieve this, abatement is considered to not be acoustically feasible. Noise barrier abatement also might not be feasible due to constructability or safety constraints.

[b]) The design year attenuation requirement for Michigan is to provide a noise reduction of 10 dB(A) for at least one benefited receptor and at least a 7 dB(A) reduction for 50 percent or more of the benefited receptor sites.

3 FINAL DESIGN NOISE ABATEMENT ANALYSIS

3.1 Modeled Future Noise Levels

TNM was used to compute Design Year (2045) Build condition loudest-hour noise levels and noise barrier performance at noise sensitive receptors in CNEs A, C, B and G, and to develop the appropriate heights, lengths, and locations for the two reasonable noise abatement measures in CNEs A and C and CNEs B and G. As previously noted, noise impact would occur wherever project noise levels for the Design Year (2045) Build condition are expected to approach within one decibel or exceed the applicable FHWA NAC at noise-sensitive land uses during the loudest hour of the day. Noise impact also would occur wherever project noise levels cause a substantial increase over existing noise levels, defined by MDOT as a 10 dB(A) increase between the existing noise level and the design year predicted traffic noise level. At 11 of the residential receptors in CNE G where noise levels would approach or exceed the NAC, there are also substantial noise increases of 10 dB(A) or greater between the existing noise level and the design year predicted noise level. The substantial noise increases are located south of the plaza where the I-94 eastbound to Pine Grove Avenue off-ramp is moving closer to residences.

Noise models for final design were developed from the preliminary noise models. The latest MicroStation roadway design and terrain contour files were supplied by the design team. The modeling accounted for variability in the local terrain and included the following parameters that affect the propagation of traffic noise: terrain lines, ground zones, building rows and fixed height barriers to represent other buildings. The default ground type used in the modeling was "lawn." The preliminary noise models for NB1 and NB2 were updated with revised barrier alignments supplied by the design team, including the following changes:

- NB1 southern segment alignment between the Black River Bridge and Hancock Street included an offset up to 36 feet closer to the right-of-way while following the roadway shoulder to better accommodate drainage and grading, as well as a length reduction of 12 feet at the north end of this segment at the intersection with Hancock Street to allow adequate protection for vehicles approaching the end of the barrier.
- NB1 northern segment alignment between Hancock Street and Garfield Street included a length reduction of 20 feet at both ends to allow adequate protection for vehicles approaching the end of the barrier.
- NB2 alignment between the Black River Bridge and Pine Grove Avenue included an adjustment of up to 74 feet to follow the roadway shoulder of the revised project design at the east end of the barrier near the intersection with Pine Grove Avenue, as

well as a length reduction of 40 feet at the west end to avoid extending the barrier onto the Black River Bridge.[3]

The updated models also included minor elevation adjustments to terrain lines and the northbound I-94 offramp to Pine Grove based on the latest supplied terrain contour files.

Modeled receivers were placed in accordance with FHWA requirements in areas with evidence of frequent human use. This area is typically located between the highway and any structure, such as a residence. CNE A includes a total of 21 TNM noise receivers representing 21 receptors (including 2 recreational outdoor seating areas and 19 single-family residences) north of I-94 from the Black River to approximately 200 feet south of Elmwood Street. CNE B includes a total of 26 TNM noise receivers representing 26 receptors (including 1 commercial property with an outdoor seating area and 25 single-family residences) south of I-94 from the Black River to 13th Avenue, generally north of Lyon Street. CNE C includes a total of 76 TNM noise receivers representing 76 single-family receptors west of I-94 from approximately 200 feet south of Elmwood Street to Garfield Street. CNE G[4] includes a total of 48 TNM noise receivers representing 52 receptors (including 48 single-family residences and 4 multi-family residences) south of I-94 from 13th Avenue to 10th Avenue, north of McPherson Street. The modeled receptors are shown in **Figures A-1** and **A-2** in **Appendix A**.

In CNE A, the results of the final design noise analysis indicate the Design Year (2045) Build condition PM peak hour noise levels would range from 61 to 76 dB(A) $L_{eq(1h)}$. Predicted future Design Year (2045) noise levels adjacent to the proposed 2022 Refined Alternative in CNE A would approach or exceed the NAC at 14 receiver locations representing two outdoor seating areas and 12 residential receptors. The noise levels at these 14 impacted receptors would range from 66 to 76 dB(A) $L_{eq(1h)}$ in the future Design Year (2045).

In CNE B, the results of the final design noise analysis indicate the Design Year (2045) Build condition PM peak hour noise levels would range from 60 to 69 dB(A) $L_{eq(1h)}$. Predicted future Design Year (2045) noise levels adjacent to the proposed 2022 Refined Alternative in CNE B would approach or exceed the NAC at six receiver locations representing six residential receptors. The noise levels at these six impacted receptors would range from 66 to 69 dB(A) $L_{eq(1h)}$ in the future Design Year (2045).

In CNE C, the results of the final design noise analysis indicate the Design Year (2045) Build condition PM peak hour noise levels would range from 55 to 69 dB(A) $L_{eq(1h)}$. Predicted future Design Year (2045) noise levels adjacent to the proposed 2022 Refined Alternative in CNE C

[3] As discussed in the preliminary noise report, the bridge would not provide sufficient strength for supporting noise barriers and drilling into the prestressed concrete beams would not be feasible. In addition, the south face of the bridge has a pedestrian facility, and a noise barrier may restrict access or views at the pedestrian facility. Cost estimates for reconstruction of the bridge to allow support for the weight of noise barriers would exceed $100 million, which would make the cost of constructing the noise barriers on the bridge not reasonable.

[4] Note that additional receptors in CNE G that were not impacted and not analyzed behind a noise barrier in the preliminary noise study are not included in this addendum.

would approach or exceed the NAC at 15 receiver locations representing 15 residential receptors. The noise levels at these 15 impacted receptors would range from 66 to 69 dB(A) $L_{eq(1h)}$ in the future Design Year (2045).

In CNE G, the results of the final design noise analysis indicate the Design Year (2045) Build condition PM peak hour noise levels would range from 59 to 68 dB(A) $L_{eq(1h)}$. Predicted future Design Year (2045) noise levels adjacent to the proposed 2022 Refined Alternative in CNE G would approach or exceed the NAC at 15 receiver locations representing 17 residential receptors. The noise levels at these 17 impacted receptors would range from 66 to 68 dB(A) $L_{eq(1h)}$ in the future Design Year (2045).

3.2 Noise Barrier Analysis

The Handbook has established the criteria for determining where noise abatement must be provided.[5]

The policy is summarized as follows:

- Where adverse noise impacts are expected to occur, noise abatement will be considered and will be implemented if found feasible and reasonable for existing developments, and future developments that were approved before the Date of Public Knowledge of the project. Approved means that a building permit has been received. After the Date of Public Knowledge, MDOT is not responsible for providing noise abatement for new developments. The Date of Public Knowledge is the date on which the project's environmental documentation (e.g., the date of the ROD for an EIS) is approved. The provision of noise abatement for new developments becomes the responsibility of local governments and private developers.
- All sites will be considered; however, it is generally known that NAC E sites prefer that there be no interference with the view to their establishments. Only residential land use that is converted or zoned commercial before the Date of Public Knowledge will be given the option on abatement.
- Feasible — This refers to engineering considerations such as: constructability of a noise barrier on the existing topography; achievement of substantial noise reductions; the presence of other noise sources in the area; and the ability to maintain access, drainage, safety, and utilities in the area. While every reasonable effort should be made to obtain a substantial noise reduction, a noise abatement measure is not feasible if it cannot achieve at least a 5 dB(A) noise reduction for 75 percent of impacted receptors during design year traffic noise.
- Reasonable — Noise mitigation will be considered reasonable if:
    - During the environmental clearance phase, the preliminary cost per benefiting unit is less than 3 percent above the allowable cost per benefited receptor unit

[5] The Handbook and other MDOT resources can be found at https://www.michigan.gov/mdot/0,4616,7-151-9621_11041_25846---,00.html.

(CPBU) of $52,248 in 2023 dollars (3 percent above results in not to exceed cost of $53,815)[6];
- The public viewpoint reasonableness factor for the environmental clearance phase receives generally positive comments from the benefiting units; and
- The noise barrier provides a design year traffic noise reduction of 10 dB(A) for at least one benefited unit and at least a 7 dB(A) for 50 percent or more of the benefited units.

At a minimum, the Handbook requires that noise barriers be analyzed as a noise abatement measure. The two noise barriers, NB1 and NB2, analyzed for this project are shown on **Figures A-1** and **A-2** in **Appendix A.**

To summarize the noise barriers analyzed:

NB1 is located along the southbound M-25 to Westbound I-94 on-ramp from Garfield Street to the Black River. NB1 is a two-barrier system totaling 3,263 feet long and ranges in height from 10 to 24 feet and was designed to provide abatement for impacted receptors located in CNEs A and C. Noise levels for receptors in CNEs A and C would range from 55 to 76 dB(A) $L_{eq(1h)}$ without the barrier and 52 to 67 dB(A) $L_{eq(1h)}$ with the barrier, with noise reduction provided by the barrier ranging from 0 to 13 dB(A). NB1 is acoustically feasible, as 79 percent of the impacted receptors achieve a 5 dB(A) reduction. The attenuation requirements of 10 dB(A) for at least one benefited receptor and 7 dB(A) for 50 percent or more of the benefited receptors are also met with 51 percent of benefited receptors achieving 7 dB(A) noise reduction and 14 benefited receptors achieving 10 dB(A) noise reduction. The estimated cost per benefited receptor ($50,452) is less than 3 percent above the allowable cost per benefited receptor ($52,248 in 2023 dollars). Therefore, NB1 is both feasible and reasonable.

NB2 is a single barrier located along the I-94 eastbound to Pine Grove Avenue off-ramp from the Black River to Pine Grove Avenue. NB2 is 2,402 feet long and ranges in height from 11 to 24 feet and was designed to provide abatement for impacted receptors located in CNEs B and G. Noise levels for receptors in CNEs B and G would range from 59 to 69 dB(A) $L_{eq(1h)}$ without the barrier and 53 to 67 dB(A) $L_{eq(1h)}$ with the barrier, with noise reduction provided by the barrier ranging from 0 to 10 dB(A). NB2 is acoustically feasible, as 83 percent of the impacted receptors achieve a 5 dB(A) reduction. The attenuation requirements of 10 dB(A) for at least one benefited receptor and 7 dB(A) for 50 percent or more of the benefited receptors are also met with 55 percent of benefited receptors achieving 7 dB(A) noise reduction and 1 benefited receptor achieving 10 dB(A) noise reduction. The estimated cost per benefited receptor ($43,562) is less than 3 percent above the allowable cost per benefited receptor ($52,248 in 2023 dollars). Therefore, NB2 is both feasible and reasonable.

[6] The 2023 CPBU is used for the final design study as this was the CPBU used in the preliminary noise study.

Receivers A-8 and B-4, each representing a single-family residence behind NB1 and NB2, respectively, are no longer benefited compared to the preliminary noise barrier analysis due to height restrictions as the barrier approaches the Black River Bridge to avoid visual impacts.

An analysis was conducted in TNM for both NB1 and NB2 to ensure the barriers would block the line-of-sight to vehicles on the nearby project roadways from ground-level receptors, including truck exhaust stacks. The barrier heights were adjusted where necessary based on the line-of-sight analysis so that ground-level benefited receptors would not have line-of-sight to truck exhaust stacks.

The results of the noise barriers analyzed for final design, including future $L_{eq(1h)}$ noise levels without and with a barrier, barrier length and height, and the noise reduction provided by the barrier, are presented in **Table 4**. Whether the barrier meets the design goal, total estimated cost (based on $45.00 per square foot), the number of benefited receptors (i.e., residences), the cost per benefited receptor, feasibility determination, and reasonableness determination for the barrier is presented in **Table 5**. The Design Year (2045) noise levels for the modeled receptors with and without the incorporation of a noise barrier are presented in **Table 6** including a receiver description, FHWA category and criteria, number of dwelling units, existing noise level, and predicted noise reduction provided by the barrier (insertion loss).

