SECTION 6.4.6
NOISE

In an environmental context, noise is generally defined as unwanted sound. The level of noise perceived at a receiver depends on numerous variables, including the noise level at the source, the distance from the noise source to the receiver, barriers present that may attenuate or block the noise reaching the receiver, and the sensitivity of the receiver.

The following three physical characteristics of noise have been identified as being important to the determination of noise acceptance: intensity, frequency, and the time-varying nature of the noise.

Intensity is a measure of the magnitude or energy of the sound and is directly related to the sound pressure level. Sound pressure levels are expressed in terms of a logarithmic scale, with units called decibels (dB) that corresponds to the way that the human ear senses noise. As the intensity of a noise increases, it is judged to be more annoying or less acceptable.

Frequency is a measure of the total qualities of sound. People are most sensitive to sounds in the middle to high frequencies; therefore, higher frequencies tend to cause more annoyance. This sensitivity has led to the use of the A-weighted sound level, which provides a single number measure that weights different frequencies on a spectrum in a manner similar to the sensitivity of the human ear. Thus, the A-weighted sound level in decibels (dB(A)) provides a simple measure of intensity and frequency that correlates well with human hearing. Common noise levels are shown in **Table 6.4.6-1**.

Environmental noise is rarely constant with time. It is necessary to use a method of measure that will account for this time-varying nature of noise. The equivalent sound pressure level (L_{eq}) is defined as the continuous steady sound level that would have the same total A-weighted sound energy as the real fluctuating sound measured over the same period of time. L_{eq} is typically used for highway noise analysis. This unit of measure, therefore, has been used in the traffic and construction noise analyses performed for this Project.

6.4.6.1 AFFECTED ENVIRONMENT

TRAFFIC NOISE ANALYSIS FRAMEWORK

The I-81 Viaduct Project is a Federal-aid highway project and is defined as a Type I noise project under the criteria identified by 23 CFR 772. Therefore, a quantitative traffic noise analysis was prepared. The traffic noise measurement and modeling methodology followed the NYSDOT TEM, Section 4.4.18, "Noise Analysis Policy and Procedures" (or "NYSDOT Noise Policy"). Consistent with 23 CFR 772, a quantitative traffic noise analysis was performed on the following scenarios:

Table 6.4.6-1
Common Noise Levels

Sound Source	(dB(A))
Military jet, air raid siren	130
Amplified rock music	110
Jet takeoff at 500 meters	100
Freight train at 30 meters	95
Train horn at 30 meters	90
Heavy truck at 15 meters	80–90
Busy city street, loud shout	80
Busy traffic intersection	70–80
Highway traffic at 15 meters, train	70
Predominantly industrial area	60
Light car traffic at 15 meters, city or commercial areas, or residential areas close to industry	50–60
Background noise in an office	50
Suburban areas with medium-density transportation	40–50
Public library	40
Soft whisper at 5 meters	30
Threshold of hearing	0

Note:
A 10 dB(A) increase in level appears to double the loudness, and a 10 dB(A) decrease halves the apparent loudness.
Sources:
Cowan, James P. Handbook of Environmental Acoustics, Van Nostrand Reinhold, New York, 1994. Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988.

- Existing Conditions (for model validation and comparison to build alternatives)
- Viaduct Alternative (year 2050)
- Community Grid Alternative (year 2050)

Field noise measurements were collected following the NYSDOT's "Field Measurement of Existing Noise Levels" manual. The FHWA Traffic Noise Model (TNM) 2.5 was used to perform the traffic noise analyses. The project study area for the noise analysis is shown on the Traffic Field Noise Receiver Locations figure in **Appendix H**. The noise study area includes the limits of construction and streets that are likely to be associated with the proposed changes in traffic patterns. Based on guidance provided in FHWA's "Highway Traffic Noise: Analysis and Abatement Guidance," the noise study area was defined as 500 feet from involved highways and 200 feet from involved local roadways.

Twenty-one (21) short-term field noise measurements were performed within the noise study area, and the approximate locations for each are shown on the Traffic Field Noise Receiver Locations figure in **Appendix H**. Of the 21 receivers, six receivers were also used as locations for 24-hour measurements. Descriptions of each identified field noise measurement receiver site are provided in the Field Noise and Validation Model Results table in **Appendix H**.

FHWA has defined Activity Categories for assigning land uses to potentially affected areas. FHWA has also identified Noise Abatement Criteria (NAC) for the Activity Categories per 23 CFR 772. The Activity Categories and associated NACs are presented in **Table 6.4.6-2**.

Table 6.4.6-2
FHWA Noise Abatement Criteria and Activity Categories

Activity Category[1]	Interior or Exterior	L_{eq} (h) (dB(A))[2]	Description of Land Use Category
A	Exterior	57	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	Exterior	67	Residential
C[3]	Exterior	67	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	Interior	52	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	Exterior	72	Hotels, motels, offices, restaurants/bars and other developed lands, properties or activities not included in A-D or F.
F	---	---	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	---	---	Undeveloped lands that are not permitted.

Notes:
(1) Activity Criteria are for impact determination only and are not design standards for noise abatement measures.
(2) L_{eq} (h) means hourly equivalent sound pressure level, in dB(A).
(3) Includes undeveloped lands permitted for this Activity Category.
Sources: FHWA Noise Abatement Criteria and Activity Categories per 23 CFR 772

One 24-hour noise measurement was collected at six locations. The locations identified for 24-hour measurement were chosen based on geographic coverage and in consideration of land uses along the corridor. The 24-hour noise measurements were used to identify the noisiest hours of the day/night (i.e., peak noise hours) within the project corridor. The results of the 24-hour measurements showed that the overall average peak noise hour for the Project is 7:30 AM to 8:30 AM. The peak noise hour identified through the 24-hour measurements was then used as the time of day for modeling of existing and proposed build traffic noise. The 24-hour field noise measurements were collected from April 20 through May 5, 2016 under the following conditions:

- Typical traffic conditions: mid-week (i.e., Tuesday, Wednesday, or Thursday), during a non-holiday week, schools in session;
- Temperature within the range of 31°F to 68°F;
- Wind speed generally less than 12 mph;
- Relative humidity between 5 and 90 percent;

- No precipitation; and
- Dry pavement.

One short-term (15 to 25 minutes) field noise measurement was collected at 21 identified field measurement receiver locations. The short-term field noise measurements were then used to validate the ability of the noise models to predict noise levels. The short-term field noise measurement locations were chosen to provide geographic coverage of the noise study area to be modeled. Short-term field noise measurements were collected from May 10, 2016 through May 12, 2016 under the following conditions:

- Typical traffic conditions: mid-week (i.e., Tuesday, Wednesday, or Thursday), during a non-holiday week, schools in session;
- At least three 5-minute readings with last two readings stable;
- Within free flow conditions and speeds and volumes not substantially different from the noisiest traffic hour;
- Temperature within the range of 47°F to 86°F;
- Wind speed less than 11 mph;
- Relative humidity between 24 and 56 percent;
- No precipitation; and
- Dry pavement.

Traffic counts, speed observations, and vehicle classification categories consistent with the traffic analysis data were also recorded during the short-term field noise measurements. Noise levels measured by the sound level meter are presented in units of equivalent noise level (L_{eq}). The "Field Noise Monitoring Logs" are provided in **Appendix H**.

For the validation modeling, noise models (reflecting site-specific conditions, geometry, traffic volumes, vehicle distributions, and speeds observed during the field noise measurements) were developed for each field measurement receiver site. The calculated noise levels from the validation modeling were compared with the existing noise levels measured in the field. At all sites, the TNM validation model results agreed with the field measured noise levels (differing by no more than 3 dB(A)), as shown in the Field Noise and Validation Model Results table in **Appendix H**. This result indicates that the TNM models developed for the Project are considered acceptable and may be used for the prediction of noise levels.

The years that were used for the noise analysis were the existing year, 2013 (for existing noise level comparison) and the project design year, 2050 (ETC+30). The year chosen for the existing noise level comparison was 2013 since traffic volumes were readily available for that year and the differences in traffic volumes between 2013 and 2016 would be relatively insignificant.

Traffic volumes, speeds, and classifications for the existing and future peak noise hour were obtained from the project traffic modeling effort (see **Chapter 5, Transportation and Engineering Considerations** for further information on the traffic data). Vehicle classifications were broken down into categories consistent with the data obtained from the traffic study.

Ground level elevations and structure elevations (e.g., bridges, buildings, walls) used within the noise models were obtained from CADD survey data when available; otherwise, elevations were estimated from United States Geological Survey (USGS) maps.

In addition to the short-term field noise measurement receiver locations used to validate the model, "model-only" receivers were identified for inclusion in the model for a total of 2,240 receiver locations overall. The added "model-only" receiver locations were based on locations within the noise study area that were considered sensitive to traffic noise and were within exterior areas of frequent human use. "Model-only" receivers were not field measured, but were added to the noise models to allow for the assessment of receivers within the study area on an individual basis.

A review of local planning documents to identify proposed construction projects in the Project Area was performed as part of the existing conditions analysis for the EIS (see **Section 6.2.1, Land Use**). As a result, undeveloped lands, for which a sensitive noise receiver is proposed and a building permit is granted, are considered in this noise study.

EXISTING CONDITIONS

Various urban and rural land uses were researched to identify NAC categories that exist and would be appropriate for analysis within the noise study area. In addition to the identification of existing land uses, undeveloped lands adjacent to highways within the study area that have been granted a building permit were treated as developed when selecting receivers for the noise analysis. The noise analysis of the 2013 existing conditions identified 696 receivers at a noise level above the NAC. Existing noise levels above the NACs have been predicted for almost all receivers within approximately 300 feet from I-81, I-481, and I-690. Existing noise levels above NACs have also been predicted adjacent to some of the larger roadways throughout Downtown Syracuse, such as North Clinton Street, North Salina Street, East Adams Street, West Street, and Irving Avenue.

The highest L_{eq} noise level for existing conditions was 78 dB(A) and the lowest L_{eq} noise level was 43 dB(A) at the chosen receivers. The highest noise levels predicted are along the Bear Trap Creek Trail, in the Town of Salina, because it is immediately adjacent to I-81. Lower noise levels ranging from 43 dB(A) to 60 dB(A) are generally located in the suburban areas behind existing noise barriers or large buildings.

The Noise Impact Summary - Model Results Table in **Appendix H** includes the noise levels for the existing receivers and their associated land use categories. A graphic representation of predicted noise results is presented on Figures 1 through 12 of **Appendix H**.

Noise ordinances defining acceptable noise levels are in place for many municipalities within the Project Area. Traffic noise is not typically governed by local noise ordinances; however, construction noise is restricted by noise ordinance at night and on some weekend days in various municipalities throughout the construction area. Some municipalities within the construction area also limit noise by decibel level. Noise ordinance construction restrictions for municipalities within the Project Area are presented in **Table 6.4.6-3**. The Project would comply with appropriate noise ordinances throughout the Project Area to the extent practicable; however, NYSDOT is exempt from local noise ordinances.

Table 6.4.6-3
Key Noise Ordinance Construction Restrictions

Municipality	Noise Ordinance Excerpt
Town of Cicero	Any construction activity before 7 am or after 8 pm on weekdays and before 8 am or after 8 pm on Saturday, or during anytime on Sunday is prohibited.
Town of Clay	Any construction activity before 7 am or after 7 pm on weekdays and before 8 am or after 5 pm on Saturday, or during anytime on Sunday is prohibited.
Town of DeWitt	Any construction activity before 7 am or after 7:30 pm during any day of the week (including Sunday) is prohibited. Noise levels that exceed 70 dB(A) between the hours of 7 am and 10 pm, or 50 dB(A) between 10 pm and 7 am, from any source of sound are prohibited.
Village of East Syracuse	Any construction activity before 7 am or after 10 pm on weekdays, or anytime on Sunday or holidays, is prohibited. Noise levels that exceed 65 dB(A) during the day (7 am-10 pm) or 50 dB(A) at night (10 pm-7 am) in residential areas is prohibited. Noise levels that exceed 65 dB(A) on Main Street or in general commercial areas are prohibited. Noise levels that exceed 75 dB(A) in industrial areas are prohibited.
Village of North Syracuse	Any construction activity before 7 am or after 10 pm on weekdays or anytime on Sunday or a holiday is prohibited.
Town of Onondaga	Any construction activity before 8 am or after 7 pm on any day of the week is prohibited. Construction noise levels that exceed 70 dB(A) during the day or 50 dB(A) at night are prohibited.
Town of Salina	Any construction activity before 7 am or after 9 pm during any day of the week is prohibited.
City of Syracuse	Any construction activity between the hours of 9 pm to 7 am Monday to Saturday and anytime on Sunday or holidays is prohibited.

Sources:
"Noise Control Law of the Town of Cicero" http://ecode360.com/12298675
"Noise Ordinance of the Town of Clay" http://www.ecode360.com/7206066
"Noise Control Law of the Town of DeWitt" http://ecode360.com/6813934
"Village of East Syracuse: Part 66 Noise Abatement" received by Village Office
"Village of North Syracuse, NY" http://ecode360.com/10880663
Town of Onondaga Noise Ordinance received by Town of Onondaga Code Enforcement
"Noise Control Code of the Town of Salina" http://ecode360.com/11092043
"Syracuse Noise Control Ordinance" https://www.municode.com/library/ny/syracuse/codes/code_of_ordinances?nodeId=REGEOR_CH40NOCOOR

6.4.6.2 NO BUILD ALTERNATIVE

Under the No Build Alternative, the existing roadways would remain with ongoing maintenance and repairs. No new roadways or associated supporting infrastructure would be constructed, and any changes in future traffic noise levels on the corridor would be associated with normal changes in traffic (i.e., those that would occur without the Project).

6.4.6.3 ENVIRONMENTAL CONSEQUENCES OF THE VIADUCT ALTERNATIVE

PERMANENT/OPERATIONAL EFFECTS

As per NYSDOT Noise Policy, traffic noise impacts occur when:

- The predicted future traffic noise levels approach within 1 dB(A) or exceed the NAC; or
- The predicted future traffic noise levels exceed existing levels by 6 dB(A) or more.

Under the Viaduct Alternative, noise impacts were predicted at 764 of the 2,240 receivers. The highest L_{eq} noise level was 78 dB(A) and the lowest L_{eq} noise level was 43 dB(A) (see the Noise Impact Summary - Models Results table in **Appendix H**). Similar to the existing conditions, the highest noise levels were identified at the receivers located closest to I-81, I-690, and I-481 and the lower noise levels were identified in the suburban areas and behind large buildings or other structures.

The TNM analysis of the 2013 existing conditions identified 696 of the 2,240 receivers at a noise level above the NAC and the TNM analysis of the Viaduct Alternative identified 764 of the 2,240 receivers at levels above the NAC. Therefore, the modeling predicts 68 additional receivers with noise levels above the NAC when compared to existing conditions (prior to performance of the abatement analysis). The higher noise levels at many of these 68 additional receivers are likely related to increases in traffic volumes between 2013 and 2050 due to normal traffic growth of the area. It is anticipated that noise abatement measures (e.g., noise barriers) would be implemented at numerous locations throughout the Project Area (as discussed in the "Abatement/Mitigation" subsection below).

In accordance with Table 3 of FHWA's "Highway Traffic Noise Analysis and Abatement Policy and Guidance," a noise level change of 3 dB(A) or less is generally imperceptible to the human ear; therefore, a comparison was made to determine the number of receivers with changes of 3 dB(A) or more as compared to existing conditions. Of the 764 impacted receivers, 32 receivers would have a perceptible increase in traffic noise levels (not accounting for the expected reductions in the areas proposed for noise abatement). The majority of the receivers that would have a perceptible noise level increase are located within the Downtown core where there would be changes to the physical width or location of the viaduct.

Overall, based on the definition of "traffic noise impacts" provided above, the Viaduct Alternative would result in impacts at 764 of the 2,240 receivers modeled.

CONSTRUCTION EFFECTS

Construction Noise

Construction noise differs from traffic noise in the following ways:

- Construction noise lasts only for the duration of the construction contract;

- Construction activities are usually limited to the daylight hours when most human activity takes place;
- Construction activities are generally short term; and
- Construction noise is intermittent and depends on the type of operation.

Construction of the Project would include excavation, sub-base preparation, roadway/bridge construction, and other miscellaneous work. This work would result in temporary construction noise at nearby receivers. The levels of noise would vary widely, depending on the construction activities undertaken and the anticipated duration of the construction. The parameters that determine the nature and magnitude of construction noise include the type, age, and condition of construction equipment; operation cycles; the number of pieces of construction equipment operating simultaneously; the distance between the construction activities and receivers; and the location of haul routes with respect to receivers. Many of these parameters would not be fully defined until final design plans and specifications have been prepared; however, representative construction scenarios based on typical construction procedures have been identified for the Project and were used to assess effects.

