CONFEDERATION BRIDGE
PONT DE LA CONFÉDÉRATION

1997-2007

STRAIT CROSSING BRIDGE LIMITED
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March 28, 2007

Ms. Katarina Cvetkovic
Program Manager
Transportation Association of Canada
2323 St. Laurent Blvd.
Ottawa, ON
K1G 4J8

Dear Ms. Cvetkovic:

Re: TAC Environmental Achievement Award

The Confederation Bridge is pleased to be celebrating 10 years of successful operation. While for many infrastructures, 10 years may represent a significant portion of its functional life; for a unique bridge facility with a design life in excess of 100 years, the Confederation Bridge is really just reaching maturity.

It is now, looking at the performance of the completed project, that the functional value can be assessed. The efficiencies offered to the movement of goods, services, and people are readily apparent. It is the environmental benefit offered by the bridge infrastructure over the ferry system that it replaced that is not so obvious; but deserves to be highlighted, especially in this time of environmental air pollutant awareness.

Attached is a report prepared by an independent environmental agency, Jacques Whitford. Detailed technical calculations show that:

- Vehicles using the Confederation Bridge consume 1/10th the fuel that the Borden-Cape Tormentine Ferry service would have consumed to transport the same vehicle across the Northumberland Strait.

- On an annual basis, the saving of fuel that can be attributed to the Confederation Bridge replacing the Borden-Cape Tormentine Ferry service is more than 16,000,000 litres of fuel.

- The replacement of the Borden-Cape Tormentine Ferry service with the Confederation Bridge is resulting in a reduction of more than 44,000 tonnes of greenhouse gas emissions per year.

The Confederation Bridge has been recognized by the Engineering Institute of Canada as one of the top five Canadian engineering achievements of the 20th century. Other awards conferred on the project have included the Canadian Construction Association's Montgomery Award for Innovation in Construction and the CCA's Environmental Achievement Award for Environmental Management during the bridge's construction.

We look forward to the Transportation Association of Canada's distinguished recognition of the Confederation Bridge as an example that improvement of Canada's transportation network can result in significant environmental benefit.

Sincerely,
STRAIT CROSSING BRIDGE LIMITED

Michel Le Chasseur
General Manager

Attachment

TAC's Environmental Achievement Award

Application Form

NOMINATION BY

TAC Member Organization: Strait Crossing Bridge Limited

Key employee representative: Mr. Michel Le Chasseur

NOMINATION FOR

Title: Confederation Bridge

__ Program X Project __ Process or __ Other

Please provide a summary paragraph about the initiative being nominated:

Reduction of air pollutant emissions associated with replacement of ferry service with bridge.

TAC Member Organization: Strait Crossing Bridge Limited

Contact Person: Michel Le Chasseur

Title: General Manager

Address: 104 Abegweit Blvd., Borden-Carleton, PE C0B 1X0

Telephone : (902) 437-7304 Email: michell@scbl.net

ATTACHED

- six paper copies of nomination submission (no longer than 10 pages - 8.5" x 11")
- one PDF electronic file of submission on CD
- supporting documents (diagrams, photos, etc.) if needed

Deadline: Friday, March 30, 2007

Send to: 2323 St. Laurent Boulevard, Ottawa, Ontario K1G 4J8

Please note that information on the evaluation criteria and process are described at

www.tac-atc.ca

If you have any questions or need clarification, please call (613) 736-1350, ext. 227 or email kcvetkovic@tac-atc.ca.

Jacques Whitford

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Project No. 1010794

FINAL DRAFT

March 29, 2007

Mr. D.J. McGinn
Director of Engineering
Strait Crossing Bridge Limited
104 Abegweit Boulevard
P.O Box 2032
Borden-Carleton, PE C0B 1X0

Dear Mr. McGinn:

Re: Air Pollutant Emissions Study of the Confederation Bridge and the Prince Edward Island Ferry

As the 10 year anniversary of the Confederation Bridge approaches, it is interesting to reflect on the many positive environmental impacts its operation has had. This report will discuss and evaluate only a few of the benefits that may not have been adequately appreciated or even understood at the outset of establishing this engineering marvel many years ago. Some examples of its positive effects are detailed in the succeeding points:

- Certain user-friendly benefits have been well recognized the moment the bridge opened such as the elimination of inefficient waiting times at either end of the crossing. The secondary benefit of this elimination has been the corresponding reduction in pollutants being released into the atmosphere.
- A more notable benefit resulting from the elimination of the ferries in Borden has been the significant reduction in overall fuel consumption which in itself translates to a corresponding reduction in CO_2 emissions, a key factor in reducing greenhouse gases and global warming.
- The following report discusses greenhouse gas emissions associated with the Confederation Bridge and Prince Edward Island (PEI) Ferry operations in terms of reduced fuel requirements and the resultant benefits thereof. An analysis of other air contaminant emissions has been included for completeness.

