Appendix 2: Neighbourhood Considerations Analyses

Noise Memo

Privacy Analysis

Privacy Section – Route 1

- Simon Fraser Village – Ran Beamish Place
- Forest Grove Elementary – Mountainside
- Forest Grove Drive – Gaglardi Way

Privacy Section – Route 2

Privacy Section – Route 3

Visual Presence Analysis

Vandalism Memo

Hemmera
An Ausenco Company

MEMORANDUM

Date:	October 19, 2020
To:	TransLink
From:	Hemmera
File:	104857-01
Re:	Burnaby Mountain Gondola Transit Noise Modelling

1.0 INTRODUCTION

TransLink is planning for the Burnaby Mountain Gondola Transit project (the Project) which would provide a fast, frequent, and reliable service between the SkyTrain network and Burnaby Mountain. TransLink is currently conducting a Multiple Accounts Evaluation (MAE) on three proposed routes:

- Route 1: Straight-line route from Production Way – University SkyTrain Station to Simon Fraser University
- Route 2: Eastern route from Production Way – University SkyTrain Station, travelling along Gaglardi Way, then changing direction to Simon Fraser University
- Route 3: Western route from Lake City Way SkyTrain Station, across Burnaby Mountain Golf Course, then changing direction to Simon Fraser University

This memorandum summarizes the results of noise modelling completed in support of the MAE.

2.0 PURPOSE AND SCOPE

The majority of noise associated with the Burnaby Mountain Gondola Transit project are from machinery and equipment located at the terminal stations. Along the route, the only source of noise is from the gondola cabins rolling over the ropeway at towers and angle stations. Exposure to increased noise levels as a result of the Project may contribute to public annoyance, sleep disturbance, and other health effects. Therefore, noise modelling was completed to evaluate potential Project-related noise effects on residential receptors.

Noise is measured in decibels, which expresses the ratio of the sound pressure level relative to a fixed reference value using a logarithmic scale. For environmental noise, the A-weighted decibel (dBA) is used as it represents the relative loudness perceived by the human ear which is less sensitive to low audio frequencies. Project-related noise is assessed based on the following metrics:

- Daytime sound level (L_d): This represents the average noise level over the daytime hours from 7:00 am to 10:00 pm.
- Nighttime sound level (L_n): This represents the average noise level over the nighttime hours from 10:00 pm to 7:00 am.

- Day-night sound level (L_{dn}): This represents the average noise level over a 24-hour period, with a 10 dB penalty added for nighttime noise to account of human's greater sensitivity to noise during this time.

As requested by TransLink, noise modelling was conducted on the following sections of the three route options based on their proximity to residential receptors:

- Route 1: Section from Tower 2 to Tower 3, over the Forest Grove neighbourhood
- Route 2: Section from Tower 3 to Tower 4, immediately east of the Forest Grove neighbourhood
- Route 3: Section from Tower 2 to Tower 3, over the Burnaby Mountain Golf Course, adjacent to the residential neighbourhood east of Arden Avenue.

The study areas for noise modelling were defined as the areas within a 300-m buffer of the sections of interest. These buffered areas were selected to represent the area of potential noise effects driven by the Project.

3.0 EXISTING CONDITIONS

Baseline or existing noise levels are used to provide context for predicted Project noise effects and to assess changes in overall noise levels. Baseline noise levels can be determined by measurement or estimation. For this study, baseline noise levels were primarily estimated based on a qualitative description of community characteristics and the average population density as summarized in **Table 1**. For Route 1, measured noise levels at Forest Grove Elementary from August 31 to September 1, 2020 are also shown. It is noted that measured noise levels were lower than estimated noise levels, potentially due to attenuation effects from the dense foliage surrounding the Forest Grove neighbourhood, and potentially due to reduced traffic levels during the measurement period as a result of the COVID-19 pandemic and the summer closure of Forest Grove Elementary.

4.0 NOISE MODELLING

Sound levels of the gondola at towers and angle stations were estimated based on measurement data provided by Leitner Poma Canada Inc. (2020). Sound levels outside towers were provided at line speeds from 4 to 7 m/s and extrapolated to a design line speed of 7.5 m/s to estimate potential Project-related noise from the proposed tower locations. In the absence of more specific data, sound levels outside (presumably) terminal stations were used to represent potential Project-related noise from the proposed angle stations. It is expected that terminal stations and angle stations would house similar machinery and equipment and therefore, the use of terminal station sound level data to represent sound levels from angle stations is expected to be reasonable.

Noise modelling was conducted using the Cadna-A sound propagation software. Towers and angle stations were modelled as point sources and were assumed to operate from 6:00 am to 1:00 am, consistent with TransLink's overall rapid transit network. Predicted Project-related sound levels at residential receptors are presented in **Table 2**. Also shown in the table are the predicted cumulative (i.e. baseline plus Project) sound levels, and the predicted change in sound levels due to the Project. Isopleth maps of predicted Project day-night sound levels are presented in **Figure 1** to **Figure 3**.

Table 1 Estimated and Measured Baseline Noise Levels

Route	Population Density [1] (per km^2)	Community Type	Estimated Baseline Noise Level [2] (dBA)			Measured Baseline Noise Level (dBA)		
			L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
Route 1	3,800 to 5,440	Noisy Urban Residential	63.0	53.0	63.0	55.8	47.2	56.5
Route 2	2,740 to 3,800	Noisy Urban Residential	63.0	53.0	63.0	-	-	-
Route 3	2,330 to 3,570	Urban Residential to Noisy Urban Residential	58.0	48.0	58.0	-	-	-

Sources: (1) Census Mapper 2020, (2) Health Canada 2017

Note: Estimated baseline noise levels are provided as a range. The lower end of the range shown in the table is conservatively used for this study.

Table 2 Predicted Project-Related Noise Levels at Residential Receptors

Route	Maximum Predicted Project Noise Level (dBA)			Maximum Predicted Cumulative Noise Level (dBA)			Increase due to Project (dB)		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
Route 1	42.3	38.8	45.9	63.0 (56.0)	53.2 (47.8)	63.1 (56.9)	0.0 (0.2)	0.2 (0.6)	0.1 (0.4)
Route 2	46.7	43.5	50.5	63.1	53.5	63.2	0.1	0.5	0.2
Route 3	44.5	41.0	48.1	58.2	48.8	58.4	0.2	0.8	0.4

Note: Cumulative noise levels presented are calculated based on estimated baseline noise levels presented in Table 1. Values in parentheses for Route 1 are calculated based on measured baseline noise levels.

