Burnaby Mountain Gondola Transit Project

Success in Integrating Sustainable Transportation and Land Use

Prepared by:

Ian Fisher, Senior Transportation Planner, TransLink

Robert Rollin, Senior Project Manager, CH2M HILL

Paper prepared for presentation

at the **Success in Integrating Sustainable Transportation and Land Use** Session

of the 2011 Annual Conference of the

Transportation Association of Canada,

Edmonton, Canada

Burnaby Mountain Gondola Transit Project

Success in Integrating Sustainable Transportation and Land Use

Abstract

TransLink, with the support of the BC Ministry of Transportation and Infrastructure and P3 Canada, is reviewing the potential for a high-capacity gondola connecting Burnaby Mountain to the nearest SkyTrain rapid transit station. The mountain accounts for 25,000 daily transit passenger trips and is home to the main campus of Simon Fraser University, with 18,200 students, growing to 25,000 in future, and the UniverCity sustainable community, with residents increasing from 3,000 to 10,000. While the mountain is only 2.7 kilometres from the nearest SkyTrain station, it is almost 300 metres higher in elevation. Approximately 45 diesel buses arrive on the mountain in the peak hour but pass-ups are common and the service is often disrupted in winter weather. An initial study indicated that a high-capacity gondola could replace most of the bus service, with bus cost savings covering the gondola operating cost and a portion of capital. Additionally, a gondola has the potential to reduce greenhouse gas emissions, increase reliability, and cut travel times by one-third, attracting more riders to transit. The costs and benefits, and potential delivery models, are being reviewed in a Business Case completed in summer 2011.

Executive Summary

Sustainable transportation and land use is a broad subject that can and has been interpreted in a multitude of ways. From the utopia of a greenfield transit-oriented development that optimizes every aspect of the project to favour increased transit ridership to a simple policy change that curtails urban sprawl, both can be successful in integrating sustainable transportation and land use.

The project reviewed today can be analyzed from different points of view: re-addressing planning decisions made years ago or simply completing the vision of a full community at Simon Fraser University (SFU) by responding to transit demand. The Burnaby Mountain Gondola Transit Project (the Gondola Project or the Project) aims to respond to ridership demand created by past land-use policies and decisions by providing the most sustainable technology available—the benefits are cleaner energy, reduced travel time, and increased service reliability.

This paper demonstrates that, while the Gondola Project does not directly promote change in land use or densification along the alignment, the choice of technology provides a sustainable solution to the demand created by land-use policies and decisions made in the past five decades.

1. Problem Statement

In 1963, following a report from the President of the University of British Columbia (UBC) concluding that further higher education establishments were needed in British Columbia (BC), the University of Victoria and SFU were created by the BC Legislative Assembly (1). In November 1963, after analyzing sites in Surrey, Langley, Delta, and Coquitlam, a site on top of Burnaby Mountain was selected as the location for SFU, and the University was opened in 1965.

In the 1960s, when universities where seen as prestigious and exclusive, a relatively inaccessible mountain-top location satisfied the socially acceptable sustainability policy of the time. In the context of today’s knowledge of the sustainability impacts related to transportation and land use, selecting a site with limited potential for adjacent development and offering limited transportation choices is questionable. The mountain-top location reduces access for many sustainable transportation modes, such as cycling or walking.

In the 40 years since its creation, the growth of SFU has resulted in four key issues for the transit system: transit volume, service reliability, environmental impacts, and cost (Figure 1).

Figure 1: Summary of Problem Statement

1.1 Transit Volume

Today, Burnaby Mountain accounts for 25,000 daily transit passenger trips (2) as a result of the 18,200 SFU students (with expected growth to 25,000 students in the future) and the 3,000 residents of the UniverCity sustainable community (with expected increases to 10,000 residents) (3). While the mountain is only 2.7 kilometres (km) from the nearest SkyTrain station, it is almost 300 metres (m) higher in elevation. Approximately 45 diesel buses arrive on the mountain in the peak hour but pass-ups are common and the service is often disrupted in winter weather.

Transit ridership to and from SFU is heavily concentrated on a single route—Route 145. Half of the transit riders use this route as it offers the most direct service to the SkyTrain at Production Way – University Station (Figure 2). This pattern holds true in the morning peak hours as well, with Route 145 carrying over 1,200 of the 2,500 transit passengers arriving on Burnaby Mountain in the morning peak hour (2).

Route 145 operates an intense service in the peak periods with articulated buses every 3 minutes in the morning peak and service every 7.5 minutes during midday. Travel time is approximately 15 minutes from SFU to the SkyTrain, and is relatively long, despite few intermediate stops and signals, due to the road distance required to overcome the elevation change.

The planned further development and increases in density of the residential units at UniverCity on Burnaby Mountain (Figure 3) will further contribute to the demand on the transit system. This, combined with the bus integration for the planned rapid transit expansion to the east to connect with Coquitlam (the Evergreen Rapid Transit Line), will increase the estimated number of buses needed to support Routes 143 and 145 from 19 peak vehicles today to 25 in 2021.