Table 4. Final Design Evaluated Noise Barriers

Barrier ID	Receiver IDs	Existing Noise Levels dB(A) $L_{eq(1h)}$	Future Noise Levels dB(A) $L_{eq(1h)}$		Noise Reduction dB(A) $L_{eq(1h)}$	Barrier Length (ft)	Barrier Height (ft)
			W/O Barrier	W/ Barrier			
NB1	A-1 through A-21 and C-1 through C-77	54 – 76	55 – 76	52 – 67	0 – 13	3,263	10 – 24
NB2	B-1 through B-26 and G-1 through G-48	53 – 66	59 – 69	53 – 67	0 – 10	2,402	11 – 24

Table 5. Final Design Noise Barrier Designs Analyzed

Barrier ID	Number of Attenuated Locations					Cost	Cost/Benefit	Feasible[a]	Reasonable[b]
	≥ 10 dB(A)	≥ 7 dB(A)		≥ 5 dB(A) (Benefited Receptors)					
		#	% of Benefited	#	% of Impacted			(Y/N)	(Y/N)
NB1	14	28	51%	55	79%	$2,774,835	$50,452	Y	Y
NB2	1	29	55%	53	83%	$2,308,770	$43,562	Y	Y

[a]) MDOT requires that noise barriers achieve a 5 dB(A) reduction at 75 percent of the impacted receptors. If a barrier cannot achieve this, abatement is considered to not be acoustically feasible. Noise barrier abatement also might not be feasible due to constructability or safety constraints.

[b]) The design year attenuation requirement for Michigan is to provide a noise reduction of 10 dB(A) for at least one benefited receptor and at least a 7 dB(A) reduction for 50 percent or more of the benefited receptor sites.

Table 6. Modeled Future (2045) PM Peak Hour Noise Levels

Receiver ID	Noise Abatement Criteria			Receptors	Noise Level dB(A) $L_{eq(1h)}$				Increase (Future No Barrier – Existing)*
	Description	Category	Criteria $L_{eq(1h)}$		Existing	Future Build (2022 Refined Alternative)			
						No Barrier	With Barrier	Insertion Loss*	
NB1									
A-1	Outdoor Seating	C	66	1	66	66	66	0	1
A-2	Outdoor Seating	C	66	1	67	68	67	0	1
A-3	Single-Family	B	66	1	76	75	66	10	-1
A-4	Single-Family	B	66	1	76	76	64	12	0
A-5	Single-Family	B	66	1	71	71	62	9	-1
A-6	Single-Family	B	66	1	71	71	64	6	0
A-7	Single-Family	B	66	1	70	70	65	5	0
A-8	Single-Family	B	66	1	69	70	65	4	1
A-9	Single-Family	B	66	1	68	69	66	4	1
A-10	Single-Family	B	66	1	67	68	65	3	1
A-11	Single-Family	B	66	1	73	72	61	12	0
A-12	Single-Family	B	66	1	66	66	59	7	0
A-13	Single-Family	B	66	1	65	66	60	6	0
A-14	Single-Family	B	66	1	65	65	60	5	0
A-15	Single-Family	B	66	1	65	65	60	5	0
A-16	Single-Family	B	66	1	65	66	62	4	1
A-17	Single-Family	B	66	1	63	62	56	7	0
A-18	Single-Family	B	66	1	65	65	59	6	0
A-19	Single-Family	B	66	1	61	61	56	5	0
A-20	Single-Family	B	66	1	63	63	58	5	0
A-21	Single-Family	B	66	1	61	61	57	4	0
C-1	Single-Family	B	66	1	60	60	56	4	0

Boldface indicates noise levels that approach, equal or exceed the NAC and create an impact with the 2022 Refined Alternative.
Green Shading indicates a benefited receptor that receives a 5 dB(A) or greater traffic noise reduction as a result of a proposed noise barrier.
*Insertion Loss and Increase may appear incorrect due to rounding.

Receiver ID	Noise Abatement Criteria			Receptors	Noise Level dB(A) $L_{eq(1h)}$				Increase (Future No Barrier – Existing)*
	Description	Category	Criteria $L_{eq(1h)}$		Existing	Future Build (2022 Refined Alternative)			
						No Barrier	With Barrier	Insertion Loss*	
C-2	Single-Family	B	66	1	60	60	56	4	0
C-3	Single-Family	B	66	1	61	61	56	5	1
C-4	Single-Family	B	66	1	62	62	56	6	1
C-5	Single-Family	B	66	1	63	64	57	6	0
C-6	Single-Family	B	66	1	63	64	57	7	0
C-7	Single-Family	B	66	1	65	65	57	9	1
C-8	**Single-Family**	**B**	**66**	**1**	**66**	**67**	**57**	**10**	**1**
C-9	Single-Family	B	66	1	65	65	56	9	1
C-10	Single-Family	B	66	1	63	63	56	6	0
C-11	Single-Family	B	66	1	61	62	56	6	1
C-12	Single-Family	B	66	1	60	61	56	5	1
C-13	Single-Family	B	66	1	59	60	55	4	1
C-14	Single-Family	B	66	1	55	57	54	3	2
C-15	Single-Family	B	66	1	59	59	55	4	0
C-16	Single-Family	B	66	1	63	63	56	8	0
C-17	Single-Family	B	66	1	63	62	55	7	0
C-18	Single-Family	B	66	1	62	62	56	5	0
C-19	Single-Family	B	66	1	57	58	54	4	1
C-20	Single-Family	B	66	1	61	61	56	5	0
C-21	Single-Family	B	66	1	61	61	56	5	0
C-22	Single-Family	B	66	1	56	57	53	4	1
C-23	**Single-Family**	**B**	**66**	**1**	**67**	**68**	**55**	**13**	**1**
C-24	Single-Family	B	66	1	60	60	55	5	0
C-25	**Single-Family**	**B**	**66**	**1**	**67**	**67**	**55**	**13**	**1**
C-26	Single-Family	B	66	1	60	60	55	5	0

Boldface indicates noise levels that approach, equal or exceed the NAC and create an impact with the 2022 Refined Alternative.
Green Shading indicates a benefited receptor that receives a 5 dB(A) or greater traffic noise reduction as a result of a proposed noise barrier.
*Insertion Loss and Increase may appear incorrect due to rounding.

Receiver ID	Noise Abatement Criteria			Receptors	Noise Level dB(A) $L_{eq(1h)}$				Increase (Future No Barrier – Existing)*
	Description	Category	Criteria $L_{eq(1h)}$		Existing	Future Build (2022 Refined Alternative)			
						No Barrier	With Barrier	Insertion Loss*	
C-27	**Single-Family**	**B**	**66**	**1**	**67**	**68**	**55**	**13**	**1**
C-28	Single-Family	B	66	1	59	59	53	6	0
C-29	Single-Family	B	66	1	56	56	53	4	1
C-30	**Single-Family**	**B**	**66**	**1**	**66**	**67**	**55**	**12**	**1**
C-31	Single-Family	B	66	1	60	60	54	6	0
C-32	Single-Family	B	66	1	56	56	53	4	1
C-33	**Single-Family**	**B**	**66**	**1**	**66**	**67**	**55**	**12**	**1**
C-34	Single-Family	B	66	1	59	60	54	5	0
C-35	Single-Family	B	66	1	56	57	53	3	1
C-36	**Single-Family**	**B**	**66**	**1**	**66**	**66**	**59**	**8**	**1**
C-37	Single-Family	B	66	1	59	60	55	5	0
C-38	Single-Family	B	66	1	60	60	56	4	0
C-39	Single-Family	B	66	1	57	57	55	3	0
C-40	Single-Family	B	66	1	61	61	58	3	0
C-41	Single-Family	B	66	1	57	58	56	2	1
C-42	Single-Family	B	66	1	57	57	56	2	1
C-43	Single-Family	B	66	1	60	60	58	2	0
C-44	Single-Family	B	66	1	60	60	57	3	1
C-45	**Single-Family**	**B**	**66**	**1**	**66**	**67**	**57**	**9**	**1**
C-46	Single-Family	B	66	1	59	59	56	4	1
C-47	Single-Family	B	66	1	54	55	53	2	1
C-48	Single-Family	B	66	1	58	59	56	4	1
C-49	Single-Family	B	66	1	58	59	55	4	1
C-50	Single-Family	B	66	1	54	55	53	3	1
C-51	**Single-Family**	**B**	**66**	**1**	**65**	**66**	**55**	**11**	**1**

Boldface indicates noise levels that approach, equal or exceed the NAC and create an impact with the 2022 Refined Alternative.
Green Shading indicates a benefited receptor that receives a 5 dB(A) or greater traffic noise reduction as a result of a proposed noise barrier.
*Insertion Loss and Increase may appear incorrect due to rounding.

Receiver ID	Noise Abatement Criteria			Receptors	Noise Level dB(A) $L_{eq(1h)}$				Increase (Future No Barrier – Existing)*
	Description	Category	Criteria $L_{eq(1h)}$		Existing	Future Build (2022 Refined Alternative)			
						No Barrier	With Barrier	Insertion Loss*	
C-52	Single-Family	B	66	1	58	59	54	5	1
C-53	Single-Family	B	66	1	54	55	53	3	1
C-54	Single-Family	B	66	1	64	65	55	10	1
C-55	Single-Family	B	66	1	58	59	53	6	1
C-56	Single-Family	B	66	1	55	56	52	4	1
C-57	Single-Family	B	66	1	54	55	52	3	1
C-58	Single-Family	B	66	1	54	55	53	3	1
C-59	**Single-Family**	**B**	**66**	**1**	**65**	**66**	**55**	**11**	**1**
C-60	Single-Family	B	66	1	59	60	54	7	1
C-61	Single-Family	B	66	1	55	56	52	4	1
C-62	**Single-Family**	**B**	**66**	**1**	**65**	**66**	**55**	**11**	**1**
C-63	Single-Family	B	66	1	58	59	54	5	1
C-64	Single-Family	B	66	1	55	56	53	4	1
C-65	**Single-Family**	**B**	**66**	**1**	**65**	**66**	**55**	**11**	**1**
C-66	Single-Family	B	66	1	58	59	55	5	1
C-67	Single-Family	B	66	1	56	57	53	4	1
C-68	Single-Family	B	66	1	56	57	54	3	1
C-69	**Single-Family**	**B**	**66**	**1**	**65**	**66**	**56**	**9**	**1**
C-70	Single-Family	B	66	1	59	60	56	4	1
C-71	Single-Family	B	66	1	56	57	54	3	1
C-72	**Single-Family**	**B**	**66**	**1**	**66**	**67**	**58**	**9**	**1**
C-73	Single-Family	B	66	1	59	60	57	3	1
C-74	Single-Family	B	66	1	56	57	55	2	1
C-75	**Single-Family**	**B**	**66**	**1**	**68**	**69**	**62**	**7**	1
C-76	Single-Family	B	66	1	59	60	58	2	1

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*Insertion Loss and Increase may appear incorrect due to rounding.

Receiver ID	Noise Abatement Criteria			Receptors	Noise Level dB(A) $L_{eq(1h)}$				Increase (Future No Barrier – Existing)*
	Description	Category	Criteria $L_{eq(1h)}$		Existing	Future Build (2022 Refined Alternative)			
						No Barrier	With Barrier	Insertion Loss*	
C-77	Single-Family	B	66	1	57	58	56	2	1
Barrier NB2									
B-1	**Outdoor Seating**	**E**	**71**	**1**	**64**	**66**	**66**	**1**	**2**
B-2	**Single-Family**	**B**	**66**	**1**	**66**	**68**	**67**	**2**	**3**
B-3	Single-Family	B	66	1	61	62	62	0	2
B-4	**Single-Family**	**B**	**66**	**1**	**66**	**68**	**64**	**4**	**2**
B-5	**Single-Family**	**B**	**66**	**1**	**65**	**67**	**64**	**3**	**2**
B-6	**Single-Family**	**B**	**66**	**1**	**64**	**66**	**63**	**3**	**2**
B-7	Single-Family	B	66	1	63	65	62	3	2
B-8	Single-Family	B	66	1	62	64	60	4	2
B-9	Single-Family	B	66	1	63	64	60	4	2
B-10	Single-Family	B	66	1	62	64	60	4	2
B-11	Single-Family	B	66	1	61	63	59	4	2
B-12	**Single-Family**	**B**	**66**	**1**	**66**	**69**	**60**	**8**	**3**
B-13	Single-Family	B	66	1	61	63	59	4	2
B-14	**Single-Family**	**B**	**66**	**1**	**64**	**68**	**59**	**9**	**3**
B-15	Single-Family	B	66	1	60	63	58	4	3
B-16	Single-Family	B	66	1	62	65	58	7	3
B-17	Single-Family	B	66	1	59	62	58	5	3
B-18	Single-Family	B	66	1	61	65	58	7	4
B-19	Single-Family	B	66	1	58	61	56	5	3
B-20	Single-Family	B	66	1	60	65	58	7	5
B-21	Single-Family	B	66	1	57	60	56	4	3
B-22	Single-Family	B	66	1	57	60	55	5	3
B-23	Single-Family	B	66	1	58	61	55	6	3

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Green Shading indicates a benefited receptor that receives a 5 dB(A) or greater traffic noise reduction as a result of a proposed noise barrier.
*Insertion Loss and Increase may appear incorrect due to rounding.

