4.11.12.2 Additional Potential Mitigation Measures

No additional mitigation measures for Visual Resources and Aesthetics have been identified by the Corps. Additional avoidance, minimization, and mitigation may be considered by the Corps in its decision-making process. Final mitigation measures may be adopted as conditions of the DA permit and documented in the Record of Decision (ROD).

4.12 NOISE AND VIBRATIONS

4.12.1 Methods and Impact Definitions

The project alternatives are expected to generate additional automobile and truck traffic; alter automobile and truck traffic patterns; alter the existing railway network with additional future tracks and at-grade rail crossings; change the number of freight train operations along certain track segments; and introduce construction noise (temporary) and operational noise. These changes have the potential to cause traffic noise impacts, rail noise and vibration impacts, and construction (temporary) and operational noise impacts for land uses located adjacent to the components of the project. The following sections provide a summary of the methods used and impact definitions for the various noise and vibration sources.

4.12.1.1 Traffic Noise Methodology and Impact Thresholds

A noise screening procedure, which is detailed in Appendix H, was developed in order to determine road segments within the study area where the alternatives may cause a traffic noise impact. As a result, eight road segments were identified for detailed noise modeling and are shown in Figure 4.12-1[74]:

- North Rhett Avenue between I-526 ramp and Braddock Avenue;
- Montague Avenue between Spruill Avenue and Virginia Avenue;
- Virginia Avenue between Montague Avenue and Buist Avenue;
- Noisette Boulevard between Twiggs Street and McMillan Avenue;
- Cosgrove Avenue (SC-7) between Spruill Avenue and Rivers Avenue;
- Spruill Avenue between Noisette Creek and N. Carolina Avenue;
- St. Johns Avenue between O'Hear Avenue and McMillan Avenue;
- Port drayage road (future) between Port access road and NBIF.

[74] For modeling purposes, in Figure 4.12-1, St. Johns Avenue was split into two segments and Spruill Avenue was divided into seven segments. Some road segments also share boxes in the figure. This is why there are twelve boxes used to represent eight road segments in the figure.


Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
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2
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Prediction Location
Port Drayage Road (future) – Alternatives 5, 6, & 7
Study Area
Source: Wyle 2016
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Miles
N
NAVY BASE ICTF EIS
Noise Prediction Locations
Figure 4.12-1
US Army Corps Of Engineers
Charleston District

For the detailed analysis, 150 noise-sensitive receptor locations were identified for the Project alternatives, representing mostly residential land uses (single- and multi-family residences), as well as churches, schools, parks, and recreation areas. Several commercial areas and vacant lots exposed to traffic noise were also included for informational purposes. An additional eighteen receptors located adjacent to the proposed Port drayage road under Alternatives 5, 6, and 7 were also identified for noise modeling. The locations of these receptors are presented in Appendix H.

Noise predictions for each project alternative were computed using the FHWA's Traffic Noise Model (TNM), version 2.5 (2004). For more information on the TNM software and its inputs and outputs, see Appendix H. The primary output from TNM is the hourly average sound level (Leq(h)) for each receptor location. Prior to conducting noise modeling for the Project alternatives, the TNM predictions were validated for the study area. Further details regarding the noise model validation process can be found in Appendix H.

The evaluation of traffic noise generally follows the NEPA process as discussed in Highway Traffic Noise: Analysis and Abatement Guidance (FHWA 2011a). To determine whether a proposed build alternative would generate noise impacts, the proposed build alternative is compared with a baseline, in this case the future No-Action Alternative. An impact occurs if Alternative 1 (Proposed Project) or alternative changes the noise levels when compared to the No-Action Alternative for the same design year. For the purpose of this noise analysis, the levels of traffic noise impact associated with a build alternative in comparison with the No-Action Alternative (for the same year) are defined as follows:

Table 4.12-1
Impact Definitions, Traffic Noise

Negligible[75]	Minor	Moderate	Major
0–3 dB(A) increase in Leq(h)	3–5 dB(A) increase in Leq(h)	5–10 dB(A) increase in Leq(h)	Increase in Leq(h) greater than 10 dB(A)

4.12.1.2 Rail Noise Methodology and Impact Thresholds

A screening procedure to identify track segments for further analysis was developed utilizing information obtained from the transportation analysis (Section 4.8 and Appendix F) and Palmetto Railways. Noise levels were computed using the procedure for general noise assessment documented in Transit Noise and Vibration Impact Assessment (FTA 2006) and the CREATE railroad noise model (refer to Appendix H for more information on the screening procedure and the CREATE railroad noise model). The model output is the Day-Night Average Sound Level (DNL) value of rail noise at a specific distance from the track to the receptor. Segments identified as a result of the screening procedure

[75] Changes of 3 dB(A) or less are barely perceptible to the human ear (FHWA, 2011).

were further reviewed for the presence of noise-sensitive land uses within 300 feet[76] of the track centerline. If no noise-sensitive land uses were present within this screening distance, then no further noise assessment was necessary for these track segments.

As a result of the screening procedure, ten track segments were identified for further noise analysis and are shown on Figure 4.12-2.

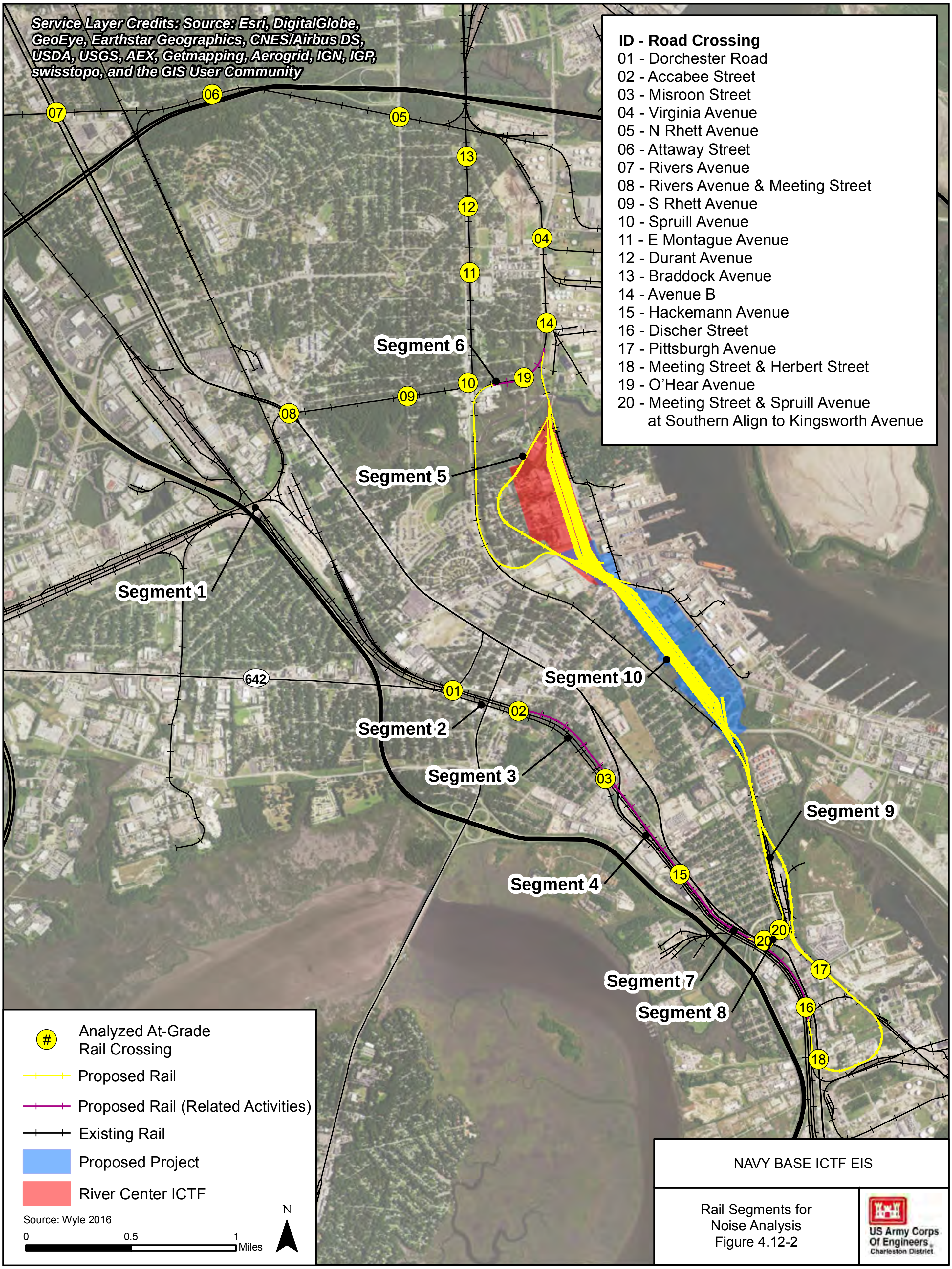
- Segment 1 – North of ID 01 Dorchester Road (existing)
- Segment 2 – Between ID 01 Dorchester Road and ID 02 Accabee Road (existing)
- Segment 3 – Between ID 02 Accabee Road and ID 03 Misroon Street (existing)
- Segment 4 – Between ID 03 Misroon Street and ID 15 Hackemann Avenue (existing)
- Segment 5 – Between ID 14 Avenue B North and ICTF (proposed) [Alternatives 1 and 3
- Segment 6 – Between ID 19 O'Hear Avenue and ICTF (proposed) [Alternative 2]
- Segment 7 – Between ID 15 Hackemann Avenue and ID 16 Discher Street (existing)
- Segment 8 – Between ID 20 Meeting Street and ID 20 Spruill Avenue (proposed) (Alternatives 3 and 6)
- Segment 9 – Between ID 20 Spruill Avenue and ICTF (proposed) (Alternatives 3 and 6)
- Segment 10 – Between ID 17 Pittsburgh Avenue and ICTF (proposed) (Alternatives 5 and 7)

Locomotive horn soundings are part of railroad operations and can contribute to rail noise impacts. Under the Train Horn Rule (49 C.F.R. Part 222), locomotive engineers must begin to sound train warning horns from 15 to 20 seconds in advance of all public grade crossings (for train speeds of 10 mph and below). The rule also provides an opportunity for localities nationwide to mitigate the effects of train horn noise by establishing quiet zones[77] (additional information on quiet zones and proposed quiet zones can be found in Appendix H).

As with the track segments, a screening procedure was developed for horn soundings (see Appendix H for more information on the screening procedure and criteria). Altogether, 20 existing and future rail crossings were modeled for horn soundings following the FTA's procedure (FTA 2006). If noise sensitive receivers are present within 300 feet of the rail crossing with the potential horn noise impact, further analysis was performed for the crossing. The rail crossings listed below met the screening criteria for further analysis (the crossing identification numbers correspond to the locations shown in Figure 4.12-2):

[76] A screening distance of 300 feet covers the first two rows of buildings nearest to the tracks. The second and subsequent rows of buildings are more remote and increasingly shielded from rail noise by intervening rows of buildings.

[77] In order to mitigate the effects of train horn noise, communities can establish "Quiet Zones" where horns are not needed due to safety improvements at the grade crossings. A guide to the quiet zone establishment process can be found at: www.fra.gov under Railroad Safety: "FRA Train Horn Rule and Quiet Zones."



Rail Segments for Noise Analysis
Figure 4.12-2

- Dorchester Road
- Accabee Road
- Misroon Street
- Hackemann Avenue
- O'Hear Avenue
- Meeting Street and Spruill Avenue at Southern Alignment

4.12.1.3 Noise Prediction Model and Analysis

The DNL contours, along the selected track segments and at-grade crossings were predicted using a combination of the CREATE Railroad Noise Model (HMMH 2006) and the FTA Manual's equations for sound wall and trench noise attenuation and horn noise level prediction. Information on the assumptions and parameters used for the modeling can be found in Appendix H. It should be noted that Segment 5 under Alternatives 1 and 3 include plans for a ground cut section (trench) and two sound walls for several sections of the northern rail tracks (see Section 4.12.3 and 4.12.5).

The resultant output from the train noise and horn noise prediction models was the location of the DNL 70, 65, and 60 dB(A) noise contours in the vicinity of the modeled rail crossings for both the No-Action and build alternatives for design year 2038. The contours in the vicinity of a rail crossing are representative of the horn sounding in addition to the train pass bys, and also represent a 24-hour average of the noise levels that can be expected as a result of locomotive horn soundings. Refer back to Figure 3.12-4 for a representation of the noise level contours that would be expected as a result of an individual incident of a locomotive horn sounding.

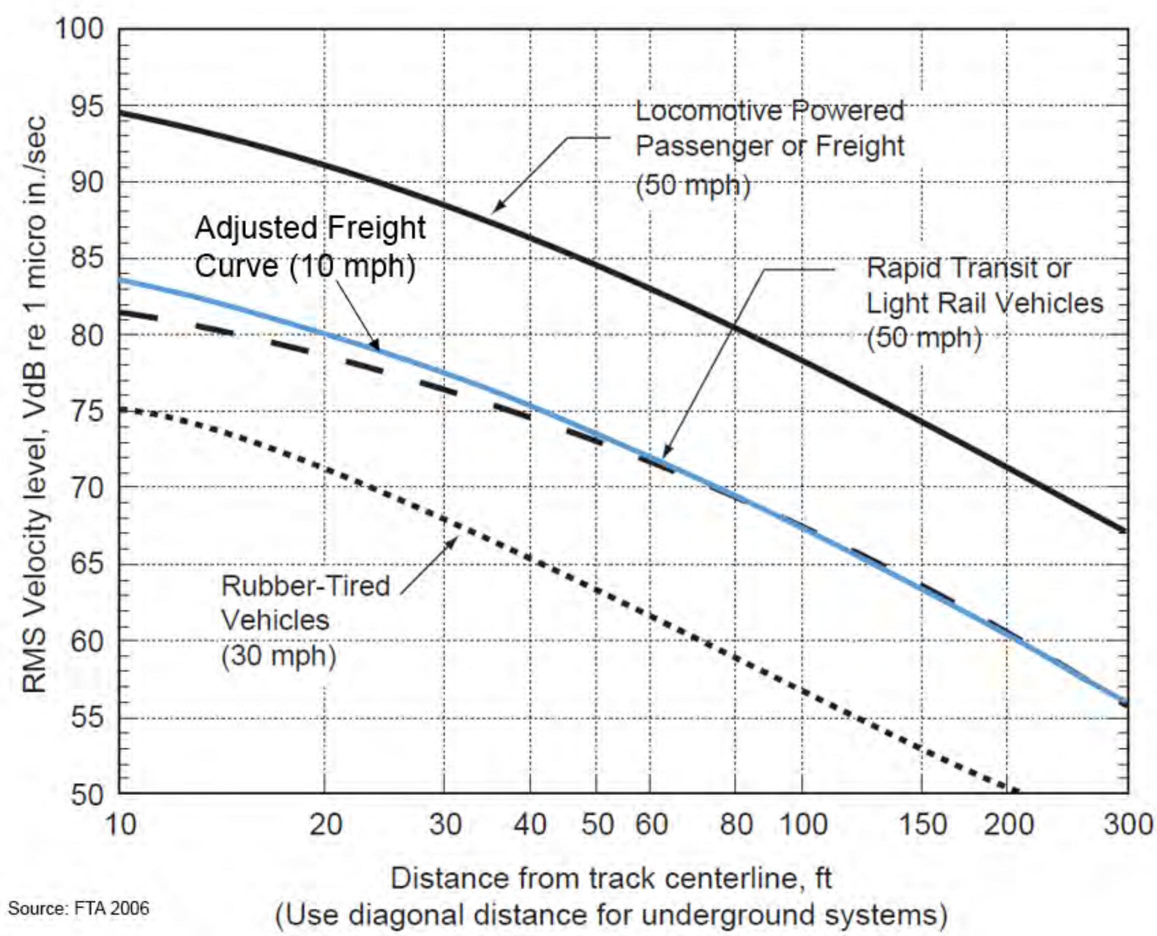
The evaluation of potential rail noise impact follows the NEPA process for environmental analyses, as applied to the traffic noise impact assessment. Similarly, a proposed build alternative is compared with a baseline (the No-Action Alternative) to determine whether or not the proposed build alternative would generate noise impacts. Alternative 1 (Proposed Project) or the alternative would cause an impact if it changes the noise levels compared to the No-Action Alternative for the same design year.

Table 4.12-2
Impact Definitions, Rail Noise

Negligible	Minor	Moderate	Major
0–3 dB(A) increase in DNL	3–5 dB(A) increase in DNL	5–10 dB(A) increase in DNL	Increase in DNL greater than 10 dB(A)

4.12.1.4 Rail Vibration Methodology and Impact Thresholds

Ground-borne vibration (VdB) of high amplitude may cause buildings to shake and rumbling sounds to be heard. Vibration from sources such as trucks and buses is not usually perceptible, even in locations close to major roads. However, it is not uncommon for freight trains to be the source of intrusive ground-borne vibration (refer back to Section 3.12 for more information on the characteristics of vibration). Vibration analysis for the selected receptors along the track segments was performed following procedures for rail transit systems; no measurements are required as part of this analysis. The FTA's Transit Noise and Vibration Impact Assessment manual provides the reference curve for vibration levels as a function of distance from the rail track (Figure 10-1 in the FTA manual) (FTA 2006). Adjustments (based on Table 10-1 of the manual) were applied to the curve to account for specific parameters such as train speed (-14 VdB for 10 mph), stiff primary suspension (+8 VdB), and coupling to house foundation (worst case for wood frame houses was used, -5 VdB). The total adjustment factor for shifting the reference curve was determined to be -11 VdB. The adjusted reference curve for a freight train at 10 mph is shown in Figure 4.12-3. It should be noted that the weight of the locomotives and rail cars does not play a significant role in vibration; however, train length and frequency of train events does impact the thresholds as more frequent events would lower the level considered an impact. For more information on the approach used in the vibration assessment, see Appendix H.



Source: FTA 2006

Figure 4.12-3. Adjusted Reference Curve for Vibration Levels of Locomotive-Powered Freight

Potential vibration impacts were analyzed in this study for freight railroads in the study area; however, no specific impact criteria exist for freight railroads. Vibration impact criterion for a single freight train pass by event is established following the FTA's manual (FTA 2006, Table 8-1). The impact criteria for ground-borne vibration are shown in Table 4.12-3.