5.0 CONCLUSION

To place the predicted Project-related sound level increases in context, qualitative auditory sensations are provided in **Table 3**.

Table 3 Auditory Perception to Sound Level Increases

Sound Level Increase (dB)	Auditory Perception
1 to 2	Not perceptible
3	Barely perceptible
5	Audible difference
10	Apparent doubling in sound

Source: Murphy and King 2014

For all three route options, the predicted Project-related sound level increase at residential receptors is less than 1 dB, well below the 3 dB threshold at which the human ear can begin to perceive a difference. Therefore, noise modelling suggests that the Burnaby Mountain Gondola Transit project will not contribute to noise effects in nearby residential neighbourhoods. Given these results, in terms of potential noise effects, there is no preferred route.

6.0 CLOSURE

This Report has been prepared by Hemmera for sole benefit and use by TransLink. In performing this Work, Hemmera has relied in good faith on information provided by others, and has assumed that the information provided by those individuals is both complete and accurate. This Work was performed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale. The findings presented herein should be considered within the context of the scope of work and project terms of reference; further, the findings are time sensitive and are considered valid only at the time the Report was produced. The conclusions and recommendations contained in this Report are based upon the applicable guidelines, regulations, and legislation existing at the time the Report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

7.0 REFERENCES

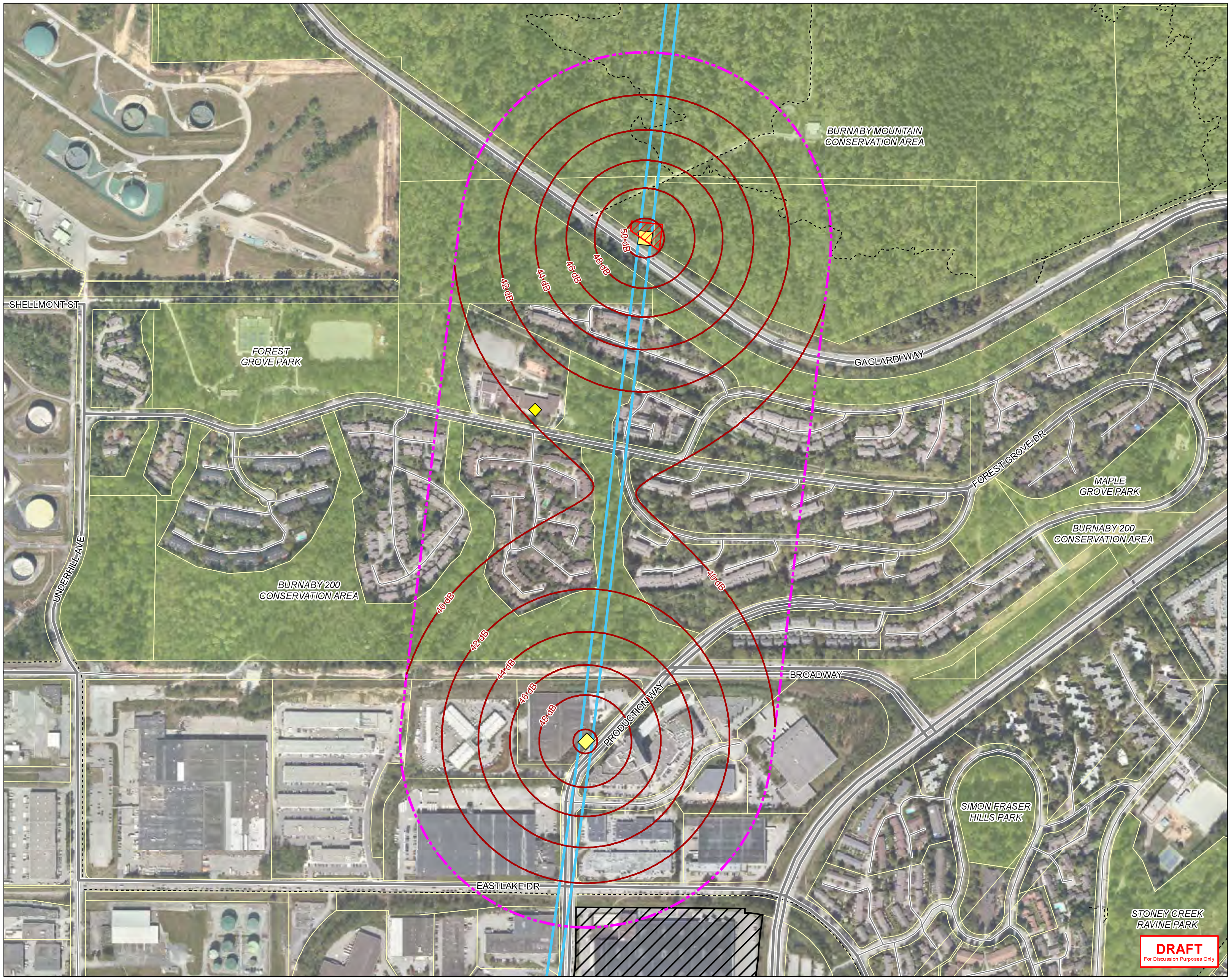
Census Mapper. 2020. Population Density (Canada Census 2016). Available online at: https://censusmapper.ca. Last accessed September 2020.

Health Canada. 2017. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise.

Leitner Poma Canada Inc. and SCJ Alliance. 2020. Burnaby Mountain Gondola, Task 2: 3S Gondola Technology Gondola Sound Emissions Summary. Prepared for TransLink.

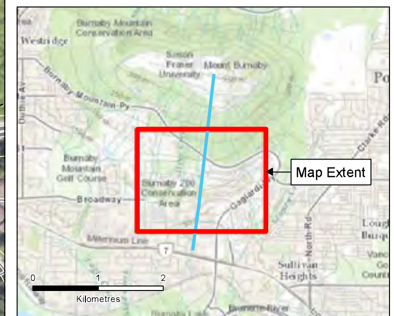
Murphy, E. and E.A. King. 2014. Environmental Noise Pollution: Noise Mapping, Public Health, and Policy.

