APPENDIX L

404 Fifth Avenue
New York, NY 10018
www.ceramiassociates.com
T.212.370.1776
F.212.370.1736

Cerami & Associates, Inc.

Vito V. Cerami
Founder

Victoria J. Cerami
President

Stephen G. Lindsey
John D. Longman

July 18, 2008
Revised August 19, 2009

Mr. Christopher Capece
Development Director
AvalonBay Communities, Inc.
135 Pinelawn Road, Suite 130S
Melville, NY 11747

Ref: Avalon – Huntington Station, NY
Train Noise and Vibration Survey
C&A Job #18363

Dear Mr. Capece:

We have completed our survey of the project site and review of the collected data. We conducted a series of acoustical measurements at the project site to measure and assess noise and vibration from the nearby train systems. The following letter presents our initial findings and comments.

I. ACOUSTICAL TERMINOLOGY AND CRITERIA

A. Acoustical Terminology

L_{EQ}: The L_{EQ} or equivalent sound level is a time average of the measured sound over a given time interval.

L_{90}: The L_{90} is a statistical descriptor representing the level exceeded for 90% of the measurement period. As such, the L_{90} provides a good measure of noise levels without the contribution of shorter term transient noise sources such as transit noise.

L_{10}: The L_{10} is a statistical descriptor representing the level exceeded for 10% of the measurement period. As such, it provides a good measure of the magnitude of transient events such as car or train passes.

L_{DN}: The L_{DN}, or day-night equivalent sound level, is a single number reflecting the equivalent level measured over a 24-hour period, with a 10 dBA penalty added to the hours between 10PM and 7AM to account for greater evening sensitivity. The L_{DN} is the standard descriptor for assessing transit noise impact upon residential land uses.

B. HUD Criteria

The Department of Housing and Urban Development (HUD) standards report for Environmental Criteria Title 24, Part 51, Subpart B, Noise Abatement and Control evaluates land use proposed for housing based on environmental noise levels and provide minimum standards. According to HUD the day-night average sound level, L_{DN}, at the interior of any residence should not exceed 45 dBA. Further, HUD lists site acceptability standards for exterior noise levels measured within 6.5 feet of the building façade.

Further, HUD lists site acceptability standards based on measured exterior day-night average sound levels. An L_{DN} not exceeding 65 dBA is classified as "Acceptable"; an L_{DN} above 65 dBA but not exceeding 75 dBA would be classified as "Normally Unacceptable"; and an L_{DN} above 75 dBA is considered "Unacceptable". Housing on "normally unacceptable" sites requires some means of noise abatement to ensure that interior noise levels are acceptable. From a practical standpoint, this usually means that buildings must be air-conditioned so that windows can be closed to reduce exterior sound transmission into interior spaces. Sites having an L_{DN} above 75 dBA are considered unacceptable, and HUD would require special approvals, environmental review, and attenuation. NOTE: This project does not need to comply with HUD standards, however they provide a useful guideline for what is considered acceptable.

C. Vibration Criteria

Our design criteria for ground-borne noise and vibration will be based upon studies conducted by the U.S. Department of Transportation's Federal Transit Administration. The results of these studies are presented in the *Transit Noise and Vibration Impact Assessment* manual, published in April 1995. The FTA guidebook lists ground-borne vibration criteria based on site usage and the frequency of events, summarized in the table below:

Table I. FTA Criteria for Ground-Borne Vibration

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re: 1 micro inch/sec)	
	Frequent Events[1]	Infrequent Events[2]
Category 1: Building where low ambient vibration is essential for interior operations.	65 VdB[3]	65 VdB[3]
Category 2: Residences and buildings where people normally sleep.	72 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use.	75 VdB	83 VdB

Notes:
1. "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
2. "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.
3. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

We have reviewed the MTA train schedules and found approximately 38 scheduled train passes during a typical weekday. Based on the FTA guidebook we therefore advise that the target criterion for ground-borne vibration should be 80 VdB for infrequent events. For reference, a vibration velocity level of 65 VdB is generally considered the threshold of perception for humans.

II. MEASUREMENT METHODOLOGY AND RESULTS

To benchmark existing conditions at the site in terms of noise and vibration levels, measurements were taken during typical daytime hours. Measurements were taken at a location along the proposed façade of the residence nearest to train tracks. To conduct the measurements, Brüel & Kjær 2250 Type I precision sound level meters were used. The meters were setup at a location approximately 25 ft from the property line, 35 ft from the train tracks, where the nearest building façade will be located.

Huntington Station is part of the Port Jefferson branch of the Long Island Railroad and is serviced mainly by diesel-powered locomotives. During the tests, we noted two electric trains were stationed east and west of the project site; however, these trains were not in service. Two passes were made by the electric trains. These passes were at extremely low speed, presumable to only move the trains between service stations. It is unclear if electric trains use these tracks regularly based on our observations on site.

