APPENDIX C – CROSSING MULTIPLE ACCOUNT EVALUATION

The Ministry uses a MAE framework to systematically assess service delivery options, including a base case, across a standard set of accounts. This multi-criteria decision support tool provides a balanced view to decision makers, and an understanding of the inevitable trade-offs which are required in any decision. The standard accounts used by the Ministry include:

1. Financial,
2. Customer service,
3. Social/community,
4. Economic development, and
5. Environmental.

Where practical, the MAE has drawn from the extensive list of standard indicators for each account as presented in the Ministry's *Benefit Cost Analysis Guidebook*. Indicators include a mix of quantitative and qualitative measures. To align the Ministry's MAE process with the specific goals and objectives of the Project, a matrix table was completed to provide a cross-reference between account indicators and Project goals and objectives. This table is provided below as Table C-1. Table C-2 provides results of the MAE.

TABLE C-1: CROSS-REFERENCE BETWEEN PROJECT GOALS AND OBJECTIVES AND ACCOUNT INDICATORS

Project Goals	Project Objectives	Financial				Customer Service						Social / Community											Economic Development								Environment			
		Capital costs	Salvage value	Operating, maintenance and rehabilitation costs	Project delivery timelines	Travel time savings	Travel time reliability	Seismic resiliency	Value of safety savings	Savings in vehicle operating costs	Emergency response	Network connectivity	Transit ridership	Consistency with local, regional and provincial plans	Modal integration for cyclists and pedestrians	Park and recreation takings	Park and recreation impacts	Residential property takings (full)	Residential property takings (partial)	Residential property impacts	Future land use implications	Visual aesthetics	Noise and light	Economic agglomeration	Marine traffic during construction	Marine access during operations	Agricultural land takings	Agricultural land impacts	Business takings (full)	Business takings (partial)	Business impacts	Regional air quality	Local air quality	Aquatic species and habitat	Wildlife and terrestrial habitat
1. Support sustainability of Fraser River communities	**1a** Improve safety for all modes of travel							◆	◆		◆																						
	1b Improve access to designated development centres					◆	◆					◆																					
	1c Manage congestion on the corridor					◆	◆																										
	1d Respect the cultural values of communities															◆	◆					◆	◆		◆	◆	◆	◆				◆	◆
	1e Enhance connections between communities					◆	◆					◆	◆		◆																		
	1f Maintain agricultural productivity																				◆					◆	◆							
	1g Avoid impacts to agricultural land																									◆	◆							
	1h Move forward quickly				◆																													
	1i Adopt a shared decision-making approach with the Task Force and participating First Nations [1]																																	
2. Facilitate increased share of sustainable modes of transport	**2a** Enhance transit service convenience and facilitate future expansion					◆	◆						◆																					
	2b Provide safe, convenient and comfortable options for pedestrians and cyclists														◆																			
	2c Encourage higher occupancy modes of travel												◆																					
	2d Ensure potential for future rail rapid transit [2]																																	
3. Enhance regional goods movement and commerce	**3a** Improve travel reliability for business and regional goods movements					◆	◆																											
	3b Support the B.C. tourism industry					◆	◆																											
	3c Protect the Fraser River for fishing and transportation																								◆	◆							◆	
	3d Support industrial land productivity					◆	◆																						◆	◆	◆			
	3e Reduce congestion-related delays for priority goods and services trips					◆	◆																											
4. Support a healthy environment	**4a** Avoid loss of habitat for fish, wildlife, birds and marine mammals																																◆	◆
	4b Improve habitat quality and protect water quality																																◆	◆
	4c Enhance land- and marine-based recreation															◆	◆																	
	4d Reduce greenhouse gas emissions and other air contaminants					◆	◆						◆		◆																	◆	◆		
Additional item(s) not specifically identified in project goals and objectives		◆	◆	◆						◆				◆				◆	◆	◆				◆										

[1] This project objective is not measured through the MAE but reflected in the projects approach to options analysis.
[2] Refer to Section 4.5.3 Further Consideration of Future Rapid Transit in the Corridor.

