# Appendix O

## Noise and Vibration Technical Memorandum

- Final EIS Addendum O, Noise and Vibration Technical Memorandum, July 2022

# Chicago Red Line Extension Project

## Noise and Vibration

## Final EIS Addendum O

July 2022

*Prepared for:*
Chicago Transit Authority
567 W. Lake Street
Chicago, IL 60661

*Prepared by:*
Cross Spectrum Acoustics
25A Granby Street
East Longmeadow, MA 01028

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## Abbreviations

| | |
|---|---|
| ANSI | American National Standards Institute |
| API | Area of Potential Impact |
| BMPs | Best Management Practices |
| CHA | Chicago Housing Authority |
| CMAP | Chicago Metropolitan Agency for Planning |
| CN/MED | Canadian National/Metra Electric District |
| CSA | Cross-Spectrum Acoustics |
| CTA | Chicago Transit Authority |
| CWR | Continuous Welded Rail |
| dBA | A-Weighted Decibel |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| FDL | Force Density Level |
| FTA | Federal Transit Administration |
| hrs | hours |
| Hz | Hertz (cycles per second) |
| IHB | Indiana Harbor Belt Railroad |
| ISO | International Standards Organization |
| $L_{dn}$ | Day-Night Equivalent Sound Level |
| $L_{eq}$ | Equivalent sound Level |
| $L_{max}$ | Maximum Noise Level |
| LSTM | Line Source Transfer Mobility |
| mph | miles per hour |
| NEPA | National Environmental Policy Act |
| NIST | National Institute of Standards and Technology |
| NS | Norfolk Southern Railway |
| RLE | Red Line Extension |
| RMS | Root Mean Square |
| RRT | Rail Rapid Transit |
| SEL | Sound Exposure Level |
| TIP | Transportation Improvement Program |
| TM | transfer mobility |
| UPRR | Union Pacific Railroad |
| VdB | Vibration Decibels referenced to 1 micro-inch per second |

# Section 1 - Summary

This technical memorandum was prepared to support the Final Environmental Impact Statement (EIS) for the Chicago Transit Authority (CTA) Red Line Extension (RLE) Project. The purposes are to identify potential noise and vibration impacts and mitigation measures associated with the Preferred Alignment of the Union Pacific Railroad (UPRR) Rail Alternative and to compare them with those identified for the UPRR East and West Options in **Appendix O** in the Draft EIS (CTA 2016).

The analysis of noise and vibration for the Preferred Alignment was carried out using methods similar to those documented in the Draft EIS, described in **Appendix O** of the Draft EIS. The primary difference is that the Federal Transit Administration (FTA) detailed analysis methodology was used rather than the FTA general assessment methodology. The analysis included updates to existing noise and vibration conditions based on noise and vibration measurements conducted in September 2020. While the results of the updated measurements were generally consistent with those conducted for the Draft EIS, they were more extensive to allow for a more detailed characterization of the existing noise and vibration conditions.

Consistent with the Draft EIS, there would be no noise or vibration impacts from the No Build Alternative. For the Preferred Alignment, the analysis identified noise impacts without mitigation at a total of 369 residences, with moderate impacts at 278 residences and severe impacts at 91 residences. In addition to these residential impacts, the analysis identified noise impacts without mitigation at three institutional receivers, including a severe impact at one church and moderate impacts at one church and a community center.

A comparison of Draft and Final EIS residential noise impacts without mitigation is provided in **Table 1-1**. As indicated in this table, a total of 369 impacts are projected for the Preferred Alignment compared to 657 impacts for the East Option and 787 impacts for the West Option. Moderate noise impacts are projected at 278 residences for the Preferred Alignment compared to 574 moderate impacts for the East Option and 738 moderate impacts for the West Option. Severe noise impacts are projected at 91 residences for the Preferred Alignment compared to 83 severe impacts for the East Option and 49 severe impacts for the West Option. In addition, noise impacts were projected at seven institutional receivers for the Draft EIS, including a severe noise impact at one park as well as moderate noise impacts at three churches and three parks for the East Option. A severe noise impact at one park and moderate noise impacts at four churches and two parks were projected for the West Option. Due to differences in analysis methodology, including refined characterization of existing conditions and more detailed calculations, the Final EIS analysis predicts a greater number of severe noise impacts than the Draft EIS analysis, but considerably fewer moderate noise impacts.

Table 1-1: Comparison of Draft and Final EIS Residential Noise Impacts Without Mitigation

| Area of Impact | UPRR Alternative East Option | | UPRR Alternative West Option | | UPRR Alternative Preferred Alignment | |
|---|---|---|---|---|---|---|
| Level of Noise Impact: | Moderate | Severe | Moderate | Severe | Moderate | Severe |
| 95th Street to 103rd Street | | | | | | |
| West of Track Structure | 167 | 25 | 209 | 32 | 40 | 12 |
| East of Track Structure | 108 | 22 | 81 | 1 | 23 | 0 |
| 103rd Street to 111th Street | | | | | | |
| West of Track Structure | 1 | 0 | 125 | 0 | 40 | 4 |
| East of Track Structure | 107 | 25 | 62 | 0 | 31 | 13 |
| 111th Street to Michigan Avenue at 116th Street | | | | | | |
| West of Track Structure | 37 | 0 | 145 | 9 | 44 | 0 |
| East of Track Structure | 98 | 4 | 47 | 0 | 35 | 21 |
| Michigan Avenue to CN/MED Rail Corridor | | | | | | |
| West of Track Structure | 16 | 0 | 41 | 7 | 18 | 8 |
| East of Track Structure | 40 | 7 | 28 | 0 | 47 | 33 |
| Total No. of Impacts: | 574 | 83 | 738 | 49 | 278 | 91 |
| | 657 | | 787 | | 369 | |

*Source: CSA 2021*

To reduce noise impacts below FTA noise impact criteria, the Draft EIS proposed constructing a noise barrier approximately 4 feet in height above the concrete deck to provide a 10-dBA (A-weighted decibel) reduction in project noise along both sides of the elevated track structure from the 95th Street/Dan Ryan terminal to the Canadian National/Metra Electric District (CN/MED) tracks near 119th Street. Based on the updated noise analysis for the Final EIS, a total of 33,600 lineal feet (6.36 miles) of noise barriers, located on both sides of the elevated track structure from just east of Wentworth Avenue in the I-57 right-of-way to the CN/MED tracks near 119th Street and extending to a height of 3.5 feet above the top-of-rail elevation, is recommended to provide a project noise reduction of up to 15 dBA.

Whereas the Draft EIS analysis for the East and West Options concluded that noise barriers would eliminate all noise impacts, the results for the Preferred Alignment indicate that moderate noise impacts are expected to remain at 15 residences after mitigation with noise barriers, primarily due to the proximity of these residences to track turnouts and crossovers. Other means to mitigate the moderate noise impacts remaining after noise barrier mitigation may be examined during detailed design.

Consistent with the Draft EIS, no vibration impacts were identified, and no vibration mitigation measures are proposed. In addition, construction best management practices (BMPs) would be used to reduce noise and vibration as described in the Draft EIS, and no construction noise or vibration impacts are anticipated.

# Section 2 - Project Description and Background

CTA, as project sponsor to the FTA, proposes to extend the existing Red Line heavy rail transit service 5.6 miles south from the existing 95th/Dan Ryan terminal to Chicago's Far South Side. This project is one part of the Red Ahead Program to extend and enhance the entire Red Line. The Red Line provides rapid transit services 24/7 and is the most heavily traveled rail line in the CTA System.

The RLE Project would reduce commute times for residents, improve mobility and accessibility, and provide connection to other transportation modes. The RLE Project could also foster economic development, where new stations may serve as catalysts for neighborhood revitalization and help reverse decades of disinvestment in local business districts. The RLE Project would also provide a modern, efficient railcar storage yard and shop facility.

CTA undertook an extensive Alternatives Analysis process from 2006 to 2009 that considered multiple modes and corridor options for the RLE Project. The Chicago Transit Board designated the UPRR Rail Alternative as the Locally Preferred Alternative on August 12, 2009. Based on further technical analysis and public input, CTA selected the UPRR Rail Alternative as the NEPA Preferred Alternative in August 2014. The Draft EIS, published on October 6, 2016, disclosed the environmental benefits and impacts of the No Build Alternative and the two UPRR Rail Alternative options: the East Option and the West Option shown in **Figure 2-1**.

Subsequent to the publication of the Draft EIS, continued design and outreach by CTA resulted in the selection of the Preferred Alignment for the RLE Project. The Preferred Alignment was announced to the public on January 26, 2018. The Preferred Alignment is a hybrid of the East and West Options of the UPRR Rail Alternative presented in the Draft EIS. CTA reviewed multiple locations for a cross-over area that would maximize the benefits and reduce the impacts of the East and West Options.

The UPRR provided comments on the Draft EIS where they expressed their preference for the West Option due to concerns for the proximity of the East Option to their tracks. UPRR noted that the location of the Roseland Pumping Station could not accommodate UPRR's requested clearance of 25 feet between the centerlines of the UPRR's potential tracks and the proposed East Option. Therefore, all hybrid options considered in selecting the Preferred Alignment started with the West Option and crossed over from the west to the east side of the UPRR tracks south of the pumping station and north of 115th Street to minimize property impacts. Comparative analysis of parcel impacts and alignment with the goals of the RLE Project identified the vicinity of 108th Place as the cross-over location that would provide the greatest benefit. A cross-over in the vicinity of 108th Place would preserve viable businesses; minimize impacts on schools, residences, and the historic

Roseland Pumping Station; and preserve properties slated for future development surrounding the station areas. However, additional engineering refined the alignment further, which moved the UPRR crossing north from 108th Place to 107th Place. The refinement would lower the 111th Street station platform height and would lower the profile of the elevated structure…

After the announcement of the Preferred Alignment in 2018, CTA continued to conduct stakeholder coordination and further develop design plans. Norfolk Southern Railway (NS) shared their plans for future potential access to Canadian National/Metra Electric District (CN/MED) tracks to the north of Kensington Yard and the national freight rail network at that location. This access would allow restoration of a former connection that the Michigan Central Railroad had with the CN/MED tracks, which were then owned by the Illinois Central Railroad. The 120th Street yard and shop presented in the Draft EIS would have precluded future potential access to those tracks as well as access to All American Recycling located west of the railroad tracks (11900 S. Cottage Grove Avenue). The All American Recycling facility is served by the NS via its joint ownership of Conrail and the Indiana Harbor Belt Railroad (IHB). This coordination with NS resulted in additional adjustments to the Preferred Alignment near the 120th Street yard and shop. The 120th Street yard and shop and the tracks south to 130th Street were shifted approximately 100 feet to the west to accommodate NS railroad access to the All American Recycling and potential improvements to the national freight rail network, namely a future connection from the NS track to CN tracks along the MED corridor. In addition, this design refinement would provide a rail connection to facilitate rail delivery of ballast, ties, and other material to support CTA operations.

In 2019, CTA began exploring an opportunity to relocate the 130th Street station, the terminating station of the RLE Project, to a location south of 130th Street. The Draft EIS had originally proposed the station location north of 130th Street. In 2017, after publication of the Draft EIS, the Chicago Housing Authority (CHA) demolished Blocks 11, 12, and 13 of the Altgeld Gardens neighborhood, creating an opportunity to relocate the station south of 130th Street to the area of the demolished blocks. The demolition of Blocks 11, 12, and 13 of Altgeld Gardens was an activity completed by CHA and was independent and unrelated to the RLE Project. CTA evaluated the station relocation for feasibility. Meetings were held with partner agencies and stakeholder groups of residents in the station area with these agencies and groups expressing support for the station relocation. The design refinement relocated the station from north of 130th Street, as presented in the Draft EIS, to south of 130th Street, adjacent to the Altgeld Gardens neighborhood.

Since the publication of the Draft EIS and selection of the Preferred Alignment, three design refinements were made as discussed above: (1) the location of the 107th Place cross-over between UPRR East and West alignment options evaluated in the Draft EIS required for selection of a hybrid Preferred Alignment; (2) refinement of the 120th Street yard and shop location; and (3) relocation

of the 130th Street station to extend the Preferred Alignment farther south so the 130th Street station would be within the Altgeld Gardens neighborhood. These design refinements were evaluated in a Supplemental Environmental Assessment (EA). The agency coordination and outreach associated with the Supplemental EA have influenced the design refinements incorporated into the Preferred Alignment and that is analyzed in this Final EIS.

Additional details about the Preferred Alignment may be found in **Appendix E**.

