

**Appendix 2.19-2**  
**Conceptual Noise Mitigation Plan**

### **2.19-2.1 INTRODUCTION**

This document presents, from a conceptual standpoint, the noise control measures that would be implemented by the New York City Department of Environmental Protection (DEP) and its contractors as part of Project 1 (Shaft and Bypass Tunnel Construction) and Project 2B (RWBT Connection and Repair, including Wawarsing) of the Delaware Aqueduct Rondout-West Branch Tunnel Repair (proposed program). A goal of this Conceptual Noise Mitigation Plan (CNMP) is to ensure that the proposed program's noise control measures are designed to decrease to the maximum extent practical the amount and duration of elevated noise levels at nearby sensitive receptors resulting from construction at both the west connection site (west of New York State Route 9W, approximately 1,100 feet north of Old Post Road in the Town of Newburgh, Orange County) and east connection site (DEP's Shaft 6 property located along River Road in the Town of Wappinger, Dutchess County).

A range of measures would be undertaken at both connection sites before and throughout construction for the proposed program. This CNMP outlines measures and procedures to consider and reduce potential noise impacts before the start of phases of construction; likely measures to control the noise resulting from construction, with a special focus on the most obtrusive construction noise sources and on the late-night construction shift, which would have the most potential to disturb sleep; and mechanisms in place to maintain oversight of noise control measures, ensure enforcement of noise mitigation plan requirements, regular reporting of plan implementation and procedures to address noise complaints from the affected communities during construction. As part of these procedures, the CNMP includes a noise monitoring program to enforce the effectiveness of the noise control measures.

The CNMP is organized as follows:

- Section 2.19-2.1.1 provides definitions for technical noise-related terms used in this document.
- Section 2.19-2.2 includes a description of the proposed program's construction, including locations, the anticipated phasing, work hours, and equipment expected to be used.
- Section 2.19-2.3 describes the noise reduction measures expected to be implemented as part of the construction program, including source controls, path controls, and receptor

controls as well as other logistical and scheduling measures designed to reduce the effects of noise generated by construction.

- Section 2.19-2.4 describes how this CNMP would be coordinated with the Traffic Management Plan for the construction of the proposed program.
- Section 2.19-2.5 describes a program of noise monitoring to be performed at each connection site during construction to continuously examine the amount of noise that would be generated by construction activities there.
- Section 2.19-2.6 describes the procedure that would be followed in responding to complaints about noise from construction at the west and east connection sites.
- Section 2.19-2.7 describes regular reports to DEP and the resident engineer regarding issues of construction noise that would be prepared and submitted by the contractors and subcontractors performing the construction work.

This CNMP outlines some of the noise mitigation and reduction measures that would be implemented during construction, and the objectives of the construction noise mitigation program. Depending upon the decisions of the board or department issuing approvals over the construction activities at the east and west connection site, a Site Plan CNMP may be required as a condition of site plan or other local approvals, which could contain additional details and refinements beyond those in this document. If required, the Site Plan CNMP for each connection site could cover all phases of construction. Noise control measures used successfully in each construction phase may be incorporated into the mitigation plans for subsequent phases where appropriate. However, before the start of any construction activity, detailed noise mitigation plans would need to be developed and initiated by the contractors and subcontractors who would perform the construction work. DEP would submit, as required, the detailed noise mitigation plans to the board or department issuing approvals over the construction activities at the east and west connection site. Each detailed noise mitigation plan would include specifics about construction equipment and logistics, evaluations of how noise would be minimized during the construction process, and explain the rationale for certain construction activities to be performed that may generate high levels of noise. The formulation of detailed noise mitigation plans will use an iterative approach. Evaluations of the success of noise control measures from the prior phases may be used to strengthen, clarify and streamline the mitigation plans for the subsequent phases. This process of developing and implementing detailed noise mitigation plans allows contractors to develop specific noise reduction measures to suit the needs of various construction activities as they arise. While some specifics would be required from its contractors, DEP would be committed to the elements that are outlined in this plan, and in the sections below, where it states “DEP will require” or the equivalent, are items that DEP commits to implementing as part of the proposed program.

Pursuant to NYC Administrative Code §24-216(b), Projects 1 and 2B will be performed in accordance with title 24, chapter 2 of the New York City Administrative Code (the Noise Control Code) and the New York City DEP Rules for Citywide Construction Noise Mitigation.

Conditions in the approvals of construction activities at the east and west connection sites shall also apply.

### **2.19-2.1.1. DEFINITION OF TERMS**

**“A” weighting**—The system of modifying measured sound pressure levels to simulate the actual response of the human ear to different sound frequencies.

**ambient noise level**—The sound level at a given location that exists as a result of the combined contribution in that location of all sound sources, excluding the contribution of a source or sources under investigation and excluding the contribution of extraneous sound sources. For purposes of the CNMP, the ambient sound level of a given location shall be determined prior to the commencement of construction activities.

**attenuation**—To reduce in level. Generally, noise from a point source (such as a single piece of equipment) attenuates at a rate of 6 dB for each doubling of distance from the source, and noise from a line source (such as a roadway) attenuates at a rate of 3 dB for each doubling of distance.

**CEQR**—City Environmental Quality Review, the local New York City law set forth by Executive Order No. 91 of 1977, governing environmental review for actions undertaken by New York City agencies.

**CEQR Technical Manual**—A guidance document in the procedures and substance of New York City’s environmental quality review process for use by government agencies, project sponsors, and the public.

**construction material**—Any material, regardless of composition, designed and customarily used in construction including but not limited to any rails, pillars, columns, beams, bricks, flooring, wall, ceiling or roofing material, gravel, sand, cement or asphalt.

**container**—Any receptacle, regardless of contents, manufactured from wood, metal, plastic, paper or any other material including but not limited to any barrel, basket, box, crate, tub, bottle, can, or refuse container.

**dB**—See *decibel*

**dBA**—A-weighted decibel. A sound pressure level that simulates the human ear’s sensitivity to pitch.

**decibel (dB)**—One-tenth of a bel. Thus, the decibel is a unit of level when the base of the logarithm is the tenth root of ten, and the quantities concerned are proportional to power.] The practical unit of measurement for sound pressure level; the number of decibels of a measured sound is equal to 20 times the logarithm to the base 10 of the ratio of the sound pressure to the pressure of a reference sound (20 micropascals); abbreviated “dB.”

**dynamic Insertion Loss**—The difference between two sound pressure levels that are measured at the same point in space before and after a muffler is inserted between the measurement point and the sound source under operating conditions as per §24-203[(cc)](29).

**extraneous sound**—Sound that is intense, intermittent, not representative of the relatively steady sound levels at a given location and not attributable to a source or sources under investigation for violation of this code. Such sound includes but is not limited to sirens of passing emergency vehicles, unusually loud motor vehicle braking (screeching) or exhaust noise, people shouting, animal vocalization, passing aircraft, horn honking, car door slamming and passing trains. Notwithstanding the foregoing provision, sounds that are individually persistent or controlling of the sound level at a given location shall not be considered to be extraneous sounds if they constitute more than 50 percent of the duration of an ambient or total sound level measurement such as for example the sound of a passing aircraft at a specific location if airplanes regularly pass over such location and the proximity of such passing aircraft to the location, its sound level, and the duration of such sound level, control the sound level at the given location at the time the sound source under investigation is being measured. For the purposes of the enforcement of this code, extraneous sounds are excluded when measuring the ambient sound level at a given location and when measuring the sound level of a source or sources under investigation for violation of this code except where such sounds are themselves under investigation for violation of this code.

**fast response mode**—The mode of operation for a sound level meter using a 0.125-second root-mean-square (RMS) detector, according to ANSI S1.4 standards.

**impulsive sound**—Sound that has short duration, with abrupt onset and short decay, and peaks lasting less than 1 second.

**$L_{eq}$** —The constant sound level in a given situation and period (e.g., 1 hour, denoted by  $L_{eq(1)}$ , or 24 hours, denoted by  $L_{eq(24)}$ ) that conveys the same sound energy as the actual time-varying sound.