TABLE C-2: MULTIPLE ACCOUNT EVALUATION RESULTS

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
1. FINANCIAL [1] [2]			
1.1. Capital costs (PV, $M)	Nil	[redacted]	[redacted]
		Capital costs relate to the hard and soft construction costs associated with each Option. The items which are not included in the present analysis are sunk costs, escalation, and effects of any nature relating to depreciation and IDC. The difference in benefit amount between the Options relates to the application of the discounting method for the assessment with Option 1 presenting a longer construction period when compared to Option 2.	
1.2. Salvage value (PV, $M)	Nil (It has been assumed that the Existing Tunnel will not present any useful life at the end of the operations period of 25 years).	[redacted]	[redacted]
		The salvage value has been calculated using the Ministry's ShortBEN model. The service life of each cost component respects the guidelines set out in the Default Value for Benefit Cost Analysis in British Columbia 2018.[3] The analysis period includes 25 years of operations.	
1.3. O&MR costs (PV, $M)	Current O&MR cost associated with the Existing Tunnel has been considered in the calculation of the incremental benefits generated by the Options.	[redacted]	[redacted]
		Estimated $[redacted]M annual OMR cost. The analysis period includes 25 years of operations.	Estimated $[redacted]M annual OMR cost. The analysis period includes 25 years of operations.

[1] The annual discount rate is equivalent to 6% as per the Ministry's Benefits Cost Analysis Guidebook (revised version as of August 2014).
[2] "PV, $M" indicates the values are in $ million on a present value basis, 2021 as base year.
[3] https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/transportation-planning/benefit-cost-analysis

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
1.4. Project delivery timelines (end of construction, excludes activities relating to the decommissioning of the Existing Tunnel)	n/a Base Case assumes continuous use of Existing Tunnel without construction works.	Q2 2030 Refer to Figure D-3, Appendix D for ITT schedule.	Q4 2028 Refer to Figure D-6, Appendix D for bridge schedule.
2. CUSTOMER SERVICE [4]			
2.1. Travel time savings (PV, $M)	n/a	917	950
		The majority of the savings are derived from the improved capacity and laning along the Highway 99 corridor (~70% is allocated to passenger vehicles; ~30% to trucks, and transit users). Although users must climb an additional 45 m for a bridge option (peak of roadway approximately 75m above ground surface) as compared to the tunnel option (lowest roadway point approximately 30 m below ground surface), it is expected that travel time savings will be similar between Options based on a climbing lane analysis for heavy vehicles. The travel time savings are monetized using the value of travel time and application of the consumer surplus method within the Regional Transportation Model (RTM). The network equilibrium capability of the RTM allows for capture of congestion relief on the Alex Fraser Bridge and the Highway 91 corridor as vehicles divert to Highway 99. Enhanced expansion factors were applied to estimate future benefits as the current specification of the RTM uses fixed time slices to estimate peak period traffic demands and congestion levels. In other words, if no improvements were made to Highway 99, then the current peak period would grow beyond levels observed today which is not specifically accounted for in the RTM. The difference in benefit amount between the Options relates to the application of the discounting method for the assessment with Option 1 starting operations in Q2 2030 while Option 2 starts in Q4 2028.	

[4] The annual discount rate is equivalent to 6% as per the Ministry's Benefits Cost Analysis Guidebook (revised version as of Aug 2014).