Receiver ID	Noise Abatement Criteria			Receptors	Noise Level dB(A) $L_{eq(1h)}$				Increase (Future No Barrier – Existing)*
	Description	Category	Criteria $L_{eq(1h)}$		Existing	Future Build (2022 Refined Alternative)			
						No Barrier	With Barrier	Insertion Loss*	
B-24	Single-Family	B	66	1	59	63	57	7	5
B-25	Single-Family	B	66	1	59	65	58	7	6
B-26	Single-Family	B	66	1	59	65	58	7	6
G-1	Single-Family	B	66	1	55	59	55	4	4
G-2	Single-Family	B	66	1	56	60	53	7	4
G-3	**Single-Family**	**B**	**66**	**1**	**58**	**66**	**58**	**8**	**7**
G-4	Single-Family	B	66	1	55	59	55	5	5
G-5	**Single-Family**	**B**	**66**	**1**	**58**	**66**	**58**	**8**	**8**
G-6	Single-Family	B	66	1	54	61	55	5	7
G-7	**Single-Family**	**B**	**66**	**1**	**57**	**66**	**58**	**8**	**9**
G-8	Single-Family	B	66	1	55	61	56	5	7
G-9	**Single-Family**	**B**	**66**	**1**	**57**	**66**	**58**	**8**	**9**
G-10	Single-Family	B	66	1	54	61	56	5	7
G-11	**Multi-Family**	**B**	**66**	**2**	**57**	**66**	**58**	**8**	**10**
G-12	**Multi**-Family	B	66	2	54	62	56	5	7
G-13	**Multi-Family**	**B**	**66**	**2**	**57**	**67**	**58**	**9**	**10**
G-14	**Multi**-Family	B	66	2	55	63	56	7	8
G-15	**Single-Family**	**B**	**66**	**1**	**56**	**67**	**58**	**9**	**11**
G-16	Single-Family	B	66	1	54	62	56	6	8
G-17	Single-Family	B	66	1	54	61	56	6	8
G-18	Single-Family	B	66	1	53	60	55	6	7
G-19	Single-Family	B	66	1	54	63	56	7	9
G-20	**Single-Family**	**B**	**66**	**1**	**56**	**68**	**58**	**9**	**12**
G-21	**Single-Family**	**B**	**66**	**1**	**56**	**68**	**59**	**9**	**12**
G-22	**Single-Family**	**B**	**66**	**1**	**56**	**68**	**58**	**9**	**12**

Boldface indicates noise levels that approach, equal or exceed the NAC and create an impact with the 2022 Refined Alternative.
Green Shading indicates a benefited receptor that receives a 5 dB(A) or greater traffic noise reduction as a result of a proposed noise barrier.
*Insertion Loss and Increase may appear incorrect due to rounding.

Receiver ID	Noise Abatement Criteria			Receptors	Noise Level dB(A) $L_{eq(1h)}$				Increase (Future No Barrier – Existing)*
	Description	Category	Criteria $L_{eq(1h)}$		Existing	Future Build (2022 Refined Alternative)			
						No Barrier	With Barrier	Insertion Loss*	
G-23	Single-Family	B	66	1	54	62	57	6	8
G-24	Single-Family	B	66	1	53	61	56	5	8
G-25	**Single-Family**	**B**	**66**	**1**	**56**	**67**	**58**	**10**	**12**
G-26	Single-Family	B	66	1	53	61	56	5	8
G-27	**Single-Family**	**B**	**66**	**1**	**55**	**67**	**58**	**9**	**12**
G-28	Single-Family	B	66	1	53	61	56	5	8
G-29	**Single-Family**	**B**	**66**	**1**	**55**	**67**	**58**	**9**	**11**
G-30	Single-Family	B	66	1	53	61	56	5	8
G-31	**Single-Family**	**B**	**66**	**1**	**55**	**67**	**58**	**9**	**11**
G-32	Single-Family	B	66	1	53	61	56	5	8
G-33	Single-Family	B	66	1	53	61	56	5	7
G-34	Single-Family	B	66	1	54	59	55	4	6
G-35	Single-Family	B	66	1	53	60	56	4	6
G-36	Single-Family	B	66	1	54	61	56	5	7
G-37	Single-Family	B	66	1	55	62	56	6	7
G-38	Single-Family	B	66	1	55	63	57	6	8
G-39	**Single-Family**	**B**	**66**	**1**	**56**	**66**	**58**	**8**	**10**
G-40	Single-Family	B	66	1	57	64	59	5	7
G-41	Single-Family	B	66	1	57	63	59	4	6
G-42	Single-Family	B	66	1	56	62	58	4	6
G-43	Single-Family	B	66	1	55	60	57	3	6
G-44	Single-Family	B	66	1	54	59	56	3	5
G-45	Single-Family	B	66	1	54	59	55	3	5
G-46	Single-Family	B	66	1	55	60	56	3	5
G-47	Single-Family	B	66	1	55	60	57	3	4

Boldface indicates noise levels that approach, equal or exceed the NAC and create an impact with the 2022 Refined Alternative.
Green Shading indicates a benefited receptor that receives a 5 dB(A) or greater traffic noise reduction as a result of a proposed noise barrier.
*Insertion Loss and Increase may appear incorrect due to rounding.

Receiver ID	Noise Abatement Criteria			Receptors	Noise Level dB(A) $L_{eq(1h)}$				Increase (Future No Barrier – Existing)*
	Description	Category	Criteria $L_{eq(1h)}$		Existing	Future Build (2022 Refined Alternative)			
						No Barrier	With Barrier	Insertion Loss*	
G-48	Single-Family	B	66	1	56	60	57	2	4

Boldface indicates noise levels that approach, equal or exceed the NAC and create an impact with the 2022 Refined Alternative.
Green Shading indicates a benefited receptor that receives a 5 dB(A) or greater traffic noise reduction as a result of a proposed noise barrier.
*Insertion Loss and Increase may appear incorrect due to rounding.

Details for the proposed noise barriers NB1 and NB2 analyzed in TNM at every 20 feet along ground-mounted noise barrier alignment and every 25 feet along the shoulder-mounted noise barrier alignment are given in **Table 7** and **Table 8,** respectively, including the station number, geographic coordinates in the NAD 1983 Michigan State Plane (feet) system[7], elevation of the existing ground, top elevation of the noise barrier, and the height of the noise barrier. Note that the dimensions presented in the following tables are based on the noise barrier analyses completed in the noise model and may not fully reflect the final structural plans for the noise abatement. The top elevations presented in the following tables represent the minimum top elevation acoustical line that will be maintained by the top of barrier panels in the final structural plans. Both noise barriers NB1 and NB2 meet MDOT's feasibility and reasonableness criteria and are proposed for construction pending a vote from the benefited receptors.

[7] NAD_1983_HARN_StatePlane_Michigan_South_FIPS_2113_Feet_Intl

Table 7. Proposed Noise Barrier NB1 Final Design Dimensions

Station No.	Barrier Coordinates (feet) (NAD 1983 MI State Plane)		Elevation (feet)		Estimated Height Above Ground (feet)
	X	Y	Estimated Existing Ground	Top of Barrier	
1135+56	13,638,067.00	553,882.20	599.6	18	617.6
1135+36	13,638,070.00	553,862.50	599.2	18	617.2
1135+16	13,638,074.00	553,842.90	599.2	17	616.2
1134+96	13,638,078.00	553,823.20	599.2	17	616.2
1134+76	13,638,081.00	553,803.50	599.1	17	616.1
1134+56	13,638,085.00	553,783.80	599.1	17	616.1
1134+36	13,638,088.00	553,764.10	599.1	17	616.1
1134+16	13,638,092.00	553,744.50	599.1	17	616.1
1133+96	13,638,095.00	553,724.80	599.1	17	616.1
1133+76	13,638,099.00	553,705.10	599.0	17	616.0
1133+56	13,638,103.00	553,685.40	599.0	17	616.0
1133+36	13,638,106.00	553,665.70	599.0	17	616.0
1133+16	13,638,110.00	553,646.10	599.0	17	616.0
1132+96	13,638,113.00	553,626.40	599.0	17	616.0
1132+76	13,638,117.00	553,606.70	599.0	17	616.0
1132+56	13,638,120.00	553,587.00	599.0	17	616.0
1132+36	13,638,124.00	553,567.30	599.0	17	616.0
1132+16	13,638,128.00	553,547.70	599.0	17	616.0
1131+96	13,638,131.00	553,528.00	599.0	17	616.0
1131+76	13,638,135.00	553,508.30	599.0	17	616.0
1131+56	13,638,138.00	553,488.60	599.0	17	616.0
1131+36	13,638,142.00	553,468.90	599.0	17	616.0
1131+16	13,638,145.00	553,449.30	599.0	17	616.0
1130+96	13,638,149.00	553,429.60	599.0	17	616.0
1130+76	13,638,152.00	553,409.90	599.0	17	616.0
1130+56	13,638,156.00	553,390.20	599.0	17	616.0
1130+36	13,638,160.00	553,370.50	599.0	17	616.0
1130+16	13,638,163.00	553,350.90	599.0	17	616.0
1129+96	13,638,167.00	553,331.20	599.0	17	616.0
1129+76	13,638,170.00	553,311.50	599.0	17	616.0
1129+56	13,638,174.00	553,291.80	599.0	17	616.0
1129+36	13,638,177.00	553,272.10	599.0	17	616.0
1129+16	13,638,181.00	553,252.50	599.0	17	616.0
1128+96	13,638,184.00	553,232.80	599.0	17	616.0
1128+76	13,638,188.00	553,213.10	599.0	17	616.0
1128+56	13,638,192.00	553,193.40	599.0	17	616.0
1128+36	13,638,195.00	553,173.70	599.0	17	616.0

Station No.	Barrier Coordinates (feet) (NAD 1983 MI State Plane)		Elevation (feet)		Estimated Height Above Ground (feet)
	X	Y	Estimated Existing Ground	Top of Barrier	
1128+16	13,638,199.00	553,154.10	599.0	17	616.0
1127+96	13,638,202.00	553,134.40	599.0	17	616.0
1127+76	13,638,206.00	553,114.70	599.0	17	616.0
1127+56	13,638,209.00	553,095.00	599.0	17	616.0
GAP					
1126+12	13,638,234.00	552,953.60	598.5	20	618.5
1125+92	13,638,238.00	552,934.00	598.0	20	618.0
1125+72	13,638,242.00	552,914.30	597.9	20	617.9
1125+52	13,638,245.00	552,894.60	597.8	20	617.8
1125+32	13,638,249.00	552,874.90	597.8	20	617.8
1125+12	13,638,252.00	552,855.20	597.7	20	617.7
1124+92	13,638,256.00	552,835.60	597.6	20	617.6
1124+72	13,638,259.00	552,815.90	597.6	20	617.6
1124+52	13,638,263.00	552,796.20	597.6	20	617.6
1124+32	13,638,266.00	552,776.50	597.5	20	617.5
1124+12	13,638,270.00	552,756.80	597.6	20	617.6
1123+92	13,638,274.00	552,737.20	597.7	20	617.7
1123+72	13,638,277.00	552,717.40	597.6	20	617.6
1123+52	13,638,280.00	552,697.70	597.5	20	617.5
1123+31	13,638,283.00	552,677.90	597.4	20	617.4
1123+11	13,638,286.00	552,658.10	597.2	20	617.2
1122+91	13,638,289.00	552,638.30	597.0	20	617.0
1122+70	13,638,292.00	552,618.50	596.8	20	616.8
1122+50	13,638,294.00	552,598.70	596.6	20	616.6
1122+30	13,638,297.00	552,578.90	596.1	20	616.1
1122+10	13,638,300.00	552,559.10	596.7	20	616.7
1121+89	13,638,303.00	552,539.30	597.2	20	617.2
1121+75	13,638,305.00	552,525.60	597.4	20	617.4
1121+69	13,638,304.00	552,519.60	597.0	20	617.0
1121+50	13,638,299.00	552,500.20	596.8	20	616.8
1121+39	13,638,297.00	552,489.40	598.0	20	618.0
1121+30	13,638,297.00	552,480.40	598.1	20	618.1
1121+10	13,638,298.00	552,460.40	598.3	21	619.3
1120+89	13,638,298.00	552,440.50	598.5	22	620.5
1120+69	13,638,299.00	552,420.50	598.3	24	622.3
1120+49	13,638,299.00	552,400.50	598.1	22	620.1
1120+28	13,638,300.00	552,380.50	598.0	21	619.0
1120+08	13,638,300.00	552,360.50	597.8	20	617.8

