CREATE

Noise and Vibration Assessment Methodology

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1. INTRODUCTION

This document discusses procedures for assessing noise and vibration impacts of proposed projects within the CREATE Program. Each proposed project will be evaluated for potential noise and vibration impacts to fulfill National Environmental Policy Act of 1969 (NEPA) requirements.

Unlike highway and transit improvement projects, there are no federal guidance documents or methods specifically applicable for the evaluation of freight train traffic noise and vibration impacts. The Federal Transit Administration (FTA) has developed a *Transit Noise and Vibration Assessment, May 2006* manual (FTA Manual) for the evaluation of transit projects, but this methodology does not specifically address freight train traffic.

These procedures include modifications to the methodology described in the FTA Manual. The modifications allow for the evaluation of freight train traffic noise and vibration impacts. Other modifications, such as those related to interior noise assessments, are also included because the CREATE Program is funded through SAFETEA-LU Section 1301. Section 1301 requires the CREATE Program to be subject to requirements of Title 23, United States Code, as applicable.

The purpose of this document is to provide noise and vibration assessment guidance by defining a consistent and defensible approach for project evaluations. As each project is unique, judgment is needed in applying the procedures to the individual projects.

2. BACKGROUND

The CREATE projects include both commuter train and freight train traffic along the project corridors. There are major differences between commuter and freight train traffic. Freight trains have different and the potential for greater noise impacts than commuter trains due to the greater locomotive horsepower, and differences in train schedules (freight trains typically have more frequent and more nighttime activity), train weight (freight trains are typically heavier), and train length (freight trains are typically longer).

The FTA methodology included in the FTA Manual is generally applicable for assessing the potential noise and vibration impacts from the proposed CREATE projects; however, due to the differing characteristics of freight trains, this document modifies some aspects of the FTA methodology for the purpose of applying it to the CREATE projects. The FTA impact criteria were developed from established basic research on noise annoyance; therefore, they are considered applicable for assessing CREATE impacts.

The FTA Manual does not include a methodology for performing interior noise assessments, nor does it include interior noise impact criteria. This document includes an interior noise assessment methodology that will be applied at locations where interior noise must be evaluated and utilizes the interior noise impact criterion included in 23 CFR Part 772 to determine whether impacts occur.
The noise screening distances and the general assessment model included in the FTA Manual have been modified to address freight train traffic associated with the CREATE Program. The train traffic input data are developed by a train traffic model that includes all of the CREATE Program infrastructure improvements. Generally, each project’s noise and vibration assessment assumes that the entire CREATE Program is implemented. Each project’s noise and vibration impacts are based on impacts resulting from implementing the entire CREATE Program rather than only the implementation of the single project that is being assessed. Any exceptions to this approach will be reviewed on a case-by-case basis.

3. OVERALL FTA IMPACT ASSESSMENT METHODOLOGY

The FTA noise assessment methodology is presented in the FTA Manual. FTA’s approach is a three-tier process and is summarized in Figure 3-1.

**FIGURE 3-1**
FTA Noise and Vibration Assessment Process

- Conduct Screening Procedure
  - Sensitive Land Use Identified?
    - Yes
    - No
      - No Further Evaluation
  - Yes

- Conduct General Assessment
  - Impact Identified?
    - No
      - No Further Evaluation
    - Yes

- Conduct Detailed Analysis
  - Impact Identified?
    - No
      - No Further Evaluation
    - Yes
      - Evaluate Mitigation
Tier 1 – Screening Procedure
The Noise Screening Procedure uses screening distances to identify noise-sensitive land uses in the vicinity of the project. The FTA screening distances are based on conservative assumptions for commuter train traffic. The Noise Screening Procedure is presented in Chapter 4 of the FTA Manual.

For the CREATE Program, new noise screening distances have been developed for identifying locations where a CREATE project may cause noise impacts from freight and commuter/passenger (Amtrak and Metra) train activity.

The Vibration Screening Procedure uses screening distances to identify vibration-sensitive land uses in the vicinity of the project. The Vibration Screening Procedure is presented in Chapter 9 of the FTA Manual.

Tier 2 – General Assessment
The General Noise Assessment methodology is presented in Chapter 5 of the FTA Manual and uses project specific information. A CREATE Railroad Noise Model User Guide, included in Appendix B, has been developed specifically for application on CREATE projects. These two guidance documents are to be used for the General Noise Assessment.

Noise levels are predicted at sensitive receptor locations for the existing, no-build and build scenarios using the FTA methodology with the CREATE railroad noise model. If the General Noise Assessment methods predict potential noise impacts, then the Detailed Noise Analysis methods are used to refine the analysis and predict potential impacts.

The General Vibration Assessment methodology is presented in Chapter 10 of the FTA Manual and uses information regarding the project specifics. If the General Vibration Assessment methods predict potential vibration impacts, then the Detailed Vibration Analysis methods are used to refine the analysis and predict potential impacts.

Tier 3 – Detailed Analysis
The Detailed Noise Analysis methodology is presented in Chapter 6 of the FTA Manual. The Detailed Noise Analysis provides the highest degree of accuracy using site-specific information. The Detailed Noise Analysis utilizes additional information not included in the General Noise Assessment, including topographic information. Noise impacts identified in the Detailed Noise Analysis will require the evaluation of mitigation. The FTA methodology provides equations in Chapter 6 (Detailed Noise Analysis) of the FTA Manual that are used to evaluate the effectiveness of noise walls.

The Detailed Vibration Analysis methodology is presented in Chapter 11 of the FTA Manual.

4. KEY ELEMENTS OF NOISE ASSESSMENT
The three-tiered methodology developed by FTA will be used to evaluate the noise impacts of proposed CREATE projects. Descriptions of the differences between the FTA Manual and procedures for the assessment of CREATE projects are discussed in the following sections. These differences relate to the utilization of the CREATE railroad
noise model, the model inputs, evaluating the existing, no-build, and build conditions, and applying the FTA impact criteria consistently for all projects. Figure 4-1 presents the general flow chart for the CREATE noise evaluation.

Application of the CREATE screening distances, the CREATE Noise Modeling and the FTA methodology will be demonstrated throughout the document using an example project (See Appendices D and E). The following is a general description of the example project.

**Example Project Description:** Example project EX-1 includes signal upgrades to improve track control between the southwest/northeast (Track 1, 2, 3 and 4) track corridor and the north/south track corridor (Track 1). (See Exhibit 1 in Appendix D.) The corridor is located within the Chicago (urban) area. Currently, trains moving from one corridor to the other are limited to 10 mph due to the restricted visibility. Signal improvements will improve track control allowing trains to move through the corridor at 30 mph. Infrastructure improvements are limited to replacing the two signal controls in the signal control box. There are no track improvements proposed. In addition to the increase in train speed between the signals, the improved track control will allow more trains to move through the switches (Track 1). No speed, volume or other changes are expected on the three additional tracks (Tracks 2, 3, and 4).
FIGURE 4-1
CREATE Noise Assessment Process

**Noise Screening Procedure**

1. **Identify Project Limits** ➔ **Apply Screening Distance** ➔ **Sensitive Land Use Within Evaluation Area?** ➔ **No**
   - **Conduct General Noise Assessment**
   - **Yes** ➔ **No Further Evaluation**

2. **Identify Noise Receptors, Receptor Clusters and Representative Receptors** ➔ **Provide CTCO Receptor Information** ➔ **Determine Background Noise Levels at Receptors with Frequent Exterior Use**
   - **Predict Existing, No-Build, & Build CREATE Program Train Noise Levels**
   - **Predict Overall Existing, No-Build and Build Noise Levels at Receptors with Frequent Exterior Use Areas** ➔ **Proceed with Impact Evaluation Based on General Assessment**

3. **Impact Evaluation**

   - **Calculate Project Noise Exposure for New and Re-introduced Rail Corridor Projects or Noise Exposure Increase for Improvement to Existing Rail Corridor Projects** ➔ **Use FTA Figure 3-1 or Table 3-1 to Determine if there are Impacts for New and Re-introduced Rail Corridor Projects. Use FTA Figure 3-2 or CREATE Table 4-6 to Determine if there are Impacts for Improvement to Existing Rail Corridor Projects. Use Interior Criteria (if applicable) if there are No Frequent Exterior Use Areas.**
   - **No Further Evaluation**
   - **No** ➔ **Impact Identified?**
   - **Yes** ➔ **Conduct Detailed Noise Analysis**

4. **Detailed Noise Analysis**

   - **Determine Background Noise Levels at Receptors with Frequent Exterior Use Areas** ➔ **Predict Existing, No-Build, & Build CREATE Program Train Noise Levels** ➔ **Predict Overall Existing, No-Build and Build Noise Levels at Receptors with Frequent Exterior Use Areas**
     - **Proceed with Impact Evaluation Based on Detailed Analysis**
     - **Impact Identified?** ➔ **No** ➔ **No Further Evaluation**
     - **Yes** ➔ **Conduct Mitigation Evaluation for Build Scenario Only Using Equations in Chapter 6 of the FTA Manual and CREATE Mitigation Criteria**
4.1 Noise Screening Procedure

**Noise Screening Procedure (Tier 1)**

Identify Project Limits ➔ Apply Screening Distance ➔ Sensitive Land Use Within Evaluation Area? ➔ No

Conduct General Noise Assessment ➔ Yes ➔ No Further Evaluation

4.1.1 Project Limits

Each proposed CREATE project was defined based upon its independent utility. Each project has unique features and proposed improvements. These site-specific conditions are to be considered in defining the project limits. The project’s purpose and need statement should be reviewed to assist in determining the project limits.

In general, for projects where a Categorical Exclusion (CE) is anticipated, the evaluation area designated for noise assessments will be based upon the project limits. The noise evaluation area will encompass the area defined by applying the appropriate screening distances to the project’s limits. The project limits should include infrastructure directly changed by the project’s proposed improvements. All infrastructure elements that affect the train characteristics (speed, volume, distance to receiver, switch locations) should be included in the project limits. The project limits do not include areas outside of the infrastructure improvement area that may experience changes as a result of the infrastructure improvements. (See example project discussion.)

