

Greenhouse gas implications of the Quinsam ferry versus a bridge

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Summary

The fuel-consumption and greenhouse gas emission implications of a fixed link to Gabriola Island have been considered. The analysis is based on the assumption that the bridge would cross from the El Verano Dr. area to Cedar via Mudge Island, and that current ferry foot passengers would have to find some alternative way to get to Nanaimo, either by car or by bus. It is also assumed that the existence of a bridge would result in a change in the travelling habits of Gabriolans and visitors to Gabriola, with an increase in the number of discretionary trips back and forth to Vancouver Island.

All of scenarios examined resulted in an increase in the fuel usage and greenhouse gas emissions for travel to and from Gabriola. The estimated increases ranged from 26% to 93% with the bridge option. The lowest number assumes that there is no increase in discretionary traffic and that 20% of current foot passengers use a bus. The highest number assumes that there is a 50% increase in traffic, and that 10% of current foot passengers use a bus.

Introduction

One of the critical issues to be considered in evaluating whether or not it is reasonable to build a bridge from Vancouver Island to Gabriola Island is the impact it would have on fuel usage and greenhouse gas (GHG) emissions. This is an important issue for those individuals who recognize the sensitivity of our climate and ecosystems to GHG levels, and also for our local governing bodies, who are compelled by the Provincial Government to take steps to limit GHG emission levels within their jurisdictions.

The following analysis is based on the premise that the ferry would be replaced by a bridge that crosses from the El Verano Dr. area to Mudge Island, and then by a new road in the Cedar area that connects with Barnes Rd. Some of the critical assumptions used in this analysis are as follows:

- 1) Based on the 2010 Island Futures Report¹ the Quinsam ferry uses 95 L of diesel per one-way trip. The engines of the Quinsam were replaced in 2010, but according to the senior captain² the rate of fuel usage has not changed significantly following the installation of the new engines.
- 2) It is assumed that the average private vehicle on Gabriola consumes 11.5 L/100 km (or 0.115L/km). This number, which represents cars, SUVs and pickup trucks, is taken from the 2010 Island Futures GHG report¹.
- 3) Because much of the population of Gabriola is clustered at the Village end of the island, the average distance to drive to the ferry at Descanso Bay is approximately 4 km. All drivers that take a vehicle on the ferry have to drive that distance on average, and some of the foot passengers do as well. Although the proportions are not known, it will be assumed here that half of the foot passengers drive (or are driven) to the ferry, while the other half walk or cycle, or take the GERTIE bus.
- 4) If a bridge was to be constructed across Mudge Island, the average distance to Nanaimo by road and bridge would be 25 km. (7 km average to the proposed bridge in the El Verano area, 5 km to connect to Barnes Rd., and 13 km from there to downtown Nanaimo.)
- 5) The load factor on the Quinsam varies widely through the day and the seasons, from just a handful of vehicles and passengers early in the morning and late at night, to over 70 vehicles and nearly 300 passengers on peak sailings. The per-passenger fuel-use (and GHG) implications of the ferry depend on the load, of course, but it is reasonable to use the annual average load numbers for an estimation of the overall implications. The following data, supplied by the Gabriola FAC³, are from 2013/14:

¹ Island Futures, 2010, GHG emissions on Gabriola Island, available at:
(<http://www.islandstrust.bc.ca/climatechange/pdf/gabriolaghgemissions2008.pdf>)

² Personal communication, Mark Waugh, November 2014

³ Personal communication, John Hodgkins, Gabriola FAC, December, 2014

	Annual	Daily average
Number of sailings	9796 (as of April 2014)	27
Total number of vehicles	340,800	933
Equivalent passenger vehicles ⁴	356,368	976
Passengers (and drivers) in vehicles	486,670	1333
Foot passengers	252,285	691

