ALTERNATE DOWNTOWN ACCESS
ROUTE SELECTION STUDY
TECHNICAL REPORT 1

DISTRICT OF SQUAMISH

PRELIMINARY ROUTE OPTIONS
AND
MULTIPLE ACCOUNT EVALUATION CRITERIA
July 13, 2006

District of Squamish
37957 Second Avenue
Squamish, British Columbia
V0N 3G0

Attention: Rod Pleasance, P.Eng., Project Engineer
Community Development Department

Dear Sir:

Re: Alternate Downtown Access Route Selection Study
Technical Report 1: Preliminary Route Options and MAE Criteria

We are pleased to enclose, for your review, Technical Report 1: Preliminary Route Options And Multiple Account Evaluation Criteria, Revision RB.

This revised report provides a more detailed assessment of six preliminary route options for the alternate access from Highway 99 to downtown Squamish. This more detailed documentation was necessitated in response to the District Council’s concerns raised at the July 4, 2006 meeting regarding our previous elimination of Option 3 (Victoria) and Option 4 (Main). We have also addressed the pros and cons of two additional options suggested by District Councillors: Option 3A (Victoria/Winnipeg), a variation on Option 3, that crosses the channel at a skewed angle; and Option 7 (Galbraith) that crosses the channel south of IR 24.

Based on our current feasibility assessment of the preliminary route options and the results of the stakeholder consultation, we wish to confirm the three route options that have been short-listed for further analysis. These are Option 1 (Pemberton), Option 2 (Winnipeg) and Option 5 (Westminster). In addition, a Multiple Account Evaluation (MAE) framework and criteria have been developed for the subsequent selection of the preferred route.

If Council agrees with the three short-listed route options, we would like to present to Council on July 18, 2006 the results of the MAE and the recommendation of the preferred route. We will then proceed with the functional design and “Class C” cost estimate of the preferred route, and prepare a preliminary implementation plan along with the necessary steps to secure regulatory approvals.

We trust that this report will provide guidance to the selection of the preferred route in the next phase of this study. If you have any questions regarding this submission, please contact the undersigned.
Yours truly,

SNC-LAVALIN INC.

Phoebe Cheung, P. Eng.
Project Manager

Enclosures
DISTRIBUTION LIST

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CLIENT: District of Squamish

PROJECT: Alternate Downtown Access
Route Selection Study

Project Manager

Reviewed by: Tim Stevens, P. Eng.
Technical Lead

Approved by: Nasir Kurji, P. Eng.
Project Sponsor

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1.0 INTRODUCTION

This report provides an assessment of six preliminary route options for an alternate access from Highway 99 to Downtown Squamish. Based on a high-level feasibility assessment of the route options and the results of stakeholder consultation to date, three route options have been shortlisted for further analysis. In addition, a Multiple Account Evaluation (MAE) framework and criteria has been developed for the selection of the preferred route.

1.1 Background

Downtown Squamish is one of four fairly distinct communities in the District of Squamish. It is located at the northern end of Howe Sound on the Pacific Ocean at the mouth of the Squamish River, and is bounded by the Mamquam Blind Channel to the east, a tidal slough to the north and the Squamish River Estuary to the west. Access to the downtown and the Squamish Oceanfront Development Corporation (SODC) site from Highway 99, the Sea to Sky Highway, is currently via a single point at the Cleveland Avenue signalized intersection, servicing traffic from the highway and the communities to the east and north of the Mamquam Blind Channel. Access to Squamish Nation Indian Reserve 24 (IR 24) is also via a single point at the Valley Drive signalized intersection.

In addition to Highway 99, a north-south municipal route via Cleveland Avenue and Buckley Avenue, located west of Highway 99, links Downtown Squamish to Squamish Business Park (currently being developed to accommodate a number of big box retail stores). To date the Highway 99/Cleveland Avenue intersection has the highest accident rate of any intersection along Highway 99. Occasionally, trains travelling on the Canadian National Railway (CNR) mainline stop and block the Cleveland Avenue at-grade railway crossing, preventing vehicles from accessing the downtown. This also cuts off the downtown from emergency services available at the hospital and fire station located east of the highway in Valleycliffe.

As part of the Sea to Sky Highway Improvement Project, the Ministry of Transportation (MoT) is undertaking improvements to Highway 99 between Horseshoe Bay and Whistler to improve its safety and reliability. By 2009, extensive highway improvements will be completed to make travel along the corridor safer for residents, commuters and tourists. In Urban Squamish, Highway 99 will be widened to four lanes from the existing two lanes. Since the four-laning work is focused on the existing highway corridor, it does not directly address the issue of providing assured access across the CNR line to the downtown and IR 24.

The District of Squamish Official Community Plan (OCP) has identified the desirability of an additional assured access from Highway 99 to the downtown. In light of the need to revitalize the downtown, the imminent upgrade of Highway 99 to four lanes through Squamish, together with the imminent development of the SODC site and the Pridham site (the former Interfor land), the District is exploring options for a suitable connection point along Highway 99 for the downtown connector and a reliable access route from Highway 99 to downtown Squamish, IR 24, the SODC site and the Pridham site. The objectives of this study are to identify a suitable connection and treatment at Highway 99, and to compare the route options for the downtown connector, together with the benefits and costs for the recommended works. A Multiple Account Evaluation (MAE) framework will be used for the
selection of the preferred route. The first phase of this study is to identify and short-list up to three route options for the MAE.

1.2 Project Objectives

The objectives of the alternate downtown access are identified as follows:

- **Downtown Revitalization**: to support and enable the revitalization of the Squamish downtown core, making the downtown core visible, accessible and attractive for local residents, travellers and tourists along Highway 99.

