
G R E E R C O N S U L T I N G S E R V I C E S
M E M O R A N D U M

TO: Don Avison
Deputy Minister
Crown Corporations Secretariat

FROM: Alan Greer

SUBJECT: Review of Rapid Transit Project Claims

DATE: April 12, 1999

I have reviewed documents provided to the government by management of the Rapid Transit Project (RTP) including Cabinet Submissions and other supporting materials that formed the basis of the government's June 1998 decision to implement SkyTrain. The following findings build on or otherwise confirm concerns I raised with you at our meeting of November 25, 1998.

The main conclusion of this review is that the most relevant information advanced in support of the SkyTrain option was misleading, incomplete or unsubstantiated. More specifically, the review found:

- cost comparisons appear to have been contrived to favour SkyTrain over LRT;
- no ridership (demand) analysis was reported to justify the high capacity system;
- air quality and transportation benefits are unsubstantiated;
- accelerated construction advantages of SkyTrain were clearly unrealistic; and
- risks associated with the SkyTrain car manufacture have not been assessed.

As this review is based on limited information provided by the RTP, further more detailed review will be necessary to confirm or counter these findings. The resulting decision to implement SkyTrain on a new route and accelerated schedule presents several important problems for the government.

1.0 BACKGROUND

In 1994-95, BC Transit and CCS undertook studies - technical engineering & ridership analysis incorporated into a Multiple Account Evaluation (MAE) - comparing SkyTrain, conventional Light Rail Transit (LRT) and Rapid Bus in three corridors in Greater Vancouver.¹ A key conclusion of the MAE was that the large capital costs of rapid transit could not be justified by the benefits of improved transit service (time savings) and reduced auto use (emission reductions) alone. Significant growth management benefits, which rapid transit can help create, must also occur.

The MAE did not recommend a particular technology but did identify the relative cost-effectiveness of Broadway-Lougheed LRT; while acknowledging implementation of rapid transit in the Coquitlam New Westminster corridor was most desirable to meet regional growth management objectives. The Richmond-Vancouver line had the highest ridership, but it also had the highest capital costs. Moreover, because the Richmond-Vancouver corridor had little potential for land-shaping (growth densification), rapid transit was not considered justified in the corridor.

As a result of this study and subsequent negotiations with the GVRD, in September 1995 the Province announced plans to implement LRT along the "T line" that was to connect Coquitlam Centre with Lougheed Mall and Central Broadway by 2005; and link Lougheed Mall with SkyTrain in New Westminster by 2008 (see Figure 1). The capital costs of the T line were estimated at \$1.5 billion.²



The Province shortly thereafter began discussions with local governments (GVRD and directly-affected municipalities) on development of the LRT. The provincial strategy was to limit local demands for costly enhancements by having local governments share costs and participate in development jointly. Given the fundamental role that land-use would play in

¹ The joint study program was directed by BC Transit's Director of Planning, Glen Leicester, and CCS's Director of Transportation Crowns, Frank Blasetti (now VP, Planning of the BC TFA). Engineering studies were conducted by N.D. Lea and Delcan. Transportation modelling and ridership analysis was conducted by BC Transit and Ward Consulting. I undertook the multiple account evaluation and authored the *Multiple Account Evaluation of Rapid Transit Options in Greater Vancouver* report.

² Including inflation and interest during construction.

determining the ultimate success of the project (both in shaping growth and building ridership), the participation of local government would be critical. A two year planning process was outlined that would give time for municipalities to develop land-use plans needed to support growth along the line while at the same time LRT design, engineering and consultation could be completed. Given that substantial land-shaping benefits would be required to justify the significant capital costs, this timing would provide greater certainty that the right conditions (i.e., supportive land-use plans) were in place to make the investment worthwhile.

Despite earlier support for a joint provincial-local approach, in 1997 the Province decided to take the lead on the LRT and appointed a Project Director who by the end of 1997 had begun to assemble a project team. The Rapid Transit Project office began work as per the 1995 LRT plans, going so far as to issue requests for proposal for engineering work on LRT project elements. At the same time, however, the RTP quietly conducted a set of studies on the previously rejected SkyTrain alternative.

Concurrently, the Province had entered into negotiations with the GVRD over funding and governance of transit and roads that eventually resulted in an agreement to establish the Greater Vancouver Transportation Authority. The agreement - ratified by both sides in February 1998 - included a 60% (Province), 40% (GVTA) cost-sharing agreement for the \$1.5 billion LRT.