**$L_{max}$** —The maximum instantaneous noise level measured during the measurement period.

**$L_x$** —The instantaneous noise level exceeded during x percent of the measurement period.

**New York City Department of Environmental Protection (DEP) Rules for Citywide Construction Noise Mitigation**—title 15, chapter 28 of the Rules and Regulations of the City of New York (RCNY) prescribes the methods, procedures, and technology that must be used at construction sites to achieve noise mitigation whenever any one or more of certain construction devices or activities set forth in §24-219 through §24-224 of the New York City Noise Control Code are employed or performed.

**New York City Noise Control Code**—title 24, chapter 2 of the New York City Administrative Code, as amended by Local Law 113 of 2005. Subchapter 4, entitled Construction Noise

Management contains certain rules for construction noise found at section §24-219 through section §24-224.

**noise absorptive quilt, or noise-insulating material**—A padded lightweight porous material sewn together into a quilt-like pattern and then attached to one side of a vinyl sheet as per §28-109.

**noise barrier**—A structure placed in proximity to a noise source to reduce the noise levels measureable at a receptor location; this can consist of noise-resistant materials, such as plywood, timbers, trailer containers, or noise curtains as per §28-109.

**noise curtain**—A noise control product, typically comprised of a ¼-inch thick vinyl sheet, to act as a noise-resistant material, with some noise-absorptive quilt material attached on one side of the vinyl as well as per §28-109.

**property line**—The line separating a parcel of land from an adjacent parcel or from the street.

**receptor also known as a receiving property**—Property, including but not limited to, buildings, grounds, offices, and dwelling units from which sound levels from sound sources outside such property may be measured as per §28-109.

**slow response mode**—The mode of operation for a sound level meter using a 1-second root-mean-square (RMS) detector, according to ANSI S1.4 standards.

**Sound Transmission Class, or STC rating**—The single index number used to describe a solid panel or material's ability to prevent noise from transferring directly through it, as per §28-109. Determination of a material's STC rating is done in accordance with the American Society for Testing and Materials (ASTM) Test Method E90.

**Total sound level**—The measured sound level that represents the combined sound level of the source or sources under investigation and the ambient sound level. Total sound level measurements shall exclude extraneous sound sources.

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## **2.19-2.2 DESCRIPTION OF CONSTRUCTION**

DEP plans to construct a new tunnel segment to bypass a leaking section of the existing RWBT tunnel; this new tunnel segment would be the *bypass tunnel*. It would be constructed between the west connection site and the east connection site. The Final Environmental Impact Statement (FEIS) for Project 1 includes analyses of construction noise at each connection site for the proposed program.

### **2.19-2.2.1 WEST CONNECTION SITE**

The west connection site is located in the Town of Newburgh in Orange County. The approximately 32.9-acre site comprises multiple parcels that have been or are in the process of being acquired by DEP: tax parcels 8-1-15.2, 15.3, 16, 17, and 19.1. The west connection site is

located on the west side of Route 9W approximately 1,100 feet north of Old Post Road. The site is steeply sloped, with a 200-foot elevation change between Route 9W and the western portion of the site. Most of the site is wooded and undeveloped, and a stream runs across part of the site. There are several vacant buildings on the eastern portion of the site, including a former restaurant and bar, and a single-family home with a barn, a cinderblock outbuilding, and several trailers. The western portion of the site contains a vacant single-family home and a shed.

The FEIS concluded that construction would result in predicted noise impacts at residences immediately south and northwest of the west connection site. Locations near the west connection site that were predicted to have the potential to experience interior  $L_{10}$  values resulting from construction greater than 45 dBA within a structure with an open window condition (which may be eligible for receptor mitigation) are shown in **Appendix Figure 2.19-1** appended to this CNMP.

#### ***2.19-2.2.1.1 CONTACT INFORMATION***

The point of contact for construction on the west connection site will be [NAME], who can be reached at [PHONE #].

#### ***2.19-2.2.1.2 CONSTRUCTION PHASING AND WORK HOURS***

Construction at the west connection site would likely be conducted in six phases: (1) Site Preparation, (2) Shaft Construction, (3) Bypass Tunnel Excavation, (4) Tunnel Lining, Project 1 Demobilization, and Preparation for Project 2B before the tunnel connection phase, (5) Project 2B – Tunnel Connection, and (6) Site Restoration and Operation. While the final construction schedule would be determined by the contractors and subcontractors who will do the construction work, the noise analysis was based on a preliminary construction schedule. The schedule information below for each phase is based on that preliminary schedule, and would be subject to change pending the final construction schedule.

The proposed program would be undertaken in two construction contracts, one of which covers phases 1 and 2, and the other of which covers phases 3 through 6. However, this CNMP would apply to all contractors and sub-contractors associated with either construction contract at the west connection site.

**Phase 1: Site Preparation** (January 2013 through February 2014)—The first phase of construction at the west connection site would consist of the demolition of certain on-site structures, the clearing and grading of a large portion of the site, and the construction of certain facilities in preparation for future construction phases, including a new site access road, a stormwater management system, and some of the infrastructure necessary for later construction phases. This phase would occur over the course of approximately 14 months and would be expected to be performed in two construction shifts (7 AM to 7 PM and 7 PM to 11 PM). One shift for the first and last 4 months and two shifts for 6 months were estimated for the site preparation phase, with some work required on Saturdays.

**Phase 2: Shaft Construction** (February 2014 through February 2015)—The second phase of construction at the west connection site would consist of the construction of a new shaft (Shaft 5B) on the site. This phase would occur over the course of approximately 13 months and would be performed in three 8-hour construction shifts (7 AM to 3 PM, 3 PM to 11 PM, and 11 PM to 7 AM).

**Phase 3: Bypass Tunnel Excavation** (March 2015 through September 2018)—The third phase of construction at the west connection site would consist of the construction of the bypass tunnel, a portion of the connector tunnel, and a portion of the inundation plug. This phase would occur over the course of approximately 43 months and would be performed in three 8-hour construction shifts (7 AM to 3 PM, 3 PM to 11 PM, and 11 PM to 7 AM), with the inundation plug work limited to 7 AM to 11 PM.

**Phase 4: Tunnel Lining, Project 1 Demobilization, and Preparation for Project 2B** (October 2018 through April 2020) —The fourth phase of construction at the west connection site would consist of two main efforts: (1) Bypass Tunnel Lining and (2) Demobilization and Preparation for Project 2B (Bypass Tunnel Connection, Inspection, and Repair). This phase would occur over the course of approximately 19 months and would be performed in three 8-hour construction shifts (7 AM to 3 PM, 3 PM to 11 PM, and 11 PM to 7 AM).

**Phase 5: Project 2B: Tunnel Connection** (May 2020 through December 2020 or as late as July 2021)—During Project 2B, the final connections between the connector tunnels and the existing aqueduct would be made. In addition, the inundation plugs and pump shafts would be completed if needed. This phase would occur over the course of approximately 8 months and would be performed in three 8-hour construction shifts (7 AM to 3 PM, 3 PM to 11 PM, and 11 PM to 7 AM), seven days per week.

**Phase 6: Site Restoration and Operation** (December 2020 or as late as July 2021 and ongoing)— Following the subsurface connection and reactivation of the Delaware Aqueduct, there would be some construction elements to complete at the surface of the west connection site. These would include final site restoration, cleanup and demobilization, which could take an additional four months to complete. Depending on the time of year after the bypass work is completed, plantings on the connection sites may have to be delayed until the appropriate season. Operation of the bypass tunnel would require very little activity at the west connection site. Very few additional workers or trucks would be required. Maintenance of the west connection site would generate only a minimal increase in on-site vehicular activity. These maintenance activities would include security inspections, maintenance of site landscaping, and annual visual inspections of the shaft.

#### **2.19-2.2.2. EAST CONNECTION SITE**

The east connection site is located in the Town of Wappinger in Dutchess County on the west side of River Road (Lot 6056-01-288977-0000). Owned by DEP, the approximately 20.1-acre



site is developed with a number of DEP facilities and offices related to the New York City water supply system, including the Shaft 6 superstructure, the Hudson River Pump Station, power supply facilities (substation), roads and parking areas, and stormwater infrastructure.

Construction at the east connection site would be performed in accordance with approvals from the Town of Wappinger.

The FEIS concluded that construction at the east connection site would result in predicted noise impacts at residences as shown in Figure 2.13-14. Locations near the east connection site that were predicted to have the potential to experience interior  $L_{10}$  values resulting from construction greater than 45 dBA within a structure with an open window condition (which may be eligible for receptor mitigation pursuant to qualifications noted in section 2.19-2.3.2 Receptor controls) are as shown in **Appendix Figure 2.13-2** appended to this CNMP.