- **Access Convenience And Reliability**: to ensure reliable road service to the downtown, IR 24, the SODC site, the Pridham development site, and other potential developable lands in the study area; and to ensure unrestricted access of emergency vehicles to these sites at all times.

- **Compatibility with Downtown Road Network**: to ensure compatibility of the downtown connector with the downtown road network; to maintain traffic circulation within the downtown and the proposed development sites; and to ensure the functionality and performance of the municipal road network in the study horizon.

- **Reduced Dependence On Highway For Local Travel**: to remove the unnecessary short local trips from Highway 99, thereby reducing congestion for local traffic via the highway, increasing mobility for highway traffic, and extending the life of the four-laning highway upgrade.

- **Reduced Dependence On At-Grade Railway Crossings**: to reduce traffic volumes accessing the downtown, IR 24 and other major development sites via at-grade railway crossings, thereby improving rail, vehicular and pedestrian safety and operations.

1.3 Project Constraints

The following are constraints potentially limiting the feasibility of the route options:

- **Physical Constraints**: Minimum design speed of 40 km/hour; maximum gradient of 8.3%\(^1\); preserve the CNR spur line on the downtown side\(^2\); connect at-grade to

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\(^1\) According to the BC MoT Highway Engineering Design Manual, 7% is the maximum desirable grade for a low design speed (30 to 40 km/h) road in rolling terrain. This grade may be exceeded by 2% only for lengths of 500 m or less. 8.3% corresponds to a maximum slope for a ramp of 12:1 and is suggested as a practical maximum gradient for the channel crossing. Since a 2.5 m wide shoulder is proposed (greater than the 1.5 m minimum for a shoulder bikeway), stronger cyclists should not have a problem cycling across the bridge. Less athletic cyclists can dismount and push the cycle on foot. A sustained grade of 8.3% will not be accessible to the mobility impaired unless landings are provided every 9 to 10 m. Such landings would significantly increase bridge costs and have not been included in our estimates.

\(^2\) Heavy rail on the spur line may need to be in operation for at least the next five years. While it remains open, the Downtown Connector will need to either touch-down before the spur or cross it at a minimum of 6.7 m (22 feet) above the top of rail; the latter would require the closure of Cleveland Avenue. District staff has expressed desire to preserve the spur line right-of-way to allow for future rapid transit opportunities.
Cleveland Avenue, its future extension and/or Galbraith Road; grade separation at CNR mainline; and provide unrestricted access to downtown and IR 24.

- **Navigability of Mamquam Blind Channel**: construction of the bridge crossing over the Channel requires compliance with the Transport Canada Navigable Waters Protection Act and regulatory approval before project procurement. Since the highest existing vessel using the channel is 18.2 m, any fixed bridge with less than 19.2 m clearance above high water level at 2.0 m (18.2 m plus 1.0 m overhead clearance) will constrain marine movements in the channel. A horizontal navigation channel width of 30.5 m also needs to be maintained.

- **Waterfront Access and Recreation**: waterfront access and recreation on, across and along both sides of the Mamquam Blind Channel are identified as core principles in the Downtown Squamish Concept Plan which was endorsed by the District Squamish Council in October 2005.

- **Property, Development and Community Impacts**: impacts to existing properties and/or proposed development sites resulting in detrimental community effects need to be considered in the feasibility assessment of the route options (e.g. impacts on existing commerce, impacts on Squamish Nation lands, impacts on viability of developable lands, etc).

### 2.0 OPTIONS DEVELOPMENT

Highway 99 in the vicinity of Clarke Drive (existing signalized intersection) is the most likely location for the eastern terminus of the route options. Further study and consultation with the MoT will be conducted to analyze the treatment and configuration of this connection, including a) an at-grade intersection at or near the current intersection location, and b) a grade separated facility at or near the Guildford/Clarke intersection. In response to the Pridham development proposal in the former Interfor land, the MoT has indicated that “with the upgrading of the Highway 99 corridor taken place, a grade separated intersection will be required” (see Appendix A).

For the short-listing of the route options, it is assumed that the alternate downtown access will connect to the highway in the vicinity of Clarke Drive (either at-grade or grade-separated), and will proceed to the west over the CNR mainline following one of the route options over the Mamquam Blind Channel. The decision of at-grade or grade separation at Clarke Drive does not influence the route options across the channel, and will be examined in the next phase of this study.

On the downtown side, the preferred western terminus for the downtown connector is Cleveland Avenue. A CNR spur line to the immediate east of Loggers Lane services two industries at the south end of the downtown, and may need to be in operation for at least the next five years. While it remains open, the spur line generates a significant constraint on the “touch down” point for all route options that require navigation clearance over the channel. In considering the appropriate navigation clearance over the channel, we note that taller boats using the marina on
the west bank between Pemberton Avenue and Winnipeg Street (three owners) could possibly be relocated south as far as Main Street. However, relocation opportunities for these tall sailboats further south of Main Street appear limited. Sea to Sky Air operates floatplanes in and out of the Mamquam Blind Channel. A new bridge crossing of the channel could impact the flight path of the floatplanes and cause operation to be relocated with consequent business losses. With all these considerations, six preliminary route options are developed across the channel by SNC-Lavalin (see Figure 1). These options, along with two more options suggested by District of Squamish Councillors, are described below.

2.1 Route Option 1 (Pemberton Avenue)

From the Highway 99 connection and the proposed CNR overpass, this alignment proceeds north parallel to the CNR mainline, along the northeast boundary of the Pridham development site, and crosses the Mamquam Blind Channel to the immediate downstream of the existing CNR bridge. The crossing will be a low elevation structure over the Channel, follow the Pemberton Avenue alignment to the west, cross the CNR spur line at-grade, and tie into the rest of the downtown road network via the Pemberton Avenue/Cleveland Avenue intersection.