Station No.	Barrier Coordinates (feet) (NAD 1983 MI State Plane)		Elevation (feet)		Estimated Height Above Ground (feet)
	X	Y	Estimated Existing Ground	Top of Barrier	
1119+88	13,638,301.00	552,340.50	597.8	20	617.8
1119+67	13,638,300.00	552,320.50	597.8	20	617.8
1119+47	13,638,300.00	552,300.50	597.7	20	617.7
1119+26	13,638,299.00	552,280.50	597.6	20	617.6
1119+06	13,638,299.00	552,260.50	597.6	20	617.6
1118+86	13,638,298.00	552,240.50	597.6	20	617.6
1118+65	13,638,296.00	552,220.60	597.7	20	617.7
1118+45	13,638,295.00	552,200.70	597.7	20	617.7
1118+25	13,638,293.00	552,180.70	597.9	20	617.9
1118+04	13,638,292.00	552,160.80	598.0	20	618.0
1117+84	13,638,290.00	552,140.90	598.4	20	618.4
1117+63	13,638,288.00	552,121.00	598.8	19	617.8
1117+43	13,638,285.00	552,101.20	599.1	19	618.1
1117+23	13,638,282.00	552,081.30	599.1	20	619.1
1117+02	13,638,280.00	552,061.50	598.7	20	618.7
1116+82	13,638,277.00	552,041.70	598.0	20	618.0
1116+62	13,638,271.00	552,022.60	597.3	20	617.3
1116+42	13,638,266.00	552,003.40	597.6	20	617.6
1116+21	13,638,260.00	551,984.30	597.8	21	618.8
1116+01	13,638,254.00	551,965.20	598.1	21	619.1
1115+81	13,638,248.00	551,946.10	598.3	21	619.3
1115+60	13,638,242.00	551,926.90	598.6	21	619.6
1115+40	13,638,237.00	551,907.60	598.9	22	620.9
1115+19	13,638,231.00	551,888.40	599.1	22	621.1
1114+99	13,638,226.00	551,869.20	599.1	22	621.1
1114+78	13,638,220.00	551,850.00	599.1	22	621.1
1114+58	13,638,215.00	551,830.80	599.2	22	621.2
1114+17	13,638,209.00	551,811.70	599.2	22	621.2
1114+16	13,638,203.00	551,792.50	599.2	21	620.2
1113+96	13,638,197.00	551,773.40	599.2	20	619.2
1111+75	13,638,191.00	551,754.20	599.1	20	619.1
1111+55	13,638,185.00	551,735.40	599.2	20	619.2
1113+34	13,638,178.00	551,716.60	599.3	20	619.3
1111+14	13,638,171.00	551,697.70	599.3	20	619.3
1112+93	13,638,164.00	551,678.90	599.4	20	619.4
1112+72	13,638,158.00	551,660.00	599.5	20	619.5
1112+52	13,638,150.00	551,641.60	599.8	20	619.8
1112+31	13,638,143.00	551,623.10	600.1	20	620.1

Station No.	Barrier Coordinates (feet) (NAD 1983 MI State Plane)		Elevation (feet)		Estimated Height Above Ground (feet)
	X	Y	Estimated Existing Ground	Top of Barrier	
1112+11	13,638,135.00	551,604.60	600.2	20	620.2
1111+90	13,638,127.00	551,586.10	600.0	20	620.0
1111+69	13,638,120.00	551,567.60	599.8	20	619.8
1111+49	13,638,111.00	551,549.50	599.8	20	619.8
1111+28	13,638,103.00	551,531.40	599.5	20	619.5
1111+07	13,638,094.00	551,513.40	599.8	20	619.8
1110+87	13,638,086.00	551,495.30	600.7	20	620.7
1110+66	13,638,077.00	551,477.20	602.0	20	622.0
1110+45	13,638,068.00	551,459.20	603.0	20	623.0
1110+24	13,638,059.00	551,441.30	603.4	20	623.4
1110+04	13,638,051.00	551,423.30	603.4	20	623.4
1109+83	13,638,042.00	551,405.30	603.5	20	623.5
1109+62	13,638,033.00	551,387.30	603.8	20	623.8
1109+42	13,638,024.00	551,369.80	604.0	20	624.0
1109+21	13,638,014.00	551,352.20	604.3	20	624.3
1109+00	13,638,004.00	551,334.70	604.5	20	624.5
1108+80	13,637,995.00	551,317.20	604.6	20	624.6
1108+59	13,637,985.00	551,299.60	604.6	20	624.6
1108+38	13,637,974.00	551,282.70	604.8	20	624.8
1108+18	13,637,964.00	551,265.70	604.9	20	624.9
1107+97	13,637,953.00	551,248.80	604.8	20	624.8
1107+76	13,637,943.00	551,231.80	604.7	20	624.7
1107+56	13,637,932.00	551,214.90	604.7	20	624.7
1107+35	13,637,920.00	551,198.80	604.8	20	624.8
1107+14	13,637,908.00	551,182.70	605.0	20	625.0
1106+94	13,637,896.00	551,166.60	605.0	20	625.0
1106+73	13,637,884.00	551,150.50	604.9	20	624.9
1106+53	13,637,873.00	551,134.40	604.7	20	624.7
1106+32	13,637,860.00	551,119.00	604.7	20	624.7
1106+11	13,637,847.00	551,103.60	604.6	20	624.6
1105+91	13,637,834.00	551,088.30	604.4	20	624.4
1105+70	13,637,821.00	551,072.90	604.4	20	624.4
1105+50	13,637,809.00	551,057.60	604.4	20	624.4
1105+50	13,637,828.00	551,040.20	611.6	16	627.6
1105+25	13,637,811.00	551,022.10	611.6	16	627.6
1105+00	13,637,794.00	551,004.00	611.6	16	627.6
1104+75	13,637,778.00	550,985.90	611.5	16	627.5
1104+50	13,637,761.00	550,967.80	611.5	16	627.5

Station No.	Barrier Coordinates (feet) (NAD 1983 MI State Plane)		Elevation (feet)		Estimated Height Above Ground (feet)
	X	Y	Estimated Existing Ground	Top of Barrier	
1104+25	13,637,743.00	550,950.90	611.4	16	627.4
1104+00	13,637,725.00	550,934.10	611.3	16	627.3
1103+75	13,637,707.00	550,917.20	611.1	16	627.1
1103+50	13,637,689.00	550,900.30	611.0	16	627.0
1103+25	13,637,670.00	550,884.50	610.8	16	626.8
1103+00	13,637,652.00	550,868.60	610.7	17	627.7
1102+75	13,637,633.00	550,852.80	610.5	17	627.5
1102+50	13,637,614.00	550,837.00	610.3	17	627.3
1102+25	13,637,594.00	550,822.20	610.1	17	627.1
1102+00	13,637,574.00	550,807.40	609.9	17	626.9
1101+75	13,637,555.00	550,792.60	609.7	17	626.7
1107+50	13,637,535.00	550,777.90	609.5	14	623.7
1101+30	13,637,518.00	550,766.10	609.5	10	619.7

Table 8. Proposed Noise Barrier NB2 Final Design Dimensions

Station No.	Barrier Coordinates (feet) (NAD 1983 MI State Plane)		Elevation (feet)		Estimated Height Above Ground (feet)
	X	Y	Estimated Existing Ground	Top of Barrier	
3103+71	13,637,677.00	550,634.60	610.0	11	620.7
3102+90	13,637,694.00	550,645.80	611.6	13	624.7
3103+10	13,637,710.00	550,657.20	611.8	17	628.7
3103+30	13,637,726.00	550,668.60	612.0	21	632.7
3103+50	13,637,743.00	550,680.10	612.1	24	636.1
3103+70	13,637,759.00	550,691.50	612.3	24	636.3
3103+90	13,637,776.00	550,702.90	612.4	24	636.4
3104+10	13,637,792.00	550,714.40	612.5	24	636.5
3104+30	13,637,808.00	550,725.80	612.7	24	636.7
3104+50	13,637,825.00	550,736.90	612.7	24	634.7
3104+50	13,637,828.00	550,733.10	610.7	24	634.7
3104+71	13,637,844.00	550,744.40	611.3	24	635.3
3104+92	13,637,861.00	550,755.40	611.3	24	635.3
3105+13	13,637,878.00	550,766.10	611.4	24	635.4
3105+33	13,637,895.00	550,776.50	611.5	24	635.5
3105+54	13,637,912.00	550,786.60	611.5	24	635.5
3105+75	13,637,930.00	550,796.30	611.5	24	635.5
3105+96	13,637,947.00	550,805.70	611.5	24	635.5
3106+16	13,637,965.00	550,814.90	611.5	24	635.5
3106+37	13,637,983.00	550,823.70	611.5	24	635.5
3106+58	13,638,001.00	550,832.10	611.4	24	635.4
3106+79	13,638,019.00	550,840.30	611.3	24	635.3
3107+00	13,638,038.00	550,848.10	611.3	24	635.3
3107+20	13,638,056.00	550,855.60	611.2	24	635.2
3107+41	13,638,075.00	550,862.70	611.1	24	635.1
3107+62	13,638,094.00	550,869.50	610.9	24	634.9
3107+83	13,638,113.00	550,876.00	610.8	24	634.8
3108+03	13,638,132.00	550,882.10	610.7	24	634.7
3108+24	13,638,151.00	550,887.80	610.5	24	634.5
3108+45	13,638,170.00	550,893.30	610.3	24	634.3
3108+66	13,638,190.00	550,898.40	610.1	24	634.1
3108+86	13,638,209.00	550,903.10	609.9	24	632.9
3109+07	13,638,228.00	550,907.50	609.7	23	632.7
3109+28	13,638,248.00	550,911.50	609.5	23	632.5
3109+49	13,638,268.00	550,915.20	609.2	22	631.2
3109+69	13,638,287.00	550,918.50	609.0	22	631.0
3109+90	13,638,307.00	550,921.40	608.8	22	630.8

Station No.	Barrier Coordinates (feet) (NAD 1983 MI State Plane)		Elevation (feet)		Estimated Height Above Ground (feet)
	X	Y	Estimated Existing Ground	Top of Barrier	
3110+11	13,638,327.00	550,924.00	608.5	21	629.5
3110+32	13,638,347.00	550,926.30	608.3	20	628.3
3110+52	13,638,367.00	550,928.20	608.1	19	627.1
3110+73	13,638,387.00	550,929.70	607.8	18	625.8
3110+94	13,638,407.00	550,930.80	607.6	18	625.6
3111+14	13,638,427.00	550,931.70	607.4	18	625.4
3111+34	13,638,447.00	550,932.40	607.2	18	625.2
3111+54	13,638,467.00	550,933.20	607.0	18	625.0
3111+74	13,638,487.00	550,933.90	606.7	18	624.7
3111+94	13,638,507.00	550,934.70	606.5	18	624.5
3112+14	13,638,527.00	550,935.40	606.3	18	624.3
3112+34	13,638,547.00	550,936.20	606.1	18	624.1
3112+54	13,638,567.00	550,936.90	605.8	18	623.8
3112+74	13,638,587.00	550,937.70	605.6	18	623.6
3112+94	13,638,607.00	550,938.40	605.4	18	623.4
3113+14	13,638,627.00	550,939.20	605.2	18	623.2
3113+34	13,638,647.00	550,939.90	605.0	18	623.0
3113+54	13,638,667.00	550,940.70	604.7	18	622.7
3113+74	13,638,686.00	550,941.40	604.5	18	622.5
3113+94	13,638,706.00	550,942.10	604.3	18	622.3
3114+14	13,638,726.00	550,942.90	604.1	18	622.1
3114+34	13,638,746.00	550,943.60	603.8	18	621.8
3114+54	13,638,766.00	550,944.40	603.6	18	621.6
3114+74	13,638,786.00	550,945.10	603.4	18	621.4
3114+94	13,638,806.00	550,945.90	603.6	18	621.6
3115+14	13,638,826.00	550,946.60	603.4	18	621.4
3115+34	13,638,846.00	550,947.40	603.1	18	621.1
3115+54	13,638,866.00	550,948.10	603.0	18	621.0
3115+74	13,638,886.00	550,948.90	602.7	18	620.7
3115+94	13,638,906.00	550,949.60	602.5	18	620.5
3116+14	13,638,926.00	550,950.40	602.3	18	620.3
3116+34	13,638,946.00	550,951.10	602.1	18	620.1
3116+54	13,638,966.00	550,951.90	601.8	18	619.8
3116+74	13,638,986.00	550,952.60	601.6	18	619.6
3116+94	13,639,006.00	550,953.40	601.4	18	619.4
3117+14	13,639,026.00	550,954.10	601.2	18	619.2
3117+34	13,639,046.00	550,954.90	601.0	18	619.0
3117+54	13,639,066.00	550,955.60	600.7	18	618.7