Figure 2: Fall 2009 Share of SFU Riders by Bus Route (2)

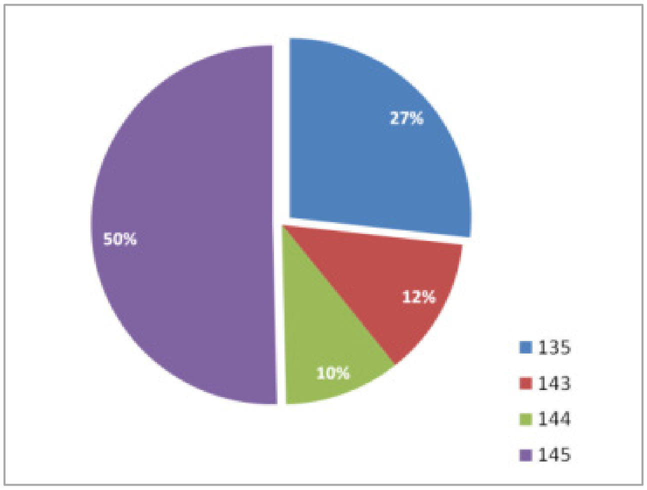


Figure 3: Burnaby Mountain Planned Development (4)

1.2 Service Reliability

Snow and ice, as well as collisions, on the roads accessing Burnaby Mountain lead to reduced or cancelled bus service (including substitution of articulated with standard buses) an estimated 10 days per year (5). This causes significant disruption to the functioning of the campus and limits the ability of UniverCity residents to reach or return from the rest of the Region.

1.3 Environmental Impacts

Travelling on an incline contributes to a very heavy duty cycle for the buses on this route, and to a lesser extent other Burnaby Mountain routes. The buses typically operate continuously at full throttle with full passenger loads while climbing the grade, then must brake almost as extensively on the descent. This, combined with the poor quality of the pavement, results in a poor overall passenger experience on the route.

The noise and emissions from the buses are also notable, particularly for the residents of the Forest Grove neighbourhood around which Gaglardi Way loops in its lower switchback, and it is estimated that the buses produce 1,700 tonnes of greenhouse gas (GHG) annually (6).

1.4 Costs

The projected increased demand for transit service has resulted in the transit exchange at SFU being oversubscribed in terms of bus layover space and passenger crowding. A plan for a much expanded transit hub with enclosed bus layover was conceptually approved in 2009 but budget for the estimated $10 million cost has not been approved.

The high duty cycle for buses serving Burnaby Mountain, which is particularly acute for vehicles on Route 145, is estimated to result in a 10 percent operating cost premium based on Coast Mountain Bus Company estimates that assume the wear-and-tear and fuel use is comparable to diesel buses in North Vancouver and Vancouver rather than the system average. Aggregate operating costs for all four routes serving Burnaby Mountain are estimated at $22.7 million in 2011, rising to $26.5 million (2011$) in 2021 due to increasing demand and Evergreen Line integration (5).

While not a monetized benefit in the Business Case, these buses also have a high impact on the road infrastructure serving Burnaby Mountain contributing to road repair and maintenance requirements on Gaglardi Way, part of TransLink's Major Road Network.

2. Project Objectives

A number of current transit projects being planned in western Canada have clearly stated their objective is to shape the land use along the alignments. For example, the City of Edmonton in Alberta and Surrey in Metro Vancouver are both intending to use light rail transit (LRT) to spur growth and redevelopment of higher density neighbourhoods along selected corridors.

The Burnaby Mountain Gondola Transit Project objectives are less aspirational and respond to existing and projected ridership demand resulting from the land-use policies and development projects since the 1960s. Contrary to other rapid transit projects, the primary objective of the Gondola Project is to address the problems associated with transit volume, service reliability, environmental impacts, and cost described in the previous section, and support current and planned development.

While recent decisions to expand SFU in campuses in downtown Vancouver and Surrey, both well served by transit, have also served to reduce demand for ridership to the Burnaby Mountain site and revitalize other urban centres, other policies, such as the introduction of U-Pass and the limiting of cars on Burnaby Mountain through parking fees, have increased ridership demand.

The objectives of the Gondola Project are extensive and include:

- Responding to current and projected ridership demand with a more sustainable transit solution by improving the efficiency of transit service delivery to Burnaby Mountain.

- Improving service reliability by ensuring transit service can be delivered without interruption during adverse winter weather and when collisions affect the road access to Burnaby Mountain.
- Attracting new riders and better serving existing riders by providing a more comfortable, faster, more frequent, and enjoyable transit experience.
- Reducing the local and global environmental impacts of transit service through reduced air and noise emissions.
- Minimizing transit's adverse effects on local residents by reducing bus traffic.
- Meeting projected demand increases for transit to and from Burnaby Mountain.
- Increasing tourist and recreational use of transit by providing a high-quality and distinctive service that is an attraction in itself, as well as serving destinations of moderate tourism and high recreational value.

3. Sustainable Transportation and Land Use in Vancouver

Metro Vancouver, with an area of 2,820 square kilometres (km^2) and comprised of 22 municipalities (7), is often regarded by urban planners as a model city in terms of land-use integration with transportation. The Liveable Region Strategy prepared in the 1970s focused on two concepts that guided land use and transportation in the Region: 1) the development of town centres and villages; and 2) the limitation of freeways. Coupled with a limited area for growth due to the ocean and mountains, Metro Vancouver developed areas of high density along transit corridors.