To evaluate potential noise levels as a result of construction of the build alternatives, the Roadway Construction Noise Model (RCNM), developed by the FHWA, was employed. The proposed construction equipment and baseline noise levels for the selected receivers close to the construction area were entered into the RCNM, along with the approximate distance from the center of the construction area to the receivers. The construction noise analysis was performed to predict noise levels due to construction of the Viaduct Alternative at the following representative five sites for the Project Area:

- Site A: I-81 Northern Segment: A location along Basin Street that is representative of the residential houses in this area.
- Site B: West Street Interchange: The front yard of a residence that is representative of the church and residential houses in this area.
- Site C: I-81/I-690 Interchange (Location 1 of 2): The side yard of an apartment building that is representative of the residential land use in this area.
- Site D: I-81/I-690 Interchange (Location 2 of 2): A location within Forman Park that is representative of this area.
- Site E: Almond Street Viaduct Area: A location within the Pioneer Homes development that is representative of this area.

The sites are shown on the Construction Noise Receiver Locations figure in **Appendix H**.

The proposed accelerated construction schedule could generate an elevated noise level due to the simultaneous use of additional construction equipment, but it would allow for a shorter period of construction noise. Due to the logarithmic nature of adding noise sources, noise from the simultaneous use of additional construction equipment may, in some cases, have a negligible effect on perceivable noise levels; therefore, a shorter construction duration may be desirable. A 3 dB(A) increase, which is normally the smallest change in noise levels that is perceptible to the human ear, would require a doubling of the noise energy produced by the construction equipment. Even in a case where the accelerated construction schedule creates a perceivable increase in noise levels, a shorter construction duration may nonetheless be desirable to receivers.

The construction equipment, utilization percentage, and expected maximum noise level (L_{max}) values listed in **Table 6.4.6-4** were used within the model. **Table 6.4.6-5** presents the resulting noise levels for the selected sites within the Project Area for the Viaduct Alternative. In addition, the "Construction Equipment Noise Summary" tables in **Appendix H** show the total number of pieces of equipment proposed for use at each site and the individual and total noise levels that they would produce per the RCNM analysis.

Table 6.4.6-4
Construction Equipment for the Viaduct Alternative

Equipment Description	Impact Device (Y or N)	Acoustical Usage Factor (%)*	L_{max} at 50 feet (dB(A))
Backhoe	N	40	78
Compactor (ground)	N	20	83
Crane	N	16	81
Dozer	N	40	82
Dump Truck	N	40	76
Excavator	N	40	81
Flat Bed Truck	N	40	74
Front End Loader	N	40	79
Jackhammer	Y	20	89
Mounted Impact Hammer	Y	20	90
Pickup Truck	N	40	75
Pneumatic Tools	N	50	85
Pumps	N	50	81
Roller	N	20	80
Vibratory Concrete Mixer	N	20	80
Welder/Torch	N	40	74

Notes: L_{max} is the maximum sound level.
Construction equipment identified above corresponds to the types of construction equipment expected to be used on this Project.
* Acoustical Usage Factor is an estimate of the fraction of time each piece of construction equipment is operating at full power (i.e., its loudest condition) during a construction operation.
Source: Acoustical usage factor percentages and L_{max} values are from FHWA Roadway Construction Noise Model User's Guide, FHWA-HEP-05-054, DOT-VNTSC-FHWA-05-01 (Final Report, January 2006)

Table 6.4.6-5
RCNM Calculated Construction Noise Levels for the Viaduct Alternative

Construction Receiver Site	Description	Viaduct Alternative (dB(A))
Site A	I-81 Northern Segment	L_{max}= 76; L_{eq}= 81
Site B	West Street Interchange	L_{max}= 78; L_{eq}= 84
Site C	I-81/I-690 Interchange (Location 1 of 2)	L_{max}= 77; L_{eq}= 82
Site D	I-81/I-690 Interchange (Location 2 of 2)	L_{max}= 78; L_{eq}= 83
Site E	Almond Street Viaduct Area	L_{max}= 84; L_{eq}= 88

Notes: L_{max} is the maximum sound level.
L_{eq} (equivalent sound level) is the sound pressure level equivalent to the total sound energy over a given period of time.
Sources: Analysis performed using FHWA Roadway Construction Noise Model (FHWA RCNM) Version 1.1.

The RCNM results indicated that all five sites would have noise levels above a L_{eq} of 80 dB(A). According to NYSDOT's Noise Policy, a construction noise effect will not normally occur at levels under L_{eq} 80 dB(A). The use of impact-related construction equipment (impact devices) is planned in all five locations. Impact construction equipment is equipment that generates short duration (generally less than one second), high intensity, abrupt impulsive noise. While the noise levels for impact devices is below 80 dB(A) for four of the five locations, impact devices can be more noticeable due to the abrupt changes in noise levels. Therefore, the five sites may experience adverse construction noise effects unless abatement measures are implemented. Based on RCNM results, without noise abatement measures, it is anticipated that average noise levels and the use of impact devices may be considered disruptive to nearby receivers. Worst case distances (i.e., the closest representative receivers) from the construction equipment to the nearest receiver were generally used for the RCNM analysis; however, realistically, given the mobile nature of road construction, the construction distances could potentially increase as the construction operations move along the roadway centerlines. In addition, construction operations are in constant flux, and the equipment and operations would not always be at the worst case levels predicted herein. Construction noise abatement measures and shielding effects are discussed in the mitigation subsection below.

A qualitative assessment of traffic noise effects related to construction detours was prepared based on the Maintenance and Protection of Traffic (MPT) routes described in **Chapter 4, Construction Means and Methods**. During certain phases of construction, various segments of roads would be closed. As a result, detour routes would be in effect to accommodate traffic through the construction zone. The detour routes would generally serve increased traffic during construction, and therefore, receivers adjacent to these routes would have the potential to realize perceptible increases in noise levels.

The objective of the construction detour traffic noise analysis was to qualitatively address which detour routes for the Viaduct Alternative would have changes in traffic volumes along alternative routes that could result in a perceptible increase in noise. Generally, when traffic volumes increase by at least 100 percent, it can be assumed that there will be a perceptible increase in noise levels (an increase of 3 dB(A)) for the surrounding area. The main changes to traffic flow throughout the corridor are expected to include the outlying highways (I-81, I-481, and I-690) and the detour routes through Downtown Syracuse. Changes in traffic volumes that are expected for the outlying highways would be due to motorists choosing alternate routes to avoid construction zones. It is anticipated that some motorists may choose to travel on I-481 and on some portions of I-690 to avoid construction lane restrictions and detour zones along I-81 and I-690. Therefore, there may be a decrease in traffic along I-81 and increases in traffic along I-481 and some portions of I-690. However, given the high volume of vehicles along these highways, it is not anticipated that the changes in noise levels would be perceptible since it is expected that traffic changes along the outlying highways would be less than 100 percent.

There are eight detour routes that would be used under the Viaduct Alternative. Therefore, block by block comparisons were made and the average increase in traffic for each detour route was calculated to see if 100 percent increases in traffic volumes would be expected, assuming that the speeds are not affected. During the comparison, each detour route was divided into blocks between intersecting streets. The receivers used for the TNM analysis were used to determine which blocks would be most sensitive to noise level increases. **Table 6.4.6-6** shows the average increases in traffic for each detour route, the number of blocks that are affected, and the range of noise levels along each detour route. Average noise levels shown in the table are based on AM peak hour traffic from the 2013 TNM noise analysis because the traffic volumes between 2013 and 2020 are expected to be similar.

Of the eight detour routes, two routes had overall increases in traffic equal to or greater than 100 percent. In addition, five routes had at least one block with an increase in traffic greater than 100 percent. These effects would be perceptible during the detour periods. The following sections of the detour routes throughout Downtown Syracuse were reviewed:

- **Salina Street:** Salina Street between Harrison Street and the ramp that leads to Pearl Street has been identified as a potential detour route. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 58 to 70 dB(A). This detour route would experience a predicted 59 percent average increase in traffic; therefore, it is anticipated that this detour route would not experience a perceptible increase in noise levels. One block (between East Willow Street and Herald Place) along the detour route had an increase in traffic greater than 100 percent; however, no noise sensitive receivers near this block would be affected.

- **Pearl Street Ramps to Northbound I-81:** This detour route includes the intersection between Pearl Street and East Willow Street, which leads to the on-ramps to northbound I-81 from Pearl Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 58 to 69 dB(A). There was an 89 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for the majority of this detour route. One block (representing the ramp between North Salina Street and Pearl Street) along this detour route had an increase in traffic greater than 100 percent. One noise sensitive receiver, which is a parklike sitting area, has been identified near this block that could have a perceptible increase in noise levels.

Table 6.4.6-6
Viaduct Alternative Traffic Detour Summary

Detour Route	Average Increase in Traffic[1]	Total Number of Blocks[2]	Number of Blocks Affected[3]	Total Number of Receivers Along Full Detour Route[4]	Number of Receivers Along Affected Blocks[5]	Range of Existing Noise Levels Along Detour Route (dB(A))[6]
Salina St	59%	8	1	12	0	58-70
Pearl St Ramps to I-81 NB	89%	5	1	4	1	58-69
Clinton St	90%	7	3	15	9	65-70
Ramps to I-81 NB from N State St	253%	2	1	0	0	N/A
S State St	51%	8	0	12	0	58-67
E Willow St	22%	1	0	0	0	N/A
Townsend St	62%	6	0	14	0	53-70
Almond St	100%	9	4	7	4	66-69

Notes:

N/A - No noise sensitive receivers were identified along the detour route; therefore, there was no average noise level calculated for the detour route.

1. The percent average along the entire detour route. Even if the average is lower than 100 percent, there can still be affected blocks along the route that are greater than 100 percent.
2. The total number of blocks that are along a detour route.
3. The total number of blocks along a detour route that had an increase in traffic greater than 100 percent.
4. The total number of receivers that are along the entire detour route.
5. The total number of receivers that are near the affected blocks along the detour route.
6. The range of noise levels (from the 2013 TNM model results) for the receivers that are along the entire detour route.

- **Clinton Street:** The detour route along Clinton Street is between Harrison Street and the start of the exit ramp from southbound I-81 to Clinton Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 65 to 70 dB(A). There was a 90 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for the majority of this detour route. Three blocks (between Herald Place and West Washington Street) along this detour route had predicted increases in traffic that were greater than 100 percent. Nine noise sensitive receivers, which include one residence, two outdoor dining areas, two outdoor seating areas, and four parklike sitting areas, have been identified near these three blocks that could have perceptible increases in noise levels.
- **Ramps to Northbound I-81 from North State Street:** This detour route includes the on-ramps to northbound I-81 from both northbound and southbound North State Street. Existing AM peak hour noise levels were not calculated along this detour route since no noise sensitive receivers were identified in this immediate area. There was a 253 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be a perceptible increase in noise levels for this detour

route. However, no noise sensitive receivers have been identified near this block that would be affected.

- **South State Street:** The detour route along South State Street is between Harrison Street and East Willow Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 58 to 67 dB(A). There was a 51 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for this detour route. There were no blocks along this detour route that had an increase in traffic greater than 100 percent.
- **East Willow Street:** The detour route along East Willow Street is between North State Street and North Townsend Street. Existing AM peak hour noise levels were not calculated along this detour route since no noise sensitive receivers were identified in this immediate area. There was a 22 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for this detour route. There were no blocks along this detour route that had an increase in traffic greater than 100 percent.
- **Townsend Street:** The detour route along Townsend Street is between Harrison Street and East Willow Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 53 to 70 dB(A). There was a 62 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for this detour route. There were no blocks along this detour route that had an increase in traffic greater than 100 percent.
- **Almond Street**: The detour route along Almond Street is between East Adams Street and Burnet Avenue. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 66 to 69 dB(A). There was a 100 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would likely be a perceptible increase in noise levels for this detour route. There are four blocks (between East Fayette Street and Burnet Avenue) along this detour route that had predicted increases in traffic of greater than 100 percent. Four noise sensitive receivers, which include one residence, one school (Syracuse Center of Excellence), and two outdoor seating areas, have been identified near these four blocks that could have perceptible increases in noise levels.

Construction Vibration

Construction activities have the potential to produce vibration levels that may result in structural or architectural damage, annoyance, and/or interference with vibration-sensitive activities. In general, vibration levels at a location are a function of the source strength (which is dependent upon the construction equipment and methods utilized), the distance between the equipment and the location, the characteristics of the transmitting medium, and the building construction type at the location. Construction equipment operation causes ground vibrations, which spread through the ground and decrease in strength with distance. Vehicular traffic, including construction-related vehicular and equipment traffic, typically does not result in perceptible vibration levels unless there are discontinuities in the roadway surface. Construction activities typically do not reach vibration levels that can cause architectural or structural damage, although fragile structures or buildings are more prone to be affected. However, construction work can produce vibration levels that may interfere with uses in adjacent buildings that are especially sensitive to vibration, including activities (such as surgery) or the use of equipment (such as microscopes and high tolerance manufacturing equipment). Levels may be perceptible and annoying in buildings very close to a construction site.

Vibration refers to oscillatory movement in a solid object (e.g., ground, structures) and can be quantified as acceleration, velocity, or displacement. These quantities can be measured on either linear or logarithmic scales, depending on the levels to be expressed. The assessment of construction vibration for the Project quantifies vibration in terms of peak particle velocity (PPV) as inches/second, and in terms of Root Means Square (RMS) of the PPV as vibration decibels (VdB) referenced to 1 micro-inch/second. Vibration levels expressed in VdB are expressed across a spectrum of frequencies for the vibration. Frequency is the rate at which acceleration, velocity, or displacement fluctuates in a cycle over a given quantity of time, and is measured in Hertz (Hz), where 1 Hz equals 1 cycle per second. Vibration levels expressed as PPV refer to the total PPV across the full frequency spectrum.

There are no FHWA or NYSDOT requirements directed specifically toward traffic-induced or construction-related vibration. However, the following criteria from the Federal Transit Administration's (FTA) Transit Noise and Vibration Impact Assessment Manual were used to assess construction vibration, as described below.

- **Architectural or Structural Damage from Vibration:** For purposes of assessing potential structural or architectural damage, the determination of adverse effects was based on the vibration impact criterion of a PPV of 0.50 inches per second. For non-fragile buildings, vibration levels below 0.50 inches per second would not be expected to result in any structural or architectural damage. For fragile buildings, vibration levels should be below 0.20 inches per second.
- **Human Perceptibility and Annoyance from Vibration:** The FTA's guidance manual also identifies threshold vibration levels that would be perceptible to humans within buildings and likely to result in annoyance, depending on the type of use (e.g., residential, school). Since the ability to perceive vibration is subjective, a range of possible vibration levels is identified in the FTA guidance manual, specifically between 72 and 83 VdB. For the purposes of this analysis, the lower limit of the range (72 VdB) was used as the threshold at which vibration may result in human annoyance.
- **Vibration Assessment Criteria for Sensitive Equipment or Activities:** Vibration criteria specifically provided for equipment by the equipment's manufacturer provide the most accurate threshold by which to judge the potential effects of vibration on vibration-sensitive equipment. However, acceptable vibration-level specifications were not available for all vibration-sensitive equipment potentially operating in the numerous medical buildings in proximity to the project work areas. Absent the availability of manufacturer-provided equipment-specific vibration criteria, general criteria outlined in

the FTA Noise and Vibration Impact Assessment Manual, Chapter 8, was used for the vibration assessment (see **Table 6.4.6-7**).

For purposes of assessing potential structural or architectural damage, PPV was used, while the vibration level in VdB, L_v(D), was used to assess potential annoyance or interference with vibration sensitive activities.

Table 6.4.6-8 shows vibration source levels for typical construction equipment.

Table 6.4.6-7
Vibration Criteria for Sensitive Equipment or Activity

Facility Equipment or Use	Max L_V (VdB)[2]
Residential Day: Barely feelable vibration. Adequate for computer equipment and low-power optical microscopes (up to 20X).	78
Residential Night, Operating Rooms: Vibration not feelable, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power optical microscopes (100X) and other equipment of low sensitivity.	72
VC-A[1]: Adequate for medium- to high-power optical microscopes (400X), microbalances, optical balances, and similar specialized equipment.	66
VC-B[1]: Adequate for high-power optical microscopes (1000X), inspection and lithography equipment to 3 micron line widths.	60
VC-C[1]: Appropriate for most lithography and inspection equipment to 1 micron detail size.	54
VC-D[1]: Suitable in most instances for the most demanding equipment, including electron microscopes operating to the limits of their capability.	48
VC-E[1]: The most demanding criterion for extremely vibration-sensitive equipment.	42

Source:
FTA Transit Noise and Vibration Impact Assessment Manual, 2006
Notes:
1-Vibration Classifications (VC) from the Institute of Environmental Sciences and Technology, “Considerations in Clean Room Design,” RR-CC012.1, 1993.
2- As measured in 1/3-octave bands of frequency over the frequency range 8 to 80 Hz.

Table 6.4.6-8
Vibration Source Levels for Construction Equipment

Equipment		PPVref at 25 feet (in/sec)	Approximate Lv at 25 feet (VdB)
Pile Driver (impact)	Upper Range	1.518	112
	Typical	0.644	104
Clam shovel drop (slurry wall)		0.202	94
Vibratory roller		0.210	94
Ram hoe		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

Source: Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06, May 2006.