It can be assumed, therefore, that with the 2013/2014 traffic patterns, an average of 976 vehicles (passenger-vehicle equivalents) would be driven every day to the Nanaimo area (or beyond) using a bridge, and that the average distance (to Nanaimo) would be approximately 25 km. The 691 daily ferry foot passengers would have to choose from two options if the ferry was replaced by a bridge: they would either take a bus, or drive⁵. Based on the numbers of passengers in cars on the ferry (an average of approximately 1.5 per vehicle) it is assumed that, in the absence of a bus, the 691 passengers would drive (or be driven in) an additional 461 vehicles. It is difficult to predict the proportion that would use a bus, assuming that convenient bus service was available to downtown Nanaimo. At present about 4% of foot passengers use the GERTIE bus to come and go from the ferry (and a similar proportion use the school bus).

6) Based on data from the GERTIE operation⁶ the typical fuel-usage rate for a bus is approximately 2 L/100 km for each passenger (or 0.02 L/passenger-km), assuming that 50% of the seats are occupied.

Fuel consumption for ferry transportation between Gabriola and Nanaimo

The current average daily fuel consumption (in litres) of cars and buses driving to the ferry on Gabriola and the ferry itself can be summarized as follows:

(1) Ferry traffic for one day with a total of 1036 vehicles with 1333 passengers plus 691 foot passengers, of which 24 take the GERTIE bus, 30 take the school bus and 345 walk or cycle	km	L
Vehicle passengers driving to/from Descanso Bay	3720	424
Foot passengers driving to/from Descanso Bay	1166	133
Foot passengers bus to/from Descanso Bay	432	9
Ferry (95 L/trip)		2565
		3131

On an average day, 566 L of fuel is used on Gabriola driving to and from the ferry, and an additional 2565 L of fuel is used by the ferry, for a total of 3131 L.

⁴ Using a BCF formula, the 340,800 vehicles (of all sizes) are equivalent to 356,368 passenger vehicles.

⁵ A foot-passenger ferry is a possible third option, but there is no evidence that this might exist if a bridge is built. If it did, it would almost certainly be a private operation, not BC Ferries, and therefore, there would be no likelihood of its permanence if it proved to be uneconomic.

⁶ Personal communication, Bob McKechnie, GERTIE bus committee, December, 2014

Fuel consumption for bridge transportation between Gabriola and Nanaimo

In the following analysis, which is based on traffic patterns similar to 2013, four scenarios are considered: 2) no bus transportation 3) 5% of current foot passengers take the bus and 95% drive, 4) 10% take the bus and 90% drive, and 5) 20% take the bus and 80% drive. Although these scenarios do not include any increase in the number of discretionary trips due to the presence of a bridge, they do include extra vehicular traffic for transportation of the 691 people each day who currently take the ferry as foot passengers. This includes an estimated additional 60 vehicles daily that are currently parked in Nanaimo overnight for use by ferry foot passengers⁷. It is assumed that these commuters would have no reason to leave their vehicles in Nanaimo if the only way to return to Gabriola was by bridge. The following tables also show the percentage by which these fuel-consumption numbers exceed that for the ferry.

(2) Bridge traffic for one day, assuming 976 vehicles, 1333 vehicle passengers, plus 691 other passengers in an additional 461 vehicles, no bus	km	L	%
1479 vehicles x 25 km	37425	4131	31

(3) Bridge traffic for one day assuming 976 vehicles, 1333 vehicle passengers, plus 656 other passengers in an additional 438 vehicles, and 35 passengers on a bus	km	L	%
1414 vehicles x 25 km	36850	4065	
35 bus passengers x 25 km	875	18	
		4083	30

(4) Bridge traffic for one day assuming 976 vehicles, 1333 vehicle passengers, plus 622 other passengers in an additional 415 vehicles, and 69 passengers on a bus	km	L	%
1391 vehicles x 25 km	36275	3999	
69 bus passengers x 25 km	1550	31	
		4030	29

(5) Bridge traffic for one day assuming 976 vehicles, 1333 vehicle passengers, plus 522 other passengers in an additional 368 vehicles, and 138 passengers on a bus	km	L	%
1344 vehicles x 25 km	35100	3864	
138 bus passengers x 25 km	3450	69	
		3933	26

⁷ Personal communication, John Hodgkins, Gabriola FAC, December, 2014

These scenarios imply fuel consumption rates that are between 26 and 31% higher than with the existing ferry option.