With the adoption of the Liveable Region Strategy, the Region was already preparing for rapid transit ahead of the implementation of SkyTrain in 1986. As soon as the SkyTrain project was announced, the municipalities started to plan development along the proposed line. The investment in SkyTrain along with complementary urban planning policies set the stage for urban growth. In the 25 years since SkyTrain started operations, the development along the corridor has followed the typical pattern of higher density close to the stations. The density increase along the corridor has followed the periods of economic growth and many areas are still in various phases of planning.

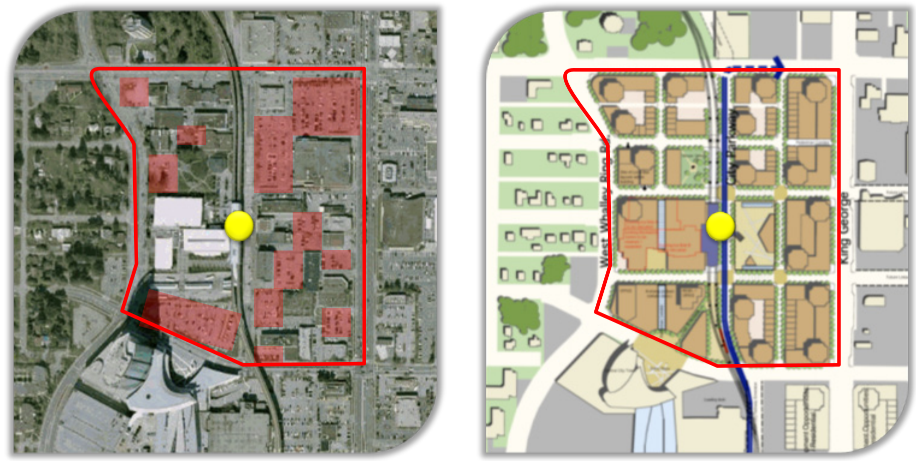
Between 1981 and 2006, the number of dwellings around the SkyTrain alignment grew at a rate almost 8 times that of the surrounding areas (8). A view of the Metro Vancouver skyline clearly shows the growth along the corridor (Figure 4). The continued effect of growth along rapid transit corridors continues in Metro Vancouver with the introduction of the Canada Line. Redevelopment at the Broadway and Cambie intersection in Vancouver began in anticipation of the arrival of the Canada Line, while Richmond plans allow for 50,000 more residents by 2041 in the city centre along the Canada Line in five high-density neighbourhoods surrounding stations (9).

Figure 4: Aerial View of Vancouver and Burnaby

While a rapid transit system like SkyTrain is conceived to link existing town centres, it fosters further growth along the alignment at the intermediate stations as well. The growth along SkyTrain in Metro Vancouver continues after 25 years and a number of town centres and villages are planned in the vicinity of existing stations (Figure 5). TransLink and the Cities of Vancouver, Burnaby, and Surrey have conducted a number of studies to analyze potential urban development to foster transit-oriented development and promote transit and non-vehicle travel modes (Figure 6).

Figure 5: Conceptual Plan of Broadway-Commercial Transit Village

Figure 6: Transit-Oriented Studies



Surrey Central SkyTrain Station Existing land consumed by surface parking

3.1 Serving Demand Instead of Shaping

In terms of potential development along the alignment, the Burnaby Mountain Gondola Transit Project will be comparable to the SeaBus route that links centres in Vancouver and North Vancouver but with no possibility for intermediate stations or development along the route. The primary purpose of the SeaBus was to connect existing town centres and respond to existing demand from North Vancouver commuters working downtown.

The SeaBus offers a prime example where the connection of the two town centres by a sustainable transit mode and supported by a clear commitment by the City of North Vancouver to higher density, has fostered significant development. Since ferry service resumed in 1977, following a failed attempt to build a freeway across Burrard Inlet, the Lower Lonsdale town centre has become one of the highest density areas in the Region and more development is planned (Figure 7). The City of North Vancouver has a population density of 3,707/km^2 compared to the regional average of 355/km^2. By comparison Vancouver has a population density of 5,335/km^2 and Burnaby, where the Gondola Project is proposed, has a density of 2,275/km^2 (10).