Table 4.12-3
Impact Criteria for Ground-Borne Vibration of Freight Train Pass By

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch/sec)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category I: Buildings where vibration would interfere with interior operations	65 VdB[4]	65 VdB[4]	65 VdB[4]
Category II: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB
Category III: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB

Notes:

1. "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
2. "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.
3. "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
4. 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.

Following the FTA recommendation, the ground-borne vibration level of 80 VdB from infrequent train pass by events typical for the Project alternatives is considered the impact criterion for vibration-sensitive land uses, such as residences and other buildings where people normally sleep (Category 2). Unlike the relative noise impact criteria that are based on a comparison of the future build alternatives with the No-Action Alternative, the vibration impact criterion is "absolute," in that the vibration impact is likely when a build alternative's predicted vibration level exceeds the vibration velocity threshold indicated above. Also in contrast to the aggregate Leq or DNL metrics used for the noise impact criteria, which combine multiple noise events within a certain time period, the vibration impact criterion applies to individual train pass by events.

It should be noted that the vibration analysis is based on the ground-borne vibration levels calculated for the straight-line track alignments and well-maintained systems. Curved track alignments are known to generate higher vibration levels. However, there is no existing methodology for modeling vibration from curved rail tracks.

Potential rail vibration impacts were evaluated for land uses identified along the selected railway segments and included 76 receptors. The locations of the 76 receptors analyzed are included in Table 4.12-4 along with their distances from the nearest rail centerline and the associated alternative(s). Based on the evaluation, it was determined that receptors located at a distance less than 20 feet from the track centerline would experience rail vibration impacts.

A special case of vibration-sensitive receptors in the study area are cultural resources, in particular historic properties reviewed in Section 3.10. The main concern for historic buildings is potential impacts to the masonry from ground-borne vibration generated by train operations. Generally, it is extremely rare for vibration from train operations to cause any sort of building damage, even minor cosmetic damage. However, there is sometimes concern about damage to historic buildings. Even in these cases, damage is unlikely except when the track would be very close to the structure. For this analysis, a vibration damage threshold of 94 VdB was applied to regular masonry buildings and 90 VdB was applied to buildings extremely susceptible to vibration damage (FTA 2006, Table 12-3).

Table 4.12-4
Location and Distance from Rail Centerline for 76 Receptors Analyzed for Vibration Impacts

Receptor Address	Approx. Distance from Nearest Rail Centerline (feet)	Alterna-tives	Receptor Address	Approx. Distance from Nearest Rail Centerline (feet)	Alterna-tives	Receptor Address	Approx. Distance from Nearest Rail Centerline (feet)	Alterna-tives
1651 Greenbay Dr	112	1 -7	1057 State Rd S-10-672	67	2	1301 Ave G	86	1, 3
1655 Greenbay Dr	100	1 -7	1065 State Rd S-10-672	100	2	1850 Truxtun Ave	71	1, 3
5465 Califf Rd	52	1 -7	1015 Aragon Ave	272	2	1800 Iris St	86	5, 6, 7
5406 Dutton Ave	161	1 -7	1071 State Rd S-10-672	120	2	1800 Calvert St	76	5, 6, 7
2001 Sylvia St	64	1 -7	1077 State Rd S-10-672	120	2	1805 Orvid St	152	5, 6, 7
2003 Sylvia St	78	1 -7	1079 State Rd S-10-672	78	2	1806 Orvid St	80	5, 6, 7
2005 Sylvia St	96	1 -7	1093 State Rd S-10-672	165	2	1807 Carlton St	80	5, 6, 7
2007 Sylvia St	66	1 -7	1046 Spartanburg Ave	34	2	1805 Carlton St	78	5, 6, 7
2009 Sylvia St	86	1 -7	3991 St Johns Ave	118	2	1804 Carlton St	69	5, 6, 7
2011 Sylvia St	89	1 -7	3975 St Johns Ave	225	2	1801 Success St	88	5, 6, 7
2013 Sylvia St	90	1 -7	4045 Gullah Ave	102	2	1800 Success St	75	5, 6, 7
5403 Gale Ave	193	1 -7	3955 St Johns Ave	185	2	1801 Leland St	61	5, 6, 7
5371 Rivers Ave	98	1 -7	3777-3799 Spruill Ave	111	2	1802 Leland St	76	5, 6, 7
2116 Taylor St	89	1 -7	3863 Reddin Rd	285	2	1803 Grayson St	58	5, 6, 7
2218 Taylor St	140	1 -7	3857 Reddin Rd	174	2	1801 Grayson St	51	5, 6, 7
2312 Taylor St	23	1 -7	3841 Reddin Rd	120	2	3250 Grayson St	59	5, 6, 7
1005 E Montague Ave	170	1 -7	3795 Spruill Ave	188	2	3244 N Carolina Ave	48	5, 6, 7
1004 Delsey St	180	1 -7	3721-3775 Spruill Ave	138	2	3250 N Carolina Ave	50	5, 6, 7
1005 Delsey St	193	1 -7	3803 Reddin Rd	121	2	3264 N Carolina Ave	64	5, 6, 7
1004 Crawford St	172	1 -7	3733 St Johns Ave	89	2	3286 N Carolina Ave	54	5, 6, 7
1005 Crawford St	178	1 -7	757 Commissary St	224	1, 3	1982 Kingsworth Ave	80	3, 6
1004 Bethany St	174	1 -7	1811 Commissary St	163	1, 3			
1005 Bethany St	171	1 -7	1014 Hunley Waters Cir	387	1, 3			
1004 Alamo St	172	1 -7	4133 St Johns Ave	96	1, 3			
1005 Alamo St	174	1 -7	4129 St Johns Ave	76	1, 3			
1004 Buist Ave	166	1 -7	4107 St Johns Ave	119	1, 3			
1005 Buist Ave	80	1 -7	1455 Ave H	132	1, 3			
1052 State Rd S-10-672	183	2	2415 Ave F	142	1, 3			

Source: Atkins 2017 (Appendix H).

4.12.1.5 Construction Noise Methodology and Impact Thresholds

Noise assessment for construction operations is conducted in accordance with the FHWA's Roadway Construction Noise Model (RCNM). Further information regarding noise from construction equipment can be found in Appendix H. No standardized criteria have been developed at a federal or state level for assessing construction noise impacts. Consequently, criteria are developed on a project-specific basis when local ordinances are not found to apply. Local noise ordinances (Charleston County 2011; North Charleston, SC Code of Ordinances) relate to nuisance and hours of allowed activities, but are not practical for assessing the impact of a major construction project. FTA guidelines for residential land uses is 80 dB(A) from daytime construction activities (FTA 2006, Page 12-8), which is an acceptable impact threshold value for construction noise of a temporary nature. Construction activities at such a level would be clearly audible over the existing ambient noise, but may be tolerable considering the temporary nature of the disturbance.

4.12.1.6 Operational Noise Methodology and Impact Thresholds

Operations of the ICTF either at the Project site or River Center project site would generate noise in the surrounding communities (refer back to Section 1.7.2 for a description of the operation activities) and would take place 24 hours a day, seven days a week. Because various noise sources would operate at different distances from the adjacent receptors, adjustments are made to the train, crane, and container impact noise data to account for the specific distance from the noise sources to the receptors and for the attenuation provided by an earthen berm between the ICTF and the nearest receptors. Detailed information regarding specific sources of operational noise, such as train and crane operations, can be found in Appendix H.

Operational noise impact from the proposed ICTF facility is based on exterior noise levels and is assessed in comparison with the exterior No-Action Alternative noise levels. Under the No-Action Alternative, construction and operation of the Navy Base ICTF would not occur and there would be no impact generated from the ICTF. There would be the potential for redevelopment of the Project site and the River Center project site to include rail-served warehousing and distribution. Detailed rail and traffic projections for the No-Action Alternative are described in Appendix F.

For the analysis of noise impacts generated by new roads and rail segments introduced with the Project alternatives in areas where roadways or railroads do not currently exist or are inactive, the No-Action Alternative is defined by the ambient noise levels anticipated in the adjacent community in the design year 2038. Noise impacts generated by operations at the Project site or River Center project site are also assessed using estimated No-Action ambient noise levels in the adjacent communities in 2038.

To characterize the existing noise environment in communities near the ICTF locations, noise measurements were conducted in July and August 2014 as detailed in Section 3.12.3. The ambient noise levels measured at 18 locations throughout the Chicora-Cherokee Community varied in the range from approximately 49 to 59 dB(A), with an overall average of 51 dB(A) (see Table 3.12-1). Due to operations of the future rail-served warehousing and distribution center, the ambient noise level in the community is assumed to grow by 2 to 4 dB(A) in 24 years from 2014 to 2038. As a result, the No-Action ambient noise level of approximately 54 dB(A) [51 + 3 = 54] is estimated for the community in 2038.

Ambient noise is also assessed for the residential community of CNYOQ Historic District, east of the River Center Site. From the 2014 field noise measurements described in Section 3.12.4 for locations at Manley Avenue (Table 3.12-1, locations M17 and M18), the average existing ambient noise level of 56 dB(A) is estimated for the community. With a 3 dB(A) growth to 2038, the No-Action ambient noise level would be expected to be around 59 dB(A) for this community.

The estimated No-Action daytime and nighttime exterior ambient noise levels are shown in Table 4.12-5.

Table 4.12-5
2038 No-Action Alternative Exterior Ambient Noise Levels[78]

Community	Daytime	Nighttime[79]
Chicora-Cherokee Community	54 dB(A)	44 dB(A)
CNYOQ Historic District	59 dB(A)	49 dB(A)

Following the NEPA approach and consistent with the traffic noise impact criteria, the criteria for operational noise impact associated with build project alternatives are based upon comparison with the No-Action Alternative for the 2038 design year and are shown in Table 4.12-6.

Table 4.12-6
Impact Definitions, Operational Noise

Negligible	Minor	Moderate	Major
0–3 dB(A) increase in Leq(h)	3–5 dB(A) increase in Leq(h)	5 –10 dB(A) increase in Leq(h)	Increase in Leq(h) greater than 10 dB(A)

[78] Note the average noise levels presented are based on the logarithmic average of the measurements taken within the neighborhoods.

[79] An adjustment factor of 10 dBA is used for all exterior sound that occurs in the nighttime hours of 10:00 p.m. to 7:00 a.m. to reflect the greater sensitivity of most people to nighttime noise.

4.12.1.7 Additive Noise Impacts

The impacts assessed for each noise source described above generally relate to different groups of affected receptors, which are analyzed separately in this document and Appendix H. For example, receptors that would experience rail noise impact (located along certain track segments), would, for the most part, not be subject to noise impacts from vehicular traffic, ICTF construction, or ICTF operations. Exceptions to this include noise sensitive receptors located along several of the road segments in the study area. Receptors along the following roadways may experience noise impacts from both traffic and rail generated noise under certain alternatives where rail tracks are located near road segments:

- Virginia Avenue between Montague Avenue and Buist Avenue (Alternatives 1, 2, 3, 5 and 6);
- St. Johns Avenue between O'Hear Avenue and McMillan Avenue (Alternatives 1 and 3);
- Spruill Avenue between Noisette Creek and N. Carolina Avenue (Alternative 2); and
- Port Drayage Road between Port Access Road and ICTF (Alternatives 5, 6, and 7).

Because traffic noise analysis and rail noise analysis are based on different noise metrics (Leq(h) and DNL, respectively), for the assessment of additive noise impacts, the units must be converted. Following the FTA Manual (FTA 2006, Appendix D), the DNL can be approximately represented by the value of Leq(h) minus 2 dB(A). For the purpose of conservative estimation of additive noise impacts, the 2 dB(A) adjustment was disregarded and the DNL generated by traffic noise was assumed to be approximately equal to the modeled Leq(h) levels described in Section 2 of Appendix H. Refer to section 4.12.10 for a discussion of additive impacts.

4.12.2 No-Action Alternative

The No-Action Alternative is described in detail in Section 2.4. Evaluation of noise conditions related to the No-Action Alternative is necessary to satisfy NEPA requirements for environmental analyses and evaluate proposed build alternatives in comparison with the No-Action Alternative to determine whether the proposed build alternatives would generate noise and/or vibration impacts. Traffic and rail activities projected for the No-Action Alternative (see Appendix F) were used for the noise impact analyses. However, for the analysis of noise impacts generated by new roads and rail segments introduced with the Project alternatives in areas where roadways or railroads do not currently exist or are inactive, the No-Action Alternative is defined by the ambient noise (see Table 4.12-5) and vibration levels anticipated in the adjacent community. In a similar manner, noise impacts generated by operations at the Project site or River Center project site are also assessed using estimated No-Action ambient noise levels in the adjacent communities.

4.12.2.1 Traffic Noise

The future traffic volumes for the No-Action Alternative reflect the growth rate of traffic not related to the Project alternatives that will be generated by various developments in North Charleston, as well as other more remote developments. Table 4.12-7 shows the average TNM modeled traffic noise levels at the receptors identified for analysis in comparison to the existing conditions. Appendix H contains data of the modeled noise levels at each individual receptor.

Table 4.12-7
Average Traffic Noise Levels for 2013 Existing Conditions
and 2038 No-Action Alternative

Description	2013 Existing Loudest-Hour Leq(h), dB(A)	2038 No-Action Loudest-Hour Leq(h), dB(A)
Virginia Avenue	70	72
Spruill Avenue from North Carolina Avenue to Cosgrove Avenue	62	67
Cosgrove Avenue	63	67
Spruill Avenue from Cosgrove Avenue to Noisette Creek	61	65
St. Johns Avenue	54	57
Noisette Boulevard	54	55
North Rhett Avenue	63	67
Montague Avenue	55	56

Source: Atkins 2017 (Appendix H).

Consistent with growth of traffic volumes that is not project related, the traffic noise levels for the 2038 No-Action Alternative would exceed the existing 2013 noise levels. As seen in Table 4.12-7, the average loudest-hour noise levels for the No-Action Alternative would increase by 1 to 5 dB(A) versus the existing condition for most of the noise receptors; however, the No-Action noise level increase versus existing conditions does not constitute a project-related noise impact. More data on individual receptors can be found in Appendix H.

4.12.2.2 Rail Noise

The future rail operations provided in Appendix F for the No-Action Alternative reflect the growing number of train occurrences or increasing average length of trains not related to the Project alternatives that would be generated by various developments in North Charleston and elsewhere.

Table 4.12-8 shows the computed distance from the rail track centerline to the DNL noise contours along the existing rail segments under the 2038 No-Action Alternative.

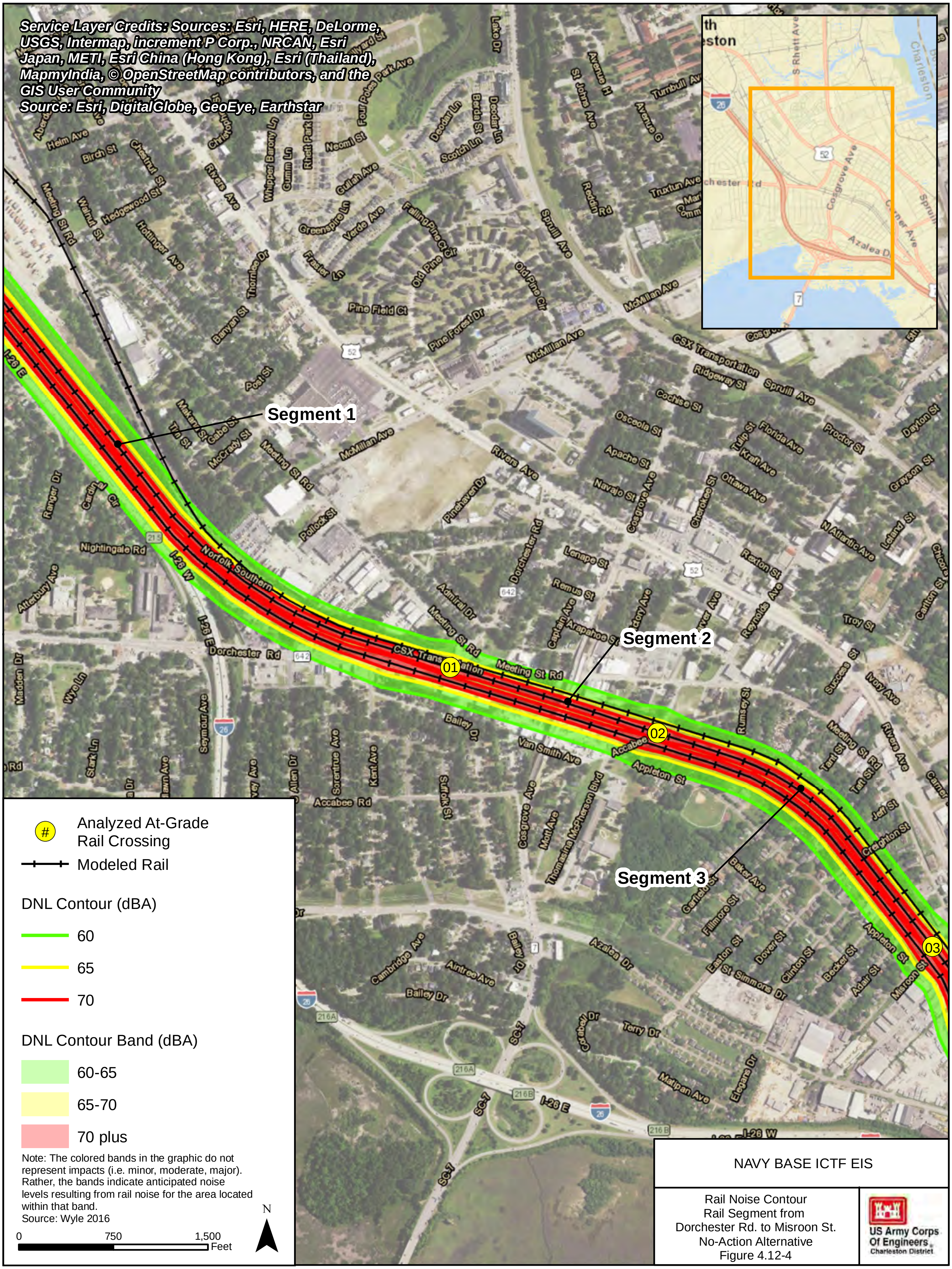
To provide a baseline for comparison with the future build alternatives, noise contours for the 2038 No-Action Alternative are reviewed for one existing rail segment, from north of Dorchester Road to Misroon Street (Segments 1, 2 and 3). Figure 4.12-4 illustrates the DNL noise contours for segments 1, 2, and 3. The noise contours also include horn noise effects. At rail crossings, the contour expands in size due to train horn soundings. Further details on the specific dimensions and distances of the noise contours at crossing locations can be found in Appendix H.