In May of 1998, the RTP approached the government with the results of their new studies and proposed abandoning LRT and building SkyTrain on a newly crafted route - a significant change in its terms of reference. At this point, there had been virtually no consultation on what was being proposed with affected provincial or local government agencies including CCS, BC Transit, the existing SkyTrain operating company, the GVRD or any affected municipalities. Based on the RTP advice, the government reversed its earlier commitment to implement LRT technology and instead approved substantial changes in project technology, phasing and schedule.

2.0 THE RTP CASE FOR SKYTRAIN

Management of the RTP argued that a switch from conventional light rail transit (LRT) technology to Bombardier's proprietary SkyTrain system was warranted based on the following key claims:

- **small cost premium** - Capital cost premium for SkyTrain (over LRT) would be lower than anticipated - down from a 60% to 8% premium - mainly due to:
 - increased demands by local governments for LRT mitigation measures (grade separations, possibly tunnelling through Central Broadway, numerous raised crossings of major road intersections);
 - special discounts available for SkyTrain cars and increased costs for LRT cars; and
 - economies of scale, particular arising from the use of the existing SkyTrain operations and maintenance centre.
- **superior transit service** - SkyTrain would have 3 times the transit capacity of LRT and provide much faster service;

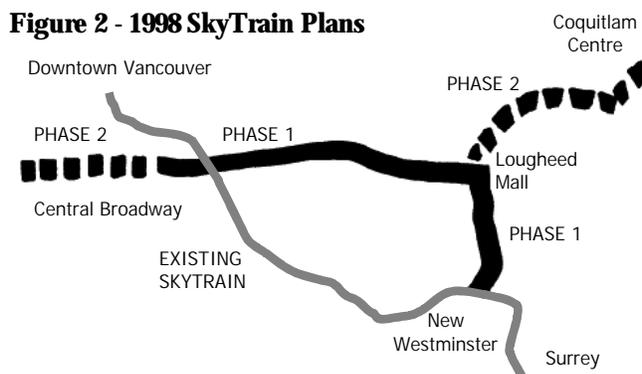
- **improving air quality / reducing traffic congestion** - SkyTrain would reduce auto use (thus reducing auto emissions) while reducing traffic congestion;
- **accelerated construction** - SkyTrain could be constructed more quickly than LRT, in June of 1998 the RTP promised construction would begin in August with one section in service by 2000 and the full line complete by 2003;
- **manufacturing jobs** - Bombardier would commit to establish a manufacturing facility for SkyTrain cars in B.C.; and
- **public support** - opinion polls showed public support clearly in favour of SkyTrain over LRT technology.

3.0 RE-ASSESSMENT OF RTP CLAIMS

3.1 Contrived Cost Comparisons

The RTP claim that capital cost advantages of LRT³ were small is based on the results of a comparative analysis of SkyTrain and LRT that is seriously flawed both in study design and in key assumptions.

The primary flaw in the study design is that costs were estimated for only part of full T line (18 of 33 km) for what the RTP called Phase 1 (see Figure 2) connecting New Westminister with Lougheed Mall and then west to Clark Drive. This segment had never previously been identified as a rapid transit corridor and has no clear purpose as a transit line. It omits the main source of new riders (Coquitlam, NE Sector) and the main destination (Central Broadway). It connects twice with the existing SkyTrain, effectively competing with the current line for riders. And, it poses significant operational difficulties at the Broadway station intersection of the two lines.



³ The same 1994-95 studies which provided the \$1.5 billion estimate for LRT, put the capital cost of SkyTrain over the full T line at about \$2.3 billion or 60% higher. This is derived by aggregating costs for two separate corridors, Broadway-Lougheed and Coquitlam-New Westminster, which together form the T line, and adjusting figures to include inflation adjustment and interest during construction. The RTP claim, however, that the difference was as small as 8%.

The RTP neglected to do analysis of the full T line begging off due to time and money constraints. Given the billions of dollars at stake and the fact that the Phase 1 analysis was done in a matter of weeks, this is unsupportable. In fact, it appears likely that the Phase 1 configuration was only developed to create the appearance of favourable costs for SkyTrain.