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
2.2. Travel time reliability (PV, $M)	n/a	192	195
		Both Options allow for reduced variability in travel times if the Existing Tunnel is replaced by a new crossing structure with higher traffic capacity. The reliability benefits account for both passenger and commercial vehicles. It is important to note that the impacts on travel time reliability during the construction period will be strongly dependent on the efficiency of the traffic management plans in place. The difference in benefit amount between the Options relates to the application of the discounting method for the assessment with Option 1 starting operations in Q2 2030 while Option 2 starts in Q4 2028.	
2.3. Improved seismic resiliency (PV, $M)	Nil	139	137
	The calculation methodology is based on the present value of the annual likelihood of a crossing failure due to a seismic event, applied to the expected cost of the failure, over a 25 year period. This methodology is consistent with that used in previous business cases for major crossings such as the Pattullo Bridge Replacement Project and previous GMTR Project. The following assumptions were considered under the scenarios:		

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
	- Return period of 1-in-240 year of a seismic event. - The traffic disruption costs associated with a crossing failure are estimated to be approximately $2.8 billon over a seven-year reconstruction period, for all options (280 million passenger-trips, $10 per trip affected). - The Existing Tunnel's early warning system for seismic events is assumed to be provided under all scenarios, making loss of life due to a seismic event unlikely, therefore, no cost associated with this event in particular has been considered. early warning system for seismic events under all scenarios; - No cost of reconstruction is assumed under the Base Case.	- Return period of 1-in-2,475 year of a seismic event. - The traffic disruption costs associated with a crossing failure are estimated to be approximately $2.8 billon over a seven-year reconstruction period, for all options (280 million passenger-trips, $10 per trip affected). - The Existing Tunnel's early warning system for seismic events is assumed to be provided under all scenarios, making loss of life due to a seismic event unlikely, therefore, no cost associated with this event in particular has been considered. Early warning system for seismic events under all scenarios - Cost of reconstruction of the crossing: If a crossing does fail because of a seismic event, it is assumed to be rebuilt on a "like kind" basis, therefore, the costs of reconstruction are equivalent to the capital costs under consideration for each scenario. In summary, the difference in benefit amount between the Options is a result of the divergent capital costs and starting operations date (Q2 2030 for Option 1, and Q4 2028 for Option 2).	

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
2.4. Safety savings (PV, $M)	n/a	68	66
		Overall, the risk of collision is reduced when modern-day design standards are implemented, and consequently, safety savings are originated. Due to the large, proposed number of design changes to the Highway 99 corridor, and in order to simplify the RTM methodology, a benchmark of collision reductions on the Port Mann/Highway 1 corridor were utilized. The collision rate on Port Mann/Highway 1 was reduced by 25% based on a review of historical collision data along this corridor. An adjusted rate for Highway 99 was developed taking into account the physical attributes of the Existing Tunnel versus the Options (no opposite traffic in the same crossing direction). Accident rates by various roadway and highway types were multiplied by vehicle volumes using the RTM to estimate the network-wide effects on the total number of accidents. For both methods, the monetary value of fatal/injury and property damage-only accidents ratio was applied to estimate total net safety savings. The difference in benefit amount between the Options relates to the application of the discounting method for the assessment with Option 1 starting operations in Q2 2030 while Option 2 starts in Q4 2028.	
2.5. Savings in vehicle operating costs (PV, $M)	n/a	(54)	(58)
		The savings in vehicle operating costs are negatively correlated to the volume of fuel consumption which is positively correlated to traffic volumes. It is important to note that forecast vehicle operating costs in the long-term will be strongly influenced by the rate of adoption of electric and autonomous vehicles (which may drive the cost of fuel consumption to lower levels). The difference in benefit amount between the Options relates to the application of the discounting method for the assessment with Option 1 starting operations in Q2 2030 while Option 2 starts in Q4 2028.	