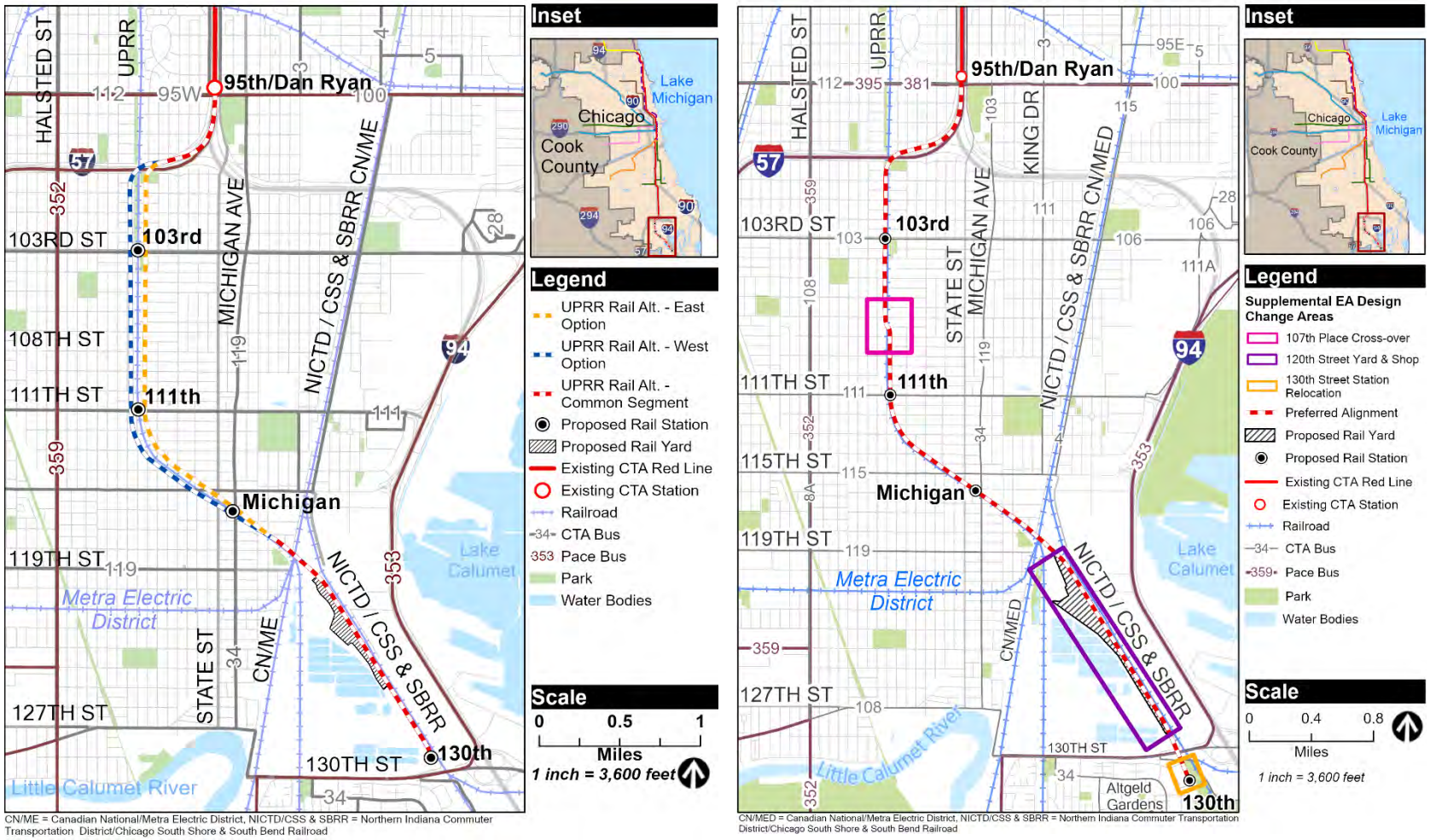



Figure 2-1: Left- East and West Options of the UPRR Rail Alternative (Draft EIS), Right- Preferred Alignment (Final EIS)

# Section 3 - Methods for Impact Evaluation

Methods presented in **Appendix O** for the Draft EIS analysis have been carried forward to evaluate the noise and vibration impacts. This section documents the methodology for evaluating this resource, consistency with the methodology used in the Draft EIS, and any methodological changes.

## 3.1 Regulatory Framework

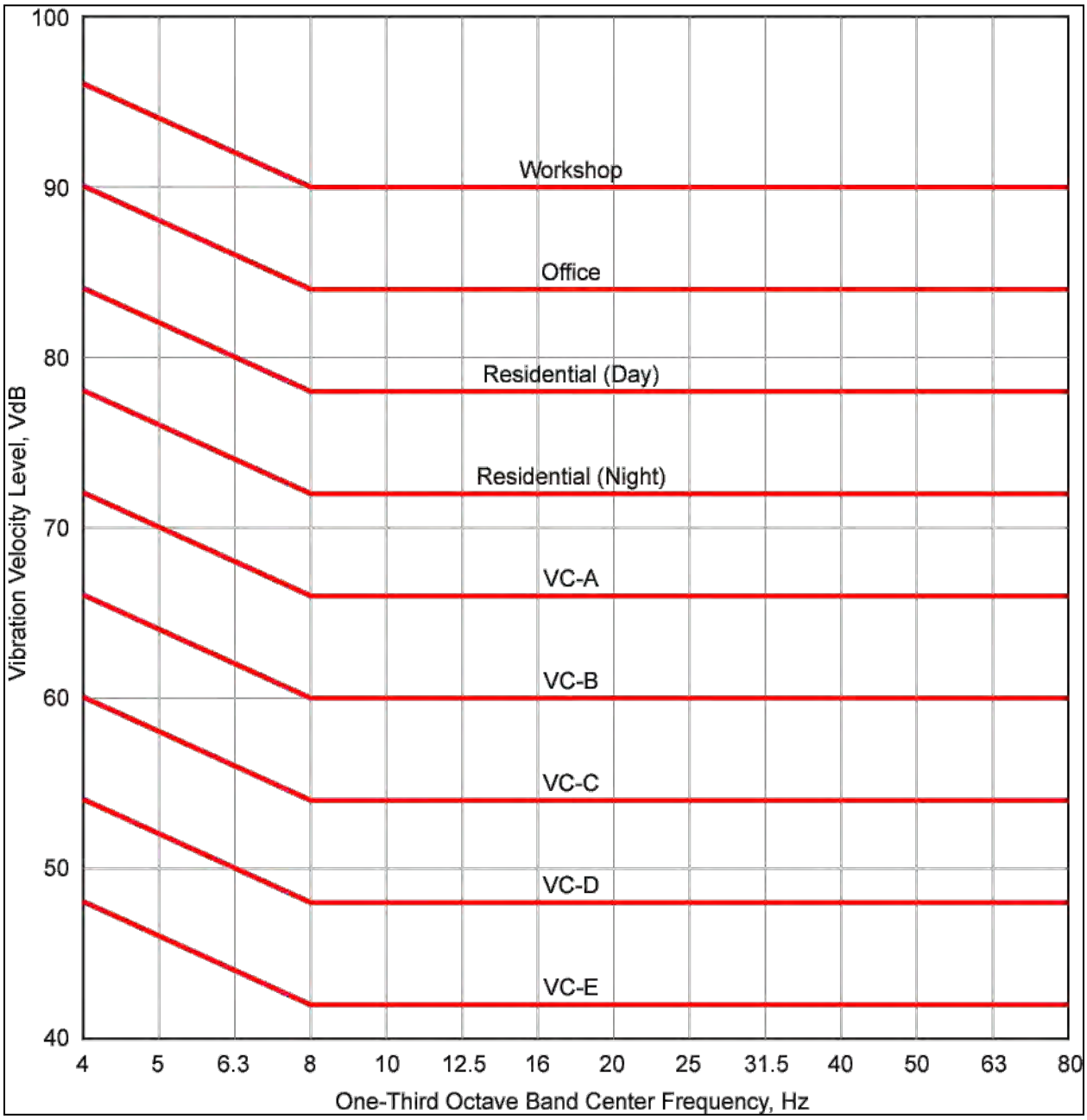
As with the Draft EIS, the Final EIS noise and vibration analyses for this project were prepared in accordance with federal guidelines. The current federal guidelines are included in the FTA *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018), which is an updated version of the 2006 guidance manual available when the Draft EIS analyses were conducted. Although the 2018 version of the manual includes some minor updates to the methodology, the noise and vibration impact criteria are the same as in the 2006 version. The primary difference relevant to the Final EIS evaluation is that the FTA detailed noise and vibration analysis procedures were used whereas the FTA general noise and vibration assessment procedures were used for the Draft EIS analyses.

There are no changes to the state or local regulations referenced in **Appendix O** of the Draft EIS. **Appendix O** further notes that the noise and vibration limits in these regulations are not applicable to the RLE Project.

## 3.2 Impact Analysis Thresholds

For the Final EIS, the impact analysis thresholds for operational noise and for construction noise and vibration are the same as those used in the Draft EIS. For operational vibration, however, the FTA vibration impact criteria for a detailed vibration analysis are applied instead of the FTA general vibration assessment criteria.

The FTA criteria for a detailed vibration assessment are shown in **Figure 3-1** and descriptions of the curves are shown in **Table 3-1**. The curves in **Figure 3-1** are applied to the projected vibration spectrum for the train operations. If the vibration level at any one frequency exceeds the criteria, there is impact. Conversely, if the entire vibration spectrum is below the curve, there will be no impact. Based on these criteria, the impact analysis thresholds for operational vibration are 72 vibration decibels (VdB) for residential buildings and 78 VdB for institutional buildings as measured in 1/3-octave bands of frequency over the frequency range from 8 to 80 hertz (Hz).




Source: FTA 2018

Figure 3-1: FTA Detailed Vibration Criteria

Table 3-1: Interpretation of Vibration Criteria for Detailed Analysis

| Criterion Curve (See Figure 3-1) | Maximum Level* (VdB) | Description of Use |
|---|---|---|
| Workshop (ISO) | 90 | Vibration that is distinctly felt. Appropriate for workshops and similar areas not as sensitive to vibration. |
| Office (ISO) | 84 | Vibration that can be felt. Appropriate for offices and similar areas not as sensitive to vibration. |
| Residential Day (ISO) | 78 | Vibration that is barely felt. Adequate for computer equipment and low-power optical microscopes (up to 20X). |
| Residential Night, Operating Rooms (ISO) | 72 | Vibration is not felt, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power optical microscopes (100X) and other equipment of low sensitivity. |
| VC-A | 66 | Adequate for medium- to high-power optical microscopes (400X), microbalances, optical balances, and similar specialized equipment. |
| VC-B | 60 | Adequate for high-power optical microscopes (1000X) and inspection and lithography equipment to 3-micron line widths. |
| VC-C | 54 | Appropriate for most lithography and inspection equipment to 1-micron detail size. |
| VC-D | 48 | Suitable in most instances for the most demanding equipment, including electron microscopes operating to the limits of their capabilities. |
| VC-E | 42 | The most demanding criterion for extremely vibration-sensitive equipment. |

* RMS vibration velocity level (in VdB re 1 micro-inch/sec) as measured in 1/3-octave bands of frequency over the frequency range from 8 to 80 Hz.
Source: FTA 2018

## 3.3 Area of Potential Impact

For the Final EIS, the area of potential impact (API) is defined based on the FTA impact screening distances from Rail Rapid Transit (RRT) sources for residential land use. The applicable screening distances for noise impact are 700 feet from the guideway centerline where the sound path is unobstructed and 350 feet from the guideway centerline where there are intervening buildings. For

vibration, the applicable screening distances are 200 feet for residential land use and 120 feet for institutional land use, as measured from the right-of-way or property line.

The API for the Final EIS analysis is greater than that defined in the Draft EIS, which was based on the moderate noise impact contours determined from a general assessment.

## 3.4 Methods

The analysis of noise and vibration for the Preferred Alignment was carried out using methods similar to those documented in the Draft EIS, described in **Appendix O**. The primary difference is that the FTA detailed analysis methodology was used rather than the FTA general assessment methodology. The noise and vibration prediction methods used for the detailed analysis are described in the subsections below.

### 3.4.1 Noise Modeling Methodology

Noise exposure levels from train operations, in terms of day-night sound level ($L_{dn}$) and peak-hour equivalent sound level ($L_{eq}$), were predicted using a spreadsheet model incorporating the methods specified in Section 4 of the FTA guidance manual for a detailed noise analysis. The predictions were based on the following assumptions (updated from the Draft EIS in some cases):

- Consistent with the FTA noise source reference level for rail transit cars, the predictions assume that a single CTA vehicle operating at 50 miles per hour (mph) on at-grade ballast and tie track with continuous welded rail (CWR) generates a Sound Exposure Level (SEL) of 82 dBA at a distance of 50 feet from the track centerline.
- Consistent with FTA methodology, an adjustment of +4 dBA is applied to the predicted noise levels along most of the Preferred Alignment where trains would operate on closed deck aerial structure with slab track.
- Based on the hourly train schedule provided by CTA, it is assumed that there would be 304 daytime (7 AM to 10 PM) train operations and 110 nighttime (10 PM to 7 AM) train operations. This schedule corresponds to a total of 414 trains over a 24-hour period (compared to 378 assumed for the Draft EIS analysis). Peak transit hour headways in each direction are assumed to range from 3 to 6 minutes, with an average of 4.5 minutes.

- It is assumed that trains would consist of eight cars between 5 AM and midnight, four cars between midnight and 4 AM, and 6 cars between 4 AM and 5 AM (the Draft EIS analysis assumed 8-car trains from 3 AM to 6 PM and 4-car trains from 6-PM to 3 AM).
- Based on speed data provided by CTA, train speeds are assumed to vary by location along the Preferred Alignment, with a maximum speed of 53 mph (the Draft EIS analysis assumed a speed of 55 mph except near the stations).
- Consistent with current FTA guidance, wheel impacts at crossovers and turnouts are assumed to cause localized noise increases of 5 dBA within a distance of 300 feet.
- To account for shielding by aerial structures, an adjustment of -5 dBA is applied to the predicted noise from trains on the far track for receivers within 150 feet of the far track.