The equipment vibration levels were projected to the various vibration receivers near the proposed project work areas to determine the expected level of vibration during various construction activities (e.g., pile driving, rock drilling). Under the Viaduct Alternative, construction activities with the highest potential to result in architectural damage due to vibration include pile driving and potentially some limited drilling in rock.

Architectural or Structural Damage from Vibration

In terms of potential vibration levels that would result in architectural damage, construction would have the most potential for producing levels that would exceed the 0.20 inches per second PPV limit for fragile buildings at locations within a distance of approximately 55 feet from the typical operation of an impact pile driver or approximately 15 feet from the operation of a drill rig. Construction would have the most potential for producing levels that would exceed the 0.50 inches per second PPV limit at locations within a distance of approximately 30 feet from the operation of an impact pile driver or approximately eight feet from the operation of a drill rig. Distances for potential structural damage were calculated using the reference values from **Table 6.4.6-8** and the damage assessment formula in Chapter 12 of the FTA Noise and Vibration Manual.

No buildings that would be considered fragile are located within the distance from the proposed construction work areas that could result in PPV levels that would potentially result in damage to fragile structures (i.e., within 55 feet). Buildings and structures located within 55 feet but more than 30 feet from the proposed construction work areas include modern structures built with contemporary building techniques, and consequently would not be expected to experience construction vibration at a level that could potentially cause damage. However, a construction vibration monitoring program would be implemented, as needed, to minimize the potential for such damage.

Human Perceptibility and Annoyance from Vibration

In terms of potential vibration levels that would be perceptible and annoying, pile driving would have the most potential for producing levels exceeding the 72 VdB limit. Using the reference values from **Table 6.4.6-8** and the annoyance assessment formula in Chapter 12 of the FTA Noise and Vibration Manual, it is likely that receivers within a distance of approximately 290 feet of typical pile driving operations would experience perceptible and annoying vibration levels. However, pile driving would occur for only limited periods of time at a particular location. Pile driving activities would progress along the project corridor at a rate of approximately 200 feet per week. Consequently, it is expected that the maximum duration that any receiver would experience perceptible/annoying levels of vibration would be three weeks. This would be a short-term temporary condition.

Vibration Assessment Criteria for Sensitive Equipment or Activities

As described above, the operation of specific equipment and specific activities can be affected by vibration even at levels lower than is perceptible or annoying to humans. Such equipment and activities, including microscopes, nuclear magnetic resonance (NMR) imaging equipment, and various types of surgery, are used or occur within various medical facilities and campuses located near the project work areas. **Table 6.4.6-7** shows predicted vibration levels at various distances from maximum vibration-producing construction activity (i.e., pile driving). The maximum expected duration is also shown based on the assumption that pile driving would progress along the project corridor at a rate of approximately 200 feet per week. The predicted levels of vibration were compared to the acceptable levels for various equipment types as shown in **Table 6.4.6-7** to determine the potential effects of the predicted vibration levels. Note that the levels in **Table 6.4.6-7** are for the basement level; vibration would be reduced at upper floors of buildings.

As described in **Table 6.4.6-9**, pile driving associated with construction of the Viaduct Alternative would have the potential to interfere with sensitive activity and equipment; however, the potential disruptions would be temporary.

Table 6.4.6-9
Vibration Analysis Results for Medical Facilities

Horizontal Distance from Pile Driver (feet)	Vibration Level (VdB)	Vibration Level (μ in. / sec)	Maximum Expected Duration	Potential Effects
80	101	107,074	< 1 day	Highly perceptible/annoying, interference with all operations/equipment
725	72	3,858	3 weeks	Not perceptible, suitable for typical operating room or surgery settings. Interference with micro/eye/neuro surgery, microscopes and imaging equipment, etc.
2000	59	857	8 weeks	Not perceptible, suitable for all surgery settings, including micro/eye/neuro surgery. Interference with magnetic resonance imaging equipment, unisolated lasers, etc.
3600	52	398	13 weeks	Not perceptible, suitable for all surgery, all microscopes, magnetic resonance imaging. Interference with cell implant equipment, unisolated lasers.
Source: FTA Transit Noise and Vibration Impact Assessment Manual, 2006.				

Based on the assessment of construction vibration presented above, no significant adverse impacts are expected to occur as a result of construction-generated vibration associated with the Viaduct Alternative.

INDIRECT EFFECTS

As indicated in **Section 6.2.1, Land Use**, the Viaduct Alternative would unlikely hinder or induce additional development beyond what would be expected under the No Build Alternative. The indirect effects of the Viaduct Alternative have been accounted for within the traffic modeling and the prediction of future traffic and noise levels for this alternative. Therefore, the indirect effects expected from this Project are reflected in the traffic noise analysis results reported above.

CUMULATIVE EFFECTS

Through the use of regional traffic modeling, the traffic analysis accounted for traffic that would be generated from reasonably foreseeable actions. Therefore, the noise levels and impacts identified above for the Viaduct Alternative reflect the traffic effects of the proposed action combined with that of reasonably foreseeable actions identified within the study area.

ABATEMENT/MITIGATION

Permanent/Operational Traffic Noise Abatement

Abatement Considerations and Procedures

When noise impacts are predicted for a project, noise abatement must be considered for the impacted areas. In accordance with the NYSDOT Noise Policy, for noise abatement measures to be recommended, an abatement measure must be both feasible and reasonable. Feasibility involves the practical capability of the noise abatement measure being built, as well as the capacity to achieve a minimum reduction in noise levels. Overall, feasibility deals primarily with engineering considerations (e.g., whether a barrier can be built given the topography of the location; whether a noise reduction can be achieved given certain access control, drainage, safety, or maintenance requirements; whether there are noise sources other than from the project present in the area; etc.). When noise abatement measures are being considered, every reasonable effort should be made to obtain noise reductions of 10 or more dB(A). For a measure to be deemed feasible, it must provide a minimum 5 dB(A) reduction to the majority of impacted receivers.

Reasonableness deals with the social, economic, and environmental factors to be considered when evaluating abatement measures. Reasonableness is based on viewpoints, cost, and noise reduction, as described below.

- **Viewpoints:** The viewpoints of the property owners and residents of the benefited receivers are a major consideration in reaching a decision on the reasonableness of abatement measures. The benefited property owners and residents must be contacted; responses must be obtained from at least half of them; and a majority of the responses must favor the abatement measure. The threshold of noise reduction that establishes a "benefited property" is at least 5 dB(A), determined at a point where frequent human use occurs and a lowered noise level would be of benefit. Viewpoints of those property owners and residents that would benefit from abatement will be obtained prior to the release of the Final Environmental Impact Statement for the Project.

- **Cost:** NYSDOT has established the following reasonableness cost indices for abatement measures:

  - For noise berm or noise insulation, a cost index of $80,000 per benefited receiver is used, based on the total cost of the material installed.

  - For barrier walls, a maximum of 2,000 square feet of wall per benefited receiver is used.

  All owner-occupied and rental dwelling units; detached, duplex, and mobile homes; and multifamily apartment units must be counted if they are benefited, regardless of whether or not they were identified as impacted.

- **Noise reduction:** The NYSDOT Noise Policy establishes a Noise Reduction Design Goal of 7 dB(A). For an abatement measure to be determined reasonable, a majority of the benefited receivers must achieve the design goal. For example, if 10 receivers were benefited, then at least 6 receivers must receive a 7 dB(A) noise reduction for the abatement measure to be considered reasonable under this criterion. Note that the other criteria above also must be met for the measure to be considered reasonable for implementation.

Based on these criteria, an assessment of noise abatement measures was performed for this Project. The following abatement measures were examined and evaluated:

- Traffic management measures, such as traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations;
- Alteration of horizontal and vertical alignments;
- Construction of noise barriers;
- Acquisition of real property to serve as a buffer zone; and
- Noise insulation of publicly owned school buildings.

An evaluation of feasibility and reasonableness for each of these potential abatement measures as they relate to the Viaduct Alternative is provided below. Noise barriers as an abatement measure are discussed in more detail in a separate section following the other measures, given that noise barriers have a greater applicability for this Project.

- **Traffic Management (Prohibition of Vehicle Types and Time-Use Restrictions):** Prohibition or time restrictions of heavy vehicles along the local roadways in these areas is not considered feasible because Downtown Syracuse is a mix of commercial and residential land uses where most of the heavy vehicles are delivery trucks and buses that are essential to commerce and public transportation within the study area and cannot be re-routed. In addition, prohibition or time restrictions of heavy vehicle use along I-81, I-481 and I-690 would not be considered feasible as these are major commerce routes for the region, and provide regional access to the local roadways in Downtown.
- **Traffic Management (Modified Speed Limits):** Speed limits can theoretically be reduced throughout the Project Area; however, generally a 20+ mph reduction in speed is necessary for a noticeable decrease in noise levels to occur. Speeds within the Downtown and local roadway network are generally posted with a speed limit of 25 to 30 mph, such that a reduction in posted speed limit to achieve a noticeable reduction in noise level would not be feasible. In addition, the highways within the overall study area (I-81, I-481 and I-690) would be anticipated to have posted speed limits of 55 to 65 miles per hour, which cannot be reduced sufficiently to have a noticeable reduction in noise level due to their intended purpose of moving people and goods through the area quickly and efficiently. Given the design and function of these highways, posted speeds of 35 to 45 mph would not be feasible or reasonable under the scope of this Project.

- **Traffic Management (Exclusive Lane Designations):** Within the Downtown areas, exclusive lane designations would not be effective or practical since the existing and proposed roadways are local collectors with driveway and side street access that must be maintained at all times for neighborhood residents, as well as for school buses and delivery trucks. Exclusive lane designations on elevated highways would not be effective in terms of noise reduction since the echo and indirect nature of the noise would not allow for a substantial reduction to occur. In addition, exclusive lane designations throughout I-81, I-481 and I-690 would not be effective as a noise abatement measure since they are not wide enough to make a difference in noise levels.
- **Alteration of Horizontal Alignments:** The use of this noise abatement measure is most feasible when a new facility alignment is proposed, rather than a widening or reconstruction along an existing alignment such as proposed for this Project. A horizontal alignment shift of more than 100 feet is generally required to yield noise reductions large enough to justify implementation of horizontal alignment change as a mitigation measure. Therefore, this abatement measure would not be suitable in the Downtown area or populated areas of the corridors where there are noise sensitive land uses or other developments on both sides of the corridor (i.e., moving the alignment away from one area of receivers may move the alignment closer to another, or cause direct encroachment impacts). In suburban areas where there may be noise sensitive uses on only one side of the road, a horizontal alignment shift may not be feasible from an engineering perspective because of the geometric requirements to transition back to the existing highway at each end. There are also other socioeconomic and environmental concerns that may exist on the other side of the highway where the horizontal shift may be made. In the case of the Viaduct Alternative, 10 locations along I-81 and I-481 were identified where the road could potentially be shifted to one side as a noise abatement measure to reduce noise levels on the impacted nearby receivers, although none of these locations were identified as being feasible or reasonable due to the extenuating circumstances identified below.
  - Greenfield Parkway vicinity along the I-81 Northern Segment near Interchange 24: Although land on the east side of I-81 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and a portion of the vacant land that exists is wetlands.
  - Bear Trap Creek Trail vicinity along the I-81 Northern Segment north of its interchange with I-90: Although land on the west side of I-81 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and a horizontal shift would likely require a non-standard bend in the road.
  - Taft Road vicinity between its intersection with I-481 and Northern Boulevard: Although land on the northeast side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and wetlands are present on that side of I-481.
  - Brittonfield Parkway vicinity immediately north of the I-481 interchange with I-90: Although land on the east side of I-481 appears to be vacant, no actual roadway

construction is currently anticipated in this area as part of the Project, and wetlands are present on that side of I-481.

- Fly Road vicinity immediately south of the I-481 interchange with Kirkville Road: Although land on the east side of I-481 appears to be vacant, this is an interchange and there are wetlands on the east side of I-481 in this area.
- Butternut Creek Trail vicinity along I-481 between Highway 5 and Kinne Road Bridge: Although land on the northwest side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and there are wetlands on the west side of I-481 in this area.
- Andrews Road vicinity along I-481 south of its interchange with Highway 5: Although land on the east side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and there are wetlands on the east side of I-481 in this area.
- Butternut Creek Golf Course along I-481 north of the Jamesville Road Bridge: Although land on the east side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area, and there are houses outside of the immediate noise impact area that could potentially be affected by noise increases if I-481 was moved closer to them.
- Church on Old Stonehouse Road near I-481 between Jamesville Road Bridge and the railroad bridge to the south: Although land on the south side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project.
- Rock Cut Road Trailer Park on Cliffside Park Road near I-481: I-481 could not be shifted northward and away from the noise receivers in this area due to wetlands and a railroad on the north side of I-481.

- **Alteration of Vertical Alignments**: Reduction of noise levels through modification of the vertical profile of the Viaduct Alternative could result from the elimination or reduction of the line-of-sight between the vehicular noise sources (tire noise and exhaust pipes) and the receivers. Most automobiles and light trucks have exhaust pipes located at approximately one to two feet above the roadway surface, although many trucks and buses have exhaust pipes that outlet at approximately 9.8 feet above the roadway surface. Options for changes in vertical alignment include the following:
  - Raising the roadway: The roadway would have to be raised approximately 8 to 10 feet to begin to noticeably reduce noise levels to adjacent receivers. However, reduction of noise levels to an extent that would justify implementation of an abatement measure would likely require a more extreme change in the vertical alignment. Within the Downtown and residential areas of the Project, engineering obstacles for raising the roadway elevation include unacceptable driveway and yard pitches and the addition of undesirable visual and aesthetic concerns. This option would not be effective within the suburban areas either because the extreme raising

of the roadway that would be required for justification of the abatement measure would not be reasonable.

- Lowering the roadway: Depending on the elevation of the receivers and their locations with respect to the roadway, the roadway would have to be lowered approximately four to six feet to begin to reduce noise levels. However, reduction of noise levels to an extent that would justify implementation of an abatement mitigation measure would likely require a more extreme change in the vertical alignment. Engineering obstacles for lowering the roadway elevation may include a seasonally high groundwater table, potential flooding concerns, and the likely requirement of pumping stations for stormwater drainage along the corridor. It should also be noted that retaining walls may be required (due to the grade change), which could, in part, function like noise barriers, while actual noise barriers may be a better solution. Lowering the roadway could also add undesirable visual and aesthetic concerns.

- **Acquisition of Real Property to Serve as a Buffer Zone:** This abatement measure allows for acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development that would be adversely impacted by traffic noise. This measure is not used to purchase homes or developed property to create a noise buffer zone. It is used to purchase unimproved property to preclude future noise impacts where development has not yet occurred. This would not be effective for the receivers located in the Downtown area of this Project since this Project is not meant to discourage additional development. In addition, the suburban areas of this Project offer enough choices for land development that this would be considered ineffective as an abatement measure.

- **Noise Insulation of Publicly Owned School Buildings:** This potential noise abatement measure would only apply to public schools that are located adjacent to the highway right-of-way in connection with a NYSDOT construction project undertaken with Federal aid. For this measure to be recommended, the NYSDOT Commissioner must determine that it is in the best interest of the State considering, among other factors, the cost and feasibility of other alternatives. The overall Project Area was investigated to identify public schools that may be impacted by this Project. Three public schools with predicted exterior noise impacts related to the Viaduct Alternative were identified within the overall Project Area, but for the reasons stated below, none of them is recommended for noise insulation specifically related to the proposed Project:

- SUNY Upstate University Hospital, which is on East Adams Street near I-81 in Downtown Syracuse, has an exterior noise level of 72 dBA. The actual school building was only recently constructed; therefore, it is anticipated that the building was constructed to be well insulated to general hospital standards. Thermal insulation that is applied to buildings, such as newer hospitals, inherently offers a high level of sound dampening that greatly reduces interior noise levels.

- SUNY Upstate University Hospital has another building near Fly Road called Upstate University Neurology. While exterior noise levels nearer to the highway than the actual building show an exceedance of the NAC, it has been determined that nearby parallel receivers that are approximately the same distance away from I-481 as the Upstate University Neurology building can be used to represent exterior noise levels near the building. It is not anticipated that there would be a noise impact adjacent to the building because a comparable receiver for the building showed a peak noise hour noise level of 64 dBA. Therefore, noise insulation of the building would not be necessary.

- Roxboro Road Middle School is near the I-81 Northern Segment between its interchanges with I-90 and Brewerton Road. The sports fields have modeled receivers on them and one has a noise level of 66 dBA while the other has a noise level of 63 dBA. This is due to one receiver being closer to I-81 than the other. The actual school building is outside the study area at a further distance from I-81 than either of these receivers. Therefore, deductive reasoning indicates that the actual school building is far enough from I-81 that there would not be a traffic noise impact adjacent to the building, and that noise insulation of the building would not be necessary.