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
2.6. Emergency response	○	●	●
	Emergency responders have difficulties responding to incidents within the Existing Tunnel. Primary contributing factors are 3.66 m lane widths with no shoulders and traffic congestion, which restrict ability to manage traffic in and around an incident. The overhead clearance of 4.15 m and limited fire suppression and ventilation conditions contribute to the incident response challenges.	The new infrastructure will be built to modern design standards with 3.7 m wide lanes and 1.12 m shoulders on the inside and outside on each side of the roadway. The additional lanes and shoulders will reduce the impact of incidents as compared to the Existing Tunnel, which has two 3.66 m lanes and no shoulders in each direction. Shoulders for Option 1 are 0.12 m wider than Option 2 to reflect best practice for tunnels. When compared to the Existing Tunnel, a new ITT would include wider roadway tubes with shoulders for better traffic management and accessibility, as well as enhanced lighting and fire life safety systems.	The new infrastructure will be built to modern design standards with 3.7 m wide lanes and 1.0 m shoulders on the inside and outside on each side of the roadway. The additional lanes and shoulders will reduce the impact of incidents as compared to the Existing Tunnel, which has two 3.66 m lanes and no shoulders in each direction. When compared to the Existing Tunnel, Option 2 would provide some additional accessibility benefits for emergency response over Option 1 as each direction of the roadway is not confined to a separate tube and is open to air.

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
2.7. Network connectivity	○	●	●
	No improvements in network connectivity are expected under this scenario.	Option 1 will provide increased vehicle capacity and incentivize active transportation through a multi-use pathway and dedicated transit lanes when compared to the Base Case. In addition, this option will improve mobility for commercial users with higher vertical clearance than the Existing Tunnel, and the accommodation of dangerous goods. This additional connectivity will result in a portion of the traffic observed on the Alex Fraser Bridge diverting to the Crossing, which provides congestion relief across the Fraser River. Overall connectivity is most enhanced between Richmond and South of Fraser communities with improved capacity, reliability and travel times.	Option 2 will provide increased vehicle capacity and incentivize active transportation through multi-use pathways and dedicated transit lanes when compared to the Base Case. In addition, this option will improve mobility for commercial users with higher vertical clearance than the Existing Tunnel, and the accommodation of dangerous goods. This additional connectivity will result in a portion of the traffic observed on the Alex Fraser Bridge diverting to the Crossing, which provides congestion relief across the Fraser River. There is potential for a higher volume of diversion under Option 2 due to unlimited vertical clearance; however, the Highway 99 corridor contains several restricted clearance features with less than 5.0 m vertical clearance[5], which is provided for by Option 1 and this additional clearance is not expected to be a significant differentiator between the options. Overall connectivity is most enhanced between Richmond and South of Fraser communities with improved capacity, reliability and travel times.

[5] Ministry of Transportation and Infrastructure, 5m Wide Load Routes (https://www2.gov.bc.ca/assets/gov/driving-and-transportation/cvse/route-maps/5-m/overview.pdf).

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
3. SOCIAL / COMMUNITY			
3.1. Transit ridership (additional trips per year)	0.0	~ 0.8 million This benefit is partially dependent on crowding and vehicle capacity. Generally, the Options provide enhanced travel time and reliability for transit users when compared to the base case scenario, and as a result, an annual increase in transit trips along the corridor is observed. The overall operation of buses along Highway 99 improves, resulting in faster travel times and improved overall reliability. The increase in ridership is also associated with the provision of transit-only lanes along Highway 99 which incentivizes the increase of transit riders.	~ 0.8 million
3.2. Consistency with local, regional and provincial plans	○ Mayors' Task Force, Vancouver Regional District Board, Official Community Plans (OCPs) of city of Delta and Richmond support the implementation of a new crossing solution in order to observe substantial benefits resulting for an improved movement of people and goods.	● Mayors' Task Force has confirmed preference for an ITT structure. One of the Indigenous Groups has stated preference for an ITT structure. RGS, RTS, Delta OCP and Richmond OCP strongly support increased public transit and alternatives to single occupancy vehicles.	● RGS, RTS, Delta OCP and Richmond OCP strongly support increased public transit and alternatives to single occupancy vehicles.