### 3.4.2 Vibration Modeling Methodology

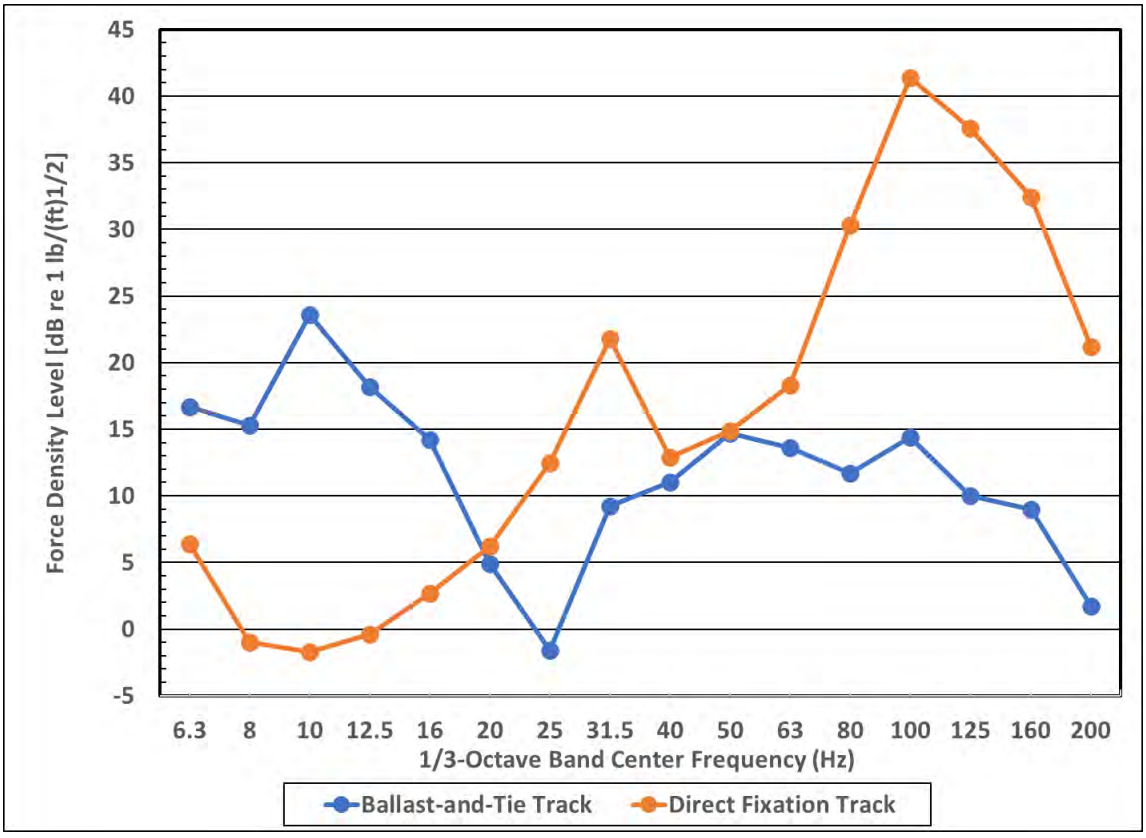
Projections of ground-borne vibration from train operations, in terms of the maximum vibration velocity level (VdB), were carried out using the detailed vibration analysis procedures specified in Section 6 of the FTA guidance manual, based on the following factors:

- Vibration source level data for the CTA vehicles operating on closed deck aerial structure with slab track and CWR were obtained from measurements conducted at existing representative CTA aerial structure locations in September 2020.
- Ground-borne vibration propagation tests were conducted at five sites along the Preferred Alignment as described in **Section 4.2**. These tests measured the response of the ground to an input force. The results of these tests were combined with vibration source level data for the CTA vehicles to project vibration levels from trains operating on the Preferred Alignment.
- Based on speed data provided by CTA, train speeds are assumed to vary by location along the Preferred Alignment, with a maximum speed of 53 mph.
- Consistent with current FTA guidance, wheel impacts at track crossovers and turnouts are assumed to cause localized vibration increases of 10 VdB within a distance of 100 feet and increases of 5 VdB at distances between 100 feet and 200 feet.
- No adjustments were made for vibration propagation from the ground to building spaces.

The source vibration characteristics of the CTA vehicles are represented by the force density level (FDL). The FDL was determined based on tests conducted adjacent to the CTA Orange Line at 53rd

Street and Kostner Avenue, where trains operate on a closed deck aerial structure with ballast-and-tie track structure. The tests included ground-borne vibration propagation measurements as well as measurements of ground vibration from train operations at the aerial structure site.

The FDL measured for ballast-and-tie track was adjusted for train operation on direct fixation slab track based on tests conducted adjacent to the CTA Red and Brown Line aerial structure north of Fullerton Station. At this site, ground vibration measurements were performed for representative train operations on the structure. The results were then compared to the ground vibration levels measured for train operations on the Orange Line structure, and the FDL was adjusted based on the difference in vibration levels at the two sites. The resulting FDL frequency spectra for CTA train operations on aerial structures with both ballast-and-tie and direct fixation track are presented in **Figure 3-2,** normalized to a train speed of 50 mph.




Source: CSA 2021

Figure 3-2: FDL Spectra at 50 mph for CTA Train Operations on Aerial Structure

The FDL for direct fixation track was combined with the ground-borne vibration propagation test results along the Preferred Alignment to project vibration levels as a function of distance for CTA operations on the RLE aerial structure.

# Section 4 - Affected Environment

This section describes updates to the existing noise and vibration conditions near the RLE Project since the publication of the Draft EIS. This section documents updates to the baseline data as well as any changes to noise and vibration planning and policy framework in the communities and jurisdictions affected by the Preferred Alignment.

## 4.1 Existing Noise Conditions

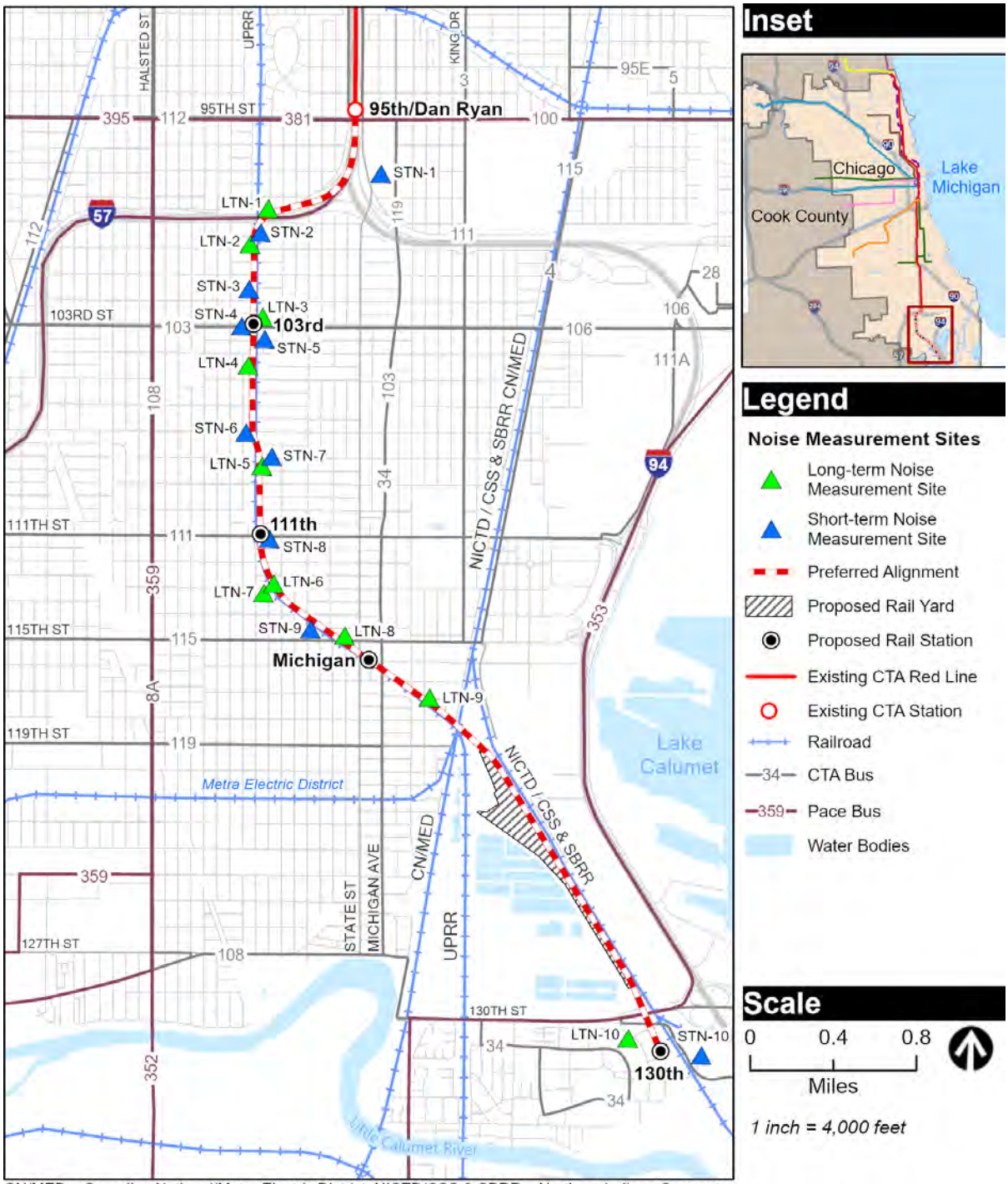
Noise-sensitive land uses along the Preferred Alignment include many residences as well as churches, schools, parks, and community facilities. Existing noise sources along the RLE Project include roadway traffic, rail operations, and local activities. The existing ambient sound levels vary by location, depending on the proximity to highways, railways, and other noise sources, and are generally typical of an urban environment. Updated existing ambient noise levels were characterized through direct measurements at representative sites in the study area on September 14-17, 2020.

### 4.1.1 Noise Measurement Locations and Procedures

The noise measurement program consisted of both long-term (24-hour) and short-term (one-hour) monitoring of the A-weighted sound level. General locations for the measurements were pre-approved by CTA and FTA, and specific sites were selected in the field to represent a range of existing noise conditions at noise-sensitive areas along the project alignment. For the Preferred Alignment, long-term noise measurements were made at ten sites (designated as LTN-1 through LTN-10) and short-term noise measurements were made at ten sites (designated as STN-1 through STN-10). The noise measurement locations are shown in **Figure 4-1**.

At each of the measurement sites, the A-weighted sound levels were continuously monitored during the measurement periods. The noise measurements were performed with NTi Audio model XL2 and Larson Davis model 820 noise monitors that conform to American National Standards Institute (ANSI) Standard S1.4 for Class 1 (Precision) sound level meters. Calibrations, traceable to the U.S. National Institute of Standards and Technology (NIST), were carried out in the field before and after each set of measurements using an acoustical calibrator.

In all cases, the measurement microphone was protected by a windscreen and supported on a tripod at a height of four to six feet above the ground and was positioned to characterize the exposure of the site to the dominant noise sources in the area. For example, microphones were located at the approximate setback lines of the receptors from adjacent roads or rail lines, and were positioned to avoid acoustic shielding by landscaping, fences, or other obstructions.




CN/MED = Canadian National/Metra Electric District, NICTD/CSS & SBRR = Northern Indiana Commuter Transportation District/Chicago South Shore & South Bend Railroad

Source: CSA 2021

Figure 4-1: Noise Measurement Site Locations

### 4.1.2 Noise Measurement Results

The results of the existing ambient noise measurements are summarized in **Table 4-1** for the long-term sites and in **Table 4-2** for short-term sites. Because UPRR train operations are a major contributor to the existing noise levels at many locations along the Preferred Alignment, $L_{dn}$ values for long-term measurements in **Table 4-1** are provided both with and without train noise.

Table 4-1: Summary of Existing Ambient Long-Term Noise Measurement Results

| Site No. | Measurement Location Description | Measurement Period | | | Noise Exposure Ldn (dBA) | |
|---|---|---|---|---|---|---|
| | | Start Date | Start Time | Duration (hrs.) | Meas. | w/o Train Noise |
| LTN-1 | 9821 S. Harvard Avenue (Residence) | 9/14/20 | 10:00 | 24 | 77 | 77 |
| LTN-2 | 400 W. 100th Street (Residence) | 9/14/20 | 10:00 | 24 | 67 | 62 |
| LTN-3 | 351 W. 102nd Place (Residence) | 9/14/20 | 10:00 | 24 | 76 | 72 |
| LTN-4 | 10427 S. Eggleston Ave. (Residence) | 9/14/20 | 10:00 | 24 | 60 | 58 |
| LTN-5 | 346 W. 108th Place (Residence) | 9/14/20 | 11:00 | 24 | 74 | 70 |
| LTN-6 | 316 W. 113th Street (Residence) | 9/15/20 | 17:00 | 24 | 72 | 65 |
| LTN-7 | 345 W. 113th Street (Residence) | 9/15/20 | 16:00 | 24 | 65 | 61 |
| LTN-8 | 32 W. 115th Street (Residence) | 9/15/20 | 16:00 | 24 | 68 | 66 |
| LTN-9 | 310 E. 117th Street (Residence) | 9/15/20 | 16:00 | 24 | 61 | 60 |
| LTN-10 | 13015 S. Ellis Avenue (Church) | 9/15/20 | 08:00 | 24 | 61 | 61 |

Source: CSA 2021

Table 4-2: Summary of Existing Ambient Short-Term Noise Measurement Results

| Site No. | Measurement Location Description | Measurement Period | | | Noise Exposure Leq (dBA) |
|---|---|---|---|---|---|
| | | Start Date | Start Time | Duration (hrs.) | |
| STN-1 | Harlan High School | 9/14/20 | 14:10 | 1 | 63 |
| STN-2 | Wendell Smith Park | 9/14/20 | 11:30 | 1 | 65 |
| STN-3 | Kingdom Global Outreach Ministries | 9/16/20 | 13:52 | 1 | 56 |
| STN-4 | Loving Spirit Missionary Baptist Church | 9/16/20 | 12:42 | 1 | 72 |
| STN-5 | Block Park | 9/17/20 | 09:00 | 1 | 61 |
| STN-6 | Mount Ebal Baptist Church | 9/16/20 | 10:49 | 1 | 69 |
| STN-7 | Kwame Nkrumah Academy | 9/16/20 | 15:08 | 1 | 54 |
| STN-8 | Agape Community Center | 9/15/20 | 11:16 | 1 | 68 |
| STN-9 | My Holy Rock Missionary Baptist Church | 9/15/20 | 08:54 | 1 | 58 |
| STN-10 | Carver Military Academy High School | 9/15/20 | 07:30 | 1 | 59 |

Source: CSA 2021

Overall, the results in **Table 4-1** and **Table 4-2** serve as the basis for determining the existing noise conditions at all noise-sensitive receptors along the Preferred Alignment. In particular, the existing $L_{dn}$ at specific receiver locations was estimated based on the representative noise measurement data by combining the $L_{dn}$ contribution from major highway or railroad noise sources along the Preferred Alignment (adjusted for distance and shielding) with the background $L_{dn}$. The source $L_{dn}$ was calculated as follows:

$L_{dn}(source) = L_{dn}(ref) - 15*\log_{10}(D/D_{ref}) - A(shielding)$

where: $L_{dn}(source)$ = $L_{dn}$ contribution from a highway or railroad source at receiver location, dBA

$L_{dn}(ref)$ = $L_{dn}$ source contribution from data at a reference noise measurement site, dBA

D = distance from a highway or railroad source to the receiver location, feet

$D_{ref}$ = distance from highway or railroad source to a reference noise measurement site, feet

A(shielding) = attenuation due to shielding by rows of houses between the highway or railroad source and the receiver location (based on FTA methodology), dBA

The assumptions used for estimating the existing noise exposure levels are provided below in **Table 4-3**.