Projects with potentially significant impacts may require the preparation of an Environmental Assessment (EA) and/or an Environmental Impact Statement (EIS). Within these environmental documents, direct noise impacts from the proposed CREATE Program will be evaluated for sensitive receptors identified within the noise evaluation area, similar to the CE projects. Additionally, these projects may require a qualitative evaluation of secondary or indirect noise and vibration impacts for those areas beyond the project limits.

**Example Project EX-1**

Infrastructure improvements are limited to upgrading two signal controls in the signal control box. While the signal controls may be in one location where the physical construction work will occur, the actual signals controlled by these improvements are in two separate locations. Therefore, the project limits extend to the signal locations and these project limits establish the basis for the noise and vibration evaluation area. See Appendix D, Exhibit 1.
4.1.2 Screening Distances and Noise Evaluation Area

Once the project limits have been determined, the first tier of the FTA assessment can be applied to determine the noise evaluation area. Noise screening distances are applied to the project limits to determine the noise evaluation area. If the project being evaluated includes improvements to more than one track, the appropriate screening distances will be applied to each track to determine the noise evaluation area for the project. For CREATE projects that include only commuter/passenger trains, the noise screening procedures in Chapter 4 of the FTA Manual will be applied. For projects that include only freight trains, or both commuter/passenger and freight trains, the procedures described below will be applied.

Noise screening distances for CREATE Program train traffic have been developed for low, medium and high train activity within three ambient noise condition categories. If there are unobstructed sight lines between the noise source (i.e., trains) and the sensitive receptor, use the screening distances in Table 4-1. If there are obstructions (e.g., buildings, terrain) in the sight line between the noise source (i.e., trains) and the sensitive receptor, use the screening distances in Table 4-2. Table 4-3 defines the low, medium and high ranges of train activity for freight and commuter/passenger rail. Table 4-4 includes the ambient noise levels for the three defined ambient noise level categories: normal suburban residential, urban residential and noisy urban residential. Refer to the supporting memorandum in Appendix A for specifics on how to use the tables.

In order to utilize these tables, the build alternative(s) train traffic information must be obtained from the Chicago Transportation Coordination Office (CTCO). A determination must be made as to which sections of the projects have generally homogeneous train traffic characteristics. These sections will likely coincide with major control points where train traffic changes substantially. Once these sections have been identified, the sections should be delineated on aerial photography and provided to the CTCO, along with other receptor specific information as described in Section 4.2.2. The CTCO will provide train volumes and other train information for each section. These train volumes will be used in conjunction with Tables 4-1 through 4-4 as appropriate in determining screening distances and establishing noise evaluation areas. The CREATE screening procedures are meant to be conservative to ensure that all potentially impacted receptors are included in the noise analysis. The highest train variable in Table 4-3 should be used to determine the activity characteristics and screening distance.

Example Project EX-1

Infrastructure improvements are limited to the two signals. Train speeds and volumes will increase beyond the two signals. The noise and vibration evaluation area will be the area along the railroad tracks between the two signals to address potential impacts of the speed change. The screening distances are measured from the railroad tracks between the two signals. See Appendix D, Exhibit 2.
An alternative screening method may be used which does not require the CTCO to provide train data for the screening process. The alternative method assumes the worst-case scenario so it is a more conservative screening method than the method described in the preceding paragraph. In this alternative screening method, use the “High (Freight)” screening distances found in Tables 4-1 and 4-2, as applicable, for the appropriate “Ambient Category” of the project (see Table 4-4). If sensitive land uses are identified within the “High” screening distance, then a General Noise Assessment must be performed as described in Section 4.2.

**TABLE 4-1**
Screening Distances for Unobstructed Sight Lines for Low, Medium and High Train Activity vs. Noise Receptor Location

<table>
<thead>
<tr>
<th>Ambient Category</th>
<th>Train Volume</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low (Freight Only)</td>
<td>Low Mix (Freight and Passenger)</td>
<td>Medium (Freight)</td>
<td>High (Freight)</td>
</tr>
<tr>
<td>Normal Suburban Residential</td>
<td>400</td>
<td>450</td>
<td>1,000</td>
<td>1,500</td>
</tr>
<tr>
<td>Urban Residential</td>
<td>300</td>
<td>350</td>
<td>750</td>
<td>1,200</td>
</tr>
<tr>
<td>Noisy Urban Residential</td>
<td>150</td>
<td>200</td>
<td>450</td>
<td>750</td>
</tr>
</tbody>
</table>

1 Addition of commuter/passenger train traffic does not change screening distances.
2 Use this category for grade crossings where horns are sounded.
3 Appropriate category when commuter/passenger/commuter present with low freight activity.
4 Table 4-1 derived from Table 4-2.

**TABLE 4-2**
Screening Distances with Intervening Obstructions** for Low, Medium and High Train Activity vs. Noise Receptor Location

<table>
<thead>
<tr>
<th>Ambient Category</th>
<th>Train Volume</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low (Freight Only)</td>
<td>Low Mix (Freight and Passenger)</td>
<td>Medium (Freight)</td>
<td>High (Freight)</td>
</tr>
<tr>
<td>Normal Suburban Residential</td>
<td>200</td>
<td>225</td>
<td>500</td>
<td>1,000</td>
</tr>
<tr>
<td>Urban Residential</td>
<td>150</td>
<td>175</td>
<td>375</td>
<td>750</td>
</tr>
<tr>
<td>Noisy Urban Residential</td>
<td>75</td>
<td>100</td>
<td>225</td>
<td>500</td>
</tr>
</tbody>
</table>

1 Addition of commuter/passenger train traffic does not change screening distances.
2 Use this category for grade crossings where horns are sounded.
3 Appropriate category when commuter/passenger/commuter present with low freight activity.
*Source for Tables 4-1, 4-2, and 4-3: Screening Distances for Potential Noise Impact by Ambient Location and Train Activity for CREATE Projects (see Appendix A).
**Obstructions can include intervening buildings, terrain, embankments, and structures such as overpasses and retaining walls that block the line of sight between the noise source (i.e. trains) and sensitive receptors.
TABLE 4-3*
Low, Medium and High Freight Train Activity Characteristics

<table>
<thead>
<tr>
<th>Train Activity</th>
<th>Trains per Day</th>
<th>Speed (mph)</th>
<th>Length of Cars (feet)</th>
<th>Locomotives /train</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>5 to 40</td>
<td>10 to 20</td>
<td>1,000 to 4,000</td>
<td>1 to 2.08</td>
</tr>
<tr>
<td>Medium</td>
<td>41 to 75</td>
<td>20 to 30</td>
<td>4,000 to 6,000</td>
<td>2.08 to 2.5</td>
</tr>
<tr>
<td>High</td>
<td>More than 75</td>
<td>More than 30</td>
<td>More than 6,000</td>
<td>More than 2.5</td>
</tr>
</tbody>
</table>

*Source for Tables 4-1, 4-2, and 4-3: Screening Distances for Potential Noise Impact by Ambient Location and Train Activity for CREATE Projects, Appendix A.

TABLE 4-4*
Ambient Noise Level Categories

<table>
<thead>
<tr>
<th>Ambient Category</th>
<th>Range of $L_{dn}$ (dB(A))</th>
<th>Average $L_{dn}$ (dB(A))</th>
<th>Average Census Tract Population Density per Square Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Suburban Residential</td>
<td>53 to 57</td>
<td>55</td>
<td>2,000</td>
</tr>
<tr>
<td>Urban Residential</td>
<td>58 to 62</td>
<td>60</td>
<td>6,300</td>
</tr>
<tr>
<td>Noisy Urban Residential</td>
<td>63 to 67</td>
<td>65</td>
<td>20,000</td>
</tr>
</tbody>
</table>

*Source for Tables 4-1, 4-2 and 4-3: Screening Distances for Potential Noise Impact by Ambient Location and Train Activity for CREATE Projects, Appendix A.

4.1.3 Identify Sensitive Receptors

The noise evaluation area is utilized to determine if there are any sensitive land uses that may be affected due to implementing the project. The three FTA land use categories (1, 2, and 3) are used to categorize sensitive receptors within the noise evaluation area. These land uses and the appropriate noise metric for assessing impacts are presented in Table 4-5.
TABLE 4-5
Land Use Categories

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>Noise Metric dB(A)</th>
<th>Description of Land Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Outdoor $L_{eq}(h)^*$</td>
<td>Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.</td>
</tr>
<tr>
<td>2</td>
<td>Outdoor $L_{dn}$</td>
<td>Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.</td>
</tr>
<tr>
<td>3</td>
<td>Outdoor $L_{eq}(h)^*$</td>
<td>Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.</td>
</tr>
</tbody>
</table>

* $L_{eq}$ for the noisiest hour of transit-related activity during hours of noise sensitivity.


Based on the review of the land uses within the project’s noise evaluation area, sensitive receptors will be identified. The noise evaluation will continue with the General Noise Assessment if noise-sensitive land uses are identified within the noise evaluation area. If there are no noise-sensitive land uses within the noise evaluation area, then no further evaluation is required, and the project should be documented accordingly.

The noise metrics established by FTA apply to exterior use area locations. If no exterior use areas are identified for receptors within the screening distance, refer to Section 5 (Interior Noise Assessment) to evaluate these receptors. Residential land uses shall always be evaluated for exterior use areas where outdoor use is most likely to occur.

For parks, if frequent exterior use locations such as paths, picnic tables, shelters, and ball fields are within the screening limits, a general assessment must be performed for the parks at these exterior use locations. If these types of frequent exterior use locations are not within the screening limits, in general, a General Noise Assessment will not be
required for these parks, even though a portion of the park with no identified exterior use locations may be within the screening distance.

