

**Bedford / Halifax Fast Ferry
Cultivation Study**

**Implementation Cost-Benefit Analysis Based on
Projections Spanning 2006 to 2016**

FINAL DRAFT

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TDV Global Inc.

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EXECUTIVE SUMMARY

The Halifax Regional Municipality (HRM) has invested significantly in the last thirty years in revitalizing the downtown core – bringing energy to the city that is comparable to other successful cities in North America. There is fine dining, culture, recreation and accommodations that are considered world class. Attracting people to the downtown core increases their demand for a space that is constrained by the geography of the peninsula. Today there is growing demand for access to the city core in its continued role as the major business centre of Atlantic Canada. Along with this success, residents of the Halifax Regional Municipality transit to the city centre in growing numbers, stressing the road systems that feed it. The same geographic features that stimulated rapid growth (e.g. proximity, and ease of access, to water and a protected deep water port) are now challenging the limits of that growth. One in particular is the traffic routing into the city through a roadway system that constricts traffic flow. The HRM uses a number of transit options in moving people into the city, relying on ferries, rapid transit buses and “park and ride” options to mitigate against increasing numbers of vehicles, and the inherent traffic woes that result.

Worsening traffic is a clear indication of economic success of a city. In the case of the HRM this traffic is concentrated through the core of the city, adding to mounting pollution, noise and traffic congestion. Increasing traffic accelerates road deterioration and road repair expenditures. Some might say that the associated increase in cost might well be worth the economic benefit of vehicles navigating through a congested city core, but when this traffic decreases the quality of life, or introduces increased occurrences of serious accident, then it is important to look at other transportation options.

As one option in providing transportation choice the commuting public of the region, the HRM began investigating the introduction of a Fast Ferry service to take advantage of the Bedford Basin and other accessible waterways as transit options. Initial high level research in 2004 led to a commitment by the municipality to look at the feasibility in more depth. This study represents the next phase in collecting information, the purpose of which is to clarify risks and opportunities related to Fast Ferry implementation. The results of this study will assist in the decision taking of the Regional Council to move the project forward. All elements of the project were guided by the business objectives highlighted in the Regional Strategic Plan.

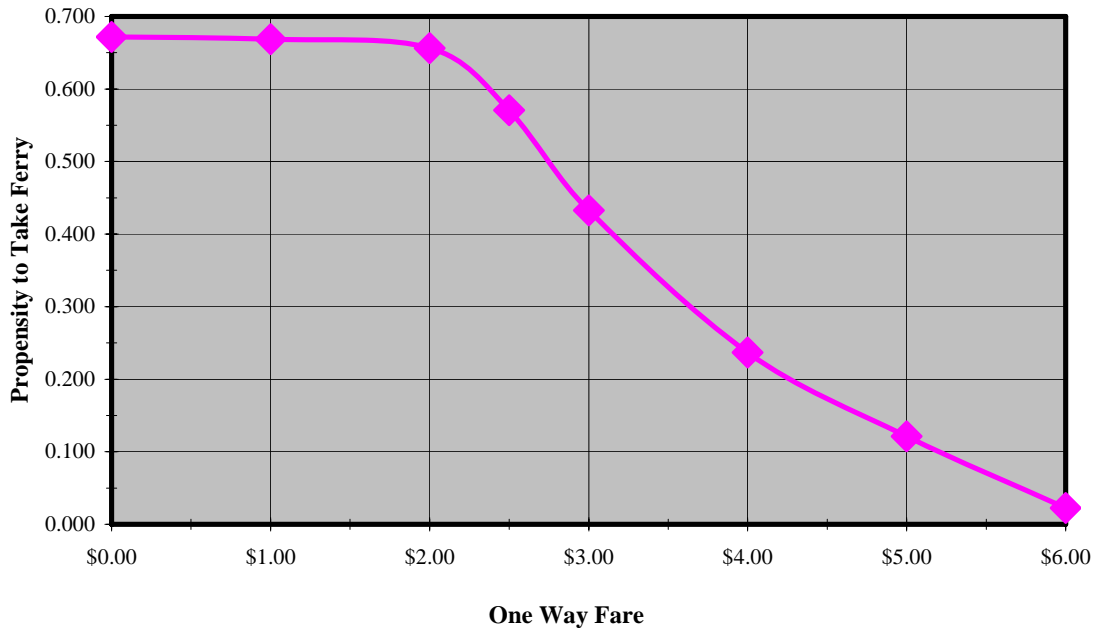
The business case was developed around the following methods: market analysis, operational analysis, and scenario development and benefit cost. In addition work was conducted in the areas of wake wash analysis, terminal development and environmental considerations. The following represent the key points of the report:

Market Study:

The market study was undertaken in the June/July period and provided the necessary information for all elements of the work undertaken. The survey development was supported with three community focus groups, which led into a comprehensive telephone survey of 774 individuals from the core market (Bedford) and tertiary market (surrounding areas). This represented a confidence level of $\pm 3.5\%$ 19 times out of 20. This confidence level is strong and therefore we can draw the conclusion that the sample population results are representative of the population as a whole.

The market analysis resulted in a number of demand curves that represented the propensity for a commuter (over 18 years of age) to choose the Fast Ferry to commute. The following graph represents one of six demand curves developed:

Propensity of the Population \geq 18 Years of Age to Take the Fast Ferry



Findings from the data collected included travel patterns, costs incurred for current travel method, reason for commuting, fare tolerance, as well as other features that would be considered essential and desirable as part of the service.

Case Studies:

Case studies were developed for operations in New York, Boston and San Francisco, in all cases these were private operations and not part of the public transportation system. The following are considered the most relevant points:

- There is an increasing demand for Ferry transit – much of it looking for Fast Ferries that address the time to commute and parking for commuters;
- The commuter is prepared to pay a premium if these issues are addressed;
- Most important success criteria hang on parking, connectivity and schedule reliability;
- Market considers this mode of transportation very secure; and
- A lot of success surrounding collaborative bundling of FF with special events such as sports and the arts.

Operational Model:

The operational modeling was initiated in the month of August with the model itself being completed end of March 2006. The model looks at the following elements as variables: commuter and tourist markets; vessel characteristics; crewing; operating costs (fuel, maintenance, staff, marketing, insurance, tickets production and distribution, etc.) and schedule. This information is being used as input variables to analyze a number of scenarios to determine the best fit for the present and future markets.

The model enabled the team to:

- Develop a list of technical characteristics for vessel selection and the development of a solid RFP;
- Design an operational schedule to meet the needs of the market;
- Provide recommendations of a fare schedule that will meet the revenue expectations of the transit system; and
- Develop a budget for capital and operations over a 10 year period.

The model was tested with two vessels that were thought to be appropriate for the market – 206 passengers with an operating speed of 28 knots and an expected route time of 60 minutes end-to-end return; and 350 passengers with an operating speed of 35 knots and an expected route time of 40 minutes end to end return. These vessels on the market have a cost for acquisition of approximately \$5.5 million and \$8.0 million respectively.

Wake Wash Analysis:

The analysis was undertaken at the end of October. The report was received at the end of November by US experts brought in specifically to run this specialized trial. The report highlighted the following:

- Fast Ferries under way at slow speed have poor wake wash characteristics;
- Public awareness regarding the realities of wake and safety of high speed operations is weak;
- Fast Ferries are very maneuverable, as demonstrated by the Whaling City Express. Vessels can stop within 1.5 boat lengths; and
- The trials vessel (Whaling City Express) is not a good example of a low wake design. Poor wake performance caused a number of harbour stakeholders to complain through the trial and request slower speeds on passing.

Wake wash is defined by both wave height and wave energy. Both of these characteristics can be minimized through advanced design techniques, and are available in current low wake fast ferry designs.

Safety:

The project team met with Port stakeholders on a number of occasions to discuss operations. Together with Harbour Pilots, DND and the Port Authority a set of operating guidelines were ironed out, in particular the need to establish a Fast Ferry operating track and a clear understanding of right-of-way. The DND trainer was used to understand the challenges of the Fast Ferry meeting a Post Panamax container ship in the narrows. It was concluded that there was ample room to maneuver safely. This dialogue was continued further toward using the “DND Trainer” as a training platform for Ferry Captains.

Terminal Development:

The downtown terminal was looked at for ease of integrating the Fast Ferry operation into the existing terminal. It was agreed through analysis that the best placement for ferry loading and off-loading would be on the court house side of the terminal enabling ease of access to exiting flow of passengers and minimal disruption to the existing infrastructure using a simple and inexpensive covered walkway.

Keeping it simple is the best approach, and most ferry operations have gone to a front end loading ferry. This is the simplest way to maneuver the ferry into position (no back and forth) the Captain simply drives into the loading slot. Using this approach reduces the cost of jetty configuration, requiring only a simple ramp system to be lowered to the front of the vessel. It also alleviates issues created by bad weather that could hamper maintaining schedule because of difficulty coming alongside.

All potential jetties will meet the needs of supporting front end loading vessels with minor enhancements (included were Downtown Halifax, Bedford Basin and China Town).

Mill Cove Terminal:

Terminal placement work was centred around the land and the current jetty. Discussions took place with the Halifax Waterfront Development Corporation and the Development community to better understand the current plan for Bedford Phase II development, HRM could use the Fast Ferry Project to increase the value of the land and leverage the implementation of the ferry and the terminal. The analysis used the development of a new tax base and the acceleration of development as the key variables. The following represent some of the issues:

- Time to create the property – landfill availability and more importantly land zoning which could take upwards of two years;
- Development restrictions around density and height of buildings – although this land would not necessarily be subjected to the density restrictions currently enforced in Bedford; and
- Access to property off the Bedford Highway.

The current ten year development plan is too long. With \$9 million investment this process could be accelerated to complete the fill operation to coincide with the ferry and terminal implementation.

Sobeys are interested in developing Moir's Pond and have raised some potential to undertake a joint project in this area. This is a new opportunity that may have an impact on the overall Terminal development decisions, specifically as it relates to parking.

The Scenarios Analyzed:

Each of the six baseline scenarios (described below) was analyzed for two different vessels and at three different fare price points. As well, they were also assessed for the procurement of two and three vessels. In total 72 scenarios were evaluated.

Vessel 1 – 206 Passenger NQEA:

- 28 knots
- 2,200 hp
- two high speed marine diesel engines
- .38 tons/hour fuel consumption at full speed
- 90% MCR
- low wake design
- propeller

Vessel 2 – 350 Passenger BMT Nigel Gee:

- 35 knots
- 4,200 hp
- four high speed marine diesel engines
- .63 tons/hour fuel consumption at full speed
- 90% MCR
- low wake design
- water jets

Three fare price points were evaluated based on the demand information drawn from the market analysis. Along the demand curves we looked at \$4, \$5 and \$6 fares. Given these parameters, when applied to the scenario descriptions below for two different vessel types, there were a total of 72 scenarios.

Baseline Fast Ferry scenarios are described as follows:

Scenario 1 - No parking at the Mill Cove Terminal and no downtown shuttle service.

Scenario 2 – Free parking at Hammonds Plains/Highway 102 and no downtown shuttle service. This scenario is based on 500 car free parking facility with a shuttle service from the parking to the terminal every 7 minutes during peak operations.

Scenario 3 - Pay parking at the Mill Cove Terminal and no downtown shuttle service. Same scenario as Scenario 2 with a parking fee.

Scenario 4 – No parking at the Mill Cove Terminal with a downtown shuttle service from the terminal to the Universities and the Hospitals.

Scenario 5 - Pay parking at the Mill Cove Terminal with a downtown shuttle service from the terminal to the Universities and the Hospitals. Same scenario as Scenario 4 with a parking fee.

Scenario 6 – Free parking at the Mill Cove Terminal with a downtown shuttle service from the terminal to the Universities and the Hospitals.

Results

The following table represents the results of the analysis:

Scenario Descriptions: P+S = Parking with Downtown Shuttle
 PNS = Parking No Shuttle
 FP+S = Fee Parking with Downtown Shuttle
 FPNS = Fee Parking No Shuttle
 NP+S = No Parking with Downtown Shuttle
 NPNS = No Parking No Shuttle

These figures represent \$Millions. Red denotes an increasing debt. All other figures demonstrate some contribution to achieving return on investment.

206 PAX by Scenario Comparison (2 Ferries)							206 PAX by Scenario Comparison (3 Ferries)					
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS
\$4	-14.7	-18.1	-19.3	-22.1	-20.3	-16.7	-18.8	-23.7	-24.3	-28.4	-26.5	-23.4
\$5	-11.5	-15.6	-17.6	-18.2	-16.4	-14	-25.6	-29.6	-21.6	-22.6	-20.8	-26.6
\$6	-30.8	-39.5	-35.5	-45.1	-44.6	-44.3	-38	-54.4	-50.4	-60	-59.5	-59.2
350 PAX by Scenario (2 Ferries)							350 PAX by Scenario (3 Ferries)					
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS
\$4	-0.5	-2.8	-11.1	-2.6	-1.2	0.7	2.4	-2.1	-8.1	-2.7	0.9	-22.3
\$5	6.9	-0.7	-1	-5.6	-4.4	-32.9	14.7	-0.3	6.8	-28.5	-28.8	-59.8
\$6	-45.6	-61.9	-57.9	-67.5	-65.9	-65.6	-72.4	-88.7	-84.7	-94.3	-92.8	-92.4

Notes:

1. All scenarios with parking also include costs for shuttle to and from parking, fee revenue for fee parking not included
2. All table values include capital for additional buses, Mill Cove Terminal, and Fast Ferries
3. All scenarios include start-up costs which include training, legal, marketing, purchase of operations management SW and Project Management
4. 350 PAX vessels are 4 engine and do not reflect savings in off-peak operations when 2 engine ops would be possible

Key Conclusions

Viability: This project is viable. The market analysis showed a strong desire to use alternative transportation modes for commuting into the downtown core other than single occupancy vehicles. This market information should be considered conservative in that fuel prices have increased from \$0.86/l at the start of the project to \$1.16/l. Growth in this area is strong at 3% per year or greater, and if the Bedford Phase II development project goes forward there is the potential of creating additional prime demand from ~1,500 new commuters.

Operations: Because the demand is so high at peak commute times the optimal solution is a large fast vessel, in lieu of many smaller slower vessels. Operations would be characterized by having a ferry arrive and depart every 20 minutes, with a 15 minute transit time. Off-peak operations would be reduced to a single ferry every hour using less power (and therefore less fuel).

The Vessel: The vessel should be able to achieve the following performance standards:

Design Parameter	Requirement
Cost	\$8 M or less
# Passengers:	350 plus
Speed:	35 knots + fully loaded
Fuel Consumption:	.6 - .7 Tons/hour at full speed
Range at Full Pwr:	300 nautical miles*
Wake Wash:	Low Wake Design
	Wash Ht: 25 cm or less
	Energy: 2,000 joules/meter
Fuel Tanks	Prohibits biodiesel cloud formation
Engine Design	Meets EPA Standards for emissions

Fare Structure: The fare structure should be based on a \$5 one way cash fare. Monthly subscribers should be given a discount based on 20 commutes of 80% of the cash fare, or \$160/month. Child and Senior discounts should be consistent with the current rates throughout the system. For those holding other passes, or tickets from other systems, individuals should pay an additional amount to be determined. It is also suggested that there would be potential to drive in additional revenue if a Premium Class of Ticket option were available. Other fare strategies should be looked into as the operation commences in an effort to flatten out the high peak demand at 8:00 a.m. Some revenue should be

collected to this operation from the UPass system, but it was not determined what this amount should be.

Key Issues:

The Rising Cost of Fuel

The cost of this service was a prime consideration as observed from the demand curves which show a steady and rapid decline in propensity to take the Fast Ferry for fares greater than \$2.00.

The rising price of fuel and its availability will eventually constrain the operations of the vessel and the profitability of the service. This being said when the Ferry service is feeling the impact of these increases so will the commuter who chooses to drive. Therefore, should the price of fuel reach a value that challenges profitability there should be adequate support to increase fares to compensate.

The fuel prices would have to reach \$1,000/ton to push the preferred option into the red. This represents in excess of 25% rise from the value used in the model.

- **Risk Mitigation: Raise fare prices as the cost of fuel increases. Communicate, through targeted marketing, the need and justification to increase the costs.**

Zoning and Time to Develop Bedford Phase II

The zoning is a fairly complicated process that could take upwards of two years iterating between the plan and the policy. This could result in some disruption to the terminal construction, or just as importantly, the development of residences that will house new commuters.

- **Risk Mitigation: Establish the development plan as part of the process. With the terminal linked to the development plan there is in fact a chance that the development approval cycle (which is very slow) and the completion of the Phase II may be done more quickly.**

Performance of the Vessel

The ferry schedule will be an important parameter in attracting and keeping passengers. The schedule must be responsive to the traveling needs of the public, the frequency must be such that it provides for flexibility in travel times and it must be consistently on-time. If the vessel cannot perform to specification then these parameters cannot be met and the Ferry system will lose clientele. Passengers will be sympathetic to inclement weather, but will not be if there are no obvious reasons.

The risk that the delivered vessel does not meet the operational requirement specified in the contract for build could result in vessel schedule frequency not being attained. This frequency is critical to moving large numbers of during peak operating times.

- **Risk Mitigation: Set performance requirements and contract penalties associated with vessel speed and fuel consumption.**

Other Benefits

The following are considered additional considerations in assessing this case, but have not been quantified:

- Job Creation – the Fast Ferry will add jobs to the Nova Scotia economy. Jobs could be categorized as direct long term – for example:
 - the vessel crewing,
 - training and ferry maintenance,
 - direct short term if Nova Scotia ship builders were to build the ferries; and
 - indirect long term services that support the ferry operation.
- Reduction in Number of Cars on the Road – the majority of commuters traveling from this area are single passengers in their vehicles. Reducing the number of vehicles will result in reduced road deterioration and green house gas emissions;
- Tourism – adding to a tourist's impression of interesting things to do in Halifax. Providing improved access for tourists to areas outside of the central urban core; and
- Cost Avoidance – using the Ferry to offset the need to undertake major road changes in the immediate future.

Recommendations

Implement the 2 – 350 35 knot Passenger Vessel Option

This is the preferred solution that will realize improved transportation for commuters in the Bedford and surrounding area.

Recommend a contract arrangement for Design and Build that encourages the designer and builder to work together in delivering a vessel that meets the performance specifications such as speed, fuel consumption and engine emission levels.

The contracting period should take no longer than 6 months, with an anticipated first vessel:

- in 12 months if it is in aluminium; and
- in 18 months if it is in advanced composite material.

The RFP should also encourage bidders to consider Nova Scotia shipbuilding in the construction of these ferries.

Adopt the Preferred Technical Characteristics as the Basis of the RFP

Use the technical characteristics that emerged from the study to go to RFP as follows:

Design Parameter	Requirement
------------------	-------------

Cost	\$8 M or less
# Passengers:	350 plus
Speed:	35 knots + fully loaded
Fuel Consumption:	.6 - .7 Tons/hour at full speed
Range at Full Pwr:	300 nautical miles*
Wake Wash:	Low Wake Design
	Wash Ht: 25 cm or less
	Energy: 2,000 joules/meter
Fuel Tanks	Prohibits biodiesel cloud formation
Engine Design	Meets EPA Standards for emissions

*Note: This will allow for three days of operations at full power without fueling.

Recommend Charge \$5 Cash Fare and Include Free Parking and Downtown Shuttle Services

Recommend charge a \$5 cash fare and \$160 monthly fare for the Fast Ferry. Other fare reductions would follow suit for Children and Seniors. Those holding fare payments for other transportation options would have to pay an additional amount to compensate for the Fast Ferry service. This amount has not been determined.

Serious considerations should be given to an Executive Service from Bedford. This should be preceded with a solid market analysis to determine if this would be something of interest.

Parking was a key consideration of commuters in making the decision to use the Ferry service. Establishing a transportation hub which includes parking has the additional potential to integrate this with retail providing additional revenue for the HRM. Free parking could become Fee Parking in time should there be a reason to collect fees – such as increased demand for parking. The Downtown shuttle service would be to Saint Mary's, Dalhousie and the Universities. The route directions should be contrary to traffic patterns.

All services should be ready with the delivery of the first vessel. This could be a challenge for the terminal, which will sit on land that is not currently zoned.

Do What is Necessary to Accelerate the Bedford Phase II Development Project

This land development and population increase is not necessary for this Ferry to succeed, however the development of the land will help to secure the ridership from the study catchment area. Critical to this is

the construction of an overpass which would give the terminal a second access a south and north access route.

By accelerating the landfill project the Development Community will be much more interested in what is happening with the Fast Ferry. This community is somewhat cynical in the development process today which is upwards of 10 years. Any improvements in this area might attract investment dollars for infrastructure.

As the principal agent in negotiating the acceleration of this project the HRM will have influence on the land development, thereby ensuring a good fit with the overall strategic plan.

Encourage the Use of Advanced Equipment and Material in Ferry Construction

By using materials/equipment that have the potential to save fuel or reduce pollution, the HRM may have access to investment dollars to offset the cost of the project from other levels of government.

Develop a Training Program Using the DND Harbour Trainer

A detailed harbour trainer model can be done quite quickly with minimal expense. Ferry design characteristics will need to be known prior to this work being completed.

It is recommended that the HRM establish a long term training relationship that will use the trainer for induction training, certification training and re-certification training.

1.0 INTRODUCTION

1.1 Business Case Subject

The Bedford Halifax Fast Ferry Cultivation business case examines the costs and benefits that follow from the proposed implementation of the fast ferry from Bedford to Halifax, as part of the Halifax Regional public transit system. The intention of this ferry service is to provide more transportation options to commuters who are faced with increasing traffic issues in that region of the municipality. It is proposed as an integral service of a growing network of transportation options, and must be consistent with designed service levels – cost and reliability. The study undertook several areas of review including: market demand and acceptance, stakeholder support, technical analysis, comparative analysis and cost/benefits review. In addition, the service was assessed as a transportation option that has potential to address the changing transportation needs of other areas of the HRM.

1.1.1 Business Objectives

The following represent the business objectives of this project:

- a) The service is to match the current and future commuter demand;
- b) The service is to contribute to HRMs dedication to addressing environmental improvement;
- c) The service is to match the current cost recovery of other transit solutions of 70% of operational costs, or better;
- d) The fare structure is to align with current HRM transportation models, or cause those figures to be adjusted;
- e) The service is to be consistent with other transportation service standards;
- f) The solution is consistent with supporting the transportation themes of encouraging an active lifestyle through the use of alternate methods of transportation and supports the concept of transit-linked services as highlighted in the HRM Regional Plan;
- g) That the solution is consistent with strategies to develop transportation options that are not automobile dependent.
- h) Implementation will offset the need to look at major road alteration options in the near term as a transportation solution;
- i) Increased transportation options improves commuter satisfaction;
- j) Provide enhanced employee opportunities for professional development and job satisfaction; and
- k) Will enhance the image of Halifax as a progressive and attractive city, and will bring a more visible municipal presence to the harbour thereby supporting higher level waterfront development and activity.

1.1.2 Scope of This Case

The scope of this business case was defined by commuters identifying the necessary conditions which result in a transportation service succeeding. For the purposes of this case we studied the transportation model that started at the front door of the commuter, and ended with their destination –this included use of the Fast Ferry for commute into work and for other purposes such as shopping, entertainment and access to downtown services.

Therefore the following transportation elements were considered:

- Access methods to the ferry – park/shuttle/ride, park/ride, walk/ride, drop-off, and other transportation connections/ride;
- Both ends of Fast Ferry connectivity; and
- Opportunities were considered for consumer value-add where they were determined to reduce the cost of the service acquisition and operation.

1.2 Business Case Purpose

The purpose of this case is to provide clear definition of the risk in implementing the Fast Ferry. This risk assessment will support the decision process within the municipality including recommendations by staff, and subsequent approval through the municipal process. The consequences of developing an understanding of this risk for HRM planners will be a clarification of:

- Market interest and market behaviour given the implementation;
- Vessel technical requirements including size, propulsion, other equipment, speed, cost and maintenance, operations;
- Other costs that will be incurred – e.g. terminals, parking, connectivity;
- Budget requirements and timing;
- Policy implications; and
- Benefits that accrue for the commuter, HRM residents and the region.