Table 4-3: Assumptions Used for Estimating Existing Noise Exposure Levels

| Receiver Location Along RLE Corridor | Source Reference | | | | Background Reference | |
|---|---|---|---|---|---|---|
| | Source | Site No. | $L_{dn}$ (dBA) | Distance (feet) | Site No. | $L_{dn}$ (dBA) |
| 95th Street - Wentworth Avenue | I-57 | LTN-1 | 71.7[1] | 200 | N.A. | 60 (est.) |
| Wentworth Avenue - 99th Place | I-57 | LTN-1 | 76.7 | 200 | N.A. | 60 (est.) |
| 99th Place[2] | UPRR | LTN-2 | 64.5 | 160 | LTN-2 | 62.2 |
| 100th Place - 102nd Street | UPRR | LTN-3 | 73.3 | 120 | LTN-2 | 62.2 |
| 102nd Street - 104th Street | UPRR | LTN-3 | 73.3 | 120 | LTN-3 | 72.0 |
| 105th Street[3] | UPRR | LTN-2 | 64.5 | 160 | LTN-4 | 58.2 |
| 106th Street - 112th Street | UPRR | LTN-5 | 72.0 | 160 | LTN-5 | 70.4 |
| 112th Street - Michigan Avenue | UPRR | LTN-6 | 70.4 | 105 | LTN-6 | 65.0 |
| Michigan Avenue - 118th Street | UPRR | LTN-9 | 55.7 | 250 | LTN-9 | 59.6 |
| South of 130th Street | (Bkgd.) | N.A. | N.A. | N.A. | LTN-10 | 61.1 |

[1] Assumes 5 decibel shielding where I-57 is in cut.
[2] Interpolate to calculate the reference train $L_{dn}$ at locations between 99th Place and 100th Place.
[3] Interpolate to calculate the reference train $L_{dn}$ at locations between 105th Street and 104th Street and at locations between 105th Street and 106th Street.
Source: CSA 2021

Finally, **Table 4-4** compares the updated noise measurements for the Final EIS with the measurements conducted for the Draft EIS along the UPRR corridor. However, because the updated measurements were made at different locations, this comparison is not direct. In particular, the measurements at locations 7, 8, 9 and 10 for the Draft EIS were made at sites that were closer to the UPRR tracks so that the measured noise exposure was likely dominated by freight train noise. Thus, to provide a meaningful comparison, the train noise component of the noise exposure ($L_{dn}$) was determined at comparable Final EIS measurement locations along the UPRR corridor (Sites LTN-3, LTN-5, and LTN-6), and adjusted to match the distance between the Draft EIS measurement locations and the UPRR tracks. As shown in **Table 4-4**, the updated noise measurement results are consistent with the Draft EIS results, both with an average train noise exposure level ($L_{dn}$) of 75 dBA at a distance of 80 feet from the UPRR tracks.

Table 4-4: Comparison of Draft and Final EIS Noise Measurements along the UPRR Corridor

| Data | Draft EIS (Locations 7, 8, 9 and 10) | | Final EIS Update (Sites LTN-3, LTN-5, and LTN-6) | | |
|---|---|---|---|---|---|
| | Range | Average | Range | Average | |
| | | | | Measured | Adjusted |
| Noise Exposure (Ldn, dBA) | 74-77 | 75 | 70-73 | 72 | 75 |
| Distance from UPRR (feet) | 70-100 | 80 | 105-160 | 130 | 80 |

Source: CSA 2021

The Draft EIS and Final EIS noise measurement results for the Altgeld Gardens neighborhood were also consistent. Specifically, the updated existing $L_{dn}$ measured at Site LTN-10 was 61 dBA, which is only slightly lower than the $L_{dn}$ of 63 dBA measured at Location 11 for the Draft EIS.

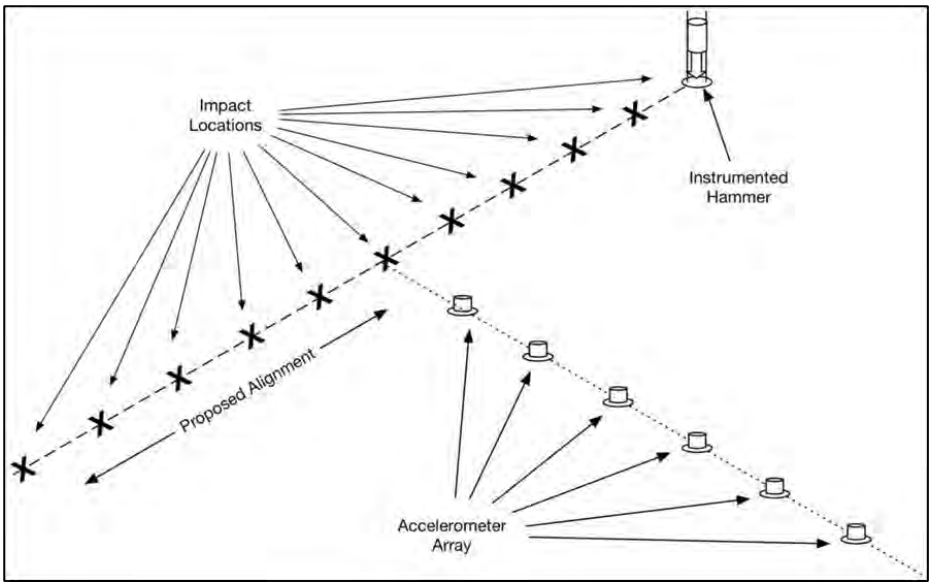
## 4.2 Existing Vibration Conditions

Vibration-sensitive land use along the Preferred Alignment is essentially the same as the noise-sensitive land use, except for parks and other outdoor sites that are not considered vibration-sensitive. Although existing vibration sources along the corridor include motor vehicles on nearby roadways, vibrations from traffic are not generally perceptible unless the roads have sizable bumps, potholes, or other uneven surfaces. Thus, the only major sources of existing ground vibration along the Preferred Alignment are freight train operations on the UPRR tracks. However, because the FTA vibration impact criteria are not ambient based (i.e., future project vibrations are not compared with existing vibrations to assess impact), the vibration measurements for the project focused on characterizing the soil conditions along the corridor as described below.

### 4.2.1 Vibration Measurement Procedures and Equipment

Vibration propagation measurements were conducted along the Preferred Alignment on September 14-16, 2020 to determine the vibration response characteristics of the ground near vibration-sensitive locations. A custom-built instrumented hammer was used to impart an impulsive force to the ground. The magnitude of the force was calculated based on the acceleration and mass of the falling hammer. The resulting vibration signals were measured using high-sensitivity accelerometers (PCB Model 393C and 393B05) mounted in a vertical direction on pavement or on steel spikes driven into the ground. The signals from the hammer and accelerometers were recorded using Data Translation DT9837A digital acquisition hardware. Data Translation's QuickDAQ software, running on a laptop computer, was used to review the measurement data.

The vibration propagation test procedure is shown schematically in **Figure 4-2**. The instrumented hammer was used to generate impulses at specific locations spaced 15 feet apart along a line on or parallel to the proposed alignment. A line of accelerometers was placed perpendicular to the line of impacts as shown in the figure. The relationship between the input force and the resulting vibration measured by the accelerometers, called the transfer mobility (TM), was calculated using proprietary software in the Cross-Spectrum Acoustics (CSA) laboratory. The transfer mobility represents the vibration propagation characteristics of the ground at the measurement site and at other sites with similar geology.




Source: CSA 2021

Figure 4-2: Vibration Propagation Measurement Schematic

In addition to the vibration propagation tests, some limited measurements were made to document existing train vibration levels at certain test sites. Although not used for the vibration assessment, these measurements supplement those conducted for the Draft EIS.

### 4.2.2 Vibration Measurement Locations

Vibration measurements were conducted at five representative sites (designated as V-1 through V-5) along the Preferred Alignment. General locations for the measurements were pre-approved by CTA and FTA, and specific sites were selected in the field to represent a range of existing soil conditions in vibration-sensitive areas along the corridor. The locations of these sites are shown in **Figure 4-3** and are described below.

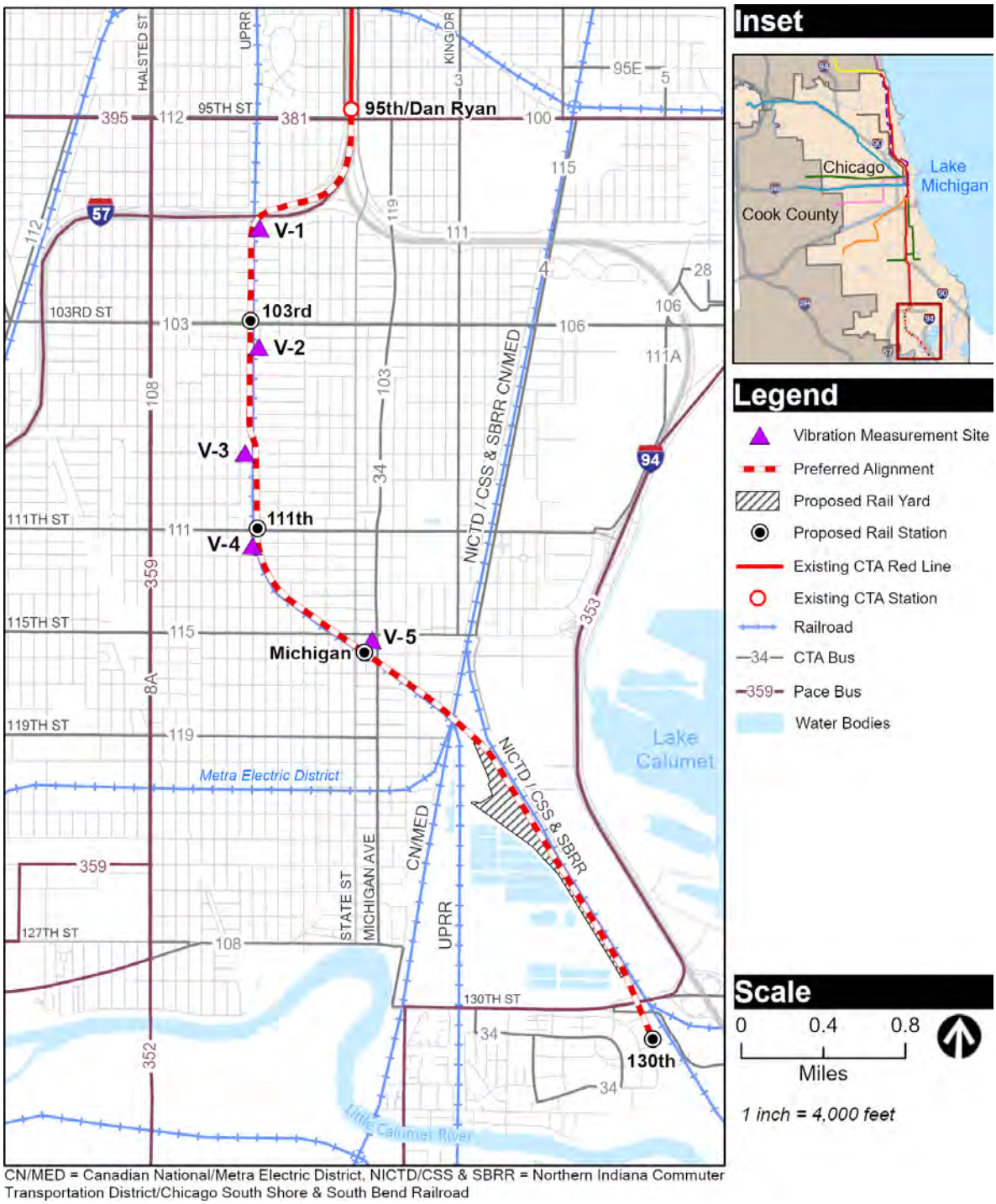
**Site V-1:** Wendell Smith Park. Vibration propagation tests and freight train vibration measurements at this site were conducted on the western edge of the baseball fields at this park, adjacent to the existing UPRR corridor.

**Site V-2:** Block Park. Vibration propagation tests at this site were conducted at the southern end of this park in the open area west of Harvard Avenue at 104th Street, adjacent to the existing UPRR corridor.

**Site V-3:** 108th Street at Eggleston Avenue. Vibration propagation tests at this site were conducted at the intersection of 108th Street and the alleyway immediately east of Eggleston Avenue, adjacent to the existing UPRR corridor.

**Site V-4:** 111th Place at 112th Street. Vibration propagation tests at this site were conducted at the intersection of 111th Place and 112th Street, adjacent to the existing UPRR corridor.

**Site V-5:** Lot at 115th Street and State Street. Vibration propagation tests and freight train vibration measurements at this site were conducted on the paved area in the empty lot north of the existing UPRR corridor, between State Street and Michigan Avenue.



