

TO: Board of Directors

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DATE: May 21, 2021

SUBJECT: SkyTrain Noise Study Update

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### **EXECUTIVE SUMMARY**

In 2018 TransLink commissioned a SkyTrain Noise Study in response to noise concerns and an increasing number of noise complaints raised by residents. The Noise Study project has now completed a series of pilot studies and investigations to identify the benefit of various noise mitigation options and has also developed an Interim Guideline for new developments in noisy areas. A plan is being developed for implementation and long-term SkyTrain noise performance monitoring.

Implementation of the recommendations of the Noise Study will not eliminate all noise or all complaints, however the study has demonstrated that significant improvements are feasible. The objective is to optimize maintenance practices to keep train pass-by noise emissions within 5 dB of the best case (minimum) noise at all times. This would represent a significant improvement in amenity for neighbouring residents, some of which currently see noise increase by 15 dB or more between maintenance intervals.

### **PURPOSE**

This report provides for information a progress update on the SkyTrain Noise Study project.

### **BACKGROUND**

In 2018 TransLink commissioned a SkyTrain Noise Study in response to noise concerns and increasing numbers of complaints raised by residents. Completed at the end of 2018, the Noise Report showed measured train pass-by noise levels of 90 dBA at some residential facades, 15 dB above the identified goal of 75 dBA. SkyTrain noise was found to be highly variable, depending on track condition which changes over time. At specific locations, the difference between the best and worst-case noise emissions can be more than 15 dB depending on maintenance and rail grinding cycles.

A Next Steps Report was prepared recommending pilot studies to confirm the feasibility and effectiveness of five noise mitigation options. The pilot studies were designed to quantify the noise benefit of each mitigation measure and to inform the development of a long-term noise mitigation implementation plan. A sixth recommendation was to create acoustic guidelines for new developments near SkyTrain.

Track condition including rail roughness and corrugation is a key factor in noise emissions. As part of the pilot studies, factors that influence changes in track condition were measured over an extended period to understand the noise benefits and operational implications of changes to BCRTC's maintenance practices.

Data collection for all mitigation pilot studies was completed in May 2021 and a final report documenting all results and outlining a plan for implementation is being prepared. Implementation is underway for two of the identified mitigation measures for which investigations were successfully completed in 2020.



## DISCUSSION

This section provides an update on the feasibility and effectiveness of each of the six mitigation measures that were recommended by the Noise Study:

1. Improvements to switch maintenance practices
2. Investigation of harder rail steel as a measure to improve long-term rail condition
3. Re-introduction of friction modifiers to improve long-term rail condition
4. Improvements to rail grinding practices to improve long-term rail condition
5. Rail dampers to reduce noise radiated from the rails and hence reduce overall noise
6. Guidelines for new residential developments near SkyTrain

### ***Improvements to Switch Maintenance***

The pilot study found that replacing worn switches can reduce noise levels by more than 10 dB. Grinding maintenance can reduce noise levels by 3-4 dB and help preserve switches in a quieter condition. However, grinding produces minimal noise benefits for severely worn switches, demonstrating that it is critical to continuously monitor the acoustic condition of switches and undertake regular maintenance starting from when new switches are installed. With more than 100 switches around the SkyTrain system, this will require increased BCRTC resources. Implementation recommendations have been made to BCRTC, with planning underway for budgets to be allocated for implementation commencing in 2022.

### ***Harder Rail Steel to Improve Long-Term Rail Condition***

Although it was standard at the time, the rail steel originally used for Expo line construction is relatively soft and prone to rapid wear. An investigation was undertaken to quantify the noise benefits and costs of using harder rail steel for SkyTrain rail replacement programs and other projects. Using premium rail steel for rail replacement is expected to result in annual average noise level reductions of 5 dB on the Expo Line. Areas with harder rail steel require less frequent grinding, which could free up capacity to address specific problem areas when required.

A recommendation to specify harder rail steel in all future rail purchases within SkyTrain's rail replacement program was implemented in early 2020. The additional capital cost of harder rail steel represents less than 0.5% of the overall cost of rail replacement and is expected to be balanced by the cost savings associated with reduced grinding requirements and longer asset life.

