MEMORANDUM

To: Amber Thomas, INDOT
From: Tony Pakeltis, Parsons
Date: November 30, 2021
Subject: Qualitative Noise Analysis

The 80/94 FlexRoad Study is considering the use of the existing shoulders as Dynamic Shoulder Lanes under certain conditions. The inside (median) shoulder is being considered for use on a regular basis during peak periods and times of severe congestion and would likely be activated over the full length of the facility (12-15 miles). The outside shoulder is being considered for use on a very limited basis, in response to an accident or construction activities and would be activated only in the area directly affected, likely no more than a 1-2 mile segment.

As part of the 80/94 FlexRoad Study, Parsons completed a qualitative noise analysis to answer the following questions:

1. Is it possible that noise barriers will be required in areas where there isn't currently noise abatement?
2. Is it possible that existing noise barriers will require increases in height to address additional noise impacts from the project?

A qualitative noise analysis methodology was prepared for this project in September 2021 to identify how these questions would be answered (Attachment C). This memorandum presents the results of the qualitative noise analysis completed.

It is anticipated that the implementation of a Dynamic Shoulder Lane for routine use, as proposed for the inside shoulder on this project, would be a Type I project under 23 CFR 772. However, the limited, infrequent use of the outside shoulder is not anticipated to be a Type I project. As such, this analysis is limited to the inside shoulder use. A final determination will be made during the NEPA process in coordination with FHWA.

Is it possible that noise barriers will be required in areas where there isn't currently noise abatement?

Areas where sensitive noise land uses are located within 800 feet of the roadway and where there is not currently noise abatement were assessed to determine if noise abatement would be likely as a result of the proposed improvements. Eight sections along the I-80/94 corridor were evaluated.

Since there are noise barriers located at many locations through the study area, it is reasonable to assume that noise impacts occur adjacent to the corridor where noise barriers do not exist. To determine the potential likelihood of noise mitigation in areas where no noise barriers presently exist, a qualitative assessment was conducted that consisted of the following:

1. Identify the number of noise sensitive receptors within 800 feet of the roadway.
2. Determine the maximum cost of a noise barrier, assuming all noise sensitive receptors could be benefited within each section. In Illinois, IDOT uses a base cost per benefited receptor of $30,000. This can be increased up to $45,000 based on the absolute noise level, the predicted noise level increase, and whether the receptor existed prior to the original construction of the highway. Using these adjustments, the assumed cost per benefited receptor in Illinois ranges from $30,000 to $32,000 in the study area. In

Indiana, INDOT uses a base cost per benefited receptor of $25,000. This can be increased to $30,000 if a majority of the development existed prior to the original construction of the highway. Based on review of historical aerial photographs, it appears that a majority of the development in the analyzed areas existed prior to the original construction of the highway. Therefore, in Indiana, the assumed cost per benefited receptor is $30,000.

3. Determine the maximum noise barrier length to achieve cost-effectiveness. This length was calculated by dividing the maximum cost of a noise barrier by the assumed noise barrier cost per square foot and by the assumed noise barrier height. Both IDOT and INDOT use a noise barrier cost of $30 per square foot in their noise policies. An assumed wall height of 15 feet was used which is relatively consistent with the existing noise barriers present through the study area.
4. Assess whether a noise barrier could be provided given the calculated maximum noise barrier length to achieve cost-effectiveness. For this analysis, noise barriers were assumed at the outside edge of shoulder. The required length of the barrier was based on the "4D rule," which estimates that a noise barrier must extend four times the distance between the wall and the receptor, in both directions, to provide substantial noise reduction. However, where cross-streets are present, the cross street served as the termination point of the noise barrier even if the length required by the 4D rule could not be achieved.

Based on this analysis, two of the eight sections analyzed were identified as potentially meeting the criteria for noise barriers. See Table 1 for the summary of this analysis and Attachment A which identifies the potential noise barrier locations analyzed.

Table 1. Evaluation of Potential New Noise Barrier Locations - Qualitative Assessment Results

Section[1]	Number of Receptors	Maximum Cost for Wall to be Cost-Effective	Maximum Wall Length to Achieve Cost-Effectiveness (feet)	Estimated Wall Length to Provide Required Noise Level Reduction (feet)	Potential New Noise Barrier Location
A1. Northeast quadrant of IL 394 interchange	59	$1,770,000	3,900	5,570	No
A2. East of Burnham Greenway Trail	26	$811,200	1,800	2,120	No
A3. Northwest quadrant of Burr Street interchange	17	$510,000	1,100	2,540	No
A4. Northeast quadrant of Burr Street interchange	**41**	**$1,230,000**	**2,700**	**2,470**	**Yes**
A5. Southeast quadrant of Burr Street interchange	12	$360,000	800	1,030	No
A6. East of Clark Rd and south of I-80/94	8	$240,000	500	4,790	No
A7. East of Clark Rd and north of I-80/94	25	$750,000	1,700	4,790	No
A8. Northeast quadrant of Grant Street interchange	**48**	**$1,440,000**	**3,200**	**2,770**	**Yes**

1. *Sections with single noise-sensitive receptors were not analyzed because they could not be cost-effective. For a noise barrier to be cost-effective for a single receptor, the noise barrier length would have to be less than 75 feet.*

Is it possible that existing noise barriers will require increases in height to address additional noise impacts from the project?

To address the second question, a simplified noise model was developed, using FHWA's Traffic Noise Model (TNM) version 2.5, to determine the effects of adding traffic on the inside shoulder. It is assumed predicted noise levels adjacent to I-80/94 will increase if the proposed improvements are implemented, and these increases will result in noise impacts that the existing barriers do not completely address. The simplified noise model was developed to roughly estimate how much of a noise level increase can be expected.

The simplified noise model was developed based on the following parameters in Table 2.

