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Article 20. Noise and Vibration

20.1 General

- (a) This Article 20 [Noise and Vibration] specifies the requirements and criteria for Design and Construction of the Project with respect to noise (including acoustical issues), vibration and hours of work for construction activities.
- (b) The Primary Contractor shall comply with the requirements and criteria set out in this Article 20 [Noise and Vibration] with respect to noise (including acoustical issues), vibration and hours of work for construction activities, unless otherwise accepted by the Province's Representative, in its discretion, in accordance with the Consent Procedure.
- (c) All stationing references in this Article 20 [Noise and Vibration] are based on the stationing shown on the Project Lands Drawings.

20.2 Interpretation

- (a) When used in this Article 20 [Noise and Vibration], the following terms have the meanings set out below:
 - (i) "**Activity Zone**" means any lands which are not a Quiet Zone.
 - (ii) "**Core Hours of Work**" means those periods each week:
 - A. from 7:00 am to 8:00 pm, Monday through Saturday; and
 - B. from 9:00 am to 8:00 pm, Sunday and Statutory Holidays.
 - (iii) "**Day Time**" means the periods during each week which begin at 6:00 am and end at 10:00 pm, Monday through Saturday; and begin at 9:00 am and end at 8:00 pm, on Sunday and Statutory Holidays.
 - (iv) "**Inaudible**" means any noise or sound which is not clearly perceptible above the ambient noise level to an individual with normal hearing who is listening at the Point of Reception.
 - (v) "**Night Hours of Work**" means the period from 10:00 pm to 6:00 am on Monday through Saturday.
 - (vi) "**Night Hours of Work Locations**" means the following locations:
 - A. Lougheed Town Centre Station;
 - B. North Road Guideway crossing north of Lougheed Town Centre Station;
 - C. the Tunnel, including south and north portals of the Tunnel and adjacent support and staging areas for Construction of the Tunnel;
 - D. Ioco Road crossing at Barnet Highway; and

- E. Lougheed Highway crossing near Barnet Highway and Pinetree Way.
- (vii) "**Night Time**" means the periods during each week which begin at 10:00 pm and end at 6:00 am on Monday through Saturday; and begin at 8:00 pm and end at 9:00 am on Sunday and Statutory Holidays.
- (viii) "**Noise and Vibration Management Plan**" or "**NVMP**" means the noise and vibration management plan to be prepared by the Primary Contractor in accordance with Article 20.3.2(c) of this Part 2 and Section 3.12 [Component Plans] of Schedule 5.
- (ix) "**Point of Reception**" means, in relation to any noise from the Site, the nearest property line of any lands which are occupied by the recipient of the noise.
- (x) "**Quiet Zone**" means any lands which are used for residential, public or institutional use (excluding parks, playgrounds and community recreation facilities), and includes community care facilities.
- (xi) "**Reverberation Time**" means, in relation to any noise, the time, in seconds, that it takes the sound level of such noise to decay by 60 dBA after the source of the noise is discontinued.
- (xii) "**Shoulder Hours of Work**" means the period from 6:00 am to 7:00 am and the period from 8:00 pm to 10:00 pm, in each case, Monday through Saturday.

20.3 Construction

20.3.1 Permitted Hours of Work and Noise Level Criteria

20.3.1.1 Emergency

- (a) Except in the case of an Emergency or unanticipated construction activities that are time critical and of short duration, the Primary Contractor shall not undertake construction activities outside the Core Hours of Work or exceed the noise levels permitted during the Core Hours of Work as set out in Article 20.3.1.2(b) of this Part 2, unless the Primary Contractor has received the acceptance of the Province's Representative in accordance with any of Articles 20.3.1.3(a), 20.3.1.3(c), 20.3.1.3(e), 20.3.1.4(a) or 20.3.1.4(c), all of this Part 2, as applicable.
- (b) If the Primary Contractor exceeds the noise levels or undertakes construction activities outside of the hours permitted by this Article 20.3 [Construction] due to an Emergency, or an unanticipated construction activity that is time critical and of short duration, the Primary Contractor shall notify the Province's Representative of such Emergency or activity in accordance with the protocols set out in the Spill Prevention and Emergency Response Plan developed by the Primary Contractor pursuant to Schedule 5 [Environmental Obligations].