2.2 Route Option 2 (Winnipeg Street)

This alignment proceeds north from the proposed CNR overpass, turns to the west to cross the Mamquam Blind Channel and ties into Winnipeg Street on the downtown side. The bridge crossing will be a mid-level fixed structure with sufficient vertical clearance (approximately 7.1 m above high water level at 2.0 m) to accommodate most of the existing power boats upstream of this proposed crossing\(^3\). In order to allow the connector to tie into Winnipeg Street at-grade before the CNR spur line on the downtown side, some tall sailboats from the existing marinas upstream of this proposed crossing will have to be relocated. The screening of the preliminary options at this stage assumes that this relocation is feasible. The impacts of this relocation (in both socio-community and financial terms) would be evaluated in the next phase of the project should this option be short-listed for further study.

2.3 Route Option 3 (Victoria Street)

This alignment proceeds west from the proposed CNR overpass, crosses the Mamquam Blind Channel and ties into Victoria Street on the downtown side. The bridge crossing will be a mid-level fixed structure with a minimum vertical clearance similar to that of Option 2 (approximately 7.1 m above high water level at 2.0 m) to accommodate most of the existing power boats. Similar to Option 2 above, in order to allow the connector to tie into Victoria Street at-grade before the CNR spur line on the downtown side, some tall sailboats from the existing marinas upstream of this proposed crossing will have to be relocated. The screening of the preliminary options at this stage assumes that this relocation is feasible.

\(^3\) According to the Navigation and Bridge Assessment Study by Bunt, Typlan and Westmar (November, 2005), 6.1 m represents the height of a significant proportion of the power boats currently using the three marinas upstream of the proposed bridge crossing at Winnipeg Street. A bridge crossing with a vertical clearance of 7.1 m above high water level at 2.0 m will accommodate these boats with a minimum 1.0 m allowance for safety clearance.
The impacts of this relocation (in both socio-community and financial terms) would be evaluated in the next phase of the project should this option be short-listed for further study.

2.4 Route Option 4 (Main Street)

This alignment borders the southeast boundary of the Pridham development site, crosses the Mamquam Blind Channel and connects to Main Street and the rest of the downtown road network. The bridge crossing will be a mid-level fixed structure with a minimum vertical clearance similar to that of Option 2 (approximately 7.1 m above high water level at 2.0 m) to accommodate most of the existing power boats. Similar to Options 2 and 3 above, in order to allow the connector to tie into Main Street at-grade before the CNR spur line on the downtown side, some tall sail boats from the existing marinas upstream of this proposed crossing will have to be relocated. The screening of the preliminary options at this stage assumes that this relocation is feasible. The impacts of this relocation (in both socio-community and financial terms) would be evaluated in the next phase of the project should this option be short-listed for further study.

2.5 Route Option 5 (Westminster Street)

From the proposed CNR overpass, this alignment proceeds southwest near the border between the Pridham development site and the land recently purchased by Squamish Nation, crosses the Mamquam Blind Channel and connects to the future Cleveland extension between Vancouver Street and Westminster Street on the downtown side. The height of land on the east side of the channel provides convenient launch for a higher level crossing at this location. In order to allow the connector to “touch down” before the CNR spur line, the vertical clearance for the navigation channel is 13.2 m with an approach grade of 8.3%. Some tall sail boats from the existing marinas upstream of this proposed crossing would have to be relocated. The screening of the preliminary options at this stage assumes that this relocation is feasible. The impacts of this relocation (in both socio-community and financial terms) would be evaluated in the next phase of the project should this option be short-listed for further study. The location and height of this crossing may also pose potential impacts to float plane operations in the channel. The vertical clearance requirement of this crossing will be confirmed at the next phase of the study in consultation with the marine users, the Transport Canada Navigable Waters Protection Division and the Canadian Aviation Regulations.

2.6 Route Option 6 (IR 24 Connector)

This alignment uses the existing Laurelwood Road right-of-way between the proposed CNR overpass and the northern border of IR 24, proceeds west along the IR 24 border, and crosses the Mamquam Blind Channel to connect to the Westminster Street right-of-way on the downtown side. To minimize impacts to the cemetery which lies just within the northern boundary of IR 24, the route would be adequately set back and buffered from the cemetery. The bridge crossing will be the same as that of Option 5.
2.7 Other Route Options

Two other route options were suggested by District of Squamish and Squamish Nation Councillors. These options are discussed below.

Option 3a (Victoria/Winnipeg Street)

This option is an hybrid option of Routes 2 and 3 where the bridge will cross the channel just south of the Option 2 on the east side and connect to Victoria Street on the downtown side. From a preliminary consideration of this option, its advantages appear to be:

- It may be less disruptive to the proposed Pridham development than Option 3 since it is located, like Option 2, at the north end of the proposed pond area.
- Unlike Option 2, it avoids the woodland and riparian vegetation on the east bank of the channel.

Its disadvantages appear to be:

- The skewed crossing of the channel creates a significantly longer water crossing (about 40% longer than Option 3). This will increase the cost of the bridge.
- The curving horizontal alignment on the bridge will be less safe for bridge traffic. Curved bridges are also more expensive to build than straight ones.
- The bridge piers demarking the edges of the navigation channel will likely need to be skewed relative to the navigation channel and the bridge superstructure. This will be a greater hazard for marine traffic and further increase the cost of the bridge.
- There will likely be more substructures in the channel than with Options 2 or 3, resulting in more construction costs and greater impacts on the fish population.
- A longer skewed bridge will certainly have a greater visual impact than the straight crossings associated with Options 2 or 3.

Because of the number and significance of disadvantages of this option, i.e., less than optimum traffic safety, skewed navigation clearances, greater impacts on fisheries values, greater visual impact, and significantly higher construction costs, we do not believe there is merit in carrying this option forward.