Introduction

Since 1917 a ferry service has traversed the approximate 13 kilometer distance across the Northumberland Strait to deliver travelers to Prince Edward Island. By 1990, the ferries were making almost 13,000 crossings per year to transport 837,791 vehicles and 1,791,286 passengers (Marine Atlantic, 1990). In 1997, the Confederation Bridge was opened, which was the first fixed link to the province that joined Cape Jourimain, New Brunswick, and Borden-Carleton, PEI. Currently, summertime travelers have the option of the bridge or ferry service from Caribou, Nova Scotia to Wood Islands, PEI. Some more detailed facts regarding the ferry and bridge are outlined in Table 1.

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TABLE 1 Facts – 1990: Borden-Tormentine Ferry, 2005: Confederation Bridge and Borden-Tormentine Ferry

1990	2005	
Borden-Tormentine Ferry	**Confederation Bridge**	**Wood Island-Caribou Ferry**
▪ Operated by Marine Atlantic until replaced by the Confederation Bridge on May 31, 1997; ▪ Fleet of two vessels in winter and four vessels in summer made almost 13,000 crossings in 1990 consumed 20 million litres of fuel while transporting 677,331 cars and 160,460 trucks (Marine Atlantic, 1990; FEARO, 1990); ▪ The largest of these vessels, the Abegweit, could realize a speed of 12 knots with 18,000 hp engines while transporting up to 250 cars; ▪ It is assumed the average crossing transported 125 passenger cars equivalent (where 1 truck = 6 passenger cars) and consumed 1538 litres of fuel; and ▪ The approximate crossing time was 50 minutes.	▪ Operated by Strait Crossing Bridge Ltd.; ▪ Operating schedule: 24 hours, 7 days a week, 52 weeks a year. ▪ Bridge Dimensions: 13 km long, 11 m wide; ▪ Speed Limit: 80 km/h; ▪ Two lanes of traffic approximately 3.75 m wide with an emergency shoulder approximately 1.75 m wide on either side; ▪ Approximate crossing time: 10 minutes; ▪ Approximately 3,300,000 car equivalents use the bridge each year (based on provided 2005 volumes); and ▪ A car crossing under its own power consumes about 1 litre of fuel during the 13km crossing.	▪ Operated by NFL Ferries; ▪ Operating Schedule: Available from May 1-December 20 (complete schedule available on NFL website); ▪ Two conventional ferries: mv Confederation, mv Holiday Island; ▪ Vessels consumed 2.9 million litres of fuel to make 3500 crossings to transport 160,000 cars and 18,000 trucks in 2005 (Chamberland, 2005); ▪ Average power employed: 5200 hp; ▪ Average speed: 14 knots; ▪ Approximate trip time: 90 minutes (75 minutes cruising, 15 minutes docking); ▪ Average fuel consumption rate: 0.4 lb/bhp.hr; ▪ Capacity: 215 passenger cars (where 1 truck = 8 passenger cars).

The air pollutant emissions associated with transportation via the Confederation Bridge and the PEI ferry were investigated for 1990 and 2005. These years were selected because 1990 was prior to the construction of the bridge and serves as the baseline year for the Kyoto Protocol from which participants can measure change in greenhouse gas emissions while 2005 represents the current state of operations.

In order to conduct a thorough evaluation with respect to traffic on the bridge, a software application program entitled MOBILE6.2C was used, which provides estimates of past, current, and future emissions from highway motor vehicles. This is the Canadian version of the United States Environmental Protection Agency's MOBILE6 program. MOBILE6.2C allows the user to fully characterize their fleet and driving conditions and reports emissions of a variety of pollutants. Pollutants evaluated in the analysis include:

1. Carbon Dioxide (CO_2);
2. Carbon Monoxide (CO);
3. Particulate Matter (PM);
4. Sulfur Dioxide (SO_2); and
5. Nitrogen Oxides (NOx).