FIGURES



Burnaby Mountain Gondola Transit Project
Burnaby, British Columbia

Project Day-Night Noise Levels - Route 1



Legend

- Baseline Noise Monitoring Location
- Noise Isopleth (dBA)

Proposed Project Features

- Route 1 Right of Way
- Route 1 Noise Study Area
- Tower
- Tree Clearing Area

Basedata

- Major Road
- Local Road
- Urban Path or Trail
- Major Redevelopment Project
- Park or Protected Area
- Property Line

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Contains information licensed under the Open Government Licences - City of Burnaby & Government of British Columbia
- Alignment: SCJ Alliance Consulting Services, 2020
- Aerial Image: City of Burnaby, 2018

N

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Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

104857-01	Production Date: Oct 16, 2020	Figure 1

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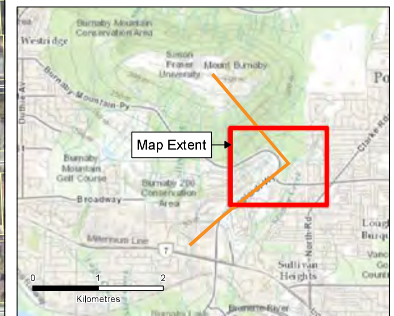
An Ausenco Company

Burnaby Mountain Gondola Transit Project
Burnaby, British Columbia

Project Day-Night Noise Levels - Route 2



Legend

- Noise Isopleth (dBA)

Proposed Project Features

- Route 2 Right of Way
- Route 2 Noise Study Area
- Tower
- Tree Clearing Area
- Turning Station

Basedata

- SkyTrain Station
- Millenium Line
- Major Road
- Local Road
- Urban Path or Trail
- Park or Protected Area
- Property Line

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104857-01	Production Date: Oct 16, 2020	Figure 2

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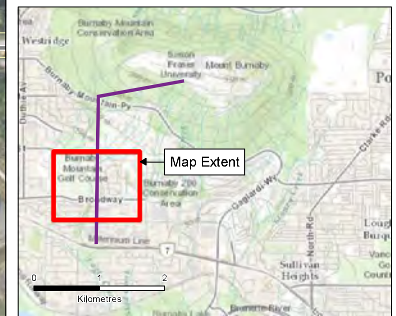
Burnaby Mountain Gondola Transit Project
Burnaby, British Columbia

Project Day-Night Noise Levels - Route 3



Legend

- Noise Isopleth (dBA)

Proposed Project Features

- Route 3 Right of Way
- Route 3 Noise Study Area
- Tower

Basedata

- Major Road
- Local Road
- Urban Path or Trail
- Park or Protected Area
- Property Line

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104857-01	Production Date: Oct 16, 2020	Figure 3

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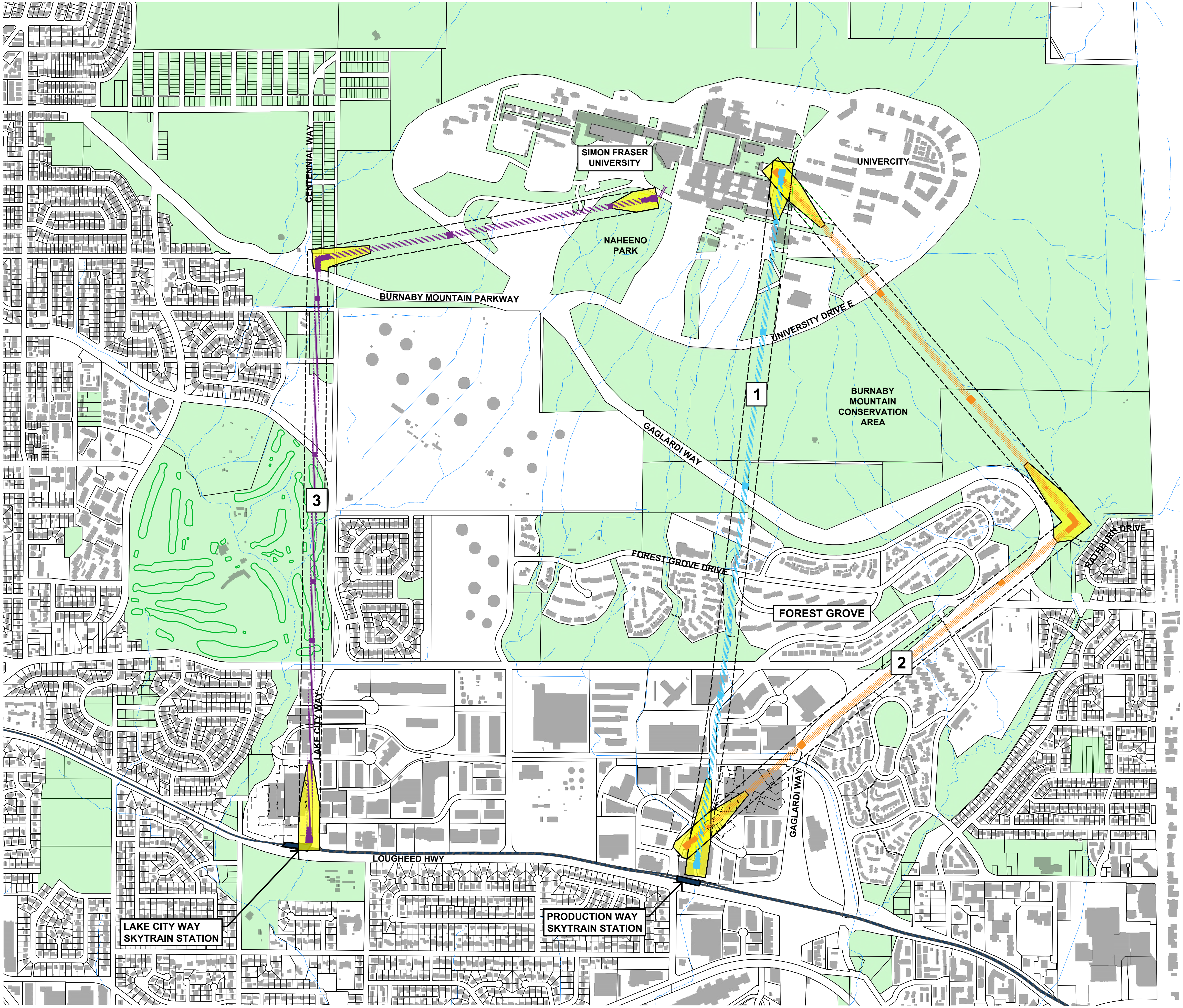