20.3.1.2 Core Hours of Work

- (a) Except as otherwise provided in this Agreement, the Primary Contractor shall undertake construction activities only during the Core Hours of Work.
- (b) During the Core Hours of Work, Continuous Noise from construction activities, when combined with the existing ambient noise, shall not exceed 85 A-weighted decibels (dBA) when measured 15m from the noise source.

20.3.1.3 Shoulder Hours of Work and Night Hours of Work

- (a) Provided that all of the requirements set out in Article 20.3.2 [Construction Noise Mitigation Requirements] of this Part 2 are met, and subject to the acceptance of the Province's Representative, acting reasonably, in accordance with the Consent Procedure, the Primary Contractor may, in addition to undertaking construction activities during the Core Hours of Work, undertake construction activities during the Shoulder Hours of Work.
- (b) During the Shoulder Hours Of Work, noise from construction activities, when combined with the existing ambient noise, shall not exceed:
 - (i) 80 dBA for Continuous Noise; and
 - (ii) 85 dBA for Non-Continuous Noise, when measured 15m from the noise source.
- (c) Provided that all requirements in Article 20.3.2 [Construction Noise Mitigation Requirements] of this Part 2 are met, and subject to the acceptance of the Province's Representative, in its discretion, in accordance with the Consent Procedure, the Primary Contractor may, in addition to undertaking construction activities during the Core Hours of Work and, where accepted, the Shoulder Hours of Work, undertake construction activities during the Night Hours Of Work at any of the Night Hours of Work Locations.
- (d) During the Night Hours of Work, noise from construction activities, when combined with the existing ambient noise, shall not exceed:
 - (i) 55 dBA for Continuous Noise; and
 - (ii) 70 dBA for Non-Continuous Noise, when measured 15m from the source.
- (e) The Primary Contractor shall submit requests to undertake construction activities during:
 - (i) the Shoulder Hours of Work; or
 - (ii) the Night Hours of Work at any of the Night Hours of Work Locations, in writing to the Province's Representative in accordance with, as the case may be, Articles 20.3.1.3(a) or 20.3.1.3(c), both of this Part 2, at least 72 hours, or such longer period as may be required to accommodate any necessary public

consultation, in advance of the commencement of construction activities during such extended hours of work, and such requests shall include the following information:

- (iii) a description of the location(s) of areas of the Site affected;
 - (iv) a description of the construction activities and the source(s) of noise in respect of the construction activities and the anticipated noise levels;
 - (v) the rationale as to why such construction activities should be undertaken during extended hours;
 - (vi) the anticipated period of time and duration of the subject construction activities; and
 - (vii) a description of the mitigation measures that the Primary Contractor will undertake to minimize noise levels.
- (f) For the purposes of each of Articles 20.3.1.3(a), 20.3.1.3(c) or 20.3.1.3(e), all of this Part 2, the 20 Business Day period referred to in Section 2.2(a) of Schedule 2 [Representatives, Review Procedure and Consent Procedure] shall be reduced to 72 hours.

20.3.1.4 Requests for Exemptions to Permitted Construction Hours or Noise Level Criteria

- (a) If the Primary Contractor wishes an exemption from the Core Hours of Work, the Shoulder Hours of Work, the Night Hours of Work, the Night Hours of Work Locations, and/or the applicable noise levels set out in Articles 20.3.1.2(b), 20.3.1.3(b) or 20.3.1.3(d), all of this Part 2, the Primary Contractor shall submit an exemption request to the Province's Representative for acceptance, in its discretion, pursuant to the Consent Procedure, of an exemption to the Core Hours of Work, the Shoulder Hours of Work, the Night Hours of Work, the Night Hours of Work Locations, and/or the applicable noise levels set out in Articles 20.3.1.2(b), 20.3.1.3(b) or 20.3.1.3(d), all of this Part 2, which exemption request shall:
- (i) be submitted at least 72 hours, or such longer period as may be required to accommodate any necessary public consultation, in advance of the commencement of the construction activities that are the subject of the exemption request; and
 - (ii) contain the information identified in Article 20.3.2 [Construction Noise Mitigation Requirements] of this Part 2 related to noise levels, construction hours of work, or Night Hours of Work Locations.
- (b) For the purposes of Article 20.3.1.4(a) of this Part 2, the 20 Business Day period referred to in Section 2.2(a) of Schedule 2 [Representatives, Review Procedure and Consent Procedure] shall be reduced to 72 hours.
- (c) If the Primary Contractor wishes to undertake construction activities near a Quiet Zone which are likely to result in noise levels above the applicable noise levels permitted by any of Articles 20.3.1.2(b), 20.3.1.3(b) or 20.3.1.3(d), all of this

Part 2, for a period exceeding one month, the Primary Contractor shall submit the proposed measures to mitigate such noise levels to the Province's Representative for acceptance, in its discretion, in accordance with the Consent Procedure.