Jacques Whitford

In combination with the computer model, several assumptions had to be made in order to carry out the analysis. These assumptions are listed below:

General

1. Air emissions associated with the ferry and bridge traffic will only include those that are generated during actual transit time (e.g. exhaust emissions and not refueling emissions or vehicle idling emissions when queuing for the ferry);
2. Emissions over the crossing distance of the Northumberland Strait were taken into consideration;
3. Normal operating conditions were assumed; therefore abnormal conditions or incidents (i.e., vehicle accidents, ferry malfunctions environmental problems) were not accounted for; and
4. Since emissions due to operations (i.e., ferry/bridge maintenance) associated with the Confederation Bridge or the PEI Ferry were not known, they could not be incorporated into the analysis.

Borden-Tormentine Ferry

1. The typical length of a ferry trip across the Northumberland Strait was assumed to be 50 minutes, with 35 minutes of running time and 15 minutes of time at the dock;
2. The average density of marine diesel IFO180 is assumed to be 990 kg/m^3 with a sulfur content of 30,000 ppm (1990);
3. The capacity of the ferry was assumed to be approximately 974 passengers, 250 cars (or 40 trucks or 20 railway cars); combination of cars, trucks and motorcycles, where 1 truck is equal to 6 cars and 1 car is equal to 2 motorcycles;
4. In terms of ferry capacity determination, the classification of trucks included RVs, buses, straight trucks, tractor trailers, and trailer-2 vehicle categories;
5. The average capacity of the ferry was assumed to have the composition: 11 trucks, 51 cars, and two motorcycles; therefore the ferry was typically carrying 125 equivalent vehicles or 50% of its capacity;
6. In operation, the ferry uses approximately 18,000 hp and travels at an average speed of 12 knots; and
7. Average emission rates of pollutants (kg/tonne fuel) were assumed to be identical for 1990 and 2005. These emission rates are shown in Table 2.

Confederation Bridge

1. Summer and winter seasons were specified in the analysis to account for changes in weather, temperature, and humidity conditions;
2. The average speed on Confederation Bridge was assumed to be 80 km/h as prescribed by the speed limit;
3. RVs and straight trucks were classified under the category of HDDV8A (Heavy Duty Diesel Vehicles with weight in the range of 33,000 - 60,000 lbs.);
4. Tractor Trailers and Trailers-2 were classified under the category of HDDV8B (Heavy Duty Diesel Vehicles with weight in excess of 60,000 lbs.);
5. To accurately represent the bus traffic volume the category of BUSURBAN was used in the MOBILE6 model;

6. Via model inputs and built-in components, MOBILE6 accounted for changes in fleet characteristics according to calendar year, evaluation month, etc.;
7. The fuel Reid Vapour Pressure (RVP) was assumed to be 10.5 psi in 1990 and 9.0 psi in 2005;
8. According to information gather from the Canadian Gazette, the sulfur content in diesel fuel was assumed to be 3,000 ppm and 500 ppm, in 1990 and 2005 respectively;
9. The maximum particle size cutoff used for evaluation in modelling air contaminant emissions from bridge traffic was 10 microns; and
10. With traffic volumes not being available for 1990, the supplied 2005 traffic volumes were assumed for both calendar years. The technology difference in the vehicle fleet from those years is captured in the model

Wood Island-Caribou Ferry

1. The typical length of a ferry trip across the Northumberland Strait was assumed to be 90 minutes, with 75 minutes of running time and 15 minutes of time at the dock.
2. The current Wood Island-Caribou Ferry service consists of a two ferry fleet: the mv Confederation and the mv Holiday Island;
3. The average density of marine diesel IFO180 is assumed to be 990 kg/m^3 with a sulfur content of 30,000 ppm (1990) and 13,000 ppm (2005).
4. As per the prescribed schedule, the ferry does not run between the period of December 21-April 30 and the number of ferry trips per day follows that which is indicated in their posted schedule (www.peiferry.com).
5. The average capacity of the ferry was assumed to be approximately 215 cars, or a combination of cars, trucks and motorcycles, where 1 truck is equal to 8 cars and 1 car is equal to 2 motorcycles.
6. In terms of ferry capacity determination, the classification of trucks included RVs, buses, straight trucks, tractor trailers, and trailer-2 vehicle categories.
7. The average capacity of the ferry was assumed to have the composition: 5 trucks, 46 cars; therefore the ferry was typically carrying 86 equivalent vehicles or 40% of its capacity.
8. In operation, the ferry uses approximately 5,200 hp and travels at an average speed of 14 knots.
9. Average emission rates of pollutants (kg/tonne fuel) were assumed to be identical for 1990 and 2005. These emission rates are shown in Table 2.