The No-Action noise level increase versus the existing condition for rail activity does not constitute a noise impact.

Table 4.12-8
DNL Contour Distance from Track Centerline for 2038, No-Action Alternative

Locations	Rail Segment	Distance (ft.) from Track Centerline to DNL Contour of		
		70 dB(A)	65 dB(A)	60 dB(A)
1–North	North of Dorchester Road (Segment 1)	37	79	170
1–2	Dorchester Road to Accabee Road (Segment 2)	37	79	170
2–3	Accabee Road to Misroon Street (Segment 3)	37	79	170
3–15	Misroon Street to Hackemann Avenue (Segment 4)	37	79	170
4–14	North of Virginia Avenue to Avenue B	24	52	112
5–East	East of North Rhett Avenue	95	205	442
5–6	Attaway Street to North Rhett Avenue	78	168	361
6–7	Rivers Avenue to Attaway Street	54	117	253
8–9	Rivers Avenue/Meeting Street to South Rhett Avenue	60	129	278
9–10	South Rhett Avenue to Spruill Avenue	63	135	290
10–11	Spruill Avenue to East Montague Avenue	65	141	303
11–12	East Montague Avenue to Durant Avenue	74	159	342
12–13	Durant Avenue to Braddock Avenue	79	169	365
13–North	North of Braddock Avenue	83	180	387
14–19	Avenue B to O'Hear Avenue	28	61	131
15–16	Hackemann Avenue to Discher Street (Segment 7)	29	55	107
16–18	Discher Street to Meeting Street	26	56	121

Source: Atkins 2017 (Appendix H).



NAVY BASE ICTF EIS

Rail Noise Contour
Rail Segment from
Dorchester Rd. to Misroon St.
No-Action Alternative
Figure 4.12-4

A number of the existing noise-sensitive land uses (defined as residences, schools, churches, hospitals, parks, etc.) would be located within the 2038 No-Action Alternative noise contours from the tracks, as the result of general non-project related developments.

The 2038 No-Action ambient noise levels in the vicinity of the future tracks are estimated to be below 60 dB(A) DNL. This estimate is based on the field-measured existing noise levels in the study area as described in Section 3.12 and adjusted for the design year 2038.

4.12.2.3 Rail Vibration

The ground-borne vibration levels generated by train activities at the vibration-sensitive receptors along the existing railroad segments would remain steady for the No-Action Alternative 2038 design year. Rail vibration effects are unlikely; however, one receptor, a single-family residence at 2312 Taylor Street, is currently located at a distance of 23 feet from the centerline of an existing track segment. This is very close to the vibration impact threshold distance of 20 feet. Due to this proximity, train activities on the track could potentially generate some vibration effects for the receptor exceeding the vibration impact criterion, even under the existing and No-Action conditions.

4.12.3 Alternative 1: Proposed Project (South via Milford / North via Hospital District)

4.12.3.1 Traffic Noise

Table 4.12-9 shows averages of the TNM modeled traffic noise levels for the receptors identified for analysis and compares those with the No-Action noise levels. Specific traffic noise levels at each receptor can be found in Appendix H. The Alternative 1 traffic volumes for Spruill Avenue are predicted to be lower than for the No-Action Alternative due to projected changes in the traffic patterns (for a description of the changes in traffic patterns under Alternative 1 refer back to Section 4.8.3). Therefore, there is a resulting decrease in noise levels at these locations. Alternative 1 would have a negligible impact on noise levels when compared to the No-Action Alternative.

Table 4.12-9
Average 2038 Traffic Noise Levels for Alternative 1 (Proposed Project) versus No-Action Alternative

Description	2038 Alternative 1 Loudest-Hour Leq(h), dB(A)	2038 No-Action Loudest-Hour Leq(h), dB(A)	Alternative 1 Minus No-Action
Virginia Avenue	74	72	2
Spruill Avenue from North Carolina Avenue to Cosgrove Avenue	66	67	-1
Cosgrove Avenue	68	67	1
Spruill Avenue from Cosgrove Avenue to Noisette Creek	65	65	0

Description	2038 Alternative 1 Loudest-Hour Leq(h), dB(A)	2038 No-Action Loudest-Hour Leq(h), dB(A)	Alternative 1 Minus No-Action
St. Johns Avenue	57	57	0
Noisette Boulevard	56	55	1
North Rhett Avenue	67	67	0
Montague Avenue	56	56	0

Source: Atkins 2017 (Appendix H).

4.12.3.2 Rail Noise

The future rail operations (Appendix F) indicate an increased number of train operations and average length of trains under Alternative 1. It should be noted that Segment 5 under Alternatives 1 and 3 includes plans for a ground cut section (trench) and two sound walls for several sections of the northern rail connection. The sound walls adjacent to St. Johns Avenue and Avenue F are designed to reduce the noise levels due to rail activities entering and exiting the ICTF facility through the northern rail connection. The sound walls would be approximately 10 feet in height. The trench is designed to level the ground under the tracks. If the trench is sufficiently deep, it also provides noise reduction effect (attenuation) for the receivers along the trench. Locations of the proposed noise mitigation measures including the trench and sound walls are shown in Figure 4.12-15. Descriptions of these mitigation measures are included in Section 4.12.12.

Table 4.12-10 shows the computed distance from the rail track centerline to the DNL noise contours along the existing and future rail segments under Alternative 1. For instance, under Alternative 1, a receptor adjacent to rail segment 1 located 68 feet or less from the rail centerline would have an expected noise level of 70 dB(A) or greater during train pass by events. A receptor located adjacent to rail segment 1 with a distance of greater than 68 feet but less than or equal to 147 feet away from the rail centerline would have an expected noise level between 65 and 70 dB(A). A receptor located adjacent to rail segment 1 with a distance greater than 147 feet but less than or equal to 316 feet away from the rail centerline would have an expected noise level between 60 and 65 dB(A). A receptor adjacent to rail segment 1 located more than 316 feet away from the rail centerline would have an expected noise level of less than 60 dB(A).

Table 4.12-10
DNL Contour Distance from Track Centerline for Alternative 1 (Proposed Project)

Locations	Rail Segment	Distance (ft.) from Track Centerline to DNL Contour of		
		70 dB(A)	65 dB(A)	60 dB(A)
1–North	North of Dorchester Road (Segment 1)	68	147	316
1–2	Dorchester Road to Accabee Road (Segment 2)	68	147	316
2–3	Accabee Road to Misroon Street (Segment 3)	68	147	316
3–15	Misroon Street to Hackemann Avenue (Segment 4)	68	147	316
4–14	North of Virginia Avenue to Avenue B	41	88	190
5–East	East of N. Rhett Avenue	90	194	419
5–6	Attaway Street to N. Rhett Avenue	79	171	369
6–7	Rivers Avenue to Attaway Street	70	151	326
8–9	Rivers Avenue/Meeting Street to S. Rhett Avenue	69	149	321
9–10	S. Rhett Avenue to Spruill Avenue	72	156	336
10–11	Spruill Avenue to E Montague Avenue	76	163	351
11–12	E. Montague Avenue to Durant Avenue	85	183	395
12–13	Durant Avenue to Braddock Avenue	92	198	426
13–North	North of Braddock Avenue	97	210	452
[1]14–ICTF	Avenue B to ICTF (Segment 5) – no trench or wall	45	97	208
	Avenue B to ICTF (Segment 5) – with trench	36–45	82–97	139–208
	Avenue B to ICTF (Segment 5) – with wall F	28	28	28
	Avenue B to ICTF (Segment 5) – with wall E	36–40	38–52	38–52
15–16	Hackemann Avenue to Discher Street (Segment 7)	56	113	233
16–18	Discher Street to Meeting Street	24	52	112
17–ICTF	Pittsburgh Avenue to ICTF	23	51	109
17–18	Meeting Street/Herbert Street to Pittsburgh Avenue	24	52	111

1. For rail Segment 5 from Avenue B to ICTF (location 14 – ICTF) the noise contour distances are provided for various conditions along the track, where neither trench nor sound wall are constructed and where the trench and sound walls are in place.

Source: Atkins 2017 (Appendix H).

The distances in Table 4.12-10 were compared to those calculated under the No-Action Alternative (refer back to Table 4.12-8), and segments where the noise contours would expand considerably were identified. The noise contours along the rail segments between Dorchester Road to Misroon Street (existing) (Segments 1, 2, and 3), Hackemann Avenue to Discher Street (existing) (Segment 7), and Avenue B and the ICTF facility (proposed) (Segment 5) would expand considerably under Alternative 1 as compared to the No-Action Alternative. Figures 4.12-5, 4.12-6, and 4.12-7 present the calculated DNL noise zones under Alternative 1 for these rail segments, and Table 4.12-11 provides a summary of the estimated number of impacted receivers along these rail segments. Impact determinations are based on the amount of increase in the decibel level between the No-Action Alternative and Alternative 1 (Proposed Project). Minor to Moderate impacts [(3 to 10 dB(A)] would occur along several segments due to increased rail activity and new track builds.

Table 4.12-11
Estimated Number of Noise Impacted Receptors for Alternative 1 (Proposed Project)

Rail Segment	Estimated Number of Impacted Receptors		
	Minor Impact (3–5 dB(A) increase)	Moderate Impact (5–10 dB(A) increase)	Major Impact (>10 dB(A) increase)
North of Dorchester Road to Misroon Street (Segments 1, 2 and 3)	25	100	0
Hackemann Avenue to Discher Street (Segment 7)	0	19	0
Avenue B to ICTF (Segment 5)	0	17[80]	0

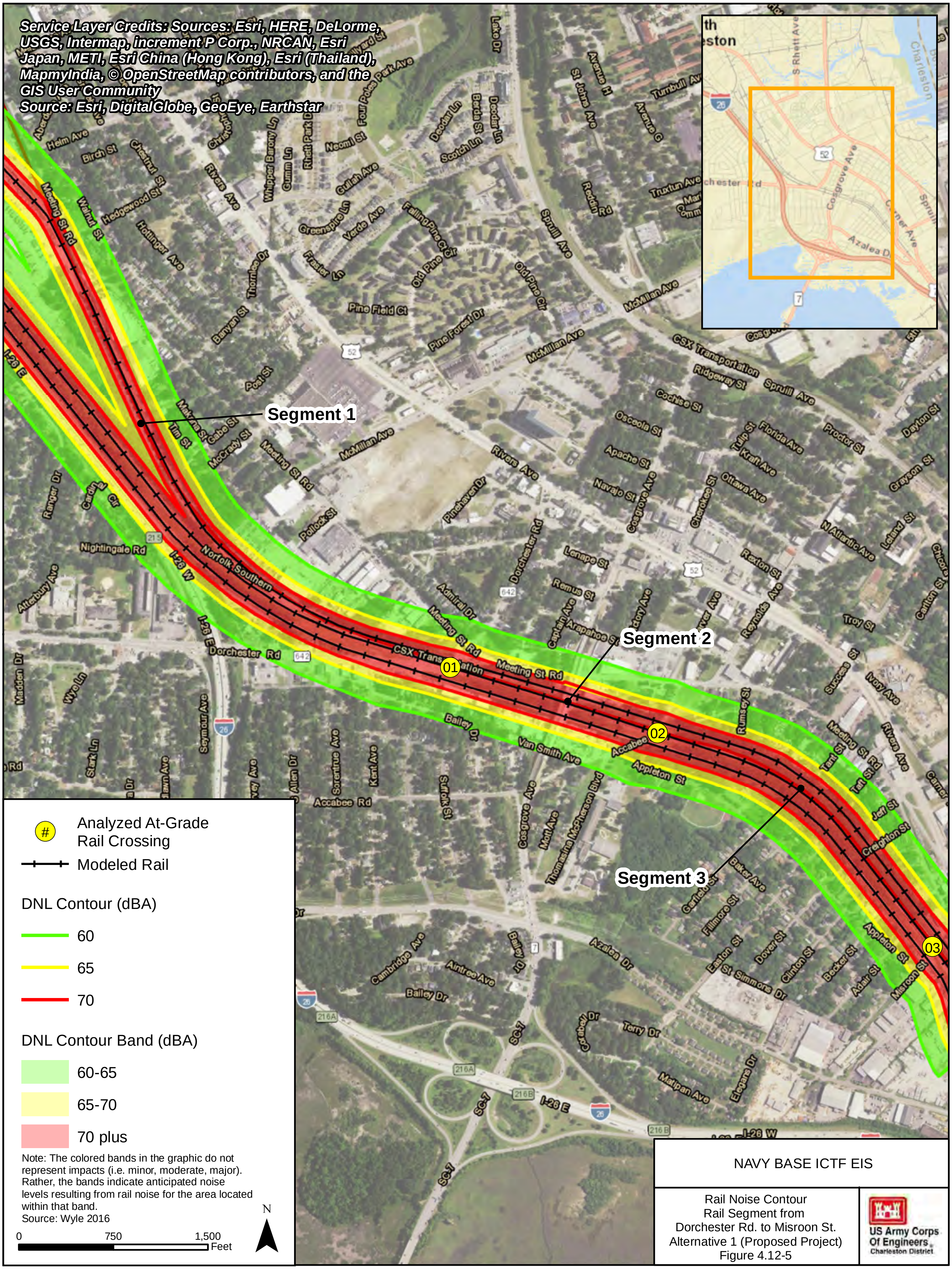
Source: Atkins 2017.

The noise contours in Figures 4.12-5, 4.12-6, and 4.12-7 include horn noise effects. For rail crossings, the contour expands in size due to train horn soundings. Further details on the specific dimensions and distances of the noise contours at crossing locations can be found in Appendix H.

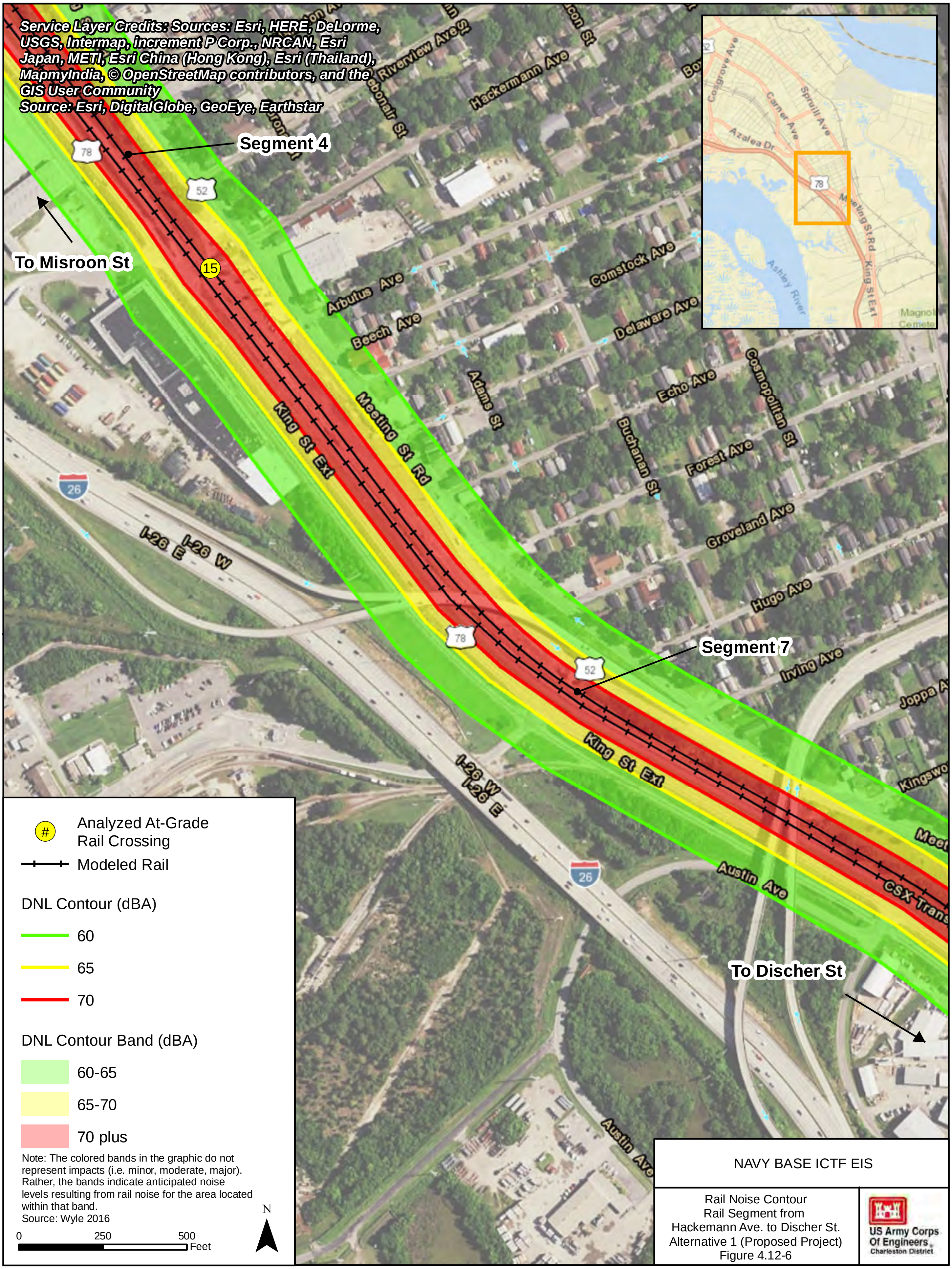
4.12.3.3 Rail Vibration

As previously noted, potential rail vibration impacts were evaluated for land uses identified along the selected railway segments and included 76 receptors (see Table 4.12-4). Based on the adjusted reference curve (refer back to Figure 14.12-3), it was determined that only receptors located less than 20 feet from the track centerline would experience rail vibration impacts, which are defined as 80 VdB. Under Alternative 1 (Proposed Project), none of the receptors are located at a distance less than 20 feet from the track centerline. Therefore, because impacts are only anticipated for receptors located less than 20 feet from the rail centerline, rail vibration effects resulting from implementation of Alternative 1 (Proposed Project) would be unlikely for the 76 receptors analyzed. The ground-borne vibration generated by train activities would produce no or negligible impact for the vibration-sensitive receptors along the railroad segments in the study area in comparison with the 2038 No-Action Alternative.