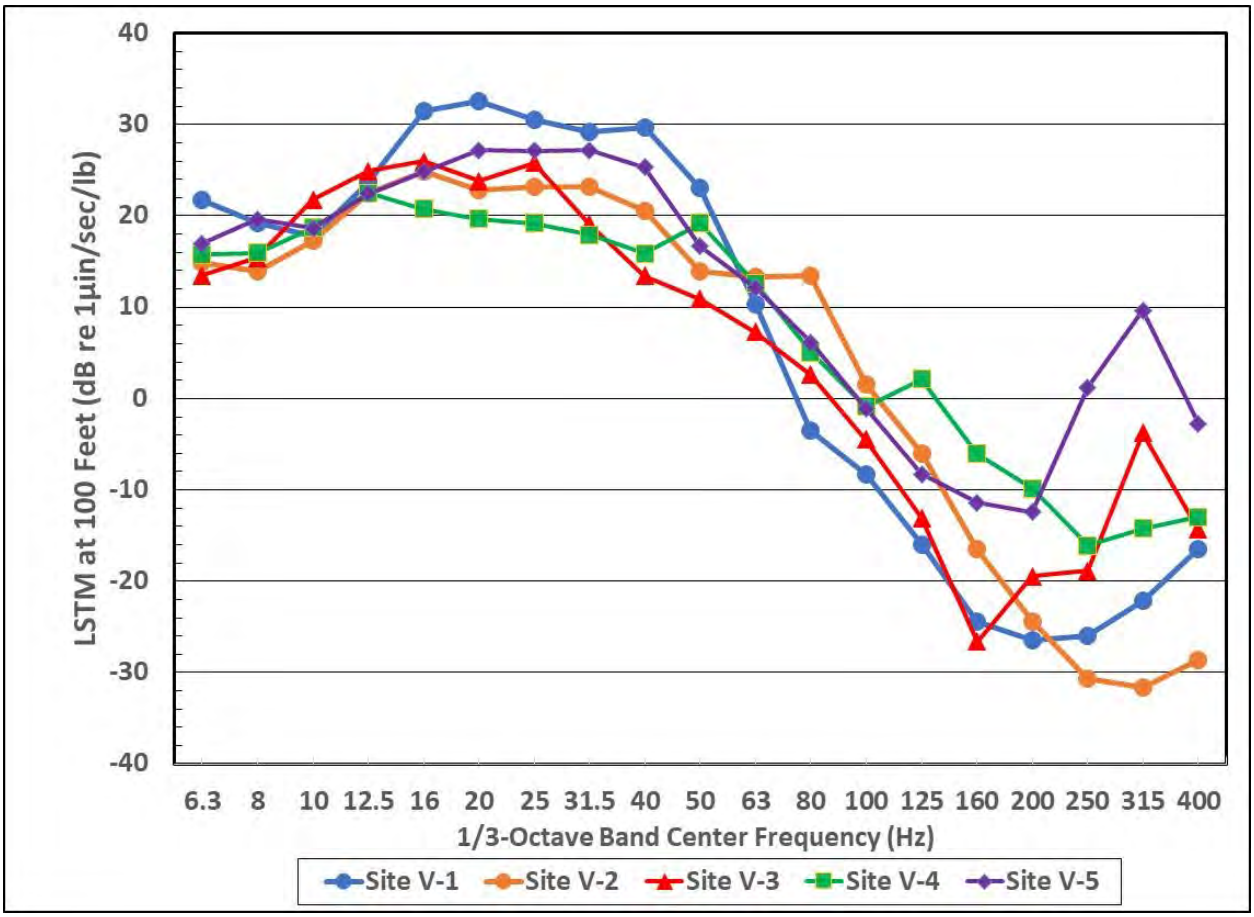

CN/MED = Canadian National/Metra Electric District, NICTD/CSS & SBRR = Northern Indiana Commuter Transportation District/Chicago South Shore & South Bend Railroad

Source: CSA 2021

Figure 4-3: Vibration Measurement Site Locations

### 4.2.3 Vibration Measurement Results

Representative results of the vibration propagation tests are shown in **Figure 4-4**. These results are provided in terms of the measured Line Source Transfer Mobility (LSTM) at a distance of 100 feet.




Source: CSA 2021

Figure 4-4: Vibration Propagation Test Data

With regard to existing vibration levels, **Table 4-5** compares the freight train vibration measurements conducted for the Final EIS with the measurements conducted for the Draft EIS along the UPRR corridor. However, because the measurements for the Final EIS were made at different locations, the results were adjusted to match the distance between the Draft EIS measurement locations and the UPRR tracks (using the FTA generalized ground surface vibration curve). As shown in **Table 4-5**, the adjusted Final EIS vibration levels of 73-78 VdB are reasonably consistent with the Draft EIS vibration levels of 75-80 VdB at 70-80 feet from the UPRR tracks.

Table 4-5: Comparison of Draft and Final EIS Freight Train Vibration Measurements along the UPRR Corridor

| Data | Draft EIS (Locations 7 and 9) | Final EIS Update | | | |
|---|---|---|---|---|---|
| | | Site V-1 | | Site V-5 | |
| | | Measured | Adjusted | Measured | Adjusted |
| RMS Velocity Level (VdB) | 75-80 | 65 | 73 | 70 | 78 |
| Distance from UPRR (feet) | 70-80 | 175 | 70-80 | 170 | 70-80 |

Source: CSA 2021

# Section 5 - Impacts and Mitigation

Consistent with the Draft EIS, the impacts and mitigation summaries are organized into three impact categories—permanent, construction, and cumulative—with references to affected communities:

- Permanent impacts relate to system operations after the project has been constructed, as well as land acquisitions necessary for the permanent right-of-way.
- Construction impacts are temporary and are anticipated to occur for the construction phase of the project, up to five years, including construction staging and utility relocations.
- Cumulative impacts are those of the project combined with other past, present, or near future projects within the API.

This section also documents any new or revised mitigation measures for identified project impacts identified under the Draft EIS, where applicable. If there is no change in the mitigation, this section indicates where there is no change when compared to the East and West Options of the UPRR Alternative evaluated in the Draft EIS. Likewise, this section indicates what additional (or fewer) measures apply to the Preferred Alignment.

## 5.1 No Build Alternative

The No Build Alternative is defined as the existing transportation system plus any committed transportation improvements that are already in the current Chicago Metropolitan Agency for Planning (CMAP) Transportation Improvement Program (TIP). No new infrastructure would be built as part of the RLE Project under the No Build Alternative. The No Build Alternative is a required alternative as part of the NEPA environmental analysis and is often used for comparison purposes to assess the relative benefits and impacts of implementing the Preferred Alignment.

It should be noted that, in accordance with FTA methodology, noise impacts (and vibration impacts in some cases) are assessed based on the existing conditions rather than on the future No Build conditions. This is because comparison of a noise or vibration projection with an existing condition is more accurate than a comparison of a projection with another projection. Because noise or vibration may increase by the time the project is operational, this approach of using existing conditions is a conservative one.

As described in **Appendix O** in the Draft EIS, there would be no noise or vibration impacts from the No Build Alternative.

## 5.2 Union Pacific Railroad Alternative – Preferred Alignment

Detailed noise and vibration impact assessments were carried out based on FTA methodology. The assessment results are presented below.

### 5.2.1 Permanent Impacts and Mitigation – Preferred Alignment

#### 5.2.1.1 Noise Impacts and Mitigation

Comparisons of the existing and future project noise levels are presented in **Table 5-1**, which includes ranges of results for FTA Category 2 (residential) receivers with both daytime and nighttime sensitivity to noise. In addition to the distances from the track and proposed train speeds, **Table 5-1** includes the existing noise levels and the projected noise levels from RLE Project train operations without mitigation. Based on a comparison of the predicted RLE Project noise levels with the FTA impact criteria, the table also includes an inventory of the number of moderate and severe noise impacts on both sides of each segment of the Preferred Alignment. Consistent with the Draft EIS, there are no noise impacts projected along the segment of the Preferred Alignment to the south of the CN/MED rail corridor, which includes the location of the relocated 130th Street station.

The results in **Table 5-1** identify noise impacts without mitigation at a total of 369 residences, with moderate impacts at 278 residences and severe impacts at 91 residences. In addition to these residential impacts, the analysis identified noise impacts without mitigation at three FTA Category 3 (institutional) receivers as follows:

1. Kingdom Global Outreach Ministries – severe noise impact is projected at this church, located on the west side of the track structure between 95th Street and 103rd Street.

2. Agape Community Center – moderate noise impact is projected at this facility, located on the east side of the track structure between 103rd Street and 111th Street.

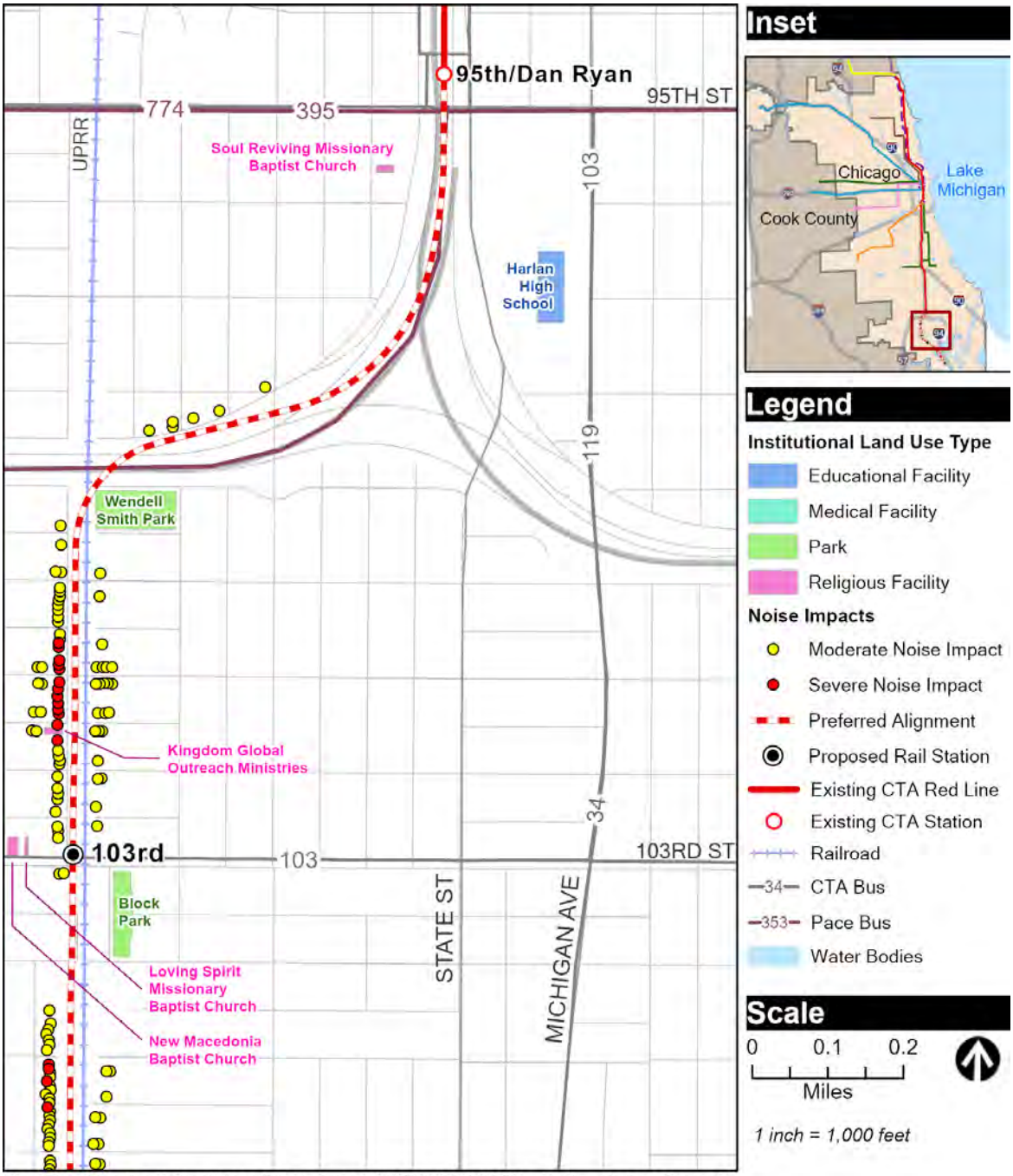
3. My Holy Rock Missionary Baptist Church – moderate noise impact is projected at this church, located between 111th Street and Michigan Avenue at 116th Street.

The locations of all projected moderate and severe noise impacts for the Preferred Alignment without mitigation are shown on the maps in **Figure 5-1**, **Figure 5-2**, **Figure 5-3**, and **Figure 5-4**.