CREATE projects often overlap or are within close proximity of other CREATE Projects in corridors with multiple rail lines. Also, some CREATE projects are in close proximity to other CREATE projects that are in different corridors. Therefore, sensitive receptors can be affected by CREATE train noise from multiple projects. When sensitive receptors have been identified for a project through the noise screening procedure, CREATE Program train noise sources from all CREATE projects, both in the same corridor and adjacent corridors, must be identified and used in the General Noise Assessment and the Detailed Noise Analysis.

4.2 General Noise Assessment

**General Noise Assessment (Tier 2)**

Once sensitive receptors are identified in the screening procedure of the noise assessment, additional project-specific information is needed to conduct the General Noise Assessment. This includes receptor specific train traffic data from the CTCO and background noise levels. The FTA General Noise Assessment methodology will be applied using these data.

4.2.1 Identify Noise Receptors, Receptor Clusters and Representative Receptors

**Receptor Clusters**

Sensitive receptors can be clustered (grouped together) where the noise level is expected to be similar and land uses are the same. For example, a group of residences equidistant from the rail line may

**Example Project EX-1**

The noise and vibration screening zones depicted in Appendix D, Exhibit 2 were reviewed for sensitive receptors which are highlighted in Appendix D, Exhibit 3. The noise screening zone varies from 750 feet based on an urban area with a high train activity level (train speed greater than 30 mph), to 1,200 feet based on urban residential with a high train activity level (See exhibit). Within each of the receptor clusters, the representative receptors locations have been identified. Based on the information available, the receptor information can be tabulated and presented to the CTCO to develop the train traffic data needed for the modeling.
be clustered, as each will have similar noise exposure. One residence can be selected within the clustered group to represent the cluster. This approach is consistent with FTA and FHWA approaches in assessing potential impacts. See Section 6.1.3 and Appendix C in the FTA Manual for further information on receptor clusters.

**Receptor Location**

Each receptor cluster will be represented by a single receptor location. The location of this receptor within the cluster shall represent the “worst case” condition allowing for a conservative estimate for the receptor cluster. For these representative receptors, and for stand-alone receptors, the distance to the railroad tracks will be measured from the frequent exterior use area facing the noise source for noise predictions. When the land use is Category 2, (residences and buildings where people normally sleep), the frequent exterior use area may be assumed to be approximately six feet from the side of the building facing the noise source, unless there is an identifiable frequent exterior use location closer to the noise source, such as a patio near the back property line of a residence. In those cases, the frequent exterior use location closer to the noise source should be analyzed for impact.

For parks (normally Category 3), use the frequent exterior use locations such as paths, picnic tables, shelters, and ball fields for assessment purposes. For schools, playgrounds are considered frequent exterior use locations.

In determining and abating noise impacts, primary consideration is given to exterior areas. Abatement will usually be necessary only where frequent human use occurs and a lowered noise level would be of benefit. In those situations where there are no exterior activities to be affected, or where the exterior activities are far from or physically shielded in a manner that prevents an impact on exterior activities, FHWA’s interior criterion will be used as the basis for determining noise impacts. For those Category 2 (hospitals only) and 3 receptors without any identifiable areas of frequent exterior use, interior noise levels will be evaluated based upon the noise level at the face of the building less the appropriate noise reduction factor, rather than six feet from the building, as discussed in Section 5, Interior Noise Assessment. The exception to this is for Land Use Category 2, residential receptors, where interior assessments are not required and an exterior location will always be evaluated based on the location most likely used for outdoor use.

The receptor elevation is not a factor in the **General Noise Assessment** as the model input only includes the horizontal distance between the source and the receptor; however, the receptor elevation (i.e. floor) in a multi-story building should be considered when evaluating the “worst-case” receptor location in the **Detailed Noise Analysis**. Elevated track locations have the potential to generate higher noise levels above the ground floor level.

For multi-story, multi-resident buildings (e.g., apartments) and/or their common areas, the area(s) of frequent use must be analyzed for impacts. -The area of frequent human
use will be exterior areas. In some instances, balconies/patios may be present that must be analyzed because they are identified as areas of frequent human use. In other instances, balconies may not exist or may have very limited use, but instead, common areas (e.g., pools, picnic areas, playgrounds) are present that must be analyzed because they are identified as areas of frequent human use. There may also be instances where both the balconies and the common area(s) need to be analyzed. Generally, in the case of common areas, impacts to the common area would be considered impacts on the residences of the apartments and each of the receptors/units generally would be considered to have the impact identified at the common area (i.e., all apartments would have the same impact).

If other, public meeting rooms, schools, churches, libraries, hospitals and auditoriums do not have frequent exterior use areas, they also must be assessed for interior noise impacts as described in Section 5.

Undeveloped lands should also be considered as potential receptor locations. If the land is to be permitted as a land use meeting one of the land use categories (see Table 4-5), it should be evaluated if it is permitted for development prior to the approval of the environmental document for the project. The undeveloped lands will be considered permitted for development and should be included in the analysis if a building permit was issued/approved before the approval of the environmental document. If an undeveloped land was not included in the initial noise analysis because no building permit had been issued/approved at that time, but a building permit is issued/approved subsequent to the analysis and prior to receiving environmental approval (i.e., approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI) for an Environmental Assessment, or the Record of Decision (ROD) for an Environmental Impact Statement), the undeveloped land must be assessed for noise and vibration impacts prior to environmental approval.

Information for both noise and vibration receptors can be incorporated into the same exhibits.

4.2.2 Provide CTCO Receptor Information

The sensitive receptors identified in the screening process will be provided to the CTCO for the purpose of generating the train traffic data needed for the noise and vibration evaluation. The identified areas selected for analysis are to be shown on an exhibit and the information specific to the receptor location summarized in a table. The following shall be provided to the CTCO:

Example Project EX-1

Appendix D, Exhibit 4 depicts an example table presenting the receptor information table to be provided to CTCO. This will be used to generate the receptor database and generate the train traffic data for the noise and vibration assessment.
- State plane coordinates, address and unique identifying number for the individual receptor or representative receptor in a cluster.
- Aerial photography depicting the individual receptor or cluster, including the representative receptor.
- Addresses or ranges of addresses of all receptors within a cluster.
- Identification of all tracks in the vicinity of the project that may be affecting the receptors for which train traffic information is needed.

4.2.3 Determine Background Noise Levels

Background noise levels have to be determined to perform noise assessments at receptors with frequent exterior use areas. Determining background noise levels is not required when performing interior noise assessments for Improvement to Existing Rail Corridor Projects. For these project types, interior noise impacts are based solely on CREATE Program Train Noise Levels, therefore, for those non-residential receptors without identifiable exterior use areas, proceed to Section 4.2.4 to predict CREATE Program Train Noise Levels without determining background noise levels. Determining background noise levels may be required when performing interior noise assessments for New and Re-introduced Rail Corridor Projects. If the CREATE Program Train Noise Level (Design Year) is below the interior noise impact threshold (51 dB(A)), the CREATE Program Train Noise Level (Design Year) will be compared to the existing background noise level to determine if there is an impact. If the CREATE Program Train Noise Level (Design Year) is more

Example Project EX-1

If the CREATE Program affects train traffic on Track 1 but does not affect train traffic on Tracks 2, 3 and 4, the train noise from non-CREATE trains operating on Tracks 2, 3 and 4 will be included in the background noise level.

If the CREATE Program affects train traffic on Tracks 1, 2, 3 and 4, the train noise from train operations on those tracks will be included in the CREATE Program train noise levels.

Example Project EX-1

Appendix E, Exhibit 5 presents the one-minute $L_{eq}$ (dB(A)) values measured at a receptor location (as an example). One train passed the meter during a five-minute period (minute 15 to minute 19). The monitoring session was extended five minutes from 60 minutes to 65 minutes to collect a full 60-minute period with no trains. The noise data with the train present was removed from the data set.

Each of the remaining one-minute $L_{eq}$ values was then converted to an equivalent sound pressure. The average equivalent sound pressure was then converted back to a decibel noise level to determine the overall hourly $L_{eq}$ value for this session (66.3 dB(A)) and represents the background noise level. If the measurement occurred between 7 am and 7 pm, the estimated $L_{dn}$ value would be 64.3 dB(A) (66.3 – 2 = 64.3 which would then be rounded to 64 dB(A)). Correction factors are in Appendix D of the FTA manual.
than 14 dB(A) above the existing background noise level, an impact occurs. Refer to Section 5, Interior Noise Assessments, for further details.

The FTA recognizes six options for determining existing noise for various land uses. These methods are described in the FTA Manual (Appendix D, Determining Existing Noise) and include look up tables (Table 5-7, Estimating Existing Noise Exposure for General Assessment) and varying noise monitoring approaches. Given the urban setting of the CREATE Program; accurately estimating existing noise levels is important. Background noise contributions from adjacent expressways, local streets, and other rail sources need to be identified as part of estimating the existing noise levels. The background noise level determined for the existing condition will be used as the background noise level for the no-build and build scenario evaluations.

For CREATE projects on new or re-introduced rail corridors, accurately estimating the existing noise levels includes capturing only background noise sources, as there is no train activity in the project corridor. For CREATE projects that improve existing corridors, accurately estimating the existing noise levels includes capturing both the background noise sources (that is, exclusive of CREATE Program train noise, such as highways, local roads, airport traffic, industrial activity, etc.) and the existing noise from CREATE Program train traffic (commuter and freight). CREATE Program train traffic can consist of two components: (1) CREATE program trains on tracks affected by the project, and (2) CREATE program trains on adjacent CREATE projects.

For the purpose of assessing CREATE projects; the following modified noise monitoring methods will be used:

**Noise Monitoring Approach (Modified FTA Option 1 and Option 4)**

If CREATE freight and commuter/passenger train traffic information is provided by the CTCO for the existing scenario, noise monitoring will be used to evaluate the background noise levels using Option #1 for non-residential land uses on page D-2 of Appendix D and Option #4 for residential land uses on page D-3 of Appendix D in the FTA Manual. The FTA appendix is included in Appendix C. These options use one-hour noise monitoring periods to measure the hourly $L_{eq}$. For residential land uses (Option #4), the $L_{dn}$ will be computed from the hourly $L_{eq}$. The noise monitoring results will be modified to account for the noise sources other than the CREATE freight or CREATE commuter trains using the corridor adjacent to the potentially affected land use if CREATE freight or commuter train traffic information is provided by the CTCO.