Figure 7: High Density in North Vancouver

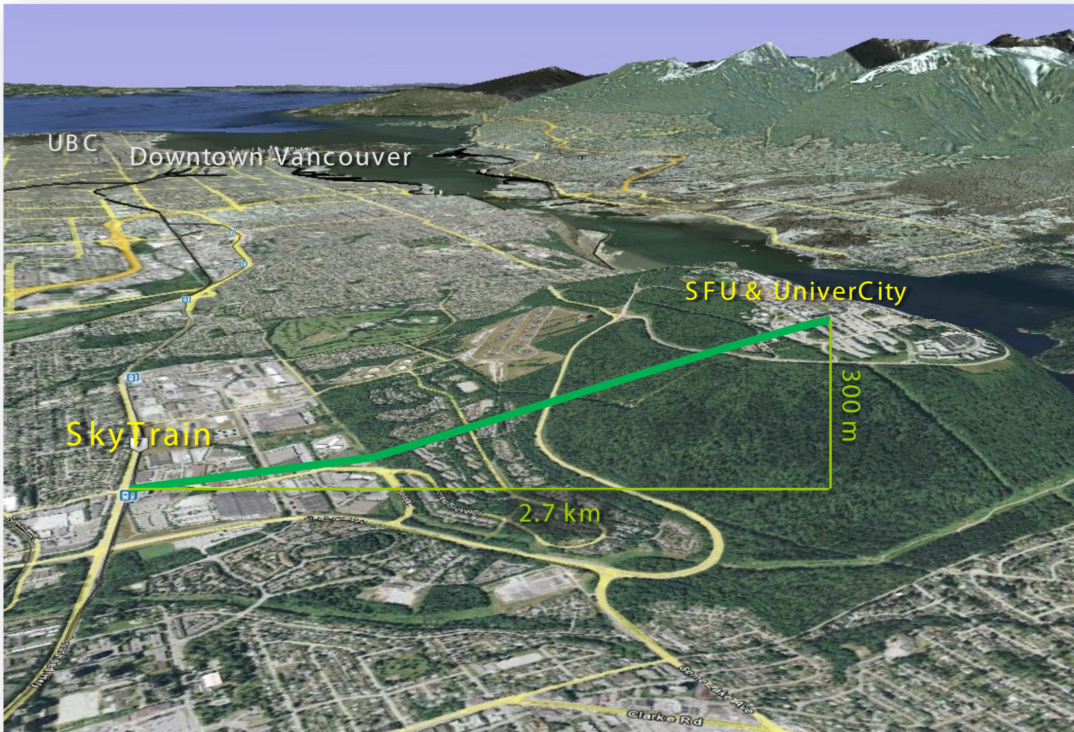
4. Gondola Technology as Sustainable Transportation

The current demand for transit due to the recent development of UniverCity on Burnaby Mountain and the predicted growth of the SFU and resident population provided an opportune time to review the service to Burnaby Mountain. UniverCity developed a feasibility study in 2008 and TransLink prepared a Business Case in 2011. Both studies looked at a number of alignments and compared various technologies to offer improvements to diesel buses in terms of capacity, travel time, reduction in GHG, and noise.

4.1 Why a Gondola?

Figure 8 provides a birds-eye view of the two activity centres to be connected by the gondola. As described in the following section, an in-depth analysis of a number of technologies and alignments was undertaken as part of this Project to determine the most sustainable solution in terms of meeting demand, environmental impacts, and capital and operating costs.

Figure 8: Gondola Alignment Overview



4.2 Technology Review

A list of the ground and aerial technologies analyzed as part of the technology review is provided in Figure 9 and a comparison of ground-based and aerial options is provided in Table 1. A range of surface-level rapid transit systems, including bus rapid transit (BRT), SkyTrain, LRT (including rack railways), and funiculars, were considered. Although they offer greater opportunity for development at intermediate stations, fundamentally all surface options are challenged by the difficulties in securing a ground-level right-of-way that has acceptable property and environmental impacts. All would require property acquisition and permanent tree clearing within the right-of-way and result in significant costs and political issues. The alignment also has to cross a conservation area where development would not be allowed, thus negating any development benefit on the other portion of the alignment. Other constraints related to surface options include:

- “Conventional” ground-level technologies (BRT and LRT) would need to follow the existing road rights-of-way to ensure grades are manageable. Some systems, such as SkyTrain, would need an even longer route due to grade limitations. Such longer routes would not achieve any time savings over the existing bus service.

- Ground-level technologies that are designed for steeper grades (for example, rack railways and funiculars) could achieve better travel times through their ability to take a direct route, but their ground-level impacts on existing uses (including local residences) would be high if their potential travel time benefits were to be achieved.

Figure 9: List of Technologies Analyzed

- Ground-based
  - Diesel bus (Base Case)
  - Trolleybus
  - LRT (Light Rail Transit)
  - GLT (Guided Light Transit)
  - Funicular
  - Rack Railway
  - Rail Rapid Transit (e.g. SkyTrain)
- Aerial
  - Aerial Tramway/Reversible Ropeway
  - Gondolas
    - Monocable
    - 2S & 3S (2 rope and 3 rope)
    - Funitel



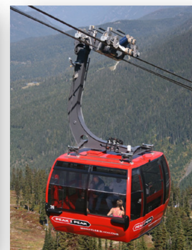



Table 1: Summary of Technology Analysis

Issue\Lower Terminal	Ground-based	Aerial
Conservation Area Impact	✗✗	✓
Residential Impact	✗	✗
SkyTrain/Transit Integration SFU Campus/UniverCity	✗	✓
Development potential	✗	✗✗
Transportation (reliability, travel time)	✗	✓
Property acquisition risk	✗✗	✗
Environmental (GHG, noise)	✗	✓✓
Safety & Approvals (external causes)	✗	✗✗
Cost (including property)	✗✗	✓

The technology review of aerial options looked at aerial tramway/reversible ropeway and a variety of gondola types. A 3S gondola is considered the most feasible option. Other aerial options are not considered to be feasible due to capacity and reliability constraints and surface impacts, including:

- A reversible ropeway system operates with two cabins shuttling between the terminals, imposing a capacity constraint that is determined by the length of the installation.