20.3.1.5 Consultation regarding Proposed Exemption

- (a) Prior to granting acceptance of an exemption request under Articles 20.3.1.4(a) or 20.3.1.4(c) of this Part 2 related to noise levels, construction hours of work, or Night Hours of Work Locations, the Province's Representative may require that the Primary Contractor undertake specific actions, including the following:
 - (i) organize and lead special meetings involving affected communities and residents for the purpose of sharing information with and receiving input from residents in areas subject to high noise levels, with any such meetings to be held at least three days prior to commencement of the construction activities referred to in the exemption request;
 - (ii) send out notices via direct communications to potentially affected residents and businesses regarding upcoming construction activities that will result in noise levels above the specified noise level criteria, which notices must also provide information regarding the timing and locations of neighbourhood meetings to be held by the Primary Contractor to discuss these issues; and
 - (iii) participate in discussions with the Province's Representative and the affected Municipality for the purpose of identifying and implementing mutually acceptable mitigation measures to address noise impacts, unless no practical options exist.

20.3.2 Construction Noise Mitigation Requirements

- (a) Prior to undertaking any construction activities, the Primary Contractor shall:
 - (i) review the noise impact assessment completed by the Province and included in Section 13 [Noise and Vibration Assessment] of the EA Application made available to the Primary Contractor as Disclosed Data; and
 - (ii) undertake a supplemental noise assessment of the Site and its vicinity to assess and describe the noise levels which will be generated by the vehicles and equipment to be used during construction activities and the methods by which construction activities are to be carried out over the levels contained in Section 13 [Noise and Vibration Assessment] of the EA Application. In preparing the supplemental noise assessment of the Site, use the ISO 9613 Standard implemented using 3-D noise modeling software (Cadna/A, SoundPlan, or equivalent), to predict construction activity noise levels. The supplemental noise impact assessment prepared by the Primary Contractor shall include the identification of the estimated noise levels at all anticipated Night Hours of Work Locations.

- (b) If the results of the supplemental noise impact assessment prepared by the Primary Contactor in accordance with Article 20.3.2(a) of this Part 2 indicate that any estimated noise level due to construction activities, when combined with the existing ambient noise level, will exceed the specified noise level criteria identified in this Article 20.3 [Construction], the Primary Contractor shall provide and implement an appropriate noise mitigation strategy, including erection of temporary noise walls. The Primary Contractor shall be responsible for proving out any proposed noise mitigation strategy through both 3-D modelling software and ongoing field noise monitoring to ensure that the noise level criteria set out in this Article 20.3 [Construction] are not exceeded.
- (c) At least 45 Business Days prior to commencement of any construction activities, the Primary Contractor shall submit an NVMP to the Province's Representative for acceptance, acting reasonably, in accordance with the Consent Procedure, which NVMP shall:
 - (i) incorporate the acoustical criteria and requirements set out in this Article 20 [Noise and Vibration];
 - (ii) describe the results of the supplemental noise impact assessment undertaken pursuant to Article 20.3.2(a) of this Part 2;
 - (iii) detail the steps that the Primary Contractor proposes to take to minimize noise impacts during construction activities, which steps shall include:
 - A. direct communication with potentially affected residents, businesses and property owners regarding any construction noise issues that may arise; and
 - B. the development of procedures for tracking and responding to any noise complaints;
 - (iv) identify construction activities that may result in elevated noise levels (including activities to be conducted at the north and south portals of the Tunnel) and set out site-specific measures to mitigate noise-related impacts to local residents and businesses;
 - (v) describe the criteria, standards, and monitoring methodology to be used by the Primary Contractor to identify the need for noise attenuation barriers and related mitigation measures during construction; and
 - (vi) incorporate a construction noise monitoring program, which specifically addresses those areas of the Site proposed for Night Hours of Work construction activities and/or that are located in proximity to Quiet Zone(s). During the course of construction activities, the Primary Contractor shall expand the noise monitoring program as necessary to include those areas of the Site where noise complaints have been received or as directed by the Province's Representative.
- (d) The Primary Contractor shall make available the results of the construction noise monitoring program obtained by the Primary Contractor on an agreed

submission basis. Notwithstanding the foregoing, if the monitoring program indicates noise levels in excess of those described in this Article 20.3 [Construction], the Primary Contractor shall immediately implement noise attenuation measures to the satisfaction of the Province's Representative.