If CREATE freight or commuter train traffic information is not provided by the CTCO for the existing scenario, the noise monitoring will have to account for all noise sources including the CREATE freight and commuter train noise sources. In these circumstances, the noise monitoring period will be determined on a case-by-case basis.
Methodology Used when CREATE Freight and Commuter Train Traffic Information is Provided by the CTCO for the Existing Scenario

**Step 1** - Monitor noise levels at the receptor locations for approximately one hour while recording the independent one-minute $L_{eq}$ values. Record the time interval when CREATE Program trains (i.e. trains traveling on tracks affected by the CREATE Program) pass the meter and extend the one-hour interval by the train event time length. (See example project discussion.)

**Step 2** - Remove the one-minute $L_{eq}$ values from the data set for the time interval(s) the CREATE Program train pass-by events occurred. Then calculate the hourly $L_{eq}$ from the remaining data. This is the background existing noise level if evaluating land use categories 1 or 3 (non-residential). For land use category 2 (residential), use the conversion method in Appendix D (Page D-4) of the FTA Manual to convert the hourly $L_{eq}$ to an $L_{dn}$ value.

Note: If there are adjacent tracks that are not affected by the CREATE Program and trains are using the track during the noise monitoring, the train information (number of trains, number of cars and locomotives per train, speed, and distance from monitor) for these lines should be recorded. These trains then become part of the background noise level. This is to assure the existing non-CREATE Program train traffic on the adjacent lines is captured in the background noise level.

If CREATE freight and commuter/passenger train traffic information for the existing scenario is not provided by the CTCO, the methodology for estimating existing scenario noise levels, including monitoring requirements, will be determined on a case-by-case basis.

**Alternative Method for Describing Background Noise along Heavily Used Rail Corridors when CREATE Freight and Commuter Train Traffic Information is Provided by the CTCO for the Existing Scenario**

The method outlined above is the preferred method as it allows the capture of background noise conditions through noise monitoring. However, it requires the availability of sufficient time for a representative measurement when no CREATE Program trains are using the tracks affected by the CREATE Program. This may not be practical along heavily used corridors where within an hour period, the train pass-by events may extend 15 minutes or more.

Noise monitoring can be limited to 60 minutes along corridors where the noise monitoring period may have extended CREATE Program train events (15 minutes or more). During the monitoring period, the CREATE Program train information will be recorded (number of trains, number of locomotives and railcars, distance to noise monitor, and the approximate speed). The noise contribution of the CREATE Program trains during the one-hour period will be estimated using the CREATE general
assessment spreadsheet and the actual CREATE Program train information collected during the one-hour period. The noise level predicted with the CREATE general assessment spreadsheet will be subtracted from the measured hourly noise level (L_{eq}) to predict the background noise level when performing a General Noise Assessment. The noise level predicted with the CREATE detailed analysis spreadsheet will be subtracted from the measured hourly noise level (L_{eq}) to predict the background noise level when performing a Detailed Noise Analysis.

**Noise Exposure Computations from Partial Measurements**

Measurements can be made at some receptors and then these measurements can be used to estimate noise exposure at nearby receptors. In general, it is preferable to take noise measurements at each receptor, or at each representative receptor in a cluster; however, measurements at one receptor can be used to represent the noise environment at other receptors, but only when proximity to major noise sources is similar among the receptors. If this methodology is proposed, documentation should be provided outlining the rationale for using representative measurement sites. Typical situations where representative measurement sites can be used to estimate noise are included in the FTA Manual, Section 6.6.3.

4.2.4 Predict Existing, No-Build and Build CREATE Program Train Noise Levels

CREATE Program Train Noise Levels have to be predicted to perform noise assessments at receptors with frequent exterior use areas and for non-residential receptors with no identifiable frequent exterior use areas.

In general, the CTCO, using the train model developed for the CREATE Program, will generate existing and future (design year) train traffic data for the existing, no-build and build scenarios for each CREATE project. This model provides freight traffic data from noon Wednesday to noon Sunday, a period of 96 hours. The train data provide the arrival and departure time for each train, the train speed, the number of rail cars, the length and weight of each train, and the number of locomotives used for each train. These data are provided for each receptor location for each track affected by the CREATE Program adjacent to the receptor location.

If CREATE freight or commuter/passenger train traffic information is not provided by the CTCO for the existing scenario, noise monitoring will be required to obtain CREATE Program Train Noise Levels for both freight and commuter/passenger trains. In these circumstances, the noise monitoring period will be determined on a case-by-case basis.

---

**Example Project EX-1**

Appendix E, Exhibit 6 depicts example CTCO data for one track adjacent to one receptor. This represents an example set of data that will be prepared for each track segment in front of each receptor location. Data will be provided for the existing, no-build and build condition. For each receptor location, the train data for each track will need to be included in the noise predictions.
The following approach will be used to calculate the rail characteristics for the number of trains, speed, number of engines and number of cars. All of these factors are needed as inputs to the noise and vibration analyses. The rail characteristics determined using the following approach will be input into the CREATE general assessment spreadsheet along with the distance between the receptor locations and the tracks to predict the train noise levels.

**Approach for $L_{dn}$ Estimation**

1. The consultant will determine the peak traffic day, (Thursday, Friday or Saturday). Wednesday and Sunday are not to be considered as part of the evaluation due to limitations of the train traffic prediction model. The day with the peak number of trains will be used for the analysis.

2. For both the daytime (7 am to 10 pm) and nighttime periods (10 pm to 7 am), the following values will be calculated:
   a. Average speed
   b. Average number of locomotives per train
   c. Average length of railcars per train
   d. Average number of trains per hour

3. The length of cars will be calculated based upon the total train length and average length of locomotives (75 feet) using the following formula:

   \[ \text{Length of Railcars} = \text{Total train length (ft)} - (\text{No. of Locomotives} \times 75 \text{ ft}) \]

**Variation for $L_{eq}$ Estimation**

For receptor locations where the $L_{eq}$ noise metric is used, the CTCO data will need to be evaluated to predict the peak hour train volume that corresponds to the hours of receptor noise-sensitivity. The above listed data will need to be calculated for the peak hour.

**Approach for $L_{max}$ Estimation**

The $L_{max}$ is the maximum A-weighted sound level for a single pass by event. The $L_{dn}$ and $L_{eq}$ noise metrics will be used to determine the potential noise impacts; however, computation of the $L_{max}$ for the existing, build and no-build alternatives provides a more complete description of the noise effects of the proposed project. Appendix F of the FTA Manual provides the formulas for calculating $L_{max}$ for the locomotives and for the railcars.

The $L_{max}$ calculation is based on the reference sound exposure level ($SEL_{ref}$), distance between the noise receptor and tracks, the speed and the length of locomotives or railcars. Determination of the project $L_{max}$ will likely require computing the $L_{max}$ for several combinations of distance, speed and length. The $SEL_{ref}$ values for the various noise sources are provided in the *CREATE Railroad Noise Model User Guide* (Table 1)
provided in Appendix B. The project documentation will report the $L_{\text{max}}$ for the receptor location with the highest $L_{\text{max}}$ value and indicate the noise source (locomotive or railcar). In order to determine which receptor location has the highest $L_{\text{max}}$ value, $L_{\text{max}}$ will be calculated for each receptor requiring a Detailed Noise Analysis.

**Additional Noise Inputs for the General Noise Assessment**

Other potential noise sources within a corridor include idling trains, horn noise, track crossovers, and worn wheels. All of these can occur under existing and future conditions on the rail lines. The CREATE general assessment spreadsheet includes input for additional noise sources not included in the original FTA general assessment spreadsheet, including idling trains and track crossovers.

**Idling Trains** - The hourly $L_{\text{eq}}$ or $L_{\text{dn}}$ value should be estimated for the idling train using the CREATE general assessment spreadsheet. The idling train noise source is identified as “layover track”. The inputs for the layover track include distance (between locomotives and receiver) and number of trains per hour. The CTCO data will identify idling trains as trains with different “HE Arrival” and “HE Departure” times. The noise assessment should capture idling noise and add that component to the General Noise Assessment. The proposed projects will likely reduce idling activity; however, there may be new locations where trains are staged.

**Horn Noise** - The hourly $L_{\text{eq}}$ or $L_{\text{dn}}$ value can be estimated for horn noise using the SELREF provided in the FTA Manual (Table 6-3, *Source Reference SELs at 50 feet: Fixed Guideway Sources at 50 mph*). The noise assessment should capture horn noise (i.e. grade crossings) and add that component to the General Noise Assessment. The proposed projects will likely reduce horn noise activity; however, there may be new locations where trains are staged. Horn noise associated with locomotive startup for idling trains is considered short in duration and will not be included in the noise assessment.

**Worn Wheels** - One variation between the evaluation of commuter train traffic and freight train traffic is the variability of wheel maintenance between carriers. In addition, one train may have rail cars from several different freight carriers. The likelihood of worn wheels on a freight train is greater when compared to commuter rail lines. To account for the higher probability of worn wheels, the CREATE general assessment freight railcars noise source includes an input for the percentage of worn wheels. Unless project specific data are available, the percentage of worn wheels should be input as 1%.

**Track Crossovers** – Track crossovers include switches, turnouts, crossing diamonds, or other track irregularities that create a wheel to rail impact, which would potentially increase the noise level. The CREATE general assessment spreadsheet includes track crossovers as a noise source. Inputs for this noise source include distance (between the track crossover and the receptor), the number of trains per hour using the crossover (day and night), and the average duration of train pass-by events in seconds (day and night). The average pass-by duration can be determined based on the average train length and average train speed.
As noted in Section 4.2.3, interior noise impacts are based solely on CREATE Program Train Noise Levels. Therefore, for those non-residential receptors without identifiable frequent exterior use areas, predict CREATE Program Train Noise Levels as follows:

For New and Re-introduced Rail Corridor Projects, there are no existing or no-build CREATE Program Train noise levels. Therefore, only the Build Scenario CREATE Program Train Noise Level (Design Year) will have to be predicted. Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from build scenario (design year) trains operating on CREATE Program tracks.