Table 5-1: Summary of FTA Category 2 (Residential) Noise Impacts for the Preferred Alignment Without Mitigation

| Area of Impact | Distance from Near Track (feet) | Train Speed (mph) | Existing Noise Level (Ldn, dBA) | Project Noise Level (Ldn, dBA) | | | Number of Residential Noise Impacts | |
|---|---|---|---|---|---|---|---|---|
| | | | | Predicted | Moderate Impact Criterion | Severe Impact Criterion | Moderate | Severe |
| 95th Street to 103rd Street | | | | | | | | |
| West of Track Structure | 76 to 281 | 33 to 40 | 64 to 77 | 61 to 72 | 60 to 65 | 66 to 74 | 40 | 12 |
| East of Track Structure | 137 to 251 | 33 to 40 | 67 to 77 | 62 to 71 | 62 to 65 | 67 to 75 | 23 | 0 |
| 103rd Street to 111th Street | | | | | | | | |
| West of Track Structure | 48 to 232 | 26 to 48 | 63 to 75 | 63 to 71 | 60 to 65 | 65 to 73 | 40 | 4 |
| East of Track Structure | 30 to 273 | 26 to 48 | 65 to 77 | 62 to 79 | 61 to 65 | 66 to 75 | 31 | 13 |
| 111th Street to Michigan Avenue at 116th Street | | | | | | | | |
| West of Track Structure | 172 to 338 | 42 to 50 | 68 to 73 | 63 to 67 | 63 to 65 | 68 to 71 | 44 | 0 |
| East of Track Structure | 33 to 217 | 21 to 50 | 66 to 74 | 61 to 76 | 61 to 65 | 67 to 73 | 35 | 21 |
| Michigan Avenue to CN/MED Rail Corridor | | | | | | | | |
| West of Track Structure | 214 to 399 | 15 to 49 | 60 to 64 | 58 to 68 | 58 to 60 | 64 to 65 | 18 | 8 |
| East of Track Structure | 62 to 316 | 15 to 52 | 60 to 62 | 58 to 73 | 58 to 59 | 63 to 64 | 47 | 33 |
| Total Number of Impacts: | | | | | | | 278 | 91 |
| | | | | | | | 369 | |

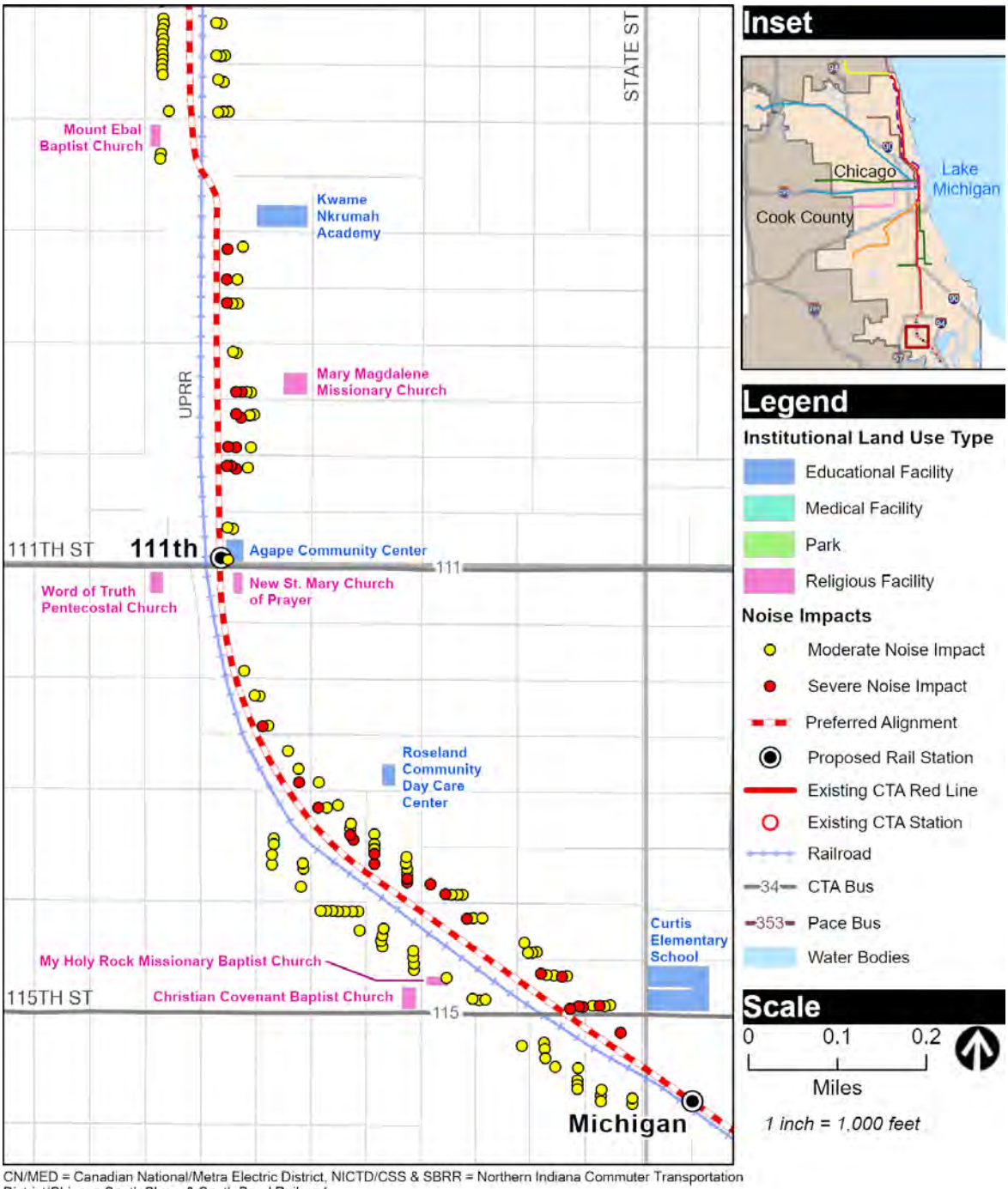
Source: CSA 2021




CN/MED = Canadian National/Metra Electric District, NICTD/CSS & SBRR = Northern Indiana Commuter Transportation District/Chicago South Shore & South Bend Railroad

*Source: CSA 2021*

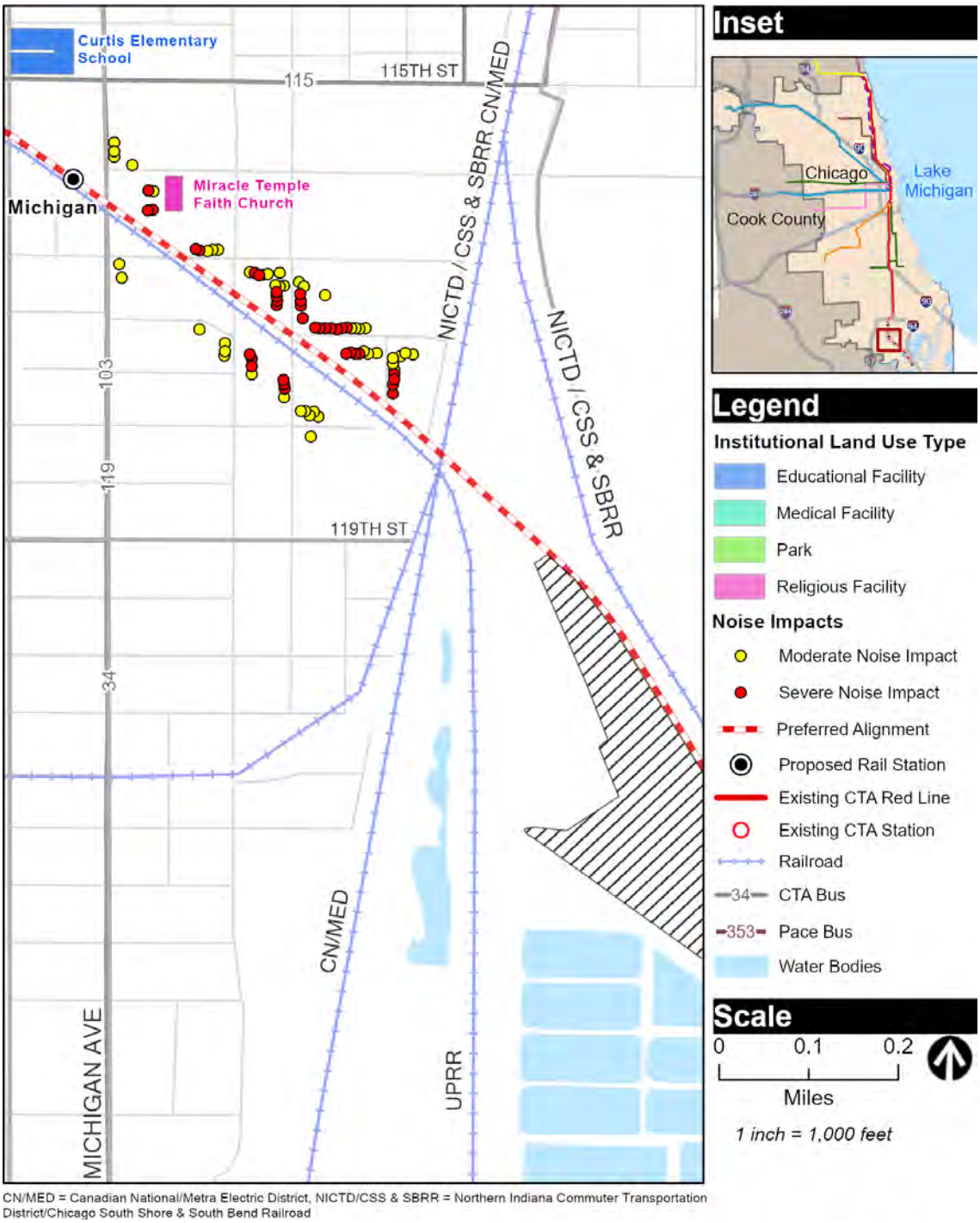
Figure 5-1: Permanent Noise Impacts without Mitigation (1 of 4)




CN/MED = Canadian National/Metra Electric District, NICTD/CSS & SBRR = Northern Indiana Commuter Transportation District/Chicago South Shore & South Bend Railroad

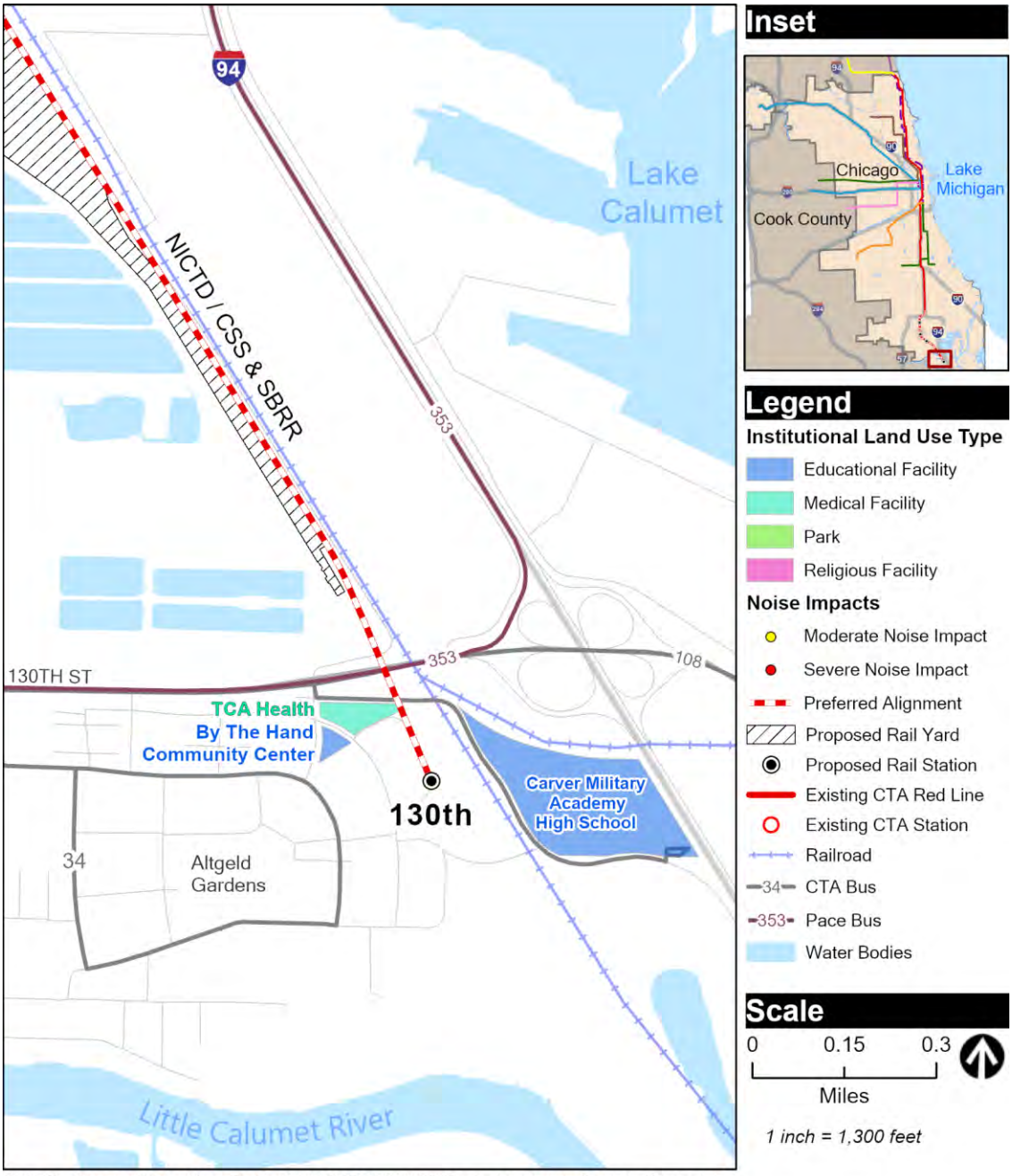
*Source: CSA 2021*

Figure 5-2: Permanent Noise Impacts without Mitigation (2 of 4)




*Source: CSA 2021*

Figure 5-3: Permanent Noise Impacts without Mitigation (3 of 4)




CN/MED = Canadian National/Metra Electric District, NICTD/CSS & SBRR = Northern Indiana Commuter Transportation District/Chicago South Shore & South Bend Railroad

*Source: CSA 2021*

Figure 5-4: Permanent Noise Impacts without Mitigation (4 of 4)

A comparison of the projected Draft and Final EIS residential noise impacts without mitigation is provided in **Table 5-2**. As indicated in this table, a total of 369 impacts is projected for the Preferred Alignment compared to 657 impacts for the East Option and 787 impacts for the West Option in the Draft EIS. Moderate noise impacts are projected at 278 residences for the Preferred Alignment compared to 574 moderate impacts for the East Option and 738 moderate impacts for the West Option. Severe noise impacts are projected at 91 residences for the Preferred Alignment compared to 83 severe impacts for the East Option and 49 severe impacts for the West Option. Thus, it is concluded that the Final EIS analysis predicts a greater number of severe noise impacts than the Draft EIS analysis, but considerably fewer moderate noise impacts.