BURNABY MOUNTAIN GONDOLA

TRANSLINK

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Mountain Resort Planners Ltd.
Box 63 Whistler, B.C. Canada V0N 1B0 (604)932-5976 Fax:(604)932-1897
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Contour Interval: 5 metre
1:15000 at A3 Print
Date: 10/2020

0m 150 300 450 600 750

LEGEND

Proposed Burnaby Mountain 3S Gondola Routes with 20m ROW and Tower

Route 1

Route 2

Route 3

TransLink SkyTrain Station

Power Lines

Burnaby Mountain Conservation Area / City Park

30.5m Setback

Privacy Impact Zone
30.5m from Gondola ROW (line of sight)

PRIVACY IMPACT ANALYSIS

BURNABY MOUNTAIN GONDOLA

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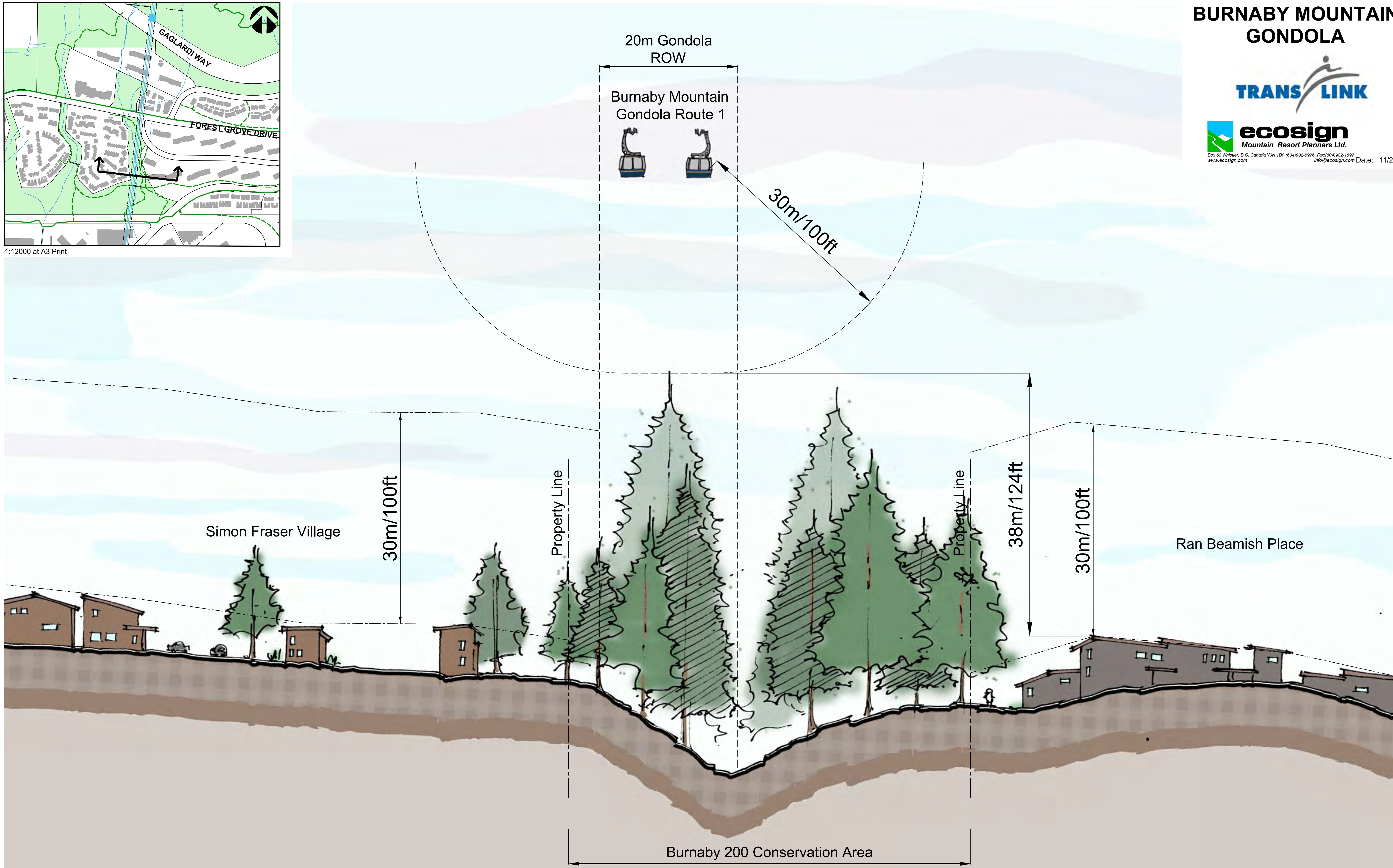

ROUTE 1 - SIMON FRASER VILLAGE - RAN BEAMISH PLACE ----

BURNABY MOUNTAIN GONDOLA

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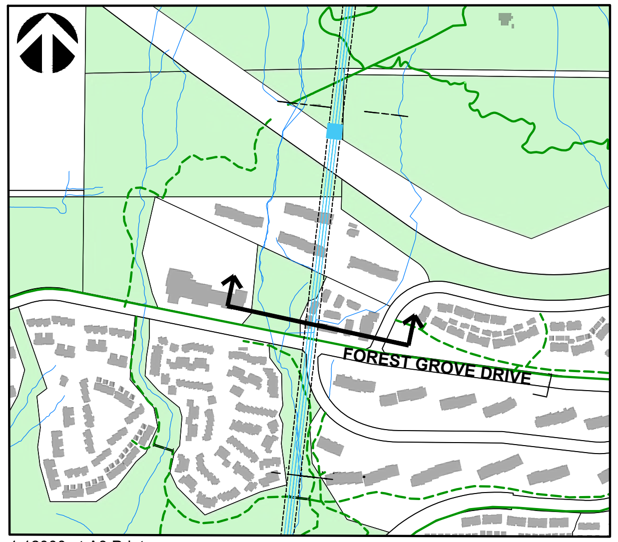