For Improvement to Existing Rail Corridor Projects, CREATE Program Train Noise Levels will be predicted for the existing, no-build and build scenarios as follows:

1. Existing Scenario CREATE Program Train Noise Level includes all train noise from existing trains operating on tracks affected by the CREATE Program.
2. No-Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from no-build scenario (design year) trains operating on tracks affected by the CREATE Program.
3. Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from build scenario (design year) trains operating on tracks affected by the CREATE Program.

For non-residential receptors without identifiable frequent exterior use areas, proceed to Section 5, Interior Noise Assessments. For receptors with frequent exterior use areas, proceed to Section 4.2.5.

4.2.5 Predict Overall Existing, No-Build and Build Noise Levels at Receptors with Frequent Exterior Use Areas

Noise assessments will be performed for the existing, no-build and build scenarios. Based on the methodology presented in Section 4.2.3, the background noise level can be predicted at each receptor location based on measurements at the site, or representative data from a similar receptor site (see Section 4.2.3 Predict Background Noise Levels, subsection “Noise Exposure Computations from Partial Measurements”).

For New and Re-introduced Rail Corridor Projects, the noise levels for the existing and no-build scenarios will be identical; therefore the noise evaluation will predict two noise levels, which are reported as whole numbers, for the scenarios as follows:

1. Existing and No-Build Scenario Noise Level (Background Noise Level)
2. Build Scenario CREATE Program Train Noise Level (Design Year)
   - Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from build scenario (design year) trains operating on tracks affected by the CREATE Program.
For Improvement to Existing Rail Corridor Projects, the noise evaluation will predict noise levels for the existing, no-build and build scenarios. The noise levels for each scenario are determined by adding the background noise level to each of the three CREATE Program train noise levels as follows:

1. Existing Scenario Noise Level (Background Noise Level + Existing Scenario CREATE Program Train Noise Level)
   - Background Noise Level includes all non-train noise and all train noise from trains operating on tracks not affected by the CREATE Program.
   - Existing Scenario CREATE Program Train Noise Level includes all train noise from existing trains operating on tracks affected by the CREATE Program.

2. No-Build Scenario Noise Level (Background Noise Level + No-Build Scenario CREATE Program Train Noise Level (Design Year))
   - No-Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from no-build scenario (design year) trains operating on tracks affected by the CREATE Program.

3. Build Scenario Noise Level (Background Noise Level + Build Scenario CREATE Program Train Noise Level (Design Year))
   - Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from build scenario (design year) trains operating on tracks affected by the CREATE Program.

The impact evaluation is presented in the following section (Section 4.3). As part of the NEPA documentation, the existing, no-build, and build noise levels will be presented with a narrative and supporting table.

4.3 Noise Impact Evaluation

**Impact Evaluation**

<table>
<thead>
<tr>
<th>Calculate Project Noise Exposure for New and Re-introduced Rail Corridor Projects or Noise Exposure Increase for Improvement to Existing Rail Corridor Projects</th>
<th>Use FTA Figure 3-1 or Table 3-1 to Determine if there are Impacts for New and Re-introduced Rail Corridor Projects. Use FTA Figure 3-2 or CREATE Table 4-6 to Determine if there are Impacts for Improvement to Existing Rail Corridor Projects. Use Interior Criteria for non-residential receptors if there are No Frequent Exterior Use Areas.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Further Evaluation</td>
<td>No</td>
</tr>
<tr>
<td>Impact Identified?</td>
<td>Conduct Detailed Noise Analysis</td>
</tr>
<tr>
<td>Yes</td>
<td><strong>No Further Evaluation</strong></td>
</tr>
</tbody>
</table>
Exterior Areas

The noise impact evaluation outlined in the FTA Manual is based on the comparison of the existing noise levels to the proposed project noise level. The impact criteria as presented in Figure 3-1 (Noise Impact Criteria for Transit Projects) in the FTA manual are most applicable to areas without existing rail activities. For CREATE projects on new and re-introduced rail corridors, Figure 3-1 or Table 3-1 in the FTA Manual will be used for evaluating potential CREATE Program noise impacts. Figure 3-1 and Table 3-1 are included in Appendix C.

Most of the CREATE projects improve existing active rail systems and have an existing train noise contribution that will be present in the build condition. For this reason, Figure 3-2 (Increase in Cumulative Noise Level Allowed by Criteria (Land Use Cat. 1& 2)) in the FTA manual can be used for evaluating potential CREATE Program noise impacts on the majority of the CREATE projects; however, Figure 3-2 does not include impact criteria for land use Category 3. Table 4-6, Cumulative Noise Level Increase Allowed by FTA Noise Impact Criteria, includes impact thresholds for Categories 1, 2 and 3, and therefore should be used instead of Figure 3-2 in the FTA Manual to determine impacts for Improvement to Existing Rail Corridor Projects.
The use of Figures 3-1 and 3-2 (FTA Manual), and Table 4-6 is for exterior locations and will require the use of two noise levels to conduct the impact evaluation. The following outlines the general procedure to evaluate the potential noise impacts for exterior use areas:

<table>
<thead>
<tr>
<th>Existing Noise Exposure</th>
<th>Impact Threshold for Increase in Cumulative Noise Exposure (dB(A))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Category 1 or 2 Sites</td>
</tr>
<tr>
<td>$L_{eq}$ or $L_{dn}$</td>
<td>No Impact</td>
</tr>
<tr>
<td>45</td>
<td>&lt;9</td>
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<tr>
<td>46</td>
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<tr>
<td>74</td>
<td>&lt;2</td>
</tr>
<tr>
<td>75</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

$L_{dn}$ is used for land uses where nighttime sensitivity is a factor; Maximum 1-hour $L_{eq}$ is used for land use involving only daytime activities.
New and Re-introduced Rail Corridor Projects

1. Determine the project noise exposure based on the train traffic data provided by the CTCO. This is determined by calculating the CREATE Program Build Train Noise Level (Design Year).

2. Determine the potential for an impact from Figure 3-1 or Table 3-1 using the Existing Scenario Noise Level (background noise level) and the project noise exposure determined in Step 1 above.

3. Determine if the project noise exposure generates no impact, a moderate impact, or a severe impact.

Improvement to Existing Rail Corridor Projects

1. Determine the noise exposure increase due to the implementation of the CREATE Program based on the train traffic data provided by CTCO. This is determined by arithmetic subtraction of the Existing Scenario Noise Level from the Build Scenario Noise Level.

   Build Scenario Noise Level (dB(A)) – Existing Scenario Noise Level (dB(A)) = Noise Exposure Increase

2. Determine the potential for an impact from Table 4-6 or Figure 3-2 using the Existing Scenario Noise Level (X-axis) and the noise exposure increase (Y-axis) determined in Step 1 above.

3. Determine if the noise exposure increase generates no impact, a moderate impact, or a severe impact.

If an impact is determined to occur using the General Noise Assessment methodology, then a Detailed Noise Analysis is required which will use additional project information to refine the predicted noise levels. The impact evaluation outlined in this section (Section 4.3) will be conducted again using the refined build and existing noise levels.

Interior Areas
As previously noted, the methodology for evaluating interior noise impacts is included in Section 5.
4.4 Detailed Noise Analysis

**Detailed Noise Analysis (Tier 3)**

The **Detailed Noise Analysis** is the third tier in the FTA noise impact assessment methodology and is conducted when noise impacts are determined using the **General Noise Assessment**. The **Detailed Noise Analysis** uses additional receptor and track information to refine the noise analysis results. The FTA methodology in Chapter 6 of the FTA Manual provides the approach used to collect and analyze the additional data. Once the overall existing, no-build, and build noise levels are predicted using the **Detailed Noise Analysis**, the impact evaluation presented in Section 4.3 is used to re-evaluate the potential noise impacts. The re-evaluation is only necessary for those receptors where impacts were identified in the **General Noise Assessment**.

The determination of noise impacts using the **Detailed Noise Analysis** warrants the evaluation of noise mitigation for the project at the impacted receptor locations using the mitigation criteria included in Section 4.5 of these procedures. The effects of incorporating noise mitigation measures into the proposed project can be predicted using the FTA Manual (**Detailed Noise Analysis**).

4.5 Mitigation Discussion

In general, mitigation evaluation will be based upon the full build condition of the CREATE Program. Any exceptions to this approach will be reviewed on a case-by-case basis. Mitigation based on the full build condition is necessary, as isolating the impacts of individual projects on receptors is generally not feasible.
The *Detailed Noise Analysis* in the FTA manual provides equations for evaluating noise barriers. When there is a noise impact, noise abatement must be considered subject to the following:

- Noise mitigation measures must provide a Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of at least five (5) dB(A) (both exterior and interior) for the mitigation measure to be considered feasible.

- For exterior moderate impacts, noise mitigation measures must not exceed a cost of $5,000 per benefited receptor for each decibel meeting and exceeding the moderate impact threshold up to a total limit of $30,000 per benefited receptor. For exterior impacts that are severe, noise walls must not exceed a cost of $30,000 per benefited receptor for which a severe impact has been identified. This can include receptors located above ground-floor elevation in multi-story buildings (e.g. second-floor apartments).

- For interior impacts, noise mitigation measures must not exceed a cost of $5,000 per benefited receptor for each decibel exceeding the Existing Scenario CREATE Program Train Noise Level up to a total limit of $30,000 per benefited receptor.

Generally, the barrier should extend four times as far in each direction as the distance from the receiver to the barrier. In some circumstances, shielding from other structures may allow the length of the barrier to be less than four times as far in each direction as the distance from the receiver to the barrier.