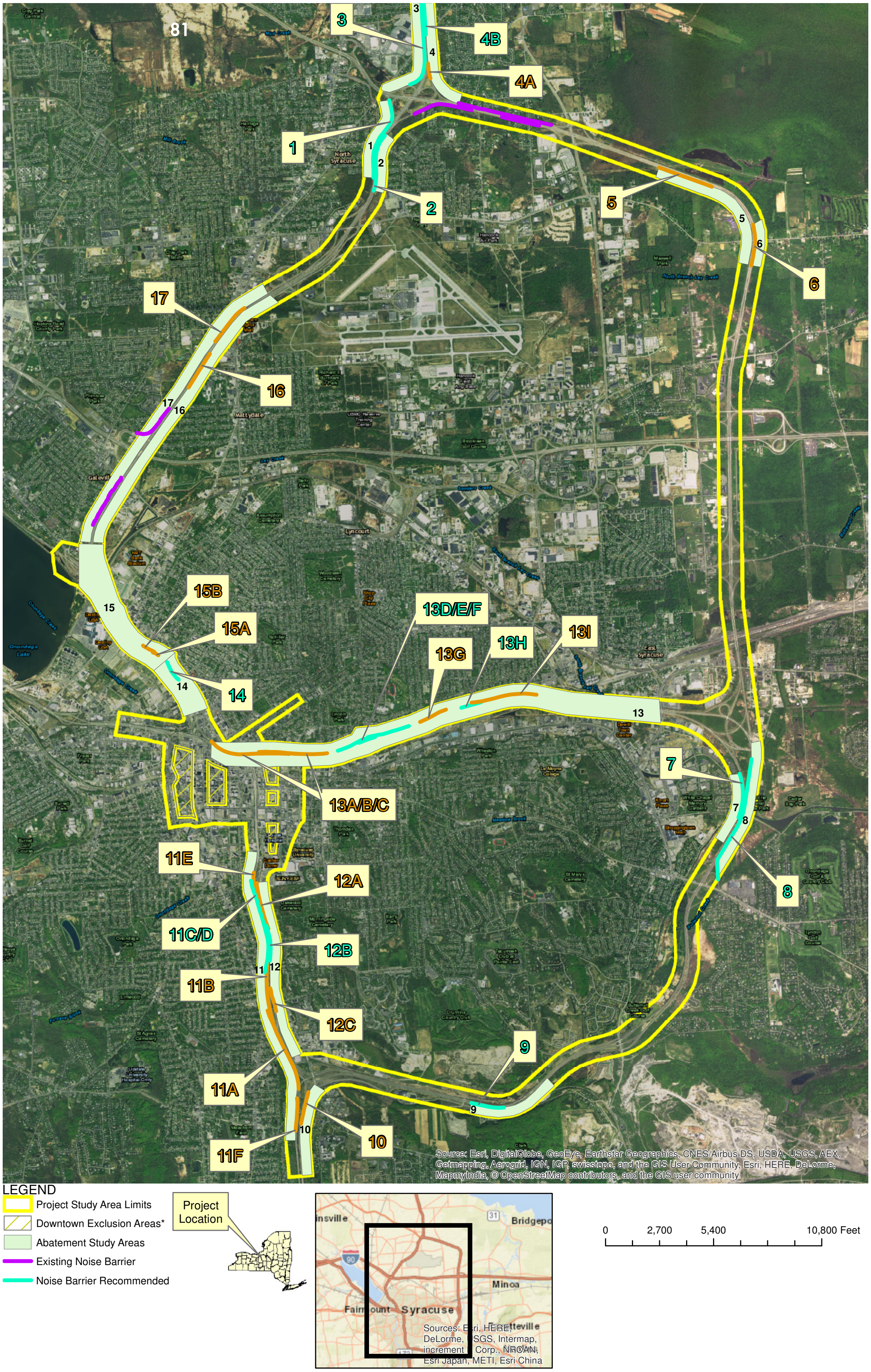
Noise Barrier Analysis

For the Viaduct Alternative specifically, the most effective method of noise abatement has been determined to be the use of noise barriers, which can be constructed of wood, steel or concrete. The use of an earthen berm instead of a noise barrier was not specifically considered due to the amount of land area required for such berms, which generally cannot be accommodated within the limited space of a highway right-of-way.

For a barrier to provide effective noise reduction, it must be continuous and designed to an elevation high enough to shield the receiver from the noise source. Noise barrier locations were chosen for study if there was a potential that noise barriers could be considered both feasible and reasonable. Noise barriers are not considered feasible along the local streets in the Downtown area of the Project since openings for driveways would need to be provided for the residences and businesses that would negate the effectiveness of the noise barrier. Therefore, no detailed evaluation of such barriers in the Downtown area was conducted.

Seventeen (17) general locations where traffic noise impacts have been predicted and a quantitative noise abatement analysis was considered appropriate were identified within the overall study area. Specifically, the areas located along the study area highways were assessed to determine whether the construction of one or more noise barriers within each of these areas would be feasible and reasonable for this Project. The locations of these 17 areas are shown in **Figure 6.4.6-1**.

The individual noise barriers within each of these areas that were developed, modeled and evaluated in terms of their feasibility and reasonableness are also depicted in **Figure 6.4.6-1**, as well as the Viaduct Alternative noise abatement figures in **Appendix H**. The topography, length and development patterns within each area were used to determine whether more than one noise barrier was considered in each area. A total of 28 noise barriers and/or noise barrier systems have been developed and evaluated throughout the Project Area for the



Noise Abatement Overview
for the Viaduct Alternative

Figure 6.4.6-1

Viaduct Alternative, with each keyed to the area in which it is located (e.g., Barriers 4A and 4B in Area 4). The locations of all barriers evaluated are listed below.

- **Barrier 1** would be located along southbound I-81 in North Syracuse between the southbound I-481 connector to southbound I-81 and the southbound I-81 off-ramp to East Taft Road.
- **Barrier 2** would be located along northbound I-81 in North Syracuse between the East Taft Road on-ramp to northbound I-81 and the northbound I-81 to southbound I-481 connector.
- **Barrier 3** would be located along southbound I-81 in Cicero between Pony Lane and the southbound I-81 to northbound I-481 connector.
- **Barrier 4A** would be located along the northbound I-481 connector to I-81 in Cicero between Bourdage Road and northbound I-81.
- **Barrier 4B** would be located along northbound I-81 in Cicero between South Bay Road and Farrington Road.
- **Barrier 5** would be located along southbound I-481 in East Syracuse between Northern Boulevard and East Taft Road.
- **Barrier 6** would be located along northbound I-481 in East Syracuse between Bridgeport Road and East Taft Road.
- **Barrier 7** would be located along southbound I-481 in East Syracuse between I-690 and Kinne Road.
- **Barrier 8** would be located along northbound I-481 in East Syracuse between the Highway 5 on-ramp to northbound I-481 and Heritage Landing Drive.
- **Barrier 9** would be located along northbound I-481 in Jamesville between the Rock Cut Road on-ramp to northbound I-481 and Rams Gulch Road.
- **Barrier 10** would be located along northbound I-81 in Syracuse between Arsenal Drive and the northbound I-81 to northbound I-481 connector.
- **Barrier 11A** would be located along southbound I-81 in Syracuse between the South Salina Street on-ramp to southbound I-81 and the southbound I-81 connector to southbound I-481.
- **Barrier 11B** would be located along southbound I-81 in Syracuse between the southbound I-81 off-ramp to South State Street and the South Salina Street on-ramp to southbound I-81.
- **Barrier 11C/D** would be located along southbound I-81 in Syracuse between the East Castle Street on-ramp to southbound I-81 and the southbound I-81 off-ramp to South State Street.

- **Barrier 11E** would be located along southbound I-81 in Syracuse between Burt Street and the East Castle Street on-ramp to southbound I-81.
- **Barrier 11F** would be located along the southbound I-481 to northbound I-81 connector in Syracuse between I-481 and Arsenal Drive.
- **Barrier 12A** would be located along northbound I-81 in Syracuse between the East Colvin Street on-ramp to northbound I-81 and the northbound I-81 off-ramp to East Castle Street.
- **Barrier 12B** would be located along northbound I-81 in Syracuse between the South Salina Street on-ramp to northbound I-81 and the East Colvin Street on-ramp to northbound I-81.
- **Barrier 12C** would be located on state right-of-way in Syracuse between the northbound I-81 off-ramp to South Salina Street and the South Salina Street on-ramp to northbound I-81.
- **Barrier 13A/B/C** would be located along westbound I-690 in Syracuse between Beech Street and the westbound I-690 connector to northbound I-81, as an overall three-barrier system.
- **Barrier 13D/E/F** would be located along westbound I-690 in Syracuse from a point just east of Peat Street to Beech Street, as an overall three-barrier system in order to provide feasible and reasonable abatement.
- **Barrier 13G** would be located along westbound I-690 in Syracuse between the westbound I-690 on-ramp from Midler Avenue to just east of Peat Street.
- **Barrier 13H** would be located along westbound I-690 in Syracuse between the westbound I-690 off-ramp to Midler Avenue and the Midler Avenue overpass.
- **Barrier 13I** would be located along westbound I-690 in Syracuse between Thompson Road and the westbound I-690 off-ramp to Midler Avenue.
- **Barrier 14** would be located on top of a retaining wall along northbound I-81 in Syracuse between the northbound I-81 off-ramp to Spencer Street and Court Street.
- **Barrier 15A** would be located within state right-of-way on top of cut between northbound I-81 and the Court Street on-ramp to northbound I-81, as part of a barrier system in conjunction with Barrier 15B between Court Street and Bear Street.
- **Barrier 15B** would be located within state right-of-way on top of cut between northbound I-81 and Sunset Avenue in Syracuse, as part of a barrier system in conjunction with Barrier 15A between Court Street and Bear Street.
- **Barrier 16** would be located along northbound I-81 in Syracuse between I-90 and the northbound I-81 off-ramp to Highway 11.

- **Barrier 17** would be located along southbound I-81 in Syracuse between South Bay Road and the Brewton Road on-ramp to southbound I-81.

Table 6.4.6-10 presents the results of the evaluation for each of the above-listed barriers and/or barrier systems, including the range of existing hourly Leq noise levels at each location, the range of future hourly Leq noise levels without and with a barrier for the receivers at each location, approximate barrier length and average barrier height. The noise level reductions and the barrier dimensions as summarized in this table were then used to assess the feasibility and reasonableness of each barrier. Also indicated in the table is the corresponding figure number for each barrier, as shown in the Viaduct Alternative Noise Abatement figures in **Appendix H.** The modeling coordinates of all noise barriers evaluated for the Viaduct Alternative are presented in **Appendix H**.

For each of the above-listed barriers, an evaluation of feasibility and reasonableness was performed pursuant to the previously stated criteria. For each barrier evaluated, **Table 6.4.6-11** presents the total number of impacted and benefited receptors; the number and percentage of impacted receptors that achieve at least a 5 dB(A) reduction; the number of benefited receptors that achieve at least a 7 dB(A) reduction; total square footage of the barrier; square footage of the barrier per each benefited receptor; feasibility of the barrier; and reasonableness of the barrier.

As indicated in **Table 4.6.4-11**, of the 28 barriers and/or barrier systems evaluated for the Viaduct Alternative, only 12 would meet the criteria for both feasibility and reasonableness, and are therefore, recommended for construction as traffic noise abatement measures, contingent on the viewpoints of benefited receptors. These include Barriers 1, 2, 3, 4B, 7, 8, 9, 11C/D, 12B, 13D/E/F, 13H and 14. All of these recommended barriers are located in areas where there would be at least 8, and up to 99, impacted receptors without the barriers in place and at least 8, and up to 184, benefited receptors that would experience a noise level reduction of 5 dB(A) or greater as a result of the barrier being in place.

At least 71 percent, and as much as 100 percent of the impacted receptors in each recommended location would receive a 5 dB(A) or greater reduction benefit, thereby meeting the feasibility requirement that such reduction be achieved by a majority of impacted receptors.

In terms of reasonableness, all of these recommended barriers would result in dimensions that allow the reasonableness threshold of a maximum of 2,000 square feet of wall per benefited receptor to be achieved. Also, all of these barriers would result in at least 50 percent of the benefited receptors achieving a 7 dB(A) reduction, with most of them resulting in close to 60 percent or more of the benefited receptors achieving this reduction.

In addition to the quantitative evaluation of noise barriers performed at the previously-described locations, a qualitative assessment was performed in areas where the non-feasibility and non-reasonableness of noise barrier construction was considered to be obvious from the outset. These include receptors within the Downtown area and isolated receptors or receptor clusters adjacent to the highways.

Table 4.6.4-10
Viaduct Alternative: Results of Noise Barrier Modeling and Evaluation

Noise Barrier ID	Noise Abatement Figure Number in Appendix H	Range of Existing Leq (1hr) Noise Levels	Range of Future Build Leq(1hr) Noise Levels, dB(A)		Barrier Characteristics	
			w/o Barrier	With Barrier	Approx. Length (ft)	Avg. Height (ft)
1	4	61-78	58-77	54-65	4154	12
2	4	61-76	61-76	55-65	2882	12
3	4	61-76	61-76	56-65	4676	14
4A	4	56-67	57-67	56-63	770	14
4B	4	62-74	62-74	57-70	2081	14
5	5	66-67	65-68	59	2805	12
6	6	61-67	61-68	56-66	2070	20
7	7&8	59-74	60-75	56-71	2233	16
8	7&8	61-73	62-73	55-62	6389	12.85
9	9	62-69	62-69	56-63	19721	12
10	10	55-69	59-69	56-67	1632	20
11A	10	50-75	43-76	73-68	4240	20
11B	10	61-71	61-71	55-70	2975	20
11C/D	10	57-72	52-72	51-70	4729	16
11E	10	54-71	52-70	48-69	1137	20
11F	10	60-66	55-68	52-67	1631	16
12A	10	62-72	61-72	56-67	2366	20
12B	10	61-72	61-73	56-63	1772	16
12C	10	58-70	61-70	59-65	1198	20
13A/B/C	1&11	57-70	57-73	50-72	7496	20
13D/E/F	11	61-71	65-72	59-67	4470	12
13G	11	58-72	65-72	60-64	1437	20
13H	11	59-75	62-75	62-73	1032	13
13I	11&12	59-72	62-73	58-66	3292	20
14	2	55-70	64-68	58-61	1078	14
15A&B	2	57-71	61-70	59-68	960	18
16	3	60-78	60-78	56-67	2000	16.4
17	3	63-69	63-69	58-67	2241	16

Notes:
Barrier 11C/D is a single barrier.
Barriers 15A, 15B and 15C are three separate barriers comprising a single barrier system, although Barrier 15C was also studied as a stand-alone barrier.

Table 6.4.6-11
Viaduct Alternative: Noise Barrier Feasibility and Reasonableness

Noise Barrier	Total # of Impacts	Number of Attenuated Locations					Sq-ft of Modeled Noise Barrier	Sq-ft of Wall Per Benefited Receptor	Feasible? (Y/N)	Reason-Able? (Y/N)
		Total No. of Benefited Receptors	≥ 5 dB(A) (Impacted Receptors)		≥ 7 dB(A) (Benefitted Receptors)					
			No.	Percent	No.	Percent				
1	60	90	57	95%	51	57%	49850	554	Y	Y
2	44	58	43	98%	33	57%	34588	596	Y	Y
3	22	33	22	100%	21	64%	65465	1984	Y	Y
4A	2	3	2	100%	2	67%	10780	3593	Y	N
4B	17	18	14	82%	11	61%	29128	1618	Y	Y
5	5	5	5	100%	4	80%	33661	6732	Y	N
6	3	6	1	33%	0	0%	41394	6899	N	N
7	21	19	15	71%	13	68%	35725	1880	Y	Y
8	22	42	22	100%	28	67%	82136	1956	Y	Y
9	14	29	14	100%	21	72%	19721	680	Y	Y
10	9	1	1	11%	0	0%	32630	32630	N	N
11A	32	31	16	50%	6	19%	84794	2735	Y	N
11B	35	9	0	0%	0	0%	59504	6612	N	N
11C/D	99	184	75	76%	106	58%	75660	411	Y	Y
11E	10	0	0	0%	0	0%	22740	-	N	N
11F	2	9	0	0%	0	0%	26099	2900	N	N
12A	14	4	3	21%	1	25%	47323	11831	N	N
12B	30	47	30	100%	33	70%	28355	603	Y	Y
12C	12	9	9	75%	7	78%	23953	2661	Y	N
13A/B/C	39	13	0	0%	6	46%	149909	11531	N	N
13D/E/F	26	28	24	92%	16	57%	53930	1926	Y	Y
13G	10	9	8	80%	1	11%	28724	3192	Y	N
13H	8	8	8	100%	5	63%	13413	1677	Y	Y
13I	10	6	5	50%	6	100%	65839	10973	Y	N
14	10	10	9	90%	5	50%	15097	1510	Y	Y
15A& 15B	14	10	9	64%	4	40%	17284	1728	Y	N
16	9	11	8	89%	7	64%	32794	2981	Y	N
17	5	7	2	40%	0	0%	35856	5122	N	N

Note:
Barriers indicated as "Y" in the "Reasonable" column are contingent on the viewpoints of the benefited receptors.