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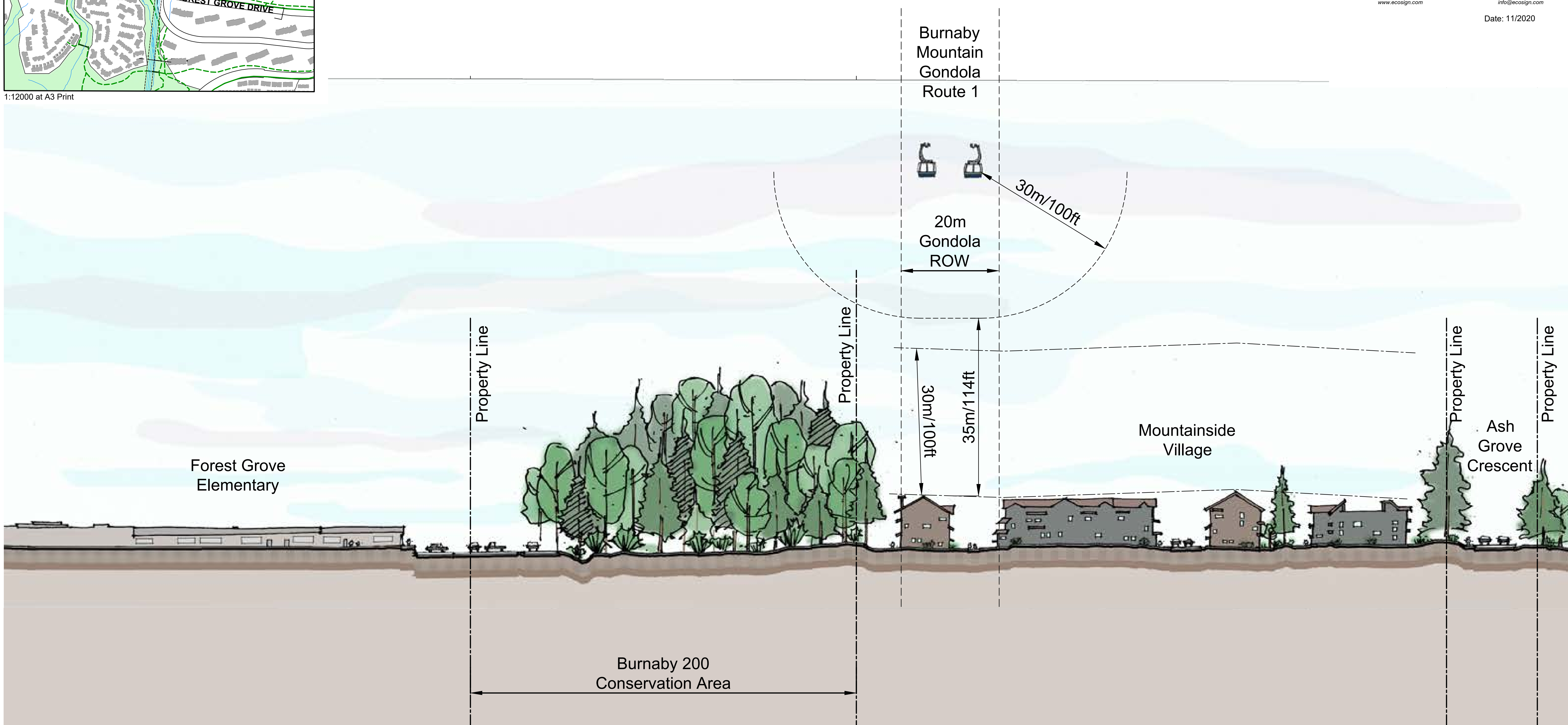

ROUTE 1 - FOREST GROVE ELEMENTARY - MOUNTAINSIDE VILLAGE ----

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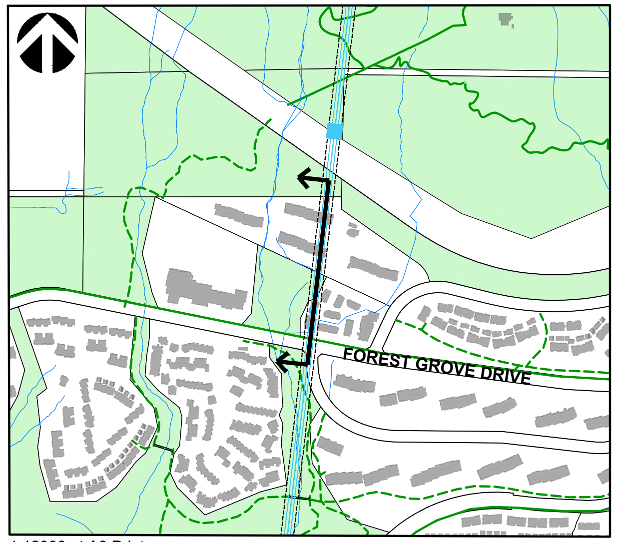

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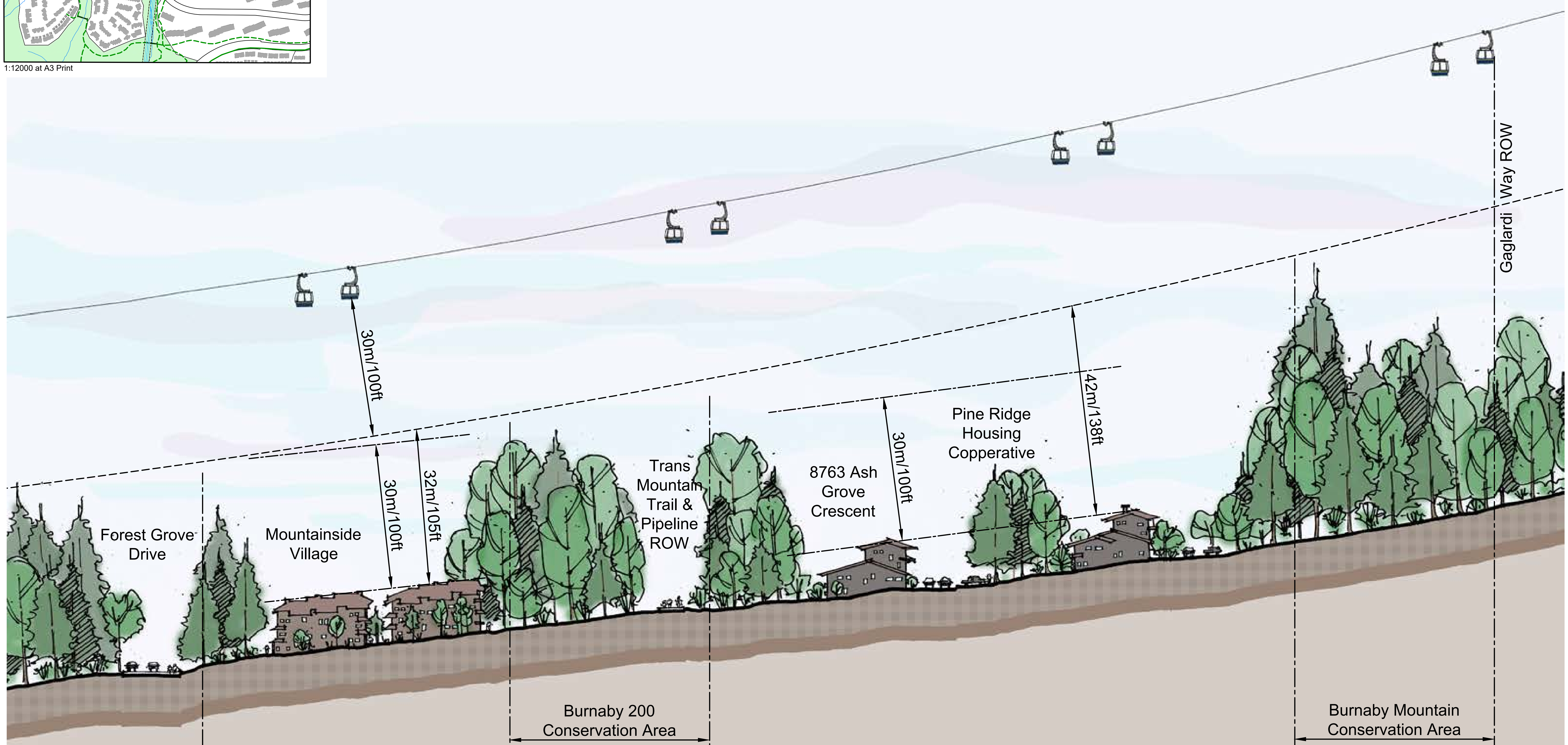