Noise mitigation measure costs are based on a $25.00 per square foot unit cost for walls up to and including 15 feet tall; $37.50 per square foot up to and including 30 feet tall, and $50.00 per square foot up to and including 45 feet tall. For exterior impacts, a benefited receptor is defined as a receptor with predicted noise impacts and that receives a Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of five (5) dB(A) or more. For interior impacts, a benefited receptor is defined as a receptor with predicted noise impacts and that receives an interior Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of five (5) dB(A) or more. This can include receptors located above ground-floor elevation in multi-story buildings (e.g. second-floor hospital rooms).

**Multi-story, Multi-Resident Buildings**

When analyzing abatement for common areas, generally consider all units to be benefited if a substantial noise reduction is achieved at the common area.

Existing noise levels for above ground floors may be modeled when balconies are present. Actual measurements do not have to be taken above ground levels.
Mitigation should not be excluded for lower floor impacts merely on the basis that mitigation cannot be provided for upper floor impacts. In any instance, mitigation should be analyzed to benefit as many floors and units as possible.

Non-residential Buildings

If impacts are identified for motels, hotels, public meeting rooms, schools, churches, libraries, hospitals or auditoriums, mitigation shall be considered. If school playgrounds are determined to have moderate or severe impacts, generally the number of classrooms facing the noise source will be used as the number of benefited receptors for the purpose of determining whether noise mitigation measures are reasonable. If an impacted playground is not located between the school and the noise source, contact FHWA/IDOT for further guidance.

Other Noise Mitigation Strategies

Noise barriers are generally the most practical noise mitigation option given their overall effectiveness and the ability to incorporate the option on railroad right-of-way; however, they may not meet the feasible (5 dB(A) Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction) or reasonable (cost-effectiveness) criteria based on site characteristics or constraints.

Acquisition of real property or interests therein (predominantly unimproved property) may be used as a noise mitigation strategy to serve as a buffer zone to preempt development which would be adversely impacted by noise.

The use of noise insulation to mitigate noise impacts for non-residential receptor locations shall be discussed with FHWA on a case-by-case basis.

If none of these measures are determined to be feasible or reasonable, noise abatement measures other than these may be proposed on a case-by-case basis.

Noise Abatement Documentation

A project's noise and/or vibration impacts may need to be re-assessed if there are revisions to the CREATE Program or to the project that may cause the results of the noise and/or vibration assessment to change. Therefore, the following statement will be included in all CREATE Program environmental documents:

“The noise and/or vibration analyses for this project may need to be reassessed if: a) the project is revised in a manner in which impacts of the project may change due to the project revisions (e.g., a new track alignment is moved closer to a receptor), or b) the CREATE Program's train model is updated due to projects being removed or added to the CREATE Program.”

The following statement will be included in all CREATE Program environmental documents where noise mitigation measures are deemed feasible and reasonable:
“The final decision on implementing noise mitigation measures will be made upon the completion of the project design and public involvement process.”

5. INTERIOR NOISE ASSESSMENT

If there are no exterior activities to be affected by the project noise (e.g., a school with no outdoor common areas), or where the exterior activities are far from or physically shielded from the project in a manner that prevents an impact on exterior activities, FHWA’s interior criterion will be used as the basis of determining noise impacts for non-residential receptor locations.

In this circumstance, $L_{eq}$ will be calculated to determine impacts. The predicted interior Build Scenario CREATE Program Train Noise Level (Design Year) may be derived by subtracting the noise reduction factor for the building in question from the computed exterior Build Scenario CREATE Program Train Noise Level (Design Year). If field measurements of these noise reduction factors are obtained or the factors are calculated from detailed acoustical analyses, the measured or calculated reduction factors should be used. In the absence of such calculations or field measurements of noise reduction, the noise reduction factor may be obtained from the following table:

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Window Condition</th>
<th>Structure Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Open</td>
<td>10 dB</td>
</tr>
<tr>
<td>Light Frame</td>
<td>Ordinary Sash (closed)</td>
<td>20 dB</td>
</tr>
<tr>
<td></td>
<td>Storm Windows</td>
<td>25 dB</td>
</tr>
<tr>
<td>Masonry</td>
<td>Single Glazed</td>
<td>25 dB</td>
</tr>
<tr>
<td></td>
<td>Double Glazed</td>
<td>35 dB</td>
</tr>
</tbody>
</table>

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

An impact occurs if the interior Build Scenario CREATE Program Train Noise Level (Design Year) is $51 \ L_{eq}(h)$ or greater; or if the predicted interior Build Scenario CREATE Program Train Noise Level (Design Year) exceeds the interior Existing Scenario CREATE Program Train Noise Level by more than 14 dB(A). If an impact occurs using the General Noise Assessment methodology, then the Detailed Noise Analysis methodology will be used with additional project information to refine the predicted interior noise levels. When assessing noise levels for multi-story buildings in the Detailed Noise Analysis, the vertical distance between the noise source(s) and the receptor must be a component included in the noise propagation equations. A Detailed Noise Analysis of interior noise levels likely will evaluate several floors of multi-story buildings. The impact evaluation outlined in this section will be conducted again during the Detailed Noise Analysis using the refined build, no-build and existing interior...
CREATE Program Train Noise Levels that are developed in the *Detailed Noise Analysis*. Mitigation assessments will be conducted using the procedures and criteria in Section 4.6.

When schools are evaluated for interior noise impacts, each classroom facing the noise source is a receptor, and a library, dining facility or auditorium facing the noise source will be equivalent to two receptors. When churches are evaluated for interior noise impacts, it is a single receptor. When hospitals, nursing homes and other similar facilities are evaluated for interior noise impacts, each room that faces the noise source that has facilities where patients/residents sleep is a receptor.

See Appendix F for additional example exterior and interior noise assessment summary tables.

6. CONSTRUCTION NOISE AND VIBRATION

The following text will be included in all CREATE project environmental documents:

“Construction Noise and Vibration

The construction of the proposed project could result in temporary noise and vibration increases within and adjacent to the project area. The noise and vibration will be generated primarily from trucks and heavy machinery used during construction. Any anticipated noise and vibration impacts will likely be confined to normal working hours, which are generally considered to be “noise and vibration tolerant” periods. Construction contractors need to be aware of local noise ordinances to assure compliance in Cook County and within the cities that construction activities occur. No adverse noise and vibration impacts are anticipated during the construction phase of the project.”

7. VIBRATION ASSESSMENT

7.1 Introduction

Vibration impacts include both Ground-Borne Vibration and Ground-Borne Noise. Vibration impacts are assessed for a one-time event and based on the maximum vibration level. While the freight locomotives are slightly heavier than the commuter/passenger locomotives, the vibration screening distances included in the FTA Manual, Section 9.2.2, Table 9-2, will be used for freight train and commuter/passenger train evaluations. The screening distances in this table are measured from existing or proposed railroad right-of-way to the receptor (see Appendix C, Exhibit 3). This application of FTA vibration screening distances is with the understanding that the FTA screening distances were developed for commuter/passenger rail projects and may have limitations in their applicability to freight rail projects. Figure 10-1 (*Generalized Ground Surface Vibration Curves*) in the FTA Manual, which is included in Appendix C, depicts the same vibration curve for passenger and freight locomotives. Therefore, the *General Vibration...*
Assessment methodology included in the FTA Manual is generally applicable to both commuter/passenger and freight rail projects.

The vibration assessment project limits are identical to the noise assessment project limits identified for the noise assessment in Section 4.1.2.

Vibration Screening Procedure
The Vibration Screening Procedure follows the methodology presented in the FTA Manual. The screening distances in Table 9-2 (FTA Manual) are applied to the project limits to identify the vibration assessment evaluation area. If there are any sensitive land uses within the vibration evaluation area, a General Vibration Assessment is required.

General Vibration Assessment and Detailed Vibration Analysis
The vibration impact evaluation for the CREATE projects generally follows the methodology presented in the FTA Manual; however, a Detailed Vibration Analysis may not always be required.

When the General Vibration Assessment identifies an impact, the determination as to whether a Detailed Vibration Analysis is required will be made on a case-by-case basis. Special track support systems and trenches have not been proven as effective measures for mitigating vibration impacts for freight rail projects, nor for at-grade or elevated heavy-rail commuter/passenger rail projects. Therefore, the only vibration mitigation measures that will be considered for the CREATE Program, other than maintenance programs, are planning and design of special track work and buffer zones. If planning and design of special track work and/or buffer zones are viable mitigation measures for CREATE projects when impacts are identified in the General Vibration Assessment, then a Detailed Vibration Analysis will be required. If planning and design of special track work and/or buffer zones are not viable mitigation measures for CREATE projects when impacts are identified in the General Vibration Assessment, then a Detailed Vibration Analysis will not be required. Figure 7-1 depicts the basic flow chart for the vibration assessment.
FIGURE 7-1
CREATE Vibration Assessment Process

**Vibration Screening Procedure**

1. Identify Project Limits ➔ Apply Screening Distance ➔ Sensitive Land Uses Within Evaluation Area?
2. Conduct General Assessment ➔ Yes ➔ No Further Evaluation
   - Yes ➔ No

**General Vibration Assessment**

1. Define Generalized Ground Surface Vibration Curve and Apply Adjustments ➔ Determine Build Vibration Level
2. Proceed with Impact Evaluation Based on General Assessment

**Impact Evaluation**

1. Use Table 4 for New or Re-Introduced Rail Corridor Projects, or Section 7.2.2 for Improvement to Existing Rail Corridor Projects for Impact Evaluation ➔ Review Train Traffic Information to Determine the Applicable Criteria
2. Impact Identified and Mitigation Measures Viable?
   - No ➔ No Further Evaluation
   - Yes ➔ Compare Predicted Build Vibration Levels to Vibration Criteria ➔ Proceed with Detailed Analysis

**Detailed Vibration Analysis**

1. Survey Existing Vibration ➔ Determine Build Vibration Level ➔ Proceed with Impact Evaluation Based on Detailed Analysis
2. Impact Identified?
   - No ➔ No Further Evaluation
   - Yes ➔ Conduct Mitigation Evaluation for Build Scenario Only Using Equations in Detailed Assessment Section of FTA Guidance Manual and CREATE Mitigation Criteria
7.2 Impact Assessment

7.2.1 Land Use Categories

The criteria for acceptable ground-borne vibration are expressed in terms of rms velocity levels in decibels and the criteria for acceptable ground-borne noise are expressed in terms of A-weighted sound levels. The limits are specified for the three land-use categories defined below:

- **Vibration Category 1 - High Sensitivity**: Included in Category 1 are buildings where vibration would interfere with operations within the building, including levels that may be well below those associated with human annoyance. Concert halls and other special-use facilities are covered separately in FTA Manual, Table 8-2. Typical land uses covered by Category 1 are: vibration-sensitive research and manufacturing, hospitals with vibration-sensitive equipment, and university research operations. The degree of sensitivity to vibration will depend on the specific equipment that will be affected by the vibration. Equipment such as electron microscopes and high resolution lithographic equipment can be very sensitive to vibration, and even normal optical microscopes will sometimes be difficult to use when vibration is well below the human annoyance level. Manufacturing of computer chips is an example of a vibration-sensitive process.