#### ***2.19-2.2.2.1 CONTACT INFORMATION***

The point of contact for construction on the east connection site will be [NAME], who can be reached at [PHONE #].

#### ***2.19-2.2.2.2 CONSTRUCTION PHASING AND WORK HOURS***

Construction at the east connection site includes six phases: (1) Site Preparation, (2) Shaft Construction, (3) Bypass Tunnel Excavation, and (4) Tunnel Lining, as well as Project 1 Demobilization, and Preparation for Project 2B, before the connection phase, (5) Project 2B – Tunnel Connection, and (6) Site Restoration and Operation. While the final construction schedule would be determined by the contractor and subcontractors who will do the construction work, the noise analysis was based on a preliminary construction schedule. The schedule information below for each phase is based on that preliminary schedule, and would be subject to change pending the final construction schedule.

The proposed program would be undertaken in two construction contracts, one of which covers tasks 1 and 2, and the other of which covers tasks 3 through 6. However, this CNMP would apply to all contractors and sub-contractors associated with either construction contract at the west connection site.

**Phase 1: Site Preparation** (January 2013 through October 2013)—The first phase of construction at the east connection site would consist of the removal or relocation of certain buildings, trailers, and storage containers that would be on-site in connection with DEP's tunnel and shaft rehabilitation construction effort. In addition, certain facilities would be constructed in preparation for future construction phases. This phase would occur over the course of approximately 10 months and would be performed in a single 8-hour construction shift (7 AM to 3 PM).

**Phase 2: Shaft Construction** (July 2013 through May 2015)—The second phase of construction at the east connection site would consist of the construction of a new shaft (Shaft 6B) on the site.

This phase would occur over the course of approximately 23 months and would be performed in two 8-hour construction shifts (7 AM to 3 PM and 3 PM to 11 PM).

**Phase 3: Bypass Tunnel Excavation** (June 2015 through September 2018)—The third phase of construction at the east connection site would consist of three main efforts: the construction of the first part of a connector tunnel, the construction of the first part of an inundation plug, and the extraction of the tunnel boring machine (TBM). Construction of the connector tunnel and extraction of the TBM would occur over the course of approximately 3 out of the 40 months and would be performed in three 8-hour construction shifts (7 AM to 3 PM, 3 PM to 11 PM, and 11 PM to 7 AM) for the first month and final two months. Construction of the inundation plugs, throughout the rest of Phase 3 would be performed between the hours of at most 7 AM to 7 PM.

**Phase 4: Tunnel Lining, Project 1 Demobilization, and Preparation for Project 2B** (October 2018 through January 2019)—The fourth phase of construction at the east connection site would consist of two main efforts: (1) Bypass Tunnel Lining and (2) Demobilization and Preparation for Project 2B (Bypass Tunnel Connection, Inspection, and Repair). This phase would occur over the course of approximately 4 months and would be performed in three 8-hour construction shifts (7 AM to 3 PM, 3 PM to 11 PM, and 11 PM to 7 AM).

**Phase 5: Project 2B: Tunnel Connection** (May 2020 through December 2020 or as late as July 2021)—During Project 2B, the final connections between the connector tunnels and the existing aqueduct would be made. In addition, the inundation plugs and pump shafts would be completed if needed. This phase would occur over the course of between 6 and 15 months and would be performed in three 8-hour construction shifts (7 AM to 3 PM, 3 PM to 11 PM, and 11 PM to 7 AM).

**Phase 6: Site Restoration and Operation** (December 2020 or as late as July 2021 and ongoing)—Following the subsurface connection and reactivation of the Delaware Aqueduct, there would be some construction elements to complete at the surface of the east connection site. These would include final site restoration, cleanup and demobilization, which could take an additional four months to complete. Depending on the time of year after the bypass work is completed, plantings on the connection sites may have to be delayed until the appropriate season. Operation of the bypass tunnel would require very little activity at the east connection site. Very few additional workers or trucks would be required. Levels of activity at the east connection site would be similar to conditions at the site prior to the construction that is underway as part of the DEP's tunnel and shaft rehabilitation of Shaft 6 (this effort, which will improve DEP's capability to unwater the tunnel, is expected to be complete in 2013).

### **2.19-2.2.3. CONSTRUCTION NOISE SOURCES**

Construction activities for the proposed program would result in increased noise levels caused by: (1) the operation of construction equipment on each connection site, including construction-related trucks, and (2) the movement of construction-related vehicles (i.e., worker trips, and

material and equipment trips) on the surrounding roadways adjacent to the connection sites during construction. The noise emission levels of typical construction equipment likely to be used as either part of the construction of the proposed program are shown below in **Appendix Table 2.19-2-1**.

**Appendix Table 2.19-2-1  
Construction Equipment Noise Emission Levels**

<b>Construction Equipment</b>	<b>L<sub>max</sub> Noise Level at 50 Feet (dBA)</b>
Backhoe	80
Chipper	88 <sup>2</sup>
Compressors	58 <sup>1</sup>
Concrete Batch Plant	83
Concrete Mixer Truck	85
Concrete Pump	82
Crane	85
Crane (shaft crane)	71 <sup>2</sup>
Bulldozer	85
Drill Jumbo	91 <sup>2</sup>
Drill Rig Truck	84
Drum Mixer	80
Dump Truck	84
Excavator	85
Fuel Truck (flatbed truck)	84
Forklift	64 <sup>2</sup>
Front End Loader	80
Generator	65 <sup>2</sup>
Grader	85
Impact Pile Driver	82 <sup>2</sup>
Lift	85
Paver	82
Pickup Truck	55
Power Plant	77 <sup>2</sup>
Pump	77
Rock Crusher	91 <sup>2</sup>
Roller/Compactor	85
Shaft Jumbo	93 <sup>2</sup>
Tractor Trailer	84
Ventilation System	82 <sup>2</sup>
Vibratory Sheeting Driver	95
Water Jet	78
Welder/Torch	73
Winch	70 <sup>2</sup>
<b>Notes:</b> <sup>1</sup> Level mandated by New York City Noise Code. <sup>2</sup> Level supplied by vendor information. <b>Sources:</b> Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006, and Federal Highway Administration Roadway Construction Noise Model (FHWA RCNM), 2006.	

**2.19-2.3 NOISE REDUCTION MEASURES**

A variety of noise reduction measures would be incorporated into the construction of the proposed program. Contractors and subcontractors would be required to provide specific noise reduction measures as applied to specific construction equipment and activities, and these measures would be described in detailed noise mitigation plans and regular reports to DEP and

the resident engineer (the likely content of regular reports regarding the implementation of the CNMP are provided at the end of the CNMP). While these specific noise reduction measures are dependent on details of construction program that have not yet been established, this CNMP describes the process by which the contractors and subcontractors would develop and report detailed noise mitigation plans, including detailed noise reduction measures. This process would attempt to proactively reduce noise levels due to construction, while also offering the flexibility to address noise issues as construction progresses and develops. Additionally, there are some specific noise reduction measures—including source controls, path controls, and receptor controls—that would definitely be implemented, and these measures are described in this CNMP.

### **2.19-2.3.1. SPECIFIC NOISE REDUCTION MEASURES AND DETAILED NOISE MITIGATION PLANS**

Contractors and subcontractors would be required to anticipate potential construction noise issues and identify solutions before new construction activities start at each connection site and as construction progresses. Specifically, contractors and subcontractors would be required to:

- Identify the loudest activities and pieces of construction equipment at the start of each new construction task and identify what measures (beyond those in this document) could be used to reduce noise from these activities or pieces of equipment.
- Determine the potential layout of equipment on the connection sites and consider whether noisy construction equipment could be located further from nearby sensitive receptors.
- Identify any equipment that is stationary or operates in a single location when on-site (e.g., drum mixers, concrete mixing trucks) and, if feasible and practicable, place this equipment behind temporary portable noise barriers.
- Determine the hours when various construction equipment would operate and tasks be conducted (including off-site truck trips), and consider whether noisy equipment or activities could be restricted to daytime working hours (7 AM to 7 PM).

Based on the above, DEP and the resident engineer would review logistical concerns and recommendations and give approval before the implementation of the individual construction tasks.