TABLE 2 Average Emission Rate for Pollutants for During Ferry Operation

Pollutant	Average Emission Rate (kg Pollutant/tonne Fuel)
Carbon Monoxide (CO)	8.2
Carbon Dioxide (CO_2)	3,043.0
Nitrogen Oxides (NOx)	72.1
Particulate Matter (PM)	3.7
Sulfur Dioxide (SO_2)	26/60*

Emission Factor for 1990 (Marine Diesel Sulfur Content of 30000 ppm)
(Rideout, BC Ferries Emissions Test Program – Report for BC Ferry Corporation)

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Air Emissions and Fuel Consumption associated with the PEI Ferry and Confederation Bridge (in lieu of the Ferry) in 1990

Emissions generated due to traffic on the Confederation Bridge and Borden-Tormentine Ferry were evaluated for 1990, which is prior to the construction of the bridge. This year was selected to examine the difference in emissions associated with ferry transport between 1990 and 2005. In addition, this year has significance because the Kyoto Protocol encourages participating countries to limit emissions to a percentage increase or decrease from their 1990 levels.

Two scenarios were investigated for 1990; the emissions generated from the actual circumstances where only the ferry was in operation and the emissions generated as if the bridge existed, in lieu of the ferry.

Borden-Tormentine Ferry in Operation in 1990

The pollutant emissions generated by the PEI ferry in 1990 were examined The total number of one-way ferry trips to accommodate all traffic was estimated to be approximately 13,000 trips (Marine Atlantic, 1990). In association with this, approximately 20,000,000 litres of diesel fuel were consumed by the ferry service (FEARO, 1990). By relating the number of required ferry trips to fuel usage and average emission rates for 1990 that incorporate the elevated diesel sulfur content (Table 2), the pollutant emissions related to ferry operations in 1990 were determined and displayed in Table 3. The pollutant emission per vehicle while in transit on the ferry was also calculated. In addition, fuel consumed per crossing and per year was determined for ferry operations. As stated in the general assumptions, emissions generated by idling vehicles in line for the ferry could not be quantified and were not included in analysis, adding to the conservatism of the results.

TABLE 3 Analysis of Pollutant Emissions and Fuel Consumption associated with Borden-Tormentine Ferry Operation in 1990

	Total Pollutant Emissions Associated with Ferry Trip		Pollutant Produced Per Car Equivalent (kg)
	Per Crossing (kg)	Per Year (tonnes)	
Fuel Consumed	1,523	19,800	12 kg
Pollutant Produced			
Carbon Monoxide (CO)	12	162	0.10
Carbon Dioxide (CO_2)	4,635	60,251	37.00
Nitrogen Oxides (NOx)	110	1,428	0.90
Particulate Matter (PM)	6	73	0.04
Sulfur Dioxide (SO_2)	91	1,188	0.70

Confederation Bridge (Assumed to be in Operation in 1990 in lieu of the Ferry)

An analysis was performed to determine the emissions generated by traffic while in transit on the bridge as if it existed in 1990. Vehicles were less efficient in 1990 (than in 2005) and thus emissions were higher in 1990, which is reflected in the table below. Table 4 shows the total annual emissions of each vehicular category for the 1990 scenario. Annual fuel consumption for each vehicular category was also included.

TABLE 4 Analysis of Annual Pollutant Emissions and Fuel Consumption associated with the Confederation Bridge (in lieu of the Ferry) of each Vehicular Category in 1990

	Vehicle Category					
	Motorcycle (tonnes/year)	Auto (tonnes/year)	Bus (tonnes/year)	RVs and Straight Trucks (HDDV8A) (tonnes/year)	Tractor Trailers and Trailer-2 (HDDV8B) (tonnes/year)	Total Pollutant Emissions from All Vehicular Categories (tonnes/year)
Fuel Consumed Per Year (tonnes/year)*	0.005	0.6	0.03	0.2	0.7	
Pollutant Produced						
Carbon Monoxide (CO)	0.700	217.0	0.30	3.0	10.0	231.0
Carbon Dioxide (CO_2) (Composite)	17.000	1,827.0	90.00	777.0	2,067.0	4,778.0
Nitrogen Oxides (NOx)	0.100	316.0	1.00	12.0	33.0	362.0
Total Particulate Matter (PM) (Composite)	0.005	0.2	0.10	1.0	2.0	3.0
Sulfur Dioxide (SO_2) (Composite)	0.004	0.4	0.20	1.0	4.0	6.0