The following table represents the case design, and the foundation of survey development and data collection for the analysis:

	Business Case Subject	Business Case Purpose
Describes...	<ul style="list-style-type: none"> • The market demand • The implementation of the FF operation • The vessel technical requirements • The cost benefit • The FF solution as an integral part of the transportation network • The infrastructure that must be considered in addition to FF acquisition 	<ul style="list-style-type: none"> • The development in the Bedford area is happening faster than the road systems can cope with – commuters are looking for alternatives • The HRM needs to understand FF operations and costs (infrastructure and resources)* to determine if they can manage the risk associated with FF operations <p>*consideration of terminal(s), parking, shuttle services, road connectivity, land acquisition, training, control systems</p>
Answers these questions...	<ul style="list-style-type: none"> • Who will take the ferry, when they will take it and what the price tolerance is • When and where does the FF need to run • What are the vessel characteristics • What is the risk in implementing this transportation mode • Who will benefit and what manner • Will this be an accepted transportation option that has the potential to grow 	<ul style="list-style-type: none"> • The HRM will use the results to: understand the market and the parameters that are key success factors, prepare realistic capital and operating budgets, develop specifications for vessel operations, develop an understanding of the necessary skills gap to operate

1.3 Background

Selected by Britain for its value in its strategic position, Halifax provided a gateway into North America with natural protecting geography, a deep and well protected harbour, an abundance of ship building and repair resources, food from the sea, significant waterside exposure and easy access to all of Britain’s trading routes in North America. The growth of Halifax as an economic hub was a natural occurrence, fuelled from time to time by wars – the Halifax Regional Municipality grew to become a modern and vibrant economic leader in the Maritimes.

Growth of the HRM is providing challenges as the use of waterways and development has much broader demand than simply military and trade. The municipality has invested significantly in the last thirty years in revitalizing the downtown core – bringing energy to the city that is comparable to other successful cities in North America. There is fine dining, culture, recreation and accommodations that are considered world class. Attracting people to the downtown core increases demand for ever increasing use of a space that is constrained by the geography of the peninsula. Today there is growing demand for access to the city core in its continued role as the major business centre of Atlantic Canada. Along with this success, residents of the Halifax Regional Municipality commute to the city centre in growing numbers, stressing the road systems that feed it. The same geographic features that supported rapid growth (e.g. close and ease of

access to water and a protected deep water port) are now challenging the limits of growth. One in particular is the traffic routing into the city through a roadway system that constricts traffic flow. The HRM uses a number of transit options in moving people into the city, relying on ferries, rapid transit buses, "park and ride", cycling and other travel options to mitigate against increasing numbers of vehicles, and the inherent traffic woes that result.

Increase in traffic is a clear indication of increasing economic success of a city. In the case of the Halifax Regional Municipality, this traffic is concentrated through the core of the city, bringing increases in pollution, noise and traffic congestion. Increasing traffic accelerates road deterioration and road repair expenditures. Some might say that this increase in cost might well be worth the economic benefit of vehicles navigating through a congested city core, but when this traffic decreases the quality of life, or introduces increased occurrence of serious accident, noise and greenhouse gases, then it is important to look at other options.

1.3.1 Problems and/or Opportunities Addressed by the Fast Ferry Business Case

The Halifax Regional Municipality has seen continued steady growth. The area surrounding Bedford/Hammonds plains has realized a rate of growth which is significant and is expected to be sustained over the next decade. As a reference point this area enjoyed 15% growth from 1986 to 2001. Recent growth trends exceeded these figures. Using these figures as the baseline is considered conservative.

Statistics Canada report that 80% of employment continues to be centred in the urban core, while growth projections point to suburban and urban/rural fringe as the areas with increasing rates of growth¹. Given the geography of Halifax it is faced with an ongoing challenge to identify innovative solutions to enable growing traffic demands through land use which some already believe to be at its maximum apportionment of roads versus other uses. During this period of growth HRM continues to study the road infrastructure options, but have yet to commit to major changes at the choke points. In particular the 102 on/off ramp at Bayers Road and Quinpool/Chebucto access routes provide for challenges. Considering that this is already a problem, and given the growth projections that will use this routing for access to the urban core, there is a looming and growing issue regarding traffic. Simply put the traffic situation today as a dissatisfier will only become worse.

The HRM Strategic Plan identified the Bedford area as a target for growth, in particular because of the opportunity to service it with transit as concluded in the Greenfield Areas Servicing Analysis Report². This strategy addresses the need to concentrate urban development thereby meeting the growing citizen demand for improved municipal services in an effective and efficient manner. Undertaking development from a strategic standpoint enables planners to design communities that are municipal nodes of activity that integrate employment opportunities, transit, leisure and other services in a manner that is not simply responsive to the development but is part of the design from the outset.

¹ 2001 Census

² "Greenfield Areas Servicing Analysis: Opportunities and Constraints Report", CBCL and Marshall, Macklin, Monaghan, Jan/03

1.3.2 Current Situation

The current transportation network is a typical urban system that combines urban core transit with longer distance express services, park and ride options from extended distances, and passenger ferry service between Dartmouth and Halifax, and between Woodside and Halifax.

Ferry services currently exist between Dartmouth and Halifax (daily service) and Woodside and Halifax (Monday to Friday service). Transit time is approximately 8 minutes and fares are the same as the bus service, with full transfer from ferry to bus and vice versa. The ferries have a carrying capacity of 398 providing transportation for upwards of 6,500 passengers per day.

The HRM has a long history of using ferries. The region is celebrating the 254th anniversary ferry services from one side of the harbour to the other.

1.3.3 Connections to other Projects/Products or Programs

There are a number of projects and studies that connect to this project. The following were considered:

- The Regional Plan and the Greenfield Areas Servicing Analysis;
- MetroLink (Bus Rapid Transit) implementation;
- The Halifax Waterfront Development Corporation Mill Cove Bedford Waterfront Phase II project;
- The Halifax Bikepath project;
- The Commonwealth Games proposal; and
- The Halifax Port Authority Seawall Redevelopment Project.

1.3.4 Other, Alternative Actions

Considering the significant growth that is taking place through the Highway 102 Hammonds Plains and Bedford West corridor there is a need to look at road options as well as alternate modes of transportation.

Other solutions could lie in the development of alternate employment nodes, close to these centres of growth. These nodes could in fact add to increase reverse (e.g. Halifax to Bedford in the morning) traffic at peak operating times.

1.3.5 Current Problems or Limitations

Amalgamation: Over the last decade the HRM amalgamated four municipal government areas: Halifax, Dartmouth, Bedford and the County. Each area entered into the amalgamation with differing levels of taxation and services. In creating a common assessment and tax structure the citizens started demanding a universal service standard. One of those services is transportation systems. The development of a regional transportation plan is key to establishing levels of service that are consistent across the HRM while considering the timing and investment required to accomplish this objective. These demands from citizens may cause issues of transportation spending that do not necessarily support the introduction of new

systems. Focus may in fact be in improvement to existing transportation services, at the expense of more strategic oriented solutions.

Growth: The HRM has grown significantly – while transportation spending has not been able to keep pace with the demands. This being said there has been significant investment in new vehicles – these operational front line assets must be supported and there has been little investment in the construction of supporting infrastructure (e.g. bus garages).

1.3.6 Other Important Historical or Situational Information

The HRM has a history of ferry transportation from Dartmouth to Halifax. These ferries pre-dated the bridges and provided car and people transit across the harbour. Other ferries have provided service across the “arm” to offset heavy traffic through the Armdale Rotary, and in 1987 a second public ferry run was established from Woodside to downtown Halifax.

1.4 Disclaimer

It should be noted that this report predicts future results, and this involves some uncertainties, and the analysis is based on information subject to change (such as prices of ferry acquisition and fuel). In addition, the data is derived from multiple sources and therefore may have had differing definitions or baselines. The project team has done what it can to ensure that a common dictionary of terms has been used and in the case of predictive data points we have undertaken both a sensitivity and risk analysis.

In addition, it should be noted that comparison against other options to relieve traffic congestions, new road systems for example, have not been undertaken in this study. Any benefits and costs are measured against the current baseline and looked at as incremental.

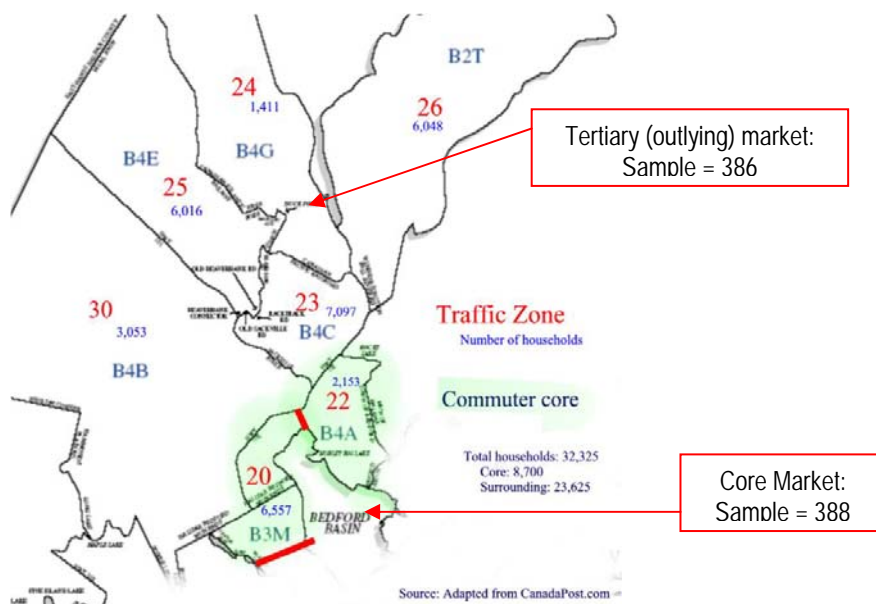
2.0 METHODS AND ASSUMPTIONS

The methods used are based on accepted models of market and operational analysis. A brief description of each is provided below. The order of data collection analysis followed from: (1) understanding the market; (2) input to the operational conditions; and (3) input cost benefit.

2.1 The Market Analysis

The Market Survey Report can be found in its entirety as Annex A. The market analysis was survey based. Respondents were drawn from the market areas shown in Table 1. These areas represented the key market draw for a potential fast ferry located in the Mill Cove area of Bedford, NS. A random sample was drawn from each market area.

Figure 1: Sample Market Zones



The final random samples had the following margins of error: core market and tertiary markets each plus/minus 5%, 19 out of 20 times; overall combined market sample of 774, plus/minus 3.5%, 19 out of 20 times.

The survey was designed to obtain feedback on various aspects of commuter habits to Halifax, as well as the likelihood of ridership for the proposed fast ferry. Supporting the survey design, the team undertook a series of focus groups to determine the best survey methods and establish a key question bank. Information was also collected on mode of travel, travel companions, reasons for travel, frequency of travel, length of commute, routes of commute, features desired in a fast ferry and a ferry terminal, various demographics, parking and fare information. Commute analysis was completed by created zones for trip origin and trip destination, then obtaining statistics for origin and destination patterns. Additional analyses

also included determination of the incidence rate of sole drivers in automobiles for travel to work, school and other activities.

A total of 6,792 calls were placed from the Bedford office of TMC, resulting in 774 completed surveys from the sampled market areas. The final response rate for the survey was 27%.

Data were weighted to reflect the number of households in each market zone (core or tertiary). Weighting factors included market core, 26.9%, and tertiary market, 73.1%. This provided for more accurate results when interpreting results from the overall sample, while also maintaining empirical reliability for each sample zone.

Data were analyzed using frequencies and cross tabulations, as required. Significance tests included Chi-Square, Analysis of Variance and Non-Parametric tests, were used as required.

2.2 The Case Studies

Three case studies were undertaken to better understand the challenges and opportunities that Fast Ferry transit provided to a municipality (refer to Annex B for full report). The cities of New York, San Francisco and Seattle were reviewed. There were some attempts to look at more international services such as Hong Kong but the distance, coupled with communication problems, eliminated this case from review. The following are a short summary of each case:

2.2.1 New York

New York city fuels the eastern seaboard economy, and those that are not lucky enough to live in Manhattan but work there must commute. The numbers commuting into the city are staggering each day; upwards of 4 million people. There are a number of New York ferry services. For the purposes of this study the Seastreak Fast Ferry was studied. The route referred to in the Case was from South Amboy New Jersey to Manhattan, taking approximately 50 minutes. The Seastreak Fleet, a private enterprise, is comprised of 7 Fast Ferries from 149 to 400 passengers. Key points in the Case:

- Wide variety of fare options – peak and off-peak, multiple ticket purchase and roundtrip savings, child discount;
- Became more attractive after 911 – considered a safe transportation option;
- Same price as the train but saves 20 minutes;
- No transfer to other public transit systems; and
- Developed special events transit packages (Yankees Ball Game Packages), and tourism excursions as well such as sunset cruises.

2.2.2 Seattle

Seattle has a population of approximately 563,400. The Kitsap Ferry Company runs a high speed commuter ferry from Bremerton (population 37,260) into the city. The ferry runs the 13.7 nautical mile route only Monday through Friday making the service primarily for commuters. The Spirit of Adventure is outfitted to accommodate up to 250 passengers. Originally the route had been provided by Washington State Transit, however the decision was made to end the service and Kitsap Transit was unable to gain voter approval. The State Transit system provides car ferry transportation only. At this time The Kitsap Ferry Company was founded. The company is still very young and faces competition from the State's Auto ferry which travels the same route and is free of charge. Although the Kitsap ferry shaves 20 minutes off commuting time, many are still opting for the longer, free ferry. The following are some key points:

- Bicycle transportation is important and the ferry has 15 first come spots for storage during transit.
- The run is 13.7 nautical miles, with a transit time of 40 minutes.
- They have successfully introduced business class travel which provides assigned seating and free coffee and newspapers.
- Cash fares are \$7.00, with age and volume purchase discounts available.

2.2.3 San Francisco

San Francisco is a bay city that boasts some of the highest real-estate costs in North America. This has caused a migration to more economic places to live resulting in a high number of commuters. The city is surrounded on three sides by water. There are three principal routes into the city: one from the south by land; and two bridges. At peak commute times these access points are jammed, causing long transit times. Having the advantage of water, the city has initiated a number of publicly subsidized Ferry options – from Larkspur and Sausalito (11 and 6 mile run respectively). These two runs use ferries that are 325 to 450 passengers. The following are the key points:

- Parking is a critical consideration, and is provided at no charge to the passengers.
- Rides are subsidized with the ticket costs covering 25% to 45% of the operating costs. Rates range from \$2.75 to \$4.70 cash fare. Significant reductions are available for multiple ticket purchases. No distinction between peak and non-peak operations.
- Increased commuter demand has led to another Fast Ferry being built for the service.
- Consideration for bicycles has been important for ridership – especially on the Larkspur run.
- Traffic has become an issue leaving the parking at the ferry terminal P.M. peak.
- As a public service transfers to the other public transit options is available with an additional cost.
- Although used primarily for commuting, the ferries also are used to promote special events as a transportation option into the city – football package tickets for example where there is a direct run to Monster Park eliminating traffic and parking issues at game time.

2.2.4 What We Learned

The following are the major points that we picked up as common threads in the Fast Ferry Case Studies:

- There is an increasing demand for ferry options that address time to commute and parking issues;
- Commuters are prepared to pay premium fares to resolve the headaches of commute;
- There is an important relationship between parking, connectivity and reliability to ferry success;
- Commuters consider Ferries as the most secure urban transit system; and
- There are many collaborative opportunities that can be exploited with sports, arts and other events.

This information was key to the development of the focus group dialogue and then the design of the survey questions.

2.3 Operational Modeling

The operational model is an Excel Spread sheet based model that links together market data with technical solutions that take into account the following variables:

- Vessel technical cost considerations – acquisition, crewing, engine configuration, maintenance and fuel consumption;
- Market – changes in market due to growth, shedding due to impact of schedule and weather;
- Schedule – optimizing route and timing to insure best service in response to market expectations; and
- Price – establishing price points based on the demand curve and establishing pricing options ensure highest return.

The operational model enables these variables to be adjusted in “What if” type scenarios thereby enabling an optimal solution to be derived based on current and projected growth.

2.4 Financial Metrics

The financial metrics (financial measures) and other decision criteria were developed from cost/benefit data. These measures enabled the team to determine which data must be included.

It is also intended to help understand which results and analyses will enable decision makers to decide or take action based on case results (the most important financial metrics were already introduced in less detailed form in Section A.2 “Business Case Purpose.” Financial metrics include:

- Net cash flow;
- Net sales and/or earnings;
- Cost per transaction – Fare;
- Cost per employee;

- Return on Investment (ROI);
- Payback period;
- Total cost; and
- Price/performance ratio.

2.5 Business Case Scope and Boundaries

This section establishes exactly whose costs and whose benefits are covered, over which time period. This scope and boundary information will be more complete than the brief statement of scope in the Subject statement (Section 1.1.3).

2.5.1 The Analysis Period

The analysis period used for the study is ten years, which considering the lifespan of Fast Ferry is 15 to 20 years is considered conservative.

2.5.2 Geography or Location

The study represents Ferry operations from Bedford (Mill Cove) to downtown Halifax using the existing Ferry Terminal.

In addition the team has looked at other Ferry Terminal opportunities and comments are provided for: Shannon Park, China Town, Eastern Passage and Purcell's Cove. However, these sites have not been fully supported with detailed market analysis to establish costing or vessel schedules. Only the Bedford analysis has been driven from a comprehensive market analysis.

2.5.3 Organizations

Metro Transit is the only organization that has been included in the analysis. That being said there is an overall impact in all supporting elements of the HRM staff that contribute to planning, finances, HR, legal, etc. This analysis considered these costs as annual costs in a contract form from the Department to the Corporation.

2.5.4 Functions and Positions

The study looks at all aspects of the Ferry operations, from crewing (numbers and certification), to engineering, marketing, and ticket sales. In addition, it is believed that there will be a need in some scenarios to establish new operational management staff and therefore will include new positions and functions as required.

2.5.5 Technology

Technology (Information Technology) has become an important element in moving new transportation systems forward. In the scenarios that are being evaluated it is important to that commuters have access

to real time information regarding schedule and commute time. In this case advanced technology, leveraging the HRM investment in geomatics has been explored. At this time HRM is currently looking at new systems to replace dated bus location and timing systems for their transportation management system.

2.5.6 Mill Cove Land Development

The Mill Cove Land (WDC Land Bedford Waterfront Phase II Project Phase II) development introduces tremendous growth opportunity for new passengers. Close proximity of this terminal to this develop should produce high levels of demand. These numbers were not considered in the analysis – numbers of the existing market were adequate.

2.5.7 Fares

Optimizing the return is the challenge faced in the benefit cost analysis – with an overall objective of realizing a 70% return of operating costs. The team has used the fare breakdown of Child, Student, Adult and Senior fare structure for this work. However, there is a need to look at the fares themselves, striving to flatten ridership out from peak times to non-peak hours of operation. Typically, this is accomplished by setting a peak fare, and then providing discounts when commuters (or others) choose to use the ferry in non-peak hours.

2.5.8 Parking

Parking has been identified as a key element in the decision process to take the ferry. The team established scenarios that provide for remote to Mill Cove Terminal as free parking, and pay parking. However, the price point of pay parking was not explored and will require further work should this be the resulting preferred solution.

2.6 Scenario Design

Baseline costs of the status quo have not been identified as part of the analysis. It was assumed that this comparative baseline would remain the same for all scenarios. For example the cost of the current transportation system would remain unchanged because of the implementation of the Fast Ferry and the new service would be considered incremental. Because of this assumption the baseline of Metro Transit will remain the same for each scenario and can therefore be cancelled out.

All scenarios were developed around transit between the Mill Cove Terminal (to be constructed) and the existing downtown Halifax facility. Schedules varied based on technical capability of the vessels, with the faster vessels enabling a greater number of runs during peak operations. Runs for each scenario during off-peak times were limited to one per hour in each direction. The downtown terminal will be modified to service the new ferries, using the existing jetty on the north side.

Each of the six baseline scenarios (described below) was analyzed for two different vessels and at three different fare price points. As well, they were also assessed for the procurement of two and three vessels.

Vessel 1 – 206 Passenger NQEA:

- 28 knots

- 2,200 hp
- two high speed marine diesel engines
- .38 tons/hour fuel consumption at full speed
- 90% MCR
- low wake design
- propeller

Vessel 2 – 350 Passenger BMT Nigel Gee:

- 35 knots
- 4,200 hp
- four high speed marine diesel engines
- .63 tons/hour fuel consumption at full speed
- 90% MCR
- low wake design
- water jets

In addition three fare price points were evaluated based on the demand information drawn from the market analysis. Along the curves we looked at \$4, \$5 and \$6 fares. Given these parameters, when applied to the scenario descriptions below with two different vessel types, there were a total of 72 scenarios.

Baseline Fast Ferry scenarios are described as follows:

2.6.1 Scenario 1 - No parking at the Mill Cove Terminal and no downtown shuttle service.

2.6.2 Scenario 2 – Free parking at Hammonds Plains/Highway 102 and no downtown shuttle service.

This scenario is based on 500 car free parking facility with a shuttle service from the parking to the terminal every 7 minutes during peak operations.

2.6.3 Scenario 3 - Pay parking at the Mill Cove Terminal and no downtown shuttle service.

Same scenario as Scenario Two with a parking fee.

2.6.4 Scenario 4 – No parking at the Mill Cove Terminal with a downtown shuttle service from the terminal to the Universities and the Hospitals.

2.6.5 Scenario 5 - Pay parking at the Mill Cove Terminal with a downtown shuttle service from the terminal to the Universities and the Hospitals.

Same scenario as Scenario Four with a parking fee.

2.6.6 Scenario 6 – Free parking at the Mill Cove Terminal with a downtown shuttle service from the terminal to the Universities and the Hospitals.

2.7 The Cost Model

The cost model was derived from the operational model first. This operational model holds true for each of the scenarios, the results of which are based on establishing the best vessel, schedule and fare for the market data.

The model uses the logic as follows in deriving the profit and loss statements:

- The market demand curves are loaded into the model as developed from the market survey. The demand curves for each scenario are unique. These demand curves enable a calculation of the total number of potential Fast Ferry riders – which can then be identified as Commuters and Other.
- The Fast Ferry operating parameters are also loaded into the model as variables. Based on size of vessel and speed the ferries will provide a number of seats for the available market considering the distribution of Commuters and Others who take the ferry in off peak time periods.
- Schedule parameters such as service start and end times, and peak times start and stop are then used to determine the number of runs that the Fast Ferries will make in a given day. Weekends reflect straight time with no peaks. The number of runs in a day, along with the vessel type establishes the number of seats available which enables two things – the determination of the number of customers; and the calculation of fuel costs.
- Vessel characteristics (e.g. 2 or 4 engines, speed, cost) also drive other costs in the system such as maintenance, insurance and crewing. These costs are also variable and contribute to the financial statements.
- The number of riders also drives other cost and revenues in the model such as purchased goods and hotel costs e.g. interior maintenance.

Modeling objectives would be to match the technical and operational solution to the demand. Certainly shifting price point enables this match of demand and solution. The model also enables the analysis to see the ferry loading across a day, and with pricing strategies develop solutions to spread out high demand during peak commutes, and encourage “others” to use the ferries – especially in runs that are in reverse of the commute direction (ferries during peak times will be full in one direction and virtually empty in the other direction).

The operational cost model includes the following specific cost line items:

2.7.1 Human Resources

Human resources include all vessel operations and support staff as follows:

- Vessel crew has been defined based on the requirements of Transport Canada³ and varies based on the number of passengers and the horsepower of the ferry;
- Support staff – ticket, marketing; and
- Peripheral staff – operational management and control.

2.7.2 Vessel Operations

The costs are described by elements that enable the vessel to go to sea. These include insurance, fuel and other consumable costs for operations.