Table 2. TNM Parameters for Qualitative Noise Assessment

TNM Feature	Comment
Horizontal Geometry	"Straight"
Roadway Profile	"Flat"
Roadways	A TNM roadway was coded for each lane of travel – 5 lanes in each direction for existing and 6 lanes in each direction for proposed. A TNM roadway will be coded for the inside and outside shoulders.
Barrier	A noise barrier was coded off the outside shoulder with a height of 15 feet. A barrier was coded to represent the median barrier.
Traffic	LOS C traffic was assigned to each lane of travel.
Receivers	Receivers were included at 50-foot intervals extending out 800 feet from the roadway.

Based on the parameters identified in Table 2, the TNM modeling results indicate that noise levels will increase approximately 1 dBA along the study area compared to existing conditions. In the areas where an existing noise barrier is present, noise impacts at FHWA Category B and C land uses are expected to extend out approximately 100 feet from the edge of the outside travel lane. Since noise impacts are possible where noise barriers are present, a qualitative assessment of modifying existing noise barriers was conducted that consisted of the following:

1. Determine the potential noise level reduction by increasing the noise barrier height. Increasing the noise barrier height from 15 to 30 feet would provide a 5 dBA reduction out to approximately 100 feet. Beyond 100 feet, the noise level reduction from this increase in barrier height is less than 5 dBA. Therefore, beyond 100 feet, there would be no benefited receptors (as defined by the IDOT and INDOT noise policies) from this noise barrier modification.
2. Identify locations where there is a dense enough grouping of noise receptors that increasing the noise barrier height by 15 feet could be cost-effective. Every 1,000 linear feet of noise barrier modified will require there to be 15 benefited receptors for the noise barrier modification to be cost-effective, assuming a cost of $30 per square foot.

None of the single-family residential development located directly adjacent to the existing noise barriers is dense enough where raising the barrier by 15 feet would be cost-effective. There are two locations where apartment complexes are located within 100 feet of the outside travel lane, and it appears that modifications to the noise barrier at these locations could be cost-effective. See Table 2 below and Attachment B for these locations.

Table 3. Potential Noise Barrier Modifications- Qualitative Assessment Results

Section	Number of Receptors	Maximum Cost for Wall to be Cost-Effective	Maximum Wall Length to Achieve Cost-Effectiveness (feet)	Estimated Wall Length to Provide Required Noise Level Reduction (feet)	Potential Noise Barrier Modification
B1. Southeast quadrant of IL 394 interchange	24	$720,000	1,600	1,540	Yes
B2. North side, east of Burnham Greenway Trail	30	$900,000	2,000	1,360	Yes

Conclusion

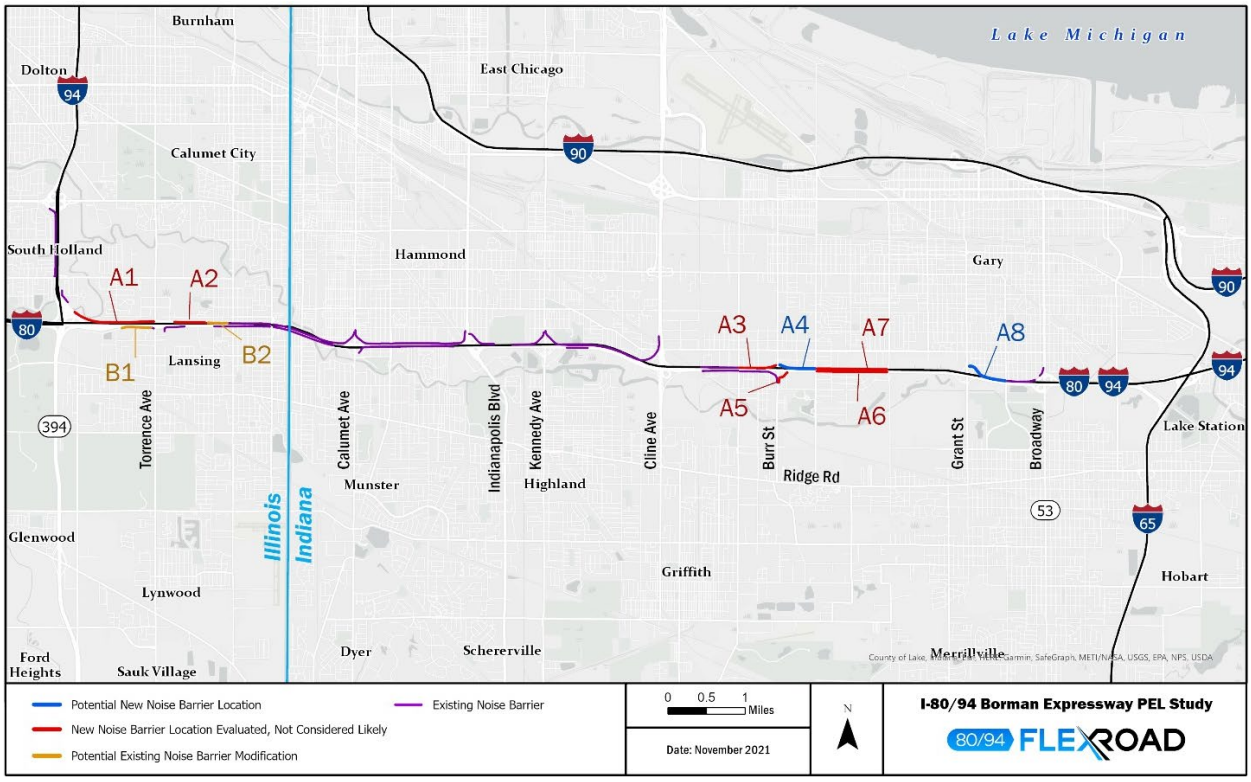
Based on this qualitative noise analysis, two potential new noise barriers and two potential noise barrier modifications were identified. Table 4 lists these four locations and the potential noise mitigation cost for the project. The potential new noise barrier and potential noise barrier modification locations are shown in Figure 1, along with the locations of the existing noise barriers and the other potential noise barrier locations evaluated.