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
3.3. Modal integration for cyclists and pedestrians	○	●	●
	Currently, no multi-use path exists in the Existing Tunnel. There is a shuttle service, but the wait time can be 30 minutes or more, and this service can be oversubscribed with riders waiting for extensive periods to make the crossing; it also only operates for limited hours during the day. The safety improvement works under this scenario do not include the implementation of a multi-use path.	Option 1 proposes to construct of one 5.0 m bidirectional multi-use path. The MUP for the ITT would be separated from vehicle traffic, covered, have a separate entrance north and south bound, lighting and air circulation (consideration for a separate HVAC system with no mixing of air with vehicular traffic). An underground structure also provides better protection from inclement weather, particularly against strong winds and rain/snow, and presents the least hill climb (~30 m) when compared to Option 2. Consistent with best practice, ITT option would include plans for CCTV, lighting, emergency call boxes, good sightlines, and use of colour, texture and potential for public art to help support an "eyes on the street", Crime Prevention Through Environmental Design (CPTED) approach for the multi-use path design. It is also noted that on balance, HUB Cycling and other cycling stakeholders expressed a slight preference for a tunnel (with appropriate CPTED principles) over a bridge because of the convenience and reduced hill climb associated with travel through a tunnel.	Option 2 proposes the construction of two 3.5 m unidirectional multi-use paths (one each side). It presents a hill climb of approximately 75 m, or 2.5 times that of the tunnel. Pedestrians would also be subjected to inclement weather, and travel in close proximity to traffic. While barrier-separated, the separation would not be absolute, as with a tunnel. Although Option 2 presents similar overall active transportation benefits, a bridge would expose users to the elements (strong wind, in particular, was noted as a concern in the engagement process) and require significant vertical climb in comparison to Option 1.

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
3.4. Park and recreation takings	0	0.24	0.13
	No park and recreation takings required.	The impact of Option 1 on existing parks and recreational facilities is low (0.24 ha of natural area in Deas Island Regional Park and Environmentally Sensitive Areas (ESA) in Delta). It is important to note that the identified area is located outside of any developed portion of the Deas Island Park (park and trail system) so minimal restoration costs and no disturbance damages beyond owner costs are expected.	The impact of Option 2 on existing parks and recreational facilities is low (0.13 ha of natural area in Deas Island Regional Park and ESAs in Delta). It is important to note that the identified area is located outside of any developed portion of the Deas Island Park (park and trail system) so minimal restoration costs and no disturbance damages beyond owner costs are expected.
3.5. Park and recreation impacts	○	○	○
	No impacts are predicted to existing parks and recreation areas.	All Options affect accessibility to recreation lands and trails during construction. During operations, overall impact is considered similar to the current situation.	
3.6. Residential property takings (full)	Nil	Nil	Nil
	No full residential takings are expected under this scenario.	No full residential takings are expected under this scenario.	
3.7. Residential property takings (partial)	Nil	Nil	1
	No residentially designated property takes in Delta or Richmond are expected under this scenario.	No partial residential takings are expected under Option 1.	One partial taking is expected (equivalent to an area of 0.03 ha) under this Option due to alignment of the new structure (which is elevated).

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
3.8. Residential property impacts	Nil	🟡	🔴
	No anticipated impact.	Both Options will generate construction and operation-related disturbances. The alignment associated with Option 1 moves north of the Existing Tunnel and closer to residential properties on River Road in Delta. No takings are expected though.	Both Options will generate construction and operation-related disturbances. The elevated structure associated with Option 2 will also impact residential properties on River Road in Delta. Under this Option, a partial taking is expected as well.
3.9. Visual aesthetics	○	○	🔴
	No anticipated visual change.	Option 1 is not anticipated to substantially change the visual aesthetic from existing conditions.	Option 2 would change the landscape at the crossing. A bridge would be highly visible from nearby parks, residences and commercial properties.
3.10. Noise and light impacts	○	○	🔴
	No changes anticipated to the existing conditions.	Noise and light emanating from the current Highway 99 sources influence Richmond and Delta the most. Overall, residentially designated land, parks and ESAs are affected more by noise and light as compared to commercial and agricultural areas. Option 1, for being an ITT as well, will have a level of influence comparable to the Base Case (area impacted is estimated to be ~ 620 ha).	Noise and light emanating from the current Highway 99 sources influence Richmond and Delta the most. Overall, residentially designated land, parks and ESAs are affected more by noise and light as compared to commercial and agricultural areas. Option 2 is likely to expose residentially designated land, parks, and environmentally sensitive areas to more noise and light influence compared to Option 1, due to the elevated structure which disperses noise and light over greater distances (area impacted is estimated to be ~ 1,200 ha).