2.7.3 Vessel Support

Maintenance costs including:

- routine maintenance (oil, lubrication, seal changes);
- unforecasted maintenance (failure of machinery); and
- dockings (hull cleaning and repair, machinery overhaul).

2.7.4 Consumables

Consumable are items such as food and newspapers that typically have a cost and a revenue stream. These services tend to be contracted out, which would be eliminated as a cost. However, for the purposes of analysis they have been included to understand the contracting out implications and developing the best return for the HRM.

2.7.5 Other Infrastructure

This included parking facilities and modifications to existing terminal.

2.7.6 Transportation Additions

Some scenarios called for the additions of shuttle services. Costs include capital, fuel, drivers, maintenance and support (e.g. ticket management fair apportionment).

³ Transport Canada TP 14070E Chapter 3

2.7.7 Road Modifications

Changes are required to some intersections in the Mill Cove/Hammonds Plains area. These modifications are specifically targeted at moving shuttle buses and drop-off traffic through Convoy Run to the proposed terminal at Mill Cove. Road modifications include traffic light change management and bus only turning lanes at the junction between the Hammonds Plains Road and the Bedford Highway.

2.7.8 Terminal Construction and Operations

This includes actual construction costs. Costs regarding the timing of the Mill Cove Bedford Waterfront Phase II project have also been developed to understand the optimal relation between the development of this area and the construction of the terminal.

Operations of the terminal are restricted to building operations such as heat and electricity. The Human Resource such as ticket sellers and security are dealt with in the HR costing section.

2.8 The Benefits Rationale

Benefits rationale will look at benefits beyond cost savings. The two cases have been built to determine how one or another proposed action contributes to *business objectives*, and the business case benefits rationale will be the basis for bringing these contributions into the business case.

The high level business objectives that motivate consideration of the case subject were introduced in the case subject statement, Section A.1.b. Such as:

2.8.1 Commuter Uptake Increase

There is a need to move to move commuters from the current behaviour of one-to-one car to using public transportation. This is particularly important as growth in this area remains consistent. Without additional commuter options, and this change in behaviour, there will be an increase in traffic congestion. Not only will this address some of the burden on traffic and roadway maintenance – it is also anticipated to respond to environmental initiative.

In addition the Mill Cove Bedford Waterfront Phase II project, as well as Bedford West and Bedford South developments will escalate this growth.

The measure is the number of commuters.

2.8.2 Financial/Business Performance

Currently the HRM Metro Transit System has the goal to achieve 70% return on operations. This standard was used initially in the analysis.

The measure is financial contribution from all revenue lines.

2.8.3 Operations

Currently the overall transit time for commuters from this area is on average 25 minutes. Achieving this time consistently (or bettering it), while providing other advantages, has a direct relationship to the market numbers. Other advantages include easing the parking situation, and providing value added services.

Two time periods must be evaluated as follows: time from embarkation to disembarkation; and time of arrival at parking to disembarkation.

2.8.4 Product and Services

The importance of additional products and services were not identified initially as part of the analysis, not at least until the focus group sessions where these were identified as positive to the market. The objective of these benefits is to establish value add to the transportation process by looking at the commute from the commuters perspective. Potential commuters highlighted such things as child care services, grocery or health club facilities.

2.8.5 Brand Recognition

As part of the HRM strategy and long range plan, the city is aiming to be recognized as a leader in innovative transportation options and the development of integration across the various transportation modes.

In addition brand recognition should position the HRM in its bid for the Commonwealth Games.

As well, this recognition should be associated with environmental stewardship as new transportation options are regarded to have a positive net benefit for the environment.

The Fast Ferry will have a direct influence over a successful Commonwealth Games bid and the environmental gains will result in positive carbon credits as part of the Kyoto Accord.

2.8.6 Internal Opportunities within the HRM

Specifically these benefits are regarded by Metro Transit as building professional development opportunities. Specifically the hiring and retention of operators with certificates is anticipated to improve. In addition Training collaboration with other users of the Harbour will build cooperative relationships. For example the Department of National Defence has a trainer that could provide for local ongoing training and skill development and retention. This arrangement is consistent with the HRM HR strategy of lifelong training which could enhance staff relations.

Proposed action contributing to such objectives, the impact may be recognized and measured immediately in financial terms (increased number of commuters using public transportation) or it may be recognized and measured in some other terms (tangible evidence of improved commuter satisfaction, for instance might appear as fewer complaints, or in the results of customer surveys). It will also reduce the training and certification costs.

2.9 Data Structure

The comparative model was based on an integrated cash flow statement over ten years. The presentation of information is a roll-up in the final statement of profit and or loss. Line items include:

- Revenue based on ridership and projected ridership over ten years, and the revenue generated from onboard sales; and
- Costs accumulated for operating costs, costs of onboard sales, disbursements, fuel and start-up costs. Start-up costs include one time charges for capital outlay, training, marketing, legal, project management and computer software.

2.10 Data Sources and Methods

This section and the following (“Assumptions,” B.8) describe the business case results and how the analysis was achieved.

2.10.1 Data Sources

The following data sources were employed:

- **Business Plan** – the HRM Transportation Regional plan was used as a primary document to obtain the business objectives and assumptions – for example the objective to create transportation networks, and the need to establish a 70% return on operations.
- **Sales Projections** – data sources for this element were derived from a number of sources as follows: the market survey; the operations of the Dartmouth Ferry; interviews with event market managers; and analysis of tourism information from Provincial reports.
- **Budget** – deriving numbers for bus operations and maintenance, Ferry operations, fuel, terminal operations and revenue generating contracts such as the terminal coffee shops.
- **Spending Record** – for example deriving real numbers for bus operations as opposed to the budget derivations.
- **Vendor Proposals** – using data sent to the Team and the HRM in preparation for the business case – costs such as vessel size, operating characteristics, crewing, fuel and maintenance were obtained.
- **Vendor-Supplied Data** – as above however more informal in nature to enable a broader cross section of analysis. This included as example technical information on a 350 passenger ferry from BMT.
- **Publicly Available** – drawn primarily from the Web, an example of which included information to understand the benefits of using advanced composite materials for the construction and its impact through life of the vessel.
- **Consultant’s Estimate** – these estimates were used to enable the team to complete the analysis. An example of this was that the number of parking places in Scenario 2 above that would not have a limiting impact for ridership numbers and that it would simply be the market response to the service that would be limiting.
- **Models** – a number of models were used to help in the analysis of the scenarios as follows:

- **Market Analysis** – based on questions and a survey, this enabled the market potential to be defined to a degree of certainty that was $\pm 3.5\%$ 19 times out of 20.
- **Operational Model** – developed to be driven by market numbers, and then conducting “what if” analysis that included variables such as vessel size and operational characteristics, fare and schedule.
- **Land Use Model** – developed to be driven by policy conditions in land development to determine best approach to terminal and land development at Mill Cove.
- **Benefit Cost Model** – developed to include variables in a comparative scenario driven system such as the issue of parking, or environmental improvements.
- **Previous Business Case** – a business case at a high level to determine if there were any reason to undertake a more complete analysis⁴.
- **October Public Trial** – in October the HRM conducted a real time operational trial. This enabled data to be collected on wake wash of a typical fast ferry and vessel traffic in the harbour. It also gave benchmark data for travel times and rider response directly from the public who took the opportunity to experience travel by Fast Ferry.
- **Published Standards** – references included Transport Canada policy on vessel crewing, and safety guidelines for harbour operations.
- **Case Studies** – drawing from existing Fast Ferry operations to determine operational methods, cost structures, opportunities and challenges.

2.10.2 Methods for Estimating Costs and Benefits

Operational Model – the operational model drew on a number of cost estimates that were generated at follows:

- **Market and Market Growth** – were developed from the market study through a questionnaire designed to collect the data needed for scenario development, a focus group to test question validity, telephone survey to collect the information and analysis of the data to develop the demand curves for each scenario.
- **Connectivity** – these are defined as the shuttle transport to and from the parking and the connection at the Halifax end to take Ferry Riders from the terminal to the major employers of Halifax (e.g. Universities and Hospitals). Cost estimates were based on current costs of bus operations in the HRM – which includes not only the cost of running the bus but also maintaining it.
- **Revenue Generation from Onboard Sales** - was developed from a simple estimate based on experience of other services and an expected return by item of 70%.

⁴ HRM Staff Report to Council dated 20 June 2004

- **Crew and Land based Personnel** – were established from Transport Canada regulations and then particularized for the number of vessels and operating schedule. As well additional backup crew were identified as a function of the number of vessels.
- **Deck, Engine and Hotel Costs Stores**
 - **Deck:** based on the total number of runs. This function is variable, and represents topside consumables - lines, fenders, lights.
 - **Engine:** based on a relation of number of trips and engine horsepower, figures used were of a comparable engine (caterpillar) and includes such items as general purpose maintenance.
 - **Hotel Stores:** include soap, toilet paper, and other items. This is a function of the number of passengers on the vessel.
 - **Lubes:** is directly related to the fuel consumption.
 - **Survey Fees:** based on a bi – annual inspection frequency required by Transport Canada.
 - **Freight:** allowance to ship emergency spares identified based on experience of operations.
 - **Hotel Refurbishment:** a function of number of passengers and trips and includes the ongoing repair to items such as seating, carpet, bulkhead finishes etc.
 - **Hull Maintenance:** is a direct function of operating sea state and vessel designed sea state. If the vessel is designed to a high sea state and operates in a lower sea state environment there will be less damage to the hull.
 - **Engine Maintenance:** this cost item is a direct relationship between time operating, and the maintenance requirements between top end overhaul and total overhaul. The model used was based on Caterpillar 1000 hp engines that are designed around a 16,000 hour major overhaul and an 8,000 top end overhaul. Costs were calculated for all engines over the 10 year period based on their operating profile and the equally apportioned over the same period. It is recognized however that there will be no engine scheduled maintenance for the first two years, and that all engines will hit their maintenance requirements at the same time. This will have to be organized by cycling the engines to limit operational impact. It is highly recommended that spare engine(s) be available for both scheduled and unforecasted maintenance.
- **Docking** – docking accrual is the investment in future work over the 10 year period of the vessel and provides for cash availability to undertake major refits of the vessel on a 4 year periodic basis.
- **Annual Contracts** – represent the identified contracts for supporting the various scenarios. This includes marketing, IT systems support, web maintenance, snow clearing (for parking options only), etc., and were generated from current HRM budgets and discussion with municipal staff.

- **Marine Insurance** – function of the cost of hull replacement and validated against the current HRM insurance costs.
- **Start-up Costs** – include vessel procurement, project management, IT procurement, training, marketing and recruiting, etc.,.

Bedford Waterfront Phase II Model – Estimates used in determining the sequencing of the development, and recommendations for approach were as follows:

- Costs for fill were obtained from the business case developed by the Halifax Waterfront Development Corporation⁵.
- Tax revenue was based on existing experience of buildings in Halifax such as the tower above Park Lane and the Condominiums at Summer Gardens and Spring Garden Road.
- Costs for unit development for waterfront property was drawn from real current costs obtained from CBCL.
- Construction costs were drawn from the business case referenced above, and validated against the experience of CBCL.

Terminal and Parking Build – the build costs for the terminal were drawn from real data for the design and build of high-end retail space provided by CBCL.

2.11 Assumptions

These major assumptions:

- Apply to all scenarios in the case
- Differentiate scenarios from each other (some may be repeated from Section 2.3, above)
- Apply to individual cost and benefit line items.

As well these assumptions are the basis for sensitivity analyses (Section 4) that follow the main business impacts (Section 3).

Assumptions will appear to address these elements:

- Prediction
 - Inflation was pegged at 3% for the model, which is somewhat higher than the current figure of 2.2%. Given the shift in resource costs (e.g. oil) and housing in Canada we decided to err on the conservative side. All operational costs are affected.
- Simplification
 - Rates of pay used averages – regardless of seniority over the 10 year period and assumed that increases would keep pace with the inflation rate.

⁵ "Stage One: Conceptual Planning and Cost Analysis Phase II Bedford Waterfront", O'HALLORAN CAMPBELL consultants limited, July 2003

- Shuttles were considered as net new, and not the transfer or replacement of other bus routes.
- Start-up Costs and Annual Contracts used estimates – although these figures should be available from existing operations, or the HRM operating budget there seemed to be tremendous variation which was dependent on contracts and or system requirement.
- Clarification
 - The FF will be owned and operated by the HRM. There may in fact be an opportunity to contract out the complete service, but decisions on a service procurement strategy have not been addressed and this assumption of clarification needed to be made to move the analysis forward.

2.12 Estimation of the Demand of Residents of the Primary and Secondary Market Areas for Travel on the Fast Ferry

Data used to estimate the demand for fast ferry service were collected via 741 telephone interviews with persons 18 years of age and older conducted in the primary and secondary market areas of the fast ferry.

Among other questions, the interviewees were asked:

- how many times each week they traveled to Halifax for work, school and/or other reasons
- the destinations of the trips; and
- their mode(s) of travel.

Interviewees were then provided some information about the transit time, origin, destination and amenities of the fast ferry.

They were then asked what one way fare they thought would be reasonable for the fast ferry, assuming all policies for discounts, bus passes and special fares will be the same as they are for transit bus travel.

Then the interviewees were asked the likelihood of them taking the fast ferry for their trips into Halifax rated on a scale from 1 (Not at All) to 10 (For Certain).

2.12.1 Estimation of the Demand Curve for Fast Ferry Services

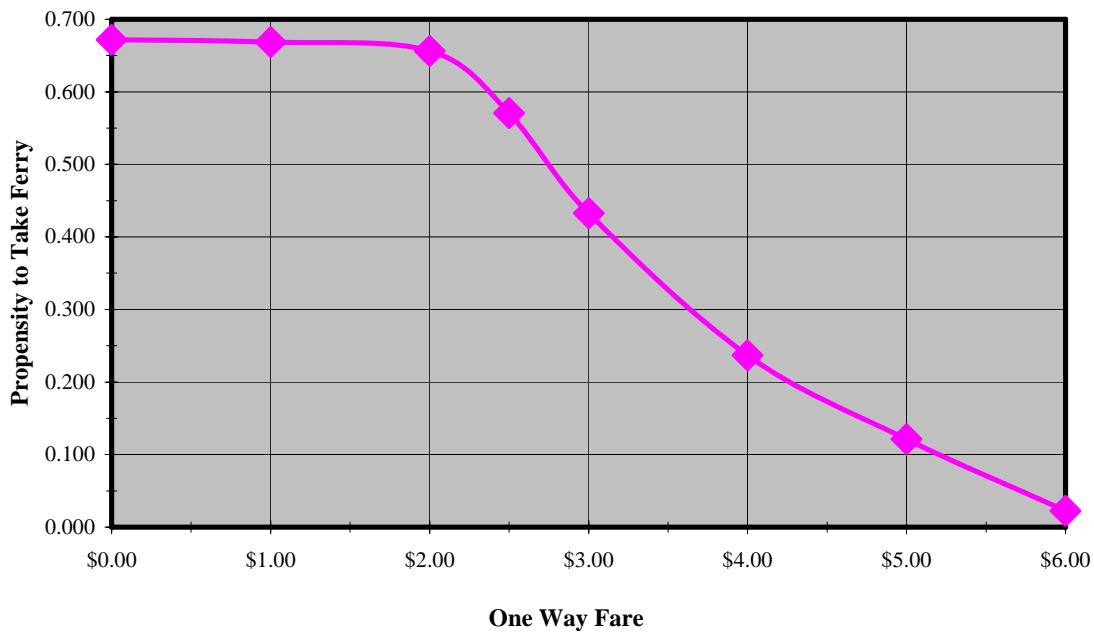
Responses to these questions allowed the consultants to estimate the percentage of persons 18 years of age and older that would take the fast ferry at a range of prices from \$0.00 to \$6.00. The results are summarized in the *Table 1*.

Estimation of the total trip demand for fast ferry service at each price level was adjusted for the finding that those that would pay a higher price tended to make fewer trips per week into Halifax. *Table 1* summarizes the relationship between willingness to pay and the average number of trips per week into Halifax.

Demand for Fast Ferry Service by Ticket Price		Relationship of Fare Considered Reasonable and Trips/Week
One Way Fare	Fraction of Population 18+ that Would Use the Fast Ferry	Trips per Week
\$0.00	0.672	NA
\$1.00	0.669	3.82
\$2.00	0.656	2.25
\$2.50	0.571	3.47
\$3.00	0.433	3.19
\$4.00	0.237	3.01
\$5.00	0.121	3.11
\$6.00	0.022	2.74

The *following exhibit* shows the decline in the propensity to take the ferry as the price increases.

Propensity of the Population >= 18 Years of Age to Take the Fast Ferry



2.1.2 Estimation of the Demand for Two-Way Trips/Week by Price

Total trip demand was estimated as:

$$(\text{Population } 18+) ^6 * (\text{propensity to take the fast ferry @ price } x) * (\text{average number of trips/week at price } x).$$

For example, at one way price of \$4.00 the demand for two-way trips/week was estimated as:

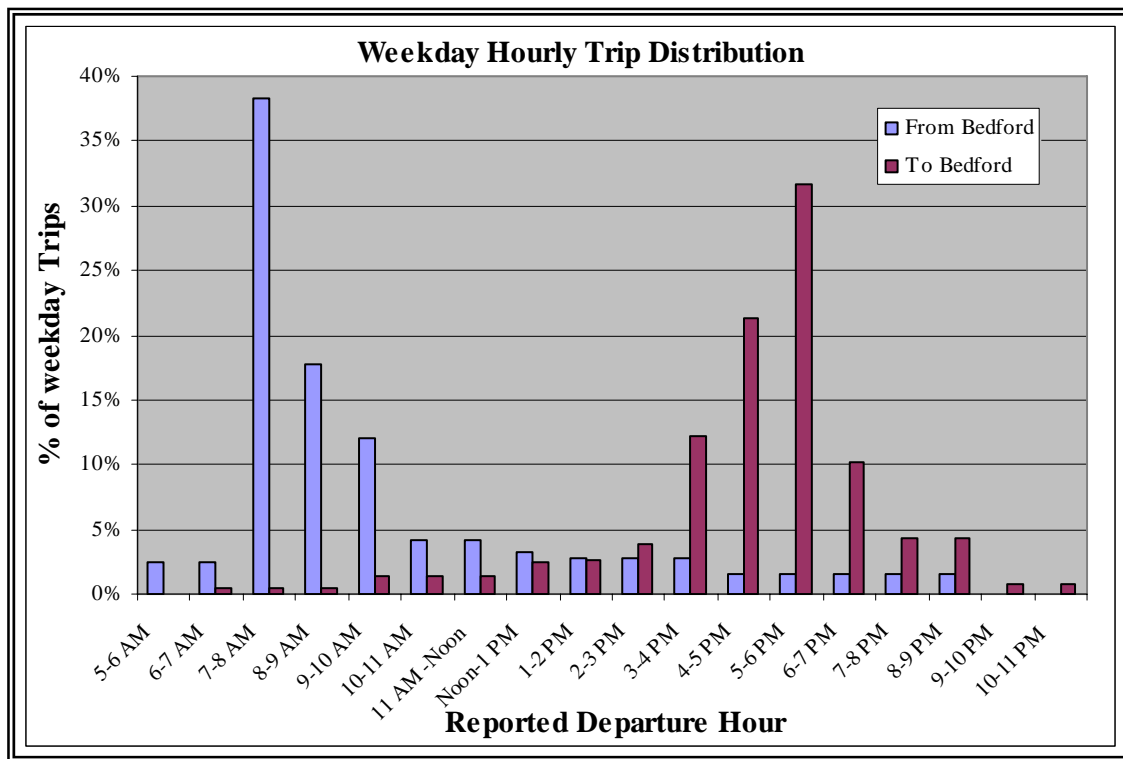
⁶ The 2006 population was estimated based on data from the 2001 Census and extrapolations of population growth in the primary and secondary market areas from 1996 – 01.

66,200 * 0.237 * 3.01; which is 47,279 (may not add due to rounding).

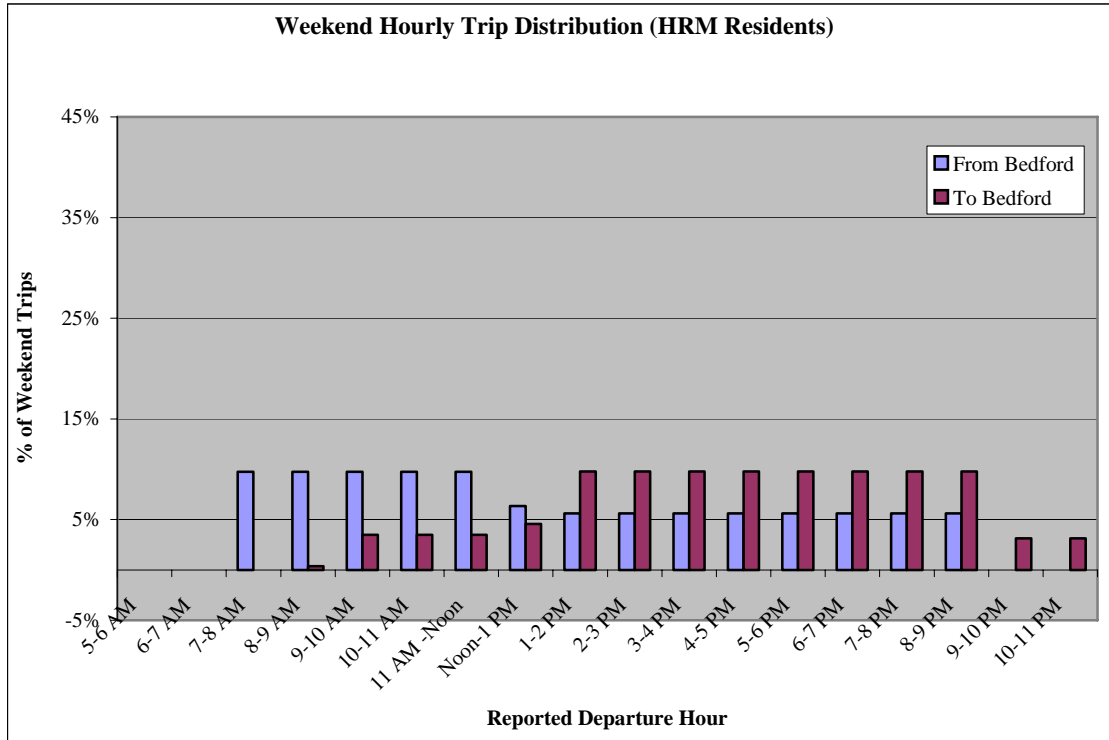
The type of trips is described in the table below:

	% of Trips	# Trips/Week
Work - weekday	54.3%	23,102
Work - weekend		2,567
School - weekday	4.2%	1,975
Other Trips – Theatre, Doctor, etc	41.5%	19,635

The *following exhibit* shows the weekday hourly distribution of trips by market area residents, from and to Bedford. The data were derived from the phone survey.



The *following exhibit shows the weekend hourly distribution of trips by market area residents*, from and to Bedford. The data were derived from the telephone survey. Departure times were reported as periods of the day (e.g., morning, early afternoon) and therefore the hourly distribution required some interpolation.



3.0 BUSINESS IMPACTS

3.1 Financial Model and Cash Flow Statements

The financial model used will include several cash flow statements as well as tables or graphs that show the behavior of key variables, assumptions or relationships between them.

In the full value approach to data structure (Section 2.6, above), there will be one cash flow statement for each case scenario. Complete full value scenarios will be included in an Annex.

Cash flow statement line items represent true cash inflows or outflows that follow from the action (subject of the case). The cash flow statement will not include accounting conventions such as depreciation expenses or allocated costs (unless they represent true cash flow). Each cash flow statement in this section has four subsections as listed below, implemented in spreadsheet form. Each subsection has line items, each on its own line (row). Columns represent time periods such as years (or quarters or months) of the analysis period.