[80] It should be noted that a few of the impacted receptors are located within the limits of construction.

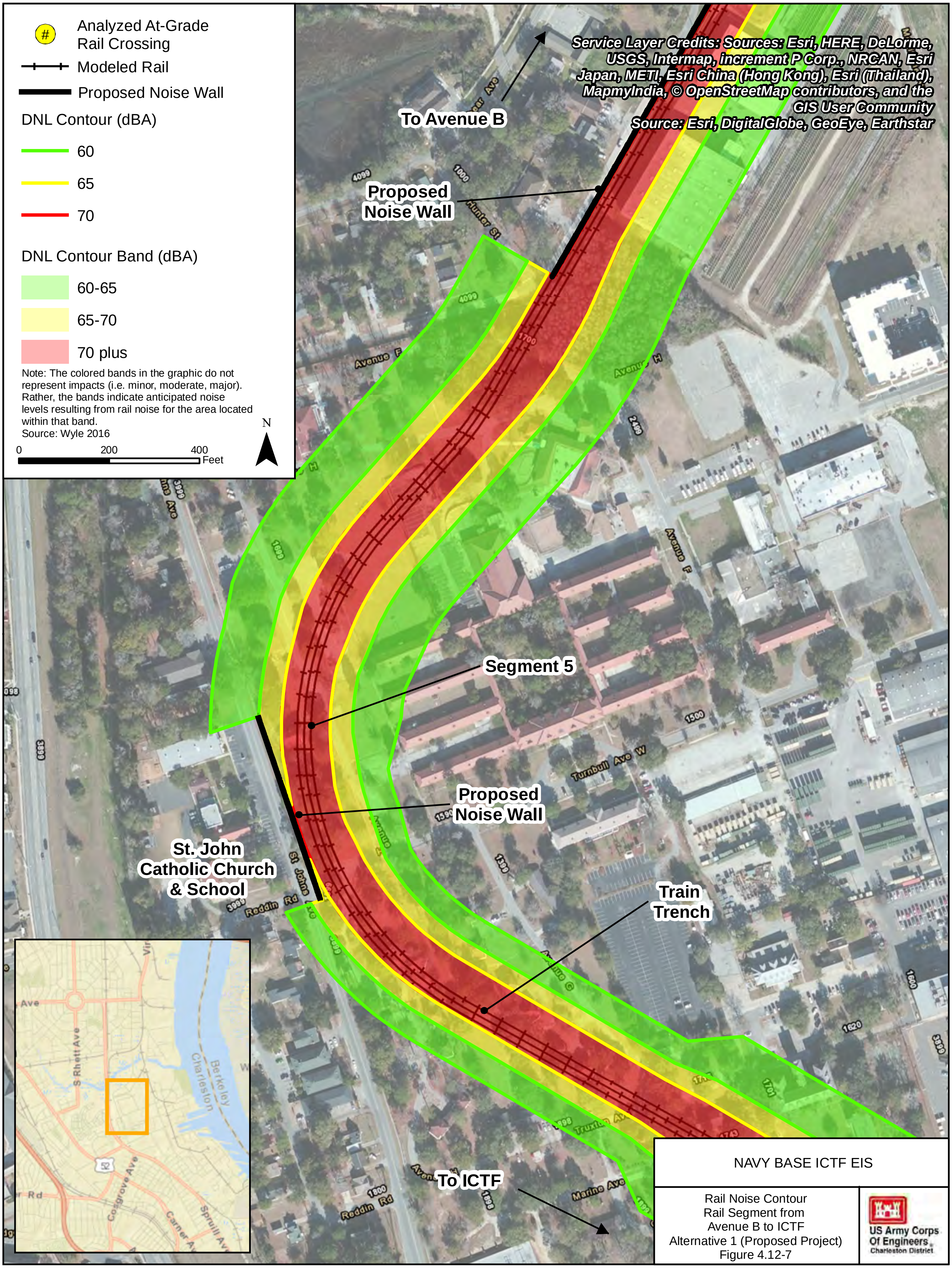


Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar
Segment 1
Segment 2
Segment 3
01
02
03
Norfolk Southern
CSX Transportation
Meeting St Rd
Dorchester Rd
I-26 E
I-26 W
Analyzed At-Grade Rail Crossing
Modeled Rail
DNL Contour (dBA)
60
65
70
DNL Contour Band (dBA)
60-65
65-70
70 plus
Note: The colored bands in the graphic do not represent impacts (i.e. minor, moderate, major). Rather, the bands indicate anticipated noise levels resulting from rail noise for the area located within that band.
Source: Wyle 2016
0
750
1,500
Feet
N
NAVY BASE ICTF EIS
Rail Noise Contour
Rail Segment from
Dorchester Rd. to Misroon St.
Alternative 1 (Proposed Project)
Figure 4.12-5
US Army Corps Of Engineers
Charleston District



NAVY BASE ICTF EIS

Rail Noise Contour
Rail Segment from
Hackemann Ave. to Discher St.
Alternative 1 (Proposed Project)
Figure 4.12-6



NAVY BASE ICTF EIS

Rail Noise Contour
Rail Segment from
Avenue B to ICTF
Alternative 1 (Proposed Project)
Figure 4.12-7

US Army Corps Of Engineers Charleston District

4.12.3.4 Construction Noise

Assessment of potential scenarios for the construction equipment distribution over the ICTF site during the construction phases noted in Appendix H was conducted using the RCNM model described in sub-section 4.12.1.4. Several scenarios including combinations of 7 to 15 individual pieces of equipment specified in Appendix H (such as excavators, front end loaders, dozers, pile drivers in operation, etc.) were modeled for each construction phase to determine associated additive impacts of the combined construction activities. The modeling was conducted for the nearest receptors, where the noise impacts would be the greatest. The representative results of the overall construction noise assessment for Alternative 1 are summarized in Table 4.12-12 for the residential receptors located 10 feet away from the berm's foot at the Project site. The predicted construction noise levels are compared with the acceptable impact threshold level of 80 dB(A) following the FTA guidelines (FTA, 2006; Page 12-8), as specified in sub-section 4.12.1.4.

Table 4.12-12
Predicted ICTF Construction Noise Levels

Construction Phase	L_{eq}, dB(A)	Acceptable Threshold	Noise Impact
Demolition and Surcharge	from 73 to 75	80 dB(A)	No
Earthen Berm Construction	from 85 to 89	80 dB(A)	Moderate
On-Site ICTF Yard – no pile driving	from 75 to 78	80 dB(A)	No
On-Site ICTF Yard – with pile driving	from 82 to 89	80 dB(A)	Minor to Moderate

Source: Atkins 2017 (Appendix H).

The average construction noise levels at the nearest residential land uses would meet the established criterion of 80 dB(A) during the general demolition/grading phase and the on-site ICTF yard construction phase. For short periods of time over the earthen berm construction (15 days) and pile diving activities (total of 90 days), the average noise levels are expected to exceed the acceptable criterion of 80 dB(A). Construction activities of the predicted noise levels would be clearly audible over the existing ambient noise in the surrounding communities, but may be tolerable due to the interim nature of the disturbance. The earthen berm construction and pile driving activities would be short-term, but still generate minor to moderate noise impacts with potential adverse community reaction.

RCNM was also utilized for modeling several potential scenarios of the equipment distribution over the northern rail connection construction area for a ground cut section (trench) and sound walls adjacent to St. Johns Avenue and Avenue F under Alternative 1 (Figure 4.12-15). For the nearest noise-sensitive receptors (residential, St. John Catholic Church and School) located at approximately 100 feet from the trench and/or sound wall, the estimated average construction noise levels would vary between 74 and 79 dB(A), thus below the established construction noise criterion of 80 dB(A). Again, construction activities of the predicted noise levels would be clearly audible over the existing ambient noise in the surrounding community, but may be tolerable due to the short-term nature of the disturbance. No noise impact due to construction activities is predicted for the ground cut section (trench) and sound walls adjacent to St. Johns Avenue and Avenue F.

Further information regarding specific construction operations and noise sources is available in Appendix H. Additionally, Appendix H contains ideal placements for specific pieces of equipment in terms of distance away from noise sensitive receivers to meet the construction noise threshold.

4.12.3.5 Operational Noise

The primary sources of the ICTF operational noise would be train movements at the classification and processing rail tracks, container loading/unloading operations performed by wide-span gantry cranes, and container stacking at the site. The noise levels generated by these sources are evaluated in Appendix H. The operational noise analysis for Alternative 1 is summarized in Table 4.12-13 for the residential receptors located 10 feet away from the berm's foot at the Project site. These receptors would be impacted the most by noise from the ICTF operations. The table presents the main individual operations generating noise at the site. Operations, such as truck movements or fork lifting would be concentrated in the area located much farther from the noise-sensitive receptors, beyond the train arrival/departure tracks, classification tracks, crane runways and container stacking area; noise levels at the residential receptors from these remote operations would be negligible in comparison with the primary noise sources.

Table 4.12-13
Operational Noise at Nearest Receivers, Alternative 1 (Proposed Project)[1]

Noise Source	Operation	Leq Type	Reference Noise Level dB(A)	Distance Attenuation dB(A)	Noise Berm Attenuation dB(A)	Noise Level at Receiver dB(A)	FRA Maximum Allowable Levels dB(A)[2]
Train (134 feet from receiver)	Arrival/ Departure	Max 1-sec Leq	81	11	10	60	90
	Car Coupling		97	11	10	76	92
	General Car Movement		64	11	10	43	88
Train (309 feet from receiver)	Arrival/ Departure	Max 1-sec Leq	81	18	10	53	90
	Car Coupling		97	18	10	69	92
	General Car Movement		64	18	10	36	88
Crane (309 feet from receiver)	Crane/Trolley Travelling	Maximum Level	70	12	10	48	n/a
	Crane Travelling	Average Level Per Hour	55	12	10	33	n/a
Container Impacts (309 feet from receiver)	Container Stacking	Max 1-sec Leq	70	12	10	48	n/a

[1] Other ICTF operational noises would be located farther from the residential receptors and would generate lower noise levels than train operations, their additive contribution to the combined noise level of the overall operations at ICTF would be minor in comparison to the train operations at the site.

[2] Appendix A to 40 C.F.R. Part 210, Summary of Noise Standards, 40 C.F.R. Part 201. Note that these allowable levels are based on a measured distance of 100 feet from the track. Also note that FRA does not regulate crane or container impact noise.

Source: Atkins 2017 (Appendix H).

The reference noise levels for train operations in Table 4.12-13 were obtained from measurements taken 38 feet from the track (see Appendix H). To verify compliance with the FRA's Railroad Noise Emission Compliance Regulations (49 C.F.R. Part 210), the reference noise levels were compared with the levels outlined in 49 C.F.R. Part 210. This guidance prescribes minimum compliance regulations for the total sound emitted by moving individual locomotives and rail cars under certain conditions. At a 100-foot measurement distance, the FRA's maximum allowable level for a moving locomotive is 90 dB(A). For comparison, the reference noise level for a train (locomotive) arrival/departure event of 81 dB(A), as measured at a distance of 38 feet, was converted[81] to a 100-foot distance, where it would be approximately 73 dB(A), which is lower than the FRA's compliance level. Also converted to a 100-foot distance, the rail car movement would have a noise level of 56 dB(A), which is lower than the compliance level of 88 dB(A) for rail cars moving with speeds less than 45 mph. At the same measurement distance, the car coupling operations would have a noise level of 89 dB(A), which is lower than the compliance level of 92 dB(A) for this operation. The above

[81] The conversion is conducted using a term 20 log10 (distance) that signifies the spherical spreading of acoustic energy with a sound level which decreases 6 dB per doubling of distance from the source.

comparisons show that the reference noise levels associated with the train operations at the Project site would be lower than the FRA's noise standards for railroad equipment, yards, and facilities.

In Table 4.12-13, the reference noise levels of the noise sources are further adjusted to account for the distance attenuation and noise attenuation due to the berm located between the sources at the Project site and the nearest noise-sensitive receptors. The appropriate distance attenuation and noise berm attenuation factors are specified in Appendix H.

The hourly average noise level of the train operations is estimated to be approximately 15 to 20 dB(A) below the maximum level measured for the car coupling (Appendix H). Applying this adjustment factor to the maximum car coupling noise level determined in Table 4.12-13, the hourly average noise level at the nearest receptors from the ICTF train operations is assessed in the range from 49 to 61 dB(A). Since other ICTF operational noise sources would be located farther from the residential receptors and would generate lower noise levels at these receivers than train operations, their additive contribution to the combined noise level of the overall operations at ICTF would be minor in comparison with the train operations at the site. Altogether, the average noise level of the total ICTF operations at the nearest residential receptors would be expected in the range from 58 to 61 dB(A).

Exterior noise impacts from Alternative 1 (Proposed Project) operations are determined in comparison with the 2038 No-Action Alternative exterior noise levels for the community adjacent to the site (see Table 4.12-5). The impacts for the nearest receptors (10 feet from the berm) are summarized in Table 4.12-14 for daytime and nighttime conditions. Daytime noise impact (7:00 a.m. to 10:00 p.m.) is most important to consider as this can affect people's activities outside their homes. The exterior noise levels from the ICTF operations would exceed the No-Action ambient noise level in the Chicora-Cherokee Communities during daytime hours by up to 7 dB(A). Such an increase constitutes a moderate noise impact for the residential land uses nearest to the Project site (as defined in Table 4.12-6). For the second row of homes along the earthen berm, assuming some shielding from the first row of homes, the daytime noise impact from the ICTF operations could be up to 4 dB(A), which is a minor impact. For the third row of homes, a negligible daytime noise impact below 3 dB(A) would likely be produced due to shielding from both the first and second rows of homes. The Corps anticipates that negligible daytime noise impacts below 3 dB(A) would be generated by the ICTF operations at distances beyond approximately 180 feet from the earthen berm.

Table 4.12-14
Operational Noise Impact at Nearest Receptors, Alternative 1 (Proposed Project)

Time of Day	Average Operational Noise Level at Receptors, dB(A)	2038 No-Action Ambient Noise Level, dB(A)	Operational Noise Impact	Approximate Number of First Row and Second Row Impacts[2]
Daytime	from 58 to 61	54	From 4 to 7 dB(A) (Minor to Moderate)	16 First Row 10 Second Row
Nighttime[1]	Exterior from 58 to 61 Interior from 38 to 41	44	Exterior from 14 to 17 dB(A) (Major)	

[1] An adjustment factor of 10 dB(A) is used for all exterior sound that occurs in the nighttime hours of 10:00 p.m. to 7:00 a.m. to reflect the greater sensitivity of most people to nighttime noise.

[2] At this time, the exact number of residential displacements that would occur due to construction of the berm is unknown (see Section 4.9.3.1). However, for the purposes of the impacts, it is assumed that only those structures that would be physically touched by the berm will be displaced. These structures are not included in total above. It should be noted that first row structures are defined as any structure that would not be shielded by other structures, and second row structures are those that would be provided with some shielding by intervening structures.

Source: Atkins 2017 (Appendix H).

With respect to operational noise, ambient noise associated with ICTF operations could expose the adjacent residential areas to exterior noise level increases over the No Action ambient of 4 to 7 dB(A) during daytime hours (defined as 7:00 a.m. to 10:00 p.m.) and 14 to 17 dB(A) during nighttime hours (defined as 10:00 p.m. to 7:00 a.m.). When compared to the No-Action ambient, this would equate to a minor to moderate impact during the daytime hours (defined as an increase of greater than 3 dB(A) to 10 dB(A) over the No Action) and a major impact during the nighttime hours (defined as an increase greater than 10 dB(A) over the No Action) to exterior noise levels. However, the nighttime hours are generally associated with sleep. The manner in which older homes were constructed generally provides a reduction of exterior-to-interior noise levels of about 20 to 25 dB(A) (Caltrans 1998) with closed windows. Taking into account a minimum 20 dB(A) reduction in noise levels from exterior to interior, interior noise levels would range from 38 to 41 dB(A) during the nighttime hours.

Numerous studies conducted over the last several decades indicate that transportation noise is a significant cause of sleep disturbance and a growing problem in cities. Studies conducted in the United States indicate that approximately 10-20 percent of sleep disturbance is related to transportation noise (Kim et al. 2012) and the World Health Organization (WHO) estimates that one in five individuals worldwide has disturbed sleep at night because of transportation-related noise (WHO 2011). Most studies focus on investigating possible secondary effects of sleep disturbance. Although no specific long-term health effects have been clearly linked to sleep disturbance, it is recognized as undesirable and thus considered an adverse noise impact. Sleep disturbance studies have become the basis for predictive models of awakenings caused by transportation noise sources. Predictive awakenings percentages are described using SEL[82].

Table 4.12-15
Sleep Disturbance as a Function of Single Event Noise Exposure[83]

Indoor SEL	Average Percent Awakened
45 dB(A)	0.8%
50 dB(A)	1.0%
55 dB(A)	1.2%
60 dB(A)	1.5%
65 dB(A)	1.8%
70 dB(A)	2.2%
75 dB(A)	2.8%
80 dB(A)	3.4%
85 dB(A)	4.2%

Source: Finegold and Elias 2002.

As explained above, the Applicant has agreed to construct an earthen berm to mitigate noise impacts; specifically, nighttime noise impacts to residents located adjacent to the noise berm. For a period of time after the initiation of operations, qualified owners will have a right to relocate if they so choose (Chapter 6 and Appendix N).

4.12.4 Alternative 2: Proposed Project Site (South via Milford/ North via S-line)

Under Alternative 2, the project would be constructed as a variation of Alternative 1 (Proposed Project). Alternative 2 differs from Alternative 1 (Proposed Project) where the northern rail connection would be located, and road and rail improvements would be adjusted accordingly to facilitate rail and road traffic as a result of the northern rail connection. The Project site construction and operational activities would remain essentially the same as for Alternative 1.

[82] SEL, sound exposure level, is the constant noise level that would deliver the same acoustic energy to the ear of a listener during a one-second exposure as the actual time-varying noise would deliver over its entire time of occurrence. For a sound lasting longer than one second, its SEL will be higher than that of the largest of the shorter duration component sounds that make up the total. For example, the SEL of a ten-second-long sound made up of 10 one-second-long component sounds, each of 60 dBA amplitude, would be 70 dBA.