Station No.	Barrier Coordinates (feet) (NAD 1983 MI State Plane)		Elevation (feet)		Estimated Height Above Ground (feet)
	X	Y	Estimated Existing Ground	Top of Barrier	
3117+74	13,639,086.00	550,956.40	600.5	19	619.5
3117+94	13,639,106.00	550,957.10	600.3	19	619.3
3118+14	13,639,126.00	550,957.90	600.1	19	619.1
3118+34	13,639,146.00	550,958.60	599.9	20	619.9
3118+54	13,639,166.00	550,959.40	599.6	20	619.6
3118+74	13,639,186.00	550,960.10	599.4	21	620.4
3118+94	13,639,206.00	550,960.90	599.2	21	620.2
3119+14	13,639,226.00	550,961.60	599.0	21	620.0
3119+34	13,639,246.00	550,962.40	598.7	21	619.7
3119+54	13,639,266.00	550,963.10	598.5	21	619.5
3119+74	13,639,286.00	550,963.90	598.3	22	620.3
3119+94	13,639,306.00	550,964.60	598.1	22	620.1
3120+14	13,639,326.00	550,965.40	597.8	22	619.8
3120+34	13,639,346.00	550,966.10	597.6	22	619.6
3120+54	13,639,366.00	550,966.90	597.4	22	619.4
3120+74	13,639,386.00	550,967.60	597.0	23	620.0
3120+94	13,639,406.00	550,968.40	596.7	23	619.7
3121+14	13,639,426.00	550,969.10	596.5	23	619.5
3121+34	13,639,446.00	550,969.80	596.3	23	619.3
3121+54	13,639,466.00	550,970.60	596.1	23	619.1
3121+74	13,639,486.00	550,971.50	595.9	23	618.9
3121+92	13,639,506.00	550,973.00	595.6	24	619.6
3122+11	13,639,526.00	550,975.10	595.4	24	619.4
3122+29	13,639,546.00	550,977.90	595.2	24	619.2
3122+48	13,639,565.00	550,981.30	595.0	24	619.0
3122+67	13,639,585.00	550,985.40	594.8	24	618.8
3122+85	13,639,604.00	550,990.10	594.6	24	618.6
3123+04	13,639,624.00	550,995.40	594.4	24	618.4
3123+23	13,639,643.00	551,001.40	594.2	24	618.2
3123+41	13,639,662.00	551,007.90	594.0	24	618.0
3123+60	13,639,680.00	551,015.10	593.8	24	617.8
3123+79	13,639,699.00	551,022.90	593.7	24	617.7
3123+97	13,639,717.00	551,031.20	593.5	24	617.5
3124+16	13,639,735.00	551,040.20	593.3	24	617.3
3124+34	13,639,752.00	551,049.70	593.2	24	617.2
3124+54	13,639,770.00	551,059.70	593.1	24	617.1
3124+74	13,639,787.00	551,069.80	593.0	24	617.0
3124+94	13,639,804.00	551,080.40	592.9	24	616.9

Station No.	Barrier Coordinates (feet) (NAD 1983 MI State Plane)		Elevation (feet)		Estimated Height Above Ground (feet)
	X	Y	Estimated Existing Ground	Top of Barrier	
3125+14	13,639,821.00	551,091.20	592.9	24	616.9
3125+34	13,639,838.00	551,102.00	592.9	24	616.9
3125+54	13,639,854.00	551,112.80	592.9	24	616.9
3125+74	13,639,871.00	551,123.60	592.9	24	616.9
3125+94	13,639,888.00	551,134.30	593.0	23	616.0
3126+14	13,639,905.00	551,145.10	593.1	22	615.1
3126+34	13,639,922.00	551,155.90	593.1	22	615.1
3126+54	13,639,939.00	551,166.70	593.3	22	615.3
3126+74	13,639,955.00	551,177.50	593.5	22	615.5

4 CONCLUSION

Based on the final design noise abatement analysis, proposed noise barriers NB1 and NB2 from the preliminary noise study are still feasible and reasonable and have been optimized based on the latest project design. NB1 and NB2 will be constructed with the project pending a vote from the benefited receptors.

NB1 is located along the southbound M-25 to Westbound I-94 on-ramp from Garfield Street to the Black River and is 3,263 feet long, ranging in height from 10 to 24 feet. The abatement would provide benefit (5 dB(A) or more of insertion loss) to 55 residences, ranging from 0 to 13 dB(A) of noise reduction. The cost per benefited receptor would be $50,452.

NB2 is located along the I-94 eastbound to Pine Grove Avenue off-ramp from the Black River to Pine Grove Avenue and is 2,402 feet long, ranging in height from 11 to 24 feet. The abatement would provide benefit (5 dB(A) or more of insertion loss) to 53 residences, ranging from 0 to 10 dB(A) of noise reduction. The cost per benefited receptor would be $43,562.

4.1 Public Involvement

Based on the studies thus far accomplished, MDOT intends to install highway traffic noise abatement in the form of barriers presented in Table 9. A final decision on the installation and aesthetics of the abatement measure(s) has been determined through the project's final design and the Context Sensitive Solutions process. Owners and residents of the receptor units that benefit from the noise barriers (NB1 and NB2) had the opportunity to vote on whether they are in favor of the proposed noise barriers, as further described below.

A public hearing for the project was held on January 24, 2023, where the preliminary noise analysis and results were presented. The public hearing introduced the project and presented the preferred alternative and impacts, including the results from the preliminary noise analysis. Public comments related to noise were minimal and were documented by the public involvement team.

On November 13, 2023, a public open house was held during the final design phase to solicit the benefiting units' vote on the abatement measures (NB1 and NB2). The public involvement efforts during the benefited receptor solicitation period are further described below.

4.1.1 Benefited Receptor Solicitation Period

Voting ballots were mailed on November 1, 2023, to benefited property owners and residents adjacent to the proposed noise barriers (NB1 and NB2), including the following:

- NB1 - Five of the benefited properties behind NB1 are rental properties with an owner and a resident. For the 55 benefited receptors, representing 55 property owners and five residents behind NB1, a total of 60 voting ballots and informational brochures were mailed on October 30, 2023.

- NB2 - Fourteen of the benefited properties behind NB2 are rental properties with an owner and a resident. For the 53 benefited receptors, representing 51 property owners and 14 residents (two of the receptors are duplexes with one owner and two units each), a total of 65 voting ballots and informational brochures were mailed on October 30, 2023.

A public open house for the benefited receptors was held during the voting period on November 13, 2023, at the MDOT BWB Annex; 84 members of the community attended. Voting materials were sent to benefited receptors on October 30, 2023 using United States Postal Services (USPS) Priority Mail. These materials included the Noise Meeting Flyer, the Noise Survey Ballots for both barriers, MDOT Noise Wall Letters for both barriers, and the noise wall brochure are included in **Appendix B**.

After the initial ballot mailing, another round of ballots was sent on December 12, 2023, to benefited receptors that did not initially respond, with the voting period ending on December 22, 2023. The second round of voting used USPS certified mail requiring signature. Both rounds of mailing included ballots which specified that no response would not be considered an affirmative vote for the noise barrier.

4.1.2 Solicitation Results

The results of the balloting to solicit the viewpoints of benefited receptors for the proposed noise barriers are described below. **Table 9** summarizes the voting point results for the proposed noise barriers (NB1 and NB2). Of the votes tallied, 50 percent or more of the benefiting units must vote in favor of the noise barrier for the abatement to be installed. In addition, MDOT policy states that a property owner of a rental benefiting dwelling unit will count as one (1) vote; however, the resident (or tenant) of a rental benefiting dwelling unit will count as one-half (0.5) vote.

A total of 55 benefited receptors representing 55 property owners and five residents (tenants) were identified adjacent to NB1. The total number of possible voting points for Barrier NB1 is 57.5, including 55 voting points for property owners (including those that are owner/residents) and 2.5 voting points for the tenants. Solicitation ballots were received from 36 of the recipients. A total of 31.5 votes were in favor of the proposed noise barrier, and a total of four votes were against the proposed noise barrier. A majority (88%) of the voting points received for benefited properties adjacent to NB1 indicated a preference of "Yes" to construction of a noise barrier along the southbound M-25 to Westbound I-94 on-ramp from Garfield Street to the Black River. In addition, the 24 ballots not returned specified that no response would not be considered as a "Yes" or "No" vote for the barrier; therefore, NB1 is proposed for construction.

A total of 53 benefited receptors representing 51 property owners and 14 residents (tenants) were identified adjacent to NB2. The total number of possible voting points for NB2 is 60, including 53 voting points for property owners (including those that are owner/residents and

two receptors that are duplexes with one property owner and two units each) and seven voting points for the tenants. Solicitation ballots were received from 31 of the recipients. A total of 26.5 votes were in favor of the proposed noise barrier, and a total of five votes were against the proposed noise barrier. A majority (85%) of the voting points received for benefited properties adjacent to NB2 indicated a preference of "Yes" to construction of a noise barrier along the I-94 eastbound to Pine Grove Avenue off-ramp from the Black River to Pine Grove Avenue. In addition, the 34 ballots returned specified that no response would not be considered as a "Yes" or "No" vote for the barrier; therefore, NB2 is proposed for construction.

Table 9. Viewpoints of Benefited Receptors (Voting Point Results Summary)

Noise Barrier	Noise Barrier Location	Total Number of Benefited Receptors	Total Possible Voting Points	Yes Points (% of Voting Points Received)	No Points (% of Voting Points Received)	Will Noise Barrier Be Constructed?[1]
NB1	Along the southbound M-25 to Westbound I-94 on-ramp from Garfield Street to the Black River	55	57.5	31.5 (88%)	4 (11%)	Yes
NB2	Along the I-94 eastbound to Pine Grove Avenue off-ramp from the Black River to Pine Grove Avenue	53	60	26.5 (85%)	5 (16%)	Yes
[1] A simple majority of points (based on votes received) determines the outcome of the wall.						

A final notification in the form of a letter/postcard will be sent to inform the benefited receptors that the noise barriers received a majority of votes in favor of construction; therefore, NB1 and NB2 are approved and will be incorporated into the Project design.

4.1.3 Noise Barrier Aesthetics

The color and texture of NB1 and NB2 will follow the previously approved aesthetic design guide including updates in the aesthetic design guide addendum (2023)[8] for the BWB Expansion project. The noise wall design is a concrete post and panel system with a repeating,

[8] Blue Water Bridge Port Huron, Michigan: Aesthetic Design Guide Addendum. October 2023.