The first advantage of the Phase 1 routing (for the SkyTrain option) is that it connects with the existing SkyTrain line at New Westminster (it would be operationally and structurally problematic to inter-link trains at the other intersection at Broadway & Commercial). This allowed the RTP to argue that the additional 40 cars could be accommodated at the existing facility at Edmonds and thus a new operating centre (rail yard) would not be necessary. In fact, that facility is near capacity now. While some work can be done to accommodate the Phase 1 complement of cars, any further growth of SkyTrain fleets - either for the existing line or completion of Phase 2 of the proposed line - would require the construction of a new facility, likely at another site. At best, the cost of a new facility would be deferred several years into the future (by their schedule as early as 2002-2003) and thus should have been included in a costing of the full T line for SkyTrain.

The RTP analysis then compounded this advantage by inflating the cost of an LRT yard to \$110 million. This is almost 3 times the 1994-95 estimate for an LRT (or SkyTrain) facility, and well outside a reasonable estimate.⁴

The second major flaw in the study design involved the use of two different consulting teams (Parsons-Brinkerhoff for LRT and Lavalin for SkyTrain) each of whom were apparently operating with different implicit terms of reference, with the result that the different options were not compared on a reasonable, equivalent basis. Lavalin has a direct interest in the technology choice, as a strategic ally to Bombardier and the preferred engineering firm for SkyTrain systems. The Lavalin assessment therefore, could best be viewed as a bid of a proponent, competitively crafted to minimize the apparent costs of the project.

Parsons-Brinkerhoff, on the other hand, were inclined to make much more conservative (and expensive) assumptions, it appears largely by direction from the RTP. A whole range of improvements (particularly grade-separations) was added to the LRT option. These were not based on any technical requirements. The consultants were instructed by RTP to include these measures, based on the claim that they were politically necessary.⁵

⁴ For example, the RTP estimate for the LRT yard includes land costs of \$36 million for 7 hectares (\$5.1 million per hectare). Yet, land at the current SkyTrain facility site has been assessed at a market value of about \$2.7 million for 2.6 hectares (\$1 million/hectare). Indeed, as part of the current SkyTrain plans, Bombardier has offered to purchase this land at somewhat less. Land for the Richmond Transit Centre cost \$11 million for 6.3 hectares of land (\$1.7 million/hectare). Land suitable for an LRT yard at the Lake City area of Burnaby was assessed at about \$0.8 million/hectare in 1994.

⁵ In the re-evaluation of the LRT for the full T, the RTP instructed the consultants to include about ten more grade separations than were included in the 1994-95 studies, at \$15 million each, on the basis that these improvements were demanded by each city. This claim has been contradicted by municipal staff and is otherwise unsubstantiated. The City of Vancouver has recently authorized a study to review options for Central Broadway - including at grade LRT.

The SkyTrain analysis reduced the costs of stations by halving the length of platforms.⁶ No such reduction was made for LRT stations by the other consultants. LRT alignment for the Broadway section leading to the western terminus was removed from the road and placed in the Grandview cut, resulting in expensive grade separation requirements and SkyTrain-like station designs (elevated or underground).

The cost of LRT cars was based on the higher end of a range of prices charged in recent US sales. Parsons-Brinkerhoff reported that lower prices were only possible where special discounts were available. Yet, the SkyTrain car costs were based on a special discount offered by Bombardier. No effort was made to seek similar bids from LRT manufacturers (which would include Bombardier as well as Siemens and others). Neither did the analysis acknowledge the real possibility that once the commitment to the system was made, Bombardier might exploit its monopoly supplier position (SkyTrain is based on proprietary technology) and future orders would become much more costly than a generic, lower-technology LRT option.

3.2 Over-Capacity / Lack of Ridership Analysis

The RTP argued that SkyTrain's capacity advantage would make the investment worthwhile and a necessary solution to solve growing demand for transit in the region. These claims are highly misleading for two reasons: first, because the capacity advantage over LRT is exaggerated, and second, because there is no basis to believe that actual demand will ever come close to the capacity limits of either SkyTrain or LRT in the foreseeable future.

The claim that SkyTrain has 3 times the capacity of LRT is exaggerated by comparing the higher end of SkyTrain capacity against a low end of the range of LRT capacity. In fact, as noted above, the RTP cost analysis assumed they would significantly enhance LRT capacity⁷ (by adding grade separated crossings) and reduce SkyTrain capacity (e.g., by halving station length). But, these alterations were forgotten when the RTP touted SkyTrain's capacity advantages.