Table 4. Potential Noise Mitigation Costs – Qualitative Assessment Results

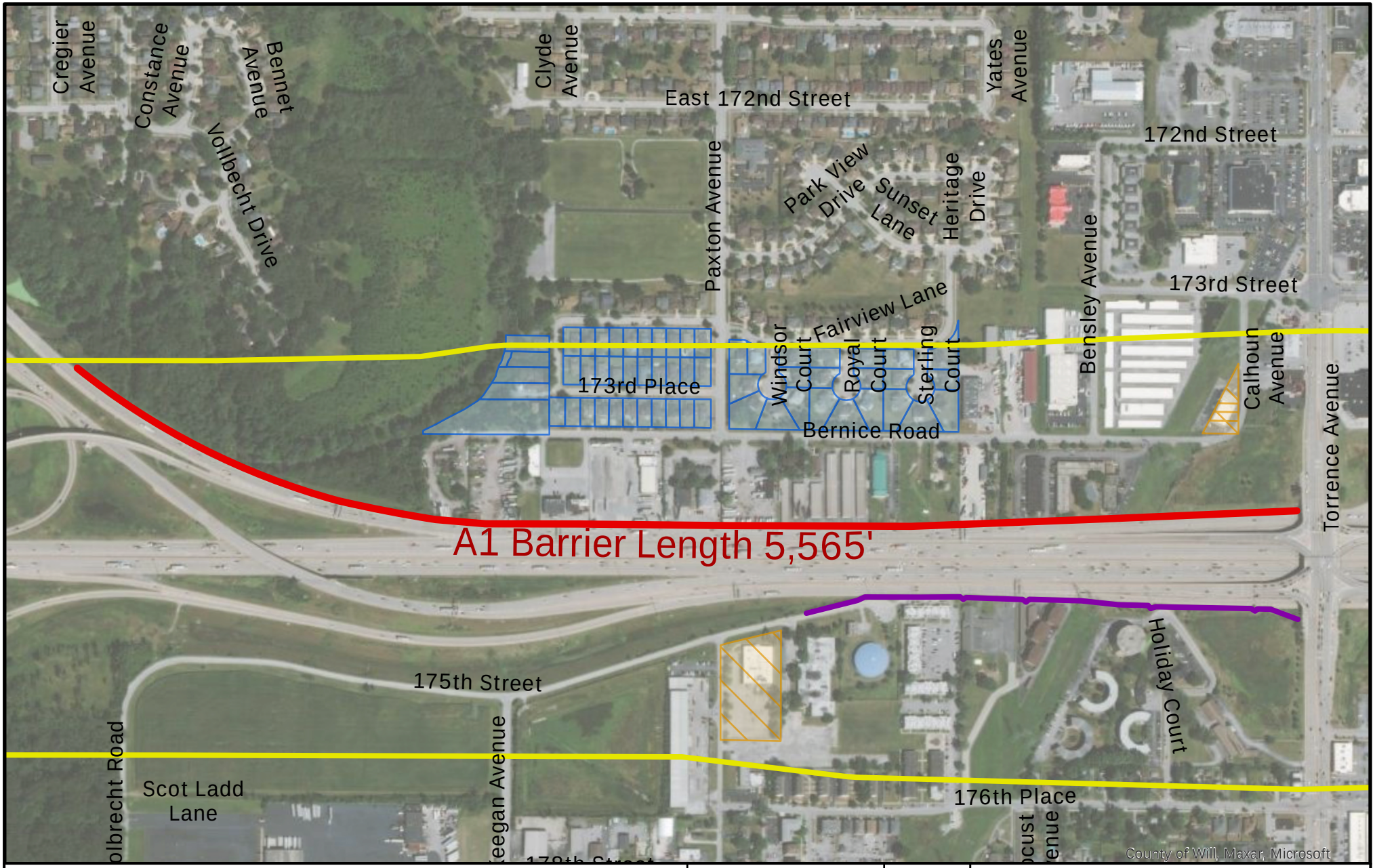
Section	Type	Number of Receptors	Estimated Noise Barrier Length (feet)	Estimated Cost
A4. Northeast quadrant of Burr Street interchange	Potential New Noise Barrier	41	2,470	$1,111,500
A8. Northeast quadrant of Grant Street interchange	Potential New Noise Barrier	48	2,770	$1,246,500
B1. Southeast quadrant of IL 394 interchange	Potential Noise Barrier Modification	24	1,540	$693,000
B2. North side of I-80/94, east of Burnham Greenway Trail	Potential Noise Barrier Modification	30	1,360	$612,000

These conclusions are considered preliminary for the PEL study phase. A complete Traffic Noise Impact Assessment with comprehensive noise modeling will be performed for the entire study area when the project is in the NEPA phase.