Option 7 (Galbraith Road)

This option crosses the channel south of IR 24 and connects to Galbraith Road on the downtown side. The Squamish Nation are understandably opposed to a new downtown connector being located through IR24 itself, this being a well established residential community with additional community facilities such as the Totem Hall. Therefore it would appear that the most northerly location for a channel crossing south of the IR24 south boundary would connect to Highway 99 at the Forestry Service Road just south of the
Stawamus River. From here the route could follow the gravel access road to the dry land log sort, then cross the channel and connect to Galbraith Road within the SODC development site.

Because of the flatness of land in the vicinity of the CNR crossing, lengthy embankments would be required as the Downtown Connector approaches the CNR mainline Bridge. It also would not provide assured access to IR24 or Pridham Development site (their access will still require at-grade crossings of CNR mainline). Because of its southerly location this crossing would likely need to provide a navigation clearance of 19.2m to accommodate all existing vessels using the channel. Moorage of tall vessels south of here would, because of high winds, require construction of a new breakwater in the vicinity of SODC. From our preliminary assessment of this route, its advantages would appear to be:

- Alternative access from Highway 99 south and Valleycliffe into downtown Squamish
- Very little impact on existing vegetation and wooded areas on the east side of the channel

Its disadvantages appear to be:

- Safety and operational concerns associated with increased traffic on the highway between two closely spaced signalized intersections (about 200 m between the existing Valley Drive signal and the proposed Forestry Road signal).
- Does not provide direct access for Squamish traffic between Valleycliffe and downtown without using the highway.
- Does not provide assured access to IR24 or Pridham Development site.
- Significant increase in cost due to lengthy embankments approaching CNR mainline bridge.
- Mamquam Channel water crossing is about 2.2 times longer than Option 5. This will also result in a significant increase in its cost.
- Impact on safety and operations of floatplanes on lower reaches of channel.
- Potential impact on SODC development plans.
- Significant visual impact.
- Significant additional number of piers in channel will impact on fisheries values.

Because of the significant disadvantage of this option, i.e. impact on Highway 99 traffic safety and operations; lack of assured access to IR24 and Pridham; impact on commercial floatplane operations and safety; impact on SODC development; impact on fisheries values; much higher cost than Option 5; we do not believe there is any merit in carrying this option forward.
2.8 Tunnel Options

One option for achieving the crossing of Mamquam Blind Channel in the case of Routes 2, 3 and 4 would be to construct a tunnel under the channel. Considerations of the tunnel options in this project are provided in Appendix B. In summary, a tunnel under the Mamquam Blind Channel is not considered a viable option for the crossing due to:

- Unpleasant to travel due to magnified traffic noise and confinement sensation in tunnel
- Unattractive for pedestrians and cyclists
- High construction and maintenance costs (lighting, ventilation, drainage system, etc)
- Requires a twin tunnel for emergency evacuation

2.9 Low Level Movable Bridge Options

Another option for achieving the crossing of Mamquam Blind Channel in the case of Routes 2, 3 and 4 would be to provide a movable span bridge over the navigation channel. The bridge could have a low profile elevation over the water (top of deck about 5 m above high water level @ 2.0 m; vertical clearance about 3 m) and gentle grades (5% maximum) on the approaches to the fixed portion of the bridge. Considerations of the movable bridge options in this project are provided in Appendix C. In summary, a movable bridge across the Mamquam Blind Channel is not considered a viable option for the crossing due to:

- High operating cost – requiring full-time operator and 24 hour emergency coverage
- Frequent interruptions to both road and marine traffic due to bridge opening and closing
- Need for periodic maintenance and replacement of mechanical and electrical components, also risk of failure, resulting in interruptions to all road and marine traffic
- Initial construction cost of a movable bridge could be higher than a fixed bridge with moderate vertical clearance
- Insecure access to downtown, thus detracting from original intent of downtown connector
3.0 OPTION EVALUATION

3.1 Feasibility Assessment of Six Route Options

As background to the feasibility assessment of the preliminary route options, a series of consultations were conducted with the major stakeholders of the project identified by the District of Squamish (see Appendix D). Through the stakeholder consultation process, a review of relevant studies in the Study Area, site visits and field observations, the Project Team has identified the major challenges and constraints associated with each of the route options and have developed the criteria for the feasibility assessment of the six preliminary route options. The primary constraints governing the design of each of the route options are associated with the geometry of the bridge across the Mamquam Blind Channel. To preserve the CNR spur line to the immediate east of Loggers Lane, the bridge crossing for all the route options will be required to “touch down” before the spur (the rationale of which was discussed in Section 1.3). With a maximum approach grade of 8.3%, the maximum vertical clearance of each of the bridge options are determined and are shown in Table 1 below. It is noted that to meet the existing navigation requirements of this channel, a 19.2 m minimum vertical clearance is required and none of the bridge options could satisfy this requirement given the physical constraints identified above.\(^4\) The vertical clearance requirement of this crossing will, therefore, have to be confirmed at the next phase of the study in consultation with the District, the marine users, and the Transport Canada Navigable Waters Protection Division.

A summary of the feasibility assessment of the six preliminary route options is shown in Table 1 below.