3.1.1 Benefits and Gains

These fall under following categories:

- Fares: Fares were assessed between \$0 and \$7+. Demand curves fed into the model however were limited to \$4, \$5 and \$6. These fares were then further altered to reflect the existing policies of monthly passes, and elderly/child pricing.
- Market growth reflected a projected 3% increase per annum with the exception of the first two years. In these years the first year will see only a 60% market take-up and 80% for the second year.
- Concession Sales which looks for a 70% return, and estimated based on experience that on average a passenger will spend \$0.50.

3.1.2 Expenses (or "Operating Expenses")

The following represent the cost profile of the model:

- Fuel Costs – fuel costs were established from the following variables: the distance traveled, the speed of the vessel, the profile of the transit (e.g. so much time as idle, maneuvering, slow speed, half speed and full speed). The following table is a representation of the transit profile for the 35 knot vessel:

Voyage Characteristics

Distance Nautical Miles	7		
Mill Cove	Minutes	Distance	Speed/Kts
Maneuver off Dock	0.5	0	
Low Speed	1	0.25	15
Slow Speed	1	0.25	20
Full Speed	10	6	35
Slow Speed	1	0.5	20
Low Speed	1	0.5	15
Maneuver into Dock	0.5	0	
Idle in Dock	5		
Block Time Used	20		
Time Under Way	15		
Halifax	Minutes	Distance	Speed/Kts
Maneuver off Dock	0.5	0	
Low Speed	1	0.25	15
Slow Speed	1	0.25	20
Full Speed	10	6	35
Slow Speed	1	0.5	20
Low Speed	1	0.5	15
Maneuver into Dock	0.5	0	
Idle in Dock	5		
Block Time Used	20		
Time Under Way	15		
Total Minutes per Round Trip	40		

Operations Cost Increases - Each vessel speed and time for the transit, based on this profile, is fed into the model along with the corresponding fuel consumption and the total fuel consumption can then be calculated by trip, by day, by week, etc.,. The fuel cost for this modeling was \$800/ton.

- The two major costs elements of operations are people and fuel. Both of these costs were calculated over the 10 year period with a 3% increase. Commuters drive costs in the area of hotel maintenance for instance.
- Connectivity – these are defined as the shuttle transport to and from the parking and the connection at the Halifax end to take Ferry Riders from the terminal to the major employers of Halifax (e.g. Universities and Hospitals). Cost estimates were based on current costs of bus operations in the HRM – which includes not only the cost of running the bus but also maintaining it.
 - **Shuttle Bus Operations from Parking to Terminal:** This cost figure was generated using the current costing model from Metro Transit of \$70/hour which represents salaries, fuel, maintenance and administration. The operating costs were based on three buses operating during peak operating times from 6:00 to 9:00 and 4:00 to 7:00 and one bus operating at non peak times on a regular cycle that provides optimal service to the ferries operational schedule. Total daily bus operating hours for the parking shuttle would be 30 bus hours per day. Annual operating costs for the bus would be \$616,000.

Shuttle service would not be provided on the weekends.

- **Shuttle Bus Operations Downtown to Universities and Hospitals:** As above the estimate was generated from the Metro Transit model of \$70/hour. This service would be limited to peak operating times from first Ferry arrival for three hours and then commencing at 4:00 ending at 7:00. Times to be adjusted to reflect commuter requirements. Total three buses for 18 hours per day for at total of \$327,600.

Note: No adjustments were made for reduced service on holidays.

- Crew – the figures were developed to reflect the total cost of each position. Note that the table below reflects the costs for the 206 passenger vessel. The larger the vessel the need for added crew members. The 350 passenger vessel will carry 6 crew.

Crew

Crew Payroll			\$ 909,632.00
Benefit	25%	of payroll	\$ 227,408.00
Training	5%	of payroll	\$ 45,481.60
Travel and Expenses	1%	of payroll	\$ 9,096.32
Uniform/per Person	200		\$ 4,000.00

Note that one crew member per vessel must have an engineering Class 2 or 3 Certificate. This is a Transport Canada requirement based on vessels of more than 1000 hp⁷. TC was approached regarding special dispensation to disregard this rule. The Ottawa office rejected an informal request. The argument for this dispensation is based on the fact that the Ferry will operate within visual contact with the shore at all times, and the inability for an engineer to undertake repairs effectively given the limited space. It was suggested to TC that an engineer be available on watch from a shored based console that would be monitoring system performance.

Although this request was rejected from Ottawa, further discussions with the local office suggested that the arguments made sense and that they would consider a formal application for dispensation. It should be noted that it is a local responsibility to grant dispensation.

⁷ Transport Canada TP 14070E Chapter 3

- Deck, Engine and Hotel Costs Stores are directly related to variables such as horsepower, numbers of passengers, speed traveled. The table below represents the values for the 206 passenger vessel:

Deck, Engine and Hotel

Deck Stores	\$ 30,660.00
Engine Stores	\$ 33,726.00
Hotel Stores	\$ 31,579.80
Lubes	\$ 82,031.14
Survey fees	\$ 8,000.00
Freight	\$ 5,000.00
Hotel Refurbishment	\$ 31,579.80
Hull	
Maintenance	\$ 78,120.00
Engine Maintenance	\$ 167,333.33

- Docking – docking accrual is the investment in future work over the 10 year period of the vessel and provides for cash availability to undertake major refits of the vessel on a 4 year periodic basis. This value is based on the insured value of the hull. This accrual represents an investment of \$550K. It is understood however, that although this cost is included in the maintenance of the vessel that accrual investment is not a method commonly used in public accounting systems. It does however provide for a better understanding of the through life costs of the vessel maintenance and establishes the need for future budget allocation.
- Shore Side Management – represents one new management position to support the Fast Ferry operation. This value was estimated at \$60K plus benefits.
- Annual Contracts – represent the identified contracts for supporting the various scenarios. This includes marketing, IT systems support, web maintenance, snow clearing (for parking options only), etc.,. The table below represents values used in the analysis:

Annual Contracts & Costs

Printing, Markets, Promotion	\$ 100,000.00
Terminal & ship cleaning	\$ 50,000.00
Parking snow removal	\$ 100,000.00
Parking Lot Management and P Shuttle	\$ 616,000.00
DT Shuttle Operations	\$ 327,600.00
Computer systems	\$ 20,000.00
Accounting, audit, legal	\$ 50,000.00
Web service	\$ 10,000.00
Travel	\$ 10,000.00
Utilities	\$ 40,000.00
Ticket Systems	\$ 10,000.00

Note: These figures do not represent start-up costs. Start-up is represented in Pre-Service Costs. As well, the Parking Lot management includes security and the shuttle operating costs.

- Marine Insurance – constructed as a percentage of the cost of hull replacement. Therefore as the cost of the vessel increases so will the insurance. 0.5% of replacement cost was used as the insured value.

Bedford Waterfront Phase II Model – Estimates used in determining the sequencing of development, and recommendations for approach were as follows:

- Costs references for fill were obtained from the business case developed by the Halifax Waterfront Development Corporation⁸.
- Tax revenue was based on existing experience of buildings in Halifax such as the tower above Park Lane and the Condominiums at Summer Gardens and Spring Garden Road.
- Costs for unit development for waterfront property was drawn from real current costs obtained from CBCL.
- Construction costs were drawn from the business case referenced above, and validated against the experience of CBCL.

Terminal and Parking Build – the build costs for the terminal were drawn from real data for the design and build of high-end retail space provided by CBCL.

3.1.3 Assets Purchased and Pre-Operations Costs

- Start-up Costs – include vessel procurement, project management, IT procurement, training, etc.,. The following table represents the pre-service costs used in the model for two 206 passenger vessels. Capital for two 350 passenger vessels is estimated at \$16 M.

Annual Contracts & Costs

Printing, Markets, Promotion	\$ 200,000.00
Operations Management System/Web	\$ 120,000.00
Training Including Salaries	\$ 100,000.00
Engineering and Project Management	\$ 100,000.00
Legal	\$ 100,000.00
Vessel Capital Cost	\$ 11,000,000.00
Parking Construction and Shuttle Procurement	\$ 2,850,000.00
Downtown Shuttle Procurement	\$ 2,500,000.00
Shore Side Terminal	\$ 5,000,000.00
Overpass Access to Phase II	\$ 3,000,000.00

⁸ "Stage One: Conceptual Planning and Cost Analysis Phase II Bedford Waterfront", O'HALLORAN CAMPBELL consultants limited, July 2003

Parking construction was based on \$1,500 per space which includes perimeter fencing and an electronic gate. The model has based the financial calculation on 700 spaces.

Note: Scenarios that do not have parking or shuttles do not include these pre-service costs. Vessel costs vary dependent on the vessel used in the analysis. The 206 passenger vessel is estimated at \$5.5 million and the 350 passenger vessel is estimated at \$8 million.

3.1.4 Cash Flow Summary

The following table represents the ten year profit or loss of each of the scenarios described in section B.5.. Individual cash flow statements are contained in Annex C.

Scenario Descriptions: P+S = Parking with Downtown Shuttle
 PNS = Parking No Shuttle
 FP+S = Fee Parking with Downtown Shuttle
 FPNS = Fee Parking No Shuttle
 NP+S = No Parking with Downtown Shuttle
 NPNS = No Parking No Shuttle

These figures represent \$Millions. Red denotes an increasing debt. All other figures demonstrate some contribution to achieving some return on investment.

206 PAX by Scenario Comparison (2 Ferries)							206 PAX by Scenario Comparison (3 Ferries)					
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS
\$4	-14.7	-18.1	-19.3	-22.1	-20.3	-16.7	-18.8	-23.7	-24.3	-28.4	-26.5	-23.4
\$5	-11.5	-15.6	-17.6	-18.2	-16.4	-14	-25.6	-29.6	-21.6	-22.6	-20.8	-26.6
\$6	-30.8	-39.5	-35.5	-45.1	-44.6	-44.3	-38	-54.4	-50.4	-60	-59.5	-59.2
350 PAX by Scenario (2 Ferries)							350 PAX by Scenario (3 Ferries)					
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS
\$4	-0.5	-2.8	-11.1	-2.6	-1.2	0.7	2.4	-2.1	-8.1	-2.7	0.9	-22.3
\$5	6.9	-0.7	-1	-5.6	-4.4	-32.9	14.7	-0.3	6.8	-28.5	-28.8	-59.8
\$6	-45.6	-61.9	-57.9	-67.5	-65.9	-65.6	-72.4	-88.7	-84.7	-94.3	-92.8	-92.4

Notes:

1. All scenarios with parking also include costs for shuttle to and from parking, fee revenue for fee parking not included
2. All table values include capital for additional buses, Mill Cove Terminal, and Fast Ferries
3. All scenarios include start-up costs which include training, legal, marketing, purchase of operations management SW and Project Management
4. 350 PAX vessels are 4 engine and do not reflect savings in off-peak operations when 2 engine ops would be possible

3.2 Analysis of Results

To simplify the analysis the \$6 fare scenario was eliminated. All options at this price point yielded a loss after a 10 year period.

3.2.1 Travel Time and Distance

The following represents the travel time comparisons at peak (7:30 – 8:30). Note that averages were developed from trial weeks in November and February taken as one week samples:

I - Transit time by vehicle average:

- Bedford Highway from Hammonds Plains to Parking at Purdys Wharf
 - 34 minutes/11.7 km
- Highway 102 from Hammonds Plains to Parking at Purdys Wharf
 - 37 minutes/10.9 km

II - Transit time by Fast Ferry (includes embarkation/disembarkation):

- 206 passenger at 28 knots 30 minutes
- 350 passenger at 35 knots 20 minutes

If the parking option at Highway 102/Hammonds Plains is included with the shuttle to the Ferry Terminal there will be an addition 7 minutes added to the time.

3.2.2 Fuel Cost Comparison

These calculations used 10.2 l/100 km as the city driving figure for calculation, at a fuel price point of \$1.10. In addition, depreciation is added at \$0.20/km⁹ based on a Chevy Malibu.

I – Transit by vehicle

- Bedford Highway route - \$3.65 per trip
- Hammonds Plains route - \$3.40 per trip

II – Transit by ferry

- 206 passenger 28 knots - \$0.29/person/trip
- 350 passenger 35 knots - \$0.23/person/trip

⁹ <http://www.canadiandriver.com/articles/jc/costofowning.htm>

3.2.3 Cost per Round Trip Comparison

These calculations are round trip, and include the cost of parking over a one month period looking at a commuter travelling to work 20 days per month. Ferry fares are based on the mid range of \$5 with a monthly purchase discount of 20% for 20 round trip tickets. Parking rates use an estimated \$145¹⁰.

I – Transit by vehicle

- Bedford Highway route - \$291 per month
- Hammonds Plains route - \$281 per month

II – Transit by Ferry

- \$160.00 per month

¹⁰ [http://www.colliersmn.com/prod/cclod.nsf/publish/BA13702D3147A08A85257051005E2BB1/\\$File/Parking+2005.pdf](http://www.colliersmn.com/prod/cclod.nsf/publish/BA13702D3147A08A85257051005E2BB1/$File/Parking+2005.pdf)

Payback Period in Years – based on the capital investment.

206 PAX by Scenario Comparison (2 Ferries)							206 PAX by Scenario Comparison (3 Ferries)					
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS
\$4	>10	>10	>10	>10	>10	>10	>10	>10	>10	>10	>10	>10
\$5	>10	>10	>10	>10	>10	>10	>10	>10	>10	>10	>10	>10
350 PAX by Scenario (2 Ferries)							350 PAX by Scenario (3 Ferries)					
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS
\$4	>10	>10	>10	>10	>10	9.9	9.4	5.7	8.5	6	6.1	>10
\$5	8.7	>10	>10	>10	>10	>10	7.9	>10	>10	>10	>10	>10

ROI (%)

206 PAX by Scenario Comparison (2 Ferries)							206 PAX by Scenario Comparison (3 Ferries)					
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS
\$4												
\$5												
350 PAX by Scenario (2 Ferries)							350 PAX by Scenario (3 Ferries)					
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS
\$4						3	6.3					
\$5	22.9						38.6		17.8			

Sales Revenue per Employee (\$Millions/employee)

206 PAX by Scenario Comparison (2 Ferries)							206 PAX by Scenario Comparison (3 Ferries)						
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS	
\$4													
\$5													
350 PAX by Scenario (2 Ferries)							350 PAX by Scenario (3 Ferries)						
Fare	P+S	PNS	FP+S	FPNS	NP+S	NPNS	P+S	PNS	FP+S	FPNS	NP+S	NPNS	
\$4						0.41	0.43		0.45				
\$5	0.51						0.48						

3.3 Other Advantages

The following are considered additional considerations in assessing this case, but have not been quantified:

- Job Creation – the Fast Ferry will add jobs to the Nova Scotia economy. Jobs could be categorized as direct long term – for example:
 - the vessel crewing,
 - training and ferry maintenance,
 - direct short term if Nova Scotia ship builders were to build the ferries; and
 - indirect long term services that support the ferry operation.
- Reduction in Number of Cars on the Road – the majority of commuters traveling from this area are single passengers in their vehicles. Reducing the number of vehicles will result in reduced road deterioration and green house gas emissions;
- Tourism – adding to a tourist's impression of interesting things to do in Halifax. Providing improved access for tourists to areas outside of the central urban core; and
- Cost Avoidance – using the Ferry to offset the need to undertake major road changes in the immediate future.

4.0 SENSITIVITY ANALYSIS

The sensitivity analysis looked at possible assumptions that could change and identifies uncertainties that may have a strong impact on projected business case results.

4.1 Sensitivity Analysis

The table below represents the 10 year profit/loss results from the model with adjustments in the variables of fuel costs, personnel costs, market share, tourism interest and vessel construction costs. The model used was the \$4 and \$5 fare rates of the Parking and Shuttle service in the downtown core scenario.

This data demonstrates that the 2 vessel \$4 fare option is less sensitive to these changes, and therefore would pose less risk in proceeding. Of particular note is the impact of rising fuel prices which demonstrates significant shift from the baseline for the 3 vessel option. In the case of this 4 engine ferry the model did not take into account increased running efficiency in non-peak hours where it would run on 2 engines at slower speed. Therefore this result should be considered conservative.

	Fare	\$4	\$4	\$5	\$5
# Ferries		2	3	2	3
Baseline (\$M)		(0.5)	6.9	2.4	14.7
Fuel Doubles in Price / Delta from Baseline		(\$28.3) / 27.8	(\$33.9) / 36.3	(\$20.8) / 27.7	(\$21.6) / 36.3
Personnel Doubles / Delta from Baseline		(\$17.6) / 17.1	(\$23.2) / 25.6	(\$10.2) / 17.1	(\$11) / 25.7
Market Share Halved / Delta from Baseline		(\$10.6) / 10.1	(\$8.7) / 11.1	(\$7.4) / 14.3	(\$2.8) / 17.5
Tourism TakeUp / Delta from Baseline	50%	(\$11) / 10.5	(\$9.4) / 11.8	(\$2.6) / 9.5	(\$5.2) / 9.5
	0%	(\$18.4) / 17.9	(\$17.4) / 19.8	(\$12.1) / 19	(\$4.4) / 19.1
Vessel Construction / Delta from Baseline Overruns	50%	(\$9) / 8.5	(\$10) / 12.4	(\$1.5) / 8.4	(\$2.2) / 12.5
	100%	(\$17.4) / 16.9	(\$22.5) / 24.9	(\$10) / 16.9	(\$10.3) / 25

Note: The green cells denote least amount of change with baseline, and the red denotes the most change.

5.0 WAKE WASH ANALYSIS AND WHALING CITY FAST FERRY TRIAL

The general perception of wake wash is that the faster a boat goes the greater the wash generated. Consequently, many harbours have strict limits on vessel speed, to minimize wash. This perception is derived entirely from conventional displacement craft, where it is almost always true. However, it is not the case for most high speed craft, and particularly not for multi hull vessels, such as catamarans.

For all craft, the impact of wake wash is more noticeable in shallow than in deep water, and the speed that generates an acceptable level of wash may be somewhat less in shallow than in deep water. Shallow water is a subjective factor related to the length of the vessel.

All high speed craft exhibit a feature called “hump speed”, which is the speed at which wash generation is the highest. This speed varies by type of vessel and hull design, typically at about 15-18 knots. Once over the hump speed wash diminishes dramatically. As an example, the wash from a fast ferry traveling at 30knots may be no more than when it is going at 10knots. Low wash designs have been developed for a number of applications, and while these still exhibit a hump speed, the wave energy developed throughout the cycle from rest to cruising speed will be significantly less than for vessels that may not have been so designed.

5.1 Wake Wash Results

A trial was conducted at the end of October to: (1) establish the wake characteristics and impact of Fast Ferry operations in the Halifax harbour; and (2) the opportunity to show case this mode of transportation to the public. The HRM contracted with the Whaling City Express from New Bedford Connecticut. Respected experts in the field of wake wash analysis (Stumbo and Associates from Washington State) were contracted to evaluate the wake characteristics of this particular Fast Ferry. The report was received at the end of November by the US experts brought in specifically to run this specialized trial. The full report is contained at Annex D.

The following were the salient points of the report and the trial:

- with Fast Ferries slow speed does not mean low wake. FF are designed to have lowest wake impact when they plane at high speed. Slowing down does not improve the wake wash situation;
- there is significant need to build cultural awareness that high speed does not create issues of safety or wake (if designed properly). All stakeholders need this awareness – including those who operate, or control, vessels in the harbour;
- FFs are very maneuverable, as demonstrated with the Whaling City Express, that the vessel can stop within 1.5 boat lengths; and
- The Whaling City Express is not a good example of a low wake design – although it did show a low amplitude, the wave itself had a lot of energy. This caused a number of harbour stakeholders to complain through the trial and request slower speeds on passing.

The following pictures give a visual representation of the vessel wake moving from the jetty to through the power spectrum to full power.



The wake wash results for this vessel are probably appropriate for use primarily as a tourist operation between New Bedford and Martha's Vineyard. For a closed harbour with a lot of traffic this standard would not work without jeopardizing schedule to adjust speed for oncoming traffic or other harbour activities (e.g. ship trials, ship painting). The report provides technical guidance on a design standard that would be considered achievable with current vessels in the market. The following technical guidance is provided:

- Maximum Wash Height – 25 cm
- Maximum Wash Energy – 2000 joules/meter



5.2 Safety of Operations in the Harbour

The wake wash trial was cause to initiate dialogue on safety of vessel operations in the harbour. Pilots and other stakeholders, working with DND are looking at vessel scenarios from a safety operations perspective. The intent of these discussions (which are ongoing) was to derive a set of operating guidelines and agreements on vessel tracks within the harbour to ensure the safest transit for all operators.

To obtain a better understanding of this impact DND and the Pilots developed an operational model in the DND Harbour Trainer. The Harbour Trainer is a bridge simulator that provides 270 degree visual representation. The trainer has been modeled to reflect specifically the dynamics of the Port of Halifax which includes variables such as wind, tide and weather (visibility for example). For the purposes of this study a model was developed to demonstrate the potential impact of a large post panamax container ship transiting the narrows at the same time as the Fast Ferry carrying 350 passengers traveling 35 knots. Those attending the meeting (DND, HRM Transportation Staff, Halifax Port Authority and Pilots) were able to experience the issues from both the perspective of the Container Ship Pilot and then the Fast Ferry Captain. The following were the results of the meeting:

- There are no issues of both vessels transiting the narrows at the same, but it was recommended that the Fast Ferry use a track that is as far to Port (when going from Bedford to Halifax) as is safe for the ferry operation;
- DND will be establishing a water side security zone which will reduce the current size of the narrows. This was considered and it was agreed that using a track as far to port in safe water would provide for adequate room for the Ferry to pass a post panamax ship;
- The track for the transit should be laid down and shared with the Pilotage Authority as part of the harbour operations;

- The Fast Ferry did experience some handling issues when passing the stern of the Container Ship; and
- The trainer could be available for training Fast Ferry Captains – both initiation training and ongoing skill retention. The Trainer operational staff are currently attempting to obtain Transport Canada accreditation to certify ships Captains through the trainer.

5.3 Transit Times

In addition, the trial gave the opportunity to visualize the expected transit times. Fully loaded this vessel achieved 28 knots. Average times for transit as follows:

- Bedford Basin alongside to just off the Downtown Halifax Terminal was 18 minutes;
- Bedford Basin to Rockingham (China Town) was 8 minutes, and then to Downtown was 11 minutes;
- Downtown to Shannon Park was 6 minutes, and then to Bedford Basin was 14 minutes;
- Downtown to Eastern Passage was 13 minutes; and
- Purcell's Cove to Downtown 6 minutes and to Bedford Basin 25 minutes.

Note that none of these times included docking. Typically docking – including passenger disembarkation and embarking is 5 to 7 minutes – and no longer than 10 minutes.

5.4 Public Opinion

Exit surveys were given for all those who rode the Whaling City Express (refer Annex E). Results of this survey (98% return) indicated that 95% said that they would take the Ferry. This information needs to be tempered by two key points: (1) 63% of respondents were not in the catchment area; and (2) it was those of keen interest that came out to take advantage of the free ride.

That being said the result is that the public saw this as a positive initiative.

6.0 MOVING TOWARD A GREENER SOLUTION

Transportation generates 25% of Canada's green house gas (GHG) emissions - more than any other sector. Reducing these emissions from transportation is both a major challenge and an important opportunity. Fuel efficiency improvement will be achieved by a combined approach of improved technology and operational practices.

Using the data from the two ferry 350 passenger option there are upwards of 4,000 one way passengers. Given that our data was collected from only individuals who were 18 and there were very few students surveyed there will be a high number drivers who will move from single passenger vehicles to public transit. A conservative estimate would be 70% which would result in the removal of 2,800 vehicles from the roadway leading into the urban core. This represents a significant impact to savings on greenhouse gas emissions. The ratio of savings from cars to ferry is 16:1 based on a straight comparison of fuel consumption.

There is also a need to reduce toxic pollutants through the implementation of MARPOL Annex VI. The Government of Canada is also exploring the possibility of establishing a North American SOx Emission Control Area (SECA) limiting fuel sulphur content to 1.5%

6.1 Industry

The marine industry recognizes its importance within the Canadian economy in supporting importers and exporters, as well as supplying domestic transportation, and hopes to continue to participate in the forecast growth of Canadian trade. The industry is also very conscious of its need to be competitive within the global marketplace. Fuel represents about one third of operating costs and consequently any measures that affect fuel price or consumption can be critical.