- A conventional (monocable) gondola could likely provide sufficient capacity but the application would be near the upper limit of its capabilities. A more significant constraint is that such systems require frequent towers, particularly to support the cabin density that would be needed in this application. This would result in large property requirements and the inability to pass readily over obstacles, particularly roads, buildings, and forest. The cabins are also relatively small, making them less accessible for wheelchairs and mobility devices.

Although the 3S gondola is a relatively new technology, it is an evolution of ropeway technology that has been proven in urban and alpine applications worldwide, such as the Metrocable in Medelin, Columbia. It has the capacity to meet the projected demand and can offer a significant travel time advantage over bus service due to in-vehicle time being cut in half and provision of a much higher frequency service, particularly in off-peak periods. The 30- to 35-passenger cabins are relatively large and offer ample room for wheelchair and cyclist access, with level loading and very slow cabin speeds in terminals. Capacity can be adjusted to meet demand by adding cabins with 3,000 passengers per hour per direction (pphpd) as the initial capacity, with planned expansion to 4,000 pphpd by 2041 and a technical limit of 5,000 pphpd.

The Burnaby Mountain Gondola would extend from a lower terminal immediately east of the Production Way – University Station, and run generally above Production Way, continue over the Forest Grove neighbourhood, the Burnaby 200 and Burnaby Mountain conservation areas, and SFU streets, and terminate just south of the existing SFU Transit Exchange. The lift would require an estimated five towers of up to 70 m in height, sufficient to allow it to pass above all existing buildings and the tree canopy. The estimated travel time would be under 7 minutes and cabins would depart about every 40 seconds.

The cost of the technology and the Gondola Project overall is significant, however, it is offset by benefits. With the planned expansion to Metro Vancouver's rapid transit system from the existing SkyTrain system to Coquitlam, (Evergreen Line) the benefits will exceed the costs by a factor of 3.6. Financial viability is suggested by there being an $11 million (net present value at 6% discount rate) gap between gondola costs and bus savings (6).

4.3 Alignment Review

The alignment review for the Burnaby Mountain Gondola had a few primary objectives. Of primary importance was minimizing the impact to the existing residents and businesses along the potential alignments. Although alignments with mid-stations were considered in a previous study (3), they were ruled out due to the excessive cost and reduction in travel gains.

Figure 10 provides an overview of the alignments analyzed and some of the key areas of impact.

Figure 10: Alignments Analyzed

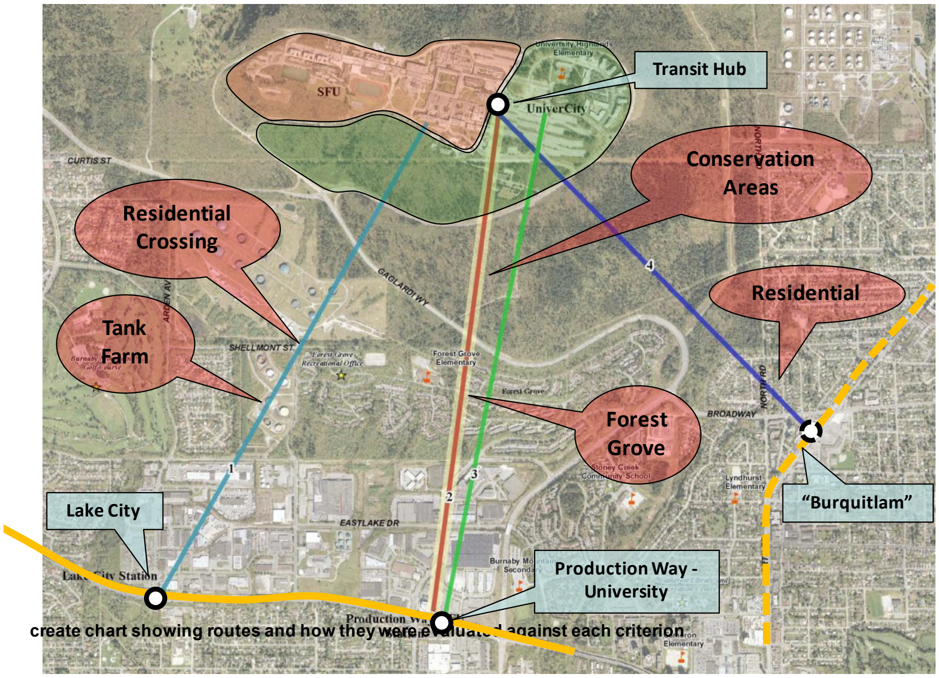


Table 2 clearly shows that Alignment 2 (Production Way – Transit Hub) provides greater benefits for minimizing the resident and property impacts while keeping the alignment short. Alignments 1, 3, and 4 all impacted the development potential at UniverCity. The land use at all three SkyTrain stations is similar with mixed use but with more residential development at Burquitlam (planned station) and more industrial development at Production Way and Lake City.