The downtown area of Syracuse with the Viaduct Alternative constructed would continue to consist mostly of city streets which are at grade with the adjacent land uses. An I-81 viaduct would also continue to exist, although it would be newly widened and realigned, while a widened and realigned Almond Street would also be constructed at-grade and adjacent to the viaduct. Given the substantial noise contribution from dense local street traffic and other noise sources in the Downtown area, it was qualitatively determined that noise barriers along the shoulders of the reconstructed viaduct would not provide feasible or reasonable abatement in that area. In order to validate this determination, a comparison was made between the future predicted noise level results with traffic on the viaduct and without traffic on the viaduct. This comparison is representative of the theoretical maximum amount of sound attenuation that could be achieved by constructing noise barriers on the viaduct. Based on this qualitative comparison, it was determined that feasible and reasonable noise abatement for receptors located in the Downtown area cannot be achieved.

Also, construction of noise barriers along Almond Street and other city streets that would be improved or would experience increased traffic as part of this alternative are determined to be not feasible and reasonable. Since barriers must be continuous and extend beyond the actual locations of impacted receptors in order to be effective, the presence of many cross streets through Downtown corridors prevent the ability to achieve this abatement design. In addition, if barriers were placed on city streets, visual and pedestrian access to and from city buildings, as well as vehicular access to driveways would be blocked.

Isolated groups of impacted receptors along the primary Project corridors were qualitatively assessed for reasonableness of abatement, rather than performing a quantitative noise barrier analysis. In accordance with NYSDOT Noise Policy, and as discussed previously, the constructed surface area of a proposed barrier must not exceed 2,000 square feet per benefited receptor for a noise barrier to be considered reasonable. In this regard, if a cluster of five residences exists in an area that is surrounded by non-sensitive land uses, a noise barrier could not exceed 12 feet in height and approximately 830 feet in length in order for it to be considered reasonable. Based on the noise barrier analysis which has been conducted at other locations, it is assumed with good engineering judgment that a barrier with such dimensions would not provide the necessary 5 dB(A) of reduction to all of the impacted residences in that cluster, nor would such a barrier provide 7 dB(A) of reduction to any benefited receptors. Therefore, wherever an isolated cluster of five or fewer receptors exists along a portion of highway, it is qualitatively concluded that a noise barrier would not be reasonable.

Construction Noise and Vibration Abatement

Abatement of construction noise related to detour traffic was considered. The proposed detours are within the downtown roadway network, which is generally not conducive to the main methods of traffic noise abatement (e.g., noise barriers, roadway realignment, or traffic management options, such as speed adjustments). Speeds are generally reduced in many areas of construction and along detour routes due to posting or congestion. It is anticipated that the construction-related reduction of traffic speeds would have the potential to slightly reduce traffic noise; however, it is not expected that these speed reductions would result in noticeably lower noise levels. Generally, a 20+ mph reduction in speed is necessary for a noticeable decrease in noise levels. Therefore, speed limit reduction is not reasonable for abatement of construction detour traffic noise.

For abatement of construction equipment noise, noise abatement strategies would be included within the contract documents to the extent practicable. Potential noise abatement measures could include training programs for contractors, designated construction time periods, and designated haul roads in areas with fewer noise sensitive receivers. Where appropriate, the use of an alternative technology (such as a vibratory pile driver in place of an impact pile driver) could also be employed for impact equipment.

Additional potential abatement strategies could include:

- Source Control: Using exhaust systems in good working order, engine enclosures and intake silencers; conducting regular equipment maintenance; using new equipment subject to new product noise emission standards; installing aprons onto the equipment to provide shielding for frequently used equipment; and using dampeners to reduce noise levels due to vibrations from construction equipment;
- Site Control: Placing stationary equipment as far away from sensitive receivers as possible; providing full or partial enclosures for stationary equipment, such as compressors and generators; strategically choosing staging sites and construction and demolition (C&D) disposal sites; and constructing temporary and/or movable shielding to act as noise barriers for construction operations;
- Time and Activity Constraints: Coordinating work operations to coincide with time periods when people would least likely be affected; and limiting work hours; and
- Community Awareness: Notifying the public of construction operations and methods.

The RCNM User's Guide provides a list of simplified shielding factors and accompanying noise reduction levels for construction equipment. The list of shielding factors that could apply to the construction of this Project includes:

- Noise barrier or other obstruction (such as a dirt mound) just barely breaks the line-of-sight between the noise source and the receiver - 3 dB(A) noise reduction
- Noise source is completely enclosed or completely shielded with a solid barrier located close to the source - 8 dB(A) noise reduction (enclosure and/or barrier has some gaps in it - 5 dB(A) noise reduction).
- Noise source is completely enclosed and completely shielded with a solid barrier located close to the source - 10 dB(A) noise reduction.
- Building stands between the noise source and receiver and completely shields the noise source - 15 dB(A) noise reduction.
- Noise source is enclosed or shielded with heavy vinyl noise curtain material (e.g., SoundSeal BBC-13-2" or equivalent) - 5 dB(A) noise reduction.

At each of the construction sites that were analyzed, physical features were identified, if present, that could help in reducing the noise levels due to construction equipment. At site B, the road elevation is lower than the surrounding area, creating a natural barrier between the receiver and the construction site. At sites A, B, and C, there are various areas under bridges that could be used to store stationary equipment, which would help in reducing the noise levels. Sites D and E are along the viaduct and Almond Street. There are no natural barriers around sites D and E other than a few large buildings; however, other mitigation strategies, such as noise enclosures, could be employed in these areas.

Using the existing barriers currently in place (e.g., berms, retaining walls, elevation changes) and determining what pieces of construction equipment could be enclosed, shielding was applied under the RCNM analysis for each piece of equipment to predict whether there would be an overall reduction in noise levels. For the Viaduct Alternative, it was determined that stationary equipment, such as pumps, vibratory concrete mixers, jackhammers, welders/torches, and pneumatic tools, could be either partially or fully enclosed behind a noise barrier or an enclosure. Stationary equipment that needs less physical access would be able to be fully enclosed to allow for a higher shielding value. Site B construction equipment that was not stationary was given a shielding factor of 3 dB(A) because there is a natural barrier/noise barrier at site B that breaks the line-of-sight between the noise source and the receiver. At sites C, D, and E, much of the construction would be taking place along the viaduct; therefore, it is assumed that the stationary equipment would not be fully enclosed since construction is taking place above the receivers. **Table 6.4.6-12** shows the RCNM noise level results in the Viaduct Alternative for construction equipment with and without shielding. The use of abatement measures at construction sites A, B, and C yielded predicted construction equipment noise levels below 80 dB(A).

Table 6.4.6-12
RCNM Calculated Construction Noise Levels With Shielding for the Viaduct Alternative

Construction Receiver Site	Without Shielding (dB(A))	With Shielding (dB(A))
Site A	L_{max}= 76; L_{eq}= 81	L_{max}= 76; L_{eq}= 78
Site B	L_{max}= 78; L_{eq}= 84	L_{max}= 75; L_{eq}= 79
Site C	L_{max}= 77; L_{eq}= 82	L_{max}= 77; L_{eq}= 79
Site D	L_{max}= 78; L_{eq}= 83	L_{max}= 78; L_{eq}= 81
Site E	L_{max}= 84; L_{eq}= 88	L_{max}= 84; L_{eq}= 86

Notes:
L_{max} is the maximum sound level.
L_{eq} (equivalent sound level) is the sound pressure level equivalent to the total sound energy over a given period of time.
Sources: Analysis performed using FHWA Roadway Construction Noise Model (FHWA RCNM) Version 1.1.

To abate the potential effects from construction vibration, a monitoring program would be developed by the Contractor. The program would include the following provisions.

- When pile driving would occur within 30 feet of a structure, a construction vibration-monitoring program would be implemented to determine whether construction vibration would exceed 0.50 inches per second. If the structure does experience PPV values in excess of 0.50 inches per second as a result of construction vibration, construction means and methods would be re-evaluated to avoid producing vibration at this level, unless an engineer's inspection of the building determines that the level of construction vibration at the building does not have the potential to result in damage.

- The Contractor would coordinate with the medical institutions and would make efforts to coordinate scheduling with the surrounding medical campuses to avoid vibration-producing construction activity during the most critical times for use of the medical facilities and minimize the potential for interference during those times.

6.4.6.4 ENVIRONMENTAL CONSEQUENCES OF THE COMMUNITY GRID ALTERNATIVE

PERMANENT/OPERATIONAL EFFECTS

As per NYSDOT Noise Policy, traffic noise impacts occur when:

- The predicted future traffic noise levels approach within 1 dB(A) or exceed the NAC; or
- The predicted future traffic noise levels exceed existing levels by 6 dB(A) or more.

Under the Community Grid Alternative, noise impacts were predicted at 679 of the 2,240 receivers. The highest L_{eq} noise level was 78 dB(A) and the lowest noise level was 41 dB(A) (see the Noise Impact Summary - Models Results table in **Appendix H**). Similar to the existing conditions, the highest noise levels were identified at the receivers located closest to I-81, I-690, and I-481 and the lower noise levels were identified in the suburban areas and behind large buildings or other structures. One of the larger changes in the soundscape for the Community Grid Alternative would be the elimination of the elevated highway throughout much of Downtown Syracuse. Much of the current noise from the overhead freeway is indirect (i.e., through vibration noise or echo) since the line-of-sight between the overhead freeway tire noise and most of the exhaust pipes (excluding some heavy trucks and buses) is obstructed by the bridge deck. Therefore, with the loss of the overhead freeway, indirect noise from the highway would be reduced; however, some of this reduction in noise would be offset by both the additional traffic that would be added to the at-grade street network and the new line-of-sight noise from the added traffic.

The TNM analysis of the existing conditions identified 696 of the 2,240 receivers at a noise level above the NAC and the TNM analysis of the Community Grid Alternative identified 679 of the 2,240 receivers at a noise level above the NAC. Therefore, the modeling predicts 17 fewer receivers with noise levels above the NAC when compared to existing conditions (prior to performance of the abatement analysis). The reduced number of receivers with noise levels above the NAC is predicted even though there are increases in traffic volumes/noise between 2013 and 2050 due to normal population growth of the area.

In accordance with Table 3 of FHWA's "Highway Traffic Noise Analysis and Abatement Policy and Guidance, a noise level change of 3 dB(A) or less is generally imperceptible to the human ear; therefore, a comparison was made to determine the number of impacted receivers with increases of 3 dB(A) or more as compared to existing conditions. Under the Community Grid Alternative, it is anticipated that traffic noise level increases would be perceptible at 74 of the 2,240 receivers and decreases in traffic noise would be perceptible at 319 of the 2,240 receivers. Of the 679 impacted receivers, 56 receivers would have a perceptible increase in traffic noise levels (not accounting for the expected reductions in the areas proposed for noise abatement).

The majority of the 74 receivers that would have a perceptible noise level increase are located within the Downtown area where streets would accommodate more traffic and near the northern interchange of I-81 and I-481. The perceptible decreases in traffic noise predicted at the 319 receivers under the Community Grid Alternative were due to decreases in traffic along the southern portion of I-81 and the removal of the viaduct in Downtown Syracuse.

Overall, based on the definition of "traffic noise impacts" provided above, the Community Grid Alternative would result in impacts at 679 of the 2,240 receivers modeled.

CONSTRUCTION EFFECTS

Construction Noise

Construction noise differs from traffic noise in the following ways:

- Construction noise lasts only for the duration of the construction contract;
- Construction activities are usually limited to the daylight hours when most human activity takes place;
- Construction activities are generally short term; and
- Construction noise is intermittent and depends on the type of operation.

Construction of the Project would potentially include excavation, sub-base preparation, roadway/bridge construction, and other miscellaneous work. This work would result in temporary construction noise at nearby receivers. The levels of noise would vary widely, depending on the construction activities undertaken and the anticipated duration of the construction. The parameters that determine the nature and magnitude of construction noise include the type, age, and condition of construction equipment; operation cycles; the number of pieces of construction equipment operating simultaneously; the distance between the construction activities and receivers; and the location of haul routes with respect to receivers. Many of these parameters would not be fully defined until final design plans and specifications have been prepared; however, representative construction scenarios based on typical construction procedures have been identified for the Project and were used to assess effects.

To evaluate potential noise levels as a result of construction of the build alternatives, the RCNM, developed by the FHWA, was employed. The proposed construction equipment and baseline noise levels for the selected receivers close to the construction area were entered into the RCNM, along with the approximate distance from the center of the construction area to the receivers. The construction noise analysis was performed to predict noise levels due to construction of the Community Grid Alternative at the following representative seven sites for the Project Area:

- Site A: I-81 Northern Segment: A location along Basin Street that is representative of the residential houses in this area.
- Site B: West Street Interchange: The front yard of a residence that is representative of the church and residential houses in this area.
- Site C: I-81/I-690 Interchange (Location 1 of 2): The side yard of an apartment building that is representative of the residential land use in this area.
- Site D: I-81/I-690 Interchange (Location 2 of 2): A location within Forman Park that is representative of this area.
- Site E: Almond Street Viaduct Area: A location within the Pioneer Homes development that is representative of this area.
- Site F: I-81/I-481 South Interchange (major construction would occur at this location only under the Community Grid Alternative): A location within the Loretto Health and Rehabilitation Center that is representative of this area.
- Site G: I-81/I-481 North Interchange (major construction would occur at this location only under the Community Grid Alternative): A location along Brigadier Drive that is representative of the residential houses in this area.

The sites are shown on the Construction Noise Receiver Locations figure in **Appendix H**.

The proposed accelerated construction schedule could generate an elevated noise level due to the simultaneous use of additional construction equipment, but it would allow for a shorter period of construction noise. Due to the logarithmic nature of adding noise sources, noise from the simultaneous use of additional construction equipment may, in some cases, have a negligible effect on perceivable noise levels; therefore, a shorter construction duration may be desirable. A 3 dB(A) increase, which is normally the smallest change in noise levels that is perceptible to the human ear, would require a doubling of the noise energy produced by the construction equipment. Even in a case where the accelerated construction schedule creates a perceivable increase in noise levels, a shorter construction duration may nonetheless be desirable to receivers.

The construction equipment, utilization percentage, and expected maximum noise level (L_{max}) values listed in **Table 6.4.6-13** were used within the model. **Table 6.4.6-14** presents the resulting noise levels for the selected sites within the Project Area for the Community Grid Alternative. In addition, the "Construction Equipment Noise Summary" tables in **Appendix H** show the total number of pieces of equipment proposed for use at each site and the individual and total noise levels that they would produce per the RCNM analysis.

Table 6.4.6-13
Construction Equipment for the Community Grid Alternative

Equipment Description	Impact Device (Y or N)	Acoustical Usage Factor (%)*	L_{max} at 50 feet (dB(A))
Backhoe	N	40	78
Compactor (ground)	N	20	83
Crane	N	16	81
Dozer	N	40	82
Dump Truck	N	40	76
Excavator	N	40	81
Flat Bed Truck	N	40	74
Front End Loader	N	40	79
Jackhammer	Y	20	89
Mounted Impact Hammer	Y	20	90
Pickup Truck	N	40	75
Pneumatic Tools	N	50	85
Pumps	N	50	81
Roller	N	20	80
Vibratory Concrete Mixer	N	20	80
Welder/Torch	N	40	74

Notes: L_{max} is the maximum sound level.
Construction equipment identified above corresponds to the types of construction equipment expected to be used on this Project.
* Acoustical Usage Factor is an estimate of the fraction of time each piece of construction equipment is operating at full power (i.e., its loudest condition) during a construction operation.
Source: Acoustical usage factor percentages and L_{max} values are from FHWA Roadway Construction Noise Model User's Guide, FHWA-HEP-05-054, DOT-VNTSC-FHWA-05-01 (Final Report, January 2006)

Table 6.4.6-14
RCNM Calculated Construction Noise Levels for the Community Grid Alternative

Construction Receiver Site	Description	Community Grid Alternative (dB(A))
Site A	I-81 Northern Construction Area	L_{max}= 76; L_{eq}= 81
Site B	West Street Interchange	L_{max}= 78; L_{eq}= 84
Site C	I-81/I-690 Interchange (Location 1 of 2)	L_{max}= 77; L_{eq}= 82
Site D	I-81/I-690 Interchange (Location 2 of 2)	L_{max}= 78; L_{eq}= 83
Site E	Almond Street Viaduct Area	L_{max}= 84; L_{eq}= 89
Site F	I-81/I-481 Interchange to the South	L_{max}= 72; L_{eq}= 77
Site G	I-81/I-481 Interchange to the North	L_{max}= 75; L_{eq}= 79

Notes: L_{max} is the maximum sound level.
L_{eq} (equivalent sound level) is the sound pressure level equivalent to the total sound energy over a given period of time.
Sources: Analysis performed using FHWA Roadway Construction Noise Model (FHWA RCNM) Version 1.1.