ROUTE 1 - FOREST GROVE DRIVE - GAGLARDI WAY ----

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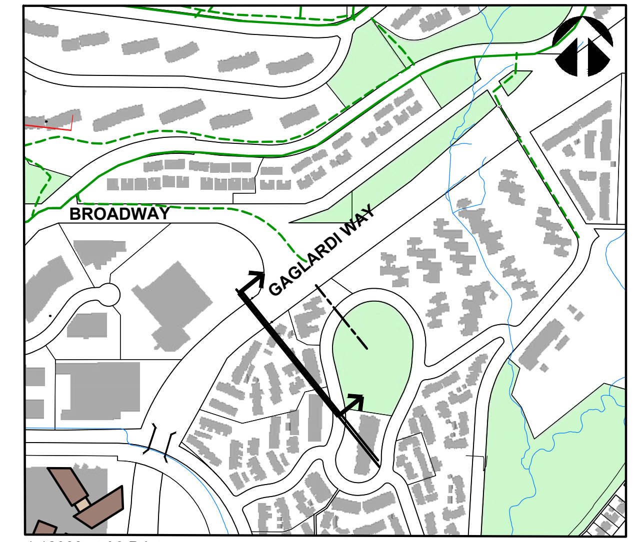

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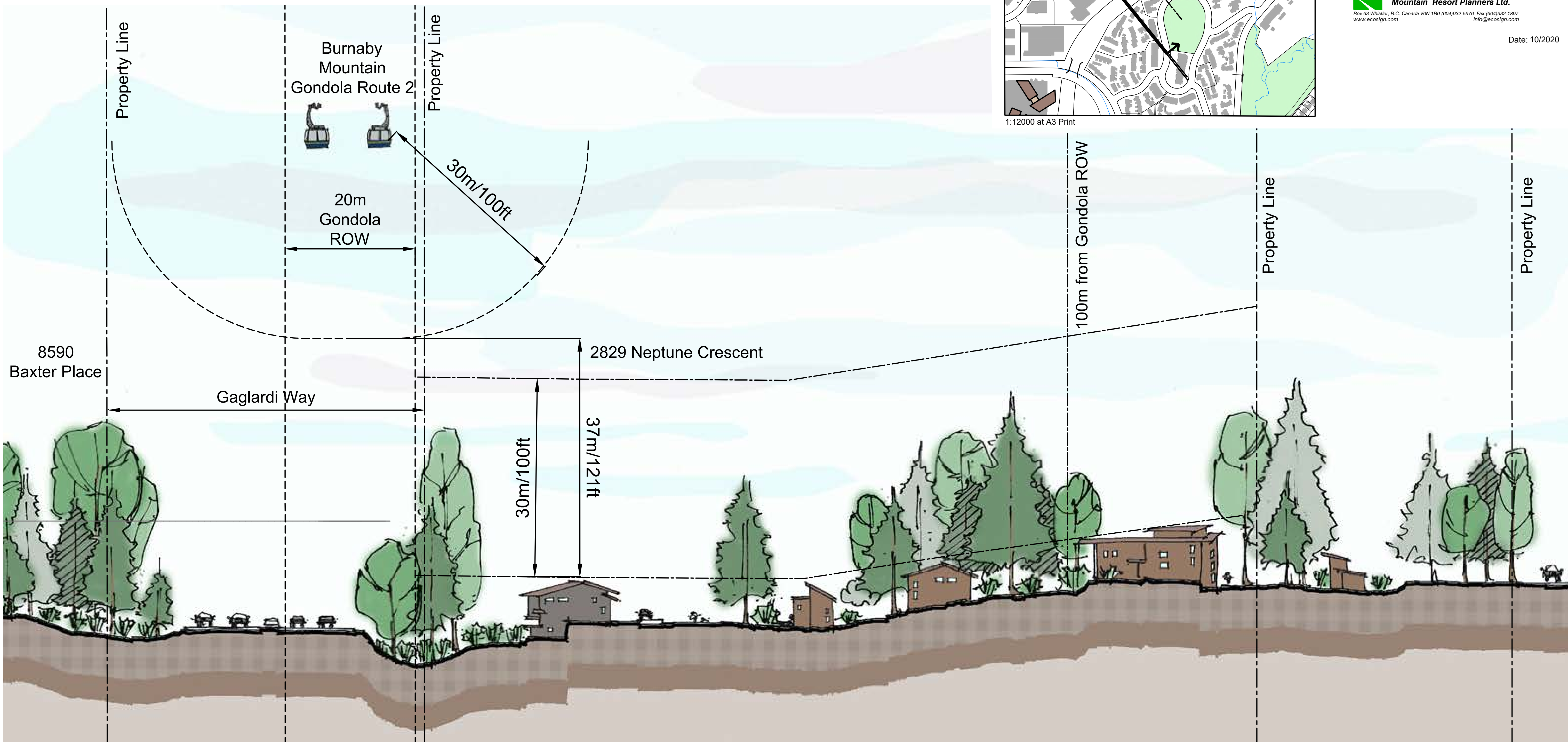