- (e) Notwithstanding any other provision of this Article 20.3 [Construction], the Primary Contractor shall design and install temporary construction noise walls at:
- (i) the south portal of the Tunnel, approximately between stations 516+340 and 516+800;
 - (ii) adjacent to the residential property lines; and
 - (iii) at the north portal of the Tunnel, approximately between stations 518+730 and 518+790,

which temporary noise walls shall be:

- (iv) designed and constructed to achieve noise levels that are no greater than the maximum noise levels permitted for Night Time construction as provided in Article 20.3.1 [Permitted House of Work and Noise Level Criteria] of this Part 2;
- (v) constructed using solid material, such as plywood;
- (vi) where reflected sound from the temporary noise walls is likely, lined with an sound absorptive material, such as 25mm to 50mm semi-rigid glass-fibre insulation; and
- (vii) where possible, made wider and higher than the noise source.

20.4 Noise Monitoring during Operations

20.4.1 Guideway

- (a) Prior to testing and commissioning of the Evergreen Line, the Primary Contractor shall establish a baseline noise monitoring program along the length of the Evergreen Line, which program shall, include all 22 baseline noise monitoring sites listed in Appendix 13B of the EA Application and any other potential areas that are prone to high operational noise levels near Quiet Zones, such as:
- (i) track switch locations;
 - (ii) Guideway sections located within rising terrain; and
 - (iii) Guideway sections comprised of tight geometry.
- (b) Depending on the Final Design of the Guideway, the Province's Representative may require the Primary Contractor to establish additional baseline monitoring sites, over and above the requirements of Article 20.4.1(a) of this Part 2. The Primary Contractor shall, until the Substantial Completion Date, be responsible for noise monitoring at all baseline noise monitoring areas, after which the

Province will take over noise monitoring, using noise monitoring equipment which shall be left in place by the Primary Contractor. The Primary Contractor shall assist the acoustic consultant retained by the Province to facilitate the acceptable assumption of the baseline noise monitoring program by the Province.

- (c) The Primary Contractor shall, if noise levels measured 15m away from Trains operating on the Evergreen Line during testing and commissioning exceed 75 dBA and exceed the noise levels generated by the same Trains operating at comparable speeds and on comparable sections of the Existing SkyTrain System, take all required steps to rectify this issue at its sole cost.
- (d) With the exception of dealing with excessive noise on the Guideway during testing and commissioning for which the Primary Contractor is responsible pursuant to Article 20.4.1(c) of this Part 2, the Province shall be responsible for providing and attaching noise barriers for the Guideway onto the Guideway parapets and where required along the centre walkway handrail at locations along the Evergreen Line to be determined by the Province.
- (e) The proposed Guideway noise barrier and attachment brackets to be used by the Province shall be similar to those used on the Existing Millennium Line. Details of the guideway noise barrier and attachments are shown on the Rapid Transit 2000 Millennium Line Noise Barrier Drawings provided as Disclosed Data. The Primary Contractor shall assist the Province by providing design input for the design of the Guideway noise barriers and their attachment brackets. The Primary Contractor shall carry out the Design and Construction of the Guideway parapet and service walkways along the Evergreen Line to permit installation of Guideway noise barriers and their attachment brackets by the Province.
- (f) Although the Province anticipates installing the Guideway noise barriers after the Substantial Completion Date, the Province may elect to install some of the Guideway noise barriers prior to the Substantial Completion Date. In the event that the Province elects to install any Guideway noise barriers prior to the Substantial Completion Date, the Primary Contractor shall:
 - (i) assist the contractor designated by the Province (which contractor shall be deemed to be a Concurrent Work Contractor for the purposes of this Agreement) to install any such Guideway noise barriers by providing reasonable access to the Guideway for such installation; and
 - (ii) be responsible for the coordination of such work by the Province's contractor in accordance with Article 6.3.1 [Coordination with Concurrent Work Contractors], Part 1 of Schedule 4.