Figure 1. Noise Barrier Locations Evaluated- Qualitative Assessment Results



ATTACHMENT A: NEW NOISE BARRIER LOCATIONS EVALUATED



Existing Noise Barrier

Potential New Noise Barrier Location

New Noise Barrier Location Evaluated, Not Considered Likely

800' From Edge of Pavement

FHWA Activity Category B

FHWA Activity Category C

0 250 500 Feet

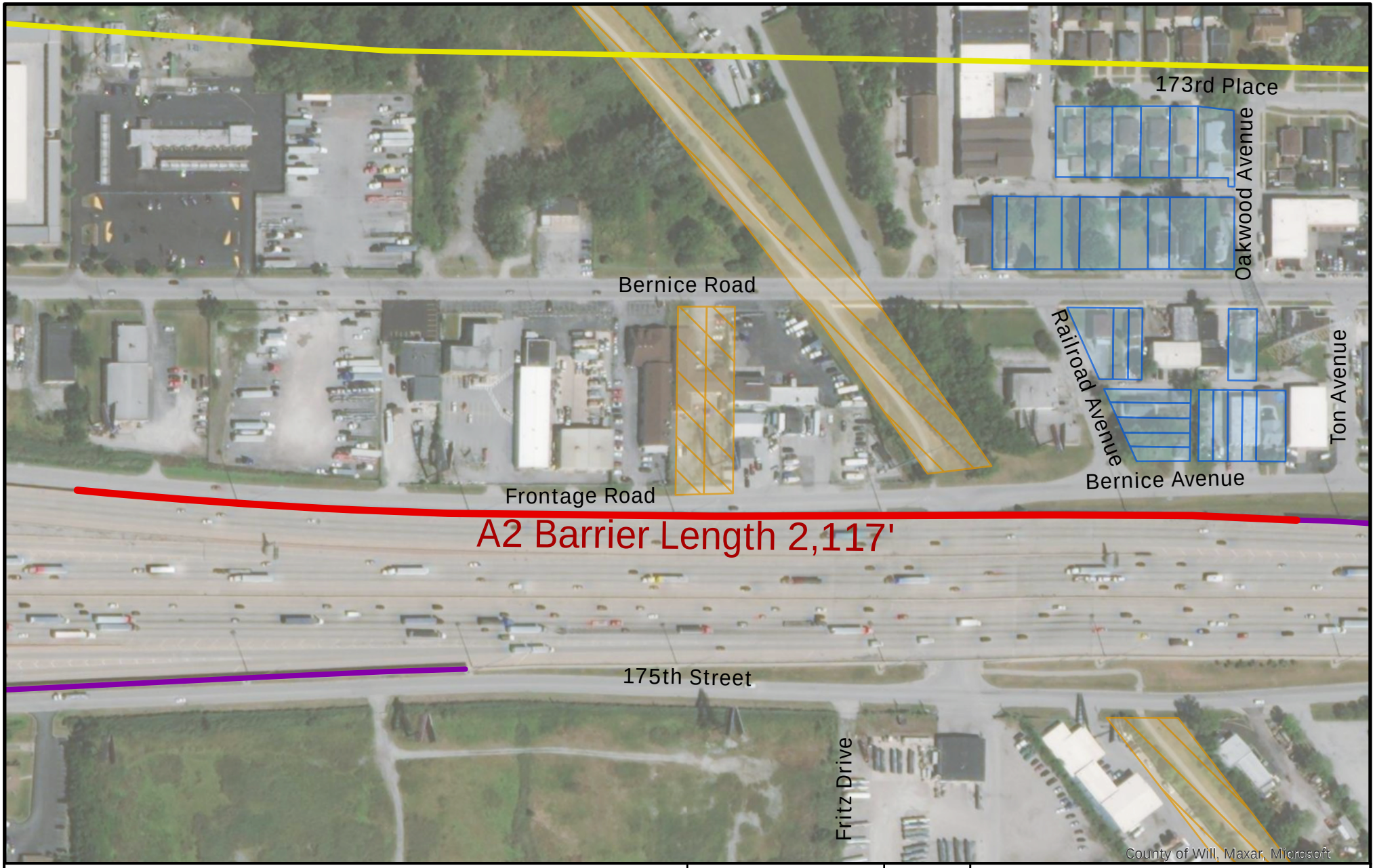
N

Date: November 2021

A-1

I-80/94 Borman Expressway PEL Study

80/94 FLEXROAD



Existing Noise Barrier

Potential New Noise Barrier Location

New Noise Barrier Location Evaluated, Not Considered Likely

800' From Edge of Pavement

FHWA Activity Category B

FHWA Activity Category C

0 100 200 Feet

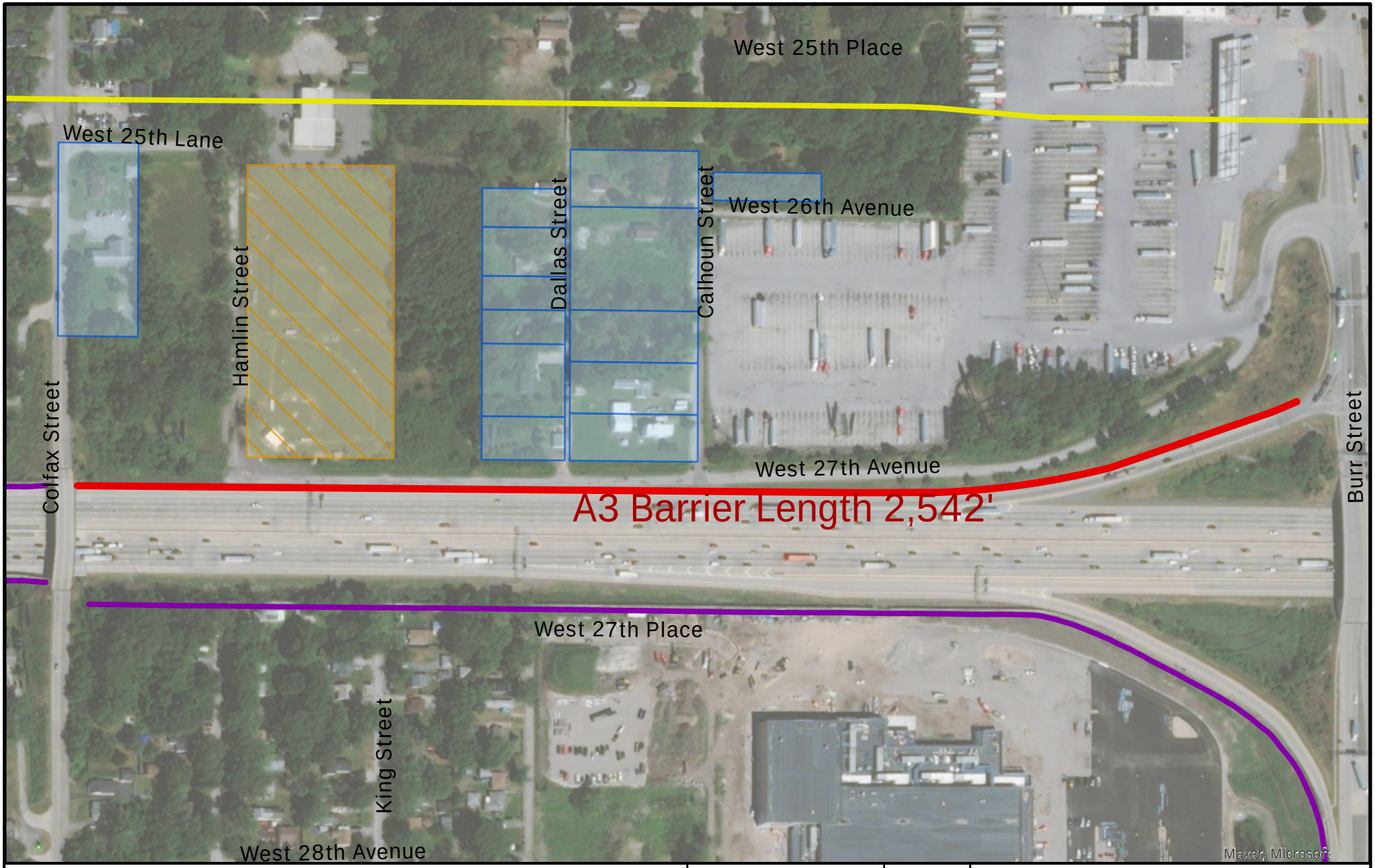
N

Date: November 2021

A-2

I-80/94 Borman Expressway PEL Study

80/94 FLEXROAD



Existing Noise Barrier

Potential New Noise Barrier Location

New Noise Barrier Location Evaluated, Not Considered Likely

800' From Edge of Pavement

FHWA Activity Category B

FHWA Activity Category C

0 110 220 Feet

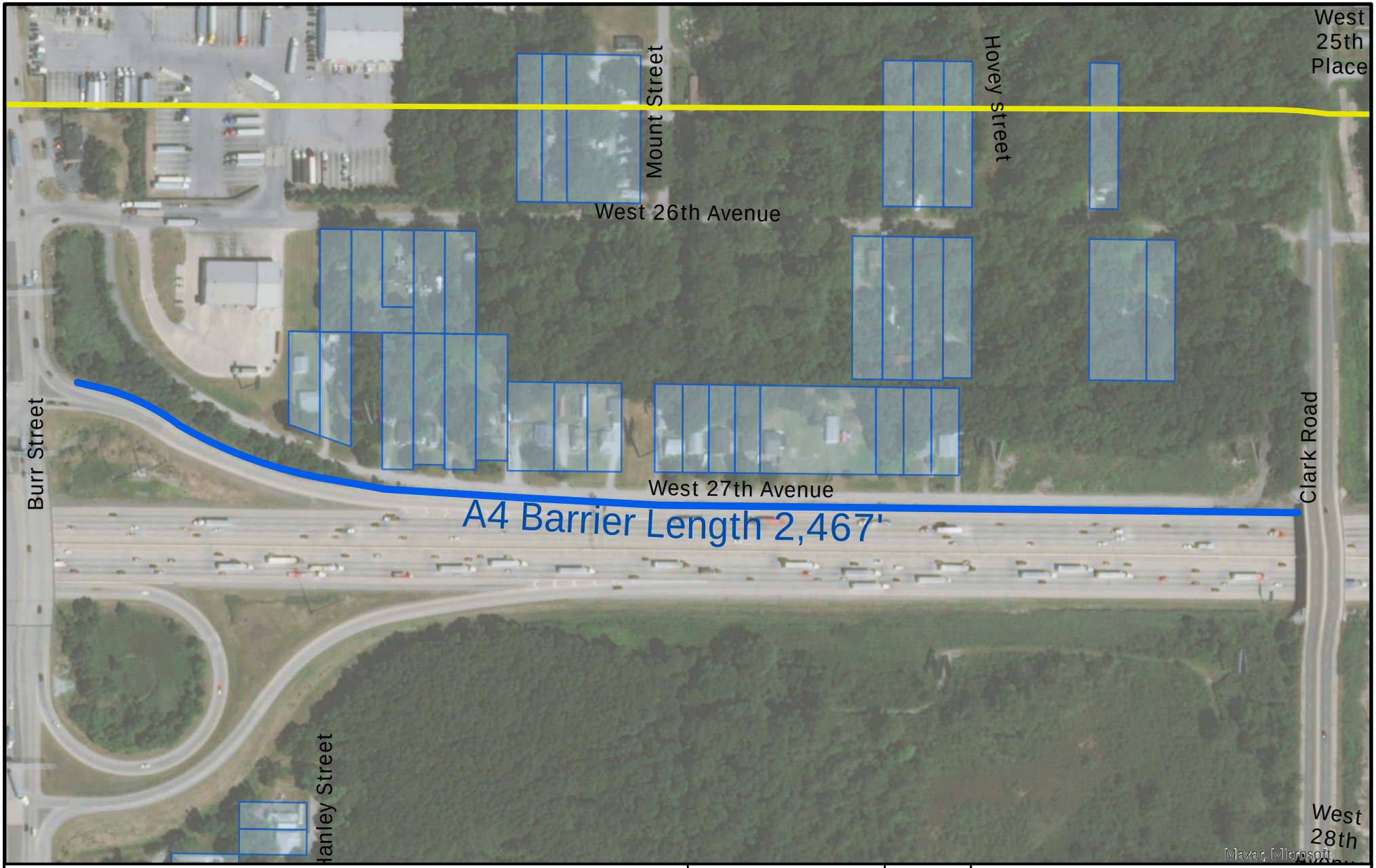
N

I-80/94 Borman Expressway
PEL Study

Date: November 2021

A-3

80/94 FLEXROAD



Existing Noise Barrier

Potential New Noise Barrier Location

New Noise Barrier Location Evaluated, Not Considered Likely

800' From Edge of Pavement

FHWA Activity Category B

FHWA Activity Category C

0 110 220 Feet

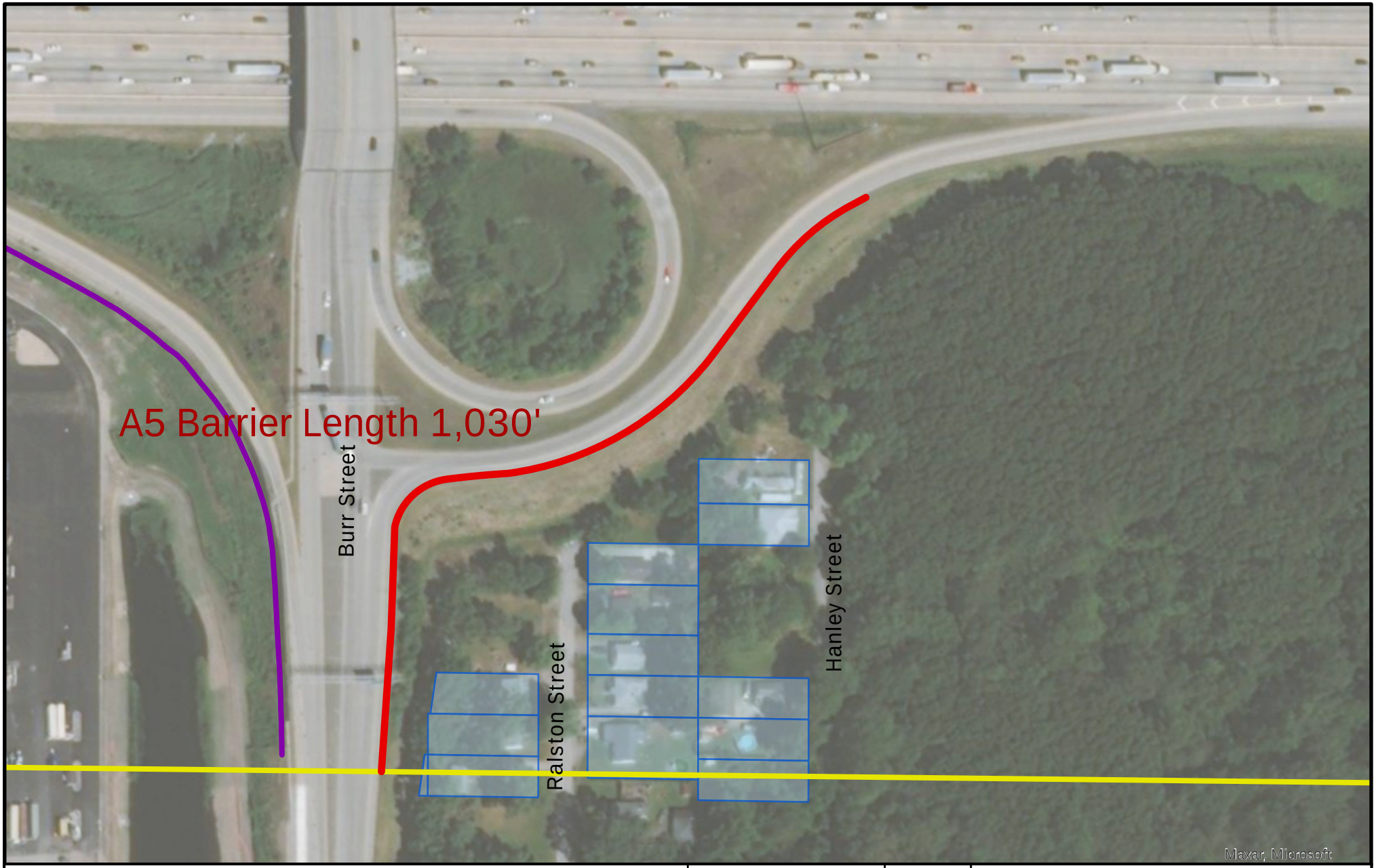
N

Date: November 2021

A-4

I-80/94 Borman Expressway
PEL Study

80/94 FLEXROAD



Existing Noise Barrier

Potential New Noise Barrier Location

New Noise Barrier Location Evaluated, Not Considered Likely

800' From Edge of Pavement