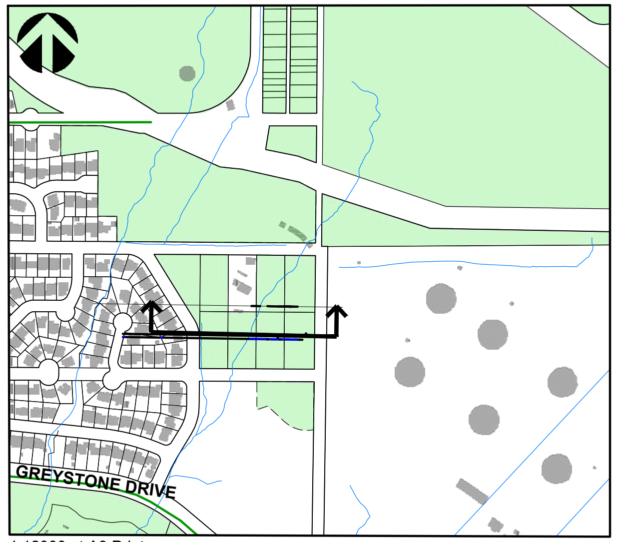
SITE SECTION - ROUTE 2 ----

BURNABY MOUNTAIN GONDOLA

TRANSLINK

ecosign Mountain Resort Planners Ltd.

Date: 10/2020



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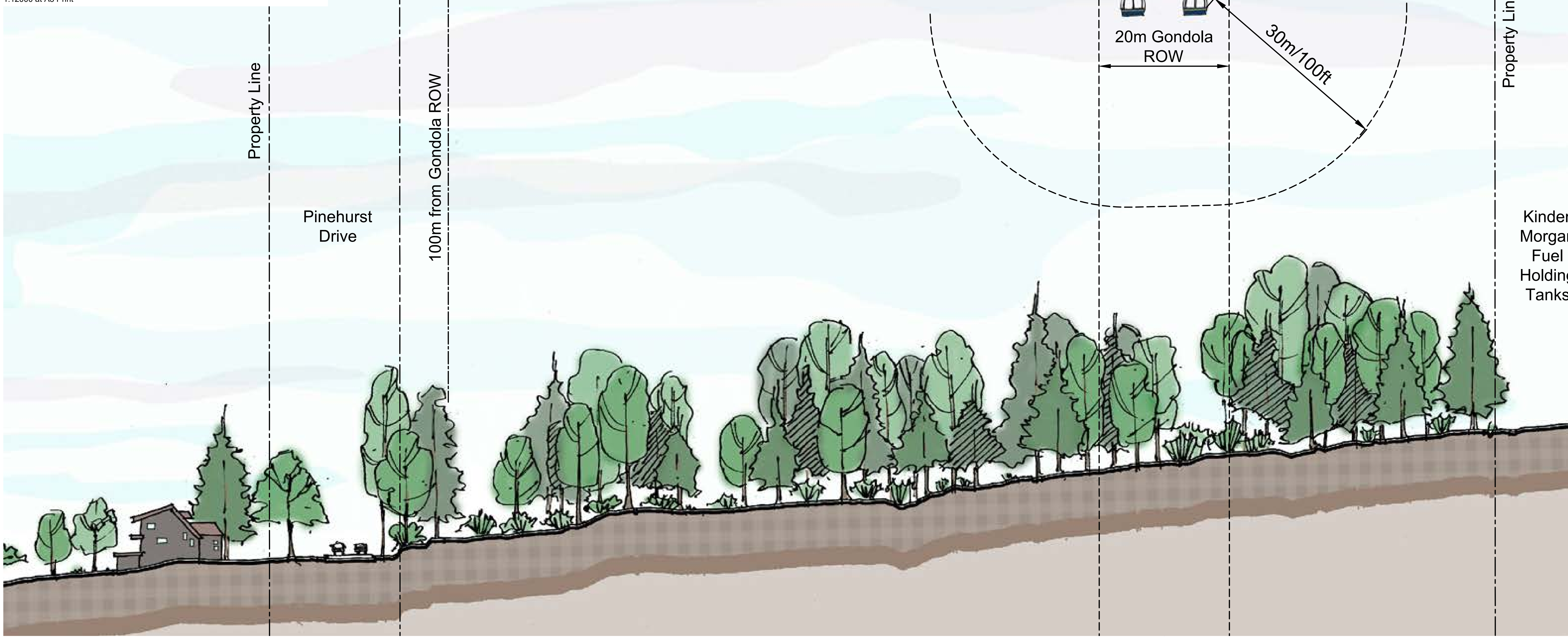
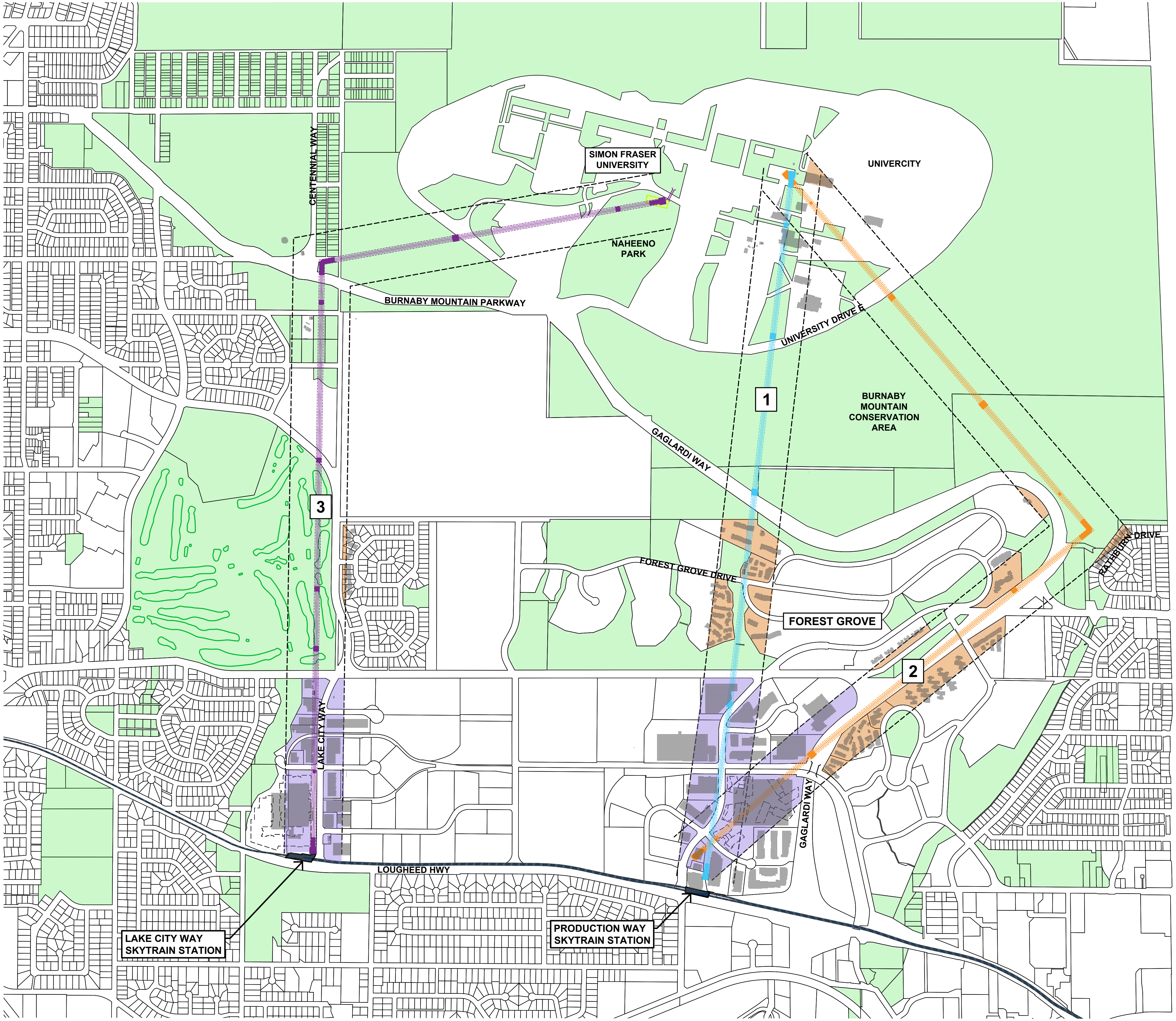