*It is assumed that Motorcycles and Autos use gasoline fuel whereas Buses, RVs, Straight Trucks, Tractor Trailers, and Trailer-2 use diesel fuel

Jacques Whitford

The total emissions in 1990 from all vehicular categories on the Confederation Bridge (in lieu of the ferry) were summarized and the amount of each pollutant produced per vehicle is shown in Table 5.

TABLE 5 Estimated Pollutant Emissions associated with Confederation Bridge in lieu of the Borden-Tormentine Ferry Operations in 1990

Pollutant	Pollutant Produced Per Year (tonnes)	Pollutant Produced Per Car Equivalent (kg)
Carbon Monoxide (CO)	231	0.100
Carbon Dioxide (CO_2)	4,778	2.000
Nitrogen Oxides (NOx)	362	0.200
Particulate Matter (PM)	3	0.002
Sulfur Dioxide (SO_2)	6	0.003

1990 Operating Conditions Summary

The best indicator to compare pollutant emissions produced by the bridge and ferry in 1990 is the amount of pollutant produced per vehicle (Table 6). Data presented in Table 6 was taken from Table 3 (Borden-Tormentine Ferry) and Table 5 (Confederation Bridge).

TABLE 6 Pollutant Produced Per Vehicle in Transit on the Borden-Tormentine Ferry and Confederation Bridge in 1990

Pollutant	Pollutant Produced (kg) Per Car Equivalent on the Borden-Tormentine Ferry	Pollutant Produced (kg) Per Car Equivalent on the Confederation Bridge
Carbon Monoxide (CO)	0.10	0.100
Carbon Dioxide (CO_2)	37.00	2.000
Nitrogen Oxides (NOx)	0.90	0.200
Particulate Matter (PM)	0.04	0.002
Sulfur Dioxide (SO_2)	0.70	0.003

As can be seen from the table above, the amount of pollutant produced per vehicle in transit on the ferry is greater than that of the bridge for carbon dioxide, nitrogen oxides, sulfur dioxide, and particulate matter. The amount of carbon monoxide produced per vehicle in transit on the bridge was found to be greater than that of the ferry.

Air Emissions and Fuel Consumption associated with the PEI Ferry and Confederation Bridge in 2005

Emissions generated due to traffic on the Confederation Bridge and Wood Islands-Caribou Ferry were evaluated for 2005. Both services were in operation that year. This year was selected since detailed traffic volume and fleet information were available for 2005 in addition to reflecting recent bridge and ferry traffic trends. Two scenarios were investigated for 2005; namely the emissions generated from the Wood Islands-Caribou Ferry and the emissions resulting from traffic traveling via the Confederation Bridge.

Wood Islands-Caribou Ferry in Operation in 2005

The 2005 pollutant emissions generated by the ferry were evaluated. The total number of one-way ferry trips to accommodate all traffic was estimated to be approximately 3,500 trips (Chamberland, 2005). By relating the number of required ferry trips to fuel usage and average emission rates for 2005 that incorporate the reduced diesel sulfur content from 1990 levels (Table 2), the pollutant emissions related to ferry operations in 2005 were determined and displayed in Table 7. The pollutant emission per vehicle while in transit on the ferry was also calculated. In addition, fuel consumed per crossing and per year was determined for each component of ferry operations. As stated in the general assumptions, emissions generated by idling vehicles in line for the ferry could not be quantified and were not included in analysis, adding to the conservatism of the results.

TABLE 7 Analysis of Pollutant Emissions and Fuel Consumption associated with Wood Islands-Caribou Ferry Operation in 2005

	Total Pollutant Emissions Associated with Ferry Trip		Pollutant Produced Per Car Equivalent (kg)
	Per Crossing (kg)	Per Year (tonnes)	
Fuel Consumed	826	2,890	10 kg
Pollutant Produced			
Carbon Monoxide (CO)	7	24	0.08
Carbon Dioxide (CO_2)	2,512	8,794	29.00
Nitrogen Oxides (NOx)	60	208	0.70
Particulate Matter (PM)	3	11	0.04
Sulfur Dioxide (SO_2)	21	75	0.20

Confederation Bridge in Operation in 2005

An analysis was performed to determine the air emissions generated by traffic while in transit on the bridge in 2005. Table 8 shows the total annual emissions of each vehicular category during this year. Annual fuel consumption for each vehicular category was also included.