There has been some degree of marine industry skepticism about the reported quantities of marine transportation emissions and their impact on the environment.

Industry sees no "silver bullet" that can address emissions issues but recognizes its need to gain a better understanding of the problems and wants to work co-operatively towards a solution. It views prescriptive regulation leading, potentially, to only grudging compliance. More preferable, the industry is looking for an approach to providing incentives for emission reduction in anticipation that this would challenge industry to develop innovative solutions.

Shipping accounts for only 1.8% of global GHG emissions while carrying 90% of the world's trade. In Canada - it accounts for 5.1% of transportation related GHG's. NOx emissions are estimated to be 14% of the global total and within the Great Lakes ships contribute 7% of NOx emissions and add to the PM burden. In the Fraser Valley, ocean going vessels are a primary source of ship pollution.

NOx controls apply to all engines installed in ships built after January 1, 2000 and hull design improvements reduce fuel consumption.

6.2 Marine Engine Combustion

Combustion in marine engines creates a variety of emissions:

- Critical air contaminants (PM, CO, NO_x, SO₂, and VOC) that cause acid rain and smog.
- Greenhouse gases (CO₂, CH₄, and N₂O) that are linked to climate change.
- Toxic substances (PM, NO_x, SO₂, VOC, and others) that have harmful effects on the environment and/or endanger human health.

While not an exact science, an inventory of marine emissions can be prepared by multiplying activity data by an emissions factor.

The 2000 national inventory identifies 33,000 tons of SO_x emissions from large marine vessels. This is forecast to rise to 44,000 tons or 54% of the total by 2030. The proportionate rise is due to major reductions in emissions by heavy trucks due primarily to improved technology. Similarly, NO_x emissions are forecast to remain constant for rail and marine but to reduce substantially for trucking.

An inventory of total transportation GHG's attributes 3.5% of GHG emissions to the domestic marine mode.

6.3 The Swedish Experience

There is a high density of marine traffic in Northern Europe, most of it within 100 miles of shore. In addition, traffic within the Baltic Sea has been increasing in the post Soviet era.

Sweden, due to its geographical position, and the prevailing westerly winds is the recipient of much of the marine emissions generated along the northern European coast and in the North Sea. Consequently, Sweden has been obliged to address the marine emissions issue and started work in the 1990's. Initially, its goal was a 50% reduction from 1992 levels but this was later modified to 30%

Led by the Swedish Maritime Administration, several demonstration projects were initiated. One new ferry achieved a 98% reduction in NO_x due to new engine technology. A work vessel equipped with a catalytic converter and water injection technology achieved significant reduction of NO_x, CO₂, and PM.

6.4 Canadian Marine Regulatory Overview

Air pollution regulations under the Canada Shipping Act introduced in 1964 are virtually unchanged and prohibit, only, the production of black smoke within one mile of land. Current and proposed regulations under the Canada Environmental Protection Act (CEPA) do not address large marine vessel emissions.

Future marine regulation has been developed under IMO MARPOL Annex VI that comes into force on May 19, 2005. It controls for ozone depleting substances, incinerators, engine emissions, and fuel quality. NO_x limits have been established for various engine speeds and a cap of 4.5% sulphur content established for diesel fuel, reduced to 1.5% in the Baltic Sea unless vessels are equipped with exhaust scrubbers.

This 1.5% restriction will be extended to the North Sea and further Sulphur Oxide Emissions Control Areas (SECA) may be established. Studies will be conducted, hopefully in collaboration with the U.S., to determine if the Great Lakes and St. Lawrence Seaway and East and West North American coasts should be similarly designated.

More stringent global standards may be considered in the future to further limit NO_x, fuel sulphur content and standards for marine engines.

6.5 Technology Solutions to Improve Fuel Efficiency and Reduce Emissions

Georgia Basin / Puget Sound and Halifax Dartmouth have been studied to quantify emissions and evaluate options for emission reduction in various vessel types. Ocean going vessels were found to account for 50 – 80% of SO_x, NO_x, and PM.

Options studied included, the costs and benefits of alternative fuels, humid air motor (HAM), continuous water injection (CWI), direct water injection (DWI), Selective Catalytic Reduction (SCR) and scrubbing of exhaust.

The studies concluded that:

- Clean fuel options are the most cost effective for vessels spending only a small amount of sailing time in the study area.
- Merchant and cruise vessels can reduce smog emissions by 40% at a cost of \$2000/tonne (about \$10,000 annually for a merchant vessel).
- Small vessels burn clean fuel and should concentrate on NO_x emission reduction by 90% using SCR at costs under \$10,000/tonne.
- The most effective options for work-boats depend on time spent in the study area.

6.5.1 Water Injection Systems

A NO_x emission study was contracted in November 2003 to research and evaluate a Water Injection System (WIS). A trial conducted on the MV Cabot has shown that cost effective emission reduction is practical for marine retrofits.

Tests showed a decrease in NO_x as the water fuel ratio is increased and further reductions as engine load is increased. However, the PM and CO emission increases under load, particularly with intermediate fuel oil (IFO). WIS has no effect on CO₂ production.

6.5.2 Fuel Borne Catalysts

The Port of Vancouver has focused attention on reducing emissions within the port area on both the water and shore sides and base line data is being collected on both. Emission reduction is being achieved through truck reservation systems, cruise bus and passenger management. Further benefits may result from studies of shore power potential and urban street and rail congestion studies.

One innovative approach is the trial of fuel additives to enhance combustion and reduce local emissions. CombustAll, a fuel borne catalyst was used in trials of a tug boat, reducing fuel consumption by 4.5%, and in larger vessels reducing consumption by 2.5% and NO_x emission reduction by 14.5%.

6.5.3 Air Humidification System

One way to reduce CO₂ emissions is to reduce fuel consumption. One way to achieve this is to reduce the fouling of internal engine components. WIS accomplishes this and also reduces NO_x emissions. However, as the water fuel ratio is increased there is a fuel consumption penalty. Results from tests show:

- Increased fuel efficiency of 5%
- Reduced NO_x up to 30% and smoke up to 20%
- Reduced exhaust gas temperature up to 25 degrees C.
- Minimized thermal stress and carbon build up on engine components.
- Reduced cylinder wear and maintenance costs.

6.6 Biodiesel for Ships

Biodiesel is a clean-burning diesel fuel additive produced from soybean and other vegetable oils instead of petroleum. Biodiesel is marketed for use in marine compression ignition (diesel) engines to enhance engine combustion performance, improve engine lubrication, and reduce air and water pollution caused by the exhaust. Biodiesel blends operate in diesel engines, from light to heavy-duty, just like petroleum diesel fuel. No engine conversions are required at all, unless an engine has old fuel lines.

Biodiesel and a blend of Biodiesel in petroleum diesel are considered alternative fuels. Biodiesel is registered as a fuel additive. Biodiesel and the blend meet clean diesel standards established by the California Air Resources Board (CARB), particularly since the Biodiesel contains no sulfur and no aromatics. Currently there is ongoing work through the American Society for Testing and Materials (ASTM) to develop a provisional ASTM standard for Biodiesel production in the U.S., which will in effect become an adopted standard in Canada.

Petroleum diesel is made up of hundreds of different hydrocarbon chains (roughly in the range of 14-18 carbons in length), with residues of sulfur and crude oil remaining. Diesel fuel sold today, even "low sulfur, low aromatic" diesel, contains 20-24% aromatics (benzene, toluene, xylenes, etc.) which are toxic, volatile compounds responsible for the fire/health hazards and pollution associated with petroleum diesel.

Since Biodiesel is made entirely from vegetable oil, it does not contain any sulfur, aromatic hydrocarbons, metals or crude oil residues. The absence of sulfur means a reduction in the formation of acid rain by sulfate emissions which generate sulfuric acid in our atmosphere. The reduced sulfur in the blend will also decrease the levels of corrosive sulfuric acid accumulating in the engine crankcase oil over time, resulting in cleaner engines and a positive impact on maintenance.

The lack of toxic and carcinogenic aromatics (benzene, toluene and xylene) in Biodiesel means the fuel mixture combustion gases will have reduced impact on human health and the environment. The high cetane rating of Biodiesel (ranges from 49 to 62) is another measure of the additive's ability to improve combustion efficiency.

6.6.1 Lower Hydrocarbon Emissions

As an oxygenated vegetable hydrocarbon, Biodiesel itself burns cleanly, but it also improves the efficiency of combustion in blends with petroleum fuel. As a result of cleaner emissions, there will be reduced air and water pollution from boats operated on Biodiesel blends. At a 20% Biodiesel blend, there will be a noticeable change in the odor and smoke in the exhaust. Older engines should also emit less soot under load and less carbon black during startup.

Independent research programs in Europe and the U.S. have shown that Biodiesel in a 20 percent blend with petroleum diesel created a significant reduction in visible smoke and odor. The studies documented the reduction in hydrocarbons, carbon monoxide and particulate matter. Biodiesel is comprised of vegetable oil methyl esters, that is, they are hydrocarbon chains of the original vegetable oil that have been chemically split off from the naturally occurring "triglycerides". Biodiesel hydrocarbon chains are generally 16 to 20 carbons in length, and they are all oxygenated at one end, making the product an excellent fuel. As discussed below, several chemical properties of the Biodiesel allow it to burn cleanly and actually improve the combustion of petroleum diesel in blends.

In research conducted in the US total Hydrocarbon emissions in the test in 1997 Cummins engines were reduced by 20% with a 20% blend. Using 100% biodiesel the hydrocarbon emissions were reduced by 94%.

6.6.2 Smoke and Soot Reduction

Smoke (particulate material) and soot (unburned fuel and carbon residues) are of increasing concern to urban air quality problems that are causing a wide range of adverse health effects for their citizens, especially in terms of respiratory impairment and related illnesses. Typically boats experience soot accumulation on the transoms and decks.

The lack of heavy petroleum oil residues in the vegetable oil esters that are normally found in diesel fuel means that a boat engine operating with Biodiesel will have less smoke, and less soot produced from unburned fuel. Further, since the Biodiesel contains oxygen, there is an increased efficiency of combustion even for the petroleum fraction of the blend. The improved combustion efficiency lowers particulate material and unburned fuel emissions especially in older engines with direct fuel injection systems.

In the updated 1998 report from the Southwest Research Institute studies, oxygen was shown to be the driving mechanism for soot reduction in truck engines operating on various blends of Biodiesel. The higher the oxygen content of the Biodiesel blend, the greater the reduction in soot emissions. However, not all the particulate emissions is fuel related. In the research conducted to look at the impact of biodiesel about 22% of the particulate emissions was unburned lubrication oil that did not change significantly when the fuels were switched to B-20 or neat Biodiesel. Carbon soot, in contrast, made up over 50% of the particulate emissions and this carbon soot component was reduced by 20% the blended biodiesel.

6.6.3 Carbon Monoxide Emissions

Carbon monoxide gas is a toxic byproduct of all hydrocarbon combustion that is also reduced by increasing the oxygen content of the fuel. More complete oxidation of the fuel results in more complete combustion to carbon dioxide rather than leading to the formation of carbon monoxide. Research conducted on truck engine exhaust emissions showed that the levels of carbon monoxide were reduced from 8% to 22% with a biodiesel blend, depending on the type of engine. When the fuel was switched from low-sulfur petroleum diesel to neat Biodiesel, there was a 28% to 37% drop in the carbon monoxide emissions.

6.6.4 Polyaromatic Hydrocarbon Emissions

Polyaromatic hydrocarbons (PAHs) are a class of heavy oil petroleum hydrocarbons defined by their complex ring structures and unique qualities. They consist of multiple benzene ring structures that make them insoluble, slow to burn and carcinogenic. The research conducted on the Cummins engine demonstrated that the blended biodiesel had a 12% drop in PAH emissions relative to petrodiesel, and a 74% drop in PAHs when the fuel was switched to neat Biodiesel. These data suggest major gains in improving the air quality around diesel engines operating on Biodiesel.

6.6.5 Nitrogen Oxides

The nitrogen oxides result from the oxidation of atmospheric nitrogen at the high temperatures inside the combustion chamber of the engine, rather than resulting from a contaminant present in the fuel. Although nitrogen oxides (NO_x) are considered a major contributor to ozone formation, they are also a reality of operating internal combustion engines. There are consistent reports of slight increases (several percent) in NO_x emissions with Biodiesel blends that are attributable, in part, to the higher oxygen content of the fuel mixture. More oxygen and better combustion of the fuel also means more formation of NO_x emissions with Biodiesel blends.

In several research studies conducted since 1993 in the U.S. and Europe, EPA-regulated emissions from an unmodified engine operating on a 20% Biodiesel/80% petrodiesel blend were shown to be lower than those for petroleum diesel, except for NO_x (nitrogen oxides) emissions, which can be 2-5% above baseline emissions.

Some reductions in NO_x emissions can be attained by retarding the timing of ignition and slowing the burn rate of the fuel in the combustion chamber. Unfortunately, any improvements in NO_x emissions are usually offset by increases in hydrocarbon, particulate material and carbon monoxide emissions caused by the mechanical adjustments to the engine. In Europe, the delays in engine ignition timing have been successfully combined with the use of catalytic converters to achieve similar reductions in both NO_x emissions and hydrocarbon emissions from transit buses.

6.6.6 Biodiesel Helps Reduce Greenhouse Gases

Unlike other "clean fuels" such as compressed natural gas (CNG), Biodiesel and other biofuels are produced from renewable agricultural crops that assimilate carbon dioxide from the atmosphere to become plants and vegetable oil. The carbon dioxide released this year from burning vegetable oil Biodiesels, in effect, will be recaptured next year by crops growing in fields to produce more vegetable oil starting material. Canada, as a signatory of the Kyoto Protocol, is under considerable pressure to take seriously its

efforts to reduce carbon dioxide, carbon monoxide and other greenhouse gases released, in part, by the combustion of fossil fuels in vehicles. While man-made CO₂ production accounts for only about 4-5% of the net CO₂ emissions, it is sufficient to have caused a net gain over the past 100 years. Fossil fuel combustion accounts for 70% of the total man-made CO₂ contribution. Supplementing our dwindling fossil fuel reserves with biomass-based fuels (Biodiesel, for petrodiesel; biomass-based alcohols or hydrogen for gasoline) helps reduce the accumulation of CO₂.

6.6.7 Positive Energy Balance for Solar Energy in Biodiesel

Although it takes fossil energy to produce and transport biofuel, Biodiesel has a very favorable energy balance, especially relative to energy-negative ethanol from corn. Biodiesel production has positive energy balance ratios ranging from 2.5:1 up to 7.4:1 in Europe, depending on oil crop and distance required to transport the raw materials.

6.6.8 Engine Performance

The following performance characteristics have been documented through extensive research in both Europe and the US:

- Improved lubricity reducing wear of moving parts and reducing time to overhaul
- No noticeable drop in engine power, and showed signs of increased power at low RPMs
- Some increase in fuel consumption – figures reported anywhere from 3% to 15%. In some part the higher fuel consumption was related to older engines.
- Accelerates the deterioration of rubber hoses and gaskets, these should be replaced with synthetic materials.
- Biodiesel has solvent characteristics that if spilled on a painted surface will lift the paint.

Engine manufacturers in Europe have a long history of supporting the Biodiesel movement, and those that produce marine engines continue to endorse the alternative fuel use in their equipment. Some manufacturers warranty their marine engines for use with 100% Biodiesel for late models or for older engines retrofitted with newer synthetic hoses and gaskets that proved more resistant to the pure methyl esters over extended periods of time. Some prefer to warranty Biodiesel engines on a case by case basis. In the U.S., diesel engine manufacturers generally stand by their warranties as long as the fuel used in their engines meet the ASTM D-975 standards defining fuel for compression ignition engines. All of the 20% blends of Biodiesel produced in North America meet the ASTM D-975 specifications.

6.7 Material Options for Construction

Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating new markets. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications.

While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites industry. It

is obvious, especially for composites, that the improvement in manufacturing technology alone is not enough to overcome the cost hurdle. It is essential that there be an integrated effort in design, material, process, tooling, quality assurance, manufacturing, and even program management for composites to become competitive with metals.

The composites industry has begun to recognize that the commercial applications of composites promise to offer much larger business opportunities than the aerospace sector due to the sheer size of the transportation industry. Thus the shift of composite applications from aircraft to other commercial uses has become prominent in recent years.

Increasingly enabled by the introduction of newer polymer resin matrix materials and high performance reinforcement fibres of glass, carbon and aramid, the penetration of these advanced materials has witnessed a steady expansion in uses and volume. The increased volume has resulted in an expected reduction in costs. High performance FRP can now be found in such diverse applications as composite armouring designed to resist explosive impacts, fuel cylinders for natural gas vehicles, windmill blades, industrial drive shafts, support beams of highway bridges and even paper making rollers. For certain applications, the use of composites rather than metals has in fact resulted in savings of both cost and weight. Some examples are cascades for engines, curved fairing and fillets, replacements for welded metallic parts, cylinders, tubes, ducts, blade containment bands etc.

Further, the need of composite for lighter construction materials and more seismic resistant structures has placed high emphasis on the use of new and advanced materials that not only decreases dead weight but also absorbs the shock and vibration through tailored microstructures. Composites are now extensively being used for rehabilitation/ strengthening of pre-existing structures that have to be retrofitted to make them seismic resistant, or to repair damage caused by seismic activity.

An examination of the diversity of some of these newer applications and the socio-commercial considerations that underpin their introduction gives an instructive insight into the future of high performance FRP.

Unlike conventional materials (e.g., steel), the properties of the composite material can be designed considering the structural aspects. The design of a structural component using composites involves both material and structural design. Composite properties (e.g. stiffness, thermal expansion etc.) can be varied continuously over a broad range of values under the control of the designer. Careful selection of reinforcement type enables finished product characteristics to be tailored to almost any specific engineering requirement.

Whilst the use of composites will be a clear choice in many instances, material selection in others will depend on factors such as working lifetime requirements, number of items to be produced (run length), complexity of product shape, possible savings in assembly costs and on the experience & skills of the designer in tapping the optimum potential of composites. In some instances, best results may be achieved through the use of composites in conjunction with traditional materials.

6.7.1 Why Composites?

Composites are able to meet diverse design requirements with significant weight savings as well as high strength-to-weight ratio as compared to conventional materials. Some advantages of composite materials over conventional ones are mentioned below :

- Tensile strength of composites is four to six times greater than that of steel or aluminium;
- Improved torsional stiffness and impact properties;
- **Higher fatigue endurance limit** (up to 60% of the ultimate tensile strength);
- 30-45% lighter than aluminium structures designed to the same functional requirements;
- Lower **embedded energy** compared to other structural materials like steel, aluminium etc.;
- Composites are **less noisy** while in operation and provide **lower vibration transmission** than metals;
- Composites are **more versatile** than metals and can be tailored to meet performance needs and complex design requirements;
- **Long life** offers excellent fatigue, impact, environmental resistance and reduced maintenance;
- Composites enjoy **reduced life cycle cost** compared to metals;
- Composites exhibit excellent **corrosion resistance** and **fire retardancy**;
- **Improved appearance** with smooth surfaces and readily incorporable integral decorative melamine are other characteristics of composites; and
- Composite parts can eliminate joints/fasteners, providing part simplification and integrated design compared to conventional metallic parts.

The resulting impact to Fast Ferry production would be a lighter and stronger vessel. Recent research has used these advanced materials in ballistics, demonstrating tremendous low weight solutions to armour plating. Recognizing that the Fast Ferries will not be subjected to war zone conditions, these technological advances of ceramic based materials would add strength to the materials at water lines – giving added protection where ice could be a problem.

Another important design characteristic is that the advanced composites are composed of two layer of the material (skin) adhered to a foam core. These panels provide not only tremendous strength but also good insulating properties – reducing inboard condensation and simplifying some of the design challenges. As well, there is no need for frames or longitudinal (traditional required strength elements in ship design) resulting in true unobstructed internal spaces.

Using these advanced materials results in upwards of 25% savings in weight. This provides the following advantages:

- The ability to select engines with lower power ratings to result in the same performance – e.g. speed;
- Smaller engines will costs less –the engines themselves are a major cost item in the ship typically 11-13% of the cost of the vessel; and
- The smaller engine will consume less fuel, saving on operating costs and reducing green gas emissions.

Simply by reducing the fuel consumption by 10% due to weight savings and using smaller engines will result in the following changes to the operational model:

	Aluminum	Adv Composite
Total Profit over 10y	\$6.9	\$9.7
Time to Payback	8.6 y	8.2 y
Return on Investment	23%	32%

Other cost savings are in the through life maintenance of the vessel. Advanced composites do not corrode, and there is less impact on machinery due to reduced vibration from the hull. The business case of the through life gains is a positive offset to slightly higher costs of production and time to build. There is evidence that the time to build can compete with aluminium and steel production, however when there aren't large numbers in a production run there is no substantial evidence that this is true. Typically production time for a vessel that would take 9 months in aluminium would require 12-14 months in advanced composite.

As with other materials in ship building, classifying bodies (Lloyds, DNV and ABS) all have procedures and quality standards for the production of ships using advanced composite materials.

6.8 Operational Practices to Improve Efficiency and Reduce Emissions

6.8.1 Engine Design

Man B&W Diesel produces the largest engines in the world. Successive designs have reduced fuel consumption but there are few further opportunities to do so.

Emission control options include improved fuel valves, SCR and water emulsion. 10% water can reduce NOx by 10%, while greater reduction is possible but with a fuel penalty. SCR can reduce PM by 60 – 90% and SOx by 90%.

Fuel injection and selective engine firing can be used to control emissions more effectively when in environmentally sensitive areas.

6.8.2 Best Practices at Teekay Shipping

Teekay Shipping is the largest crude oil tanker company in the world transporting 10% of the world's sea-borne crude. Fuel is 33% of all costs and there is a corporate goal of 7% fuel savings annually. 9

The fuel saving goal is allocated among engine efficiency (2%), vessel reporting performance (2%), voyage optimization (1.5%), and automated on board data collection (1.5%).

Engine efficiency is assessed and adjustment made using diesel performance analyzers. Performance reporting improves execution of maintenance and scheduling. Data is collected regularly on engine,

voyage, and vessel performance and analyzed. Best practices are shared and performance issues and deviations flagged for follow up.

Teekay Shipping demonstrates a very comprehensive methodology for developing and executing corporate goals for fuel savings by taking a holistic approach in working with suppliers, partners and staff. Every action and activity affecting fuel consumption is carefully monitored and timely feedback provided to everyone influencing fuel cost and consumption.

6.9 Moving Towards Sustainability

Industry recognizes that Canada is 650,000 tons behind in its Kyoto commitment and that credits will cost \$10/tonne. Additionally, the marine industry contributes to NOx and SOx emissions.

Regulation of sulphur emissions for cars and trucks has been achieved, primarily through regulating fuel quality. However, the marine industry is essentially a recycler of residual fuel and achieving similar emission reduction in the marine mode presents challenges for vessel technology and vessel operations, as well as fuel suppliers. Planning our approach to these challenges must also recognize the marine industry's important role as a contributor to GDP. The solutions may be found among better fuel, improved technology, and possibly alternative energy sources.

In approaching these issues the marine industry believes it needs to improve its information and understanding, as well as to develop abilities to monitor and measure progress. Better understanding of fuel supply issues and mechanisms to evaluate the merits of the various technological and operational approaches to emission control is crucial.

7.0 THE MILL COVE TERMINAL

The final report "Stage One: Conceptual Planning and Cost Analysis Phase II Bedford Waterfront"¹¹ provides two options for the creation of land for Phase II of the development of the Bedford Waterfront:

- **Option 1**- land fill using material provided "free" from other construction and development sites; and
- **Option 2** - land fill using material that, after January 2003 is paid for.

The main differences between the two options are:

- **Cost**¹² - Land creation in Option 1 shows net revenue of \$10.5 million because acidic slate is accepted for fill at a tipping fee of \$15/yd.³. Whereas Option 2 has a net cost of \$9.0 million, a difference of \$19.5 million.
- **Timing** - Land creation in Option 1 would take about 10 years longer than Option 2.