### **2.19-2.3.2. RECEPTOR CONTROLS**

Receptor controls (noise reduction methods implemented at the receptor itself) would be available to residents predicted to experience significant adverse impacts in certain circumstances. DEP will make the following measures available to residences contained within the attached figures as a result of construction at the proposed program:

- Re-caulking and re-sealing of existing windows and air-conditioning louvers with a line of sight to the east or west connection site.

- Installation of storm windows in existing window openings at bedrooms with a line of sight to the east or west connection site, if required.
- Provision of window air-conditioner units for bedrooms with a line of sight to the east or west connection site, if required.

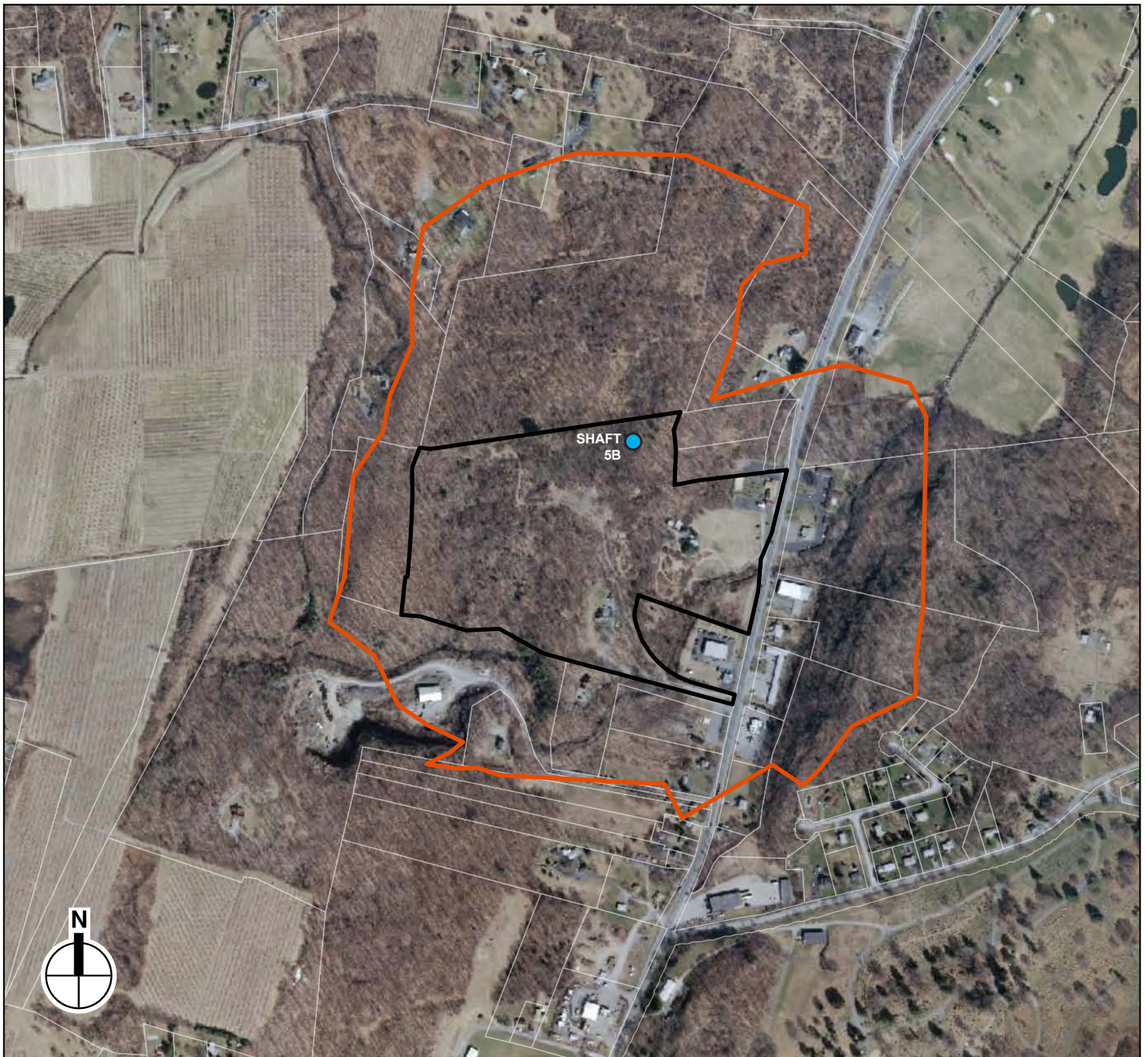
Residences would only be eligible to receive the above receptor controls if all of the following conditions are met:

- The residence is predicted in the FEIS to experience interior  $L_{10}$  values exceeding 45 dBA or shown by measurements during the construction period to experience interior  $L_{10}$  values exceeding 45 dBA as a result of the project construction (as shown in **Appendix Figure 2.19-2-1** and **Appendix Figure 2.19-2-2**; and
- The residence does not already have well-sealed double-glazed windows and air-conditioning in potentially impacted living spaces before construction starts in 2013.



### **2.19-2.3.3. SOURCE CONTROLS**

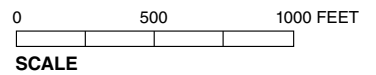
The following types of source control (methods to reduce noise levels at the noise source) measures would be required for the propose program construction:

- DEP will require that noise emission levels of construction equipment operating at the surface on either connection site meet the mandated New York City Noise Control Code levels, and not to exceed the noise emission levels shown in Appendix Table 2.19-2-1.
- DEP will require that contractors submit their equipment lists and requested hours of use for each piece of equipment along with a justification for the use of any potentially loud equipment during the night-time hours (7 PM to 7 AM).
- DEP will require that trucks not be allowed to idle more than 5 minutes at the construction site, except as allowed by New York State's Heavy Duty Vehicle Idling Laws.
- Contractors would limit the operational equipment on-site to only that necessary for construction.
- Contractors and subcontractors would be required to properly maintain their equipment and have quality mufflers installed.
- Where practicable and feasible, particularly noisy equipment would be fitted with additional noise control measures, including silencers or mufflers on equipment exhausts, and/or shrouds or wraps on equipment engines or motors.
- DEP will require that, where practicable and feasible, during the third construction shift (11 PM to 7 AM), the only trucks that would leave or enter the east connection site would be concrete trucks.
- Construction-related vehicles containing a compression brake system or systems (e.g., jake brakes) would not be permitted to use their compression brakes while operating on a



**Legend**

-  West Shaft Site
-  Receptor Control Area

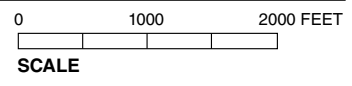


This Figure is New to the FEIS

Appendix Figure 2.19-2-1  
**West Connection Site  
Receptor Control Area**



- East Shaft Site
- Receptor Control Area



This Figure is New to the FEIS

Appendix Figure 2.19-2-2

### East Connection Site Receptor Control Area

public road or right-of-way in the Towns of Newburgh and Wappinger, except under emergency conditions.

- Contractors will be required to comply with signage posted on local roads in the Town of Wappinger used to access and depart the east connection site by the project's construction truck traffic
- DEP will require that, where practicable and feasible and as allowed by applicable laws and regulations, backup alarm noise on the connection sites would be minimized. In particular, equipment stationed on the east or west connection sites would utilize quieter backup alarms, including backup alarms that allow manual adjustment of the volume of the alarm and/or white noise backup alarms (as opposed to tonal alarms).
- DEP will require that dump trucks, muck bins, and other containers used to transport soil or rock to, from, or around either the west or east connection sites be outfitted with rubberized liners to reduce the amount of noise generated from materials being loaded into the containers.

#### **2.19-2.3.4. PATH CONTROLS**

The following path controls (methods to reduce noise by increasing the distance or placing an obstacle that would have a material effect on reducing off-site noise levels between the source and receptor), which go beyond typical construction techniques, would be required based on the commitments made in the FEIS and the site plans for each connection site:

- In addition to the source controls described above, where practicable and feasible, particularly noisy equipment, such as generators, cranes, trailers, concrete pumps, concrete trucks, and dump trucks, would be shielded and positioned away from sensitive receptor locations.
- Contractors and subcontractors would be required to identify the loudest pieces of construction equipment at the start of each new construction task and identify potential locations for such equipment and whether it would be possible for the equipment to be located farther from nearby sensitive receptors.
- At the east connection site, DEP will require that double-stacked Conex trailer barriers be installed to provide a 16-foot noise barrier immediately east of the Shaft 6B location. Any gaps between the Conex trailers would be filled with noise curtain material. These Conex trailer barriers would remain in place throughout construction at the east connection site (see Appendix Figure 2.19-2-3).
- At the east connection site, DEP will require that noise barriers be installed along the northern property line (except where there are already Conex trailer barriers), eastern property line (except for the driveway entrance at the southeastern corner of the site), and southern property line. These noise barriers would remain in place throughout construction at the east connection site (see Appendix Figure 2.19-2-3).