TABLE 8 **Analysis of Annual Pollutant Emissions and Fuel Consumption associated with the Confederation Bridge of each Vehicular Category in 2005**

	Vehicle Category					
	Motorcycle (tonnes/year)	Auto (tonnes/year)	Bus (tonnes/year)	RVs and Straight Trucks (HDDV8A) (tonnes/year)	Tractor Trailers and Trailer-2 (HDDV8B) (tonnes/year)	Total Pollutant Emissions from All Vehicular Categories (tonnes/year)
Fuel Consumed (tonnes/year)*	0.0070	0.80	0.03	0.3	0.8	
Pollutant Produced						
Carbon Monoxide (CO)	0.9000	111.00	0.10	1.0	5.0	118.0
Carbon Dioxide (CO_2) (Composite)	21.0000	2,933.00	100.00	1,041.0	3,052.0	7,147.0
Nitrogen Oxides (NOx)	0.2000	7.00	0.70	11.0	36.0	54.0
Total Particulate Matter (PM) (Composite)	0.0050	0.20	0.03	0.3	0.9	1.4
Sulfur Dioxide (SO_2) (Composite)	0.0005	0.06	0.03	0.3	1.0	1.4

*It is assumed that Motorcycles and Autos use gasoline fuel whereas Buses, RVs, Straight Trucks, Tractor Trailers, and Trailer-2 use diesel fuel

Jacques Whitford

The total emissions in 2005 from all vehicular categories are summarized and the amount of each pollutant produced per vehicle in shown in Table 9.

TABLE 9 Estimated Pollutant Emissions associated with Confederation Bridge in 2005

Pollutant	Pollutant Produced (tonnes)	Pollutant Produced Per Vehicle (kg)
Carbon Monoxide (CO)	118.0	0.0400
Carbon Dioxide (CO_2)	7,147.0	2.0000
Nitrogen Oxides (NOx)	54.0	0.0200
Particulate Matter (PM)	1.4	0.0004
Sulfur Dioxide (SO_2)	1.4	0.0004

2005 Operating Conditions Summary

Another indicator to compare pollutant emissions produced by the bridge and ferry in 2005 is the amount of pollutant produced per vehicle (Table 10). Data presented in Table 10 was taken from Table 7 (Wood Islands-Caribou Ferry) and Table 9 (Confederation Bridge).

TABLE 10 Pollutant Produced Per Vehicle in Transit on the Wood Islands Ferry and Confederation Bridge in 2005

Pollutant	Pollutant Produced (kg) Per Car Equivalent on the Wood Islands-Caribou Ferry	Pollutant Produced (kg) Per Car Equivalent on the Confederation Bridge
Carbon Monoxide (CO)	0.08	0.0400
Carbon Dioxide (CO_2)	29.00	2.0000
Nitrogen Oxides (NOx)	0.70	0.0200
Particulate Matter (PM)	0.04	0.0004
Sulfur Dioxide (SO_2)	0.20	0.0004

As can be seen from the table above, the amount of pollutant produced per vehicle in transit on the ferry is greater than that of the bridge for all of the pollutants modelled.

Discussion and Conclusions

In 1990, the emissions associated with the operation of the Borden-Tormentine ferry to transport the equivalent of 1,640,091 cars were the following:

TABLE 11 Summary of Consumption for the Borden-Tormentine Ferry in 1990

	Per Car Equivalent	Annually
Fuel (L)	12.00	20,000,000
	Pollutant Produced	
Carbon Monoxide (CO) (kg)	0.10	162,000
Carbon Dioxide (CO_2) (kg)	37.00	60,251,000
Nitrogen Oxides (NOx) (kg)	0.90	1,428,000
Particulate Matter (PM) (kg)	0.04	73,000
Sulfur Dioxide (SO_2) (kg)	0.70	1,188,000

In 2005, the emissions associated with approximately 3,300,000 car equivalents (based on provided 2005 traffic volumes), using their own vehicle and fuel, crossing the Confederation Bridge was the following:

TABLE 12 Summary of Consumption for the Confederation Bridge in 2005

	Per vehicle	Annually
Fuel (L)	1.1000	3,609,717
Pollutant Produced		
Carbon Monoxide (CO) (kg)	0.0400	118,000
Carbon Dioxide (CO_2) (kg)	2.0000	7,147,000
Nitrogen Oxides (NOx) (kg)	0.0200	55,000
Particulate Matter (PM) (kg)	0.0004	1,000
Sulfur Dioxide (SO_2) (kg)	0.0004	1,000

In 2005, the emissions associated with operation of the Wood Islands-Caribou Ferry to transport the equivalent of 304,000 cars (Chamberland, 2005) are shown in Table 13.