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
4. ECONOMIC DEVELOPMENT			
4.1. Economic agglomeration (PV, $M)	n/a	192	205
		Benefit is a function of effective job density and travel time. Investment in transportation infrastructure brings firms, people and places closer together by reducing travel times among them, which in turn facilitates economic interactions within business clusters. Lane capacity also influences the outcomes of this indicator, in other words, benefits associated with a roadway with laning configuration of 6 GP plus 2 dedicated transit lanes will present a lower amount largely due to the loss of vehicle capacity in the peak direction if compared to a 8 GP configuration. Finally, the difference in benefit between Option 1 and 2 is derived from their distinct service delivery timeline as the discounting method is applied when calculating the benefits.	
4.2. Marine navigation during construction	○	●	●
	No anticipated change.	Tunnel construction requires temporary (24 to 48 hour) closures of the entire navigable channel of the Fraser River during immersion of each element (six elements in total; approximately two to four weeks between immersions), and restrictions to navigation in the crossing area during instream works. During construction of the Deas Slough bridge, there will be scheduled restrictions to vessel movements in Deas Slough. During decommissioning and removal of the Existing Tunnel, there will be several scheduled temporary partial/full navigation channel closures in the Fraser River.	During construction of the bridge there will be limited disturbance to marine traffic as the majority of construction will advance from the abutments of the bridge. During construction of the Deas Slough bridge, there will be scheduled restrictions to vessel movements in Deas Slough. During decommissioning and removal of the existing tunnel, there will be several scheduled temporary partial/full navigation channel closures in the Fraser River.

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
4.3. Marine navigation during operations	○	○	●
	No anticipated change.	The water draft for Option 1 matches the water draft requirements of the Existing Tunnel, which meets the VFPA navigational requirements, and will not result in a change to the navigational channel for the South Arm of the Fraser River. The air draft for the Deas Bridge is also similar to the existing bridge and no change to navigability in Deas Slough is anticipated.	Option 2 has an air draft of 62.5 metres and will meet approximately 98% of the VFPA estimated future navigability requirements; tidal assist would be required to achieve 100% alignment with the VFPA's draft cruise ship strategy. The air draft for the Deas Bridge is greater than the existing bridge and increases air draft navigability into Deas Slough.

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
4.4. Agricultural land takings (ha)	0	4.1 ha	6.2 ha
	No impacts on agricultural land are expected.	The preliminary property impacts drawings for each Option have been considered when identifying the potentially affected agricultural land area. 	The preliminary property impacts drawings for each Option have been considered when identifying the potentially affected agricultural land area. 
4.5. Agricultural land impacts	○	●	●
	No impact on agricultural land are required.	During operations, improvements to access routes for better goods and equipment movement are anticipated for all options. The new crossing and highway upgrades will handle greater volumes of traffic assisting with access to and from agricultural areas. During construction there will be access limitations and restrictions with both Options.	

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
4.6. Business takings (full)	0	0	0
	No impact to commercial properties (business takings) are required.	No full business takings were identified for either Option.	
4.7. Business takings (partial)	0	8	3
	No impact to commercial / industrial properties (business takings) are expected.	[redacted]	[redacted]
4.8. Business impacts	○	●	●
	No impact to commercial properties (business takings) are expected.	The new crossing will handle greater volumes of traffic assisting with access to and from commercial areas. During construction there will be temporary access limitations and restrictions with both options. During operation, improvements to access routes for better goods and services transit are anticipated for both options.	