Under both options the conceptual plan recommends infilling in three stages, first along the shore line and then two additional stages extending into the basin. This process will extend the timeline to build-out because the second and third infill stages will require transit through previously filled and compacted areas. We recommend a pattern of land filling that will see land created in developable sections. That is, to infill based on radial segments versus segments adding on to the first stage shoreline infill.

The cost of land creation Option 2 to the HRM is obvious. However, there are benefits to the option that can help outweigh the incremental costs. These benefits include earlier development and therefore earlier:

- earning of property taxes by the HRM;
- influence of the HRM over adjacent land use to better suit the HRM master plan; and
- support for the fast ferry due to the population growth adjacent to the terminal.

7.1 Fast Ferry Terminal Development

At peak travel times, about 1,050 passengers would pass outbound through the Bedford Terminal per hour. Therefore, the ferry service, during weekdays would serve about 50% of the potential total trip demand, which is the equivalent of a service population of about 7,850 individuals.

The Bedford fast ferry terminal would be constructed as a mixed use facility. Obviously, the majority of the facility would be a dedicated to the movement of passengers of the fast ferry. Based on peak passenger flows and a construction cost of about \$2,150/m.² (\$200/ft.² – 300/ft.²) the ferry terminal proper would cost \$1,400,000 - \$2,100,00 for a 7,000 sq foot building.

¹¹ O'HALLORAN CAMPBELL consultants limited, July 2003.

¹² Costs do not include HST, administration, engineering inspection and construction of the silt curtain.

7.1.1 Retail, Service and Commercial Service Space at the Terminal

The terminal facility will also include retail and service establishments that would appeal to the needs of the commuter population. These services would include personal services such as a dry-cleaning and the day care establishments, coffee and snack shops, newspaper and book stands, and so on. The daily commuter will use retail and service establishments at the terminal primarily during their commutes. Granted, retail and service establishments offering unique products could draw customers from the general population but given the distance from the bulk of the population and the number of available intervening opportunities the product or service offered would need to have a long and powerful reach.

Notwithstanding, some types of retail and services could serve an effective population of almost 7,850. These would include retail and service types that customers use regularly and use them in combination with other trips, such as dry cleaners, day cares, magazine and newspaper stands/convenience stores, coffee and light meal establishments, gift/novelty/souvenir outlets, and so on. The mix might also include a service station with service bays.

The customer base for these establishments would be expanded by:

- tourist and leisure travel on the ferry¹³;
- traffic not using the ferry, such as people that would make a special trip to the terminal service area for day care services or car maintenance;
- growth in ferry traffic as commuters adapt their travel schedules to times when ferry seats are available; and
- growth in service levels as the population in the primary and secondary market areas grow.

Based on the data and assessment outlined above we make provision for three to five retail establishments at the terminal at start-up. The number would grow as traffic builds beyond the level projected for 2006. Based on four establishments the total retail, service and commercial space would amount to 4,600 ft.². Construction and fit-out costs (at \$120/ ft.²) would amount to about \$552,000.

7.2 Residential Development at Phase II of the Bedford Waterfront Development

Based on current land use bylaws residential development on the land created during Phase II of the Bedford Waterfront Development would be restricted to eight floors and 35 units per net acre. However, the Municipal Planning Strategy suggests that higher densities, in the order of 50 units per net acre could be possible. Therefore, from 1,295 to 1,850 units, most likely condominium units could be built on the land created for Phase II of the Bedford Waterfront Development. The selling price of each unit can reasonably be assumed at about \$250,000 to \$300,000. Property taxes on the condominiums and land would therefore range from about \$5.0 million to \$8.4 million.

¹³ The operating scenarios outlined in this report assume that tourist and leisure travel by HRM residents will account for about 11,000 trips per week at a \$5 price point from late spring until early fall.

7.2.1 Costs and Benefits of Option 2 for Land Creation at the Bedford Waterfront

- **Costs** - The major cost of Option 2 is the combination of foregone income from tipping fees for fill received and the payment for fill, which would be about \$29.5 million.
- **Benefits** - There are three main benefits.

- The *first* is the advancement of the receipt of property taxes from development at Phase II of the Bedford Waterfront. Paying for fill to create land advances site development by about 10 years. Therefore, we can also assume that the property taxes generated by residential development on the site would also be advanced 10 years.

It is safe to assume that if development on the Phase II site is delayed 10 years condominiums would be built elsewhere in the Bedford area. However, it is unlikely that other sites in the Bedford area would offer the quality of location that the Phase II site will offer. Hence, we assume that, on average, condominiums at the Phase II site would sell for a premium of about 15% to 20%. Therefore, the net annual value of earlier property taxes would be about \$0.9 million to \$1.5 million. The present value of the 10 years stream of the earlier tax receipts would be about \$9.5 million.

- The *second major benefit* is the earlier influence that the HRM will have over land development at the terminal site and on lands adjacent to the Phase II of the Bedford Waterfront. The HRM will have this influence because it will be a major land holder in the area and hence has influence, via bylaw, market force (i.e., the type of development its land is home to will influence the investment decisions of adjacent land owners) and moral suasion.
- The *third benefit* is the fact that the earlier development of the Phase II lands will help secure the future of the fast ferry because it will be home to a potential market that due to the proximity of the fast ferry terminal would be more likely than others to use the fast ferry. It will also accelerate the creation of the overpass, providing access to the terminal from a secondary route. The second access would enable traffic to flow in and out of the terminal onto the Bedford highway in a contrary to traffic flow at peak times. Shuttle service to the parking lot on Hammonds Plains will be over the overpass going north and then turning left onto Hammonds Plains. The reverse direction will be appropriate in the afternoon, exiting the terminal site across Convoy Run overpass turning south onto the Bedford Highway and right onto Hammonds Plains Road.

In addition, by helping secure the future of the fast ferry for commuters, the advanced development of the Phase II land would help expand the tourism infrastructure of the HRM sooner.

7.3 Creating a Destination – Encouraging Reverse Flow of Fast Ferry Riders

Disney World was built in an uninhabitable area of Florida 40 years ago. It has since generated billions of dollars in tourism and continues to see the region building upon the destination. It is not suggested that the Bedford Waterfront Phase II project be considered the next Disney World, but it is important to understand that it will take vision and planning to develop this land if there is any desire to establish it as more than a residential complex.

From the Fast Ferry perspective creating a destination will add revenue for return ferries in peak times. At the present time there is little reason for travelers to go in reverse flow to the peak commute leaving Mill Cove in the morning and returning in the evening.

During management interviews, and during the focus groups, individuals were asked what they would like to see developed in that area. Input included such things as museums, art galleries, theatre and sports facilities. What didn't seem to emerge in the dialogue was the importance of developing something different or unique – a vision for the future. The ideas that were generated would have more to do with attracting people from Bedford to this area than encouraging Haligonians to venture in the Bedford direction.

Discussions with the development community were much more enlightening. They very much identified this as having the potential to develop a theme with the land, to create something very different and unique to draw people to the Phase II Development such as architecture, shops and complimentary activities.

One idea was to develop this land as a mosaic of contemporary architecture and design, and couple that with a museum of Atlantic Canadian contemporary architecture. People would not only be drawn to the museum but also the concentration of innovative design. This land would not have a "signature" building but the land itself and all of its contents would be considered "signature". With this approach unique shopping and dining experiences would go hand-in-hand. The land might be serviced by innovative transportation and incorporate water and park features that are fully integrated into the buildings.

Any use of the Fast Ferry in contrary direction will result in an improved revenue position.

7.4 A Concept for Efficient Movement of People¹⁴

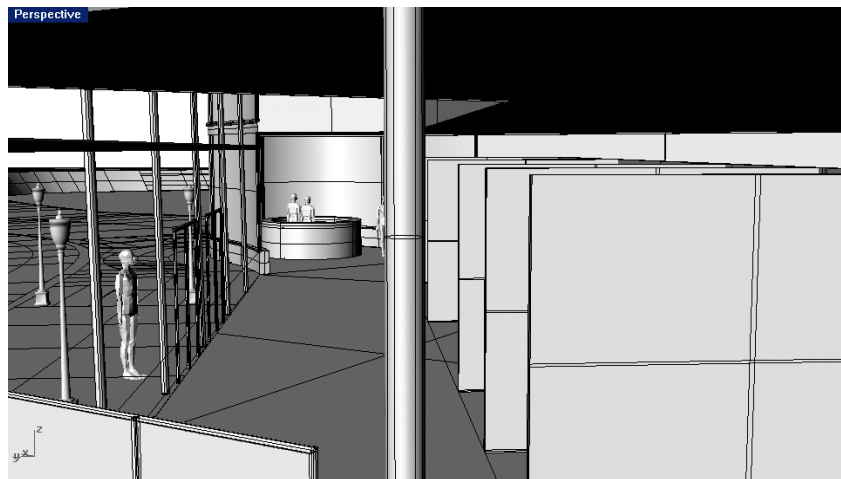
The Terminal at Mill Cove will open up a number of opportunities as follows:

- Establish the development imprint of creating something unique, and itself initiate the tempo and the concept;
- Engage the commuter as a value added part component of the commute offering services that reflect the needs of the commuter – Child Care, appropriate retail (coffee, dry cleaning, convenience store), and Health Club; and
- Create a destination in itself through tourism services, ticket outlet for HRM venues and a restaurant.

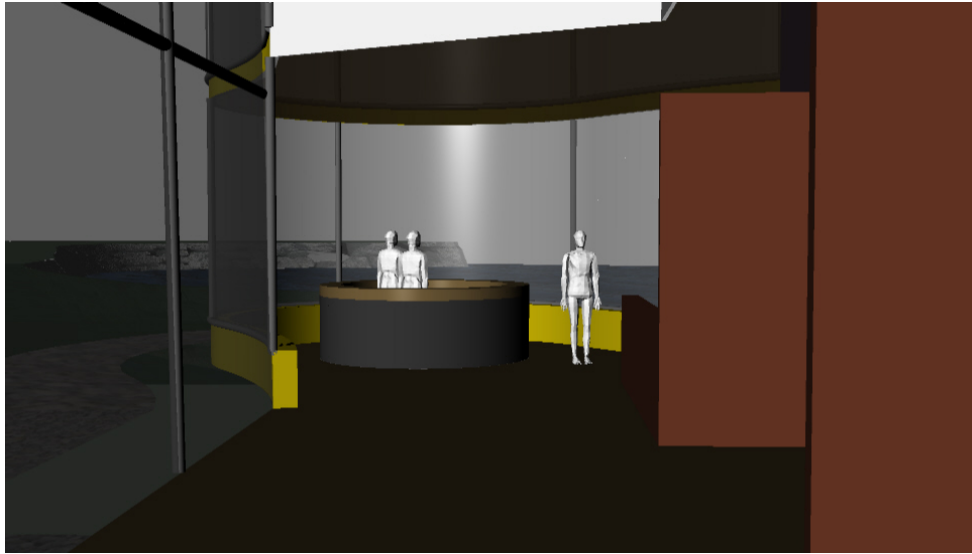
¹⁴ Note: the Drawings that accompany this section of the report are 3D Rhino drawings.



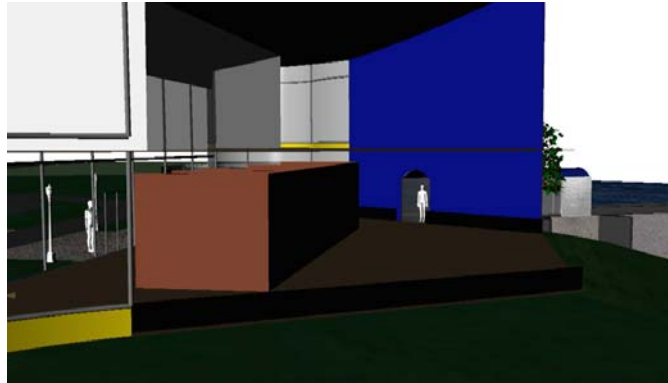
The picture above represents one such model, developed to respond to the needs of commuters. The model is based on current airport terminal design. Entry into the terminal the commuter is immediately faced with retail options at ground floor level. This building has incorporated sufficient space for four retail operations. In addition, the terminal must be designed to optimize the movement of people while ensuring the safe and secure passage of the commuter.



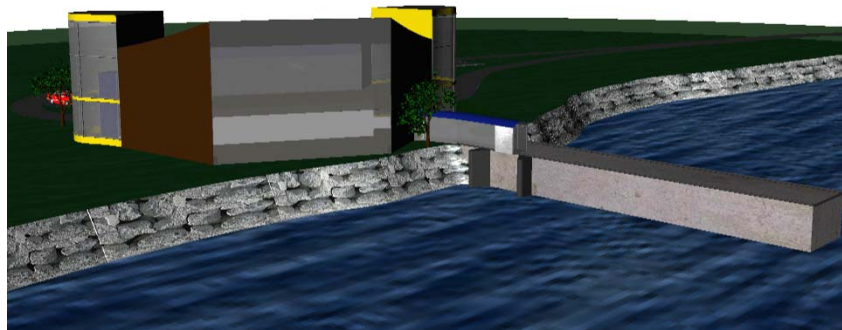
Turning to the left the commuter is provided with access to the ticket and tourism kiosk as well as the ticket control point. All fares would have electronic access through a ticket collection gate.



The seating area of this building provides for adequate space for 400 passengers, which would allow for seating all passengers awaiting the next ferry. The space was using airport seating dimensions – 20 inches width and length – 18 inches in height.



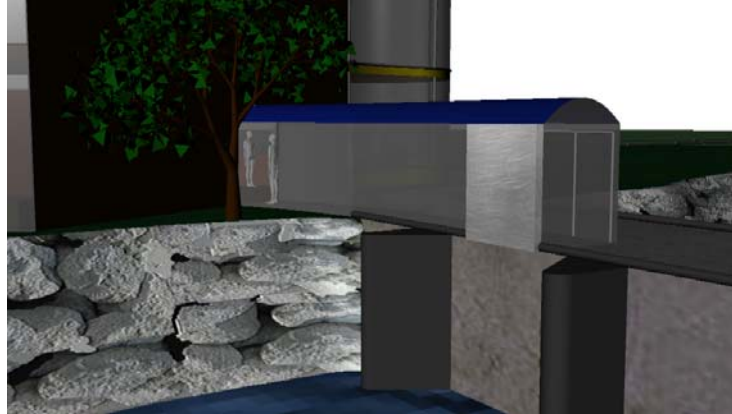
This picture shows a wall cut away, and the back portions of the retail operations which forms the waiting area wall. The opposite side is a full window looking out at the water and the arrival of the ferry. The ferry access tunnel is visible in this shot providing covered access to the ferry ramp.



The ferry access tunnel was developed around a model that was 10 feet wide – allowing for three commuters abreast to move through the tunnel in comfort. The height of the tunnel was based on 8 feet. The tunnel itself is 25 feet long, and can hold 25 people comfortably. Given the average walking pace of an individual of 3 mph¹⁵ (or 264 ft/min) it would take 0.095 minutes to discharge 25 commuters. Given that there are 350 at peak this would result in a time to discharge of 1.33 minutes assuming a steady flow through the tunnel.

To alleviate issues of interference of boarding and discharge passengers the suggested design is that the tunnel have a door that allows discharging passengers exit to the jetty.

¹⁵ <http://www.bellaonline.com/articles/art20257.asp>



The ferry proposed in this case is a front end loading ferry. The black bumpers on the jetty enable the ferry to be easily funneled into position for the drop ramp to be lowered onto the bow of the vessel. Turning to the right upon entering the terminal individuals will have access (by stairs or elevator) to the second floor service area. This area could include a health club, restaurant and child care facility.



The challenges of course are how to develop a space that both provides these services, while at the same time allows for the safe, secure and efficient flow of commuters. The flow of commuters is an essential element in satisfying their needs. This carries on equally to the Terminal access.

The requirements that must be considered are:

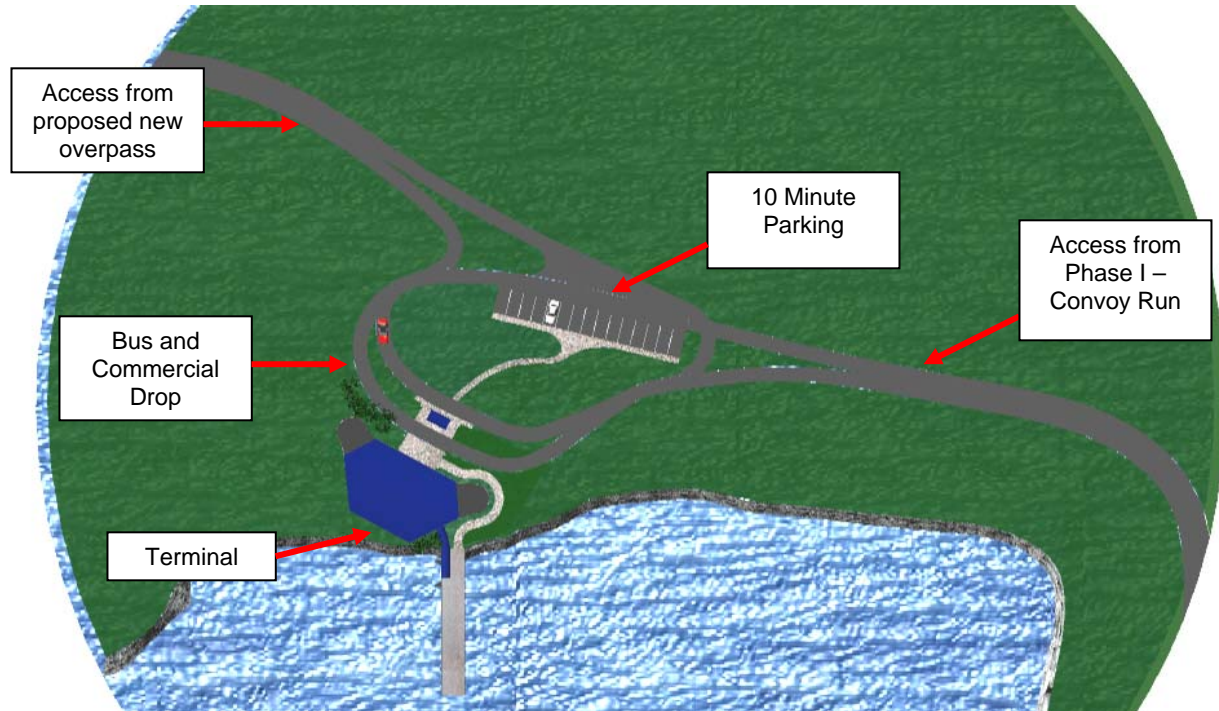
- Rapid discharge and boarding of shuttle bus services;
- Other vehicle drop-off and pick-up;
- Commuter wait facilities for those waiting for drop-off and pick-up; and
- Vehicle short-term parking facility for those waiting to pick-up.



This picture, and the one below, depict a frontal view of the terminal with these services in view:



A plan view is provided to show the terminal position, in relation to the jetty and the proposed road system for access. This road system includes the proposed overpass access to Phase II, which is portrayed on the plan view by the roadway coming into the left of the drawing. Vehicle traffic around the terminal area will be oneway.



7.5 Conclusion Regarding Benefits and Costs of Advancing the Development of Land at Phase II of the Bedford Waterfront Development

Advancement of property taxes would lower the immediate cash cost to land creation to about \$20.0 million. The remaining cost increase over Option 1 for land creation at Phase II of the Bedford Waterfront development could largely be made up for by benefits associated with:

- HRM's earlier influence over adjacent land development;
- Improved prospects for the longer term feasibility of the fast ferry, which in turn
- Brings an earlier and more certain improvement to the tourism infrastructure of the HRM.

8.0 TERMINAL AND DOCKING MODIFICATIONS

The terminal and docking requirements are an important consideration in the overall capital costs of this project. Major changes to existing infrastructure could require significant start-up capital. The project team, along with a Fast Ferry expert from BMT Nigel Gee, reviewed the current terminal and jetty configurations to assess adaptability and estimate cost.

8.1 The Main Downtown Terminal

The main downtown terminal currently provides ticket sales services, a Tim Hortons concession and HRM office space. The terminal supports both the Dartmouth and the Woodside routes. Tickets are collected and the travelers enter a large waiting area for the arrival and boarding of the ferry.

Given that at peak loads the current terminal is currently capable of supporting in excess of 400 passengers traveling to both Dartmouth and Woodside the floor space would be adequate to house one 350 passenger Fast Ferry. It is questionable however that the wait by all passengers in the terminal at peak times for all three ferries could be accommodated.

8.2 Loading and Unloading Ferry

It was determined that the current floating boarding platform would not be appropriate for Fast Ferry operations for three reasons:

- The relatively high freeboard of the Fast Ferry would require a very sophisticated gangway system;
- Increased traffic and competition for the space during peak operating times; and
- More complex along side maneuvering, resulting in time delays.

For these reasons the two jetty positions to either side of the terminal were looked at for viability.

It was decided, that based on all the jetty configurations of existing proposed sites, that the Fast Ferries should be front end loading design. This provides for two advantages as follows:

- Ease of docking – the Captain drives into a “V” shaped slot and the shore based gangway is lowered to the deck front; and
- Speed of loading/off loading process – using a wide front door enables off loading passengers to disembark quickly.

The picture below shows a Fast Ferry front end loader servicing New York for the New York Fast Ferry:



Given this approach both sides of the terminal are quite able to bow loading. What differentiates the two positions however, to favour the left side of the terminal over the right are:

- The right side of the terminal would require the Fast Ferry to cross the paths of the Dartmouth and Woodside Ferries which could jeopardize the schedule of any of the three, and create an additional safety issue; and
- The left side would enable a simple tie-in to the existing passenger loading design and ramp system.



Tie-in to existing
passenger load
off-load system

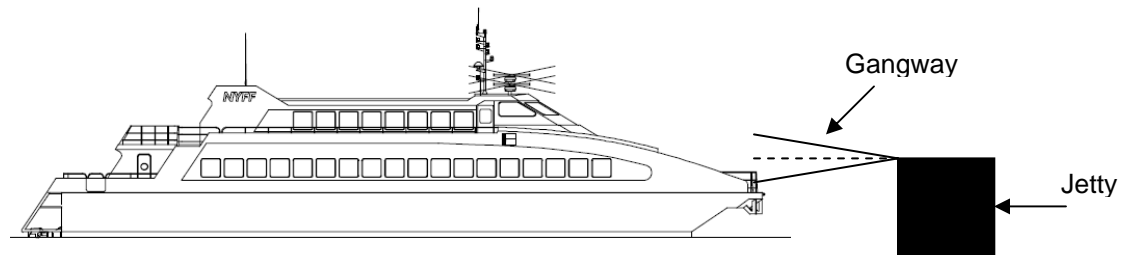


The pictures below represent a typical front end load ramp, and "V" berth.



This approach is a low cost solution, requiring simple changes to the jetty face and the construction of a retractable gangway. Detailed estimate were not obtained, but high level cost consideration without major structural re-enforcement, is estimated at \$75K to \$100K per jetty.

Tide deviations, with jetty height and vessel freeboard, would realize reasonable ramp angles. At tide midpoint the gangways ramp downtown would be close to true horizontal. This is based on freeboard height of a typical 350 passenger vessel. Tidal change at its peak is about 1.6 metres, or 5 ft 3 inches – resulting in the ramp pivoting 2 feet 6 inches past the horizontal.