Ground-borne vibration measurements were taken using a PCB accelerometer (2 to 10,000 Hz, 0.00008 g RMS) at one-third octave bands up to 4,000 Hz. Data was obtained by hammering a metal stake in the ground, and mounting the accelerometer atop using a magnet. The data reflects east and westbound Metro-North (MTA) trains. Results from the vibration measurements are provided in the table below:

Table II. Vibration Measurement Results

Direction	Propulsion Type	Maximum Measured Vibration Level (VdB)	Description
Ambient		*<50*	*No train activity*
Eastbound	Diesel	80	Full speed
Eastbound	Diesel	73	Half speed
Westbound	Diesel	74	Decelerating
Westbound	Diesel	75	Half speed
Westbound	Diesel	80	Full speed
Eastbound	Electric	77	Low speed
Westbound	Electric	76	Low speed

Ambient vibration levels with no train activity measured under 50 VdB. As shown in the table above, maximum vibration levels from train passes measures up to 80 VdB for diesel locomotives. Electric powered trains measured between 75 and 80 VdB. The maximum vibration levels recorded were both due to diesel-powered trains passing at full speed.

Airborne noise level measurements were also conducted during train activity. Maximum noise levels from train passes measured in the high 70 dBA range, approaching 80 dBA. Electric trains measured from 65 – 70 dBA.

In addition to noise and vibration spot measurements, a continuous noise test was setup to measure noise levels over a typical 48-hour period. We noted that based on

our survey results, during the period from approximately 1:00 AM to 7:00 AM that activity at or near the site resulted in measurements unusually high. These levels (L_{90} and L_{min}) measured higher during these hours than the measured daytime levels during both 24-hour periods. It is not known what caused these high levels. Despite these unusually high levels during these normally quiet hours, our data still shows an L_{DN} at the project site of approximately 64 dBA. The average ambient noise level at the project site measured approximately 42 dBA.

III. POTENTIAL NOISE IMPACTS

A. Noise Impact to the Proposed Development

As shown in the previous section, results of our survey indicate an L_{DN} of approximately 64 dBA. This complies with the HUD criteria for normally acceptable sites. Typical building construction should provide a noise reduction of approximately 25 dBA, which would result in an interior L_{DN} of under 45 dBA, further complying with the HUD criteria for maximum interior L_{DN} levels.

We advise, however, that currently train events raise exterior ambient levels by up to 40 dBA. Based on a fairly typically indoor noise level of 35 dBA we anticipate that indoor noise levels may increase by 10-15 dBA. Studies have shown that an increase of 10 dBA is sufficient to rouse an average person from sleep.

B. Vibration Sources

On site levels, as mentioned above, reached as high as 80 VdB during train passes. Taking into account losses for coupling to a wood-frame building, the anticipated vibration levels in ground floor residences nearest the tracks will approximate 75 VdB during train activity. This would comply with FTA criteria for Category 2 land uses, which lists a maximum allowable level of 80 VdB for infrequent events. We advise, however, that while vibration levels may not necessarily exceed the criteria, this does not translate to a condition of imperceptibility. Vibration within the residences may still be perceptible during train activity even at vibration levels not exceeding 72 VdB, with the threshold of human perceptibility around 68 VdB.

IV. COMMENTS AND RECOMMENDATIONS

As discussed in the previous section, noise levels measured at the site comply with acoustical criteria outlined by HUD. Further, vibration levels comply with guidelines set by the FTA. Therefore, noise and vibration at the project site are in line with these general criteria and guidelines. However, as discussed above instantaneous noise levels will still be clearly audible within residences, and vibration levels may still be perceptible. Depending on the level of expectation for the development, providing upgraded façade construction to minimize noise intrusion should be considered.

Recommendations for façade construction are provided below:

A. Windows

We suggest limiting train noise (with windows closed) to less than 10 dBA above ambient. The transmission loss of standard 1" insulating glass (1/4" glass, 1/2" airspace, 1/4" glass) is around 25 dBA. Based on measured noise levels while on site, it will be necessary to provide upgraded constructions for windows of the residences facing the tracks. We recommend, at minimum, laminating both layers of the glazing. Alternatively, a wider airspace could be provided. Laminating both layers of the glazing should result in noise levels at or below 40 dBA. Exact recommendations will vary based on the proposed window systems for the site.

B. Façade Construction

We assume that standard Avalon façade construction is proposed at this site. This includes metal siding on sheathing, with insulation and drywall layers on the interior side. Depending on the expectations for the site and the exact construction proposed, it may be necessary to provide additional mass for the construction in order to reduce noise levels further.

NOTE: Depending on the proposed window and façade construction, upgraded construction may also be needed for residences located further back from the tracks, rather than just residences located immediately along the tracks.

C. Building Isolation

As discussed in Section III.B above, the maximum measured vibration levels within the building due to train activity could reach levels of approximately 75 VdB and while complying with criteria outlined by the FTA does not translate to a condition of imperceptibility. Depending on the level of expectations for the project, it may be necessary to explore building construction techniques or isolation to limit transmission of vibration to the building.

This concludes our report at this time. If you have any questions, comments, or concerns please do not hesitate to contact us.

Regards,

Justin Y. Lau
Associate

JYL:yc

cc: Kim Gennaro / VHB
Stephen G. Lindsey / Cerami & Associates, Inc

J:\18000-18499\18363\correspondence\Huntington Station jyl ac 001.rev1.doc