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
5. ENVIRONMENTAL			
5.1. Regional air quality	○	●	●
	No anticipated change to regional air quality.	Reductions in the volume of criteria air contaminants and greenhouse gas emissions are expected from this option when compared to the existing conditions, in large part due to improvements in vehicle emission standards, replacement of older vehicles over time, and reduction in vehicle idling time due to reduced congestion. The highest concentrations of criteria air contaminants are anticipated nearby the tunnel portals where emissions from the crossing are collected and dispersed by exhaust fans. This option has a higher carbon footprint due to the greater volume of concrete used in the construction of the tunnel elements.	Reductions in the volume of criteria air contaminants and greenhouse gas emissions are expected from this option when compared to the existing conditions, in large part due to improvements in vehicle emission standards, replacement of older vehicles over time, and reduction in vehicle idling time due to reduced congestion. Overall emissions of criteria air contaminants are marginally higher than the tunnel due to the greater elevation changes of the bridge. However, the concentrations of air contaminants around the bridge are lower than the tunnel because they are distributed across the entire crossing area (i.e., better dispersion).

Scenario #	Base Case	Option 1	Option 2
Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
5.2. Local air quality	○	●	●
	No anticipated change to local air quality. Maximum concentrations of criteria air contaminants in the future are highest for the base case, are focused on the tunnel portal areas on the north bank of the Fraser River and on Deas Island.	Improvements in the volume of criteria air contaminant emissions when compared to the existing conditions, largely due to improvements in vehicle emission standards, replacement of older vehicles over time, and reduction in vehicle idling time due to reduced congestion. Similar to the Base Case, the maximum concentrations of air emissions are focused on the tunnel portal areas on the north bank of the Fraser River and on Deas Island.	Improvements in the volume of criteria air contaminant emissions when compared to the existing conditions, largely due to improvements in vehicle emission standards, replacement of older vehicles over time, and reduction in vehicle idling time due to reduced congestion. Maximum emission concentrations for the bridge are lower than those for the tunnel because bridge emissions are more dispersed.
5.3. Aquatic species and habitat	○	●	●
	No anticipated change to aquatic species and habitat.	Option 1 has the greatest impact on fisheries, approximately 15 hectares of aquatic and riparian fish habitat. A casting basin facility is required for tunnel construction, and this would affect additional aquatic and riparian fish habitat that will be calculated after a location is determined. It is noted that other casting basin options, such as floating dry dock, casting in the approaches, or use of existing facilities, would mitigate impacts associated with the casting basin concept assessed for the ITT option. Under both Options, removal of the Existing Tunnel is expected which impacts the current conditions.	Option 2 has substantially reduced instream work and associated impacts, approximately two hectares of aquatic and riparian fish habitat. There are more options for offsetting, primarily within Deas Slough, when compared to Option 1. Under both Options, removal of the Existing Tunnel is expected which impacts the current conditions.

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Scenario description	**Continuous use of the Existing Tunnel**	**8-lane ITT 11.5m water draft plus decommissioning of the existing tunnel**	**8-lane Bridge 62.5m air draft plus decommissioning of the existing tunnel**
Laning configuration	**4 GP**	**6 GP + 2 transit lanes**	**6 GP + 2 transit lanes**
5.4. Wildlife and terrestrial habitat	○	●	●
	No anticipated change to wildlife and terrestrial habitat.	Option 1 will affect approximately 4.6 ha of natural habitat supporting wildlife. These effects include direct footprint effect on forests in and adjacent to Deas Island Regional Park. The offsetting opportunities on Deas Island are substantial. Green Slough realignment as an offset will not be possible.	Option 2 will affect approximately half the area impacted by Option 1. The offsetting opportunities on Deas Island are substantial. Green Slough realignment remains as an offset option. Option 2 has a collision potential effect for birds transiting along the Fraser River, which is avoided by the at-grade tunnel structures (Base Case and new ITT). Finally, a bridge has greater noise effects on wildlife during operations as its elevated structure allows wider dispersion. Indigenous groups have noted concerns with noise and light effects on migrating birds and their ability to practice traditional harvesting.