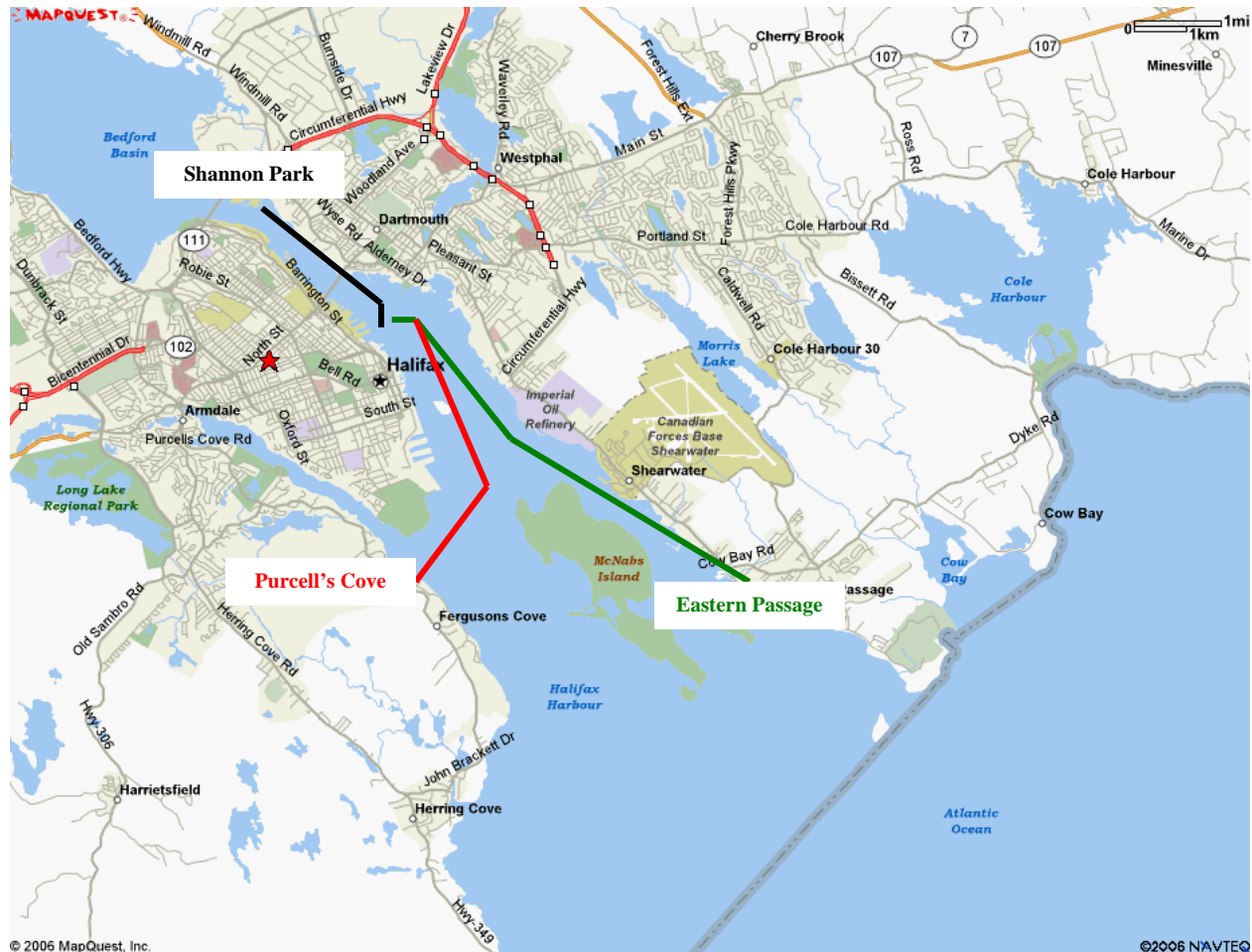
8.3 Other Potential Terminals

There has been considerable interest in the Fast Ferry project, and certainly a number of individuals through the process have been asked about future opportunities for runs to Eastern Passage and Purcell's Cove. The table below represents potential time savings from various locations. All route timings were taken at peak commute times, and were logged into Purdy's Wharf:

	Car	Ferry
Shannon Park	20 min	6 min
Purcell's Cove	32 min	13 min
Eastern Passage – Fisherman's Cove	37 min	13 min

These results demonstrate tremendous savings in time and gas, and eliminate the bridge and rotary traffic.

It must be noted that the comments below are not supported by market analysis. Any move toward establishing new locations for terminals should be preceded by a market analysis.



Shannon Park: Good access to the Burnside industrial park, and would be a viable option for those using the A. Murray MacKay bridge. This option is of interest to the development of the Commonwealth Games bid and should the games be granted to HRM will become a destination. Existing infrastructure, which represents a jetty, is not adequate to use and will require significant investment to support operations. This has the potential to provide good two-way traffic – if there are good public transportation connections into the industrial park.

Purcell's Cove: Primary interest is driven from the frustration of growing traffic issues along Purcell's Cove road and the Armdale Rotary. There is no existing infrastructure and access to the HRM land holding in the cove will be difficult. This site would only be appropriate for "kiss and ride" options unless land holdings close to the site could be made available for parking. As well, growth in this area although steady is not expected at the same rate as other area such as the Bedford area. Another weakness regarding this area is that once the ferry passes George's Island outbound it is subjected to swell requiring the vessel to have ride control. Although this time will be minimal "ride" is a significant consideration for the commuter.

Eastern Passage: This area was to have been serviced by the Woodside Ferry. Market data was not available regarding those from this area who use the Ferry, but given the lack luster performance of this run

Market penetration into Eastern Passage and beyond is not good. Fisherman's Cove is already a destination, with adequate jetty space to support Fast Ferry operations. Minimal changes would support the Fast Ferry using this as a terminal. This has good potential to have two-way traffic, particularly in the summer months, marketing the Fisherman's Cove destination with tourists and Haligonians.

8.4 Other Stops to be Considered

The Dockyard: The market analysis indicated three primary employers in the HRM – the Hospitals, Universities and the Department of National Defence. The Hospitals and the University market has been addressed with the addition of shuttle services from the terminal direct to those locations. There is another opportunity to attract DND personnel if a stop was identified during some of the peak runs. It is expected that this would be considered attractive to this population. The estimated delay in a run would be approximately 10 minutes. The required infrastructure exists and would require minimal capital. One issue is the new perimeter security system on the waterside of the harbour. This would require policy and planning consideration which may not be trivial to develop.

China Town: China Town represents the most southerly section of the Market Segment that was surveyed. This site would provide easier access to the Fast Ferry considering those in this area would have to back-track to Mill Cove to use the service. There are parking facilities and the owners (United Gulf) indicated that they would be interested in having the Fast Ferry stop at this location, and use the parking facility that exists there. The Jetty that exists is adequate to meet the needs of a Fast Ferry stop. In this case stopping to pick-up after Mill Cove would not be recommended as a scheduled stop that is full leaving Mill Cove would not be able to pick up additional passengers. It is suggested that if this is of interest it is recommended that there are Fast Ferry runs that start from this location. Schedule frequency has not been determined. The run to China Town is 11 minutes.

9.0 FARES AND OTHER REVENUE GENERATING STRATEGIES

9.1 Eliminating the Peak for Increased Revenue

The model did not look at anything but a flat fare structure, in keeping with the current Metro Transit approach. Therefore the limitations were on cash fares and discounts for monthly passes and age. There is a need to look at fare strategies however to try and flatten out the ridership and encourage potential riders to take the Fast Ferry in the reverse direction.

Currently there are a number of riders without seats during peak operating times. Providing more Ferries, or increasing the number of seats, will address this issue – however, at what cost? At a fare price of \$4 upwards of 400 riders will not have a seat in a given day. Peak has been defined as 6:30 to 9:00. It may be possible to either charge these individuals a premium to try and encourage them to take ferries before 6:30 or after 9:00. About 550 seats will go unused out of peak operating times in the direction of interest (e.g. toward Halifax in the morning and toward Mill Cove in the afternoon). Pricing strategies could be effective in attracting some of those 400 who do not have access to a seat. If 25% successful this would translate into \$500 additional revenue in a given day – or \$182K over the year.

Pricing strategies have been effectively used in the New York and San Francisco case studies.

9.2 Introducing an Executive Service

Given that Bedford is recognized for having a concentration of high income earners, there may be interest in partitioning some of the vessel for premium seating which would offer additional services such as:

- Guaranteed seating;
- Newspapers; and
- Coffee.

This premium seating would include increased fare pricing. For Premium Seating at a monthly fare price of \$192 per monthly pass and a one way cash fare of \$6 the Parking and Shuttle scenario with a normal \$4 cash fare would realize an increase in revenue from (\$ 0.5) M to \$ 4.7 M over 10 years.

9.3 Creating Packages in Partnership with Venues in Halifax

Each of the case studies identified event driven runs as part of their revenue generating strategy. These included primarily sporting and entertainment events – but did from time-to-time partner with major city initiative such as “Run for the Cure”.

Individuals representing the Metro Centre, the Symphony and Neptune Theatre were approached to gauge interest in establishing packages using the Fast Ferry. The following are the salient and common points of the discussion:

- The market share in Bedford is weak. These venues are having difficulty attracting people back into the city for any reason. Having access to a Fast Ferry package (ticket and transportation) could be what might be key at attracting more of this attractive market;
- Making sure connectivity was developed (especially for symphony goers) will be key to success because of the age demographic and the distance from the ferry to the attraction;
- Planning schedule, or schedule changed, to suit the event;
- Work jointly on the marketing, possibly sell tickets from HRM ticket locations; and
- Develop the attraction start at the terminal and on the ferry – thereby extending the event for the patron and giving them extra value. As well, this approach would provide additional marketing to those riding the Ferry but not attending the event. An example of this is to have someone aboard giving a description of the concert they are about to hear – or a musician providing onboard entertainment.

The selling features of these opportunities is to simplify going back into the city for those who are returning – eliminating the issues of downtown parking and the travel time. These initiatives would not only provide additional market share to improve success of the venue, but it would also drive up ridership numbers of non-peak operating times. These increased revenues were included in the calculations and were identified as “others” in the model who travel in off-peak times.

9.4 Tourism

There is a lucrative tourism market in the HRM, situated around the harbour as an attraction. A number of operators provide harbour tours, and dinner excursions from the Halifax waterfront. In the case of Seastreak in New York, they have augmented their operations with sunset, dinner and beach cruises. In addition, they hire their vessels out for corporate functions. This provides a tremendous offset in the cost of the operation for private operators, providing them solid revenue to compensate for any losses they may have incurred.

In Halifax, public transport being used in this manner would not be regarded well by the current tour operators. The HRM should not be seen to be competing with the private sector. However, should there be clear availability of Fast Ferries during non-peak operating times it is highly recommended that the vessels be contracted out for in-harbour tours. Out of the harbour tours is very weather dependent, and will be difficult to coordinate. Ferries leaving the confines of the harbour (e.g. past George’s Island) must be fitted with active ride control. Active ride control adds another \$300K to the cost of the vessel.

10.0 CONTRACTING AND FINANCE OPTIONS

A number of options exist to move this project forward.

10.1 Contracting Perspective

- The current HRM position is to contract out the design, and own it. Then go to tender with the specific HRM design, for a builder. The strengths of this approach is that the HRM pays for a design and then holds it as the owner. Accepting a design and performance is difficult if the customer (in this case HRM) does not have any in-house expertise to accept and manage the design. When the HRM then goes to the build portion of the project they have just inserted themselves into conflict between the designer and the builder should something go wrong. It should also be noted as a weakness that there are some designers who will not shift ownership of a design over to a customer, thereby limiting some very good design possibilities.
- A modification of this approach to provide for some third party classification system such as Lloyds Survey to oversee the construction of the vessel. In addition to this the HRM would have to insist that any successful bidder to build would be required to have an independent design review conducted. This approach would remove the HRM from any potential issues, and draw on the classification body to resolve any issues. Designs in this case would have to reflect the rules of the classification body. The weakness here is that the cost per vessel will go up the amount of which is very dependent on the classification body.
- Contract out design and build, stating clearly what the performance criteria of the vessels has to be. This scenario would require ongoing involvement of the designer with the shipyard through the build removing the HRM from any conflict. The weakness here is that there is no “off ramp” for the project based on a design build approach between the design and the construction. This can be worked around by developing a caveat in the contract that moving forward to construction is at the discretion of the HRM. This caveat will come with a price however if exercised.
- Purchase off- the-shelf vessels – used. Prices are remarkably good, however the cost of retrofit to Transport Canada regulations can be staggering. Particularly in additional safety gear and electrical wiring. Both of these are very expensive. Additional fees such as duty will also need to be applied. If there is a 350 passenger low wake design on the open market this approach may in fact enable the HRM to get vessels into service early at a reasonable cost.
- Purchase the complete service – design, build and operate. Attractive from the capital outlay perspective as the costs would be buried in operations and amortized over a ten year period. This approach however would not let the HRM take advantage of some of the investment opportunities that this project could provide in funding.

Financing Options – the following are programs that could provide investment dollars to the HRM project:

- The Transport Canada research program;
- Carbon credits – post project revenue stream;
- ACOA; and

- Industry Canada.

10.2 Can Nova Scotia Deliver the Goods?

In the event that the HRM chooses to move forward on the Fast Ferry initiative one area that needs to be looked into is the economic benefit that this could introduce to the Nova Scotia economy. This province has a strong maritime ship building heritage that through the years has been crushed by strong Asian competition, and the Jones Act in the USA. Introducing an opportunity to build new Fast Ferries represents a direct benefit of \$11 to \$16 million to the Nova Scotian shipbuilding economy, and follow-on work of about \$350K per year in maintenance and repair.

This opportunity would diminish somewhat however if the core capability did not exist in the province. Three shipyards were visited, and provided a copy of a requirements document for Fast Ferry which laid out specific design characteristics – e.g. speed, draft, length and breadth, horsepower, etc.. Each yard was then asked to describe how they would approach such a project and describe the challenges associated with it. The three yards visited were Halifax Shipyard, Shelbourne and AF Theriault. Halifax Shipyard and AF Theriault were very capable yards in the area of new construction, and both could respond more than adequately to this requirement.

Halifax Shipyard currently does not have experience in building aluminium catamaran vessels, but are prepared to develop a purpose built workshop just for this project at their Woodside location. This environment would allow for construction of both vessels within a clean environment. Skill would have to be purchased. In the event that the hull selection would be an advanced composite material Halifax Shipyard would not be interested in pursuing this opportunity. The Shelbourne facility currently has a Canadian Welding Bureau Certificate (CWB) for Aluminium, which has been transferred up to Halifax Shipyard under the Irving Group of Companies. The ability to transfer this certificate would need to be investigated further. This shipyard is ISO 9000:2000 certified, and has full engineering support.

AF Theriault has recent experience in building catamarans in both aluminium and advanced composite materials. The facility includes a number of workshops, two of which are adequate for aluminium construction. One shop could support a single build and is both climate and humidity controlled. The second shop could support construction of two vessels at one time. The yard has a current CWB certificate and more than a half dozen qualified aluminium welders. In addition they have a close working relation with the Yarmouth and Halifax Campuses of the Nova Scotia Community College welding program. AF Theriault does not have onsite engineering support but uses a number of trusted and reputable firms to support this need.

10.2.1 Challenges

Procurement Process – the current procurement process has been developed to ensure that the tax payer receives best value. Governments at all levels strictly adhere to this competitive process, which not only opens the opportunity up for the rest of Canada but also those countries that are NAFTA signatories.

- **Mitigation:** Develop a competitive system that encourages points for partnering with Nova Scotia shipyards and economic development targets.

The Bond - The bond requirements tend to be onerous for small yards, even though they have proven track records producing solid quality vessels.

- **Mitigation:** Investigate novel financing arrangements to keep the field open for these yards based on experience and technical capability.

Retaining Skills – Nova Scotia, along with many smaller provinces are experiencing the skills drain to Alberta. The result could be an unstable workforce capacity in important trade areas.

- **Mitigation:** Ensure that bidding companies will be able to deliver.

10.2.2 Advantages

- Close proximity to client – ease of decision taking and problem resolution.
- Economic advantage being returned to Nova Scotia.
- Building of capacity that in itself will attract more work.
- Demonstration to world of skill and capability, establishing Nova Scotia as a place to have boats built.

10.3 Background Information on Carbon Credits

The Kyoto Protocol, adopted unanimously at the meeting of the Conference of Parties to the United Nations Convention on Climate Change held in Kyoto, Japan in 1997, went into effect on February 16, 2005. The agreement legally binds participating industrialized countries to reduce their emissions of greenhouse gases during the five year commitment period of calendar years 2008 - 2012 as compared to baseline emissions in the year 1990. The Protocol does not set limits on the greenhouse gas emissions of developing nations. So far, the agreement had been ratified by 141 countries, representing over 61% of global emissions. Those countries include the 25 countries of the European Union, China, India, Japan, Canada, Russia and New Zealand. The U.S. has not ratified the agreement.

Commitments under the Protocol vary from nation to nation. The overall 5% target for developed countries is to be met through cuts of 8% in the EU and 6% in Poland, for example. The agreement offers flexibility in how countries may meet their targets. For example they may partially compensate for their emissions by increasing "sinks" - forests, which remove carbon dioxide from the atmosphere. Or they may pay for foreign mechanisms set up for this purpose such as emissions trading, the Clean Development Mechanism (CDM) or joint implementation, which are explained below.

Joint Implementation (JI) and Clean Development Mechanism (CDM) are project related. An investor achieves a measurable CO₂ reduction in another country, which can be sold to a country requiring the reduction. Such investments in energy projects are of interest to the host country because they contribute to sustainable economic growth. These are projects that might not have been achieved without carbon finance. JI is aimed at countries that also have a reduction obligation under Kyoto, mainly Central and Eastern Europe and North America. CDM focuses on developing countries without reduction obligation.

The JI program allows industrialized countries to meet part of their required cuts in greenhouse gas emissions by paying for projects that reduce emissions in other industrialized countries. In practice, this will likely mean facilities built in the countries of Eastern Europe (including Poland) and the former Soviet Union (the so-called "transition economies") will be paid for by Western European and North American countries.

The sponsoring governments will receive credits that may be applied to their emissions targets and the recipient nations will gain foreign investment and advanced technology (but not credit toward meeting their own emissions caps; they will have to do that themselves).

10.3.1 What are Carbon Credits?

Carbon credits are reductions of emissions of greenhouse gasses caused by a project and are equal to 1 ton of CO₂ removed from the atmosphere or prevented from being added to the atmosphere. Credits hover around the \$16.50 mark (including taxes) per credit¹⁶, dependent on type of project.

10.3.2 How do Carbon Credits work?

Companies in countries can buy the emission reduction achieved (carbon credits) that you realize through your investment and that would not have existed without your investment. Prices are realised by a process of competitive bidding. Carbon credits may be generated from investments in renewable energy, energy efficiency, fuel switch and waste management projects.

Transportation is one area where carbon credits are applicable. Credits can be accumulated by reducing baseline operations fuel consumption through advanced engine design and exhaust treatment systems, or other methods that result in the reduction of GHG.

10.3.3 Baselines

Before you can sell carbon credits you first of all determine how much your project reduces emissions. Prior to this you define a baseline, which is a scenario in which you provide supporting evidence about what the emission of greenhouse gases would be until 2012 without your investment. You compare this baseline with the lower emission that will be achieved through your investment. The difference between them is the amount of saleable carbon credits. In the case of JI projects you can only sell the reduction achieved between 2008 and 2012 and not what you achieved in the previous years or years after. The process for submission and review is contained at Annex C.

10.3.4 Certification Requirements

A validation or certification organisation, acting as an independent third party, validates the baseline drawn up for the project. This organisation must work according to the "Accreditation Guidelines on the Application of EN 45004 (ISO/IEC Guide 17020) for the Validation and Verification of JI projects or according to the guidelines of the UNFCCC Executive Board for CDM projects.

¹⁶ http://www.carbonplanet.com/home/carbon_credits_faq.php

10.4 Timelines for Contracting

Contracting timelines will be constrained by the following:

Contracting Element	Estimated Time in Months
1. Preparation of contracting strategy and RFP for design	1 m
2. Tendering and bid review process for design	4 m
3. Contract	1 m
4. Design	2 m
5. RFP development for construction	1 m
6. Tendering and bid review process for construction	4 m
7. Construction	10 m Aluminium 12 – 14 m Adv Comp
Total Time	24 to 27 m

The time can be advanced if the HRM was to adopt a design and build strategy for the contract with adequate off-ramps build into the contract. This savings could be as much as 5 months to the overall process.

11.0 CONCLUSIONS

The business case that was developed was designed around a number of questions that needed to be answered in support of the decision taking process of the HRM. These questions will be used in the following section to draw conclusions regarding this case.

11.1 Who will take the ferry, when they will take it and what is the price tolerance?

The fast ferry will be a Bedford and surrounding area transportation mode. The ridership will draw mostly from the Bedford, Sackville, Hammonds Plains and surrounding areas (Kingwood) for example. Those surveyed represented a population 18+ years. The total population of the catchment area was estimated at 66,200 calculated from census data 2001 census data for the area.

The following represents the reasons for travel, and based on a propensity to take the Fast Ferry at a fare of \$4 the number of trips in a given week were calculated:

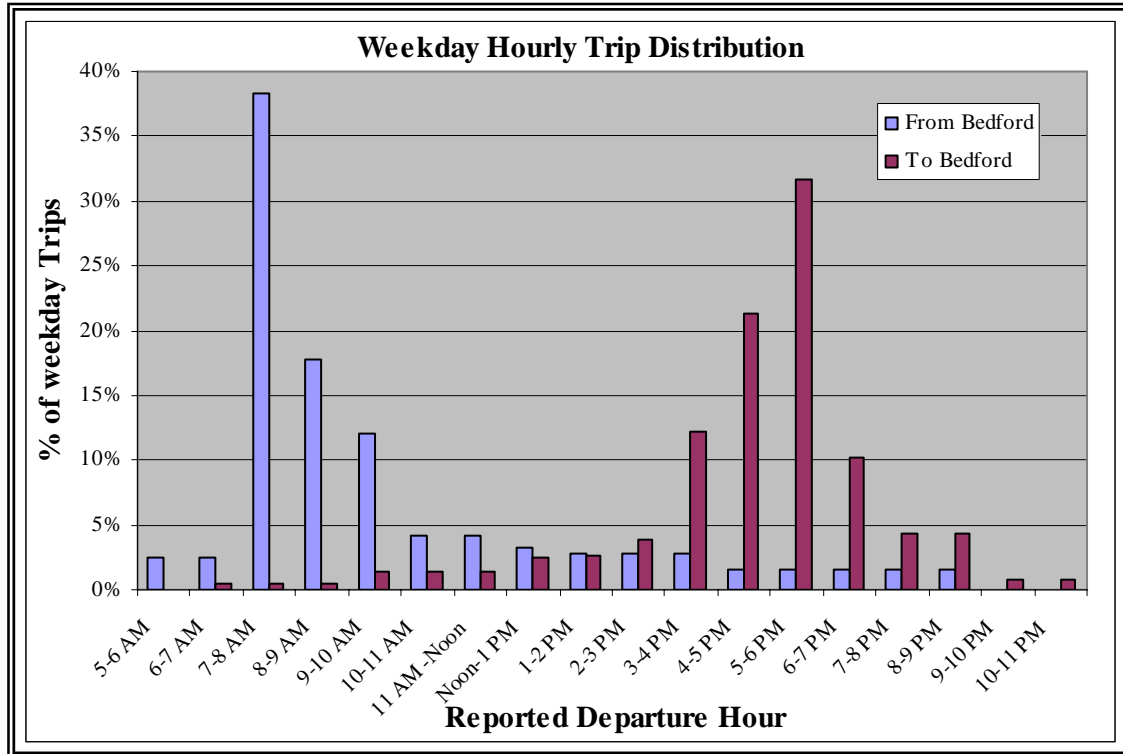
	% of Trips	# Trips/Week
Work - Weekday	54.3%	23,102
Work - Weekend		2,567
School - Weekday	4.2%	1,975
Other Trips – Theatre, Doctor, etc	41.5%	19,635

The timing of trips is consistent with what one would expect considering that there is considerable numbers who commute to the city for work each day. The following table represents the time distribution of when people travel, it is logical to assume that the high peaks around 7:00 to 8:00 am and 5:00 to 6:00 pm reflect the commuter work patterns expected.

What is important to note is that the morning travel has a demand for a certain time which is more concentrated around 8:00, and that the afternoon distribution is much less abrupt showing more interest in traveling during the shoulder times.