The RCNM results indicated that five of the seven sites (A through E) would have L_{eq} noise levels above 80 dB(A). Sites F and G were below 80 dB(A). According to the NYSDOT Noise Policy, a construction noise effect will not normally occur at levels under L_{eq}=80 dB(A). The use of impact-related construction equipment (impact devices) is planned at all seven locations. Impact construction equipment is equipment that generates short duration (generally less than one second), high intensity, abrupt impulsive noise. While the noise levels for impact devices is below 80 dB(A) for six of the seven locations, impact devices can be more noticeable due to the abrupt changes in noise levels. Therefore, five of the seven sites may experience adverse construction noise effects unless abatement measures are implemented. Based on RCNM results, without noise abatement measures, it is anticipated that average noise levels and the use of impact devices may be considered disruptive to nearby receivers. Worst case distances (i.e., the closest representative receivers) from the construction equipment to the nearest receiver were generally used for the RCNM analysis; however, realistically, given the mobile nature of road construction, construction distances could potentially increase as the construction operations move along the roadway centerlines. In addition, construction operations are in constant flux, and the equipment and operations would not always be at the worst case levels predicted herein. Construction noise abatement measures and shielding effects are discussed in the mitigation subsection below.

A qualitative assessment of traffic noise effects related to construction detours was prepared based on the Maintenance and Protection of Traffic (MPT) routes described in **Chapter 4, Construction Means and Methods**. During certain phases of construction, various segments of roads would be closed. As a result, detour routes would be in effect to accommodate traffic through the construction zone. The detour routes would generally serve increased traffic during construction, and therefore, receivers adjacent to these routes would have the potential to realize perceptible increases in noise levels.

The objective of the construction detour traffic noise analysis was to qualitatively address which detour routes for the Community Grid Alternative would have changes in traffic volumes along alternative routes that could result in a perceptible increase in noise. Generally, when traffic volumes increase by at least 100 percent, it can be assumed that there will be a perceptible increase in noise levels (an increase of 3 dB(A)) for the surrounding area. The main changes to traffic flow throughout the corridor are expected to include the outlying highways (I-81, I-481, and I-690) and the detour routes through Downtown Syracuse. Changes in traffic volumes that are expected for the outlying highways would be due to motorists choosing alternate routes to avoid construction zones. It is anticipated that some motorists may choose to travel on I-481 and on some portions of I-690 to avoid construction lane restrictions and detour zones along I-81 and I-690. Therefore, there may be a decrease in traffic along I-81 and increases in traffic along I-481 and some portions of I-690. However, given the high volume of vehicles along these highways, it is not anticipated that the changes in noise levels would be perceptible since it is expected that traffic changes along the outlying highways would be less than 100 percent.

There are nine proposed detour routes in Downtown Syracuse that would be used under the Community Grid Alternative. Therefore, block-by-block comparisons were made and the average increase in traffic for each detour route was calculated to see if 100 percent increases in traffic volumes would be expected, assuming that the speeds are not affected. During the comparison, each detour route was divided into blocks between intersecting streets. The receivers used for the TNM analysis were used to identify which blocks would be most sensitive to noise level increases. **Table 6.4.6-15** shows the average increases in traffic for each detour route, the number of blocks that are affected, and the range of noise levels along each detour route. Average noise levels shown in the table are from the 2013 TNM noise analysis because the traffic volumes between 2013 and 2020 are expected to be similar.

Table 6.4.6-15
Community Alternative Traffic Detour Summary

Detour Route	Average Increase in Traffic[1]	Total Number of Blocks[2]	Number of Blocks Affected[3]	Total Number of Receivers Along Full Detour Route[4]	Number of Receivers Along Affected Blocks[5]	Range of Existing Noise Levels Along Detour Route (dB(A))[6]
W Genesee St + Erie Blvd	99%	12	5	19	8	60-71
Washington St	75%	8	2	6	1	61-66
Fayette St	48%	10	1	11	1	55-70
S Crouse Ave	432%	7	7	12	12	53-65
Irving Ave	602%	3	3	6	6	55-62
Salina St	72%	8	1	12	0	63-70
Pearl St Ramps to NB I-81	152%	6	4	4	3	58-70
Clinton St	73%	7	1	15	4	62-70
Ramps to NB I-81 from N State St	296%	2	1	0	0	N/A

Notes:
N/A - No noise sensitive receivers were identified along the detour route; therefore, there was no average noise level calculated for the detour route.
1. The percent average along the entire detour route. Even if the average is lower than 100 percent, there can still be affected blocks along the route that are greater than 100 percent.
2. The total number of blocks that are along a detour route.
3. The total number of blocks along a detour route that had an increase in traffic greater than 100 percent.
4. The total number of receivers that are along the entire detour route.
5. The total number of receivers that are near the affected blocks along the detour route.
6. The range of noise levels (from the 2013 TNM model results) for the receivers that are along the entire detour route.

Of the nine detour routes, five routes had overall increases in traffic equal to or greater than 100 percent. All nine detour routes had at least one block with an increase in traffic greater than 100 percent. These effects would be perceptible during the detour periods. The following sections of the detour routes throughout Downtown Syracuse were reviewed:

- **West Genesee Street and Erie Boulevard:** The detour route along West Genesee Street and Erie Boulevard is between the exit ramp from North West Street and South Crouse Avenue. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 60 to 71 dB(A). There was a 99 percent average increase in traffic that was predicted along this detour route; therefore, it is anticipated that there would be an overall perceptible increase in noise levels for this detour route. There are five blocks (between the I-690 off-ramp and North Franklin Street and between North McBride Street and South Crouse Avenue) along this detour route that had predicted increases in traffic greater than 100 percent. Eight sensitive receivers, which include one residence, a church playground, Syracuse VA Dental Clinic, Time Warner Cable News studio, and three outdoor seating areas, near these five blocks could have a perceptible increase in noise levels.

- **Washington Street:** The detour route along Washington Street is between South Clinton Street and Forman Avenue. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 61 to 66 dB(A). There was a 75 percent average increase in traffic that was predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for the majority of this detour route. Two blocks (between South McBride Street and Forman Avenue) along the detour route had predicted increases in traffic greater than 100 percent. One sensitive receiver, which is a school (Syracuse Center of Excellence), has been identified near these two blocks that could have a perceptible increase in noise levels.

- **Fayette Street:** The detour route along Fayette Street is between South Clinton Street and South Crouse Avenue. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 55 to 70 dB(A). There was a 48 percent average increase in traffic that was predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for the majority of this detour route. However, one block (between Forman Avenue and Irving Avenue) along this detour route had predicted increases in traffic greater than 100 percent. One sensitive receiver, which is an outdoor seating area, has been identified near this block that could have a perceptible increase in noise levels.

- **South Crouse Avenue:** The detour route along South Crouse Avenue is between Harrison Street and the on-ramp from South Crouse Avenue to eastbound I-690. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 53 to 65 dB(A). There was a 432 percent average increase in traffic that was predicted along this detour route; therefore, it is anticipated that there would be a perceptible increase in noise levels for this detour route. All blocks along this detour route had predicted increases in traffic that were greater than 100 percent. Twelve (12) sensitive receivers, which include one outdoor vendor, seven residential areas, and four medical buildings (Hill Medical Center, Pulmonary Health Physicians, Arthritis Health Associates, and Crouse Medical Practice), have been identified along this detour route that could have a perceptible increase in noise levels.

- **Irving Avenue:** The detour route along Irving Avenue is between East Genesee Street and Erie Boulevard. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 55 to 62 dB(A). There was a 602 percent average increase in traffic that was predicted along this detour route; therefore, it is anticipated that there would be a perceptible increase in noise levels for this detour route. All blocks along this detour route had predicted increases in traffic that were greater than 100 percent. Six sensitive receivers, which include one church (First Fruit Ministries), one medical building (Syracuse VA Dental Clinic), an outdoor seating area, and three residential areas, have been identified near this detour route that could have a perceptible increase in noise levels.

- **Salina Street:** The detour route along Salina Street is between Harrison Street and the ramp to Pearl Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 63 to 70 dB(A). There was a 72 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for the majority of this detour route. One block (between East Willow Street and Herald Place) along the detour route had a predicted increase in traffic greater than 100 percent; however, no sensitive receivers have been identified near this block that would be affected.
- **Pearl Street Ramps to Northbound I-81:** This detour route includes the segments of Hickory Street and East Willow Street that lead to Pearl Street and the on-ramps to northbound I-81. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 58 to 70 dB(A). There was a 152 percent average increase in traffic that was predicted along this detour route; therefore, it is anticipated that there would be a perceptible increase in noise levels for this detour route. Four blocks (between the ramp to Pearl Street and the ramp to I-81 from Pearl Street southbound and between Pearl Street and East Willow Street north of Pearl Street) had predicted increases in traffic that were greater than 100 percent. Three sensitive receivers, which include one parklike sitting area, one church (The Samaritan Center), and one picnic area, have been identified near these four blocks that could have a perceptible increase in noise levels.
- **Clinton Street:** The detour route along Clinton Street is between Gifford Street and the exit ramp from I-81 Southbound to South Clinton Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 62 to 70 dB(A). There was a 73 percent average increase in traffic that was predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for the majority of this detour route. One block (between Herald Place and James Street) along the detour route had a predicted increase in traffic that was greater than 100 percent. Four sensitive receivers, which include one residence, one outdoor seating area, and two outdoor dining areas, have been identified near this block that could have a perceptible increase in noise levels.
- **Ramps to Northbound I-81 from North State Street:** This detour route includes the on-ramps to northbound I-81 from both northbound and southbound North State Street. Existing AM peak hour noise levels were not calculated along this detour route since no noise sensitive receivers were identified in this immediate area. There was a 296 percent average increase in traffic that was predicted along this detour route; therefore, it is anticipated that there would be a perceptible increase in noise levels for this detour route. One block (the ramp to northbound I-81 from southbound North State Street) along this detour route had a predicted increase in traffic greater than 100 percent. However, no sensitive receivers have been identified near this block that would be affected.

Construction Vibration

There are no FHWA or NYSDOT requirements directed specifically toward traffic-induced or construction-related vibration, although there are criteria from the Federal Transit Administration's (FTA) Transit Noise and Vibration Impact Assessment Manual, among other sources, that were used to assess construction vibration. These criteria, as well as basic information about vibrations and the relationship of vibration impacts to construction activities were discussed in detail for the Viaduct Alternative and are not repeated here, although they are applicable to the Community Grid Alternative as well. Vibration criteria, vibration source levels for construction equipment and vibration analysis results for medical facilities are presented in **Tables 6.4.6-7, 6.4.6-8 and 6.4.6-9**, respectively. Under the Community Grid Alternative, construction activities with the highest potential to result in architectural damage due to vibration include pile driving and potentially some limited drilling in rock.

Architectural or Structural Damage from Vibration

In terms of potential vibration levels that would result in architectural damage, construction would have the most potential for producing levels that would exceed the 0.20 inches per second PPV limit for fragile buildings at locations within a distance of approximately 55 feet from the typical operation of an impact pile driver or approximately 15 feet from the operation of a drill rig. Construction would have the most potential for producing levels that would exceed the 0.50 inches per second PPV limit at locations within a distance of approximately 30 feet from the operation of an impact pile driver or approximately eight feet from the operation of a drill rig. Distances for potential structural damage were calculated using the reference values from **Table 6.4.6-8** and the damage assessment formula in Chapter 12 of the FTA Noise and Vibration Manual.

No buildings that would be considered fragile are located within the distance from the proposed construction work areas that could result in PPV levels that would potentially result in damage to fragile structures (i.e., within 55 feet). Buildings and structures located within 55 feet but more than 30 feet from the proposed construction work areas include modern structures built with contemporary building techniques, and consequently would not be expected to experience construction vibration at a level that could potentially cause damage. However, a construction vibration monitoring program would be implemented, as needed, to minimize the potential for such damage.

Human Perceptibility and Annoyance from Vibration

In terms of potential vibration levels that would be perceptible and annoying, pile driving would have the most potential for producing levels exceeding the 72 VdB limit. Using the reference values from **Table 6.4.6-8** and the annoyance assessment formula in Chapter 12 of the FTA Noise and Vibration Manual, it is likely that receivers within a distance of approximately 290 feet of typical pile driving operations would experience perceptible and annoying vibration levels. However, pile driving would occur for only limited periods of time at a particular location. Pile driving activities would progress along the project corridor at a rate of approximately 200 feet per week. Consequently, it is expected that the maximum duration that any receiver would experience perceptible/annoying levels of vibration would be three weeks. This would be a short-term temporary condition.

Vibration Assessment Criteria for Sensitive Equipment or Activities

As described above, the operation of specific equipment and specific activities can be affected by vibration even at levels lower than is perceptible or annoying to humans. Such equipment and activities, including microscopes, nuclear magnetic resonance (NMR) imaging equipment, and various types of surgery, are used or occur within various medical facilities and campuses located near the project work areas. **Table 6.4.6-7** shows predicted vibration levels at various distances from maximum vibration-producing construction activity (i.e., pile driving). The maximum expected duration is also shown based on the assumption that pile driving would progress along the project corridor at a rate of approximately 200 feet per week. The predicted levels of vibration were compared to the acceptable levels for various equipment types as shown in **Table 6.4.6-7** to determine the potential effects of the predicted vibration levels. Note that the levels in **Table 6.4.6-7** are for the basement level; vibration would be reduced at upper floors of buildings.

As described in **Table 6.4.6-9**, pile driving associated with construction of the Community Grid Alternative would have the potential to interfere with sensitive activity and equipment; however, the potential disruptions would be temporary.

Based on the assessment of construction vibration presented above, no significant adverse impacts are expected to occur as a result of construction-generated vibration associated with the Community Grid Alternative.

INDIRECT EFFECTS

Indirect effects of this Project would include the foreseeable development that this Project would stimulate by the year 2050, including new commercial or residential land uses that would lead to additional traffic and noise. As indicated in **Section 6.2.1, Land Use,** the Community Grid Alternative could potentially result in additional development on parcels that would be created within roadway realignments and in the former right-of-way of I-81 in Downtown to the east of Almond Street between Erie Boulevard and East Genesee Street. These growth-inducing effects have been accounted for within the traffic modeling and the prediction of future traffic and noise levels for this alternative. Therefore, the indirect effects expected from this Project are reflected in the traffic noise analysis results reported above.

CUMULATIVE EFFECTS

Through the use of regional traffic modeling, the traffic analysis accounted for traffic that would be generated from reasonably foreseeable actions.. Therefore, the noise levels and impacts identified above for the year 2050 Community Grid Alternative reflect the traffic effects of the proposed action combined with that of reasonably foreseeable actions identified within the study area.

ABATEMENT/MITIGATION

Permanent/Operational Traffic Noise Abatement

Abatement Considerations and Procedures

When noise impacts are predicted for a project, noise abatement must be considered for the impacted areas. In accordance with the NYSDOT Noise Policy, for noise abatement measures to be recommended, an abatement measure must be both feasible and reasonable. Feasibility involves the practical capability of the noise abatement measure being built, as well as the capacity to achieve a minimum reduction in noise levels. Overall, feasibility deals primarily with engineering considerations (e.g., whether a barrier can be built given the topography of the location; whether a noise reduction can be achieved given certain access control, drainage, safety, or maintenance requirements; whether there are noise sources other than from the project present in the area; etc.). When noise abatement measures are being considered, every reasonable effort should be made to obtain noise reductions of 10 or more dB(A). For a measure to be deemed feasible, it must provide a minimum 5 dB(A) reduction to the majority of impacted receivers.

Reasonableness deals with the social, economic, and environmental factors to be considered when evaluating abatement measures. Reasonableness is based on viewpoints, cost, and noise reduction, as described below.

- **Viewpoints:** The viewpoints of the property owners and residents of the benefited receivers are a major consideration in reaching a decision on the reasonableness of abatement measures. The benefited property owners and residents must be contacted; responses must be obtained from at least half of them; and a majority of the responses must favor the abatement measure. The threshold of noise reduction that establishes a "benefited" property is at least 5 dB(A), determined at a point where frequent human use occurs and a lowered noise level would be of benefit. Viewpoints of those property owners and residents that would benefit from abatement will be obtained prior to the release of the Final Environmental Impact Statement for the Project.
- **Cost:** NYSDOT has established the following reasonableness cost indices for abatement measures:
  - For noise berm or noise insulation, a cost index of $80,000 per benefited receiver is used, based on the total cost of the material installed.
  - For barrier walls, a maximum of 2,000 square feet of wall per benefited receiver is used.

  All owner-occupied and rental dwelling units; detached, duplex, and mobile homes; and multifamily apartment units must be counted if they are benefited, regardless of whether or not they were identified as impacted.
- **Noise reduction:** The NYSDOT Noise Policy establishes a Noise Reduction Design Goal of 7 dB(A). For an abatement measure to be determined reasonable, a majority of the benefited receivers must achieve the design goal. For example, if 10 receivers were

benefited, then at least 6 receivers must receive a 7 dB(A) noise reduction for the abatement measure to be considered reasonable under this criterion. Note that the other criteria above also must be met for the measure to be considered reasonable for implementation.