20.5 Permanent Noise Walls

20.5.1 Locations of Permanent Noise Walls

- (a) The Primary Contractor shall design and construct permanent noise walls which conform with the requirements of this Article 20.5 [Permanent Noise Walls]:
 - (i) near the south portal of the Tunnel, to the west of the Guideway between stations 516+340 and 516+800; and
 - (ii) along Golden Spike Lane, to the south of the Guideway from stations 520+740 to 521+040.

The Primary Contractor shall construct the permanent noise wall located near the south portal of the Tunnel beginning at the point where the top of rail is 3m above the existing grade and ending at the point where the top of rail is 3m or less below the existing grade.

- (b) The Primary Contractor shall not construct permanent noise walls at any other location unless the Design of such permanent noise walls, including specific locations and required height and length of noise walls at each location and other design parameters, is accepted by the Province's Representative, acting reasonably, in accordance with the Consent Procedure.

20.5.2 Permanent Noise Wall Requirements

- (a) Permanent noise walls designed and constructed by the Primary Contractor pursuant to Article 20.5.1(a) of this Part 2 shall, as a minimum, meet the following requirements:
 - (i) be at least 3m in height;
 - (ii) be constructed from products selected from the Recognized Products List and employ a surface finish using Ashlar stone (or comparable) on both sides;
 - (iii) consist of reinforced concrete or steel posts, panels and cap rail. Alternative materials may be considered by the Province's Representative, provided that the panels have a minimum surface weight of 20 kg/m². The Primary Contractor shall submit any proposed alternate materials for the permanent noise walls to the Province's Representative for approval in its discretion. The minimal weight requirement set out in this Article 20.5.2(a)(iii) is based on acoustical needs only and the actual weight and thickness shall be increased as necessary for durability and wind resistance. In particular, panels shall be sufficiently thick and strong to prevent damage which could result in gaps or openings in the noise walls. In the event of damage, replacement panels shall be readily available from the manufacturer and easily installed;

- (iv) the ground supporting the base panels of such permanent noise walls shall be stripped of topsoil and backfilled with nominal 20mm crush for a minimum width of 500mm, centred under the panel. Once installation is complete, the ground on at least one side of the panels shall be loaded with additional 20mm crush to a minimum depth of 75mm, measured up from the bottom of the panel;
- (v) if drains are required at some locations to permit storm runoff from one side of the permanent noise wall to the other, rather than removing above-grade sections of the panels, the drains shall consist of grates and drain pipe installed so as to pass beneath the noise wall;
- (vi) the panels of such permanent noise walls shall be designed and installed so that they mate together, forming an airtight joint in order to prevent leakage of sound. This may require both tongue and groove joints and acoustic caulking or gasketing. Joints between the panels and the cap rail, as well as between the planks and the vertical posts, shall be designed and installed in a similar manner to prevent sound leakage;
- (vii) sound absorptive surfaces shall be employed on both sides of such permanent noise walls with a sound absorptive facing which will provide a Noise Reduction Coefficient (NRC) of at least 0.80 when tested in accordance with ASTM C423, using Type "A" mounting per ASTM E795-92. Such sound absorptive facing shall be suitable for long-term exposure to the climatic conditions at the Site;
- (viii) the Primary Contractor shall ensure that manufacturer's and/or installer's shop and installation drawings, including details that indicate how airtight joints will be achieved between the various elements of such noise walls, are provided for the permanent noise walls;
- (ix) the Design of such permanent noise walls shall include considerations for aesthetics, long term maintenance, urban design and neighbourhood fit. The Primary Contractor shall provide the Province's Representative with a choice of materials, finishes and colours consistent with the requirements of this Article 20.5.2 [Permanent Noise Wall Requirements] for review, acting reasonably, in accordance with the Review Procedure;
- (x) the Design of such permanent noise walls adjacent to roadways shall accommodate snow loads associated with snow build-up and snow plough spray. Wherever permanent noise walls may be impacted by roadway vehicles, such noise walls shall either be protected or combined with a concrete roadside barrier. The complete permanent noise wall assembly shall be PL2-Rated satisfying CAN/CSA S6-06 PL2, including crash testing;
- (xi) permanent noise walls which are adjacent to roadways shall be designed and constructed such that any impact to the noise wall by a roadway vehicle will not result in any portion of the noise wall entering the Guideway; and

- (xii) permanent noise walls shall have a minimum design life of 75 years and shall resist rotting, mildew and fungus growth, rusting, warping, animal and insect nesting and infestation. Permanent noise walls shall not display any significant deterioration, delaminating, disfigurement or failure for a minimum 10-year period.