Table 2: Summary of Alignment Analysis

Issue\Lower Terminal	1: Lake City	2: Production Way – Transit Hub	3: Production Way – Tower Rd	4: Burquitlam
Conservation Area Impact	✓	✗	✗	✗✗
Residential Impact	✓	✗	✗✗	✗✗
SkyTrain/Transit Integration	✗	✓✓	✓	✗
SFU Campus/UniverCity Integration	✗	✓✓	✗	✗
Property acquisition risk	✗✗	✓	✗	✓
Safety & Approvals (external causes)	✗✗	✓	✓	✓
Cost (including property)	✗	✓	✗	✗

4.4 Gondola – A Sustainable Solution

The key advantages of the 3S gondola technology and the alignment option selected are described below in terms of how they meet the Project objectives:

- Reliability during adverse weather is very high. This has been demonstrated by other ropeway systems, including those in urban environments such as the Portland Aerial Tram and Roosevelt Island Tram. 3S gondolas can operate at the highest typical wind speeds historically recorded at Burnaby Mountain and are not subject to the winter road conditions that often disrupt service today (11, 12).
- By cutting the in-vehicle travel time from about 15 minutes to less than 7 minutes and by greatly increasing frequency, particularly in the off-peak period, the gondola could attract additional ridership. The regional transportation demand model projects that the gondola would handle 72% of all transit travel to and from Burnaby Mountain (6).
- Additional riders and revenue would result from the novelty of the system and its support of the tourist and recreational uses of Burnaby Mountain, including the conservation area.
- Gondolas are driven electrically and are very energy efficient given that the system operates in a loop with the mass of ascending cabins balanced by descending cabins. In an urban environment this effect is enhanced as passengers travel in both directions, compared to a ski lift operation where most passengers only travel on the ascent. This results in the potential for large reductions in GHG emissions, estimated at 7,000 tonnes annually in 2021. About 1,800 tonnes comes from substituting the gondola for diesel buses and the remainder is from a shift from automobiles due to the service being more attractive (6).
- Gondolas are almost silent when travelling between terminals, and noise and vibration isolation measures are taken at the towers to reduce noise at these points. A gondola would allow large reductions in diesel bus service and the near-elimination of Route 145, which now wraps around a residential neighbourhood.
- Additional gondola capacity can easily be added provided that towers and structures are designed anticipating this at the outset. The design, as proposed, would be capable of expansion to 4,000 pphpd, 20% above modelled 2021 demand, but this margin could be increased to the technology's limit of approximately 5,000 pphpd.

The main disadvantages and risks associated with the 3S gondola and preferred alignment include:

- The technology is relatively new and has largely been used in recreational applications to date. The hours of service required daily in an urban transit setting are much longer than typical in recreational use, though the operating environment in terms of weather and accessibility is better. Urban ropeway systems with comparable hours of operation to that proposed do exist, but they are relatively few in number.
- The reference alignment has been selected to minimize property impacts but it still crosses above portions of six multi-family residential buildings (Figure 11). The Project budget has been developed taking these conditions into account, and the Project would have virtually

no impact on the liveability of the units. However, the potential exists for political risks associated with the alignment.

- The alignment must cross over the Burnaby Mountain Conservation Area, which is defined by a covenant between the City of Burnaby and the Province that restricts uses. While the gondola would increase access to the conservation area, while reducing most environmental impacts (particularly noise and emissions), the interpretation of the covenant may generate concern.

- To minimize the property and environmental impacts of the gondola, innovative rescue systems would be required. Conventional rescue systems involve lowering passengers directly to the ground. This requires land clear of trees and buildings, which would impose significant property and environmental impacts. The latest practice in Europe is to include a very high level of drive redundancy in the terminals, removing the need for other forms of rescue (11, 12). The latter approach is considered highly beneficial for the Gondola Project and initial discussions with the BC Safety Authority are promising.

- Passenger safety and security is a potential issue as the cabins would be unstaffed, though the terminals must be staffed on a full-time basis. The cabins would be fitted with intercoms, closed circuit television (CCTV), and lighting to mitigate this issue. A daily shift of Transit Police is also included in the Project operating budget. Given these factors, personal security would be comparable to or better than the current SkyTrain system in Metro Vancouver.

- Environmental approvals are a potential risk for the Gondola Project as the middle section of the route crosses conservation areas with watercourses. The streams are small and construction methods can likely be adapted to mitigate impacts, subject to greater review through an Environmental Assessment.