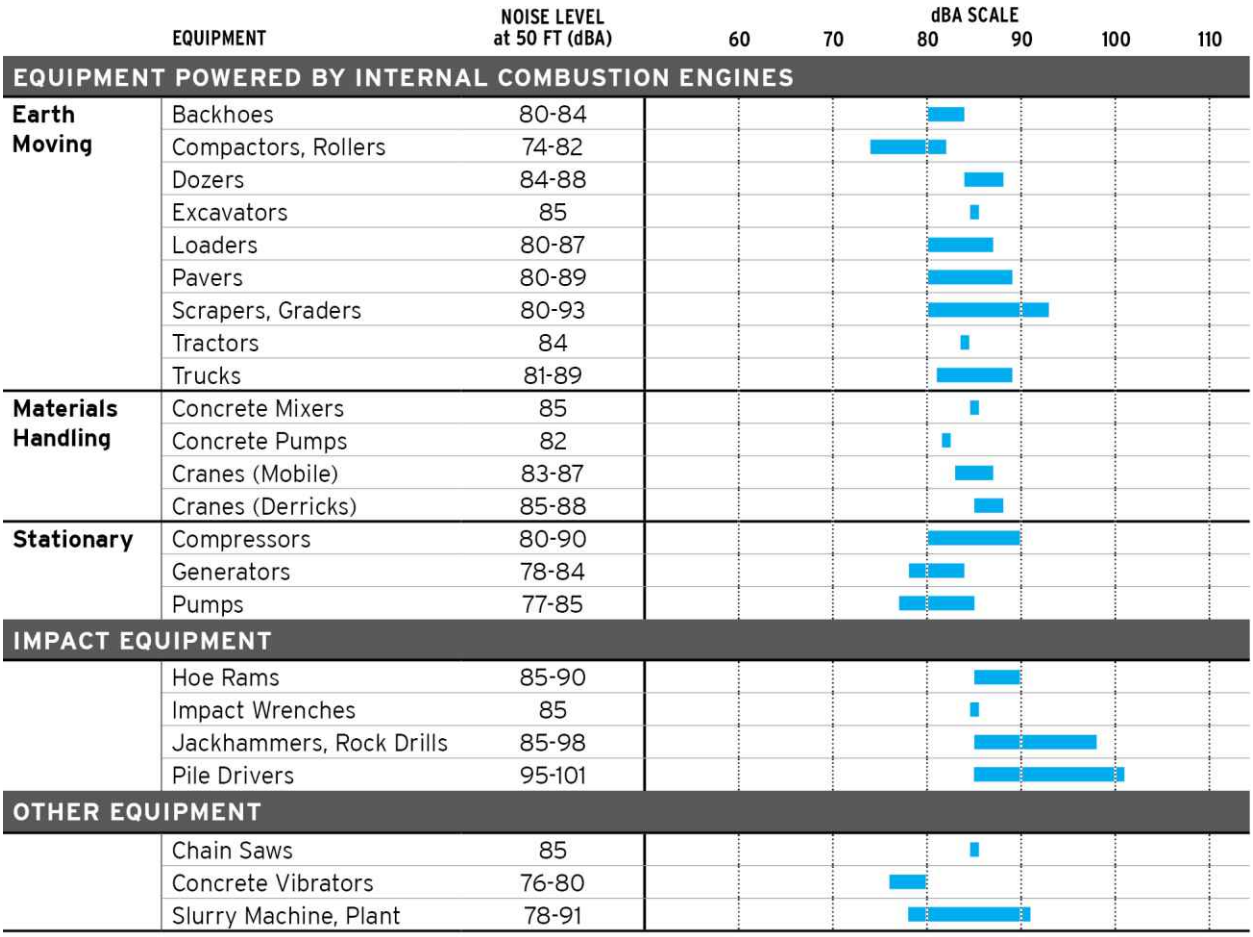
three-dimensional wave patterned cap, muti-colored brick textured panels, and a smooth base panel. Both sides of the noise wall are identical. Images of the noise barrier design is included in the materials in **Appendix C**.

4.2 Construction Noise

In addition to noise from traffic, construction activities themselves can produce increased noise of a temporary nature. The major construction elements of this project are expected to be demolition, hauling, grading, paving, and bridge construction. Construction of the proposed improvements will result in a temporary increase in the ambient noise level along the BWB Plaza corridor. General construction noise impacts for passerby and those individuals living or working near the project can be expected particularly from demolition, earth moving, pile driving, and paving operations. Equipment associated with construction generally includes backhoes, graders, pavers, concrete trucks, compressors, and other miscellaneous heavy equipment.

Figure 2 illustrates typical peak operating noise levels at 50 feet, grouping construction equipment according to mobility and operating characteristics. Considering the nature of construction noise, impacts are not expected to be substantial. The transmission loss characteristics of nearby structures are believed to be sufficient to moderate the effects of intrusive construction noise.

Figure 2. Construction Noise Levels [dB(A) at 50 feet]



SOURCE: FHWA, Effective Noise Control During Nighttime Construction, *https://ops.fhwa.dot.gov/wz/workshops/accessible/schexnayder_paper.htm*

4.3 Construction Vibration

Temporary vibration impacts could occur in residential areas and at other vibration-sensitive land uses from activities associated with construction of the project, such as excavation, demolition, and vibratory compaction, as well as pile-driving at bridges, noise walls, and retaining walls. The potential for vibration impacts would be greatest at locations near pile-driving for bridges and other structures, pavement breaking, and at locations close to vibratory compactor operations.

The equipment with the highest vibration level for roadway construction is the vibratory roller, and the highest potential vibration level for pile driving is with the impact pile driver. For buildings near pile driving activities, short-term construction vibration impact can extend to approximately 100 feet from the construction site. For buildings near roadway construction activities, short-term construction vibration impact can extend to approximately 30 feet from the construction site.

Human annoyance from pile driving could extend to approximately 400 feet from the construction site while roadway construction annoyance could extend to approximately 100 feet from the construction site.

The primary means of mitigating short-term vibration impacts resulting from construction activities is to require the contractors to prepare a vibration control plan. Key elements of a plan include:

- Identify vibration-sensitive buildings;
- Conduct a pre-construction of inspection of residences and historical and other vibration-sensitive structures in the project corridor;
- Prohibit certain activities that create higher vibration levels during nighttime hours;
- Implement vibration control measures where appropriate; and
- Develop a method for responding to community complaints.

5 REFERENCES

Anderson, G. S., C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model®, Version 1.0 User's Guide", Federal Highway Administration, January 1998, p. 60.

FHWA, Noise Policy FAQs – Frequently Asked Questions, https://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/faq_nois.cfm#D4e.

FHWA, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, Code of Federal Regulations, Title 23 Part 772 (23 CFR 722), July 13, 2010.

FHWA, *Recommended Best Practices for the Use of the FHWA Traffic Noise Model (TNM), TNM Object Input, Noise Barrier Optimization, and Quality Assurance, Final Report*, December 8, 2015.

Michigan Department of Transportation, Commission Policy 10136, Noise Abatement, July 31, 2003.

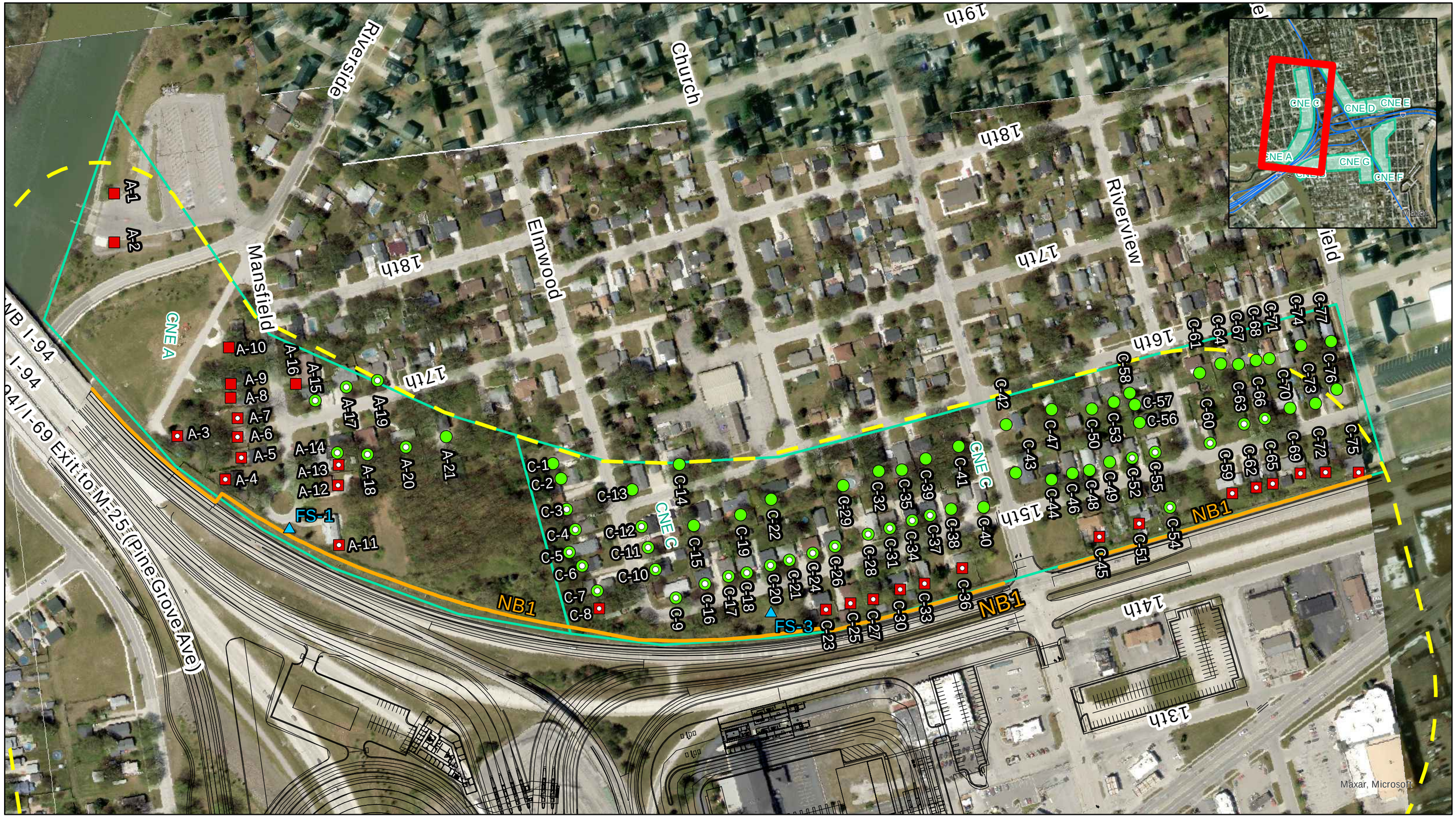
Michigan Department of Transportation, Commission Policy 10136, Noise Abatement, October 17, 2019.

Michigan Department of Transportation, Highway Noise Analysis and Abatement Handbook, July 2011.

Transportation Research Board, National Cooperative Highway Research Program Report 791, *Supplemental Guidance on the Application of FHWA's Traffic Noise Model (TNM)*, 2014, Chapter 4.

Zurburg, Tom, Email regarding "RE: MDOT 2023 CPBU". MDOT Noise Barrier Program Manager, September 29, 2022.

Appendix A: Final Design Noise Analysis Exhibits



Legend

- Measurement Site
- Noise Barrier
- Project Linework
- Common Noise Environment (CNE)
- Noise Study Area

Noise Receivers

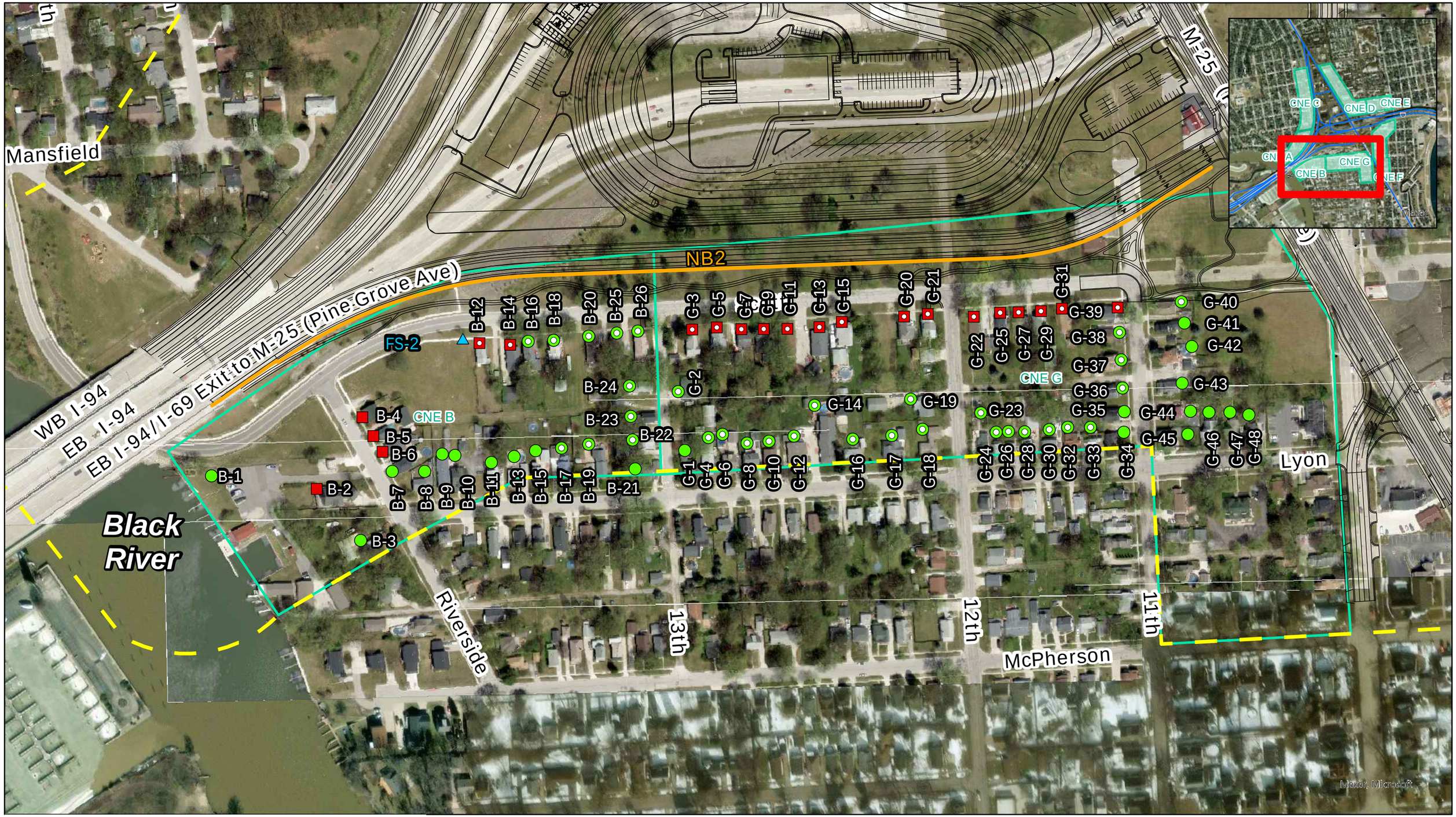
- Not Impacted, Not Benefited
- Not Impacted, Benefited
- Impacted, Not Benefited
- Impacted, Benefited