[83] Note that the tabulated awakening percentages (P_{ind}) apply only to a single noise event. The occurrence of multiple noise events during a night (or day) would result in a higher compound awakening percentage for those exposed than that expected for one event. This compound awakening percentage (P_{tot}) would increase as the individual SEL and the number of events (n) increase according to the following formula: $P_{tot} = 1 – (1- P_{ind})n$. For example, if the individual awakening probability for one event is 5 percent, with 10 such events per night the compound awakening probability would be 40 percent.

4.12.4.1 Traffic Noise

Table 4.12-16 shows the average TNM modeled traffic noise levels for Alternative 2 and compares those with the No-Action Alternative noise levels. Specific traffic noise levels for individual receptors are available in Appendix H. Table 4.12-16 shows that under Alternative 2, none of the roadway segments analyzed are expected to experience traffic noise increases exceeding 3 dB(A) in comparison with the 2038 No-Action Alternative. Therefore, Alternative 2 would have a negligible traffic noise impact.

Table 4.12-16
Average 2038 Traffic Noise Levels for Alternative 2
versus No-Action Alternative

Description	2038 Alternative 2 Loudest-Hour Leq(h), dB(A)	2038 No-Action Loudest-Hour Leq(h), dB(A)	Alt 2 minus No-Action
Virginia Avenue	74	72	2
Spruill Avenue from North Carolina Avenue to Cosgrove Avenue	66	67	-1
Cosgrove Avenue	68	67	1
Spruill Avenue from Cosgrove Avenue to Noisette Creek	65	65	0
St. Johns Avenue	55	57	-2
Noisette Boulevard	56	55	1
North Rhett Avenue	67	67	0
Montague Avenue	56	56	0

Source: Atkins 2017 (Appendix H).

4.12.4.2 Rail Noise

Under Alternative 2, the rail operations on the rail segments from north of Dorchester Road to Misroon Street (Segments 1, 2 and 3) and from Hackemann Avenue to Discher Street (Segment 7) would increase similar to Alternative 1. The data shown for Alternative 1 in Table 4.12-10 and Figures 4.12-5 and 4.12-6 are applicable (within several feet) to the DNL contours and noise zones for Alternative 2 for these rail segments.

Figures 4.12-8 and 4.12-9 show new build rail segments from O'Hear Avenue to the ICTF facility in the vicinity and south of crossing 19 (Segment 6). These stretches of track would only be built under Alternative 2, and noise from trains would impact eight residences along the first segment and 10 residences along the southern continuation of the rail line parallel to Spruill Avenue. Impacts along these rail segments would be moderate to major. It should be noted that land uses in closer proximity to the track path may need to be demolished in order to construct the track.

Table 4.12-17 provides a summary of the estimated number of impacted receivers along the rail segments discussed above.

Table 4.12-17
Estimated Number of Noise Impacted Receptors for Alternative 2

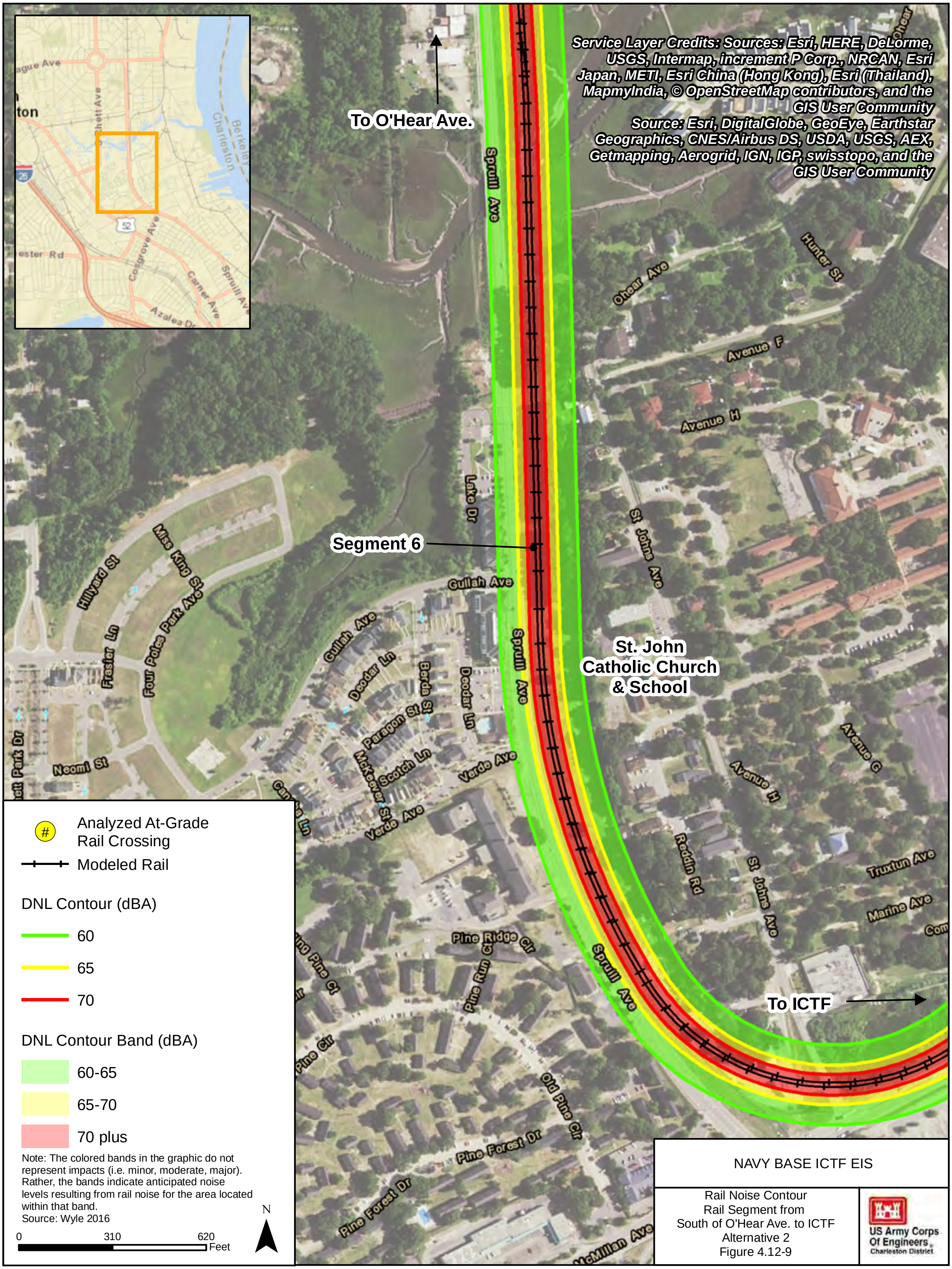
Rail Segment	Estimated Number of Impacted Receptors		
	Minor Impact (3–5 dB(A) increase)	Moderate Impact (5–10 dB(A) increase)	Major Impact (>10 dB(A) increase)
North of Dorchester Road to Misroon Street (Segments 1, 2 and 3)	25	100	0
Hackemann Avenue to Discher Street (Segment 7)	0	19	0
O'Hear Avenue to ICTF (Segment 6)	0	14	4

Source: Atkins 2017.

The noise contours include horn noise effects. For rail crossings, the contour expands in size due to train horn soundings. Further details on the specific dimensions and distances of the noise contours at crossing locations can be found in Appendix H.

NAVY BASE ICTF EIS

Rail Noise Contour
Rail Segment from
O'Hear Ave. to ICTF
Alternative 2
Figure 4.12-8



NAVY BASE ICTF EIS

Rail Noise Contour
Rail Segment from
South of O'Hear Ave. to ICTF
Alternative 2
Figure 4.12-9

4.12.4.3 Rail Vibration

Under Alternative 2, the ground-borne vibration generated by train activities would produce no or negligible impact for the majority of vibration-sensitive receptors along the railroad segments in the study area in comparison with the 2038 No-Action Alternative. Rail vibration effects would be unlikely for the 74 receptors analyzed. For the receptors located closer than 100 feet from the curved track along Spruill Avenue (State Rd S-10-672) and Aragon Avenue (Segment 6), vibration impacts might occur under Alternative 2 due to the rail curvature (the strength of the potential impact cannot be assessed, because no methodology exists to quantify vibration levels at receptors located near a segment of curved track).

A separate special case was considered for a bank building located at 1900 McMillan Avenue to address concerns related to potential false triggering of the bank security alarm by the train operations at the Spruill Avenue track segment. The closest wall of the building would be located at a distance of 250 feet from the rail track. Ground-borne vibration level at this one-story masonry building is estimated at 56 VdB. The vibration impact criterion for buildings with moderately sensitive equipment is 65 VdB (FTA 2006). The train vibration at the bank under normal conditions would be below this criterion, and false alarm triggering would not be expected.

4.12.4.4 Construction Noise

Noise conditions related to the ICTF construction activities under Alternative 2 are identical to the conditions estimated under Alternative 1 (Proposed Project).

4.12.4.5 Operational Noise

Noise impacts from the Project site operations under Alternative 2 are identical to the conditions estimated for Alternative 1 (Proposed Project).

4.12.5 Alternative 3: Proposed Project Site (South via Kingsworth / North via Hospital District)

Under Alternative 3, the Palmetto Railways Project would be constructed as a variation of the Alternative 1 (Proposed Project). Alternative 3 differs from Alternative 1 (Proposed Project) where the southern rail connection would be located, and road and rail improvements would be adjusted accordingly to facilitate rail and road traffic as a result of the southern rail connection. Alternative 3 includes a new at-grade crossing at Spruill Avenue and Meeting Street. The Project site construction and operational activities would remain essentially the same as for Alternative 1 (Proposed Project).

4.12.5.1 Traffic Noise

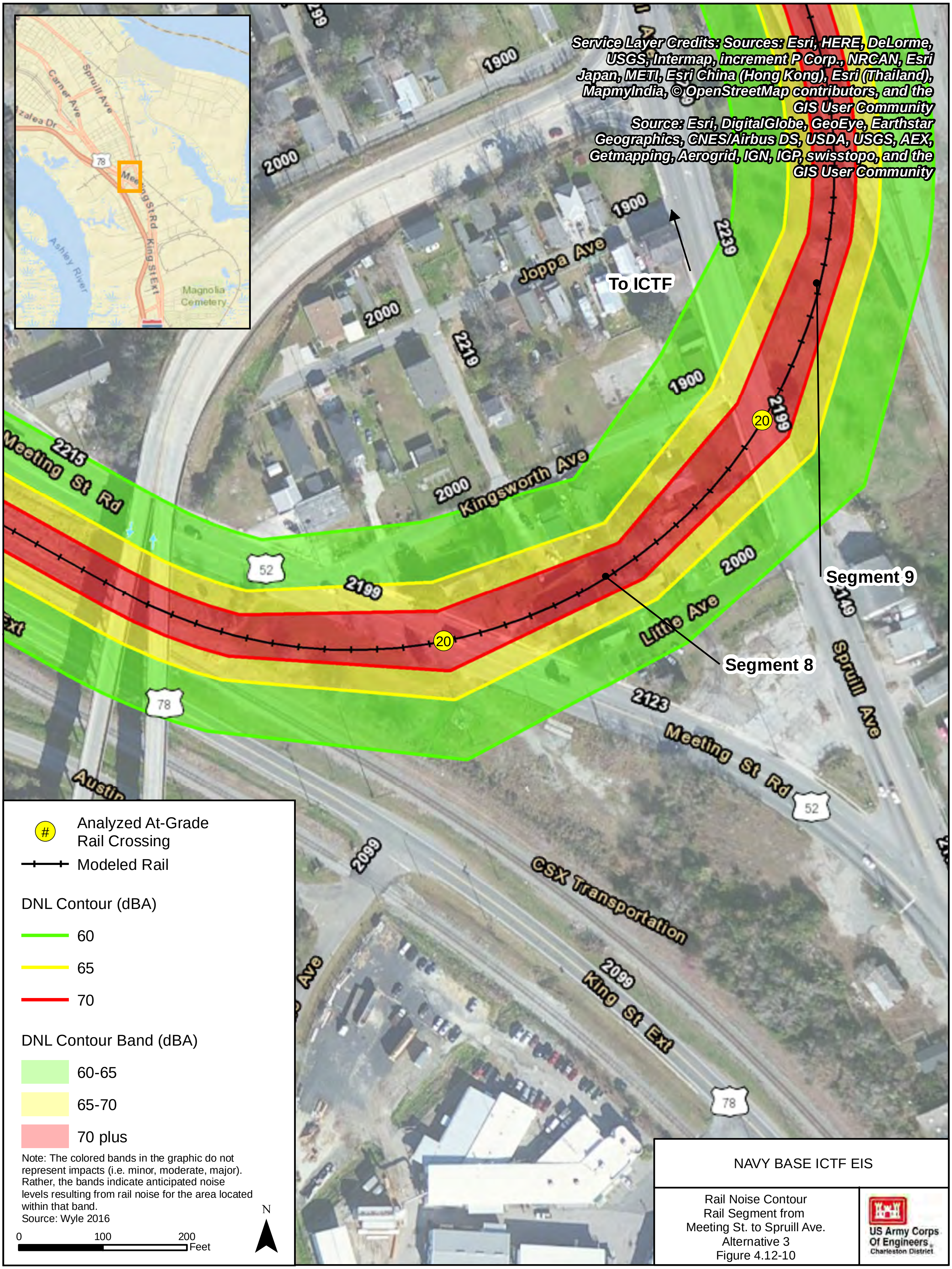
Under Alternative 3, the ICTF would be located and would operate the same as described under Alternative 1 (Proposed Project), and the road improvements and traffic volumes on the roads in the vicinity would also be identical. Therefore, the TNM modeling results for traffic noise levels shown in Table 4.12-9 apply to Alternative 3. Alternative 3 would have a negligible traffic noise impact on noise-sensitive land uses.

4.12.5.2 Rail Noise

Under Alternative 3, the rail operations would increase similar to Alternative 1. Also as with Alternative 1, Segment 5 includes plans for a ground cut section (trench) and two sound walls for the northern rail connection. Table 4.12-10 and Figure 4.12-5 provided for the rail segment from north of Dorchester Road to Misroon Street (Segments 1, 2 and 3) under Alternative 1 are applicable (within several feet) to the DNL contours and noise zones under Alternative 3. Slightly smaller noise zones were determined for the rail segment from Hackemann Avenue to Discher Street (Segment 7) under Alternative 3 when compared to Alternative 1.

Figure 4.12-10 shows a new build rail segment from Meeting Street to Spruill Avenue in the vicinity of crossing 20 (Segment 8). This stretch of track would only be built under Alternatives 3 and 6, and noise from trains would impact 10 noise sensitive receivers along the segment. The noise contours shown include horn noise effects. For rail crossings, the contour expands in size due to train horn soundings. Further details on the specific dimensions and distances of the noise contours at crossing locations can be found in Appendix H. The noise impact for these receivers would be minor to moderate. Land uses in closer proximity to the track path may be demolished in the construction of the rail track for this alternative.

Under Alternative 3, the proposed rail configuration between Avenue B and the ICTF facility (Segment 5) is identical to the Alternative 1 alignment with a trench and two sound walls for several sections. Slightly smaller noise zones were determined for this segment under Alternative 3 than for Alternative 1.



Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Carner Ave
Spruill Ave
Azalea Dr
78
Meeting St Rd
King St Ext
Ashley River
Magnolia Cemetery
1900
2000
2219
2239
Joppa Ave
To ICTF
Kingsworth Ave
2199
20
Meeting St Rd
2215
52
Segment 9
Segment 8
Little Ave
2123
2149
Spruill Ave
78
Austin
2099
CSX Transportation
King St Ext
Analyzed At-Grade Rail Crossing
Modeled Rail
DNL Contour (dBA)
60
65
70
DNL Contour Band (dBA)
60-65
65-70
70 plus
Note: The colored bands in the graphic do not represent impacts (i.e. minor, moderate, major). Rather, the bands indicate anticipated noise levels resulting from rail noise for the area located within that band.
Source: Wyle 2016
0
100
200
Feet
N
NAVY BASE ICTF EIS
Rail Noise Contour
Rail Segment from
Meeting St. to Spruill Ave.
Alternative 3
Figure 4.12-10
US Army Corps Of Engineers
Charleston District

Table 4.12-18 provides a summary of the estimated number of impacted receivers along the rail segments discussed above.

Table 4.12-18
Estimated Number of Noise Impacted Receptors for Alternative 3

Rail Segment	Estimated Number of Impacted Receptors		
	Minor Impact (3–5 dB(A) increase)	Moderate Impact (5–10 dB(A) increase)	Major Impact (>10 dB(A) increase)
North of Dorchester Road to Misroon Street (Segments 1, 2 and 3)	25	100	0
Hackemann Avenue to Discher Street (Segment 7)	0	16	0
Meeting Street to Spruill Avenue (Segment 8)	3	7	0
Avenue B to ICTF (Segment 5)	0	17[84]	0

Source: Atkins 2017.

4.12.5.3 Rail Vibration

Under Alternative 3, the ground-borne vibration generated by train activities would produce no or negligible impact for the majority of vibration-sensitive receptors along the railroad segments in the study area in comparison with the 2038 No-Action Alternative. Rail vibration effects would be unlikely for the 74 receptors analyzed. For the receptors located closer than 100 feet from the curved track near Kingsworth Avenue (Segment 8), vibration impacts might occur under Alternative 3 due to the rail curvature (the strength of the potential impact cannot be assessed, because no methodology exists to quantify vibration levels at receptors located near a segment of curved track).

4.12.5.4 Construction Noise

Noise conditions related to construction activities for the ICTF and northern rail connection ground cut section (trench) and sound walls under Alternative 3 are identical to the ones evaluated under Alternative 1.

4.12.5.5 Operational Noise

Noise impacts from site operations under Alternative 3 are identical to the ones estimated under Alternative 1.

[84] It should be noted that a few of the impacted receptors are located within the limits of construction.

4.12.6 Alternative 4: Proposed Project Site (South via Milford)

Alternative 4 would be constructed as a variation of Alternative 1 (Proposed Project) where trains enter and exit the Navy Base ICTF from a southern rail connection. A tail track would extend through the Hospital District and stop short of Noisette Creek. Road improvements would be the same as those identified in Alternative 1. The Project site construction and operational activities would also remain essentially the same as for Alternative 1.