\(^4\) According to the Navigation and Bridge Assessment Study by Bunt, Typlan and Westmar (November, 2005), the tallest sail boat currently using the channel has a height of 18.2 m. A bridge crossing with a vertical clearance of 19.2 m above high water level at 2.0m will accommodate all the existing boats with a minimum 1.0m allowance for safety clearance above the tallest boat.
# TABLE 1: FEASIBILITY ASSESSMENT OF SIX PRELIMINARY ROUTE OPTIONS

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<tr>
<th>A. Physical Constraints</th>
<th>Option 1 (Pemberton)</th>
<th>Option 2 (Winnipeg)</th>
<th>Option 3 (Victoria)</th>
<th>Option 4 (Main)</th>
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<td>V. 7.1 m X H. 30.5m</td>
<td>V. 7.1 m X H. 30.5m</td>
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<td>43 boats restricted (60% of existing users)</td>
<td>43 boats restricted (60% of existing users)</td>
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<td><strong>Room for Tall Boat Relocation (for Mid-level Bridge at 7.1m Clearance Above HWL)</strong></td>
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<td>Waterfront walkway discontinued on west side of channel</td>
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<td>Significant impacts to proposed development on both sides of channel (i.e. Pridham and BCR Properties)</td>
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<td>Requires road right-of-way from IR 24</td>
<td>Significant impact to IR 24 cemetery</td>
</tr>
<tr>
<td><strong>Traffic Impacts to Downtown Network</strong></td>
<td>New entry point in close proximity to existing entry point; Require intersection improvements at Loggers Lane and Cleveland Avenue</td>
<td>Significant property and traffic operational impacts along Loggers Lane and Cleveland Avenue</td>
<td>Significant property and traffic operational impacts along Loggers Lane and Cleveland Avenue</td>
<td>Significant property and traffic operational impacts along Loggers Lane and Cleveland Avenue</td>
<td>Least impact on downtown intersections</td>
<td>Least impact on downtown intersections</td>
</tr>
<tr>
<td><strong>E. Environmental Impacts</strong></td>
<td>Some environmental impacts related to fish and fish habitat</td>
<td>Significant impacts related to fish, fish habitat, riparian vegetation, and dredging on east side of channel</td>
<td>Some impacts related to fish, fish habitat and dredging on east side of channel</td>
<td>Some impacts related to fish, fish habitat and dredging on east side of channel</td>
<td>Significant impacts to fish, fish habitat and forested area in Squamish Nation land</td>
<td>Significant impacts to fish, fish habitat and forested area in Squamish Nation land</td>
</tr>
</tbody>
</table>

Note: HWL = High Water Level at 2.0 m above Geodetic Datum; Legend: ● = Least Impacts; ○ = Some Impacts; ◊ = Significant Impacts

---

July 13, 2006

Squamish Route
Study Technical Report 1
3.2 Eliminated Options

Based on the feasibility assessment of the six preliminary route options, the following 3 route options are ranked the least favourable considering the significant impacts they pose to the project constraints.

Route Options 3 (Victoria) and 4 (Main) are not selected due to:

- Restriction on the navigation of the Mamquam Blind Channel and the lack of opportunities for relocation of tall sail boats from the existing marinas at the north end of the channel
- Significant impact on the proposed development of the waterfront precinct (which are considered core principles in the Downtown Squamish Concept Plan endorsed by the District Council in October 2005)
- Significant property and development impacts as expressed by Pridham Development Inc. and British Columbia Rail (BCR) Properties during the stakeholder meetings
- Significant traffic operational impacts due to the limited right-of-way along Loggers Lane and operational requirements along Cleveland Avenue where the Downtown Connector joins the existing downtown road network at-grade

Route Option 6 (IR 24 Connector) is not selected due to:

- Significant concerns as expressed by the Squamish Nation regarding the route running adjacent to the cemetery located in IR 24.

3.3 Short-listed Options

Based on the feasibility assessment summarized in Table 1, the following three options are short-listed for the Multiple Account Evaluation in the next phase of this study:

- Route Option 1 (Pemberton Avenue): low-level fixed bridge next to the existing CNR bridge at the end of the channel
- Route Option 2 (Winnipeg Street): mid-level fixed bridge with 7.1 m vertical clearance over the navigable channel
- Route Option 5 (Westminster Street): high-level fixed bridge with 13.2 m vertical clearance over the navigable channel

To provide guidance to the Multiple Account Evaluation in the next phase of this study, the advantages and disadvantages of the three short-listed route options are described in Table 2 below.
Table 2: Advantages and Disadvantages of Three Short-Listed Route Options

<table>
<thead>
<tr>
<th>Option 1 (Pemberton)</th>
<th>Option 2 (Winnipeg)</th>
<th>Option 5 (Westminster)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td><strong>Disadvantages</strong></td>
<td><strong>Advantages</strong></td>
</tr>
<tr>
<td>• No impact to navigability of the channel or waterfront access</td>
<td>• Route parallels CNR and terminates close to Cleveland/CNR crossing – increased risk in case of railway incident</td>
<td>• Provides a significant network alternative to the existing downtown access at Hwy 99/Cleveland intersection</td>
</tr>
<tr>
<td>• Parallels railway right-of-way, reducing land severance and property acquisition costs</td>
<td>• Indirect access to centroid of downtown – least conducive to traffic circulation through and within downtown</td>
<td>• Eliminates the “dead end” aspect of Downtown road network by creating a circle route</td>
</tr>
<tr>
<td>• Reduced physical, environmental and potential archaeological impacts with a relatively short span and low level navigation clearance</td>
<td>• Significant increase of left turn volumes on Pemberton/Cleveland intersection</td>
<td>• Uses high ground on east side of channel as a springboard for the bridge crossing</td>
</tr>
<tr>
<td>• Promotes walking/cycling across channel</td>
<td>• Unattractive to traffic from Squamish North and Highway 99 North, and inconvenient for traffic destined to south end and SODC site</td>
<td>• Provides higher navigation clearances than other options</td>
</tr>
<tr>
<td>• Relatively low construction cost</td>
<td>• Adversely impacts commercial autobody shop operations on Pemberton Avenue</td>
<td>• Least impact on downtown intersections (reduces SODC traffic through downtown; defers timing of Cleveland Ave parking restrictions)</td>
</tr>
</tbody>
</table>