The vibration limits for Vibration Category 1 are based on acceptable vibration for moderately vibration-sensitive equipment such as optical microscopes and electron microscopes with vibration isolation systems. Defining limits for equipment that is even more sensitive requires a detailed review of the specific equipment involved. This type of review is usually performed during the Detailed Vibration Analysis associated with the final design phase and not as part of the environmental impact assessment. Mitigation of transit vibration that affects sensitive equipment typically involves modification of the equipment mounting system or relocation of the equipment rather than applying vibration control measures to the rail project.

Note that this category does not include most computer installations or telephone switching equipment. Although the owners of this type of equipment often are very concerned about the potential of ground-borne vibration interrupting smooth operation of their equipment, it is rare for computer or other electronic equipment to be particularly sensitive to vibration. Most such equipment is designed to operate in typical building environments where the equipment may experience occasional shock from bumping and continuous background vibration caused by other equipment.

- **Vibration Category 2 - Residential**: This category covers all residential land uses and any buildings where people sleep, such as hotels and hospitals. No differentiation is made between different types of residential areas. This is primarily because ground-borne vibration and noise are experienced indoors and building occupants have practically no means to reduce their exposure. Even in a noisy urban
area, the bedrooms often will be quiet in buildings that have effective noise insulation and tightly closed windows. Moreover, street traffic often abates at night when trains continue to operate. Hence, an occupant of a bedroom in a noisy urban area is likely to be just as exposed to ground-borne noise and vibration as someone in a quiet suburban area. The criteria apply to the rail-generated ground-borne vibration and noise whether the source is subway or surface running trains.

- **Vibration Category 3 - Institutional:** Vibration Category 3 includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. Although it is generally appropriate to include office buildings in this category, it is not appropriate to include all buildings that have any office space. For example, most industrial buildings have office space, but it is not intended that buildings primarily for industrial use be included in this category.

Table 7-1 (referenced from FTA Manual Table 8-1) shows the land use categories for ground-borne vibration and noise, which are similar to those for noise assessments.
TABLE 7-1
Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria for General Assessment

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>GBV Impact Levels¹ (VdB re 1 micro inch/sec)</th>
<th>GBN Impact Levels¹ (dB re 20 micro Pascals)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequent Events²</td>
<td>Occasional Events³</td>
</tr>
<tr>
<td>Category 1:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td>65 VdB⁵</td>
<td>65 VdB⁵</td>
</tr>
<tr>
<td>where low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>background</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vibration is</td>
<td></td>
<td></td>
</tr>
<tr>
<td>essential for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>operations.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 2:</td>
<td>72 VdB</td>
<td>75 VdB</td>
</tr>
<tr>
<td>Residences and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>where people</td>
<td></td>
<td></td>
</tr>
<tr>
<td>normally</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sleep.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 3:</td>
<td>75 VdB</td>
<td>78 VdB</td>
</tr>
<tr>
<td>Institutional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>land uses with</td>
<td></td>
<td></td>
</tr>
<tr>
<td>primarily</td>
<td></td>
<td></td>
</tr>
<tr>
<td>daytime use.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. An impact occurs if the GBV and GBN levels in the table are achieved or exceeded.
2. “Frequent Events” is defined as more than 70 vibration events per day. For a typical line-haul freight train where the rail car vibration lasts for several minutes, the frequent events criterion should be applied to the rail car vibration. Most rapid transit projects fall into this category.
3. “Occasional Events” is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations. Generally this category not applicable to freight rail cars but could apply to freight locomotives.
4. “Infrequent Events” is defined as fewer than 30 vibration events per day. This category includes most commuter rail branch lines. Generally this category is not applicable to freight rail cars but could apply to freight locomotives. The locomotive vibration only lasts for a short time, the infrequent-events criteria are appropriate for fewer than 30 events per day.
5. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

Note: Vibration-sensitive equipment is not sensitive to ground-borne noise.

7.2.2 Impact Criteria

Vibrations from locomotives and railcars must be assessed separately for freight rail trains. To determine the unadjusted ground surface vibration for locomotives, use the “Locomotive Powered Passenger or Freight (50 mph)” curve shown in Figure 10-1 (FTA Manual). For freight rail cars, use the “Rapid Transit or Light Rail Vehicles (50 mph)” curve shown in Figure 10-1 (FTA Manual). Adjustment factors for the generalized prediction of ground-borne vibration and noise are included in Table 10-1 (FTA Manual). Once the base curve has been selected, these adjustment factors can be used to develop vibration projections for specific receiver positions inside the buildings. It has been determined that the elevated structure adjustment in Table 10-1 would not be appropriate for embankments and only a -5VdB adjustment should be made for embankments.

If vibration impact levels from either locomotives or rail cars meet or exceed the criteria in Table 7-1, an impact occurs. Vibrations from locomotives and railcars are not assessed separately for commuter/passenger rail trains. If the project being evaluated includes improvements to more than one track, and there are sensitive land uses within the vibration evaluation area, the General Vibration Assessment and the Detailed Vibration Analysis (if required) must evaluate the track that most closely approaches the impact threshold if no impacts are identified, or the track that exceeds to impact criteria to the greatest degree if impacts are identified.

**New or Re-introduced Rail Corridor**

Table 7-1 will be used to determine if there are impacts.

**Improvement to Existing Rail Corridor**

One factor not incorporated in the criteria is how to account for existing vibration. In most cases, the existing environment does not include a substantial number of perceptible ground-borne vibration or noise events. The existing train vibration can be either measured or estimated using the General Assessment procedures in Chapter 10. The most common example of needing to account for the pre-existing vibration is when the project is located in an existing rail corridor. Following are methods of handling representative scenarios:

1. *Infrequently-used rail corridor (existing train volume is fewer than 5 trains per day):* Use the general vibration criteria, Table 7-1, to determine whether the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria. The Build Scenario CREATE Program Train Vibration Level (Design Year) only considers vibrations from the additional trains operating on tracks affected by the CREATE Program - in the design year. When using Table 7-1, the frequency category (frequent, occasional, or infrequent) and impact level is determined by the additional number of commuter/passenger rail trains and freight rail trains (use “frequent events” if any additional freight trains) operating on the tracks affected by
the CREATE Program as a result of the implementation of the CREATE Program. If the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria, a potential impact occurs. If the Build Scenario CREATE Program Train Vibration Level (Design Year) does not exceed the impact criteria, a potential impact does not occur and no further analysis is required. Existing vibration, even if it exceeds the impact criteria, is not a factor in determining whether the Build Scenario CREATE Program Train Vibration Level (Design Year) results in an impact.

2. Moderately-used rail corridor (existing train volume is from 5 to 12 trains per day): If the existing train vibration exceeds the impact criteria given in Table 7-1, there will be no impact from the Build Scenario CREATE Program Train Vibration Level (Design Year) if the levels estimated using the procedures outlined in either Chapter 10 or 11 of the FTA Manual are at least 5 VdB less than the existing train vibration. The impact criteria shall be applied as described for the following two conditions:

Existing Train Vibration Exceeds the Impact Criteria: If the Build Scenario CREATE Program Train Vibration Level (Design Year) is at least 5 VdB or less than existing, then a potential impact does not occur and no further analysis is required. For example, if the existing vibration level is 65 VdB, no impact would be assessed if the Design Year vibration level was 60 VdB or less. Otherwise, use the general vibration criteria, Table 7-1, to determine whether the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria. If the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria, a potential impact occurs. If the Build Scenario CREATE Program Train Vibration Level (Design Year) does not exceed the impact criteria, a potential impact does not occur and no further analysis is required.

Existing Train Vibration Does Not Exceed the Impact Criteria: Use the general vibration criteria, Table 7-1, to determine whether the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria. If the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria, a potential impact occurs. If the Build Scenario CREATE Program Train Vibration Level (Design Year) does not exceed the impact criteria, a potential impact does not occur and no further analysis is required.

3. Heavily-used rail corridor (existing train volume is more than 12 trains per day): If the existing train vibration exceeds the impact criteria given in Table 7-1, the Build Scenario CREATE Program Train Vibration Level (Design Year) will cause additional impact if the Build Scenario CREATE Program train volumes substantially increase the number of vibration events. Approximately doubling the number of events is required for a substantial increase.

If the existing train vibration exceeds the impact criteria given in Table 7-1, and there is not a significant increase in vibration events, there will be additional impact only if the Build Scenario CREATE Program Train Vibration Level (Design Year),
estimated using the procedures of Chapters 10 or 11 (of the FTA Manual), is 3 VdB or more than the existing vibration level.

If the existing train vibration does not exceed the impact criteria given in Table 7-1, use the general vibration criteria, Table 7-1, to determine whether the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria. If the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria, an impact occurs. If the Build Scenario CREATE Program Train Vibration Level (Design Year) does not exceed the impact criteria, an impact does not occur and no further analysis is required.