4.12.6.1 Traffic Noise

Under Alternative 4, the ICTF would be located and would operate the same as described in Alternative 1, and the road improvements and traffic volumes would also be identical. Therefore, the traffic noise levels shown in Table 4.12-9 for Alternative 1 (Proposed Project) apply to Alternative 4. Alternative 4 would have a negligible traffic noise impact on noise-sensitive receptors.

4.12.6.2 Rail Noise

Under Alternative 4, the noise contours along the rail segment from north of Dorchester Road to Misroon Street (Segments 1, 2 and 3) shown in Figure 4.12-11 would be significantly expanded in comparison to the No-Action Alternative. The number of residences located within the 70, 65, and 60 dB(A) noise zones would increase.

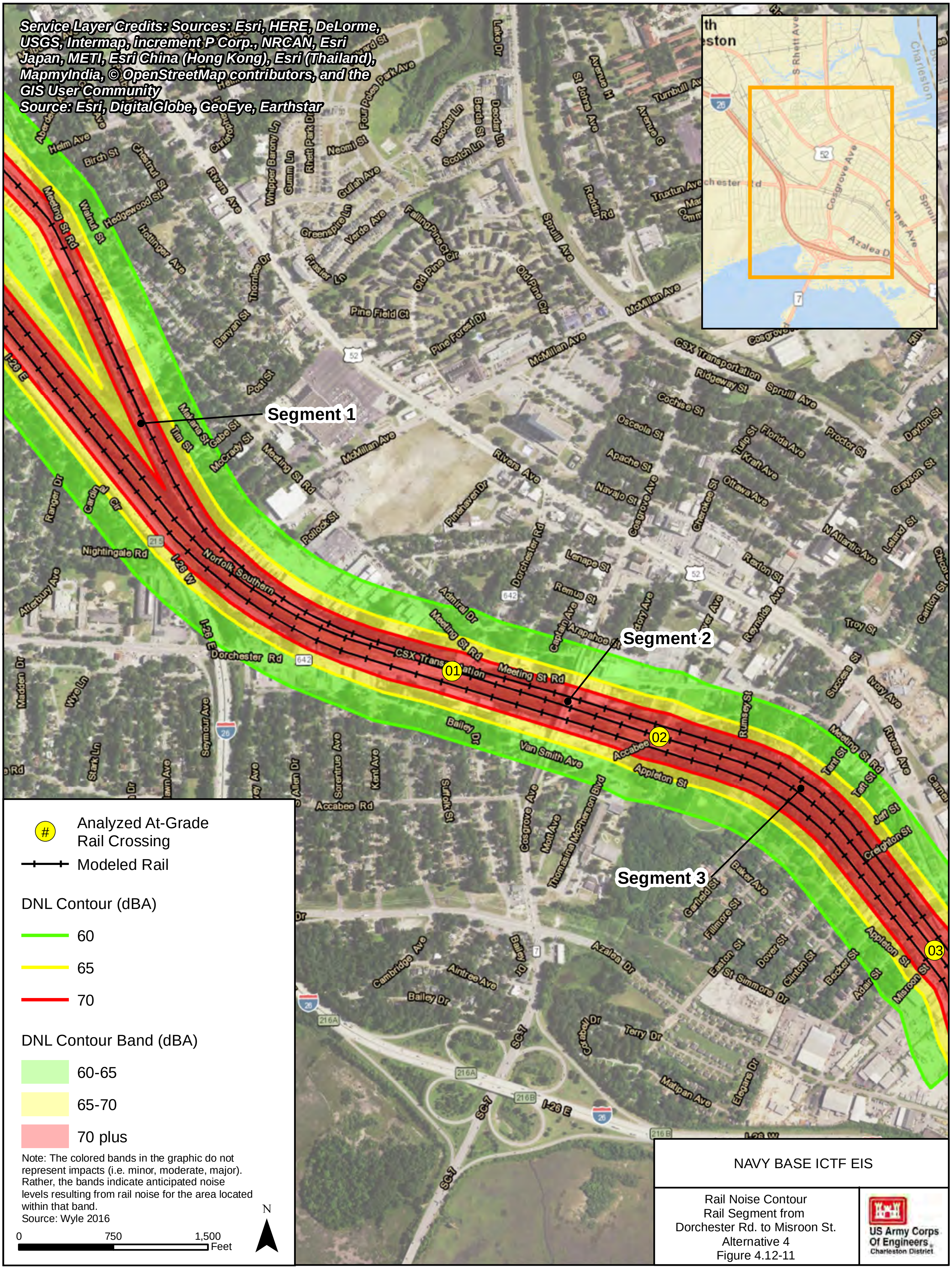
For the existing track from Hackemann Avenue to Discher Street (Segment 7), Figure 4.12-12 displays the DNL zones generated by the Alternative 4 rail operations between crossing locations 15 and 16. Under Alternative 4, the noise zones would expand considerably in comparison to the No-Action Alternative.

Table 4.12-19 provides a summary of the estimated number of impacted receivers along the rail segments discussed above.

Table 4.12-19
Estimated Number of Noise Impacted Receptors for Alternative 4

Rail Segment	Estimated Number of Impacted Receptors		
	Minor Impact (3–5 dB(A) increase)	Moderate Impact (5–10 dB(A) increase)	Major Impact (>10 dB(A) increase)
North of Dorchester Road to Misroon Street (Segments 1, 2, and 3)	60	170	0
Hackemann Avenue to Discher Street (Segment 7)	10	39	0

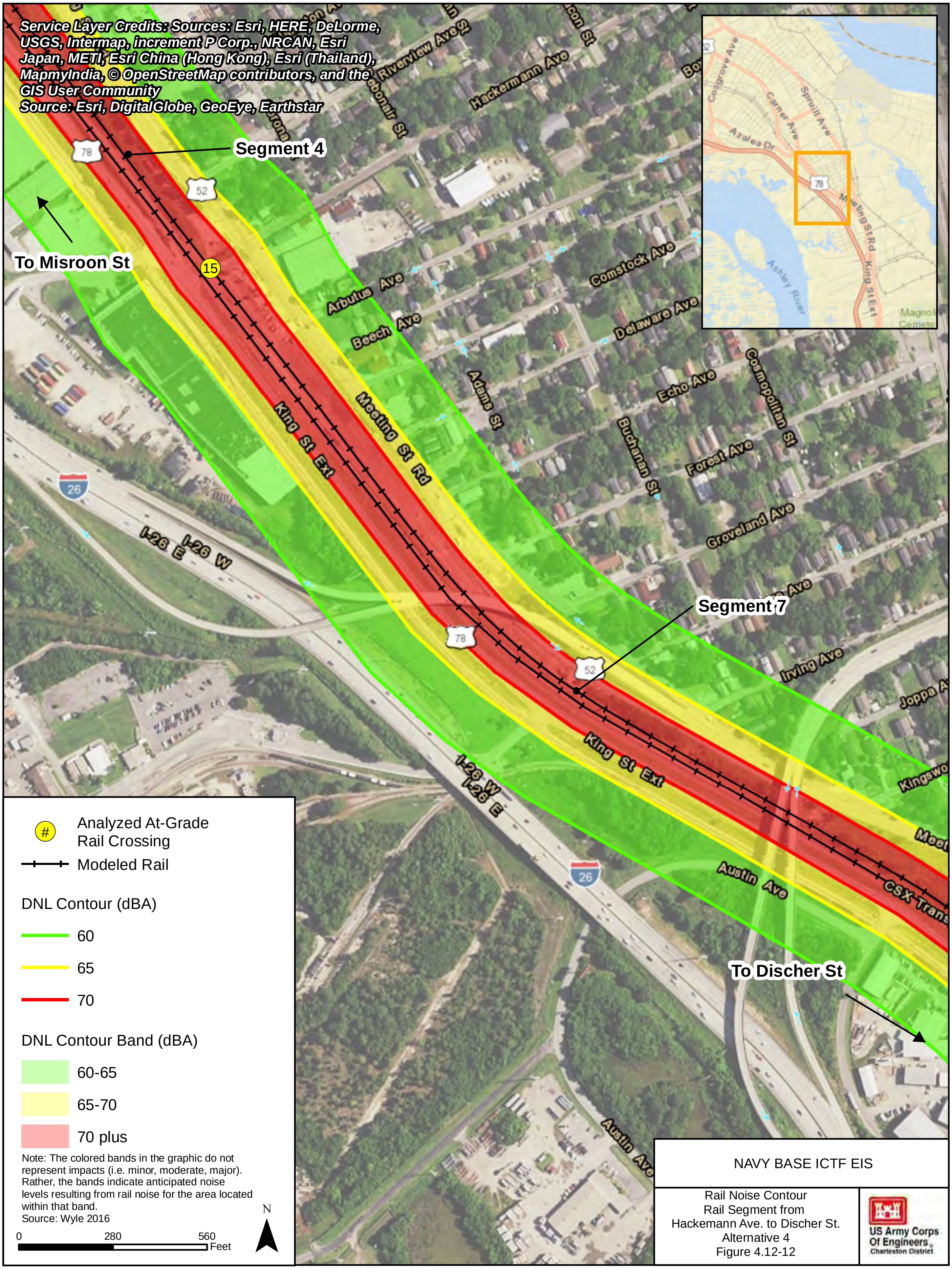
Source: Atkins 2017.



NAVY BASE ICTF EIS

Rail Noise Contour
Rail Segment from
Dorchester Rd. to Misroon St.
Alternative 4
Figure 4.12-11

US Army Corps Of Engineers
Charleston District



NAVY BASE ICTF EIS

Rail Noise Contour
Rail Segment from
Hackemann Ave. to Discher St.
Alternative 4
Figure 4.12-12

US Army Corps Of Engineers
Charleston District

The noise contours include horn noise effects. For rail crossings, the contour expands in size due to train horn soundings. Further details on the specific dimensions and distances of the noise contours at crossing locations can be found in Appendix H.

4.12.6.3 Rail Vibration

Under Alternative 4, the ground-borne vibration generated by train activities would produce no or negligible impact for the vibration-sensitive receptors along the railroad segments in the study area in comparison with the 2038 No-Action Alternative. Rail vibration effects would be unlikely for the 76 receptors analyzed.

4.12.6.4 Construction Noise

Noise conditions related to the ICTF construction activities under Alternative 4 are identical to the conditions evaluated under Alternative 1.

4.12.6.5 Operational Noise

Noise impacts from the Project site operations under Alternative 4 are identical to the conditions estimated under Alternative 1 (Proposed Project).

4.12.7 Alternative 5: River Center Site (South via Milford / North via Hospital District)

Alternative 5 is a variation of Alternative 1 (Proposed Project) with the Project site being moved to the River Center project site. Road and rail improvements would be adjusted accordingly to facilitate rail and road traffic at the new site. Roadway improvements for this alternative would incorporate a new segment of Port drayage road through the Proposed Project's site and other road modifications. Operation activities associated with the ICTF at the River Center project site would be similar to Alternative 1 (Proposed Project); however, different communities would potentially experience associated noise impact for adjacent sensitive land uses. A sound attenuation and security wall would be constructed adjacent to Noisette Boulevard along the length of the eastern boundary of the facility site.

4.12.7.1 Traffic Noise

Table 4.12-20 shows the average TNM modeled traffic noise levels for the receptors identified in Appendix H for Alternative 5 and compares those with the No-Action noise levels. Specific traffic noise levels for individual receptors can be found in Appendix H.

Table 4.12-20
Average 2038 Traffic Noise Levels for Alternative 5 versus No-Action Alternative

Description	2038 Alternatives 5 Loudest-Hour Leq(h), dB(A)	2038 No-Action Loudest-Hour Leq(h), dB(A)	Alternatives 5 minus No-Action
Virginia Avenue	74	72	2
Spruill Avenue from North Carolina Avenue to Cosgrove Avenue	67	67	0
Cosgrove Avenue	67	67	0
Spruill Avenue from Cosgrove Avenue to Noisette Creek	66	65	1
St. Johns Avenue	58	57	1
Noisette Boulevard	53	55	-2
North Rhett Avenue	67	67	0
Port drayage road	59	53	6
Montague Avenue	56	56	0

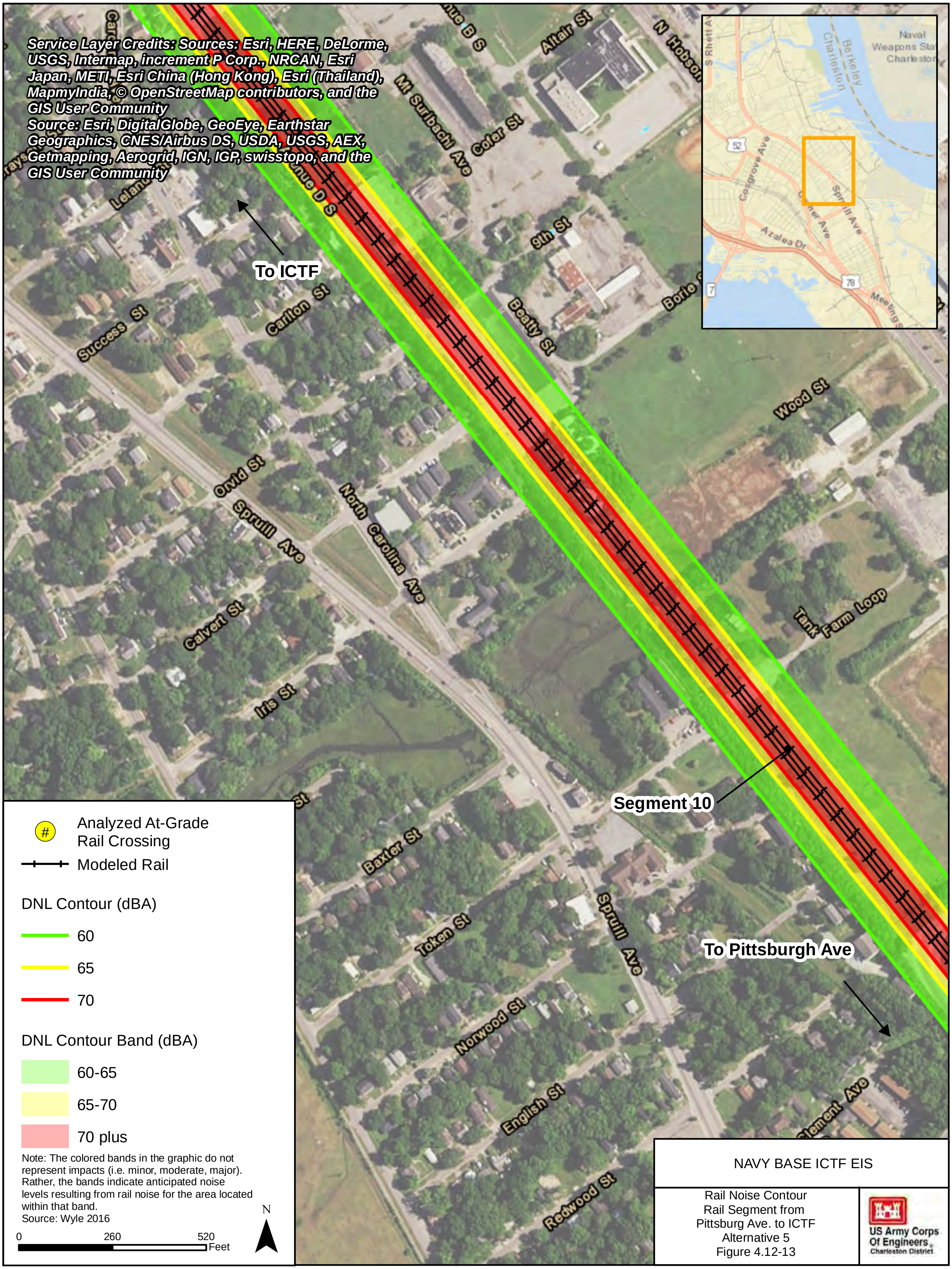
Source: Atkins 2017 (Appendix H).

As shown in Table 4.12-20, the change between the loudest-hour Leq(h) for Alternative 5 and the 2038 No-Action Alternative would not exceed 3 dB(A) for any receptor, with the exception of 18 receptors exposed to the proposed Port drayage road. For these 18, residential land uses in the Chicora-Cherokee community, the Alternative 5 noise levels would exceed the No-Action Alternative levels by 4 to 7 dB(A), which indicates a minor to moderate traffic noise impact. For all the other noise-sensitive land uses, negligible traffic noise impacts are anticipated under Alternative 5.

4.12.7.2 Rail Noise

Under Alternative 5, operations on the rail segment from north of Dorchester Road to Misroon Street (Segments 1, 2 and 3) would increase in comparison to the No-Action Alternative, similar to Alternative 1 (Proposed Project). The data presented for Alternative 1 (Proposed Project) for this rail segment are applicable (within several feet) to the DNL contours and noise zones under Alternative 5. The same conclusion applies to the rail segment from Hackemann Avenue to Discher Street (Segment 7).

Figure 4.12-13 shows a new build rail segment from Pittsburg Avenue to the ICTF facility (Segment 10), north of crossing 17. Under Alternative 5, the ICTF facility would be located at the River Center project site. Along this stretch of track, 23 noise sensitive receivers within the Chicora-Cherokee communities would be impacted by rail activity, as shown in Figure 4.12-13. Most of the affected residential land uses would be located within the DNL zone from 60 to 65 dB(A). They would be exposed to moderate noise impacts [from 5 to 10 dB(A)] in comparison with the 2038 No-Action Alternative.



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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
To ICTF
Segment 10
To Pittsburgh Ave
Altair St
Mt Suribachi Ave
Cofer St
9th St
Beatty St
Borie St
Wood St
Tank Farm Loop
Leland St
Carlton St
Success St
Orvid St
Spruill Ave
North Carolina Ave
Calvert St
Iris St
Baxter St
Token St
Norwood St
English St
Redwood St
Clement Ave
N Hobson
Cosgrove Ave
Spruill Ave
Azalea Dr
Meeting St
Berkeley
Charleston
Naval Weapons Sta Charleston
Analyzed At-Grade Rail Crossing
Modeled Rail
DNL Contour (dBA)
60
65
70
DNL Contour Band (dBA)
60-65
65-70
70 plus
Note: The colored bands in the graphic do not represent impacts (i.e. minor, moderate, major). Rather, the bands indicate anticipated noise levels resulting from rail noise for the area located within that band.
Source: Wyle 2016
0
260
520
Feet
N
NAVY BASE ICTF EIS
Rail Noise Contour
Rail Segment from
Pittsburg Ave. to ICTF
Alternative 5
Figure 4.12-13
US Army Corps Of Engineers
Charleston District

Table 4.12-21 provides a summary of the estimated number of impacted receivers along the rail segments discussed above.