- Higher construction cost
3.4 Mitigation of Navigation Impacts of Mamquam Blind Channel

It is recognized that the fixed bridge across the channel for Options 2 and 5 will have negative impacts on the navigation of the Mamquam Blind Channel. For Option 2, the restriction on the navigation channel is limited to three existing marinas at the end of the channel. Since a good portion of the channel will remain open downstream of this proposed crossing, and a number of new marinas are being proposed in the Pridham site and the BCR Properties site on both sides of the channel, it is likely that suitable relocation of the tall sail boats from these marinas could be accommodated. For Option 5, even though the proposed vertical clearance will not accommodate all existing users of the channel, it should be referenced that the vertical clearance for the Vancouver Airport Connector Project is 10.5 m over a navigable arm of the Fraser River, namely the Morray Channel, and the proposed Pitt River Bridge project is 16.0 m. Furthermore, additional new marinas are being proposed downstream of this crossing in the Westmana site and the SODC site where tall sail boats could be accommodated.

The negative impacts on the navigability of the channel could, therefore, be ameliorated in the following manner:

- Seek suitable relocation sites for some users of the three existing marinas at the end of the channel to accommodate the tall sail boat operations further downstream.

- Compensate marina owners (one time payments) for the business loss associated with not being able to accommodate any boats higher than 6.1 m (Option 2) or 12.2 m (Option 5), based on the loss on number of boats moored in recent years that were greater than this height. If the marina owner could demonstrate that the height restriction would put them out of business, it would be necessary to offer a complete buy-out of their business.

- Close or relocate in the future the heavy rail operation on the CNR spur line. This would provide more flexibility in the location of the touch-down point on the west side of the channel, could allow a reduction in the grade of the bridge and therefore a higher navigation clearance over the channel, and could, in the case of Option 2, reduce the dredging required in the channel.

- Landscape the approaches to a fixed bridge and select suitable architecture for the bridge in order to minimize the visual impacts of the crossing and to harmonize with the physical environment.

A bridge crossing at Option 5 will, understandably, pose restrictions to the navigation of the channel due to its southerly location. To maximize the vertical clearance of the bridge above the channel, the feasibility of the following measures can be explored:

i) Relocate the CNR spur from south of Vancouver Street across Cattermole Slough to serve the existing industrial land uses. A low-level rail bridge could be built across the slough for this purpose and the existing moorage on the slough would be relocated.
further south. This would be compatible the partial fill-up of the slough to allow the southerly extension of Cleveland Avenue over SODC Lands. Future LRT services along the waterfront on the existing rail spur north of Vancouver Street could also be maintained through the downtown core.

If the closure of the CNR spur in this section is proved feasible, it would allow the bridge touch-down to be moved west by about 60 m to the extension of Cleveland Avenue, and, maintaining 8.3% on the bridge grade, the navigation clearance to be increased by almost 5 m to 18.2 m.

ii) Raise the existing elevation of Galbraith Road by a nominal 6 m to facilitate touch down of the bridge approach road at the downtown end. This would increase the bridge navigation clearance by 6 m to 19.2 m to accommodate all the existing marine traffic while maintaining 8.3% on the bridge grade. This will involve reconstruction and raising of Galbraith Road from Vancouver Street south for about 300 m. If the CNR spur could be closed at some future date, this option would allow for the future westerly extension of the Downtown Connector from Galbraith Road to the Cleveland extension.

4.0 MULTIPLE ACCOUNT EVALUATION

The intention of Multiple Account Evaluation is to measure the impact of each project option relative to the conditions which would occur in the absence of the project. There are three components to the evaluation including: 1) the accounts or evaluation criteria, 2) the scores for each option and 3) the weights assigned to each criteria.

The accounts include the criteria used to evaluate each option. It is generally better to evaluate using a small number of relevant criteria than a large number of detailed but less significant criteria. In this case, evaluation criteria are grouped into the five categories as shown in Table 3. The first two accounts, Financial and Customer Service, are evaluated quantitatively in dollar terms. The Social, Environmental and Local Economy accounts are evaluated qualitatively and, together with their scores and weights, are the subject of the MAE Workshop. These five accounts are described below.

1) Financial Account – For each option this is the present value of capital, maintenance, rehabilitation and salvage values over the life of the project.

2) Customer Service Account – This is the dollar value of time, accident and vehicle operating costs savings associated with each option, calculated as a present value over the life of the project.

3) Social/Community Account – This documents other impacts of the project on the community. The criteria identified initially include:
   - Emergency Services – degree to which each option improves emergency access to the area.
   - Property Displacement – refers to commercial and residential property takings.
   - Downtown Revitalization – options improving accessibility into the downtown core are generally good for businesses in this area.
Gateway Value – options present an inviting entrance to Downtown Squamish.

Waterfront Access & Recreation – the degree to which each option supports access and recreation to and along the waterfront,

Pedestrian/Cyclists/Alternative Transport Modes – primarily access and safety issues for non-motorized travel on the alternate access route.

Human Impacts – any significant impacts on human emotions regarding the route options.

Environmental – This summarizes the impact of each option on the natural environment relative to the existing condition in the absence of the project. Criteria identified initially include:

Fish and Fish Habitat – impacts are typically negative or mitigated to achieve a neutral impact.

Contaminated Sites Risk – this includes risk of contaminated soils not already identified or included in the construction cost.

Archeological Risk – possibility of finding artifacts of cultural significance which would impact on construction.


Air Quality & Noise Impacts – impacts on air quality and noise pollution levels.

Local Economy - This is intended to document real income and employment benefits to the local economy beyond the immediate direct impacts of the project to road users.