FHWA Activity Category B

FHWA Activity Category C

0 60 120 Feet

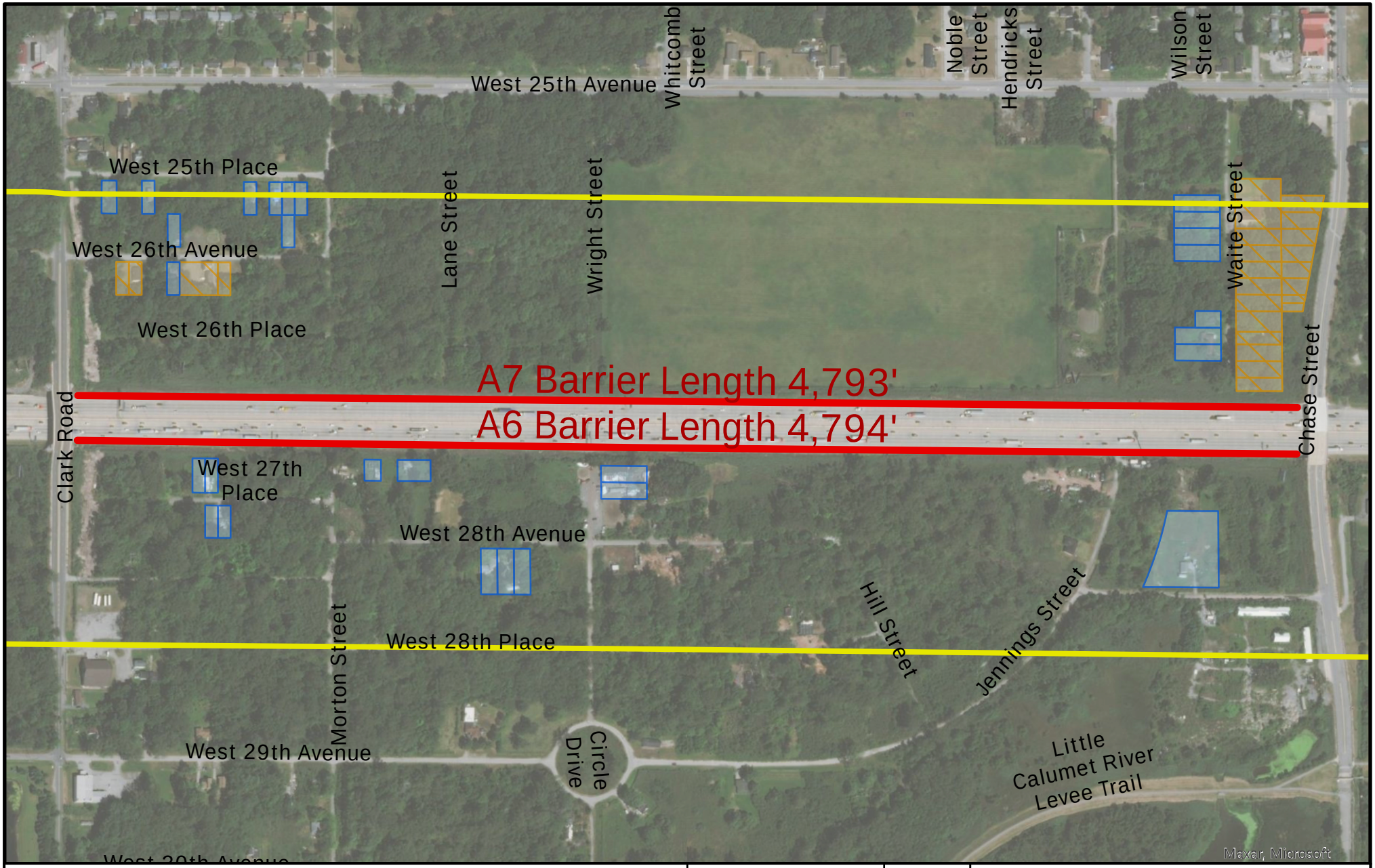
N

Date: November 2021

A-5

I-80/94 Borman Expressway
PEL Study

80/94 FLEXROAD



Existing Noise Barrier

Potential New Noise Barrier Location

New Noise Barrier Location Evaluated, Not Considered Likely

800' From Edge of Pavement

FHWA Activity Category B

FHWA Activity Category C

0 225 450 Feet

N

Date: November 2021

A-6

I-80/94 Borman Expressway
PEL Study

80/94 FLEXROAD

Existing Noise Barrier

Potential New Noise Barrier Location

New Noise Barrier Location Evaluated, Not Considered Likely

800' From Edge of Pavement

FHWA Activity Category B

FHWA Activity Category C

0 120 240 Feet

N

Date: November 2021

A-7

I-80/94 Borman Expressway
PEL Study

80/94 FLEXROAD

ATTACHMENT B: POTENTIAL NOISE BARRIER MODIFICATION LOCATIONS

Existing Noise Barrier

Potential Existing Noise Barrier Modification

Potentially Benefited Receptors

FHWA Activity Category B

FHWA Activity Category C

0 75 150 Feet

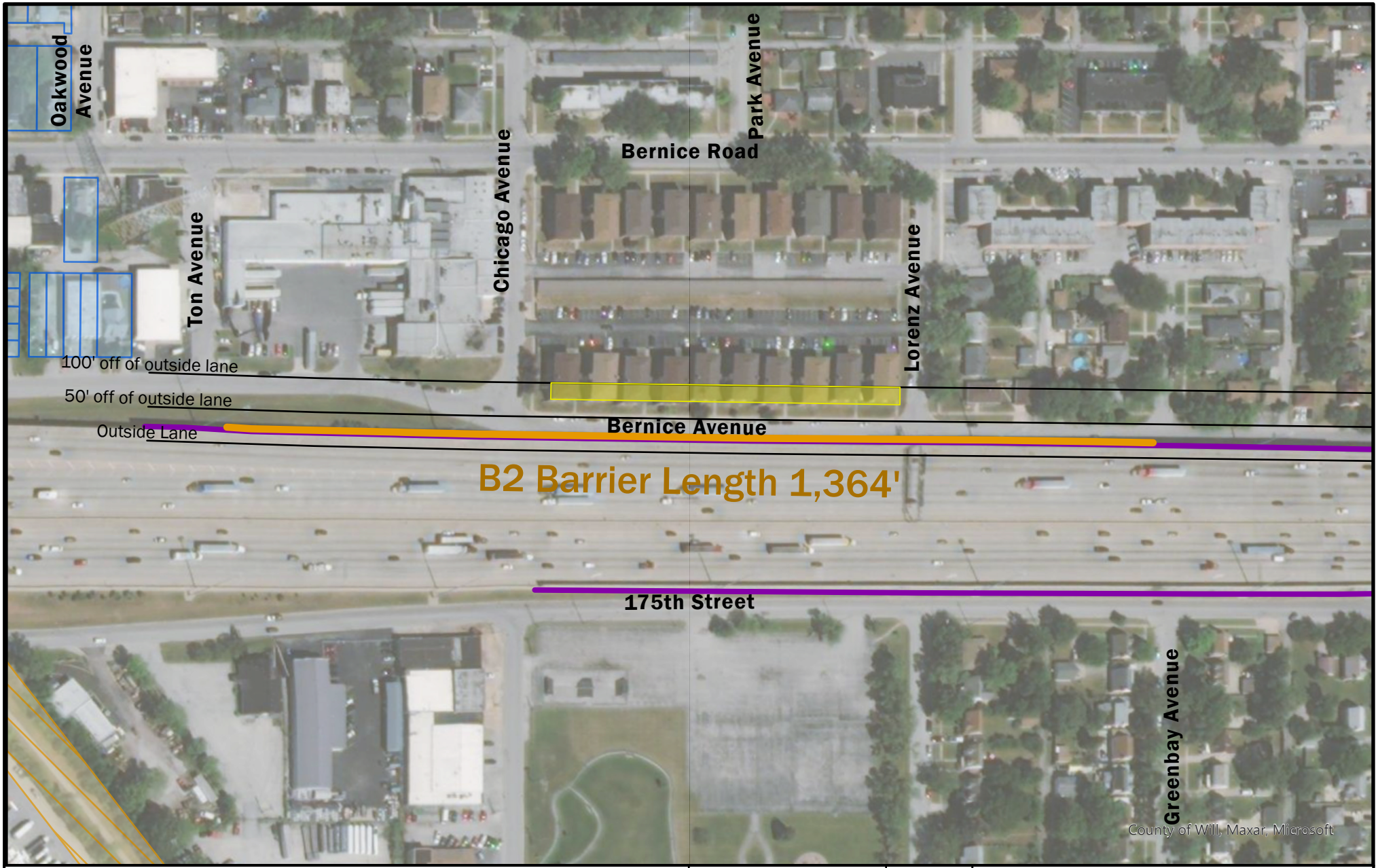
N

Date: November 2021

B-1

I-80/94 Borman Expressway PEL Study

80/94 FLEXROAD



Existing Noise Barrier

Potential Existing Noise Barrier Modification

Potentially Benefited Receptors

FHWA Activity Category B

FHWA Activity Category C

0 75 150 Feet

N

I-80/94 Borman Expressway PEL Study

Date: November 2021

B-2

80/94 FLEXROAD

ATTACHMENT C: QUALITATIVE NOISE ANALYSIS METHODOLOGY

MEMORANDUM

To: Amber Thomas, INDOT
Laura Hilden, INDOT

From: Tony Pakeltis, Parsons

Date: September 27, 2021

Subject: Qualitative Noise Analysis Methodology