- At the east connection site, DEP will require that an additional noise barrier south of the Shaft 6 parking lot parallel to the southern property line. This noise barrier would remain in place throughout construction at the east connection site (see Appendix Figure 2.19-2-3).
- At the east connection site, DEP will require that an additional noise barrier extending from the eastern end of the Conex trailer barriers parallel to the northern property line to the eastern edge of the Shaft 6 parking lot and then turning south parallel to the eastern property line until a point behind the Shaft 6 superstructure building. This noise barrier would remain in place throughout construction at the east connection site (see Appendix Figure 2.19-2-3).
- All noise barriers would be constructed in compliance with NYC building codes.
- All noise barriers, with the exception of the Conex trailer barriers, would be constructed at a height of 12 feet, have a Sound Transmission Class (STC) of at least 30, and a Noise Reduction Class (NRC) of at least 0.85 as described in the DEP Rules for Citywide Noise Mitigation. Contractors and sub-contractors would be required to provide documentation that barriers other than the Conex trailer barriers meet these STC and NRC requirements.
- All noise barriers would be maintained such that they are free of gaps and maintain a clean appearance.

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#### **2.19-2.4 COORDINATION WITH TRAFFIC MANAGEMENT PLAN**

In addition to the mitigation measures presented in the FEIS, the following measures would be part of an overall Traffic Management Plan (TMP):

- DEP resident engineers and public liaison contacts would be assigned to the entire construction period of the proposed program. The contact information would be made available to all stakeholders in the area and posted on the construction signs in front.
- DEP would inform the pertinent stakeholders of the time and dates of any exceptional truck activity (oversized/weight transport of loads) and coordinate with the appropriate entities to ensure safe and efficient traffic operating conditions on the roadways in the area. Coordination typically would involve the following measures:
  - The development of Work Zone Traffic Control Plans (WZTCPs) to be implemented by the contractor with the approval of, and in coordination with, governing roadway agencies at locations where it may be necessary. This would include any type of constrained truck maneuvers as well as the temporary use of flagmen and various traffic control devices (standard signs, variable message signs, traffic cones, etc.). The contractor's construction health and safety plans would be required to provide visual assistance for any off-site truck turnarounds in the east of Hudson study area.



- Project Site Boundary
- A ●** Noise Monitoring Location
- Barrier
- - - - Conex Boxes
- - - - Adjacent Property Owners



This Figure is New to the FEIS

Appendix Figure 2.19-2-3

### Conceptual Noise Mitigation

- Coordination with the Marlboro Central School District and Newburgh Enlarged City School District, Wappinger Central School District, and Dutchess Stadium. DEP has met with school district officials and has obtained existing information regarding bus routes, bus stop locations, bus operating hours, and school locations. DEP has committed to coordinate with the district regularly as mentioned above, via the liaison contacts (on the phone, by e-mail, and in person whenever necessary), to inform them of any operations that would potentially require coordination with construction activity and school bus operations.
- Coordination with the Town of Newburgh officials, the New York State Police, Orange County Sheriff's Office, and the Town of Newburgh Police would also be part of the TMP.

In addition to these measures, traffic associated with each upcoming construction task would be examined to determine whether there would be a way to alter the schedule or route of the traffic to reduce the amount of noise generated at sensitive receptors by off-site traffic trips. For instance, truck trips that might occur between the hours of 11 PM and 7 AM would be avoided wherever possible to minimize the amount of noise generated at off-site locations during these most sensitive of hours.

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## **2.19-2.5 NOISE MONITORING PROGRAM**

DEP will require that the construction manager, working with the contractors and subcontractors, measure the  $L_{max}$  in dBA at a distance of 50 feet for each piece of equipment and log the results in order to demonstrate compliance with equipment limits immediately upon the equipment's arrival on one of the sites. This requirement applies to both connection sites. Throughout construction at both sites, DEP will require that continuous noise monitoring be performed to determine and record the amount of noise generated by construction activities. While the construction manager would perform the noise monitoring, a contractor or contractors would be responsible for providing and installing the noise monitoring equipment. The noise monitoring program would include measurements performed before the start of construction to determine the baseline noise levels at the monitoring locations.

### **2.19-2.5.1. NOISE MONITORING LOCATIONS**

#### **2.19-2.5.1.1 WEST CONNECTION SITE**

The nearest residences to the west connection site include:

- 95 Lockwood Lane, 430 feet from the property line of the west connection site;
- 8 Pine Drive, 430 feet from the property line of the west connection site;
- 69 Lockwood Lane, 714 feet from the property line of the east connection site; and

- 65 Lockwood Lane, 1,000 feet from the property line of the east connection site.

Noise monitoring would be performed at four locations along west connection site property line. These locations are representative of the nearest residences to the west connection site and directions in which sound may travel from the west connection site towards these residences and other residences in the area (see Appendix Figure 2.19-2-4):

- Location A is located along the west connection site northern property line adjacent to 95 Lockwood Lane.
- Location B is located along the west connection site southern property line adjacent to 8 Pine Road.
- Location C is located along the west connection site eastern property line.

Location A is set back approximately 1500 feet from Route 9W, location B is set back approximately 1,000 feet from Route 9W, and location C is set back approximately 10 feet from Route 9W.

At each west connection site monitoring location, monitoring would be performed at a height of 5 feet above grade.

#### ***2.19-2.5.1.2 EAST CONNECTION SITE***

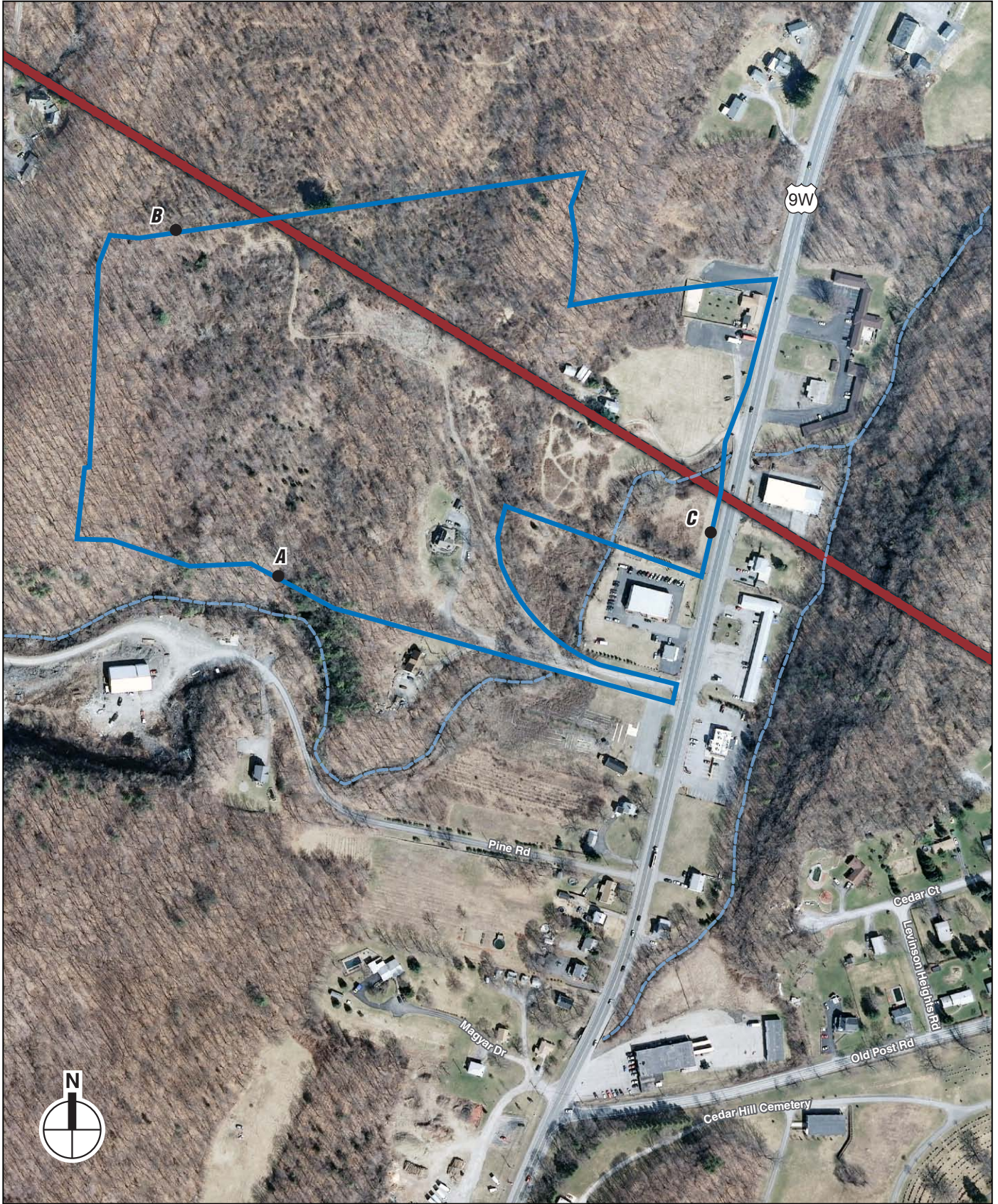
The four nearest residences to the east connection site include:

- 191 River Road North, 39 feet from the property line of the east connection site;
- 198 River Road North, 121 feet from the property line of the east connection site;
- 217 River Road North, 177 feet from the property line of the east connection site; and
- 219 River Road North, 48 feet from the property line of the east connection site.

Noise monitoring would be performed at four locations along the Shaft 6 property line. These locations are representative of the nearest residences to the east connection site and directions in which sound may travel from the east connection site towards these residences and other residences in the area (see Appendix Figure 2.19-2-3):

- Location A is located along Shaft 6 southern property line adjacent to 191 River Road North.
- Location B is located along Shaft 6 eastern property line adjacent to 198 River Road North.
- Location C is located along Shaft 6 northern property line adjacent to 217 River Road North.
- Location D is located along Shaft 6 northeastern property line adjacent to the Shaft 6B location.

Location A is set back 141 feet from River Road North, location B is set back 8 feet from River Road North, location C is set back 157 feet from River Road North, and location D is set back 479 feet from River Road North.



 Delaware Aqueduct Rondout-West Branch Tunnel

 West Connection Site

**A ●** Noise Monitoring Location

0 200 400 FEET  
SCALE

This Figure is New to the FEIS

**Delaware Aqueduct** Rondout-West Branch Tunnel Repair Project

Appendix Figure 2.19-2-4  
**West Connection Site  
Conceptual Mitigation**

At each east connection site monitoring location, monitoring would be performed both above the height of the site-boundary barrier (at a height of 13 feet above grade for sites A through C, and 17 feet above grade for site D) and a height of five feet above grade inside the site-boundary barrier. The monitoring performed above the height of the site-boundary barriers would be representative of a second story window in a residence immediately adjacent to the east connection site, although it may include noise from non-construction sources located outside the east connection site. The monitoring performed at-grade inside the site-boundary barriers would measure all on-site construction noise, and be shielded from off-site non-construction sources, although it would not demonstrate the benefit of the site-boundary barriers. Together, measurements at both the elevated and at-grade locations would provide a more complete assessment of noise generated by construction at the east connection site.

### **2.19-2.5.2. NOISE MONITORING METHDOLOGY**

#### **2.19-2.5.2.1 BASELINE NOISE MEASUREMENTS**

Baseline noise measurements near the connection sites were performed as part of the construction noise analysis for the proposed program in the Draft Environmental Impact Statement (DEIS) for Project 1 and supplemented with additional baseline noise measurements for the FEIS. These baseline noise measurements included continuous and spot measurements at various locations in the vicinity of the east and west connection sites as well as expected traffic routes to and from the sites. The results of these measurements, as described in the DEIS, served as a baseline for determining construction noise impacts.

As part of the ambient noise monitoring program to be performed during construction, additional baseline noise measurements would be performed near the east connection site to gather additional baseline noise level data at the noise monitoring locations. This additional ambient noise monitoring would be performed at the noise monitoring locations described above. This data would aid in establishing a level for comparison for the levels measured during construction. It would also be used in determining thresholds of concern for the construction noise monitoring and a threshold for automatic audio recording during the construction noise monitoring.

Measurements would be performed at the noise monitoring locations described above before the start of construction to establish baseline noise levels against which the construction noise levels would be compared. At each noise monitoring location, noise levels would be measured for a full week before the start of construction. The following continuous measurement procedure would be used:

- Calibrate noise meter at the beginning of the noise monitoring period.
- Annotate site-specific information, such as location, weather conditions, direction of traffic, and distance of microphone to curb or nearest traffic lane.

- Begin  $L_{eq}$ ,  $L_{10}$  and  $L_{max}$  noise measurements, with automatic data logging at 60-minute intervals (the meter operated unattended for the measurement period).
- Set a threshold for automatic audio recording so that events resulting in elevated noise levels would be recorded and can be identified. The threshold would be set based on observations of noise-generating events in the area as well as previously collected noise data.
- Perform calibration check at the end of the noise monitoring period.

As recommended by the *2012 CEQR Technical Manual*, noise monitoring would not be performed when:

- Area pavement is not generally dry;
- Winds are greater than 12 miles per hour;
- Relative humidity exceeds 90 percent; and
- There is extraneous noise, such as that caused by sirens or horn honking

However, since noise monitoring would last over an extended period, it would not be unusual for any of the conditions above to occur temporarily. Where appropriate, data would be excluded if it included any of these conditions as shown by a visual inspection or meteorological data collection service.

#### ***2.19-2.5.2.2 NOISE MONITORING DURING CONSTRUCTION***

During construction at the east connection site, noise would be continuously monitored at locations described above. The following continuous measurement procedure would be used:

- Calibrate noise meter at the beginning of the noise monitoring period and at a regular period not exceeding one week.
- Begin  $L_{eq}$ ,  $L_{10}$  and  $L_{max}$  noise measurements, with automatic data logging at 60-minute intervals (the meter operated unattended for the measurement period).
- Set a threshold for automatic audio recording so that events resulting in elevated noise levels would be recorded and can be identified.
- Perform calibration check at the end of the noise monitoring period.

The results of the monitored data would be reviewed by DEP and the resident engineer on a daily basis when exceedances of monitoring thresholds are recorded. Monitored noise data would not be considered applicable if it was collected under any of the following conditions as shown by audio data, a visual inspection, or meteorological data collection service:

- Area pavement is not generally dry;
- Winds are greater than 12 miles per hour;
- Relative humidity exceeds 90 percent; and

- There is extraneous, such as that caused by sirens or horn honking.

#### **2.19-2.5.2.3 NOISE MONITORING EQUIPMENT**

All noise measurements would be performed with an instrument that meets the criteria for a Type 1 (Precision) Sound Level Meter (SLM), as defined in American National Standard Institute (ANSI) Standard S1.4. The sound level meter would be capable of measuring  $L_{eq}$ ,  $L_1$ ,  $L_{10}$ ,  $L_{50}$ ,  $L_{90}$ ,  $L_{min}$ , and  $L_{max}$  in dBA noise levels and collect data on both the “slow” and “fast” response settings. All sound level meters, microphones, and calibrators proposed for use would undergo certified laboratory calibration testing prior to use and be field calibrated on a regular basis during the construction period. Housing of instruments would be required to be protected from weather and tampering. Daily information from recordings would be available for review by DEP’s construction management team. The SLMs will have the capability to automatically record audio upon the exceedance of a pre-determined noise level threshold (based on the thresholds discussed in the next section) to assist in identifying the noise source and whether they are likely related to the construction of the proposed program. Windscreens would be used during all sound measurements except for calibration. All measurement procedures would conform to the requirements of ANSI Standard S1.13-2005.