Based on these criteria, an assessment of noise abatement measures was performed for this Project. The following abatement measures were examined and evaluated:

- Traffic management measures, such as traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations;
- Alteration of horizontal and vertical alignments;
- Construction of noise barriers;
- Acquisition of real property to serve as a buffer zone; and
- Noise insulation of publicly owned school buildings.

An evaluation of feasibility and reasonableness for each of these potential abatement measures as they relate to the Community Grid Alternative is provided below. Noise barriers as an abatement measure are discussed in more detail in a separate section following the other measures, given that noise barriers have a greater applicability for this Project.

- **Traffic Management (Prohibition of Vehicle Types and Time-Use Restrictions):** Prohibition or time restrictions of heavy vehicles along the local roadways in these areas is not considered feasible because Downtown Syracuse is a mix of commercial and residential land uses where most of the heavy vehicles are delivery trucks and buses that are essential to commerce and public transportation within the study area and cannot be re-routed. In addition, prohibition or time restrictions of heavy vehicle use along I-81, I-481 and I-690 would not be considered feasible as these are major commerce routes for the region, and provide regional access to the local roadways in Downtown. **Traffic Management (Modified Speed Limits):** Speed limits can theoretically be reduced throughout the Project Area; however, generally a 20+ mph reduction in speed is necessary for a noticeable decrease in noise levels to occur. Speeds within the Downtown and local roadway network are generally posted with a speed limit of 25 to 30 mph, such that a reduction in posted speed limit to achieve a noticeable reduction in noise level would not be feasible. In addition, the highways within the overall study area (I-81, I-481 and I-690) would be anticipated to have posted speed limits of 55 to 65 miles per hour, which cannot be reduced sufficiently to have a noticeable reduction in noise level due to their intended purpose of moving people and goods through the area quickly and efficiently. Given the design and function of these highways, posted speeds of 35 to 45 mph would not be feasible or reasonable under the scope of this Project.
- **Traffic Management (Exclusive Lane Designations):** Within the Downtown areas, exclusive lane designations would not be effective or practical since the existing and proposed roadways are local collectors with driveway and side street access that must be

maintained at all times for neighborhood residents, as well as for school buses and delivery trucks. Exclusive lane designations on elevated highways would not be effective in terms of noise reduction since the echo and indirect nature of the noise would not allow for a substantial reduction to occur. In addition, exclusive lane designations throughout I-81, I-481 and I-690 would not be effective as a noise abatement measure since they are not wide enough to make a difference in noise levels.

- **Alteration of Horizontal Alignments:** The use of this noise abatement measure is most feasible when a new facility alignment is proposed, rather than a widening or reconstruction along an existing alignment such as proposed for this Project. A horizontal alignment shift of more than 100 feet is generally required to yield noise reductions large enough to justify implementation of horizontal alignment change as a mitigation measure. Therefore, this abatement measure would not be suitable in the Downtown area or populated areas of the corridors where there are noise sensitive land uses or other developments on both sides of the corridor (i.e. moving the alignment away from one area of receivers may move the alignment closer to another, or cause direct encroachment impacts). In suburban areas where there may be noise sensitive uses on only one side of the road, a horizontal alignment shift may not be feasible from an engineering perspective because of the geometric requirements to transition back to the existing highway at each end. There are also other socioeconomic and environmental concerns that may exist on the other side of the highway where the horizontal shift may be made. In the case of the Community Grid Alternative, 10 locations along I-81 and I-481 were identified where the road could potentially be shifted to one side as a noise abatement measure to reduce noise levels on the impacted nearby receivers, although none of these locations were identified as being feasible or reasonable due to the extenuating circumstances identified below.
    - Greenfield Parkway vicinity along the I-81 Northern Segment near Interchange 24: Although land on the east side of I-81 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and a portion of the vacant land that exists is wetlands.
    - Bear Trap Creek Trail vicinity along the I-81 Northern Segment north of its interchange with I-90: Although land on the west side of I-81 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and a horizontal shift would likely require a non-standard bend in the road.
    - Taft Road vicinity between its intersection with I-481 and Northern Boulevard: Although land on the northeast side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and wetlands are present on that side of I-481.
    - Brittonfield Parkway vicinity immediately north of the I-481 interchange with I-90: Although land on the east side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and wetlands are present on that side of I-481.

- Fly Road vicinity immediately south of the I-481 interchange with Kirkville Road: Although land on the east side of I-481 appears to be vacant, this is an interchange and there are wetlands on the east side of I-481 in this area.
- Butternut Creek Trail vicinity along I-481 between Highway 5 and Kinne Road Bridge: Although land on the northwest side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and there are wetlands on the west side of I-481 in this area.
- Andrews Road vicinity along I-481 south of its interchange with Highway 5: Although land on the east side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project, and there are wetlands on the east side of I-481 in this area.
- Butternut Creek Golf Course along I-481 north of the Jamesville Road Bridge: Although land on the east side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area, and there are houses outside of the immediate noise impact area that could potentially be affected by noise increases if I-481 was moved closer to them.
- Church on Old Stonehouse Road near I-481 between Jamesville Road Bridge and the railroad bridge to the south: Although land on the south side of I-481 appears to be vacant, no actual roadway construction is currently anticipated in this area as part of the Project.
- Rock Cut Road Trailer Park on Cliffside Park Road near I-481: I-481 could not be shifted northward and away from the noise receivers in this area due to wetlands and a railroad on the north side of I-481.

- **Alteration of Vertical Alignments**: Reduction of noise levels through modification of the vertical profile of the Community Grid Alternative could result from the elimination or reduction of the line-of-sight between the vehicular noise sources (tire noise and exhaust pipes) and the receivers. Most automobiles and light trucks have exhaust pipes located at approximately one to two feet above the roadway surface, although many trucks and buses have exhaust pipes that outlet at approximately 9.8 feet above the roadway surface. Options for changes in vertical alignment include the following:
  - Raising the roadway: The roadway would have to be raised approximately 8 to 10 feet to begin to noticeably reduce noise levels to adjacent receivers. However, reduction of noise levels to an extent that would justify implementation of an abatement measure would likely require a more extreme change in the vertical alignment. Within the Downtown and residential areas of the Project, engineering obstacles for raising the roadway elevation include unacceptable driveway and yard pitches and the addition of undesirable visual and aesthetic concerns. This option would not be effective within the suburban areas either because the extreme raising of the roadway that would be required for justification of the abatement measure would not be reasonable.

- Lowering the roadway: In general, elimination of the existing I-81 viaduct as part of the Community Grid Alternative would already function, to an extent, as a form of noise abatement in that area of the Project. Throughout the rest of the Project Area, depending on the elevation of the receivers and their locations with respect to the roadway, the roadway would have to be lowered approximately four to six feet to begin to reduce noise levels. However, reduction of noise levels to an extent that would justify implementation of an abatement measure would likely require a more extreme change in the vertical alignment. Engineering obstacles for lowering the roadway elevation may include a seasonally high groundwater table, potential flooding concerns, and the likely requirement of pumping stations for stormwater drainage along the corridor. It should also be noted that retaining walls may be required (due to the grade change) which could, in part, function like noise barriers, actual noise barriers may be a better solution. Lowering the roadway could also add undesirable visual and aesthetic concerns.

- **Acquisition of Real Property to Serve as a Buffer Zone:** This abatement measure allows for acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development that would be adversely impacted by traffic noise. This measure is not used to purchase homes or developed property to create a noise buffer zone. It is used to purchase unimproved property to preclude future noise impacts where development has not yet occurred. This would not be effective for the receivers located in the Downtown area of this Project since this Project is not meant to discourage additional development. In addition, the suburban areas of this Project offer enough choices for land development that this would be considered ineffective as an abatement measure.

- **Noise Insulation of Publicly Owned School Buildings**: This potential noise abatement measure would only apply to public schools that are located adjacent to the highway right-of-way in connection with a NYSDOT construction project undertaken with Federal-aid. For this measure to be recommended, the NYSDOT Commissioner must determine that it is in the best interest of the State considering, among other factors, the cost and feasibility of other alternatives. The overall Project Area was investigated to identify public schools that may be impacted by this Project. Two public schools with predicted exterior noise impacts related to the Community Grid Alternative were identified within the overall Project Area, but for the reasons stated below, neither of them are recommended for noise insulation specifically related to the proposed Project.

  - SUNY Upstate University Hospital has a building near Fly Road called Upstate University Neurology. While exterior noise levels nearer to the highway than the actual building show an exceedance of the NAC, it has been determined that nearby parallel receivers that are approximately the same distance away from I-481 as the Upstate University Neurology building can be used to represent exterior noise levels near the building. It is not anticipated that there would be a noise impact adjacent to the building because a comparable receiver for the building showed a peak noise hour noise level of 64 dBA. Therefore, noise insulation of the building would not be necessary.

- Roxboro Road Middle School is near the I-81 Northern Segment between its interchanges with I-90 and Brewerton Road. The sports fields have modeled receivers on them and one has a noise level of 66 dBA while the other has a noise level of 62 dBA. This is due to one receiver being closer to I-81 than the other. The actual school building is outside the study area at a further distance from I-81 than either of these receivers. Therefore, deductive reasoning indicates that the actual school building is far enough from I-81 that there would not be a traffic noise impact adjacent to the building, and that noise insulation of the building would not be necessary.

Noise Barrier Analysis

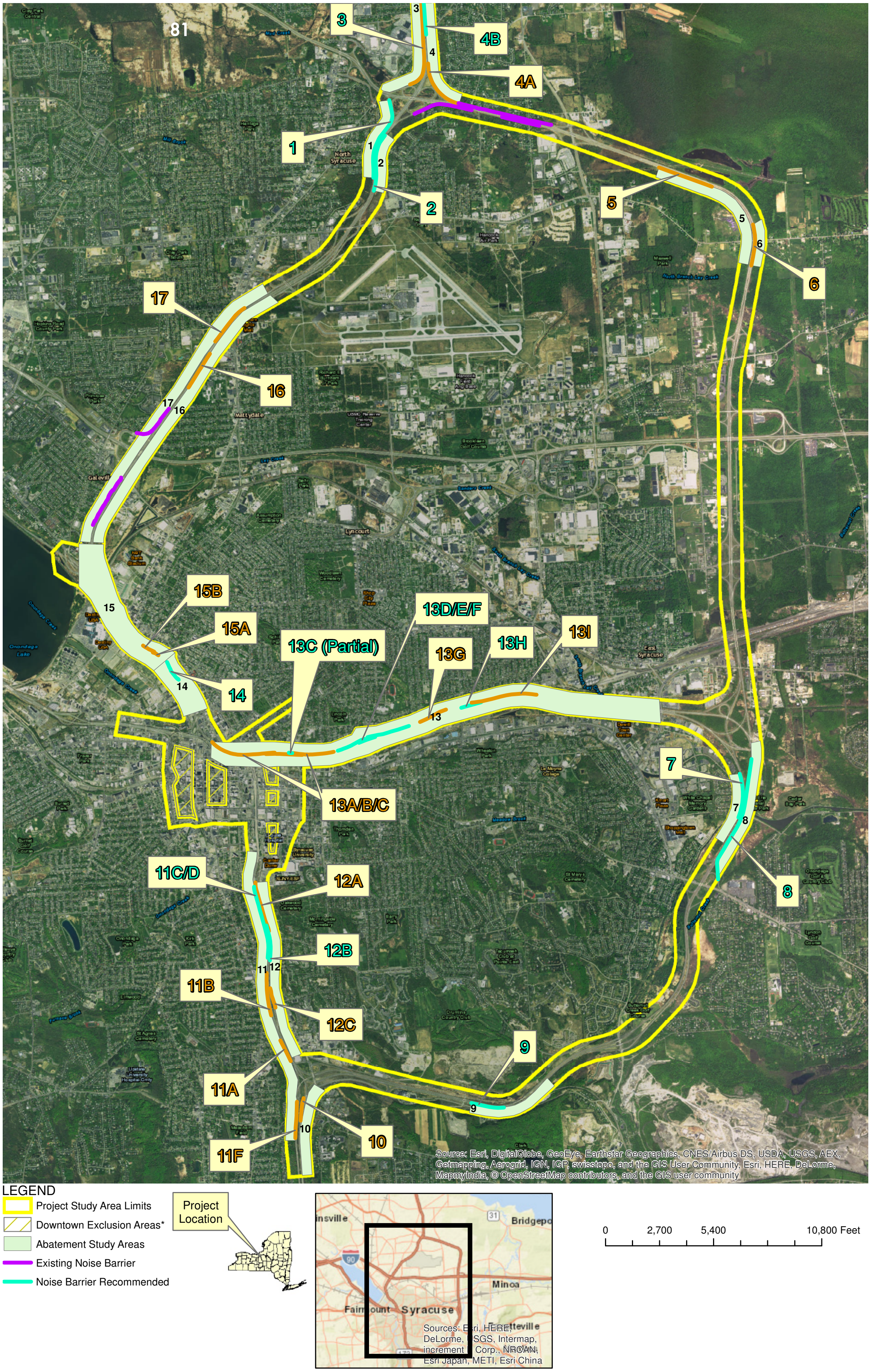
For the Community Grid Alternative, the most effective method of noise abatement has been determined to be the use of noise barriers, which can be constructed of wood, steel or concrete. The use of an earthen berm instead of a noise barrier was not specifically considered due to the amount of land area required for such berms, which generally cannot be accommodated within the limited space of a highway right-of-way.

For a barrier to provide effective noise reduction, it must be continuous and designed to an elevation high enough to shield the receiver from the noise source. Noise barrier locations were chosen for study if there was a potential that noise barriers could be considered both feasible and reasonable. Noise barriers are not considered feasible along the local streets in the Downtown area of the Project since openings for driveways would need to be provided for the residences and businesses that would negate the effectiveness of the noise barrier. Therefore, no detailed evaluation of such barriers in the Downtown area was conducted.

Seventeen (17) general locations where traffic noise impacts have been predicted and a quantitative noise abatement analysis was considered appropriate were identified within the overall study area. Specifically, the areas located along the study area highways were assessed to determine whether the construction of one or more noise barriers within each of these areas would be feasible and reasonable for this Project. The locations of these 17 areas are shown in **Figure 6.4.6-1**.

The individual noise barriers within each of these areas that were developed, modeled and evaluated in terms of their feasibility and reasonableness are also depicted in **Figure 6.4.6-2**, as well as in the Community Grid Noise Abatement figures in **Appendix H.** The topography, length and development patterns within each area were used to determine whether more than one noise barrier was considered in each area. A total of 28 noise barriers have been developed and evaluated throughout the overall study area for the Community Grid Alternative, with each keyed to the area in which it is located (e.g., Barriers 4A and 4B in Area 4). The locations of all barriers evaluated are listed below:

- **Barrier 1** located along southbound I-81 in North Syracuse between the southbound I-481 connector to southbound I-81 and the southbound I-81 off-ramp to East Taft Road.



Noise Abatement Overview for the Community Grid Alternative

Figure 6.4.6-2

- **Barrier 2** located along northbound I-81 in North Syracuse between the East Taft Road on-ramp to northbound I-81 and the northbound I-81 to southbound I-481 connector.
- **Barrier 3** located along southbound I-81 in Cicero between Pony Lane and the southbound I-81 to northbound I-481 connector.
- **Barrier 4A** located along the northbound I-481 connector to I-81 in Cicero between Bourdage Road and northbound I-81.
- **Barrier 4B** located along northbound I-81 in Cicero between South Bay Road and Farrington Road.
- **Barrier 5** located along southbound I-481 in East Syracuse between Northern Boulevard and East Taft Road.
- **Barrier 6** located along northbound I-481 in East Syracuse between Bridgeport Road and East Taft Road.
- **Barrier 7** located along southbound I-481 in East Syracuse between I-690 and Kinne Road.
- **Barrier 8** located along northbound I-481 in East Syracuse between the Highway 5 on-ramp to northbound I-481 and Heritage Landing Drive.
- **Barrier 9** located along northbound I-481 in Jamesville between the Rock Cut Road on-ramp to northbound I-481 and Rams Gulch Road.
- **Barrier 10** located along northbound I-81 in Syracuse between Arsenal Drive and the northbound I-81 to northbound I-481 connector.
- **Barrier 11A** located along southbound I-81 in Syracuse between the South Salina Street on-ramp to southbound I-81 and the southbound I-81 connector to southbound I-481.
- **Barrier 11B** located along southbound I-81 in Syracuse between the southbound I-81 off-ramp to South State Street and the South Salina Street on-ramp to southbound I-81.
- **Barrier 11C&D** located along southbound I-81 in Syracuse between the East Castle Street on-ramp to southbound I-81 and the southbound I-81 off-ramp to South State Street.
- **Barrier 11F** located along the southbound I-481 to northbound I-81 connector in Syracuse between I-481 and Arsenal Drive.
- **Barrier 12A** located along northbound I-81 in Syracuse between the East Colvin Street on-ramp to northbound I-81 and the northbound I-81 off-ramp to East Castle Street.
- **Barrier 12B** located along northbound I-81 in Syracuse between the South Salina Street on-ramp to northbound I-81 and the East Colvin Street on-ramp to northbound I-81.
- **Barrier 12C** located on state right-of-way in Syracuse between the northbound I-81 off-ramp to South Salina Street and the South Salina Street on-ramp to northbound I-81.