The 80/94 FlexRoad Study is considering the use of the existing shoulders as Dynamic Shoulder Lanes under certain conditions. The inside (median) shoulder is being considered for use on a regular basis during peak periods and times of severe congestion and would likely be activated over the full length of the facility (12-15 miles). The outside shoulder is being considered for use on a very limited basis, in response to an accident or construction activities and would be activated only in the area directly affected, likely no more than a 1-2 mile segment.

As part of the 80/94 FlexRoad Study, Parsons will complete a qualitative noise assessment to evaluate the following

1. Is it possible that noise barriers will be required in areas where there isn't currently noise abatement?
2. Is it possible that existing noise barriers will require increases in height to address additional noise impacts from the project?

Detailed noise modeling using the Traffic Noise Model will occur for the project when it moves into the NEPA phase. However, to support this qualitative assessment, simplified TNM modeling will be developed as needed to assess the general effect of the proposed improvements on predicted noise levels. Based on our review of projects in other states, we anticipate that the implementation of a Dynamic Shoulder Lane for routine use, as proposed for the inside shoulder on this project, would be a Type I project under 23 CFR 772. However, we believe that the limited, infrequent use of the outside shoulder would not be a Type I project. As such, the analysis would be limited to the inside shoulder use. A final determination will be made during the NEPA process in coordination with FHWA.