TABLE 13 Summary of Consumption for the Wood Islands-Caribou Ferry in 2005

	Per vehicle	Annually
Fuel (L)	10.00	2,919,000
Pollutant Produced		
Carbon Monoxide (CO) (kg)	0.08	24,000
Carbon Dioxide (CO_2) (kg)	29.00	8,794,000
Nitrogen Oxides (NOx) (kg)	0.70	208,000
Particulate Matter (PM) (kg)	0.04	11,000
Sulfur Dioxide (SO_2) (kg)	0.20	75,000

From the above discussion, it is evident that there has been a significant traffic volume increase between 1990 and 2005. The Confederation Bridge accommodated approximately 92% of the 2005 PEI traffic volume while maintaining lower annual emissions in comparison to that emitted by the Wood Islands-Caribou Ferry on a per vehicle basis. In 2005, a vehicle in transit on the Wood Islands-Caribou Ferry produced more than ten times the amount of CO_2 produced by a vehicle on the Confederation Bridge. In addition, in 2005 a vehicle in transit on the Wood Islands-Caribou Ferry consumed ten times more fuel than a vehicle in transit on the Confederation Bridge. On a per vehicle basis, vehicles in transit on the bridge consumed 1.1L of fuel whereas vehicles in transit on the ferry consumed 10L of fuel.

When looking back at the 1990 emissions associated with the Borden-Tormentine Ferry, the reduction in fuel consumption and CO_2 emissions resulting from the inclusion of the Confederation Bridge is unmistakable. In 1990, the Borden-Tormentine Ferry consumed more than 20,000,000 L of fuel and produced approximately 60,251 tonnes of CO_2. Regardless of the increase in 2005 traffic volume, the inclusion of the Confederation Bridge represented a reduction of over 16,000,000 L of fuel consumed and a decrease of more than 44,000 tonnes of CO_2 from 1990 figures.

Summary Analysis of the Previous Borden Ferry Operation

- Vehicles using the Confederation Bridge consume about 1/10th the fuel that the Borden-Cape Tormentine Ferry service would have consumed to transport the same vehicle;
- Based upon 2005 traffic volumes, the annual saving of fuel that can be attributed to the Confederation Bridge replacing the Borden-Tormentine Ferry is approximately 16,000,000 litres of fuel;

Summary Analysis of the Existing Confederation Bridge Operation

- The replacement of the Borden-Cape Tormentine Ferry service with the Confederation Bridge is resulting in a reduction of about 44,000 tonnes of CO_2 emissions per year, which is a significant reduction in greenhouse gas emissions;
- On each crossing, drivers electing to use the bridge prevent approximately 27 kg of CO_2 emissions;

Summary Analysis of the Existing Woods Island Ferry Operation

- The fuel consumed by a typical passenger vehicle using the Confederation Bridge is 1.1 litre. The fuel used by the Wood Island-Caribou Ferry to transport the same vehicle is about 10 litres; and
- On an annual basis, it is estimated the Wood Island Ferry produces 8,794 tonnes of CO_2. In comparison, vehicles using the Confederation Bridge produce 7,147 tonnes of CO_2 while transporting nearly 11 times as many vehicles.

References

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Closure

This report has been prepared for the sole benefit of Strait Crossing Bridge Limited. This report may not be relied upon by any other person or entity without the express written consent of Jacques Whitford and Strait Crossing Bridge Limited. Any use of this report by a third party, or any reliance on decisions made based upon this report, are the responsibility of the third party. Jacques Whitford accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

If you have any questions regarding the contents of this report, or require any additional information, please do not hesitate to contact the undersigned.
Yours truly,

JACQUES WHITFORD LIMITED

Original Signed By

Martin Janowitz, M.E.S.
Vice President

MJ/tw

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Jacques Whitford