Fuel consumption for bridge transportation if traffic increases

The limited schedule, cost and wait-time implications of the ferry forces Gabriolans to think carefully about making the trip to and from Nanaimo, and most ensure that they are accomplishing several tasks each time they take a discretionary trip. If there was a bridge to Nanaimo, and drivers didn't have the constraints of the ferry service, and assuming that the toll fee was lower than the ferry fare, it is almost certain that there would be more discretionary trips back and forth than there are now⁸. Some of those trips would be "necessary" trips, while others would not, and far fewer travellers would plan their trips as carefully as they do now. It is impossible to predict how many extra trips would be taken. In the following analysis three scenarios are considered: 6) there are 10% more trips than at present, 7) there are 25% more trips than at present, and 8) there are 50% more trips than at present. In all of these scenarios it is assumed that 10% of those that would have travelled as foot passengers on the ferry would take a bus to Nanaimo.

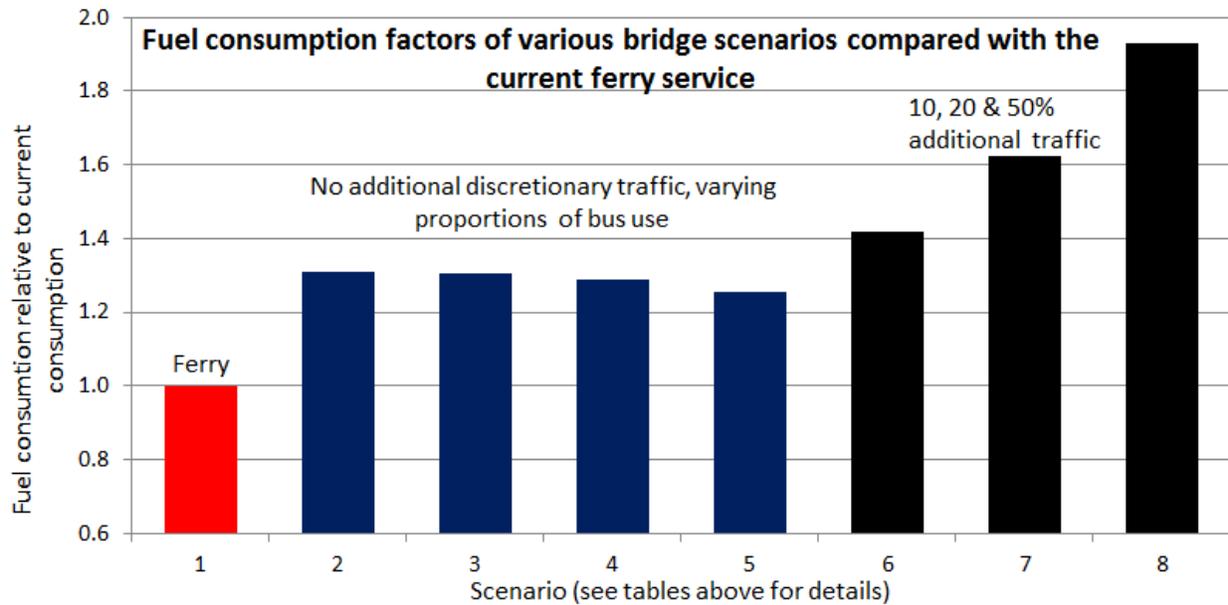
(6) Bridge option assuming 10% more trips than at present: 1530 vehicles, and 76 passengers on a bus			
	km	L	%
1530 vehicles x 25 km	38250	4399	
76 bus passengers x 25 km	1900	38	
		4437	42
(7) Bridge option assuming 25% more trips than at present: 1738 vehicles, and 86 passengers on a bus			
	km	L	%
1738 vehicles x 25 km	43450	4997	
86 bus passengers x 25 km	4300	86	
		5083	62
(8) Bridge option assuming 50% more trips than at present: 2086 vehicles, and 103 passengers on a bus			
	km	L	%
2086 vehicles x 25 km	52150	5997	
103 bus passengers x 25 km	2575	52	
		6049	93

These three scenarios imply fuel consumption rates that are between 42 and 93% higher than with the existing ferry option.