To address the first question, areas where sensitive noise land uses are located within 800 feet of the roadway and where there is not currently noise abatement will be assessed to determine if noise abatement would be likely. Since there are noise barriers located at many locations throughout the corridor, it is reasonable to assume that noise impacts occur adjacent to the corridor where noise barriers do not exist. Through the areas to be evaluated, an estimated noise barrier height and length will be assumed. Based on that information an estimated cost will be calculated. This wall cost will be used to determine the number of receivers that would have to be benefited by a noise barrier to be considered cost-effective. Based on this information, a qualitative assessment will be made to determine if it is possible that noise barriers could be cost-effective per each states' policies at these locations. For the purposes of the PEL study, any of these new noise barriers that are identified as potentially cost effective will be identified as possible and included in the planning level cost estimates prepared for this project.

To address the second question, a simplified noise model will be developed to determine the effects of adding traffic on the inside shoulder. It is assumed predicted noise levels adjacent to I-80/I-94 will increase if the proposed improvements are implemented, and these increases will result in noise impacts that the existing barriers do not completely address. The simplified noise model will be used to roughly estimate how much of a

noise level increase can be expected. The simplified noise model will also be used to determine how much of a noise barrier height increase would be required for potentially benefited receptors to receive an additional 5 decibel reduction or greater from the increased barrier height. A cost will be estimated for this additional height, and that information will be used to determine how many benefited receptors would be required for a noise barrier height increase to be classified as cost-effective per each states' policies. This approach is based on Illinois DOT policy for "Assessing Feasibility and Reasonableness of Modifying Existing Noise Barriers". Indiana DOT does not have a similar policy so it is recommended that the Illinois approach be applied through the entire project area.

The simplified noise model will be developed based on the following parameters in Table 1.

Table 1. TNM Parameters for Qualitative Noise Assessment

TNM Feature	Comment
Horizontal Geometry	"Straight"
Roadway Profile	"Flat"
Roadways	A TNM roadway will be coded for each lane of travel – 5 lanes in each direction for existing and 6 lanes in each direction for proposed. A TNM roadway will be coded for the inside and outside shoulders.
Barrier	A noise barrier will be coded off the outside shoulder with a height of 15 feet. A barrier will be coded to represent the median barrier.
Traffic	LOS C traffic will be assigned to each lane of travel.
Receivers	Receivers will be included at 50-foot intervals extending out 800 feet from the roadway.

Results of this qualitative noise assessment will be used to identify potential noise mitigation costs. A complete Traffic Noise Impact Assessment will be performed when the project is in the NEPA phase.