- **Barrier 13A/B/C** would be located along westbound I-690 in Syracuse between Beech Street and the westbound I-690 connector to northbound I-81, as an overall three-barrier system.
- **Barrier 13C (Partial),** which is the western-most portion of Barrier C included in the Barrier 13A/B/C system, would be located along westbound I-690 in Syracuse immediately to the east of North Crouse Avenue. This partial barrier was studied as an independent barrier in order to provide feasible and reasonable abatement.
- **Barrier 13D/E/F** would be located along westbound I-690 in Syracuse from a point just east of Peat Street to Beech Street, as an overall three-barrier system in order to provide feasible and reasonable abatement.
- **Barrier 13G** would be located along westbound I-690 in Syracuse between the westbound I-690 on-ramp from Midler Avenue to just east of Peat Street.
- **Barrier 13H** would be located along westbound I-690 in Syracuse between the westbound I-690 off-ramp to Midler Avenue and the Midler Avenue overpass.
- **Barrier 13I** would be located along westbound I-690 in Syracuse between Thompson Road and the westbound I-690 off-ramp to Midler Avenue.
- **Barrier 14** located on top of a retaining wall along northbound I-81 in Syracuse between the northbound I-81 off-ramp to Spencer Street and Court Street.
- **Barrier 15A** located within state right-of-way on top of cut between northbound I-81 and the Court Street on-ramp to northbound I-81 in Syracuse, as part of a barrier system in conjunction with Barrier 15B between Court Street and Bear Street.
- **Barrier 15B** located within state right-of-way on top of cut between northbound I-81 and Sunset Avenue in Syracuse, as part of a barrier system in conjunction with Barrier 15A between Court Street and Bear Street.
- **Barrier 16** located along northbound I-81 in Syracuse between I-90 and the northbound I-81 off-ramp to Highway 11.
- **Barrier 17** located along southbound I-81 in Syracuse between South Bay Road and the Brewton Road on-ramp to southbound I-81.

Table 6.4.6-16 presents the results of the evaluation for each of the above-listed barriers, including existing hourly Leq noise levels, the range of future hourly Leq noise levels without and with a barrier for the receivers at each location, approximate barrier length and average barrier height. The noise level reductions and the barrier dimensions as summarized in this table were then used to assess the feasibility and reasonableness of each barrier. Also indicated in the table is the corresponding figure number for each barrier, as shown in the Community Grid Noise Abatement figures in **Appendix H.** The modeling coordinates of all noise barriers evaluated for the Community Grid Alternative are presented in the Community Grid Noise Abatement tables in **Appendix H.**

Table 4.6.4-16
Community Grid Alternative: Results of Noise Barrier Modeling and Evaluation

Noise Barrier No.	Noise Abatement Figure Number in Appendix H	Range of Existing Leq (1hr) Noise Level	Range of Future Build Leq(1hr) Noise Levels, dB(A)		Barrier Characteristics	
			w/o Barrier	With Barrier	Approx. Length (ft)	Avg. Height (ft)
1	4	61-78	58-78	54-65	4154	12
2	4	61-76	61-76	55-65	2882	12
3	4	61-76	61-76	57-64	4670	14
4A	4	56-67	58-67	57-62	2746	18
4B	4	62-74	61-74	58-70	2082	12
5	5	66-67	65-68	59	2805	12
6	6	61-67	62-68	57-66	2070	20
7	7-8	59-74	61-76	57-71	2233	16
8	7-8	61-73	64-74	56-63	6389	12.85
9	9	62-69	63-70	57-64	1643	12
10	10	55-69	56-69	55-69	1146	20
11A	10	50-75	57-72	56-64	1156	20
11B	10	61-71	57-68	52-68	2137	18.77
11C/D	10	57-72	53-70	48-70	3645	20
11F	10	60-66	54-69	51-69	1827	20
12A	10	62-72	57-66	52-61	2539	18
12B	10	61-72	57-70	52-62	1772	16
12C	10	58-70	58-67	58-65	1011	19
13A/B/C	1&11	57-70	56-73	48-68	7360	20
13C (Part)	1&11	62-68	70-73	58-66	178	14
13D/E/F	11	61-71	65-72	59-67	4470	12
13G	11	58-72	65-72	60-64	1437	20
13H	11	59-75	65-75	63-67	1032	13
13I	11&12	59-72	63-73	58-66	3292	20
14	2	55-70	64-68	58-61	1078	14
15A&B	2	57-71	61-69	58-67	960	15
16	3	60-78	60-78	55-67	2000	16.4
17	3	63-69	63-69	56-67	2241	16

Notes:
Barrier 11C/D is a single barrier.
There is no Barrier 11E associated with the Community Grid Alternative.
Barriers 15A, 15B and 15C are three separate barriers comprising a single barrier system, although Barrier 15C was also studied as a stand-alone barrier.

For each of the above-listed barriers, an evaluation of feasibility and reasonableness was performed pursuant to the previously stated criteria. For each barrier evaluated, **Table 6.4.6-17** presents the total number of impacted and benefited receptors; the number and percentage of impacted receptors that achieve at least a 5 dB(A) reduction; the number of benefited receptors that achieve at least a 7 dB(A) reduction; total square footage of the barrier; square footage of the barrier per each benefited receptor; feasibility of the barrier; and reasonableness of the barrier.

As indicated in **Table 4.6.4-17**, of the 28 barriers and/or barrier systems evaluated for the Community Grid Alternative, only 12 would meet the criteria for both feasibility and reasonableness, and are therefore, recommended for construction as traffic noise abatement measures, contingent on the viewpoints of benefited receptors. These include Barriers 1, 2, 4B, 7, 8, 9, 11C/D, 12B, 13C (Partial), 13D/E/F, 13H and 14. All of these recommended barriers are located in areas where there would be at least 8, and up to 59, impacted receptors without the barriers in place and at least 7, and up to 91, benefited receptors that would experience a noise level reduction of 5 dB(A) or greater as a result of the barrier being in place.

At least 57 percent, and as much as 100 percent of the impacted receptors in each recommended location would receive a 5 dB(A) or greater reduction benefit, thereby meeting the feasibility requirement that such reduction be achieved by a majority of impacted receptors.

In terms of reasonableness, all of these recommended barriers would result in dimensions that allow the reasonableness threshold of a maximum of 2,000 square feet of wall per benefited receptor to be achieved. Also, all of these barriers would result in at least 50 percent of the benefited receptors achieving a 7 dB(A) reduction, with most of them resulting in close to 60 percent or more of the benefited receptors achieving a 7 dB(A) reduction.

The Downtown area of Syracuse with the Community Grid Alternative constructed would continue to consist mostly of city streets which are at grade with the adjacent land uses. The I-81 viaduct would be fully replaced by a widened and realigned Almond Street that would continue to be at-grade. Construction of noise barriers along Almond Street and other city streets that would be improved or would experience increased traffic as part of this alternative are determined to be not feasible and reasonable. Since barriers must be continuous and extend beyond the actual locations of impacted receptors in order to be effective, the presence of many cross streets through Downtown corridors prevent the ability to achieve this abatement design. In addition, if barriers were placed on city streets, visual and pedestrian access to and from city buildings, as well as vehicular access to driveways would be blocked.

Table 6.4.6-17
Community Grid Alternative: Noise Barrier Feasibility and Reasonableness

Noise Barrier	Total # of Impacts	Number of Attenuated Locations: Total No. of Benefited Receptors	≥ 5 dB(A) (Impacted Receptors) No.	≥ 5 dB(A) (Impacted Receptors) Percent	≥ 7 dB(A) (Benefitted Receptors) No.	≥ 7 dB(A) (Benefitted Receptors) Percent	Sq-ft of Modeled Noise Barrier	Sq-ft of Wall Per Benefited Receptor	Feasible? (Y/N)	Reason-Able? (Y/N)
1	59	91	58	98%	57	63%	49850	548	Y	Y
2	44	56	43	98%	33	59%	34588	618	Y	Y
3	20	23	19	95%	13	57%	65378	2843	Y	N
4A	4	10	4	100%	3	30%	49419	4942	Y	N
4B	16	14	13	81%	7	50%	24979	1784	Y	Y
5	5	5	5	100%	4	80%	33661	6732	Y	N
6	3	6	1	33%	0	0%	41394	6899	N	N
7	25	19	17	68%	14	74%	35725	1880	Y	Y
8	30	42	30	100%	28	67%	82136	1956	Y	Y
9	25	29	24	96%	20	69%	19721	680	Y	Y
10	9	0	0	0%	0	0%	22930	-	N	N
11A	4	6	4	100%	4	67%	23113	3852	Y	N
11B	4	6	0	0%	0	0%	40117	6686	N	N
11C/D	21	91	12	57%	50	55%	72906	801	Y	Y
11F	6	0	0	0%	0	0%	36542	-	N	N
12A	2	4	2	100%	3	75%	45695	11424	Y	N
12B	15	40	14	93%	26	65%	28298	707	Y	Y
12C	2	8	2	100%	2	25%	19201	2400	Y	N
13A/B/C	42	11	8	19%	9	82%	147203	13382	N	N
13C (Part.)	8	8	8	100%	6	75%	2491	311	Y	Y
13D/E/F	28	27	25	89%	17	63%	54120	2004	Y	Y
13G	12	7	7	58%	1	14%	28724	4103	Y	N
13H	8	7	7	88%	5	71%	13413	1916	Y	Y
13I	12	6	6	50%	6	100%	65839	10973	Y	N
14	10	10	9	90%	5	50%	15097	1510	Y	Y
15A& 15B	14	9	9	64%	4	44%	14069	1563	Y	N
16	9	11	8	89%	7	64%	32794	2981	Y	N
17	5	7	2	40%	0	0%	35856	5122	N	N

Note:
There is no Barrier 11E associated with the Community Grid Alternative.
Barriers indicated as ”Y” in the “Reasonable” column are contingent on the viewpoints of the benefited receptors.

Isolated groups of impacted receptors along the primary Project corridors were qualitatively assessed for reasonableness of abatement, rather than performing a quantitative noise barrier analysis. In accordance with NYSDOT Noise Policy, and as discussed previously, the constructed surface area of a proposed barrier must not exceed 2,000 square feet per benefited receptor for a noise barrier to be considered reasonable. In this regard, if a cluster of five residences exists in an area that is surrounded by non-sensitive land uses, a noise barrier could not exceed 12 feet in height and approximately 830 feet in length in order for it to be considered reasonable. Based on the noise barrier analysis which has been conducted at other locations, it is assumed with good engineering judgment that a barrier with such dimensions would not provide the necessary 5 dB(A) of reduction to all of the impacted residences in that cluster, nor would such a barrier provide 7 dB(A) of reduction to any benefited receptors. Therefore, wherever an isolated cluster of five or fewer receptors exists along a portion of highway, it is qualitatively concluded that a noise barrier would not be reasonable.

Construction Noise and Vibration Abatement

Abatement of construction noise related to detour traffic was considered. The construction detours would be in the downtown roadway network, which is generally not conducive to the main methods of traffic noise abatement (e.g., noise barriers, roadway realignment, or traffic management, such as speed adjustments). Speeds are generally reduced in areas of construction and detours due to posting or congestion. The construction-related reduction of traffic speeds would have the potential to slightly reduce traffic noise; however, these speed reductions probably would not result in noticeably lower noise levels. Generally, a 20+ mph reduction in speed is necessary for a noticeable decrease in noise levels. Therefore, speed limit reduction is not reasonable for abatement of construction detour traffic noise.

For abatement of construction equipment noise, noise abatement strategies would be included within the contract documents to the extent practicable. Potential noise abatement measures could include training programs for contractors, designated construction time periods, and designated haul roads in areas with fewer noise sensitive receivers. Where appropriate, the use of an alternative technology (such as a vibratory pile driver in place of an impact pile driver) could also be employed for impact equipment.

Additional potential abatement strategies could include:

- Source Control: Using exhaust systems in good working order, engine enclosures and intake silencers; conducting regular equipment maintenance; using new equipment subject to new product noise emission standards; installing aprons onto the equipment to provide shielding for frequently used equipment; and using dampeners to reduce noise levels due to vibrations from construction equipment;
- Site Control: Placing stationary equipment as far away from sensitive receivers as possible; providing full or partial enclosures for stationary equipment, such as compressors and generators; strategically choosing staging sites and construction and

demolition (C&D) disposal sites; and constructing temporary and/or movable shielding to act as noise barriers for construction operations;

- Time and Activity Constraints: Coordinating work operations to coincide with time periods when people would least likely be affected; and limiting work hours; and
- Community Awareness: Notifying the public of construction operations and methods.

The RCNM User's Guide provides a list of simplified shielding factors and accompanying noise reduction levels for construction equipment. The list of shielding factors that could apply to the construction of this Project includes:

- Noise barrier or other obstruction (such as a dirt mound) just barely breaks the line-of-sight between the noise source and the receiver - 3 dB(A) noise reduction
- Noise source is completely enclosed or completely shielded with a solid barrier located close to the source - 8 dB(A) noise reduction (enclosure and/or barrier has some gaps in it - 5 dB(A) noise reduction).
- Noise source is completely enclosed and completely shielded with a solid barrier located close to the source - 10 dB(A) noise reduction.
- Building stands between the noise source and receiver and completely shields the noise source - 15 dB(A) noise reduction.
- Noise source is enclosed or shielded with heavy vinyl noise curtain material (e.g., SoundSeal BBC-13-2" or equivalent) - 5 dB(A) noise reduction.

At each of the construction receiver sites for the Community Grid Alternative, physical features were identified, if present, that could help in reducing the noise levels due to construction equipment. For receiver sites A, B, C, D, and E, the locations are the same as in the Viaduct Alternative, therefore, any physical barriers in these areas would remain the same for the Community Grid Alternative. At receiver site F, there are various locations where there are embankments between the receiver and the construction site. These embankments could act as natural noise barriers, which would help in reducing noise levels during construction. Receiver site G is mostly flat and open; therefore, there are no natural barriers that could help in reducing noise levels.

Using the barriers currently in place (e.g., berms, retaining walls, elevation changes) and determining what pieces of construction equipment could be enclosed, shielding was applied under the RCNM analysis for each piece of equipment to predict whether there would be an overall reduction in noise levels. For the Community Grid Alternative, it was determined that stationary equipment, such as pumps, vibratory concrete mixers, jackhammers, welders/torches, and pneumatic tools, could be either partially or fully enclosed behind a noise barrier or an enclosure. For site B, construction equipment that was not stationary was given a shielding factor of 3 dB(A) because there is a natural barrier at site B that breaks the line-of-sight between the noise source and the receiver. Stationary equipment that needs less physical access would be able to be fully enclosed to allow for a higher shielding value. **Table 6.4.6-18** shows the noise level results in the Community Grid Alternative for construction equipment with and without shielding. The use of abatement measures at sites A, B, and C yielded predicted construction equipment noise levels below 80 dB(A). Sites F and G were already predicted below 80 dB(A) without shielding; however, with shielding, noise levels at sites F and G were reduced further by 3 dB(A) and 2 dB(A), respectively.

Table 6.4.6-18
RCNM Calculated Construction Noise Levels With Shielding for the Community Grid Alternative

Construction Receiver Site	Without Shielding (dB(A))	With Shielding (dB(A))
Site A	L_{max}= 76; L_{eq}= 81	L_{max}= 76; L_{eq}= 78
Site B	L_{max}= 78; L_{eq}= 84	L_{max}= 75; L_{eq}= 79
Site C	L_{max}= 77; L_{eq}= 82	L_{max}= 77; L_{eq}= 79
Site D	L_{max}= 78; L_{eq}= 83	L_{max}= 78; L_{eq}= 80
Site E	L_{max}= 84; L_{eq}= 89	L_{max}= 84; L_{eq}= 86
Site F	L_{max}= 72; L_{eq}= 77	L_{max}= 72; L_{eq}= 74
Site G	L_{max}= 75; L_{eq}= 79	L_{max}= 75; L_{eq}= 77

Notes:
L_{max} is the maximum sound level.
L_{eq} (equivalent sound level) is the sound pressure level equivalent to the total sound energy over a given period of time.
Sources:
Analysis performed using FHWA Roadway Construction Noise Model (FHWA RCNM) Version 1.1.

Construction Vibration

To abate the potential effects from construction vibration, a monitoring program would be developed by the Contractor. The program would include the following provisions.

- When pile driving would occur within 30 feet of a structure, a construction vibration-monitoring program would be implemented to determine whether construction vibration would exceed 0.50 inches per second. If the structure does experience PPV values in excess of 0.50 inches per second as a result of construction vibration, construction means and methods would be re-evaluated to avoid producing vibration at this level, unless an engineer's inspection of the building determines that the level of construction vibration at the building does not have the potential to result in damage.
- The Contractor would coordinate with the medical institutions and would make efforts to coordinate scheduling with the surrounding medical campuses to avoid vibration-producing construction activity during the most critical times for use of the medical facilities and minimize the potential for interference during those times.