Existing Business – impacts are typically positive

New Development – potential for property development of undeveloped or underdeveloped land (IR 24, former Interfor site, etc)
Table 3: MAE Framework: Squamish Downtown Access Route Selection Study

<table>
<thead>
<tr>
<th>ACCOUNT</th>
<th>Option 1 (Pemberton)</th>
<th>Option 2 (Winnipeg)</th>
<th>Option 5 (Westminster)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FINANCIAL ($millions)</strong></td>
<td>Quantitative Accounts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Cost*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Salvage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= Present Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CUSTOMER SERVICE ($millions)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Savings</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Accident Savings</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Vehicle Operating Cost Savings</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Benefit/Cost Ratio</td>
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<td></td>
<td></td>
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<tr>
<td>NPV Ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SOCIAL/COMMUNITY</strong></td>
<td>Qualitative Accounts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property Displacement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downtown Revitalization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gateway Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waterfront Access &amp; Recreation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian/Cyclists/Alternative Transport Modes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Impacts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ENVIRONMENTAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish and Fish Habitat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contam. Sites Risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archeological Risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flora &amp; Fauna</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Quality &amp; Noise</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LOCAL ECONOMY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing Business</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Development</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scoring</th>
<th>Relative to Existing</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>Significantly worse</td>
</tr>
<tr>
<td>-1</td>
<td>Worse</td>
</tr>
<tr>
<td>0</td>
<td>Neutral</td>
</tr>
<tr>
<td>1</td>
<td>Better</td>
</tr>
<tr>
<td>2</td>
<td>Significantly better</td>
</tr>
</tbody>
</table>

The analysis assumes that budget and right-of-way are available for all options. These factors potentially limit the scope of options available for evaluation but are not themselves treated as evaluation criteria in the analysis.
5.0 NEXT STEPS

Based on the selection of the three short-listed options and the MAE criteria described above, the following tasks were conducted to further evaluate these options:

- Conceptual design of the three short-listed routes to determine high-level project costs and to identify technical, property and environmental issues as input to the MAE;

- Traffic modelling of the downtown connector and its integration with the downtown road network to evaluate the project benefits in terms of user travel time, safety and vehicle operating costs;

- Continued consultation with directly affected stakeholders regarding the three short-listed route options (see Appendix D for the Stakeholder Consultation Summary Report);

- Public Open House to obtain feedback on the three short-listed options as input to the MAE; this was held on June 22, 2006 in the Squamish Totem Hall (see Appendix E for the Community Consultation Summary Report);

- MAE Workshop with the District, MoT and SNC-Lavalin Project Team for the selection of the preferred route; this was held in the SNC-Lavalin Office on June 26, 2006;

- Met with District Council on July 4, 2006 to present the study findings to date;

A follow-up presentation will be made to the District Council on July 18, 2006 to present the results of the MAE of the three short-listed options and the recommendation of the preferred route. Upon District approval, the SNC-Lavalin Project Team will proceed with the functional design and “Class C” cost estimate of the preferred route. A preliminary implementation plan will be prepared to address work staging, funding opportunities and regulatory approval issues.
APPENDIX A: COPY OF MOT LETTER TO DOS REGARDING PRIDHAM DEVELOPMENT INC. PROPOSAL

March 28, 2006

District of Squamish
PO Box 310
Squamish, BC VON 3G0

Attention: Cameron Chalmers, Manager of Planning Services of Planning


Ministry staff have discussed and reviewed the Pridham Development Inc. proposal. The Ministry supports the proposed neighborhood and rezoning of the lands in principle, but cannot give final approval at this time.

Before the Ministry can grant final approval, the Ministry requires the following:

1) Finalization of the alternative route location to access downtown Squamish.
2) Written assurances from the District and Pridham Developments of the location of the alternative route and construction timeframe of the alternate route. A temporary access to Highway 99 will not be granted to serve any staged development.
3) Finalization of alternate route location to downtown and Highway 99. As there is an opportunity to not only provide an alternative access to downtown in the area of Clark Drive other surrounding lands should be taken into account. With the upgrading of the Highway 99 corridor taken place a grade separated intersection shall be required.

Please quote file number 01-006-23225 when contacting this office.

Yours truly,

Deputy Approving Officer

APPENDIX B: CONSIDERATIONS FOR TUNNEL OPTIONS

One option for achieving the crossing of Mamquam Blind Channel in the case of Routes 2, 3 and 4 would be to construct a tunnel under the channel. The reasons a tunnel might be considered at these locations are:

- A tunnel would not pose any navigation clearance restrictions as long as the top of the tunnel was at or below the bottom of the existing channel bed;
- A tunnel would not be seen from the channel or its immediate banks and would not therefore create the visual impacts associated with a bridge crossing which may be considered positive or negative depending on the personal likes or dislikes of the viewer;
- The ground on either side of the channel at these route locations (Options 2, 3 and 4) is fairly low and flat, necessitating a relatively short length of tunnel (about 220m) compared with a much longer requirement along Routes 5 or 6.

General design considerations for tunnels include the following: ⁶

- Tunnels should be as short as practical because the feeling of confinement and magnification of traffic noise can be unpleasant to drivers, and tunnels are the most expensive road structure to construct;
- Keeping as much of the tunnel length and its approaches as practical on a horizontal tangent will minimize its length and improve operating efficiency;
- Lighting expenses are highest near portals;
- Ventilation costs depend on length, grades, natural and vehicle-induced ventilation, type of system, and air quality constraints;
- Tunnel design should avoid the need for guide signs within tunnels, because normal vertical and lateral clearances are usually insufficient;
- Full shoulder width should desirably be carried through the tunnel. If the shoulder is not provided, intolerable delays may result when vehicles become disabled. Where it is not practical to provide shoulders in a tunnel, arrangements should be made for around-the-clock emergency service vehicles that can promptly remove any stalled vehicles;
- Raised sidewalks are desirable beyond the shoulder to serve the dual purpose of pedestrian safety and as a buffer to prevent the overhang of vehicles from damaging the wall finish or the tunnel lighting fixtures;
- Directional traffic is usually separated for safety reasons and to relieve the dizzying effect of two-way traffic in a confined space.