Table 5-2: Summary of Draft and Final EIS Residential Noise Impacts Without Mitigation

| Area of Impact | UPRR East Option | | UPRR West Option | | Preferred Alignment | |
|---|---|---|---|---|---|---|
| Level of Noise Impact: | Moderate | Severe | Moderate | Severe | Moderate | Severe |
| 95th Street to 103rd Street | | | | | | |
| West of Track Structure | 167 | 25 | 209 | 32 | 40 | 12 |
| East of Track Structure | 108 | 22 | 81 | 1 | 23 | 0 |
| 103rd Street to 111th Street | | | | | | |
| West of Track Structure | 1 | 0 | 125 | 0 | 40 | 4 |
| East of Track Structure | 107 | 25 | 62 | 0 | 31 | 13 |
| 111th Street to Michigan Avenue at 116th Street | | | | | | |
| West of Track Structure | 37 | 0 | 145 | 9 | 44 | 0 |
| East of Track Structure | 98 | 4 | 47 | 0 | 35 | 21 |
| Michigan Avenue to CN/MED Rail Corridor | | | | | | |
| West of Track Structure | 16 | 0 | 41 | 7 | 18 | 8 |
| East of Track Structure | 40 | 7 | 28 | 0 | 47 | 33 |
| Total Number of Impacts: | 574 | 83 | 738 | 49 | 278 | 91 |
| | 657 | | 787 | | 369 | |

Source: CSA 2021

For noise-sensitive institutional receivers along the Preferred Alignment, a comparison of the projected Draft EIS and Final EIS noise impacts without mitigation is provided in **Table 5-3**. As indicated in this table, noise impacts are projected at three institutional receivers for the Preferred Alignment, including a severe impact at one church as well as moderate impacts at a community center and one church. By comparison, noise impacts were projected at seven institutional receivers for the Draft EIS, including a severe noise impact at one park as well as moderate noise impacts at three churches and three parks for the East Option. A severe noise impact at one park and moderate noise impacts at four churches and two parks were projected for the West Option.

Table 5-3: Summary of Draft and Final EIS Institutional Noise Impacts Without Mitigation

| Receiver Location and Description | UPRR East Option | UPRR West Option | Preferred Alignment |
|---|---|---|---|
| | Level of Noise Impact | | |
| **95th Street to 103rd Street** | | | |
| **West of Track Structure** | | | |
| Soul Reviving Baptist Church | Moderate | Moderate | None |
| Kingdom Global Outreach Ministries | Moderate | Moderate | Severe |
| **East of Track Structure** | | | |
| Robert Abbot Park | Moderate | Moderate | None |
| Wendell Smith Park | Severe | Severe | None |
| **103rd Street to 111th Street** | | | |
| **West of Track Structure** | | | |
| Mount Ebal Missionary Baptist Church | None | Moderate | None |
| **East of Track Structure** | | | |
| Block Park | Moderate | None | None |
| Agape Community Center | None | None | Moderate |
| **111th Street to Michigan Avenue at 116th Street** | | | |
| **West of Track Structure** | | | |
| My Holy Rock Missionary Baptist Church | Moderate | Moderate | Moderate |
| **East of Track Structure** | None | None | None |
| **Michigan Avenue to CN/MED Rail Corridor** | | | |
| **West of Track Structure** | None | None | None |
| **East of Track Structure** | | | |
| Kensington Park | Moderate | Moderate | None |

Source: CSA 2021

To reduce noise impacts below FTA noise impact criteria, the Draft EIS proposed constructing a noise barrier approximately 4 feet in height (measured from the top surface of the concrete deck) to provide a 10-dBA reduction in project noise along both sides of the elevated track structure from the 95th Street/Dan Ryan terminal to the CN/MED tracks near 119th Street. Based on the updated noise analysis for the Preferred Alignment at 30 percent design, a total of approximately 33,600 lineal feet (6.36 miles) of noise barriers, extending from the top surface of the concrete deck to a minimum height of 3.5 feet above the top-of-rail elevation, is recommended to provide project noise reductions of up to 15 dBA. However, final design would be analyzed for noise to confirm impact thresholds would be met.

The recommended noise barrier locations are along both sides of the elevated track structure from just east of Wentworth Avenue in the I-57 right-of-way to the CN/MED tracks near 119th Street as

shown in **Figure 5-5**, **Figure 5-6**, and **Figure 5-7**. The civil station locations and dimensions of the recommended noise barriers are summarized in **Table 5-4**.

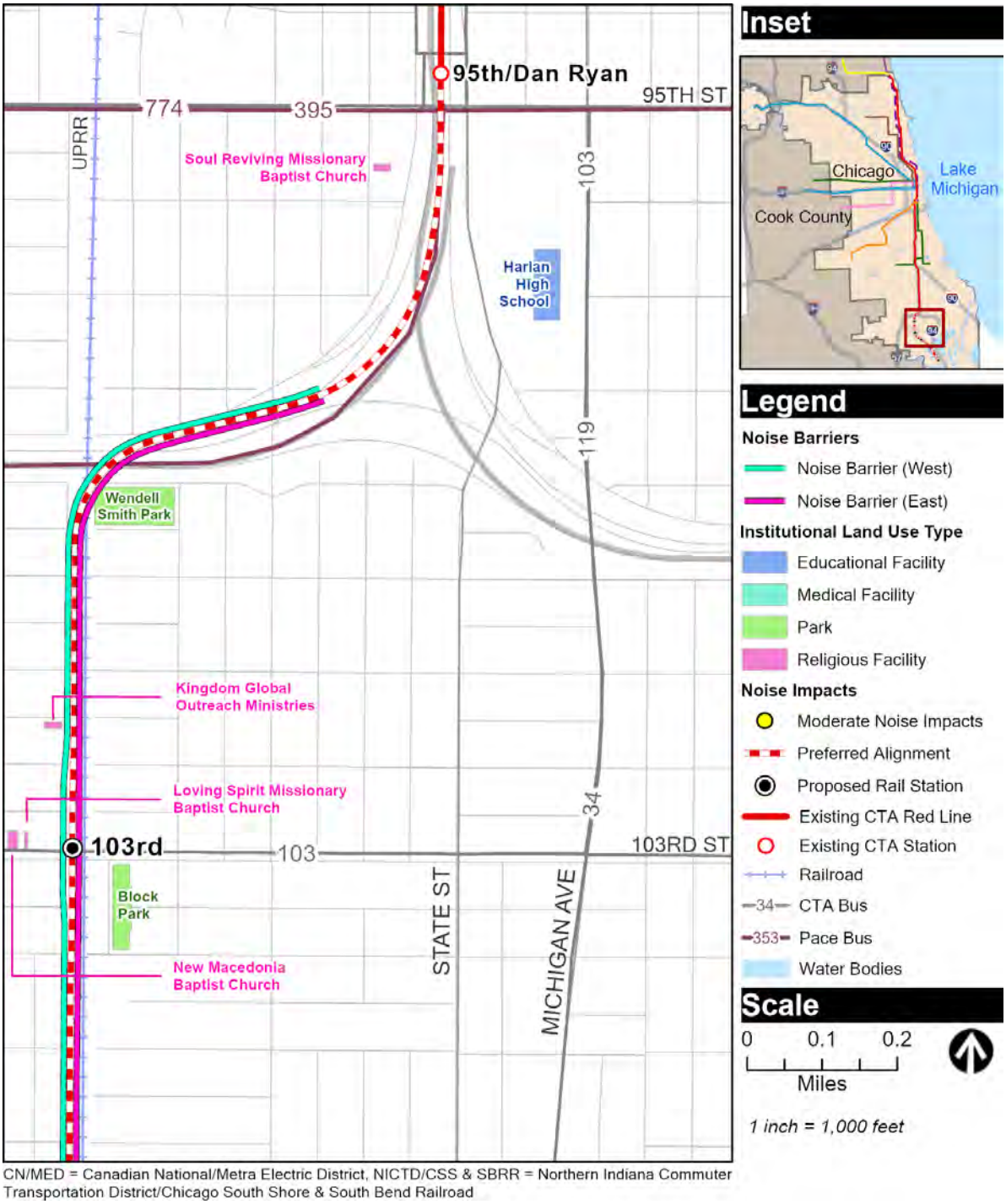
Table 5-4: Summary of Recommended Noise Barrier Locations and Dimensions

| Noise Barrier | Side of Track Structure | Civil Station Limits | | Height (feet) | Length (feet) |
|---|---|---|---|---|---|
| | | Start | End | | |
| 1 | West | 20+00 | 188+00 | 3.5 | 16,800 |
| 2 | East | 20+00 | 188+00 | 3.5 | 16,800 |
| **Total Length of Noise Barriers:** | | | | | 33,600 |

Source: CSA 2021

Although the noise impacts were determined using FTA criteria based on a comparison of future project noise with existing noise, the impacts are also related to the increase in cumulative noise (i.e., the difference between the future overall noise exposure with the project and the existing noise exposure). It is projected that the largest increase in noise exposure at sensitive receivers along the Preferred Alignment would be 13 dBA without mitigation and 2-3 dBA with the recommended noise barriers. The noise increases would be highest at locations close to the Preferred Alignment and would be lower at locations farther away.

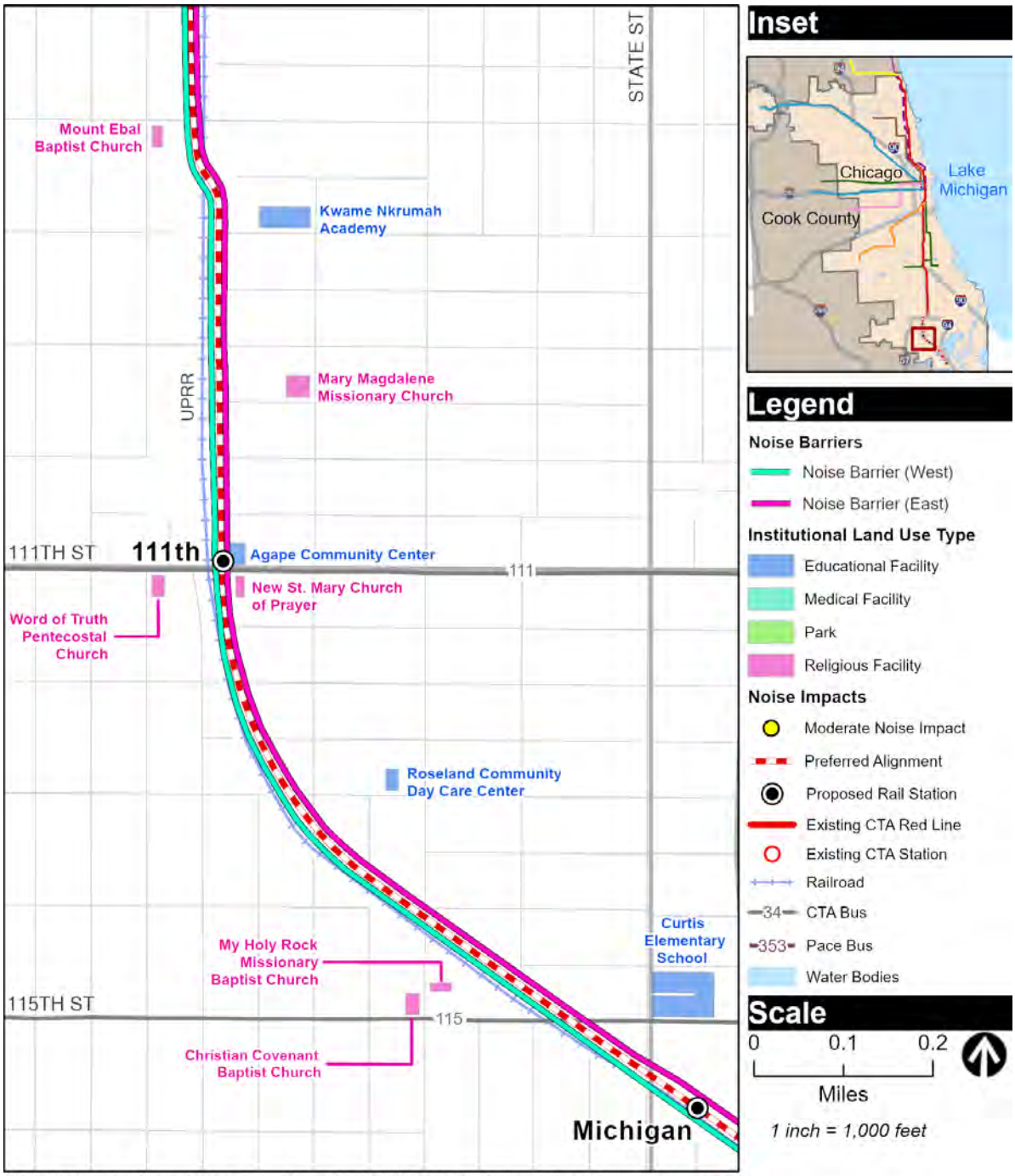
In accordance with FTA guidelines, noise barriers were recommended to eliminate all severe impacts and as many of the moderate impacts as reasonable. The mitigation goal was to gain substantial noise reduction, not simply to reduce the predicted levels to just below the severe impact threshold. Based on the mitigation analysis, it was determined that a barrier extending to a height of 3.5 feet above the top-of rail elevation would mitigate the identified severe impacts, the identified moderate impacts at institutional receivers, and the identified moderate impacts at residences, except for 15 residual moderate impacts at residential receivers that would remain on the east side of the RLE between Indiana Avenue and Calumet Avenue. The residual impacts are in the lower 50 percent of the moderate noise impact zone, with projected noise increases of less than 3 dBA.