20.6 Stations

20.6.1 General

- (a) This Article 20.6 [Stations] sets out design goals for acoustics and noise control relating to the Stations on the Evergreen Line and contains acoustic design goals for maximum noise levels and provides guidelines for acoustic treatment within the Stations. The Primary Contractor shall:
 - (i) meet the acoustic design goals;
 - (ii) incorporate and integrate the treatments outlined in this Article 20.6 [Stations] into the Design for the Stations; and
 - (iii) include proper documentation showing compliance with these acoustic design goals in its drawings and specifications.
- (b) The acoustic design goals are to:
 - (i) minimize intrusion of noise from the Stations into the adjacent communities;
 - (ii) provide a comfortable environment for passengers within the Stations; and
 - (iii) permit intelligible communication, including public address (PA) systems, within the Stations.

20.6.2 Noise Intrusion to Communities

- (a) Sources of noise from the Stations shall be controlled to minimize disturbance to the adjacent communities. Any such noise shall not exceed the criteria set out in Table 20.6.2 [Maximum Exterior Noise Levels for Stations] of this Part 2 during the periods indicated.
- (b) Noise levels shall be measured at the Point of Reception using “slow response” on the sound level meter unless otherwise noted. A-weighted noise levels can be read directly from a sound level meter and correlate well with the subjective perception of noise.

Table 20.6.2 Maximum Exterior Noise Levels for Stations

Type of Noise	Maximum Noise Level (dBA)			
	Quiet Zone		Activity Zone	
	Day Time	Night Time	Day Time	Night Time
Continuous Noise	55	45	60	55
Non-Continuous Noise	75	70	75	70
Noise with tonal components (e.g., electrical transformers, some fans)	50	40	55	50
Noise from periodic Day Time testing of emergency generators	65	n/a	80	n/a
Noise from communication or annunciator systems (e.g., PA systems, door chimes on trains)	Inaudible	Inaudible	Inaudible	Inaudible

- (c) The noise level emitting from fan and vent shafts with surface openings shall be limited by the Primary Contractor in accordance with the criteria for Continuous Noise set out in Table 20.6.2 [Maximum Exterior Noise Levels for Stations] of this Part 2. The acoustic treatment of vent shaft noise reduction by the Primary Contractor may include installation of silencers for the fan, application of sound absorption treatment to the shaft walls and ceilings, and application of sound absorption treatment to the fan ventilation room. The Primary Contractor shall determine the extent of the acoustic treatment based on the noise level of the fan and the existing ambient noise level on the street.

20.6.3 Station PA Systems

- (a) Where noise levels associated with PA systems are of concern to neighbouring residential properties, the Primary Contractor shall design and construct the PA system for the Stations so that signal levels do not exceed ambient levels at all listener locations by more than 20 dBA.
- (b) The PA system for each Station shall include ambient noise compensation in accordance with the requirements set out in Article 13.6.2.1 [Public Address System] of this Part 2.

20.6.4 Reverberation Times

- (a) Although Reverberation Times are frequency dependent, the Primary Contractor shall use the Reverberation Time at 500 Hz for preliminary design purposes.

20.6.5 Station Platform

- (a) The Primary Contractor shall design and construct each Station so that the Reverberation Time on the Station platform does not exceed 1.5 seconds (at 500 Hz). To meet this requirement, the Primary Contractor shall ensure that a

minimum of 35% of all wall and ceiling areas are sound absorptive. To reduce wheel and rail noise at those Stations which have overhanging platforms, the Primary Contractor shall ensure that sound absorptive treatment is applied to the underside of overhanging platforms. However, since this treatment has little effect on Reverberation Times, the Primary Contractor shall not include it in the calculation of the above minimum percentage of total area of wall and ceiling treatment for reverberation control.

- (b) The Primary Contractor shall ensure that noise levels on the platforms of the Stations which are produced by mechanical and electrical systems shall not exceed 55 dBA.

20.6.6 Enclosed Concourse Areas

- (a) For the enclosed concourse areas of the Stations, including those areas of Lougheed Town Centre Station that are newly constructed for the Evergreen Line (such as mezzanines, passageways, fare collection areas, stairs and escalators), the Primary Contractor shall design and construct the Stations such that the Reverberation Times do not exceed 1.2 seconds.
- (b) The Primary Contractor shall ensure that noise levels inside the Stations which are produced by mechanical and electrical systems shall not exceed 50 dBA in areas normally occupied by passengers or employees.