⁶ See AASHTO Geometric Design of Highways and Streets 2001 “Tunnels”.
In addition to the above considerations from AASHTO, we note that a 220m long road tunnel under the Mamquam Blind Channel would likely require a parallel tunnel with doors at intervals between both tunnels, to provide an escape route in the event of fire. In practice, this would be achieved by providing two tunnels, one for westbound traffic, and one for eastbound traffic, with a firewall between them. Each tunnel would need to be wide enough to accommodate 2 trucks, in case one stalls, and sidewalks as shown in the Figure B-1 below.

Figure B-1: Possible Tunnel Cross Section (dimensions in meters)

Furthermore, a tunnel under the channel require a continuously operating pumped drainage system to pick up and discharge ground water seepage and also to handle storm drainage from rainfall. We also note that because of the confining sensation of driving, walking or cycling through a tunnel compared with a bridge, many people may choose to use the existing route via the Highway99/Cleveland Avenue intersection across the CNR to and from the downtown.

Considering the many disadvantages of a tunnel versus a bridge as shown in Table B-1 below, for the Mamquam Blind Channel crossing, SNC-Lavalin decided not to pursue this option further. With respect to the navigation clearances associated with the bridge options, we will work closely with Transport Canada and the local marinas to achieve a satisfactory solution.
<table>
<thead>
<tr>
<th></th>
<th>Tunnel</th>
<th>Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marine navigational constraint</strong></td>
<td>Water depth only</td>
<td>Height and width of navigation channel</td>
</tr>
<tr>
<td><strong>Sense of confinement for all users</strong></td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Noise for all users</strong></td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Horizontal alignment constraint</strong></td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Lighting costs</strong></td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Ventilation costs</strong></td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Placement of guide signs</strong></td>
<td>Difficult</td>
<td>Relatively easy</td>
</tr>
<tr>
<td><strong>Time to access disabled vehicles</strong></td>
<td>Critical</td>
<td>Less critical</td>
</tr>
<tr>
<td><strong>Pedestrian and fire precautions</strong></td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Drainage system</strong></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Construction cost</strong></td>
<td>Very high</td>
<td>High</td>
</tr>
</tbody>
</table>
APPENDIX C: CONSIDERATIONS FOR LOW LEVEL MOVABLE BRIDGE OPTIONS

Another option for achieving the crossing of Mamquam Blind Channel in the case of Routes 2, 3 and 4 would be to provide a movable span bridge over the navigation channel. The bridge could have a low profile elevation over the water (top of deck about 5 m above high water level @ 2.0 m; vertical clearance about 3 m) and gentle grades (5% maximum) on the approaches to the fixed portion of the bridge. Such a scheme would have the following advantages:

- It would avoid the necessity of relocating sailing boats and taller power boats from the existing marinas north of Winnipeg Street.
- It would ease travel effort for cyclists or pedestrians crossing the channel.
- It would be less visually intrusive than a higher-level fixed link.
- It could touch down east of Cleveland Avenue and just east of the CNR spur line, thus enabling the line to remain open indefinitely.
- It would require lower approach fills in both sides of the channel, thus reducing right-of-way or retaining wall requirements.

A movable bridge would need to have a clear opening a little greater than 30.5 m (100 ft) width, 30.5 m being the width of the navigation channel. A movable bridge could be one of a number of types including the following:

- A single or double cantilever span that rotates in a horizontal plane above a pivot point: commonly known as a swing bridge.
- A single span that breaks in the middle and rotates into two vertical leaves: commonly known as a bascule bridge.
- A single span that rises horizontally between two towers: commonly known as a lift bridge.
- A single span that rotates into one vertical position: also known as a lift bridge.

In light of the above advantages, it is noted that a movable bridge has the following disadvantages:

- It would require a full-time operator to be present for 12 hours per day (365 days per year); an operator would also need to be on call for the remaining portion of the 24-hour period, 365 days per year. Salary costs would be considerable over the life of the bridge.
- The mechanical and electrical components needed for the movable portion of the bridge would require periodic maintenance and replacement when they wear out. Because the mechanical components are frequently in motion, they will require replacement more frequently than would structural components of a fixed bridge.
- There will be frequent interruptions to both road and marine traffic owing to the opening and closing of the bridge for these two components of traffic.
If there is an electrical or mechanical failure, or a need for extensive maintenance of the moving components, the bridge could end up closed to either marine or road traffic for an extended period of time.

The initial construction cost of a movable bridge would likely be significantly higher than for a fixed bridge with a moderate vertical clearance for navigation i.e. 7.1 m or 10.5m above high water level @ 2.0 m.

Because of the uncertainty factor for road vehicle operators, “Will the bridge be open or closed when I arrive there?”, a significant number of drivers may choose to use the existing Cleveland Avenue route into downtown, across the CNR at-grade crossing, thus detracting from the benefits of investing public funds in the new channel crossing.

Considering the above advantages and disadvantages of a movable bridge for the Mamquam Blind Channel crossing, we feel that the advantages are outweighed by the disadvantages. Consequently we propose dropping the movable bridge concept for Options 2, 3 or 4 from further consideration. A low level movable bridge at Options 5 or 6 (the Westminster crossing), is also not considered feasible because of the high ground and steep slopes to the waterline on the east side of the channel.