CN/MED = Canadian National/Metra Electric District, NICTD/CSS & SBRR = Northern Indiana Commuter Transportation District/Chicago South Shore & South Bend Railroad

Source: CSA 2021

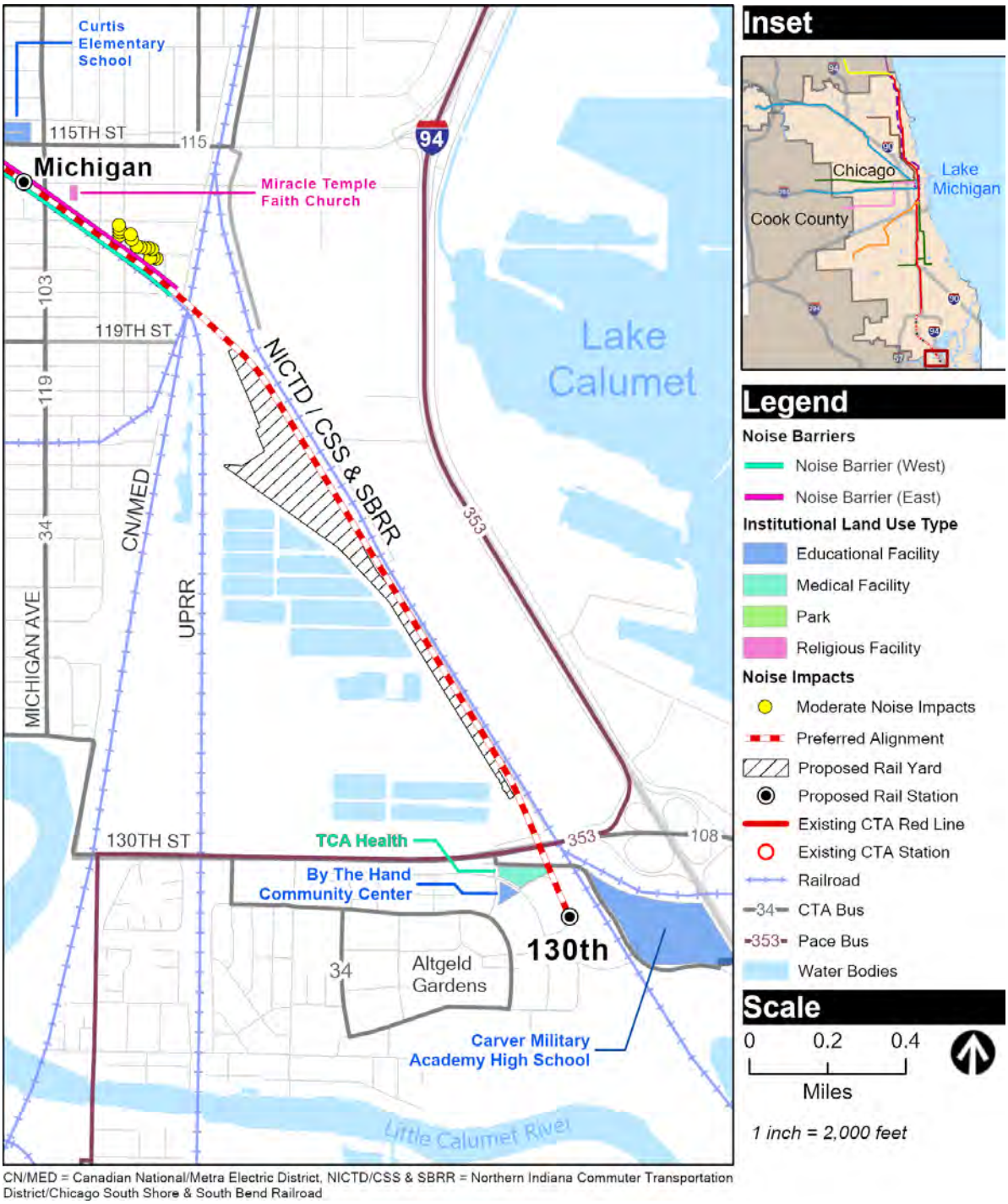
Figure 5-5: Recommended Noise Barrier Locations and Residual Noise Impacts (1 of 3)




CN/MED = Canadian National/Metra Electric District, NICTD/CSS & SBRR = Northern Indiana Commuter Transportation District/Chicago South Shore & South Bend Railroad

Source: CSA 2021

Figure 5-6: Recommended Noise Barrier Locations and Residual Noise Impacts (2 of 3)




CN/MED = Canadian National/Metra Electric District, NICTD/CSS & SBRR = Northern Indiana Commuter Transportation District/Chicago South Shore & South Bend Railroad

Source: CSA 2021

Figure 5-7: Recommended Noise Barrier Locations and Residual Noise Impacts (3 of 3)

### 5.2.1.2 Vibration Impacts and Mitigation

A summary of the detailed vibration impact assessment is presented in **Table 5-5**, which includes the results for FTA Category 2 (residential) receivers. In addition to the distances from the track and proposed train speeds, **Table 5-5** includes the projected maximum vibration levels from RLE train operations without mitigation. Based on a comparison of the predicted RLE vibration levels with the impact criteria, the table also includes an inventory of the number of vibration impacts on both sides of each segment of the corridor. There are no vibration-sensitive receivers within the FTA vibration impact screening distances along the segment of the Preferred Alignment to the south of the CN/MED rail corridor.

The results in **Table 5-5** indicate that no vibration impacts are projected at residential receivers for the Preferred Alignment. Similarly, no vibration impacts are projected at any of the institutional receivers along the alignment. Thus, consistent with the results of the Draft EIS analysis for the UPRR East and West Options, there would be no vibration impacts from RLE Project train operations and no vibration mitigation measures would be required.

Table 5-5: Summary of Vibration Impacts for the Preferred Alignment Without Mitigation

| Area of Impact | Distance from Near Track (feet) | Train Speed (mph) | Vibration Level (VdB)* | | Number of Residential Impacts |
|---|---|---|---|---|---|
| | | | Maximum Predicted | Impact Criterion | |
| 95th Street to 103rd Street | | | | | |
| West of Track Structure | 76 | 33 | 55 | 72 | 0 |
| East of Track Structure | 139 | 37 | 49 | 72 | 0 |
| 103rd Street to 111th Street | | | | | |
| West of Track Structure | 48 | 37 | 54 | 72 | 0 |
| East of Track Structure | 34 | 40 | 70 | 72 | 0 |
| 111th Street to Michigan Avenue at 116th Street | | | | | |
| West of Track Structure | 172 | 44 | 43 | 72 | 0 |
| East of Track Structure | 33 | 50 | 66 | 72 | 0 |
| Michigan Avenue to CN/MED Rail Corridor | | | | | |
| West of Track Structure | 223 | 42 | 40 | 72 | 0 |
| East of Track Structure | 70 | 34 | 61 | 72 | 0 |
| **Total Number of Vibration Impacts:** | | | | | 0 |

* RMS vibration velocity level (in VdB re 1 micro-inch/sec) as measured in 1/3-octave bands of frequency over the frequency range from 8 to 80 Hz.

Source: CSA 2021

### 5.2.2 Construction Impacts and Mitigation - Preferred Alignment

The Preferred Alignment would include the construction of elevated and at-grade track structure, stations, parking facilities at the stations, and roadway improvements. Similar to the findings for the UPRR East and West Options described in **Appendix O** in the Draft EIS, construction noise levels for the Preferred Alignment with mitigation are not expected to exceed the FTA construction noise criteria.

The construction contractor would employ noise-reducing construction best management practices (BMPs). The contractor would keep all construction equipment exhaust mufflers in a state of good repair. As part of the construction specifications, the contractor would be responsible for adhering to the noise control requirements of the project. To the maximum extent possible, vehicles not in use would avoid idling on construction sites. CTA would limit nighttime construction near residences to the extent practicable. As discussed in **Appendix H**, CTA would inform community members about construction schedules and would coordinate in advance with aldermen and local officials.

High-vibration activities during construction include demolition of buildings, construction of aerial structures, pavement breaking, and ground compaction. Similar to the findings for the UPRR East and West Options described in **Appendix O** in the Draft EIS, construction vibration levels for the Preferred Alignment are not expected to exceed the FTA construction criteria for vibration damage.

As was determined from the Draft EIS analysis, most of the equipment can be operated without risk of vibration damage at distances of 15 feet or greater from non-engineered timber and masonry buildings or at distances of 8 feet or greater from reinforced concrete buildings. Impact pile-driving would be avoided in the vicinity of the historic Roseland Pumping Station, and the vicinity from the I-94 ramp crossing to the east of CN/MED and south of 130th Street, as well as adjacent to sensitive noise and vibration receivers identified in the Final EIS such as residences, parks, churches, etc. There would be no residential noise-sensitive receivers within 150 feet of the construction activity along the I-57 right-of-way.

### 5.2.3 Cumulative Impacts and Mitigation - Preferred Alignment

Cumulative effects are those resulting from past, present, and reasonably foreseeable future actions, combined with the potential noise and vibration effects of the RLE Project. In general, noise levels are likely to increase in the future as a result of increases in population and accompanying development, as well as overall increases in traffic levels and potential future transportation projects.

The noise analysis compares project conditions with the existing conditions, which is conservative because noise is likely to be higher in the future with population growth and expanded highways. However, highway or rail improvements would need to double their capacity to noticeably increase noise levels for the average person (i.e., an increase of 3 dBA), which is unlikely to occur. Project-related construction noise, construction vibration, and operational vibration are expected to be highly localized and are therefore not anticipated to contribute to any adverse cumulative noise effects.

Overall, the project's contribution to cumulative operational and construction noise and vibration effects is not anticipated to be cumulatively adverse. This finding has not changed since the Draft EIS.

# Section 6 - Impacts Remaining after Mitigation

This section describes the permanent impacts of the RLE Project remaining after mitigating for impacts as described in **Section 5**.

## 6.1 No Build Alternative

Consistent with the findings of the Draft EIS, there would be no adverse noise or vibration impacts as a result of the No Build Alternative.

## 6.2 Union Pacific Railroad Alternative - Preferred Alignment

For the Preferred Alignment at 30 percent design, the estimate of noise barriers is approximately 33,600 lineal feet (6.36 miles) of noise barriers, extending from the top surface of the concrete deck to a minimum height of 3.5 feet above the top-of-rail elevation, to provide a project noise reduction of up to 15 dBA. The recommended noise barrier locations are shown in **Figure 5-5, Figure 5-6,** and **Figure 5-7**. However, final design would need to be analyzed for noise to confirm impact thresholds would be met.

A summary of the noise impact assessment with the recommended barriers is presented in **Table 6-1**, which includes ranges of results for FTA Category 2 (residential) receivers with both daytime and nighttime sensitivity to noise. In addition to the distances from the track and proposed train speeds, **Table 6-1** includes the existing noise levels and the projected noise levels from RLE Project train operations with mitigation. Based on a comparison of the predicted RLE Project noise levels with the impact criteria, the table also includes an inventory of the number of moderate and severe noise impacts remaining after mitigation on both sides of each segment of the corridor.

Whereas the Draft EIS analysis for the UPRR East and West Options concluded that noise barriers would eliminate all noise impacts, the results for the Preferred Alignment in **Table 6-1** indicate that moderate noise impacts are expected to remain at 15 residences after noise barrier mitigation. The locations of these residual noise impacts are shown in **Figure 5-7**. However, no noise impacts are projected at any noise-sensitive institutional locations after noise barrier mitigation.

The residual noise impacts are due to proximity to the alignment, and proximity to track turnout and crossover locations in particular. Because the impacts of rail vehicle wheels over rail gaps at such locations increase noise by about 5 dBA close to the track, turnouts can be a major source of noise impact. Other means to mitigate the moderate noise impacts remaining after noise barrier mitigation may be examined during detailed design.

Table 6-1: Summary of Residential Noise Impacts for the Preferred Alignment with Noise Barrier Mitigation

| Area of Impact | Distance from Near Track (feet) | Train Speed (mph) | Existing Noise Level (Ldn, dBA) | Project Noise Level (Ldn, dBA) | | | Number of Residential Noise Impacts | |
|---|---|---|---|---|---|---|---|---|
| | | | | Predicted | Moderate Impact Criterion | Severe Impact Criterion | Moderate | Severe |
| 95th Street to 103rd Street | | | | | | | | |
| West of Track Structure | 273 | 40 | 70 | 63 | 64 | 69 | 0 | 0 |
| East of Track Structure | 137 | 39 | 76 | 61 | 65 | 74 | 0 | 0 |
| 103rd Street to 111th Street | | | | | | | | |
| West of Track Structure | 135 | 44 | 67 | 59 | 62 | 68 | 0 | 0 |
| East of Track Structure | 34 | 40 | 74 | 65 | 65 | 73 | 0 | 0 |
| 111th Street to Michigan Avenue at 116th Street | | | | | | | | |
| West of Track Structure | 213 | 50 | 70 | 58 | 65 | 70 | 0 | 0 |
| East of Track Structure | 33 | 50 | 71 | 63 | 65 | 70 | 0 | 0 |
| Michigan Avenue to CN/MED Rail Corridor | | | | | | | | |
| West of Track Structure | 214 | 37 | 64 | 58 | 60 | 65 | 0 | 0 |
| East of Track Structure | 70 to 160 | 34 to 48 | 61 | 59 to 61 | 58 to 59 | 64 | 15 | 0 |
| Total No. of Impacts: | | | | | | | 15 | 0 |
| | | | | | | | 15 | |

Source: CSA 2021

# Section 7 - References Cited

Chicago Transit Authority (CTA). 2016. Chicago Red Line Extension Draft Environmental Impact Statement and Section 4(f) Evaluation. Available at https://www.transitchicago.com/rle/drafteis/. Accessed on October 28, 2020.

Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment Manual. FTA Report No. 0123. September 2018.