#### **2.19-2.5.2.4 CONSTRUCTION NOISE THRESHOLDS FOR ADDITIONAL MITIGATION**

This section establishes thresholds for construction noise that would constitute cause to examine additional noise control measures or enforcement of measures expected to be implemented under the noise mitigation plan. These are based on the results of the construction noise modeling performed in the Environmental Impact Statement (EIS) for the program as well as the New York City Noise Control Code, which deals with prohibited noise from construction related sources in section §24-228. These thresholds are consistent with the results of presented in the FEIS and with areas eligible for receptor controls shown in Appendix Figure 2.19-2-1 and 2.19-2-2, as they are based on the same input assumptions to the noise prediction model.

While the thresholds described in this section would represent the maximum allowable noise levels at these locations, when contractors and sub-contractors develop their Detailed Noise Mitigation Plans, they would endeavor, where practicable and feasible, to establish lower noise thresholds.

#### ***Construction Noise Thresholds Based on Noise Modeling ( $L_{eq}$ threshold)***

##### **West Connection Site**

*All times:* The  $L_{eq(1h)}$  is not to exceed 85 dBA or 5 dBA above the measured ambient sound level  $L_{eq}$  for this time period, whichever is greater.

It should be noted that, though the property line limit for the west connection site is relatively high, the nearest sensitive receptors are located a great distance away from the west connection



site property line and would consequently experience substantially lower noise levels, and would experience interior  $L_{10}$  levels less than 45 dBA.

### **East Connection Site**

#### **Project 1**

*7 AM to 7 PM:* The  $L_{eq(1h)}$  is not to exceed 75 dBA or 5 dBA above the measured ambient sound level  $L_{eq}$  for this time period, whichever is greater at sites A, B, and C and 86 dBA or 5 dBA above the measured ambient sound level  $L_{eq}$  for this time period, whichever is greater at site D.

*7 PM to 11 PM:* The  $L_{eq(1h)}$  is not to exceed 71 dBA or 5 dBA above the measured ambient sound level  $L_{eq}$  for this time period, whichever is greater at sites A, B, and C and 86 dBA or 5 dBA above the measured ambient sound level  $L_{eq}$  for this time period, whichever is greater at site D.

*11 PM to 7 AM:* The  $L_{eq(1h)}$  is not to exceed 68 dBA or 5 dBA above the measured ambient sound level  $L_{eq}$  for this time period, whichever is greater at sites A, B, and C and 84 dBA or 5 dBA above the measured ambient sound level  $L_{eq}$  for this time period, whichever is greater at site D.

#### **Project 2B**

*All times:* The  $L_{eq(1h)}$  is not to exceed 75 dBA or 5 dBA above the measured ambient sound level  $L_{eq}$  for this time period, whichever is greater at sites A, B, and C and 86 dBA or 5 dBA above the measured ambient sound level  $L_{eq}$  for this time period, whichever is greater at site D.

### ***Construction Noise Thresholds Based on NYC Noise Code ( $L_{max}$ Threshold)***

#### ***§24-228 (1) Non-Impulsive Construction Activities***

Not to exceed 85 dBA ( $L_{max}$ , “slow” response) at 50 feet or more from the source(s) at: (a) a point outside the property line where the source(s) are located or (b) as measured 50 feet or more from the source(s) on a public right-of-way.

#### ***§24-228 (2) Impulsive Construction Activities***

Not to exceed 15 dBA ( $L_{max}$ , “fast” response) or more above the ambient sound level (dBA, “slow” response) as measured: (a) at any point within a receiving property or (b) as measured at a distance of 15 feet or more from the source(s) on a public right-of-way.

Consequently, the following thresholds would constitute cause for the examination of additional noise control measures or enforcement of measures expected to be implemented under the noise mitigation plan:

- For non-impulsive sound attributable to construction, a level of 85 dBA or more ( $L_{max}$ , “slow” response) at any of the noise monitoring locations.
- For impulsive sound attributable to construction, a level that exceeds the ambient by 15 dBA ( $L_{max}$ , “fast” response) at any of the noise monitoring locations (with the ambient

level at each location being established from the baseline levels performed before construction begins).

Near the east connection site, the  $L_{eq}$  and  $L_{max}$  thresholds would apply to the elevated noise measurements at noise monitoring locations A through D, since those elevated measurement points are at the east connection site property line. The at-grade measurements at noise monitoring locations A through D would be inside the east connection site property line, so the above thresholds would not apply. However, they would be considered representative of the amount of construction noise that would reach an at-grade location outside the east connection site property line without the benefit of the site-boundary barriers. The site-boundary barriers can be expected to provide up to 10 dBA of shielding for at-grade receptors depending on the specific configuration of construction equipment, so the above noise level thresholds can be applied to the at-grade measurements at noise monitoring locations A through D, once 10 dBA has been subtracted from the measured levels to account for the site-boundary barriers when evaluating effect to receptors near the barriers.

Near the west connection site, the above  $L_{eq}$  and  $L_{max}$  thresholds would apply to the elevated noise measurements at noise monitoring locations A through C.

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### **2.19-2.6      RESPONDING TO NOISE COMPLAINTS**

In consultation with the local Town representatives, a series of procedures would be developed to log and address noise complaints received during construction of the proposed program. While the methods to respond to noise complaints will be developed at a later date, it is likely they would include a rigorous set of procedures, including the following (or similar) elements.

A single point of contact and mechanisms (e.g., phone call or email) to report noise complaints would be identified. A standardized form of recording the type of complaint would be developed to ensure an understanding of the type/nature of the complaint can be recorded.

Upon receipt of complaints, DEP would have the ability to correlate the time/date/nature of the complaint with recorded noise monitoring levels and activities on the applicable connection site. DEP would undertake evaluation of whether the complaints were a result of on-site construction related activities, and whether the noise impacts from such activities could be reduced.

Noise complaints resulting from construction related activities would be investigated by DEP, in collaboration with the construction management staff, immediately, and the contractor would be notified as necessary. Such investigations would include interior measurements at the complainant's residence if appropriate and requested. If noise levels are found to be in excess of the applicable limits, contractors would have a cure period to present and implement a plan for additional mitigation to eliminate the noise level exceedances to DEP and the DEP resident engineer. This cure period would be established in consultation with the contractor upon selection. The period would be set to the minimal period necessary to develop and implement control measures. If, after that period, the noise level exceedance persists, the construction

activity or equipment that causes the exceedance would be discontinued until all steps that could be undertaken to eliminate the noise level exceedance have been implemented or demonstrated.

If off-site noise complaints due to vehicular traffic are identified, DEP would coordinate with the DEP resident engineer responsible for the Traffic Management Plan to determine if such noise complaints may have been related to construction activities at the nearby connection site, and whether procedures were followed or need to be revised to reduce such off-site impacts.

Results of noise complaints and procedures to identify if related to construction of the proposed program and actions undertaken to reduce noise impacts on the affected community would be included in the reporting during construction (see next section).

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### **2.19-2.7 REPORTING DURING CONSTRUCTION**

The construction manager would be responsible for monthly reports submitted to DEP and the resident engineer on the implementation of the CNMP for the west and east connection sites, based on information provided by the contractor or sub-contractors. These reports would include a summary of the CNMP implementation including noise source evaluations, control measures and monitoring results as applicable. Noise complaints and follow up undertaken to address such would be included. Planned changes in next month's construction activities, work hours and noise control measures would be included, along with evaluations of required changes in 24 hour work activities. In addition, these reports will be made public on DEP's forthcoming the Water for the Future website on a regular basis.