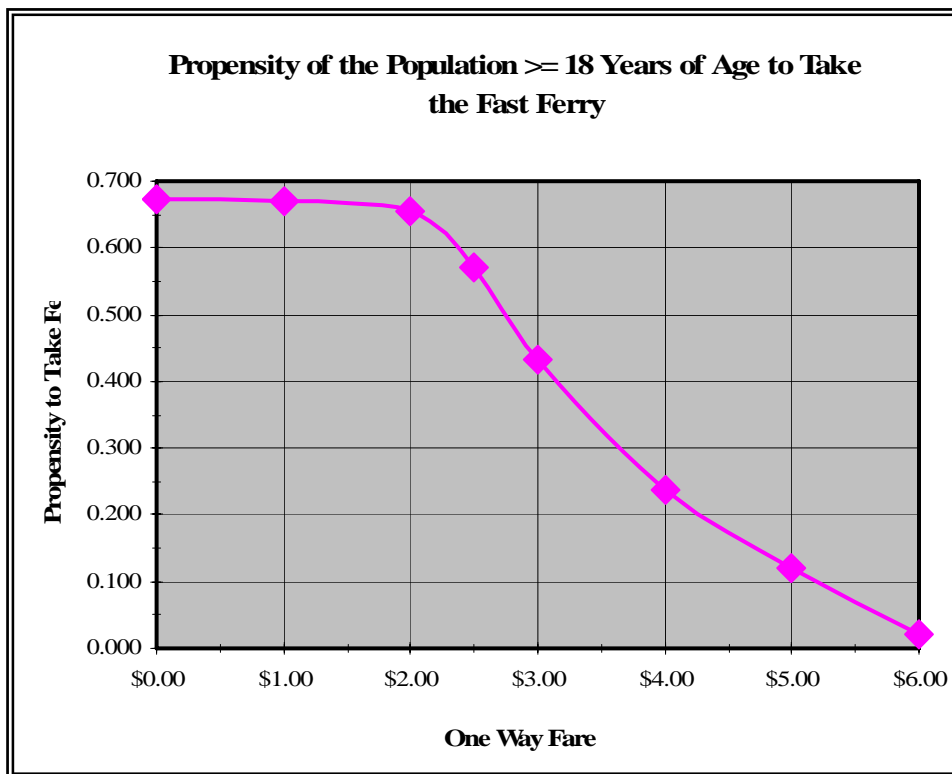
It is this basic observation of the morning that introduces the greatest challenge in providing Fast Ferry services. The numbers desiring this service are high, but it is essential that this distribution is spread out. The 7:00 - 8:00 concentration may in fact be due to commuters trying to beat the rush, only to create it. The result is that they compensate for getting work on time by leaving early and accepting the traffic load. This survey data is further corroborated from traffic data around the Hammonds Plains Road which also shows high traffic patterns around those same times with more concentration at 8:00 am and broader distribution in the afternoon.

This concentration could in fact flatten out simply by the fact that commuting to work will become worry and traffic free.



Fare strategies can also flatten these peaks out, designed to give an impetus for those traveling at 8:00 to travel at 6:30 or 9:15. If the curve does not flatten the Ferry will not only loose the rider in the morning but also the afternoon. Fare premiums are currently used on the Seastreak Ferry in New York City, and the rail system in Britton. The transportation systems do not market them as premium pricing, but suggest these are the real prices and the others are discounted or "Super Saver" pricing.

Through the survey we were able to construct a number of demand curves – which established the propensity, given a certain set of parameters, that a commuter will take the ferry or not. These curves were used to reflect the importance of each of the characteristics of the scenarios – fee and free parking and shuttle services. The following graph represents the demand curve for the scenario that provides both free parking and a downtown shuttle service.



Usually the demand is matched to the solution. Based on the information of each of the scenarios it is clear that price balance is somewhere between \$5 and \$6 dollars. This solution however rapidly moves into an option that is no financially viable if any of the variable change.

In applying these curves to the model the best financial position over time is a cash price point of \$5 per trip. In referring to the tables on Page 30 and 36 to 37 it is observed that at \$5 HRM will have the highest return, least amount of time for payback and best ROI. However, this rate demonstrates more risk when looking at the sensitivity analysis with greatest impact of fuel increases, market decline, personnel cost and construction cost increases. Given the shifting fuel prices, which is the greatest impact, the two vessel \$5 rate is preferred.

At \$4 there exists a large number of commuters who will not be able to take the Fast Ferry – an average of 11,000 per week for a 350 passenger ferry. This represents commuters who would take the ferry but could not because of inadequate number of seats. This could cause dissatisfaction, and riders who will not take the ferry again. One way to counter this issue is to raise the price so that there will be fewer dissatisfied.

At the \$5 fare the number of commuters without seats would be about 5,500. That being said the \$5 fare has greater room to absorb changes in variables such a fuel price increase or Capital construction over-runs. If fuel prices were to climb to \$1,000 the 10 year profit/loss statement goes into the red.

Currently the HRM has a fare discount for seniors and for students. These discounts were integrated into the model and are reflected in the profit and loss statements. These fares for the low fare option were \$2.80 per trip.

What was impossible to consider was the impact of the current Transportation Pass arrangements with Dalhousie University and Saint Mary's University. No revenue was considered for these agreements, and therefore any contribution would be a net gain. That being said, it is not clear what impact having the Fast Ferries and shuttle services to the Universities might have in increasing numbers in that area using public transit. Additional travelers using passes at peak times would have an overall negative impact on both the service (eliminating a commuter who may not come back) and reduced revenue.

11.2 Where and when does the FF need to run?

The location of Mill Cove was predetermined from the study. This area was selected because of the rapid growth that it is currently experiencing and, based on the Regional Plan, the growth that is being planned for by the development strategy. It is suggested that a year over year increase of 3% can be expected in this area. The Regional Plan has been developed to establish development concentration thereby enabling the HRM to invest in cost effective services.

Other areas that will experience growth will be in the Purcell's cove area and Eastern Passage – however both of these areas will be slow in comparison. Purcell's Cove for example has limited development opportunities because of the large holdings of Crown Land.

The land identified at Mill Cove is well positioned to support a ferry operation. There is adequate deep water and a substantial jetty, and although it is fairly open to weather this situation will not exist once the development on the Mill Cove Phase II project is completed.

The Ferry will track to the Dartmouth side of the Narrow, leaving adequate room for passing a Post Panamax container ship. There is adequate space given the current largest size vessel to enter Halifax Harbour on transit to the Fairview Terminal. This was validated in the Harbour Trainer operated at DND.

The schedule is of prime importance to the operation. Clearly, from the diagram above the solution must max out the number of seats during this period. There are two ways to do this – one is to have a very large vessel, or many small vessels and the other is to have a faster vessel so that you can increase the frequency. Given that each vessel has a high capital cost, increasing too many small vessels would quickly eliminate any ROI and the operation would continuously be in the red. Increasing size is another option, but in this case the operation would need 600 or 700 passenger vessels. The capital required to purchase these is very high - \$15M to \$20M. In addition, maintenance through life costs is directly related to the acquisition cost of the vessel. What seems to drive an optimal solution then is a fairly large fast ferry. The model uses a 350 passenger 35 knot vessel, which when paired provides three pickups during peak operating times – collecting 1,050 passengers. The slower smaller options will only pickup twice during the peak operation, and with a 206 passengers will only pickup 412 passengers in the same period. This represents a revenue difference of \$2,400 in one peak hour.

Therefore, the faster ferry is preferred – which will dictate availability for schedule and total number of runs in a day. The following represents the schedule available from the model of 2 X 350 passenger vessels (Ferry 1 and Ferry 2) that operate at 35 knots.

Weekdays

Weekends

6:00	1	
6:30	2	
7:00	1	
7:20	2	
7:40	1	
8:00	2	1
8:20	1	
8:40	2	
9:00	1	1
9:30	2	
10:00	1	1
11:00	2	1
12:00	1	1
13:00	1	1
14:00	1	1
15:00	1	1
16:00	1	2
16:20	2	
16:40	1	
17:00	2	2
17:20	1	
17:40	2	
18:00	1	2
18:20	2	
18:40	1	
19:00	2	2
20:00	2	2
21:00	2	2
22:00	2	2
23:00	2	
24:00	2	2* (Sat Only)

From the discussions however, there was considerable interest noted for schedule options that included other stops. During the one hour runs for example it would be reasonable to pick-up at China Town. This would make it easier for those people who live on this boundary to make the decision to take the Fast Ferry into Halifax.

Other runs that were discussed earlier (refer to Sections 8.3 and 8.4) were not based on clear market data. Adding these runs should only be considered after a complete market analysis. The runs to Purcell's Cove and Shannon Park both require significant additional capital for start-up. The Eastern Shore option however would need little to provide terminal services. Given the time impact from the shore to the downtown core (37 minutes by car vs. 13 minutes by ferry) this option could be easily implemented.

11.3 What are the preferred vessel characteristics?

It is important first of all to state that for the purpose of analysis two arbitrary vessels were chosen that represent good seagoing and wake characteristics. Using this technical data the study was able to ascertain the benefits and costs of a low speed relatively small option against a higher speed larger option. The intent of which was to ascertain the types of vessel characteristics that best suit the operation in the HRM and provide a technical profile that could then be used in developing and RFP.

The study scenarios also compared 2 and 3 boat acquisition. This was primarily to drive up the ability to capture the large market demand during peak operations. It is recognized however that there is a cap on available capital for this project at this time. Given the need to generate seating at the critical peak time adding a third boat of 206 passengers at 28 knots increases the carrying capacity to just over 600 at a cost of \$16.5 M – which cannot compare with the 1000 carrying capacity of the 350 passenger vessel for \$16 M.

Another benefit of the 350 passenger vessel is the 4 engine propulsion configuration which provides for operational redundancy, enabling an engine to go down and maintain schedule. As well, during non peak operations the 350 passenger vessel can shut down two engines and realize tremendous savings in fuel – almost 50%. This dynamic was not modeled but would represent a time of slower speed of 50% power for 37.5% during the day (representing non-peak times). This could translate into fuel savings per vessel in the order of \$500K per vessel per year.

The tables contained on page 30 demonstrates that only the 350 passenger vessel options show profit for some scenarios, and time to payback within the 10 year term. This is not the case for the 206 passenger vessel option, which does not demonstrate any positive return over the same period.

In addition, the discussion regarding environmental stewardship in the operation of diesel engines concludes two important points:

- Weight savings which translate into reduced engine power requirements for the same performance should be explored given the direct relationship to burning of hydrocarbons and engine size. Improvement in weight to weight comparison between Aluminium and Advanced Composites show a 25% savings. This weight savings could be translated into engine size reduction and a possible savings. Even a 10% fuel saving would reduce the pollution by the same degree and net savings in fuel costs to increase the profit over 10 years by \$2.8 M (refer to Section 6.7.1 Page 53); and
- Biodiesel has a major impact on improving green house gas emissions. Research has demonstrated reductions in hydrocarbon emissions, smoke and soot, carbon monoxide and polyaromatic hydrocarbons (carcinogens). It does not affect NOX emissions however, with is accomplished with catalytic converters. The use of biodiesel also improves lubrication of moving parts (improving the maintenance profile of the engines and therefore cost to

maintain). Biodiesel has no impact on engine performance – with the exception that there will be increased fuel consumption. Care must be taken in the storage of this fuel as there is a fairly low cloud point which could cause clogging of injectors or filter systems. Design considerations must be taken.

The following represents the technical specifications for the optimal vessel:

Design Parameter	Requirement
Cost	\$8 M or less
# Passengers:	350 plus
Speed:	35 knots + fully loaded
Fuel Consumption:	.6 - .7 Tons/hour at full speed
Range at Full Pwr:	300 nautical miles*
Wake Wash:	Low Wake Design Wash Ht: 25 cm or less Energy: 2,000 joules/meter
Fuel Tanks	Prohibits biodiesel cloud formation
Engine Design	Meets EPA Standards for emissions

*Note this will allow for 3 days of operations at full speed without fueling.

11.4 What is the preferred scenario?

Other than the types and number of vessels there were a number of scenarios explored which included: Parking and a Downtown Shuttle; Fee Parking and a Downtown Shuttle; No Parking and a Downtown Shuttle; Parking and no Downtown Shuttle; Fee Parking and no Downtown Shuttle; and No Parking No Shuttle.

Note: All parking uses the HRM land at Highway 102 and Hammonds Plains junction, with a shuttle service.

From the financial tables found on Page 30 there is a clear separation of preferred model with a 10 year performance of the Parking + Shuttle realizing a return of \$14.7 M in profit for three 350 passenger 35 knot vessels. The same scenario with three vessels show some better performance as described in the comparison table below for the two options:

	2 Ferries	3 Ferries
Profit after 10 years	\$6.9 M	\$14.7 M
Payback Period	8 y 7 m	7 y 11 m

Return on Investment	22.9%	38.6%
Revenue per Employee	\$0.51 M	\$0.48 M

These are fairly comparative on the surface – however there are two distinctive issues the first is that the 3 ferries require more crew and hence overall the revenue per employee is better in the 2 ferry option. What is most important however is that the three ferry option is more susceptible to wider swings due to changes in variables. Take for instance the doubling of fuel costs – the resulting 10 year picture for the two vessel option is a total loss of \$20.8 M and for the three vessel option is \$21.6 M. This may seem too close to call any differences. However it is in the swing value that we note significant differences in that the two vessel option only changed \$27.7 M whereas the three vessel option changed \$36.3 M. As well, construction cost over runs will have a greater impact simply because of the fact that there is one more vessel – as such the start-up capital will increase not only by the percentage of cost over runs but also because there is an additional ferry.

Establishing the Hammonds Plains/102 Parking the HRM has an opportunity to create a transportation hub that can integrate a number of transportation options – including local buses, express buses, shuttle services and National Service bus lines. This concept could put “choice” of transport into the commuters hands. Once at the parking lot the commuter could be given travel choices and times to commute using the various options. They could then select their preferred option based on real time operations information. For example a commuter arrives and is given information that the next express bus will be leaving the Hub in 5 minutes and that the expected arrival at destination will be 48 minutes because of traffic build-up. As well in 7 minutes the shuttle to the Fast Ferry terminal will be leaving and the Ferry expected arrival at destination will be 37 minutes. The commuter could then select the preferred option.

11.5 What are the risks in implementing this transportation mode?

The risks are all tied to the business imperatives:

11.5.1 The Cost of Commute and the Price of Fuel

The cost of this service was a prime consideration as observed from the demand curves which show a steady and rapid decline in propensity to take the Fast Ferry for fares greater than \$2.00.

The rising price of fuel and its availability will eventually constrain the operations of the vessel and the profitability of the service. This being said when the Ferry service is feeling the impact of these increases so will the commuter who chooses to drive. Therefore, should the price of fuel reach a value that challenges profitability there should be adequate support to increase fares to compensate.

The fuel prices would have to reach \$1,000/ton to push the preferred option into the red. This represents in excess of 25% rise from the value used in the model.

- **Risk Mitigation:** Raise fare prices as the cost of fuel increases. Communicate, through targeted marketing, the need and justification to increase the costs.

11.5.2 The Performance of the Vessel

The schedule will continue to be an important parameter in attracting and keeping passengers. First the schedule must be responsive to the traveling needs of the public, second the frequency must be such that it provides for flexibility in travel times and last it must be consistently on-time. If the vessel cannot perform to specification then these parameters cannot be met and the Ferry system will lose clientele. Passengers will be sympathetic to inclement weather, but will not be if there are no obvious reasons.

The risk is that the delivered vessel does not meet the operational requirement specified in the contract for build. This could result in vessel schedule frequency not being attained. This frequency is critical to moving large numbers of during peak operating times.

- **Risk Mitigation: Set performance requirements and contract penalties associated with vessel speed and fuel consumption.**

11.6 Who will benefit and in what manner?

The Commuter: The most important point to realize is that the commuter will have an additional transportation option. The time and the cost for the preferred option are comparable to what the commuter currently pays in gas and parking. What they will dispense of is the frustration factor associated with sitting in traffic. As well, they will not be subjected to situations when traffic backs up and delays.

The following represents the cost comparison based on a \$4 fare and gas prices of \$1.10/litre:

- **I – Transit by Vehicle**
 - Bedford Highway route - **\$226 per month**
 - Hammonds Plains route - **\$216 per month**
- **II – Transit by Ferry**
 - **\$160.00 per month**

These numbers reflect the current costs of fuel. In addition, the ferry option has significant price flexibility to absorb fuel increases, where the commuter who uses their car will have a direct impact.

Other Travelers to Downtown Halifax: The cost for casual trips to Halifax will be \$7.30 plus parking. A standard meter in downtown Halifax is \$1/hour, with consideration at HRM to increase this by 50%. Average daily indoor parking is \$12.50¹⁷. Therefore the casual trip from Bedford along the Bedford highway will cost \$29.80. In addition to the cost savings these travelers will see this as simplifying their journey, or creating an excursion. When traveling for an event in the downtown core it will eliminate issues of parking and post game traffic.

The Land Development Community: The land development community has expressed strong support for the Fast Ferry. Without exception they see this service as adding value to their development initiatives. When asked about the importance as increasing the property value of waterfront they did not agree that the Fast Ferry could add value to what is already considered most valuable. However, this statement needs to be explored further prior to any negotiations in seeking investment by the development community in

¹⁷ [http://www.colliersmn.com/prod/cclod.nsf/publish/BA13702D3147A08A85257051005E2BB1/\\$File/Parking+2005.pdf](http://www.colliersmn.com/prod/cclod.nsf/publish/BA13702D3147A08A85257051005E2BB1/$File/Parking+2005.pdf)

infrastructure. There were some overtones from this community that investment would be possible, but without a negotiation it is difficult to understand at what price.

Some developers felt that area specific shuttle services would be attractive, especially in how these developments represent "life styles".

Of greatest interest is access to the Phase II project land. The development community views the Fast Ferry as accelerating this project and access to what will be a very profitable project.

The HRM: The HRM will first be fulfilling its Transportation Plan in creating innovative integrated transportation options. The solution suggested provides a perfect opportunity to introduce choice into the commuters' hands.

The HRM will also be seen as:

- addressing environmental issues by taking cars off the road;
- a leader in innovative transportation options; and
- a leader in challenging emerging technologies in the construction of the ferry.

Brand recognition through the basin will be significant. The trial vessel in October created a substantial positive buzz. Branded consistent with other premium transportation will help to grow public support.

HRM Sports and Entertainment: The Bedford and surrounding area markets for events in Halifax have mystified coordinators. For the most part there is a sense that once a commuter has returned home there is little to coerce them back into the city for an event. Some exceptions of course would be the annual Fireworks. All event marketing directors of the premiere events in Halifax agreed that packaging Fast Ferries with the event would realize growth in the market segment from this area. Those would be the direct benefits, other hospitality enterprises would also benefit from this increase.

The Commonwealth Games Bid Team: One assessed area in the bid for the Commonwealth Games is transportation. Adding the Fast Ferry with direct access to the sporting venues would enhance the bid.

11.7 Will this be an accepted transportation option that has the potential to grow?

The market information substantiates that this will be an accepted transportation option. It favours a \$5 fare – that includes free parking and downtown shuttle service to Universities and Hospitals. In this scenario there is high interest, to the level that the Fast Ferry would need to be 700 passengers to address the peak needs. Certainly with the existing market this means that the Fast Ferry could grow and still be profitable. In fact, the scenario with 3 vessels is more profitable but comes with higher risk with shifts in most of the variables (e.g. fuel price).

In addition to growth within one market, there has been interest in growing the Fast Ferry service in other areas. Specifically discussed were Purcell's Cove, Shannon Park and Eastern Passage. All of these options demonstrate solid time savings for the commuter and could be seen as valuable to the market if it identifies saving time as important. Key with this statement is that each of these areas there is no current understanding of the market, its requirements, size and growth.

With Purcell's Cove and Shannon Park considerable investment would have to be made to establish a terminal. Jetties are not available and this adds to both the time to implement and the cost. Shannon Park does have one advantage over Purcell's Cove in that it has access to Burnside Industrial Park which could balance out travel to and from the terminal with no peak linked to a particular direction. Eastern Passage has the easiest transformation potential in that an adequate jetty exists and will need minor change to allow for embarkation. It also has available parking and it is also an established destination. With market information this could be a second viable route – especially considering the tremendous time savings that commuters would realize (37 minutes by car to 13 minutes by Ferry). Experience with Woodside and the slow take-up will have to be reviewed to ensure that weaknesses in that service are addressed to secure this market.

Other growth could be developed by including a run on a regular basis from China Town and targeted stops at Dockyard. These could be done at off peak times such as the 6:30 am and 7:00 am runs and then 3:30 and 4:00 in the afternoon. This would coincide with the Dockyard flex hours.

12.0 RECOMMENDATIONS

12.1 Implement the 2 – 350 35 knot Passenger Vessel Option

This is the preferred solution that will realize improved transportation for commuters in the Bedford and surrounding area.

Recommend a contract arrangement for Design and Build that encourages the designer and builder to work together in delivering a vessel that meets the specification that are necessary to secure the schedule, provide fuel efficiency and address issues related to the environment.

The contracting period should take no longer than 6 months, with an anticipated first vessel:

- in 12 months if it is in aluminium; and
- in 18 months if it is in advanced composite material.

The RFP should also encourage bidders to consider Nova Scotia shipbuilding in the construction of these ferries.

12.2 Adopt the Preferred Technical Characteristics as the Basis of the RFP

Use the technical specification that emerged from the study to go to RFP as follows:

Design Parameter	Requirement
Cost	\$8 M or less
# Passengers:	350 plus
Speed:	35 knots + fully loaded
Fuel Consumption:	.6 - .7 Tons/hour at full speed
Range at Full Pwr:	300 nautical miles*
Wake Wash:	Low Wake Design
	Wash Ht: 25 cm or less
	Energy: 2,000 joules/meter
Fuel Tanks	Prohibits biodiesel cloud formation
Engine Design	Meets EPA Standards for emissions

*Note: Represents 3 days of operations at full power without fueling.

12.3 Charge \$5 Cash Fare and Include Free Parking and Downtown Shuttle Services

Recommend a \$5 cash fare and \$160 monthly fare for the Fast Ferry. Other fare reductions would follow suit for Children and Seniors. In addition, those holding fare payments for other transportation options would have to pay an additional amount to compensate for the Fast Ferry service. This amount has not been determined.

Serious considerations should be given to an Executive Service from Bedford. This should be preceded with a solid market analysis to determine if this would be something of interest.

Parking was a key consideration of commuters in making the decision to use the Ferry service. Establishing a transportation hub which includes parking has the additional potential to integrate this with retail providing additional revenue for the HRM. Free parking could become Fee Parking in time should there be a reason to collect fees – such as increased demand for parking. The Downtown shuttle service would be to Saint Mary's, Dalhousie and the Universities. The route directions should be contrary to traffic patterns.

All services should be ready with the delivery of the first vessel. This could be a challenge for the terminal, which will sit on land that is not currently zoned.

12.4 Do What is Necessary to Accelerate the Bedford Phase II Development Project

This land development and population increase is not necessary for this Ferry to succeed, however the development of the land will help to secure the ridership from the study catchment area. Also critical to this is the second access as an overpass which would give both a south and north access route. By accelerating the landfill project the Development Community will be much more interested in what is happening with the Fast Ferry. This community is somewhat cynical in the development process today which is upwards of 10 years. Any improvements in this area might attract investment dollars for infrastructure.

As the principal agent in negotiating the acceleration of this project the HRM will have influence on the land development, thereby ensuring a good fit with the overall strategic plan.

12.5 Encourage the Use of Advanced Equipment and Material in Ferry Construction

By using materials/equipment that have the potential to save fuel or reduce pollution, the HRM may have access to investment dollars to offset the cost of the project from other levels of government.

12.6 Develop a Training Program Using the DND Harbour Trainer

A detailed harbour trainer model can be done quite quickly with minimal expense. Ferry design characteristics will need to be known prior to this work being completed.

It is recommended that the HRM establish a long term training relationship that will use the trainer for induction training, certification training and re-certification training.