Table 4.12-21
Estimated Number of Noise Impacted Receptors for Alternative 5

Rail Segment	Estimated Number of Impacted Receptors		
	Minor Impact (3–5 dB(A) increase)	Moderate Impact (5–10 dB(A) increase)	Major Impact (>10 dB(A) increase)
North of Dorchester Road to Misroon Street (Segments 1, 2 and 3)	25	100	0
Hackemann Avenue to Discher Street (Segment 7)	0	19	0
Pittsburg Avenue to ICTF (Segment 10)	0	23	0

Source: Atkins 2017.

The noise contours include horn noise effects. For rail crossings, the contour expands in size due to train horn soundings. Further details on the specific dimensions and distances of the noise contours at crossing locations can be found in Appendix H.

4.12.7.3 Rail Vibration

Under Alternative 5, the ground-borne vibration generated by train activities would produce no or negligible impact for the vibration-sensitive receptors along the railroad segments in the study area in comparison with the 2038 No-Action Alternative. Rail vibration effects would be unlikely for the 76 receptors analyzed.

4.12.7.4 Construction Noise

The ICTF construction at the River Center project site would be accomplished similarly to construction at the Project site in Alternative 1 (Proposed Project). Similar construction phases, time schedules, and equipment would be utilized; however, due to differing site layout, different communities would be exposed to construction noise. The earthen berm would not be constructed; however, a sound attenuation and security wall would be constructed adjacent to Noisette Boulevard along the length of the eastern boundary of the River Center project site for abatement of noise from ICTF operations.

Analysis of the noise conditions related to construction activities under Alternative 1 (Proposed Project) is valid for the River Center project site under Alternative 5 (see Table 4.12-12). Construction of the sound attenuation wall would occur in proximity to the residential community of the CNYOQ Historic District. Impact pile drivers would be utilized in various locations at the site in construction of the sound wall, support pads for rail mounted gantry cranes, and for driving H-beam piles for box culvert upgrades. The average construction noise levels at the nearest residential land uses would meet the established criterion of 80 dB(A) during the general demolition/grading phase and the on-site ICTF yard construction phase. For short periods of time during the sound wall construction and other pile diving activities, the average noise levels will exceed the accepted criterion. Construction activities would be clearly audible over the existing ambient noise in the community, but may be tolerable due to the interim nature of the disturbance. The pile driving activities would be short-term.

4.12.7.5 Operational Noise

Operational noise analysis for the River Center project site is similar to that prepared for Alternative 1 (Proposed Project). Operation activities would be identical, the primary sources of operational noise would be the same, and the site layout would also be similar but with the reversed north-south general orientation. No earthen berm would be constructed, but a sound attenuation and security wall would be built, as noted above. The nearest noise-sensitive receivers would be located in the CNYOQ Historic District along Manley Avenue (east of Noisette Boulevard), at a distance of 150 feet from the ICTF train operations. Table 4.12-22 summarizes the operational noise analysis for the River Center project site for these receptors that would be impacted the most by noise from the ICTF operations. The table presents the main individual operations generating noise at the site (train, crane, and containers). Operations such as truck movements or fork lifting would be concentrated in the area located much farther from the noise-sensitive receptors, beyond the train arrival/departure tracks, classification tracks, crane runways and container stacking area; noise levels at the residential receptors from these remote operations would be negligible in comparison with the primary noise sources.

Table 4.12-22
Operational Noise at Nearest Receptors, Alternative 5

Noise Source	Operation	Leq Type	Reference Noise Level dB(A)	Distance Attenuation dB(A)	Sound Wall Attenuation dB(A)	Noise Level at Receiver dB(A)
Train (150 feet from receiver)	Arrival/ Departure	Max 1-sec Leq	81	11	10	60
	Car Coupling		97	11	10	76
	General Car Movement		64	11	10	43
Train (382 feet from receiver)	Arrival/ Departure	Max 1-sec Leq	81	20	10	51
	Car Coupling		97	20	10	67
	General Car Movement		64	20	10	34
Crane (382 feet from receiver)	Crane/Trolley Travelling	Maximum Level	70	13	10	47
	Crane Travelling	Average Level Per Hour	55	13	10	32

Noise Source	Operation	Leq Type	Reference Noise Level dB(A)	Distance Attenuation dB(A)	Sound Wall Attenuation dB(A)	Noise Level at Receiver dB(A)
Container Impacts (309 feet from receiver)	Container Stacking	Max 1-sec Leq	70	12	10	48

Source: Atkins 2017 (Appendix H).

The projected noise levels for train operations in Table 4.12-22 are the same as for Alternative 1 (Proposed Project), as shown in Table 4.12-13, and would comply with the FRA noise regulation discussed in section 4.12.3.5. The reference noise levels associated with the train operations at the River Center project site would be lower than the FRA's noise standards for railroad equipment, yards, and facilities.

In Table 4.12-22, the reference noise levels of the noise sources are further adjusted to account for the distance attenuation and noise attenuation due to the sound wall located between the sources at the River Center project site and the nearest noise-sensitive receptors. These adjustment factors were determined to also be similar to the ones for the Proposed Project (refer back to Section 4.12.3.5). The resulting total average noise levels from the ICTF operations at the nearest receptors would be in the range from 58 to 61 dB(A), similar to the Proposed Project site.

Noise impacts from the River Center operations are based on exterior levels and determined in comparison with the 2038 No-Action Alternative noise levels for the community adjacent to the site (see Table 4.12-5). The impacts for the nearest receptors are summarized in Table 4.12-23 for daytime and nighttime conditions. Daytime noise impact (7:00 a.m. to 10:00 p.m.) is most important to consider, as this can affect people's activities outside their homes. The exterior noise levels from the ICTF operations would exceed the daytime No-Action ambient noise level at the edge of the CNYOQ Historic District during daytime hours by up to 2 dB(A), which is a negligible impact (as defined in Table 4.12-6). Loud operations like rail car coupling would be audible at the nearest residences but, in general, operational noise levels would remain comparable to the ambient noise. Homes east of Manley Avenue and beyond are also expected to experience negligible or no noise impact from daytime ICTF operations due to increased distance and shielding effect from other homes.

Table 4.12-23
Operational Noise Impact at Nearest Receivers, Alternative 5

Time of Day	Average Operational Noise Level at Receptors, dB(A)	2038 No-Action Ambient Noise Level, dB(A)	Operational Noise Impact
Daytime	from 58 to 61	59	From 0 to 2 dB(A) (Negligible)
Nighttime	Exterior from 58 to 61 Interior from 38 to 41	49	Exterior from 9 to 12 dB(A) (Moderate to major)

Source: Atkins 2017.

With respect to operational noise, ambient noise associated with ICTF operations could expose the adjacent residential areas to exterior noise level increases over the No-Action ambient of 0 to 2 dB(A) during daytime hours (defined as 7:00 a.m. to 10:00 p.m.) and 9 to 12 dB(A) during nighttime hours (defined as 10:00 p.m. to 7:00 a.m.). When compared to the No-Action ambient, this would equate to a negligible impact during the daytime hours and a moderate to major impact during the nighttime hours to exterior noise levels. However, the nighttime hours are generally associated with sleep. Refer back to Section 4.12.3.5 for the discussion on nighttime noise impacts and sleep disturbance.

In general, noise impacts generated by the River Center project site operations are lower in comparison with the impacts produced by the Proposed Project operations due to higher No-Action ambient noise levels anticipated in the vicinity of the River Center project site.

4.12.8 Alternative 6: River Center Site (South via Kingsworth / North via Hospital District)

Under Alternative 6, the ICTF would be located at the River Center project site. Road improvements for this alternative would be the same as described in Alternative 5. Rail improvements would be similar to those described for the northern and southern rail connection in Alternative 5, except that the southern rail connection would connect to an existing rail line near Kingsworth Avenue. This would result in a new at-grade crossing at Spruill Avenue and Meeting Street. The River Center project site construction and operational activities would remain essentially the same as for Alternative 5.

4.12.8.1 Traffic Noise

Under Alternative 6, the road improvements and traffic volumes would be identical to the ones under Alternative 5. Therefore, Alternative 6 would generate equal noise levels, and TNM modeling results for traffic noise levels shown in Table 4.12-20 apply to Alternative 6. Alternative 6 would have a minor to moderate traffic noise impact for the 18 residential land uses in the Chicora-Cherokee community. For all the other noise-sensitive land uses, no or negligible traffic noise impacts are anticipated under Alternative 6.

4.12.8.2 Rail Noise

Under Alternative 6, operations on the rail segment from north of Dorchester Road to Misroon Street (Segments 1, 2, and 3) would increase similar to Alternative 5. Slightly smaller noise zones with lower counts of impacted residences are determined for the rail segment from Hackemann Avenue to Discher Street (Segment 7) under Alternative 6 as compared to Alternative 5.

Figure 4.12-10 shows a proposed rail segment from Meeting Street to Spruill Avenue in the vicinity of crossing 20 (Segment 8). This stretch of track would only be built under Alternatives 3 and 6, and noise from trains would impact 10 noise sensitive receivers along that segment. Land uses in closer proximity to the track path may be demolished for construction of the proposed rail track.

Under Alternative 6, the proposed new rail segment between Spruill Avenue and the ICTF facility (Segment 9) would impact 23 noise sensitive receivers in the Chicora-Cherokee communities as shown in Figure 4.12-13[85]. A moderate noise impact is estimated for these land uses in comparison with the 2038 No-Action Alternative.

Table 4.12-24 provides a summary of the estimated number of impacted receivers along the rail segments discussed above.

Table 4.12-24
Estimated Number of Noise Impacted Receptors for Alternative 6

Rail Segment	Estimated Number of Impacted Receptors		
	Minor Impact (3–5 dB dB(A) increase)	Moderate Impact (5–10 dB dB(A) increase)	Major Impact (>10 dB dB(A) increase)
North of Dorchester Road to Misroon Street (Segments 1, 2, and 3)	25	100	0
Hackemann Avenue to Discher Street (Segment 7)	0	16	0
Meeting Street to Spruill Avenue (Segment 8)	3	7	0
Pittsburg Avenue to ICTF (Segment 9)	0	23	0

Source: Atkins 2017.

The noise contours include horn noise effects. For rail crossings, the contour expands in size due to train horn soundings. Further details on the specific dimensions and distances of the noise contours at crossing locations can be found in Appendix H.

[85] Segments 9 and 10 are similar in the vicinity of the Chicora-Cherokee communities under Alternatives 5 and 6, hence the use of the same figure, and differ southeast of the displayed area.

4.12.8.3 Rail Vibration

Under Alternative 6, the ground-borne vibration generated by train activities would produce no or negligible impact for the majority of vibration-sensitive receptors along the railroad segments in the study area in comparison with the 2038 No-Action Alternative. Rail vibration effects would be unlikely for the 74 receptors analyzed. For the receptors located closer than 100 feet. from the curved track near Kingsworth Avenue (Segment 8), vibration impacts might occur under Alternative 6 due to the rail curvature (the strength of the potential impact cannot be assessed, because no methodology exists to quantify vibration levels at receptors located near a segment of curved track).

4.12.8.4 Construction Noise

Noise conditions related to the ICTF construction activities under Alternative 6 are identical to the ones evaluated under Alternative 5.

4.12.8.5 Operational Noise

Noise impact from the River Center project site operations under Alternative 6 is identical to those estimated for Alternative 5.

4.12.9 Alternative 7: River Center Site (South via Milford)

Under Alternative 7, the ICTF would be located at the River Center project site. Roadway improvements and traffic projections would be the same as described in Alternative 5. Rail improvements for Alternative 7 would be similar to those described under Alternative 5 with the exception that trains would enter and exit the ICTF from a southern rail connection only. The River Center project site construction and operational activities would remain essentially the same as for Alternative 5.

4.12.9.1 Traffic Noise

The TNM modeling results for traffic noise levels shown in Table 4.12-20 apply to Alternative 7, and the conclusions provided for Alternative 5 are valid for Alternative 7. Alternative 7 would have a minor to moderate traffic noise impact for the 18 residential land uses in the Chicora-Cherokee community. For all the other noise-sensitive land uses, no or negligible traffic noise impacts are anticipated under Alternative 7.

4.12.9.2 Rail Noise

Expansion of the noise contours under Alternative 7 is similar to Alternative 4 for the rail segment from north of Dorchester Road to Misroon Street (Segments 1, 2, and 3) (see Figure 4.12-11) when compared to the No-Action Alternative. A similar conclusion applies to the rail segment from

Hackemann Avenue to Discher Street (Segment 7), shown in Figure 4.12-12. Under Alternative 7, the DNL zones would also expand considerably versus the 2038 No-Action Alternative.

Figure 4.12-14 shows a new build rail segment from Pittsburg Avenue to the ICTF facility at the River Center project site (Segment 10). This stretch of track would only be built for the southern alignment under Alternatives 5, 6, and 7. Under Alternative 7, however, the DNL zones extend much farther from the track than for the other two alternatives. A moderate noise impact is estimated for most of these land uses in comparison with the 2038 No-Action Alternative.

Table 4.12-25 provides a summary of the estimated number of impacted receivers along the rail segments discussed above.

Table 4.12-25
Estimated Number of Noise Impacted Receptors for Alternative 7

Rail Segment	Estimated Number of Impacted Receptors		
	Minor Impact (3–5 dB dB(A) increase)	Moderate Impact (5–10 dB dB(A) increase)	Major Impact (>10 dB dB(A) increase)
North of Dorchester Road to Misroon Street (Segments 1, 2, and 3)	60	170	0
Hackemann Avenue to Discher Street (Segment 7)	10	39	0
Pittsburg Avenue to ICTF (Segment 10)	10	59	0

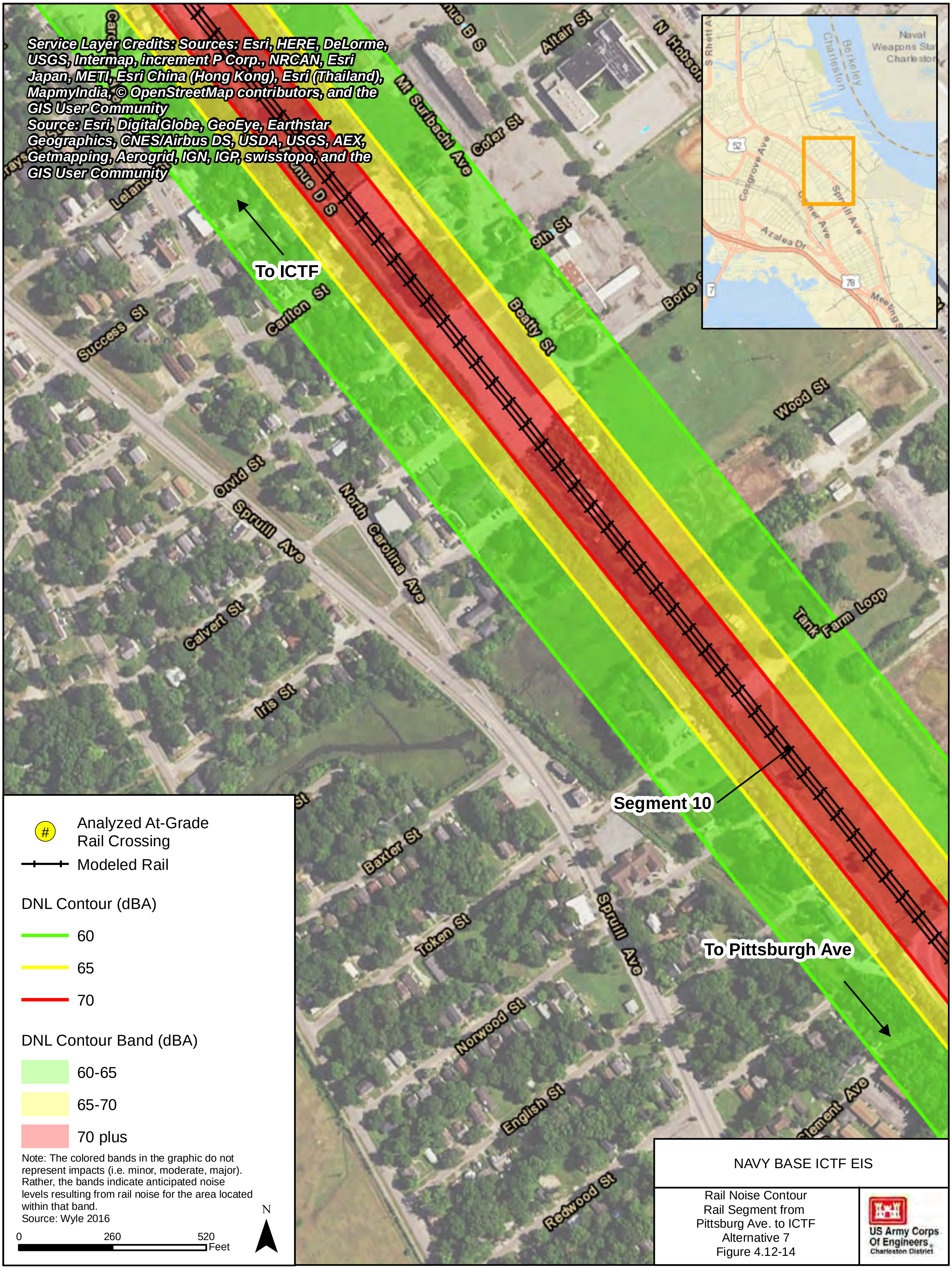
The noise contours include horn noise effects. For rail crossings, the contour expands in size due to train horn soundings. Further details on the specific dimensions and distances of the noise contours at crossing locations can be found in Appendix H.

4.12.9.3 Rail Vibration

Under Alternative 7, the ground-borne vibration generated by train activities would produce no or negligible impact for the vibration-sensitive receptors along the railroad segments in the study area in comparison with the 2038 No-Action Alternative. Rail vibration effects would be unlikely for the 76 receptors analyzed.