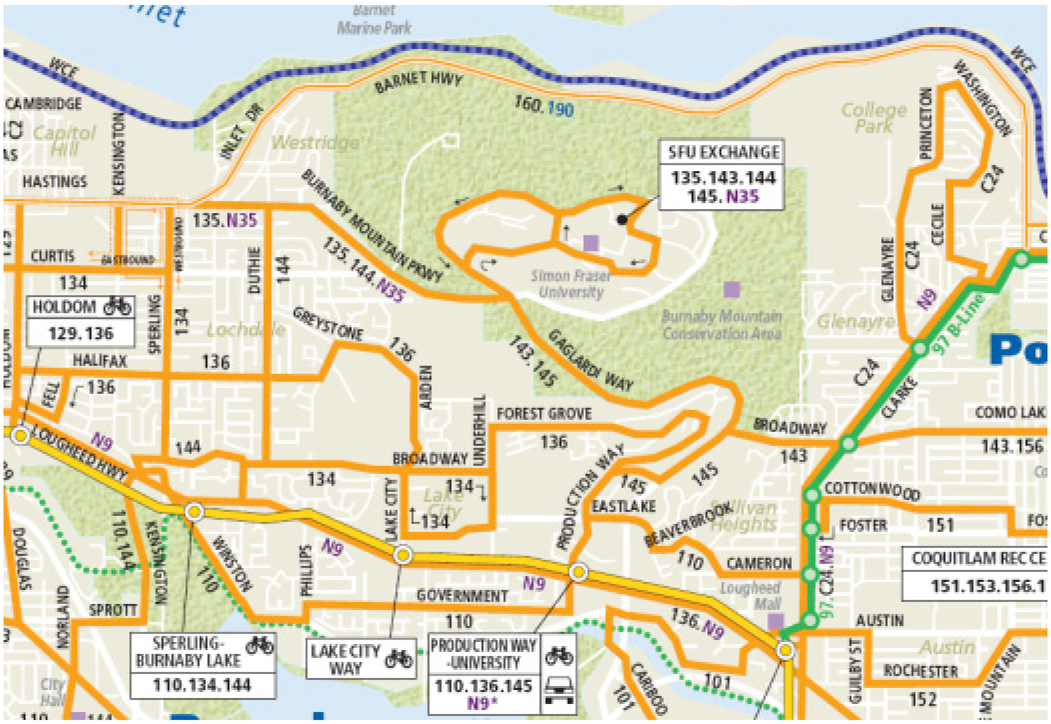
Figure 11: Rendering of Gondola over Residences

4.5 Cost Efficiencies and Bus Savings

A primary motivation for considering alternatives to bus service to Burnaby Mountain is the reduction in operating costs that occurs when bus services are replaced by a gondola. To calculate these savings, the regional transportation demand model was run with and without the gondola with pre-gondola bus service assumptions in both scenarios. The appropriate revisions to the bus service assumptions for the scenario with the gondola can then be based on the change in demand patterns by service observed from the model.

Figure 12 shows the four bus routes presently serving Burnaby Mountain. Route 135 from the west (downtown Vancouver), Route 143 from the east (Coquitlam), Route 144 from the south (Burnaby), and Route 145 linking directly from Production Way to Burnaby Mountain. As stated earlier, Route 145 operates at 3-minute headway during peak periods.

Figure 12: Existing Bus Routes (13)



The results of the modelling exercise were very clear. With the gondola in operation, ridership on the bus route it most closely parallels was reduced from over 1,200 pphpd today to single digits. This is not surprising since the gondola cuts the travel time in half and operates more frequently. Thus, Route 145 could be assumed to be eliminated. Furthermore, a bus route from the east that is expected to be a major connection between the planned SkyTrain expansion and Burnaby Mountain showed a drop from 430 pphpd today down to about 48 pphpd in 2021 with the gondola in operation. This result was also somewhat expected since the travel time for passengers remaining on SkyTrain to the station served by the gondola, plus the gondola travel time, is highly competitive with the direct bus travel time. In consequence, the gondola integration scenario assumes the direct bus route is discontinued. The other two bus routes serving Burnaby Mountain showed smaller reductions in demand of 25% and 33%.

Some portions of the remaining routes operate at near policy levels (every 12 minutes peak) and serve other major activity centres along the routes, including Burnaby City Hall and a number of schools. These routes would also be the most direct substitute for the gondola for any passengers with vertigo or other concerns and would provide a local distribution function on the mountain-top for trips with origins or destinations that are some distance from the gondola terminal. Taking these factors into consideration, service levels on these routes were assumed to be unaffected by the gondola.

With the initial travel demand model results showing essentially no use of the two bus routes proposed for elimination, and no changes to service on the other two routes, there was no need to rerun the model to reflect the bus integration plan proposed.

The bus savings were then calculated using a spreadsheet model of round-trip times (including recovery/layover time) and all-day headways. Small corrections were required to the resulting estimates of vehicle hours in order to ensure the base scenario matched current scheduled hours. With this data in hand, operating cost savings were calculated using the projected savings in vehicle hours and recent bus operating cost data from Coast Mountain Bus Company, TransLink's bus subsidiary. A 10% premium was applied to the average system cost per hour to reflect the severe duty cycles on the bus routes concerned with their heavy passenger loads and the continuous steep grades of Burnaby Mountain. Reductions in the number of buses required were also estimated and the capital savings included in the analysis. The assumption is that these saved vehicles will either be used elsewhere in the Region if TransLink is in a service expansion mode, or could be stored or used to accelerate vehicle retirements.

4.6 Gondola Serving Demand

Similar to the SeaBus discussed in previous sections, the Gondola Project will link existing activity centres—SFU and UniverCity to the SkyTrain rapid transit station at Production Way. The primary need of the Project is driven by existing and projected demand rather than the need to shape land use. The aerial technology offers no possibility for intermediate stations without significant costs, and the only potential development opportunities are near the terminal locations. UniverCity has already planned for the development of the area adjacent to the terminal location on top of Burnaby Mountain. While there is currently no active development at Production Way, the municipality has identified this as an area for more high-technology office and industrial uses, and an improved link to the academic and research communities at SFU is believed to be a major benefit. The local Official Community Plan (OCP) also calls for further residential development south of Lougheed Highway at Production Way Station (14).