0 125 250 500

Feet

Blue Water Bridge Plaza Study
Saint Clair County, Michigan

Final Design Noise Analysis



Legend

- Measurement Site
- Noise Barrier
- Project Linework
- Common Noise Environment (CNE)
- Noise Study Area

Noise Receivers

- Not Impacted, Not Benefited
- Not Impacted, Benefited
- Impacted, Not Benefited
- Impacted, Benefited

0 125 250 500

Feet

Blue Water Bridge Plaza Study
Saint Clair County, Michigan

Final Design Noise Analysis

Appendix B: Public Involvement Materials

ANTICIPATED TIMELINE

11/01/2023	12/01/2023	2024 Construction Season
Surveys sent to benefited receptors	Surveys returned to MDOT	Anticipated to start construction of noise barriers

RETURN OF SURVEYS

Completed surveys may be submitted in one of the following ways:

- Via e-mail to: WarrenC1@michigan.gov
- Via text message to (313) 287-1458
- U.S. Postal Service via pre-paid stamped survey
- In person at our public open house November 13, 2023

Open House, Monday November 13 | 2 – 6 p.m.
MDOT Blue Water Bridge Annex | 2127 11th Avenue | Port Huron, MI 48060

In-person meetings are available upon request.

- Meetings with Project Manager, Carrie Warren, PE, at the MDOT Port Huron Office: phone (313) 287-1458 or email WarrenC1@michigan.gov

Noise Barriers

Project Background

The project is located at The Port Huron U.S. Customs and Border Protection (CBP) Land Port of Entry (LPOE), commonly referred to as the Blue Water Bridge (BWB) Plaza. The facility is built on an elevated 11.5-acre plaza on the U.S. side of the BWB, which connects Port Huron, MI with Sarnia, Ontario, across the St. Clair River.

The existing plaza site is bordered by Elmwood Street on the north, Harker Street on the south, the M-25 connector on the west, and 10th Street on the east. Pine Grove Avenue (also known as M-25), one of Port Huron's major north-south connector streets, passes beneath the elevated plaza.

In partnership with the Federal Highway Administration (FHWA),MDOT completed an environmental study in 2009 and divided the project into four phases. The first three phases have been completed, and the BWB Expansion is the fourth and last phase of the project. In 2021, MDOT proposed a refined plaza design with a smaller impact than what was originally studied and approved. MDOT has done a reevaluation of the project based on the design change. The project limits for the noise analysis are along I-94 from approximately the Black River Bridge at the western terminus to Stone Street at the eastern terminus, and between Garfield Street at the northern terminus to McPherson Street at the southern terminus.

Blue Water Bridge Expansion Project
St. Clair County

CONTACT INFORMATION

For additional information, please visit the Project website at www.Michigan.gov/BWBPlaza or contact BWB Project Team at **WarrenC1@michigan.gov** or call (313) 287-1458

MDOT Michigan Department of Transportation

A traffic noise analysis was conducted for the project. The noise analysis identified noise impacts at properties west of I-94 from the Black River to Garfield Street and south of I-94 from the Black River to Pine Grove Avenue. Two noise barriers at these locations were evaluated to decrease these impacts (see Figure 1). Noise Barrier 1 (NB1) is proposed along southbound M-25 to the westbound I-94 on-ramp from Garfield Street to the Black River. NB2 is located along I-94 eastbound to the Pine Grove Avenue off-ramp from the Black River to Pine Grove Avenue. The average heights of NB1 and NB2 are 19 feet and 21.5 feet, respectively.

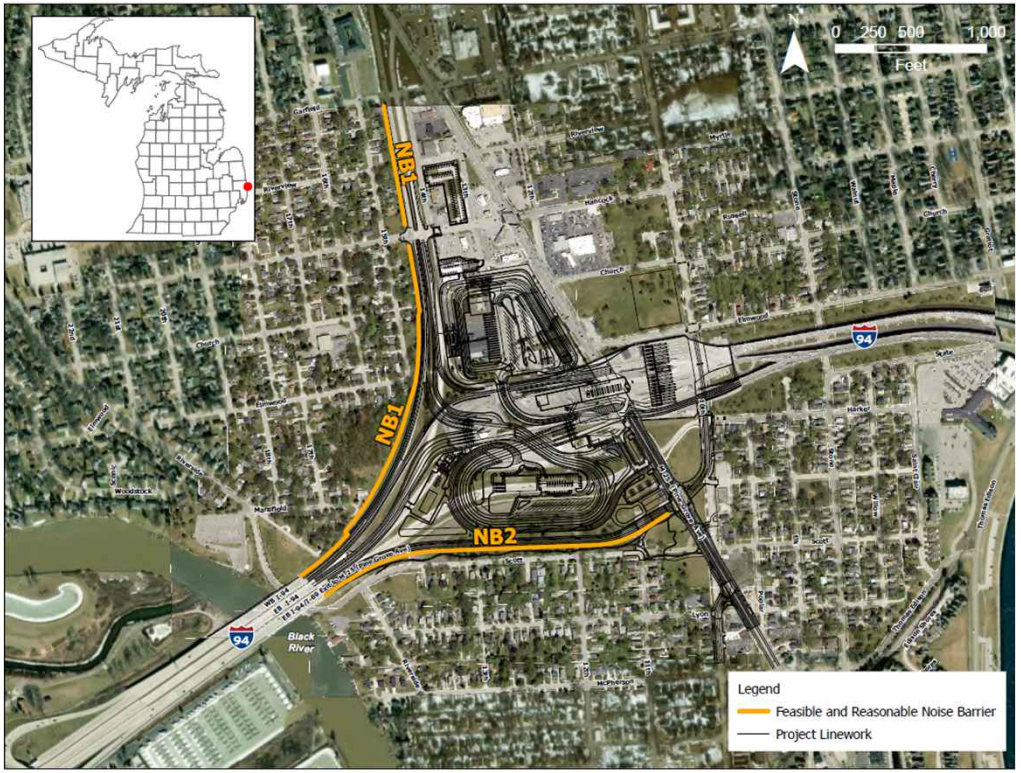
MDOT is currently reaching out to those who will benefit from the noise barriers to vote for or against them. A property is considered to benefit if noise levels would be reduced by at least 5 decibels (dB(A)) at that location.

Surveys have been sent to the benefited property owners and residents, who are being requested to submit their viewpoints by December 1, 2023. Voting is applicable to only the noise barrier adjacent to your residence. A majority of the responses received must favor the noise barrier for the barrier to be recommended for construction. MDOT works diligently to get as many responses as possible.

Figure 2 provides an example of what the noise barriers would look like based on the 2009 Blue Water Bridge Aesthetic Design Guide.

Figure 2: Noise Barrier – Aesthetic Guide Example

Figure 1: Two Proposed Noise Barriers (NB1 and NB2)



For more information about MDOT's Noise Abatement program, visit the Noise Abatement site:

https://www.michigan.gov/mdot/Programs/highway-programs/Environmental-Efforts/noise-abatement

CONTACT INFORMATION

For additional information, please visit the Project website at www.Michigan.gov/BWBPlaza or contact BWB Project Team at **WarrenC1@michigan.gov** or call (313) 287-1458

MICHIGAN DEPARTMENT OF TRANSPORTATION

Blue Water Bridge Plaza Expansion Project

Open House

Monday, Nov. 13th | 2 – 6 p.m. | 2127 11th Ave., Port Huron

Please join us for an open house style update on the Blue Water Bridge Plaza Expansion project, including noise barrier information.

Agenda:

- Project Updates
- Next Steps
- Noise Barrier Information
- Schedule
- Open Discussion

Location:
MDOT Blue Water Bridge Annex
2127 11th Avenue
Port Huron, MI 48060

Monday, November 13, 2023 | 2 – 6 p.m.
Stop in any time

Visit us online at:
www.Michigan.gov/BWBPlaza

[DATE]

RE: Blue Water Bridge Plaza Expansion Project - Outreach for Proposed Noise Barrier along the southbound M-25 to Westbound I-94 on-ramp from Garfield Street to the Black River

Owner/Resident,

The Michigan Department of Transportation (MDOT) is in the final design phase of the south area of the Blue Water Bridge Plaza Expansion Project (Component 1). The project will ensure both people and goods are able to cross the Canadian-U.S. border in Port Huron in a safe, efficient, and secure manner. It will also help support the economies of Michigan, Ontario, Canada, and the United States while meeting both countries' border related national security needs. For more information about the project, please visit the project website at: www.Michigan.gov/BWBPlaza.

Based on a noise analysis conducted for the project, the project will result in traffic noise impacts at properties west of I-94 from the Black River to Garfield Street and south of I-94 from the Black River to Pine Grove Avenue. MDOT proposes noise barriers to lessen these impacts. Noise Barrier 1 (NB1) is near your residence, see Figure 1 (next page).

MDOT is seeking your feedback on the proposed noise barrier shown below. Please complete the enclosed survey, indicating whether you are "in favor" or "not in favor" of the proposed noise barrier. To be recommended for construction, at least 50 percent of the responses received must be in favor of the barrier.

Please submit your survey by **December 01, 2023,** in one of the following ways:

- Via e-mail to: WarrenC1@michigan.gov
- Via text message to (313) 287-1458
- Via U.S. Postal Service using the prepaid enclosed survey (fold and tape where indicated)
- In person at the Open House on Monday, November 13th

The enclosed "Noise Barriers" brochure provides a map of the location of the proposed noise barriers. The enclosed flyer has information on the open house on November 13, 2023. For additional information, please contact Carrie Warren (email: WarrenC1@michigan.gov or phone: (313) 287-1458) or visit the project website at www.Michigan.gov/BWBPlaza.

Sincerely,

Carrie A. Warren, PE
Senior Project Manager, Plaza Expansion
Michigan Department of Transportation

Tom Zurburg
Noise Barrier Program Manager
Michigan Department of Transportation

Encl: Noise Barrier Brochure, Stamped Noise Barrier Survey, Open House Flyer

Figure 1: Noise Barrier 1 (NB1)

[DATE]

RE: Blue Water Bridge Plaza Expansion Project - Outreach for Proposed Noise Barrier along the I-94 eastbound to Pine Grove Avenue off-ramp from the Black River to Pine Grove Avenue.

Owner/Resident,

The Michigan Department of Transportation (MDOT) is in the final design phase of the south area of the Blue Water Bridge Plaza Expansion Project (Component 1). The project will ensure both people and goods are able to cross the Canadian-U.S. border in Port Huron in a safe, efficient, and secure manner. It will also help support the economies of Michigan, Ontario, Canada, and the United States while meeting both countries' border related national security needs. For more information about the project, please visit the project website at: www.Michigan.gov/BWBPlaza.

Based on a noise analysis conducted for the project, the project will result in traffic noise impacts at properties west of I-94 from the Black River to Garfield Street and south of I-94 from the Black River to Pine Grove Avenue. MDOT proposes noise barriers to lessen these impacts. Noise Barrier 2 (NB2) is near your residence, see Figure 1.