Nevertheless, the differences in maximum capacity are immaterial. The appropriate capacity can only be judged after an analysis of demand. This is the most glaring omission in the RTP case: no demand or ridership analysis has been reported.⁸

⁶ Reducing station platform length reduces the maximum capacity of the system, by limiting how many cars can be linked into one "consist" at a time. This assumption is an admission that the RTP expects demand to fall substantially below the capacity levels that a full SkyTrain could provide. Nevertheless they continue to cite greater capacity as proof of SkyTrain's superiority (see following discussion of capacity and ridership).

⁷ The capacity of LRT depends on whether the train operates on protected or raised guideway for all or part of its length, and when operating in traffic whether priority measures are used.

⁸ The RTP have promised to release the results of ridership analysis to local governments, BC Transit / GVTA, and others who require this data to make any reasonable assessment of the project. It appears likely that this ridership analysis has been done but the RTP has yet to release any results.

Table 1	
Capacity	Ridership at Max. Load Point persons per hour per direction
<u>SkyTrain</u>	20,000 (current MK I car) 30,000 (proposed MK II car)
<u>Calgary LRT (at-grade)</u>	14,580 (current max 3-car train)
<u>Rapid Bus</u>	5,000
Demand	
SkyTrain (existing line)	7,500 (actual 1998)
Proposed SkyTrain - Phase 1	~3,000 (est. 2001)
Proposed SkyTrain - Complete T	~5,000 (est. 2003)

The standard approach to modelling transportation options uses the EMME/2 model which has been configured to represent the Greater Vancouver transportation system and land-use and travel patterns. Despite the usual limitations of such models, EMME has proved reasonably accurate, and as a result there is a general consensus in the transportation community on its suitability.

Although the RTP has not released any ridership analysis, both the GVRD and consultants working for the GVTA have undertaken their own rudimentary modelling analysis based on available information. Demand modelling conducted by the GVTA shows peak ridership as low as 3,000 for Phase 1, with levels only approaching 5,000 upon full completion of the T line.⁹ This is not surprising given the poor transit design of Phase 1.

3.3 Unproven Transportation / Air Quality Benefits

Furthermore, without ridership analysis, the RTP cannot claim anything about the actual transportation or air quality benefits of SkyTrain. Time savings and air quality (reduced auto emissions) benefits are based on the result of the ridership analysis. Air quality benefits depend on how many SkyTrain passengers are ex-auto users (not those who simply switch from a bus to the new line). If levels of new transit riders are very low, then air quality benefits will be also. Without ridership analysis, it remains unclear if any substantial increase in transit market share can be expected with the addition of the proposed SkyTrain to the system. And without ridership estimates, nothing can be said about the reduction in traffic volumes.¹⁰

⁹ Over 13 years in service, on much higher volume route, the existing SkyTrain has build ridership to levels of only 7,500 (still well below the ultimate capacity for LRT and fully 1/3 of its own capacity).

¹⁰ Moreover, any road space freed up by those who switch will likely be filled quickly by additional drivers.

3.4 Delayed Acceleration

The RTP has also touted SkyTrain's supposed advantage in allowing a more accelerated implementation than would be possible with LRT. Indeed, the RTP has suggested that this is a key advantage to SkyTrain. If so, events have proven that the RTP was seriously mistaken.

The proposed LRT design schedule (18 - 24 months) was based on the need to allow for completion of supportive land-use plans before construction. Its construction schedule was based on actual experience with the original SkyTrain. There is no compelling argument that the proposed SkyTrain has any advantages over LRT in this respect. The RTP could just as easily have been compressed the LRT schedule and further segmented it into smaller phases (as has been proposed for SkyTrain) to achieve an accelerated timeframe if that was a priority.

Moreover, the RTP has consistently underestimated the real constraints posed by public consultation demands, consultation with local governments and environmental assessment requirements (see Attachment). Federal officials have only recently begun their environmental assessment process and are likely to complete in the Fall of 1999, this would suggest construction might begin at earliest 15 months later than the RTP accelerated schedule is based on. The arguments of faster construction are no more convincing. For the first phase of the existing SkyTrain it took 5 years to complete construction of 22 km of line from New Westminster to Downtown even with the accelerated pace required to be ready for Expo 86.