Below is a possible Table of Contents for such reporting:

- 1) Noise Source/Control/Monitoring
- 2) Noise Complaints
- 3) Planned Changes in Next Month's Activities
  - a) Noisiest sources
  - b) Construction site layout
  - c) Stationary equipment
- 4) Planned Changes in Noise Reduction Measures
  - a) Source controls
  - b) Path controls
- 5) Upcoming Requirements / Changes Related to 24-hour Work
- 6) Upcoming Requirements for Truck Trips Between (11 PM and 7 AM)
- 7) Upcoming Requirements for Weekend Construction Work and Truck Traffic

In addition to reports as described above, DEP and a representative from the Construction Management Staff will attend meetings as requested by the local towns issuing approvals over the construction activities at the east and west connection to discuss issues. The changes and clarifications to the Noise Mitigation Plan will be incorporated as necessary and appropriate based upon the experiences of the project as it proceeds. \*

**Attachment 1 to Appendix 2.19-2**

**Croton Water Treatment Plant,  
Measured Noise Attenuation from Conex Containers**

### Croton WTP, Monitoring Point behind Container, Construction Noise Readings

Date: 3/22/05

Max Leq (60), dBA = 65.8

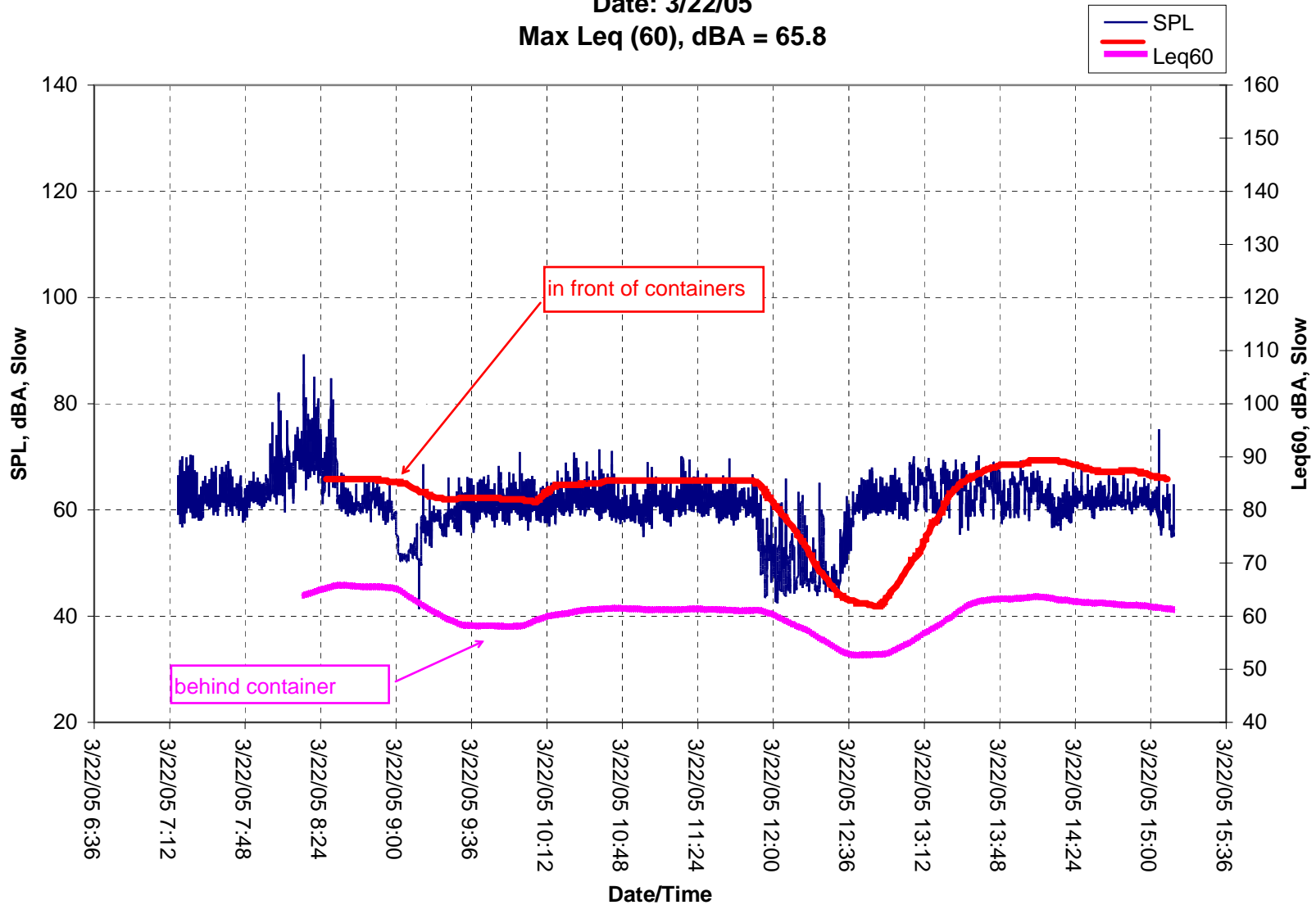


Figure 4 : Noise Attenuation Results

of the noise monitoring and distances from the source are given in figure 1. Details of the testing and results from the testing are detailed in figure 4.

The maximum  $Leq(60)$  obtained was 81.3dBA (50 feet from the machine), while at monitoring location MGC-S1 for the same period the maximum  $Leq(60)$  obtained was 66.3dBA. The usage factor of 60% was used based upon working at full power for 40 minutes in the hour, for a period of 7 hours out of an 8 hour work day.

Over a distance of 130feet, using a 60% usage factor, together with a G factor of 0.29 the expected noise recording at S1 would be 77.3dBA.

The calculations for the G factor are detailed in figure 2.

As the excavation works continue the G factor will change based upon the details given in figure 2. The higher G factor once excavation works have begun will provide further attenuation and thus lower the recorded noise at each monitoring location.

Therefore using the above an attenuation of  $(77.3 - 66.3) = 11\text{dBA}$  was recorded.

The 11dBA can be attributed to the timber lagging and concrete blanket, together with the site perimeter fence, and also position of the rock drill.

As detailed within section 6, the  $Leq(60)$  for six rock drills will be 85.1dBA (60% usage factor), which in turn is an increase of 7.8dBA over a single piece of equipment. To meet the target of 65dBA at noise monitoring location MGC-S1 an attenuation of 23.3dBA or 14.9dBA is required depending upon whether construction sequence A or B ongoing at the site.

On 10<sup>th</sup> March 2005 testing was carried on shipping containers placed on the south western corner of the site. Testing was then carried out to determine the how effect the barrier was in providing noise attenuation. Details are given in figure 5 of this report.

The shipping containers were double stacked thus making a barrier 16 feet high. Noise monitoring took place 8feet in front of the container, and at the same time 8feet behind the container. Therefore the distance between the noise monitoring devices was 24feet. The calculation of sound attenuation over a distance of 24 feet (usage factor of 1) is 3.4dBA.

The graphical output of the results show that the  $Leq(60)$  had a maximum value of 81.8dBA in front of the container, while behind the container a  $Leq(60)$  had a maximum value of 61.3dBA. Using the distance between the containers as a guide such results show a decrease of approximately  $(20.5 - 3.4 = 17.1\text{dBA})$ . For

this calculation the G factor was kept at zero since the ground was flat and the distance was short between the two noise monitoring devices.

Therefore based upon the results detailed above, we will assume that a 16dBA reduction is being obtained via the use of the double stacked shipping containers with concrete blankets.

The same test on the shipping containers was performed on 16<sup>th</sup> March 2005. The Leq(60) in front of the containers was 89.6dBA, while behind the containers it was 71.2dBA. This gives a difference of 18.4dBA. Taking into consideration the distance between the receivers, there should have been a natural drop of 3.4dBA. Therefore the shipping containers give an attenuation of  $(18.4 - 3.4) = 15\text{dBA}$ .

The results obtained is in line with the results which were obtained on 10<sup>th</sup> March 2005, however it must be noted during this test small machines were operational behind the containers, thus the higher Leq(60) recorded compared to the previous test. Details of tests are recorded within figure 4.

The measures detailed below shall be completed, which in turn will further increase the amount of attenuation recorded.

A noise tent shall be constructed around the machine, which in turn will be placed around the rear of the machine. The barrier will encompass three sides of the machine, with the opening section of the barrier facing the opposite direction to the receptor at S1.

- The noise tent shall be constructed out of a steel frame, which will be interlaced with the 1 inch wood which has been utilized for the site perimeter. The inside face of the tent shall be covered with the noise attenuation material which is detailed within appendix A (or equivalent).
- The noise tent shall be of a height which is approximate two feet above the highest point of body the machine, and the width shall be twice the length of the machine. The tent shall be portable so as the machine is operational the tent can be moved and thus direct the noise towards the centre of the construction site. The tent becomes more effective the closer to the machinery, and the percentage of the machinery which is covered. A tent which covers at least fifty percent of the area should allow at least a 5 dB decrease in noise to be recorded. The attenuation produced by the completion of the site perimeter fence will also reduce the noise to further increase the attenuation of 5dB as produced by the noise tent around the rock drill.