20.6.7 Sound Absorptive Finishes

- (a) The Primary Contractor shall select sound absorptive materials by taking the following factors into consideration:
 - (i) the amount of treatment required;
 - (ii) architectural considerations;
 - (iii) ability to withstand pressure transient loading caused by incoming and outgoing Trains;
 - (iv) resistance to mechanical abuse; and
 - (v) BCBC requirements.
- (b) Where sound absorptive finishes are vulnerable to damage, the Primary Contractor shall place such materials out of reach of passengers.
- (c) In those areas of the Stations that consist primarily of concrete construction, the Primary Contractor shall provide sound absorptive finishes consisting of suspended acoustic tile ceilings and/or acoustic insulation thicknesses of 50 to 75mm to provide sound absorption throughout the entire frequency range. In concourse areas constructed using stud partitions and that provide some low frequency sound absorption, the Primary Contractor may reduce acoustic insulation thickness to no less than 25mm. For certainty, the Primary Contractor shall, at all new Stations located on the elevated Guideway, provide sound

absorptive finishes for those concourse areas located under the platform but not those areas located under the Guideway (similar to the provision of sound absorptive finishes at stations along the Millennium Line). For Lougheed Town Centre Station, the sound absorptive finishes within the concourse areas provided by the Primary Contractor shall be similar to existing acoustic finishes within the station. Sound absorptive finishes shall be provided by the Primary Contractor at Ioco Station within the underground platform areas.

- (d) If a continuous panel system or a suspended acoustic tile ceiling is used in the platform areas of the Stations or those areas of Lougheed Town Centre Station that are newly constructed for the Evergreen Line, the Primary Contractor shall provide gaps or openings to permit free air flow between the panels and the structure behind to minimize loading of the acoustical panels by air pressure transients. All acoustic systems subject to air pressure transients shall be positively anchored in place.

20.6.8 Room Shape

- (a) The Primary Contractor shall, in the Design of the Stations, avoid the use of concave walls and ceilings and, in particular, domed ceilings or any other architectural design which focuses sound and causes objectionable room acoustics or poor speech intelligibility.

20.6.9 Ancillary and Service Rooms

- (a) The ancillary and service rooms in the Stations (including those that are newly constructed in Lougheed Town Centre Station for the Evergreen Line) shall be designed and constructed so that mechanical, transformer, electrical equipment, switch control rooms and washrooms are acoustically separated from public areas. Access to such ancillary and service rooms and any similarly noisy areas shall be via series doors with a good sound rating. Transformer rooms adjacent to public spaces shall have an acoustical treatment, the extent of which shall be based on the noise levels and the volume of the room.

20.7 Tunnel Ventilation System

- (a) The Primary Contractor shall carry out the Design and Construction of the TVS such that the noise generated by the TVS does not exceed the following:
 - (i) during maintenance and operations, the noise level from a ventilation system shall not exceed 45 dBA, measured at the nearest Point of Reception in a residential zone;
 - (ii) during emergency testing, the noise level from a ventilation system shall not exceed:
 - A. 45 dBA, if testing lasts 3 minutes or more; or
 - B. 75 dBA, if testing lasts less than 3 minutes,

- as measured at the nearest Point of Reception in a residential zone; and
- (iii) the maximum sound power level of each ventilation fan shall not exceed 92 dBA at the nearest Point of Reception.
 - (b) The Primary Contractor shall implement noise mitigation measures if noise levels from the TVS exceed the limits set out in Article 20.7(a) of this Part 2. Noise mitigation measures by the Primary Contractor may include installation of silencers on the fan or provision of noise walls at affected locations.
 - (c) All Equipment related to the TVS which produces vibration shall be vibration-isolated from the structure to which it is attached by springs or neoprene isolators and all piping and ducts shall have flexible connections to isolate such vibration causing equipment.

20.8 Vibration

- (a) The Primary Contractor shall design and construct the Evergreen Line in accordance with the acceptable levels of vibration recommended in the Transportation Research Board Report 57 - Track Design Handbook for Light Rail Transit. The Design of the Evergreen Line shall address vibration effects of the Operational Evergreen Line on adjacent lands and infrastructure.
- (b) The Primary Contractor acknowledges that it has reviewed and confirms that it shall comply with the vibration criteria for Vehicles provided as Disclosed Data.