In addition, the RTP argued that local government demands and public complaints where LRT construction was on existing roadways would have created significant delays and would be hugely unpopular. While this would have presented a challenge, it is now apparent that SkyTrain will have as much, if not more, difficulty gaining community acceptance for construction works due to the intrusiveness of the elevated guideway. Experience in provincial and municipal road construction (on ongoing feature of urban life) shows that travel patterns adjust within a short period where obstructions arise, people take alternative routes and the system adjusts itself. During recent bridge work on the Ironworker's Memorial and the Oak Street Bridge, commuters changed travel patterns quite effectively to adapt (especially increased transit use). This would be even more manageable in the middle of the Burrard peninsula where alternative routes are plentiful.

3.5 Prospects for Car Manufacturing Exports

The establishment of a manufacturing facility for SkyTrain cars in BC has been cited as a special benefit of the agreement with Bombardier. To assess this claim one need give some consideration to what the alternatives might be and how they would compare. LRT manufacturers are numerous, in North America, there are at least two - Bombardier and Siemens. It is equally possible that a deal could have been struck with either to locate LRT manufacturing here. The prospects for future sales from such a facility might more promising. SkyTrain is a relatively rare technology, the only other complete system is in Kuala Lumpur. Bombardier would likely place most hopes on sales to Asian mega-cities (where population densities may justify its high capacity), however, current economic conditions there have dampened prospects for future sales. On the other hand, numerous LRT projects are underway or currently planned in North America.

3.6 Overstated Public Support

The final remaining RTP argument is that public opinion favours SkyTrain. These results are not surprising given that SkyTrain is a familiar system. However, it is apparent that in the polling or public consultation, the RTP made no effort to put forward an attractive LRT alternative (of which there are many working examples) but instead defined it as a poorer alternative ("like a bus"). Survey respondents asked to compare alternatives were informed that LRT was "cheaper and slower".¹¹ Moreover, the surveys made no mention of the substantial incremental cost of SkyTrain.

Attractive, modern LRT designs are being built in cities throughout the US and Europe (the Bombardier mock-up for SkyTrain MK II cars owes much to the Strasbourg LRT). Trends in transportation design suggest modern urban rail transit systems will increasingly be ground-orientation (on road, at street-level) where overhead structures are minimized and open air, walk-on access is a priority. This is particularly the case in low-to-medium density cities such as Vancouver.

Despite its many advantages, SkyTrain has significant negative public attributes. First, it is visually intrusive. When above ground, it requires a large, concrete guideway structure (a continuous bridge) mounted on concrete pillars. Noise carried over a wider area, shade and loss of privacy combine to diminish property values for adjacent lots. Second, SkyTrain is removed from street level. Passengers must either ascend or descend stairs, escalators or elevators to raised or underground stations. Public safety experts recommend transit stations have open design that minimize walls and obstructions (pillars, stairwells and corners). While this is straightforward with ground-oriented systems, it is increasingly more challenging for grade-separated SkyTrain systems.

4.0 CURRENT POLICY ISSUES

The commitment to implement SkyTrain as planned raises several important policy issues that need to be addressed.

Route phasing - Phase 1 as proposed by the RTP is problematic and dysfunctional. If the government is to retain its commitment to implement SkyTrain, may be more sensible to build one complete corridor first: implementing SkyTrain in Coquitlam-New Westminster. This would involve continuing as planned by the RTP with construction from New Westminster north to Lougheed Mall, and instead of turning west, continuing north and then east to Port Moody and then Coquitlam.

Negative service impacts - Current plans may actually result in diminished transit service for existing users of SkyTrain. Replacing trains of 4 Mark I cars with trains of 2 (higher capacity) Mark II cars will actually result in a substantial reduction in seated capacity (the newer cars provide increased capacity through more standing area). Other impacts will result from

¹¹ An excerpt from the RTP's assessment of public opinion: "Survey results show that awareness of the proposed LRT is relatively high (53%). Focus group research, however, revealed that people don't actually know what an LRT system is. What they heard is that there is going to be some form of transit system along the Broadway/Lougheed corridor and shown illustrations of LRT systems participants characterised the LRT being like a bus."

congested passenger transfer flows at the Broadway station and introduction of alternate destination trains.