### ***Friction Modifiers to Improve Long-Term Rail Condition***

Friction modifiers are products applied between the wheel tread and the top of the rail. When applied correctly, these products control friction, reducing wear and roughness of the wheels and rails, and hence reduce noise. A pilot study of this mitigation measure has been undertaken. A trial site was selected, and noise measurements were taken over a period of 9 months after rail grinding to determine the rate of noise increase over time. Then, friction modifier was applied, and measurements were repeated again following rail grinding. The friction modifier was found to give a 5 dB benefit, keeping noise levels to a minimum in the months immediately following rail grinding.

Recommendations for implementation of friction modifiers are currently being developed.

### ***Improvements to Rail Grinding Practices***

Rail grinding is a critical maintenance practice which is required to remove rail defects and correct the rail profile following wear. If the track condition is poor, rail grinding reduces noise. However, in some cases, grinding can leave marks on the rail head that cause a noticeable whining characteristic, causing noise complaints. Rail grinding requires balancing the amount of material to be removed with the targets for rail surface finish. If a large amount of material removal is required, for example to remove corrugation or to correct the rail profile, then coarser grinding stones are used. If only a small amount of material is required to be removed, finer stones can be used to leave a better surface finish.

The noise study measured rail condition periodically at several sites with a range of different rail steels following grinding using coarse and fine stones. It was found that locations with harder rail steels benefit from the use of fine stones, whereas locations with original rails are best ground using coarser stones. Recommendations have been made to BCRTC to optimize rail grinding practices. Implementation of the recommended changes will lead to the most effective use of grinding resources and reduce complaints associated with freshly ground rails.

### ***Rail Dampers***

Rail dampers are a component that is clipped to the rails to absorb vibration and reduce radiated noise. A pilot study of rail dampers identified that these components can reduce noise levels by 4 to 6 dB, and recommended installation along a total track length of 3.2 km in hotspot areas on the Expo line. Procurement is underway with installation scheduled to commence in late 2021 / early 2022.

### ***Interim Guidelines for New Developments***

The minutes of the TransLink Board of Directors public meeting on September 28, 2017 recorded that the Board discussed the possibility of “region wide construction standards for buildings such as triple glazing on windows, enclosed balconies and air conditioning” to address noise. The Noise Study project team has confirmed the utility of such a guideline in consultation with municipal planning staff. To be useful in practice in situations where individual developments are affected by multiple noise sources (from roads, rail, aircraft, industry, for example), guidelines must address all environmental noise sources, not only SkyTrain noise.

Interim Guidelines for new noise-sensitive developments have been created and are attached to this report. Administration of environmental noise guidelines for new developments is outside of TransLink’s authority, therefore the Interim Guidelines are provided as an example for information and as a tool that planning authorities may choose to use. The Guidelines are titled “Interim” since wider consultation with developers, acoustic practitioners and others is recommended before adoption by planning authorities.

Management proposes the following steps in relation to the Interim Guidelines, completion of these steps will represent the end of TransLink's involvement with the Guidelines.

- a. Request to present the Interim Guidelines and the background to their development to the RPAC
- b. Introduce the Interim Guidelines to RTAC for information
- c. Publish Interim Guidelines to TransLink website as a product of the Noise Study
- d. Notify managers of major projects
- e. Notify municipal staff who participated in the early development consultation
- f. Notify the director of the Building and Safety Standards Branch of the Ministry of Municipal Affairs

### **Customer Impact**

The Noise Study was undertaken in response to complaints from residents living near SkyTrain. Implementation of the recommendations of the Noise Study will not eliminate all noise or all complaints, however the study has demonstrated that improvements are feasible. The objective of implementation is to optimize maintenance practices to keep train pass-by noise emissions within 5 dB of the best case (minimum) noise. This will represent a significant improvement in amenity for neighbouring residents, some of which currently see noise increases of the order of 15 dB between maintenance intervals.

### **Communications**

Communications on Noise Study progress have been provided through TransLink's website as the pilot studies have progressed. Implementation of the full suite of noise mitigation recommendations is a long-term undertaking linked to the rail replacement project schedule, which will be ongoing over at least 10 years. Monitoring the effectiveness of noise mitigation measures and communication of progress will be ongoing for the foreseeable future. Regular updates will be provided following completion of the Noise Study mitigation pilot reports, updates on noise mitigation implementation progress and compliance performance.

### **ATTACHMENTS**

Attachment 1 - Interim Guidelines for New Development Environmental Noise Assessment, May 2021