⁸ These potential increases in travel frequency assume the current level of economic activity on Gabriola and the current population. Those factors might change with a bridge, but that is not considered in this analysis.

Summary of fuel-use implications for bridge versus ferry transportation between Gabriola and Vancouver Island

The estimated fuel-use implications of a bridge connection between Gabriola and Nanaimo compared with the current ferry service are summarized on the following diagram.



If the bridge did not lead to more traffic than is currently the case, then the fuel consumption is estimated to be between 26 and 31% higher than with the ferry. If, as would be expected, the bridge contributed to between 10 and 50% more discretionary travel to and from Nanaimo, the fuel implications are likely to be between 42 and 93% higher than the current usage. It is possible that a bridge would promote even more than 50% additional discretionary traffic, in which case the increases in fuel consumption would be even greater than those depicted here.

The analysis done here is highly sensitive to the assumption of average fuel consumption for the vehicles that are used to travel between Gabriola and Nanaimo. The value used: 11.5 L/100 km is probably close to the actual value, but it is instructive to use a different value to see what difference it makes. The following table shows the percentage greater fuel consumption for the various scenarios described above, if we assume that the average fuel consumption for vehicles travelling between Gabriola and Nanaimo is 10 L/100 km. The percentage increases in fuel consumption range from 11% for high use of a bus service and no additional traffic, to 71% for moderate bus use and 50% greater traffic.

Estimated fuel-use changes based on an average vehicle fuel consumption of 10 L/100 km

	Varying use of bus transportation				Varying additional traffic		
Scenario	2	3	4	5	6	7	8
% higher than ferry	17	15	14	11	25	44	71

Some readers might assume that if they drive a vehicle that has a fuel consumption of less than 11.5 or less than 10 L/100 km that this analysis does not apply to them or that the overall implications should be different than those shown here. In fact the fuel consumption of any individual vehicle is not relevant to this analysis, it is the average of all of the vehicles that matters.

Some might also assume that in the near future there will be many more fuel-efficient vehicles on the road, including more electric vehicles. This may indeed be the case, but if such a change is happening it is not happening quickly. In fact the current trend in Canada is in the opposite direction, with a trend of increases in the sale of pick-up trucks and decreases in the sale of cars. In November of 2014 truck sales outnumbered car sales by a factor of 1.6 to 1⁹. At the same time, fuel-efficient (e.g., hybrid) or all electric vehicles remain a tiny fraction of the Canadian car market. This is unlikely to change soon, especially with the current low price of fuel.

Greenhouse Gas implications of a bridge between Gabriola and Vancouver Island

Based on these various scenarios the GHG emissions¹⁰ attributed to travel between Gabriola and Nanaimo would also increase by between 26 and 93% as the result of replacement of the ferry by a bridge. Expressed as tonnes of carbon dioxide, these emissions would increase from the current 8.1 T/day (2956 T/year) to between 10.2 and 15.6 T/day (3725 to 5694 T/year) if the ferry were to be replaced by a bridge.

⁹ <http://www.cbc.ca/m/touch/business/story/1.2858067>

¹⁰ Gasoline and diesel have quite similar CO₂ emission factors (0.00276 T CO₂/L for diesel and 0.00241 T CO₂/L for gasoline) and since a mixture of the two would be used in either scenario, an average value of 0.00258 T CO₂/L has been used to make this conversion.