Figure 1: Noise Barrier 2 (NB2)

MDOT is seeking your feedback on the proposed noise barrier shown above. Please complete the enclosed survey, indicating whether you are "in favor" or "not in favor" of the proposed noise barrier. To be recommended for construction, at least 50 percent of the responses received must be in favor of the barrier.

Please submit your survey by **December 01, 2023,** in one of the following ways:

- Via e-mail to: WarrenC1@michigan.gov
- Via text message to (313) 287-1458
- Via U.S. Postal Service using the prepaid enclosed survey (fold and tape where indicated)
- In person at the Open House on Monday, November 13th

The enclosed "Noise Barriers" brochure provides a map of the location of the proposed noise barriers. The enclosed flyer has information on the open house on November 13, 2023. For additional information, please contact Carrie Warren (email: WarrenC1@michigan.gov or phone: (313) 287-1458) or visit the project website at www.Michigan.gov/BWBPlaza.

Sincerely,

Carrie A. Warren, PE
Senior Project Manager, Plaza Expansion
Michigan Department of Transportation

Tom Zurburg
Noise Barrier Program Manager
Michigan Department of Transportation

Encl: Noise Barrier Brochure, Stamped Noise Barrier Survey, Open House Flyer

NOISE BARRIER SURVEY

Blue Water Bridge Plaza Expansion Project

Port Huron, Michigan

Property ID #: «Unique_ID»
Benefited Property: «Receptor_Address»

Dear Property Owner/Resident,

Please check one box below indicating whether you are "In Favor" or "Not in Favor" of the proposed noise barrier near your property. The barrier will run along southbound M-25 to the westbound I-94 on-ramp from Garfield Street to the Black River. One survey response is allowed from each property owner. For rental properties, one survey response from the property owner and one survey response from each rental unit is allowed.

☐ **YES, in Favor of Noise Barrier** ☐ **NO, not in Favor of Noise Barrier**

NAME(S): _____

DATE: _____

DO YOU OWN OR RENT THIS PROPERTY? ☐ Own ☐ Rent

Contact Information (optional)**:**

Address: _____

Phone: _____

E-mail: _____

Survey may be submitted via:

- E-mail to: WarrenC1@michigan.gov
- Text message to (313) 287-1458
- U.S. Postal Service via this pre-paid survey (please fold and tape this form prior to mailing)
- In person at the open house (see enclosed flyer)

PLEASE SUBMIT THIS SURVEY NO LATER THAN DECEMBER 1, 2023

Blue Water Bridge Expansion Project
Carrie A. Warren, PE
Senior Project Manager
Blue Water Bridge
1410 Elmwood
Port Huron, MI 48060

FOLD HERE

FOLD HERE

PLACE
STAMP
HERE

MDOT
Michigan Department of Transportation

Blue Water Bridge Expansion Project
Carrie A. Warren, PE
Senior Project Manager
1410 Elmwood
Port Huron, MI 48060

TAPE HERE

NOISE BARRIER SURVEY

Blue Water Bridge Plaza Expansion Project

Port Huron, Michigan

Property ID #: «Unique_ID»
Benefited Property: «Receptor_Address»

Dear Property Owner/Resident,

Please check one box below indicating whether you are "In Favor" or "Not in Favor" of the proposed noise barrier near your property. The barrier will run along I-94 eastbound to the Pine Grove Avenue off-ramp, from the Black River to Pine Grove Avenue. One survey response is allowed from each property owner. For rental properties, one survey response from the property owner and one survey response from each rental unit is allowed.

☐ **YES, in Favor of Noise Barrier** ☐ **NO, not in Favor of Noise Barrier**

NAME(S): _____

DATE: _____

DO YOU OWN OR RENT THIS PROPERTY: ☐ Own ☐ Rent

Contact Information (optional)**:**

Address: _____

Phone: _____

E-mail: _____

Survey may be submitted via:

- E-mail to: WarrenC1@michigan.gov
- Text message to (313) 287-1458
- U.S. Postal Service via this pre-paid survey (please fold and tape this form prior to mailing)
- In person at the open house (see enclosed flyer)

PLEASE SUBMIT THIS SURVEY NO LATER THAN **DECEMBER 1, 2023**

Blue Water Bridge Expansion Project
Carrie A. Warren, PE
Senior Project Manager
Blue Water Bridge
1410 Elmwood
Port Huron, MI 48060

FOLD HERE

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PLACE
STAMP
HERE

MDOT
Michigan Department of Transportation

Blue Water Bridge Expansion Project
Carrie A. Warren, PE
Senior Project Manager
1410 Elmwood
Port Huron, MI 48060

TAPE HERE

Appendix C: Noise Barrier Design Materials

Noise Walls

Noise wall aesthetics are being introduced as part of this ADG Supplement as there were no noise walls proposed as part of the 2009 project. Currently there are two noise walls being proposed for this project, one on the west side of the plaza adjacent to an existing neighborhood, (See **Figures 38, and 39,** pg. 40) and one on the south side of the project north of Scott Avenue. (See **Figure 69,** pg. 62)

The proposed noise walls will be designed to be consistent with other proposed free-standing and security walls with concrete posts, simulated brick panels, a 'wave' cap detail, and a smooth base detail. Wall heights will vary to meet noise mitigation requirements. (See **Figures 34, 35, 36, and 40,** pgs. 38, and 41)

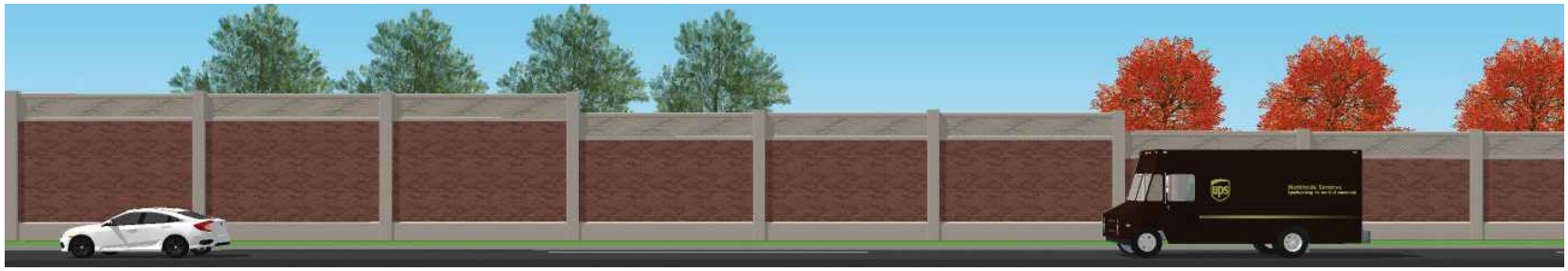


Figure 34: Noise Wall Elevation

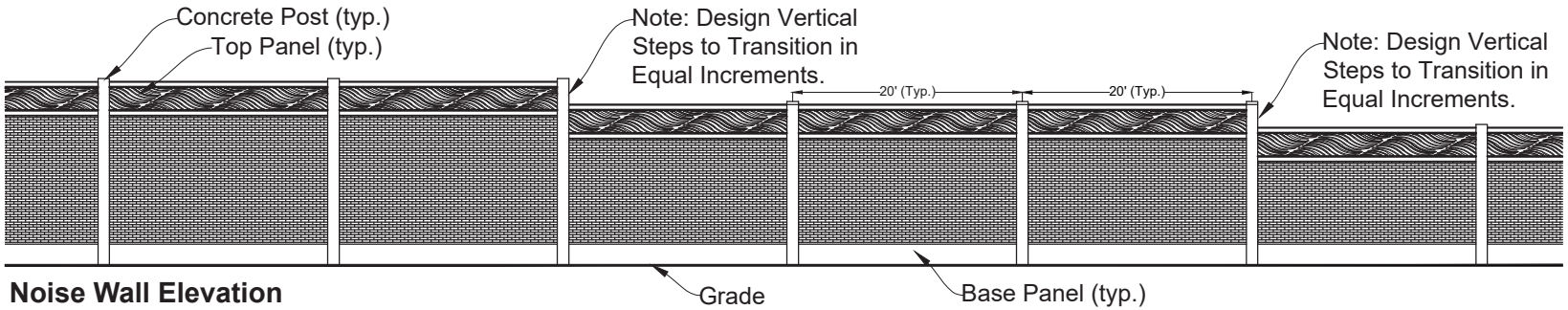
Figure 35: Noise Wall Perspective

Figure 36: Noise Wall Detail

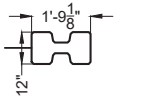
Figure 37: Potential Noise Wall Locations

Figure 38: Proposed Noise Wall #1 on 15th Avenue Looking Southeast Towards Plaza

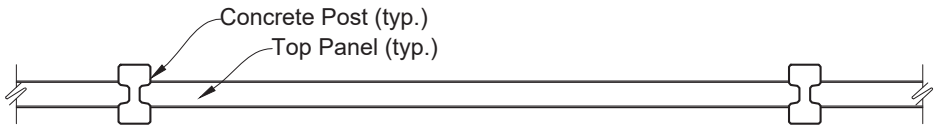
Figure 39: Existing View



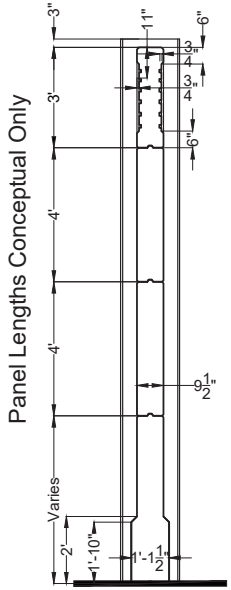
Noise Wall Elevation



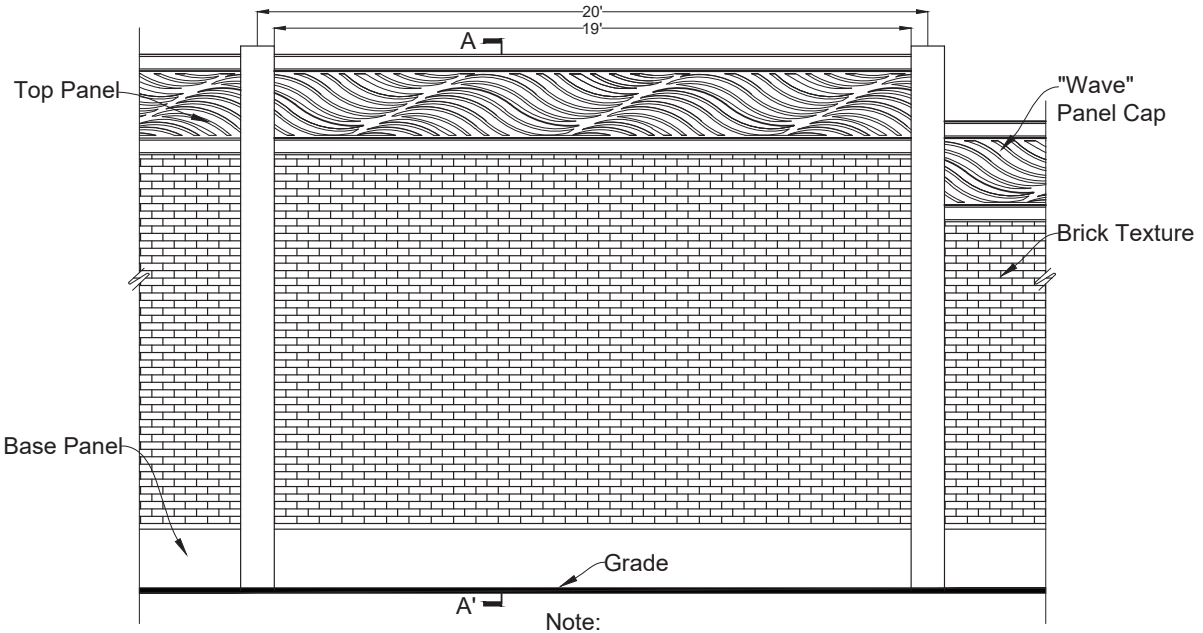
Plan View



Plan View



Section AA'



Noise Wall Details

Note:

1. All Exposed Faces of Posts, Panel Cap and Panel Base to Receive Concrete Surface Coating. Color to be AMS-STD-595A #38424 Warm Gray.
2. Brick Texture to be Minimum $\frac{1}{4}$" Deep. Brick to be Multi-Color Blend. 'Mortar" Recess to be AMS-STD-595A #38424 Warm Gray.

Figure 40: Noise Wall Details - 1