Adjacent to the upper terminal, UniverCity is a leasehold community being developed to provide an endowment to support SFU. It is designed to be a compact, mixed-use, and transit-oriented community founded on principles of environmental, economic, and social sustainability. It has received the American Planning Association's inaugural National Award of Excellence for innovation in green community planning.

The residential component was already envisioned in the 1963 initial campus plan. The Official Community Plan of 1996 allowed for 4,536 units on 65 hectares (ha) with up to 10,000 residents at build-out (15). Development of UniverCity started in 2002 and current residents number approximately 3,000 with the first residents taking ownership in late 2004. UniverCity now has a full grocery store and the elementary school opened in 2010.

UniverCity was also planned as a transit community. Residents can opt into a community transit pass program launched in 2006, which provides significant savings on the monthly transit fare. The results show significant benefits: while 40% of residents were students, staff, or faculty at SFU, another 36% use transit for commuting (16). This is in comparison to 17% regionally. If one assumes that residents working at or studying at SFU do not use transit to commute, this shows impressive transit usage.

5. Progress Status and Approvals

The Business Case has been completed but funding for current projects, such as the Evergreen Line Rapid Transit Project, are under consideration at the time of this paper.

Pre-consultation was conducted in late 2010 and the first phase of public consultation was conducted in the spring of 2011 to provide local residents and businesses with a project update and supplement information shared during previous public engagement work performed by the SFU Community Trust. Additional consultation will be conducted once project funding has been secured.

Once the procurement decision has been made and funding is secure, preliminary engineering can proceed. This will entail further design work to optimize relational issues between tower design, heights, locations, and construction methodology to mitigate environmental effects.

5.1 Regulatory Approvals Process

To proceed with implementation of the Gondola Project, the expected regulatory approvals required include:

- City of Burnaby and/or Provincial approval for any relaxations to the covenants and bylaws that created the Burnaby Mountain and Burnaby 200 Conservation Areas
- An Environmental Assessment Certificate
- An installation permit and operating permit from the BC Safety Authority
- An emergency response plan, as a component of other approvals
- Roads and utilities crossing, proximity, and access agreements

Future rezoning requirements will need to be assessed but the proposed use appears consisted with existing zoning. The terminal at the upper station will be on mixed-use zoning and will be located near the existing bus loop. The lower station is zoned as industrial north of Lougheed Highway with a residential area with planned increased density south of Lougheed Highway.

6. Success in Integrating Sustainable Transportation and Land Use

This paper has looked at one specific project that demonstrates that success in integrating land use and sustainable transportation can apply to serving demand as well as shaping demand. In particular, it addresses a location that was established in the 1960s with a university that generates very high travel demand, but has been a major challenge to serve by sustainable modes due to topography. Fortunately, sustainable transportation technologies have now caught up with the needs of the land uses selected.

Upgrading to a more sustainable transit system from a conventional one that has reached capacity can be considered one of the better possible successes in integrating land use and transportation. The efficiency of a gondola in terms of travel time and operating costs, coupled with limited environmental impact, makes this solution environmentally sustainable and very compelling through conventional measures such as travel time savings, ridership increases, and mode share changes.

7. References

1. Simon Fraser University. 2011. Simon Fraser University Timeline. http://www.lidc.sfu.ca/timeline/ . Accessed July 29, 2011.

2. TransLink. 2009. Automatic Passenger Counts September to November 2009.

3. Tupper, B. 2009. Proposed Burnaby Mountain Gondola Transit Project: Initial Feasibility Study. Prepared for Simon Fraser University Community Trust. April.

4. UniverCity. 2011. www.univercity.ca. Accessed July 29, 2011.

5. Coast Mountain Bus Company. 2010. Personal Communication.

6. CH2M HILL. 2011. Burnaby Mountain Gondola Transit Project Business Case. Prepared for TransLink.

7. Metro Vancouver. 2011. Metro Vancouver Facts and Figures. www.metrovancouver.org/about/pages/faqs.aspx. Accessed July 29, 2011.

8. Dublanko, N. 2009. Long-term urban change around SkyTrain stations in Vancouver, BC: A demographic shift-share analysis. April. http://www.geog.ubc.ca/~ewyly/students/Dublanko(2009).pdf. Accessed July 29, 2011.

9. City of Richmond. 2011. Towards a Sustainable Community, Official Community Plan (OCP) – 2041 Update. http://www.richmond.ca/__shared/assets/ocp3rounddisplayboards30715.pdf. Accessed July 29, 2011.

10. Wikipedia. 2011. http://en.wikipedia.org/wiki/Metro_Vancouver. Accessed July 29, 2011.

11. Lietner-Poma of America. 2011. Personal Communication and http://www.leitner-poma.com/. Accessed July 29, 2011.

12. Doppelmayr Canada Ltd. 2011. Personal Communication and http://www.doppelmayrusa.com/. Accessed July 29, 2011.

13. TransLink. 2011. http://www.translink.ca/en/Schedules-and-Maps/Transit-Maps/System-Maps.aspx. Accessed July 29, 2011.

14. City of Burnaby. 2000. Lake City Business Guide Plan.

15. City of Burnaby. 1996. Simon Fraser University Official Community Plan. Amended 2008.

16. Mustel Group Market Research. 2010. UniverCity Resident Survey. June. http://4.www.univercity.ca/resources/community_survey.70.html. Accessed July 29, 2011.