SITE SECTION - ROUTE 3 ----

BURNABY MOUNTAIN GONDOLA



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Date: 10/2020

0m 150 300 450 600 750

LEGEND

Proposed Burnaby Mountain 3S Gondola Routes with 20m ROW and Tower

Route 1

Route 2

Route 3

TransLink SkyTrain Station

Power Lines

Burnaby Mountain Conservation Area / City Park

100m Setback from Gondola ROW

Visual Presence Zone (Residential Areas)
100m from Gondola 20m ROW

Visual Presence Zone (Industrial/Commercial Areas)
100m from Gondola 20m ROW

VISUAL PRESENCE ANALYSIS

SCJ ALLIANCE
CONSULTING SERVICES

Memorandum

To	Holly Foxcroft, Project Manager, TransLink
From:	Steve Dorau, Senior Project Manager
Date:	October 19, 2020
Project:	1418.04 Burnaby Mountain Gondola
Subject	Gondola System Vandalism

SCJ Alliance prepared this memorandum to provide comments to TransLink regarding the recent news that the Sea-to-Sky Gondola in British Columbia was vandalized for a second time in just over a year. SCJ understands that the vandalism is concerning to both TransLink and the public, especially in light of the developing plans for the Burnaby Mountain Gondola (BMG). In concert with the gondola advisory services that the SCJ and Leitner-Poma Canada team are providing to TransLink, SCJ Alliance offers our ropeway transportation experience in evaluating this issue. We hope we can both reassure rightful concerns and provide recommendations for use in the gondola planning process. SCJ believes that through comprehensive planning, careful design and the active management of risk, the BMG can be protected from similar vandalism. This is especially important as the BMG may cross over a number of properties and structures, where it would be unacceptable for a similar event to occur. SCJ hopes the suggestions in this memo inspire brainstorming during the planning process. Every situation is unique and so are the possible solutions.

Could this Happen to the BMG?

More than 700 ski areas dot North American alpine landscapes with thousands of ski lifts and gondolas in use at any given time. These lifts, gondolas and cable cars transport hundreds of thousands of passengers per day without incident. While vandalism is not unheard of, it is very uncommon. The scale of the damage to the Sea-to-Sky Gondola is exceptional in our industry. The fact that there was clear intention to cause such damage makes this a completely unprecedented situation.

This is not the work of a typical vandal. The culprits would have had to know the terrain well enough to traverse it at night, be physically fit, be equipped with powerful tools and possess the ability and knowledge to use these tools to sever the cable without harming themselves. That alone should provide some comfort. The public should gain further relief from the fact that such vandalism would be virtually impossible to accomplish while the gondola system was operating due to the difficulty in cutting a moving cable. Further, in a transit environment, the best defense against vandalism is observant passengers, employees and pedestrians notifying authorities of suspicious behavior.

So, the answer is “no” in the case of the BMG. Since this system is still being contemplated and planned, TransLink can make design choices as the project progresses that will make the likelihood of this type of vandalism nearly zero. The following page describes some mitigation strategies that can be employed.

Potential Mitigation Strategies

The solution to this type of destructive vandalism centers on controlling and monitoring access to a gondola system's stations, towers and, most importantly, the cables used to propel and support the gondola cabins.

- Firstly, all system access points should be monitored via closed circuit cameras and motion detection systems.
- Secondly, design implementations such as physical barriers, gates and locks should be used to impede access to system critical components so that authorities have sufficient time to reach the site in the event that a vandal gains access to the system.
- Finally, stations and towers should be designed in a way that eliminates the possibility of unauthorized persons accessing critical system components, specifically the system's cables. Stations are buildings and typical barriers to entry and security systems are adequate to protect the system's cables. With regards to towers, rather than constructing lattice-type towers similar to power transmission towers, unclimbable tubular towers can be installed. Additionally, instead of placing maintenance ladders on the exterior of towers, ladders can be placed on the inside as is done with wind turbine towers. In this configuration, tower access would be controlled by lockable doors and monitored with a security system. A similar arrangement was implemented on an urban cable car system in Ankara, Turkey.