Realistic timing - A realistic understanding of the time required to complete the Canadian Environmental Assessment Act (CEA) process and the need to await its completion is required. The RTP claim construction will begin in March 1999 and may be contemplating proceeding with construction prior to the CEA completion. The CEA process is required by federal statute (one which has recently been interpreted by the courts to require a broad review). It may be unrealistic to assume construction starting before late 1999. This will of course set back in-service dates promised by the RTP.

Liabilities - The agreement with Bombardier commits the Province to purchase the car manufacturing facility if it does not otherwise fulfil its commitment to purchase SkyTrain technology. The Province also agreed to allow Bombardier to take over operations of a unified SkyTrain operations centre (existing and new operation) and to operate the whole system under an operating agreement with the GVTA. As new owners of the existing SkyTrain, the GVTA may not agree with this arrangement.

Cost-sharing negotiations with GVTA - The 60/40 cost-sharing formula for rapid transit which is set out in the GVTA Act is conditional on the Authority agreeing to "cost, scope and design." The GVTA is unlikely to agree to pay the 40% from existing sources for several reasons. The GVTA funding arrangements were structured on the assumption that they would require \$600 (40% of \$1.5 billion) over ten years. The GVTA simply could not afford to pay 40% of the full T line with SkyTrain because total costs are likely to be 50% higher than budgeted for LRT and because the GVTA Act phases in numerous revenue sources over the longer timeframe originally planned for the LRT. Given planned bus system expansions, the GVTA will likely be reluctant to repeat recent history where the bus fleet was underfunded to pay for the existing SkyTrain.

High costs - The additional amount of capital required for SkyTrain is large. For a full T-line, SkyTrain may cost on the order of \$2.7 billion. The GVTA contribution is unlikely to exceed the \$600 million, the Province would need to contribute more than double its originally budgeted \$900 million (directly or through tax transfers) within a substantially shorter timeframe (by 2003 instead of 2008).

Completion of T line - The prospects for completion of the T line or future expansions of the system are poor. Strong local resistance to overhead structures (now experienced in New Westminster, certainly greater for Central Broadway) would force tunnelling at a significant increased cost limiting the affordability of each additional kilometre.

5.0 RECOMMENDATIONS

The issues raised here deserve further review and discussion within relevant government agencies and at the Board of Rapid Transit 2000 Ltd. To address these issues at least in part, the following key steps are recommended:

1. **Project review** - A detailed financial and engineering review of the project plan covering scope, schedule and budget should be conducted.

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99-04-12

Page 11 of 12

2. **Transit design /land use review** - A review of the transit design (integration with buses and with existing SkyTrain, complete ridership analysis), and review of the land-use planning (e.g., suitability of municipal zoning, station location) of the project should be conducted.
3. **Project cost/schedule tracking** - In the past, the Province has used an independent project management team to track large capital projects (e.g., Vancouver Island highway, Northeast Coal, previous SkyTrain). Given the limited factual information provided by the RTP, it would appear most appropriate that a similar mechanism be established soon to ensure the RTP is operating within the government's cost and timing expectations.

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ATTACHMENT

Cracks show in SkyTrain proposal

By Frank Luba, Lower Mainland Reporter
Vancouver Province, March 3, 1999

Not one concrete guideway has gone up on the new SkyTrain line, but there are growing cracks in the foundation of the public transit system.

Two of the five communities in the project, New Westminster and Port Moody, have rejected the line as planned by the rapid transit project office (RTPO), and Coquitlam isn't getting a station it wanted.

Along with Coquitlam, New Westminster also is in favour of that Maillardville station - which would have avoided affecting the Lower Lougheed neighbourhood that rejected a track through its heart.

But the RTPO has no plans for a Maillardville stop and has rejected a proposal for a cut-and-cover tunnel in the Fraserview neighbourhood citing cost.

According to Arthur Griffiths, the RTPO's chief negotiator, the project has a route that's been approved and a budget to follow.

"If you can come up with \$75 million (for a tunnel), New Westminster, we would look at it," Griffiths said yesterday.

No matter what the municipalities say, Griffiths also confirmed that the final decisions on the line are up to the provincial government in consultation with the Greater Vancouver Regional District and the Greater Vancouver Transportation Authority.

But the SkyTrain divisiveness is such that speculation already has begun about postponing the project.

"I find it difficult to believe that the time frame they (RTPO) have established can be met," said George Puil, chairman of the GVRD and the GVTA.