4.12.9.4 Construction Noise

Noise conditions related to the ICTF construction activities under Alternative 7 are identical to the ones evaluated for Alternative 5.


Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
To ICTF
Segment 10
To Pittsburgh Ave
Leland St
Success St
Carlton St
Ovid St
Spruill Ave
North Carolina Ave
Calvert St
Iris St
Baxter St
Token St
Norwood St
English St
Redwood St
Mt Suribachi Ave
Cofer St
Altair St
N Hobson
9th St
Beatty St
Borie
Wood St
Tank Farm Loop
Clement Ave
Naval Weapons Sta Charleston
Charleston
Berkeley
Cosgrove Ave
Spruill Ave
Azalea Dr
Meeting
52
78
7
Analyzed At-Grade Rail Crossing
Modeled Rail
DNL Contour (dBA)
60
65
70
DNL Contour Band (dBA)
60-65
65-70
70 plus
Note: The colored bands in the graphic do not represent impacts (i.e. minor, moderate, major). Rather, the bands indicate anticipated noise levels resulting from rail noise for the area located within that band.
Source: Wyle 2016
0
260
520
Feet
N
NAVY BASE ICTF EIS
Rail Noise Contour
Rail Segment from
Pittsburg Ave. to ICTF
Alternative 7
Figure 4.12-14
US Army Corps Of Engineers
Charleston District

NAVY BASE ICTF EIS

Proposed Noise Mitigation Measures
Figure 4.12-15

4.12.9.5 Operational Noise

Noise impacts from the River Center project site operations under Alternative 7 are identical to those estimated for Alternative 5.

4.12.10 Additive Noise Impacts

The impacts indicated for each noise source generally relate to different groups of affected receptors, which are analyzed separately in this document and Appendix H. For example, receptors that would experience rail noise impact (located along certain track segments), would, for the most part, not be subject to noise impacts from vehicular traffic, ICTF construction, or ICTF operations.

Exceptions to the general rule above include noise sensitive receptors located along several of the road segments in the study area. Table 4.12-26 summarizes the anticipated additive impacts associated with receptors located along certain roadways, where either rail noise or operational noise may contribute to increased noise levels when added to traffic noise. A description of each additive noise impact follows. Detailed descriptions of additive noise impacts can be found in Appendix H.

Table 4.12-26
Additive Noise Impacts

Description	Alternative(s)	2038 Traffic Noise Level (dB(A) DNL)[1]	2038 Rail Noise Contour Level (dB(A) DNL)	2038 Operations Noise (dB(A) DNL)	Additive Noise Level (dB(A) DNL)	Impact (versus the No-Action Alternative)
Virginia Avenue (between Montague Avenue and Buist Avenue)	1, 2, 3, 5 and 6	74	60–65	n/a	74	Negligible
St. Johns Avenue (between O'Hear Avenue and McMillan Avenue)	1 and 3	54-56	62	n/a	57–64	Minor to Moderate
Spruill Avenue (between Noisette Creek and N. Carolina Avenue)	2	65	60–65	n/a	65–67	Negligible
Port drayage road (between Port Access Road and ICTF)	5 and 6	59–60	62–63	n/a	65	Major
Port drayage road (between Port Access Road and ICTF)	7	59–60	65–70	n/a	71	Major

Description	Alternative(s)	2038 Traffic Noise Level (dB(A) DNL)[1]	2038 Rail Noise Contour Level (dB(A) DNL)	2038 Operations Noise (dB(A) DNL)	Additive Noise Level (dB(A) DNL)	Impact (versus the No-Action Alternative)
Noisette Boulevard (vicinity of the River Center site)	5, 6 and 7	54–56	n/a	49–61	55-67	Negligible (daytime) Moderate – Major (nighttime)

[1] As noted in Section 4.12.1, for the purposes of conservative estimation of additive noise impacts, DNL generated by traffic noise was assumed to be approximately equal to the modeled Leq(h) levels. Also note that the traffic noise levels presented were taken from the traffic noise tables in Appendix H. These noise levels are associated with the receptors within each roadway segment that could receive noise from multiple sources and are not the average noise levels presented in prior sections of this chapter.

Source: Atkins 2017 (Appendix H).

For Virginia Avenue (rail segment from North of Virginia Avenue to Avenue B, Alternatives 1, 2, 3, 5 and 6), because rail-generated DNL at these residences are much lower than DNL sound levels generated by traffic noise, rail noise does not provide a noticeable effect in addition to traffic noise.

For St. Johns Avenue (between O'Hear Avenue and McMillan Avenue, Alternatives 1 and 3), the proposed rail tracks would be located at a close distance in the vicinity of St. John Catholic Church and School. A proposed sound wall along St. Johns Avenue would shield the rail noise from some of the receptors. In this case, the rail-generated noise would dominate over the traffic-related noise, especially at receptors not protected by the sound wall to the same extent as others. As a result of additive impacts, an estimated increase of 4 to 7 dB(A) could occur, which is a minor to moderate noise impact.

For Spruill Avenue (from Noisette Creek to McMillian Avenue, Alternative 2), due to the distance from Spruill Avenue and the proposed track, the additive traffic noise and rail noise DNLs would not increase by more than 3 dB(A) in comparison with the No-Action Alternative, which is a negligible noise impact.

Under the River Center Site (Alternatives 5 through 7), a new rail track segment would run from Pittsburg Avenue to the ICTF along the new Port drayage road in the vicinity of the eastern neighborhood boundary of the Chicora-Cherokee community. The predicted traffic noise levels from Utility Tractor Rig (UTR) trucks on the drayage road would combine with the rail noise under Alternatives 5 and 6, and the additive level of up to 65 dB(A) DNL would exceed the No-Action level (53 dB(A) by up to 12 dB(A)), generating a major additive noise impact for those receptors.

Under Alternative 7, with higher train volumes at the track segment from Pittsburg Avenue to ICTF along the new Port drayage road in the vicinity of the eastern neighborhood boundary of the Chicora-Cherokee community, the additive traffic/rail DNL of up to 71 dB(A) would exceed the No-Action levels by up to 18 dB(A), producing a major additive noise impact at the nearest residences. The second and third rows of residences along the property line are also expected to experience somewhat lesser major to moderate additive noise impacts.

Noise sensitive receptors along Noisette Boulevard in the vicinity of the River Center site would experience both traffic noise and ICTF operational noise under Alternatives 5, 6, and 7. The operational noise range would essentially remain unaffected when taking into account traffic noise. As the result, the River Center Site operational noise levels would, on average, exceed the noise levels generated by traffic on Noisette Boulevard, and the noise impact analysis of sub-section 4.12.7.5 remains valid.

4.12.11 Summary of Impacts Table

The noise impact analyses are summarized above for the No-Action Alternative and Alternatives 1 through 7, and in Appendix H. The traffic noise receptors analyzed are presented in Figures 4.12-1 and Appendix H. The rail segments analyzed are shown in Figure 4.12-2, with the related rail noise contours provided in Figures 4.12-4 through 4.12-14.

Table 4.12-26 summarizes the impacts due to traffic noise, rail noise, rail vibration, facility construction, and facility operation, and additive noise impacts for all potential build alternatives as compared to the No-Action Alternative. The numbers in parentheses for the traffic and rail noise impacts indicate the exterior impact values in comparison with the exterior noise levels for the No-Action Alternative. For the rail vibration impacts, the numbers in parenthesis indicate comparison with the impact criterion of 80 VdB. Construction noise impacts are shown in comparison with the impact threshold value of 80 dB(A) (see subsection 4.12.1.4). Operational noise impacts are shown in comparison with the exterior No-Action daytime and nighttime ambient noise levels for the related residential community indicated in Table 4.12-5.

Table 4.12-27
Summary of Impacts, Noise and Vibration

Alternative	Traffic Noise Impacts	Rail Noise Impacts	Rail Vibration Impacts	Construction Noise Impacts	Operational Noise Impacts	Additive Noise Impacts
***No-Action**	None	None	None	None	None	None
1: ***Proposed Project: Milford / Hospital District***	Negligible impact [0 to 2 dB(A)]. Negligible beneficial effect for several street segments.	Minor to Moderate impact [(3 to 10 dB(A)] along several segments due to increased rail activity and new track builds.	Negligible impact (below 80 VdB)	Minor to Moderate impact [3 to 9 dB(A)] in the vicinity of noise berm due to frequent operations of construction equipment.	Minor to Moderate exterior daytime impact [4 to 7 dB(A)] and major exterior nighttime impact [14 to 17 dB(A)]**.	Negligible [Virginia Avenue (Traffic + Rail Noise)] Minor to Moderate [St. Johns Avenue (Traffic + Rail Noise)]

Alternative	Traffic Noise Impacts	Rail Noise Impacts	Rail Vibration Impacts	Construction Noise Impacts	Operational Noise Impacts	Additive Noise Impacts
2: *Milford / S-line*	Similar to Alternative 1 (Proposed Project).	Minor to Moderate impact [(3 to 10 dB(A)] along several segments due to increased rail activity and new track builds. Major impact [above 10 dB(A)] for up to 4 land uses along one future track segment.	Negligible impact (below 80 VdB) for the majority of receptors. Potential impact for two or three receptors near curved track of S-line.	Similar to Alternative 1 (Proposed Project).	Similar to Alternative 1 (Proposed Project).	Negligible [Virginia Avenue and Spruill Avenue (Traffic + Rail Noise)]
3: *Kings-worth/ Hospital District*	Similar to Alternative 1 (Proposed Project).	Similar to Alternative 1 (Proposed Project).	Negligible impact (below 80 VdB) for the majority of receptors. Potential impact for one or two receptors near curved track at Kingsworth Avenue.	Similar to Alternative 1 (Proposed Project).	Similar to Alternative 1 (Proposed Project).	Similar to Alternative 1 (Proposed Project).
4: *Milford*	Similar to Alternative 1 (Proposed Project).	Minor to Moderate impact [(3 to 10 dB(A)] along several segments due to increased rail activity in the southern alignment.	Similar to Alternative 1 (Proposed Project).	Similar to Alternative 1 (Proposed Project).	Similar to Alternative 1 (Proposed Project).	n/a
5: *River Center Project Site: Milford /Hospital District*	Negligible impact [0 to 2 dB(A)]. Minor to Moderate impact [4 to 7 dB(A)] along one future road.	Minor to Moderate impact [(3 to 10 dB(A)] along several segments due to increased rail activity and new track builds. Moderate impact [(5 to 10 dB(A)] along one new build future segment.	Negligible impact (below 80 VdB).	Minor to Moderate impact [3 to 10 dB(A)] in the vicinity of construction activities due to frequent operations of construction equipment.	Negligible exterior daytime impact [0 to 2 dB(A)] and Moderate to Major exterior nighttime impact [9 to 12 dB(A)]**.	Negligible (daytime) Moderate to Major (nighttime) [Noisette Boulevard (Traffic + Operations)] Negligible [Virginia Avenue (Traffic + Rail Noise)] Major [Port drayage road (Traffic + Rail)]

Alternative	Traffic Noise Impacts	Rail Noise Impacts	Rail Vibration Impacts	Construction Noise Impacts	Operational Noise Impacts	Additive Noise Impacts
6: ***River Center Project Site: Kingsworth /Hospital District***	Similar to Alternative 5.	Minor to Moderate impact [(3 to 10 dB(A)] along several segments due to increased rail activity and new track builds. Moderate impact [(5 to 10 dB(A)] along one new build future segment.	Negligible impact (below 80 VdB) for the majority of receptors. Potential impact for one or two receptors near curved track at Kingsworth.	Similar to Alternative 5.	Similar to Alternative 5.	Similar to Alternative 5.
7: ***River Center Project Site: Milford***	Similar to Alternative 5.	Minor to Moderate impact [(3 to 10 dB(A)] along several segments due to increased rail activity in the southern alignment. Moderate impact [(5 to 10 dB(A)] along one new build future segment.	Similar to Alternative 5.	Similar to Alternative 5.	Similar to Alternative 5.	Major [Port drayage road (Traffic + Rail)] Negligible (daytime) Moderate to Major (nighttime) [Noisette Boulevard (Traffic + Operations)]

Traffic Noise Impact Definitions

Negligible = 0–3 dB(A) increase in Leq(h); **Minor** = 3–5 dB(A) increase in Leq(h);
Moderate = 5–10 dB(A) increase in Leq(h)**; Major** = Increase in Leq(h) greater than 10 dB(A)

Rail Noise Impact Definitions

Negligible = 0–3 dB(A) increase in DNL; **Minor** = 3–5 dB(A) increase in DNL;
Moderate = 5–10 dB(A) increase in DNL; **Major** = increase in DNL greater than 10 dB(A)

Rail Vibration Impact Definitions

Negligible = less than 80 VdB based on FTA recommended impact criterion for ground-borne vibration.

Construction Noise Impact Definitions

No standard criteria have been developed at the federal or state level for assessing construction noise impacts. Noise assessment has been conducted in accordance with FHWA's Roadway Construction Noise Model (See Impact Definitions above for Traffic Noise). Construction noise would be tolerable due to temporary nature of the disturbance.

Operational Noise Impact Definitions

Negligible = 0–3 dB(A) increase in Leq(h); **Minor** = 3–5 dB(A) increase in Leq(h);
Moderate = 5–10 dB(A) increase in Leq(h); **Major** = Increase in Leq(h) greater than 10 dB(A).

*No-Action noise level increase versus existing conditions does not constitute a project-related noise impact.
**Refer to subsections 4.12.3.5 and 4.12.7.5 for information on exterior to interior noise reduction.

4.12.12 Mitigation

4.12.12.1 Applicant's Proposed Avoidance and Minimization Measures

The Applicant has committed to several measures that avoid and/or minimize potential impacts of Alternative 1 (Proposed Project). These measures are taken from Palmetto Railways Mitigation Plan provided in Appendix N. Some of these measures are required under federal, state, and local permits; others are measures that Palmetto Railways has incorporated into the design and operations of Alternative 1 (Proposed Project). Each mitigation measure is also designated as one that either helps to avoid an impact or one that minimizes an impact.

- To minimize noise impacts associated with operation of the site, the facility will use state-of-the-art equipment, such as electric wide-span gantry cranes, that will minimize sound emissions during operations. (Minimization)
- To further minimize noise impacts to the communities adjacent to the proposed facility, an earthen berm will be used to mitigate the noise/visual impacts. The earthen berm is planned for the western boundary of the site between the facility and adjacent neighborhoods. (Minimization)
- To minimize the impact of vibrations on the adjacent community, the Applicant will create a 100-foot buffer to the west of the current property line. This is expected to reduce the impacts of property damage, deterioration of residents' foundations, and structural damage to homes as it relates to vibrations associated with the construction and operations of the facility. (Minimization)
- One sound attenuation and security wall will be used, where appropriate, in place of the earthen berm adjacent to waters of the U.S. to avoid filling wetlands. One sound-attenuation wall will be located at the northern end of the earthen berm. Two sound attenuation walls will be used to minimize noise and visual impacts in two areas along the northern rail connection. (Minimization)
- The Applicant and the City of North Charleston are collaborating on the design of a mutually agreeable landscaping program for the ICTF. (Minimization)
- Support the Cities of Charleston and North Charleston, and Class I Rail Carriers, in the establishment of rail "Quiet Zones[86]. (Minimization)*
- The existing topography of the North Lead will require a substantial cut (trench) section to provide adequate grades to accommodate train movements. This cut section will mitigate visual and noise impacts that may result from the movement of trains in and out of the facility from the north. (Minimization)

[86] In order to mitigate the effects of train horn noise, communities can establish "Quiet Zones" where horns are not needed due to safety improvements at the grade crossings. A guide to the quiet zone establishment process can be found at: www.fra.gov under Railroad Safety: "FRA Train Horn Rule and Quiet Zones."

- Provide relocation services for a period of 3 years to owner-occupied residential property owners who reside in the Relocation Area from 100 feet of the Project up to North Carolina Avenue. (Minimization)

These avoidance and minimization measures, except the items noted with an asterisk (*), have been considered in the preceding impact analysis. The complete list of Applicant-proposed avoidance and minimization measures related to noise and vibrations is also provided in Chapter 6.

4.12.12.2 Additional Potential Mitigation Measures

No additional mitigation measures for Noise and Vibration have been recommended by the Corps. Additional avoidance, minimization, and mitigation may be considered by the Corps in its decision-making process. Final mitigation measures may be adopted as conditions of the DA permit and documented in the Record of Decision (ROD).

4.13 AIR QUALITY

4.13.1 Methods and Impact Definitions

Impacts on Air Quality by Alternative 1 (Proposed Project) and the alternatives were evaluated by estimating the criteria pollutant and Hazardous Air Pollutant (HAP) emissions associated with each alternative's construction and operation. As discussed in Chapter 3, criteria pollutants of concern for this Project include CO, NO_2, O_3, $PM_{2.5}$, PM_{10}, and SO_2. NO_2 impacts are commonly evaluated by analyzing NO_x, which is done in this analysis. O_3 is not directly emitted, but rather formed in the air through a photochemical reaction of NO_x and VOCs, referred to as O_3 precursors. O_3 impacts are evaluated by analyzing NO_x and VOC emissions. All sources of criteria pollutant and HAP emissions that were reasonably foreseeable were included in this analysis. Air emissions were evaluated for the full build-out year 2038 to best represent the air emissions at full operating capacity. Accordingly, 2038 criteria pollutant and HAP emissions inventories represent the criteria pollutant and HAP emissions for all operating years after 2038, and a conservative estimate for interim years between opening year 2018 and full build-out year 2038.

4.13.1.1 Construction NAAQS Emissions Inventory

Construction period criteria pollutant emissions inventories of CO, NO_x, $PM_{2.5}$, PM_{10}, SO_2, and VOCs included emissions from construction equipment exhaust, haul truck trips for importing and exporting material, and worker and vendor commute to and from the construction sites. Pollutant emissions would also be caused by off-gassing emissions from solvents in architectural paints and asphalt paving. Additionally, particulate matter would be emitted from surface disturbance activities, building demolition, the material movement of imports and exports, and on-road vehicle activity. Pollutant emissions from each of these activities were quantified using the EPA Motor Vehicle Emissions Simulator (MOVES) model, EPA guidance, activity information provided by Palmetto