4. Moving existing tracks: Another scenario where existing vibration can be substantial is when new train operations will use an existing railroad right-of-way and result in shifting the location of existing railroad tracks. The track relocation and reconstruction can result in lower vibration levels, in which case the CREATE Program is beneficial to those receptors within project’s vibration evaluation area. On the other hand, the track relocation and reconstruction can result in higher vibration levels, in which case the CREATE Program may result in an adverse impact to those receptors within the project’s vibration evaluation area.

If the existing (pre-move) train vibration equals or exceeds the impact criteria given in Table 7-1, and the post-move vibration from existing operations exceeds the pre-move vibration by 3 VdB or more, an impact occurs.

If the existing (pre-move) train vibration equals or exceeds the impact criteria given in Table 7-1, and the post-move vibration from existing operations does not exceed the pre-move vibration by 3 VdB or more, the determination as to whether impacts occur should be determined by applying the appropriate criteria from either scenario 1, 2, or 3 above. In this instance, for the tracks that are moved, use the total number of trains using the moved tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1. For example, if the existing (pre-move) train vibration equals or exceeds the impact criteria in Table 7-1, and the post-move vibration from existing operations does not exceed the pre-move vibration by 3 VdB or more, and the train volumes in the corridor on the tracks affected by the CREATE Program meet the definition of a heavily used rail corridor, apply the criteria in scenario 3 above to determine if an impact occurs.

If the existing (pre-move) train vibration does not equal or exceed the impact criteria given in Table 7-1, the determination as to whether impacts occur should be determined by applying the appropriate criteria from either scenario 1, 2 or 3 above. In this instance, for the tracks that are moved, use the total number of trains using those tracks in the design year to determine the frequency category (i.e., frequent, occasional or infrequent) and the vibration impact level in Table 7-1.
The *General Vibration Assessment* identifies the potential ground-borne vibration and ground-borne noise impacts; a detailed assessment confirms whether a vibration impact occurs. As presented in Section 7.1, the need for a *Detailed Vibration Analysis* will generally be conducted if planning and design of special trackwork or buffer areas are viable mitigation options.

Spreadsheet examples have been prepared for each of the four scenarios and for the no-build alternative (see Appendix E). The analyst should be aware of the following:

1. The spreadsheets are based upon the specific conditions in Example Project EX-1. In the example project, two tracks are affected by the CREATE Program, and the train traffic characteristics are similar for both tracks. Therefore, in the spreadsheets, the same adjustment factors (speed, source, path and receiver) are applied to both tracks. If these assumptions are not valid for the project being assessed, the analyst will have to modify the spreadsheets to reflect the specific project’s conditions. For instance, the spreadsheets may need to be revised to analyze a different number of involved tracks. Additionally, different adjustment factors may have to be applied to each track based upon the specific train traffic characteristics for each track.

2. The distance measured is from the centerline of the track to the face of the building.

3. The Moving Existing Tracks spreadsheets are applicable for projects in which the CREATE Program will move existing tracks. The spreadsheets simply evaluate the effect of changing the distance between the track and the receptor. The existing (pre-move) and build (post-move) scenarios are both analyzed using the existing train operations.

   The Moving Existing Tracks spreadsheets are used to perform a quick screening within the general assessment process that requires few calculations. If an impact is assessed based on the quick screening process, then the detailed assessment should be considered. If an impact is not assessed using the quick screening process, then the standard general assessment spreadsheets (infrequently-used, moderately-used, or heavily-used corridor analyses) must be used to determine if an impact would be assessed based upon the **Build Scenario CREATE Program Train Vibration Level (Design Year)**. The Moving Existing Tracks spreadsheets cannot be used to determine that a project does not result in vibration impacts.
7.3 Vibration Mitigation Discussion

In general, when there is a vibration impact based on the Detailed Vibration Analysis, vibration abatement should be evaluated as part of the proposed project unless any one of the following cannot be satisfied:

1. The minimum length of track mitigated must be determined from calculations based on the FTA Detailed Vibration Analysis method.
2. The vibration mitigation treatment must provide at least 3 VdB reduction for every impacted dwelling to be considered effective.
3. The following formula will be applied to determine if the mitigation is cost effective: Mitigation cost divided by VdB reduction divided by number of buildings protected. If this dollar amount exceeds $15,000, the treatment is not considered to be cost effective.

A commitment will be included in the NEPA document to re-assess the project's vibration impacts if there are revisions to the CREATE Program or the project may cause the results of the vibration assessment to change.

Vibration Abatement Documentation

The following text will be included in all CREATE Program environmental documents when vibration impacts occur:

“The following maintenance procedures will be accomplished by the rail industry to mitigate vibration impacts through minimizing vibration sources:

- Regularly scheduled rail grinding
- Wheel truing programs
- Vehicle reconditioning programs
- Use of wheel-flat detectors”
8. **HIGHWAY-RAIL GRADE SEPARATION NOISE AND VIBRATION ASSESSMENTS**

For highway-rail grade separation projects, highway noise analyses will be performed as per IDOT’s Bureau of Design and Environment Manual, Chapter 26, Section 26-6. Furthermore, the following screening procedures will be applied to determine if train noise and vibration analyses are required for potential receptors adjacent to the rail corridor:

**Noise Screening Procedure**

1. Identify Project Limits (4.1.1)
2. Apply Screening Distance (4.1.2)
3. Noise-sensitive Land Use Within Evaluation Area?
   - Yes
   - No
4. Is the CREATE Grade Separation Project Physically Altering the Rail Tracks (horizontal or vertical alignment changes), or Adding Capacity, or Is the CREATE Grade Separation Project Increasing Train Traffic/and or Speed?
   - Yes
   - No
5. On a Case-By-Case Basis, IDOT/FHWA Will Determine the Need for Further Evaluations (i.e., Conducting a General Assessment, Detailed Analysis and Mitigation Evaluation as Required as per Sections 4 and 5).

**Vibration Screening Procedure**

1. Identify Project Limits (4.1.1)
2. Apply Screening Distance (Table 9.2 FTA Manual)
3. Noise-sensitive Land Use Within Evaluation Area?
   - Yes
   - No
4. Is the CREATE Grade Separation Project Physically Altering the Rail Tracks (horizontal or vertical alignment changes), or Adding Additional Capacity, or Is the CREATE Grade Separation Project Increasing Train Traffic/and or Speed?
   - Yes
   - No
5. On a Case-By-Case Basis, IDOT/FHWA Will Determine the Need for Further Evaluations (i.e., Conducting a General Assessment, Detailed Analysis and Mitigation Evaluation as Required as per Section 7).
9. NEPA PROJECT EVALUATION

The CREATE Program noise and vibration impact assessment is being conducted to fulfill NEPA requirements. Using the evaluation outlined in this methodology manual, the potential noise and vibration impacts will be identified using the suggested documentation formats. Example tables of the noise and vibration evaluation data are included in Appendix E. Exterior noise impacts will be identified as no impact, moderate impact, or severe impact. Interior noise impacts will be identified as no impact or impact. Vibration impacts will be identified as no impact or impact.

Based on the evaluation results, IDOT and FHWA will review the data and documentation. This will include but is not limited to the review of the following:

- Build alternative(s) noise/vibration levels compared to the existing and no-build alternative levels
- Build alternative(s) level of impact (no impact, moderate impact or severe impact for exterior use areas; no impact or impact for interior use areas)
- Absolute noise/vibration levels
- Noise/vibration level above impact criteria
- Receptor type
- Number of impacted receptors
- Feasibility and reasonableness of mitigation options

FHWA, in consultation with IDOT, will determine if any of the noise and/or vibration impacts are significant, based on both context and intensity of impacts. The following summarizes the actions to be taken based on the results of the noise and vibration (which includes ground-borne vibration and ground-borne noise) impact evaluation:

- If no noise or vibration impacts are identified, the evaluation should be documented and presented to the public through the normal public involvement activities.

- If noise or vibration impacts are identified but mitigation is determined not to be feasible and reasonable, and if there are any potential historic buildings (over 50 years old) within the possible impact area, an ESRF addendum will be required to determine if the resource is potentially eligible for the National Register of Historic Places (NRHP).

- If noise or vibration impacts are identified, mitigation is determined to be feasible and reasonable and is proposed, and impacts still occur with proposed mitigation; and if there are any potential historic buildings (over 50 years old) within the possible impact area, an ESRF addendum will be required to determine if the resource is potentially eligible for the NRHP.
• If noise or vibration impacts are identified, regardless of proposed mitigation measures, IDOT and FHWA will determine if the impacts are significant.
  
  o If the impacts are deemed significant, an EIS will be required which includes the noise and vibration impact analyses. The Draft EIS (DEIS) will be available for public review and comment.
  o If the impacts are deemed non-significant, the ECAD or Environmental Assessment process can continue and the information will be presented through the normal public involvement process. Information presented will include the noise and vibration impact evaluations.

• If mitigation is feasible and reasonable, the public has the opportunity to comment on the proposed abatement measures via the public involvement process. If the public does not want the proposed mitigation measures to be implemented, a letter must be obtained from a local official through the public involvement process documenting this position.

If vibration impacts have been identified, it should be determined if mitigation is feasible and reasonable. Programmatic mitigation measures should always be documented in the environmental document when impacts are identified. These programmatic measures will be identified as activities that are being implemented to minimize impacts. This information shall be presented to the public through the normal public involvement process.
APPENDIX A

Screening Distances for Potential Noise Impact by Ambient Location and Train Activity for CREATE Projects
APPENDIX B

APPENDIX C

Table and Figure Excerpts from
FTA *Transit Noise and Vibration Impact Assessment*  
(May 2006)
APPENDIX D

Example Project EX-1 Exhibits
APPENDIX E

Example Project EX- 1 Noise and Vibration Assessment Summary Tables
APPENDIX F

Additional Example Exterior and Interior Noise Assessment Summary Tables