Chapter 2
Project Information

2 PROJECT INFORMATION

2.1 Introduction

VAFFC proposes to develop a new aviation fuel delivery system that will serve YVR's fuel requirements over the long-term. The Project is located in the City of Richmond, Lower Mainland, B.C. (see **Figure 2.1.1**) and consists of the following component infrastructure:

- Upgrades to an existing marine terminal wharf on the South Arm of the Fraser River (Fraser River or river) to accommodate a range of aviation fuel cargo vessel types and sizes;
- Construction and operation of facilities at the marine terminal to off-load and transfer fuel from vessels;
- Construction and operation of a new fuel receiving facility located on land near to the marine terminal;
- Construction and operation of a new pipeline to transfer off-loaded fuel from the marine terminal to the new fuel receiving facility; and
- Construction and operation of a new pipeline to deliver fuel from the new fuel receiving facility to VAFFC's fuel facilities at YVR.

The Project is subject to provincial environmental assessment review under the BCEAA following opt in, and "triggers" a federal screening environmental assessment review under the CEAA due to the requirement for Port Metro Vancouver Approval under the Canada Port Authority Environmental Assessment Regulations. The review of the Project will proceed under a single harmonized provincial/federal environmental assessment review process.

2.1.1 Project Overview

2.1.1.1 Marine Terminal

VAFFC owns a waterfront property and wharf on the Fraser River. The wharf will be upgraded to meet current seismic design criteria, improve structural capacity and accommodate fuel cargo off-loading and transfer facilities for vessels ranging in size from barges up to Panamax-class. Minor dredging of the riverbed around the existing perimeter wall and installation of new pipe-pile breasting dolphins, re-grading of rip-rap, and land-based ground improvements, are among the activities VAFFC expects to undertake.

2.1.1.2 Fuel Receiving Facility

The location for the development of a new fuel receiving facility has been identified within a parcel of Port-owned lands adjacent and northeast of VAFFC's marine terminal property. VAFFC proposes to lease this parcel of land from the Port. The fuel receiving facility will include six aboveground tanks capable of providing a total capacity of approximately 80 million litres (e.g., 500,000 barrels).

2.1.1.3 Fuel Pipelines

A short pipeline (e.g., approximately 0.5 kilometres long) will be constructed to transfer fuel from vessels at the marine terminal to the fuel receiving facility. A longer pipeline (approximately 15 kilometres) will be constructed to deliver fuel from the fuel receiving facility to YVR.

A preferred route has been identified by VAFFC for the delivery pipeline which is expected to utilize existing transportation and/or utility corridors in the City of Richmond. VAFFC proposes to install a large section of the pipeline within the existing Canadian National Rail Company (CNR) railway corridor, which runs parallel to Shell Road between Williams Road and the Bridgeport Trail. VAFFC has entered into a conditional purchase agreement with CNR to acquire that portion of the corridor. The railway corridor is scheduled to be decommissioned by CNR as an operating railway line, and CNR has initiated an ongoing process for such decommissioning.

2.1.1.4 Vessel Movements

Project operations are expected to generate approximately 36 to 60 vessel movements on the Fraser River per year (e.g., vessel traffic is expected to include one to two barges every two weeks and one larger tanker vessel every month; monthly frequency is estimated at three to five vessels). These vessels will include a mix of barges, similar to those currently delivering into Burrard Inlet, and Handysize and Panamax-class from offshore sources.

2.2 Proponent Information

2.2.1 Introduction and Background

VAFFC (the Proponent) is a not-for-profit company owned by a consortium of international and domestic commercial airlines that operate at YVR. Currently, there are 25 consortium members (**Table 2.2.1**). VAFFC owns and operates fuel storage and distribution facilities at YVR, and has over 20 years of experience in fuel handling activities at the airport. Similar fuel facility corporations operate at all of the major international airports across Canada. VAFFC contracts the management, construction and operation of its facilities to qualified organizations, and draws expertise from a network of experienced engineering and environmental consultants specializing in fuel infrastructure.

The consortium structure provides efficient sharing of costs and risks between member airlines. Although membership may vary with the airlines serving YVR, the VAFFC structure remains stable over time. VAFFC has invested over $60 million in fuelling infrastructure at YVR over the last 15 years, and capital financing of over $100 million is attainable within VAFFC's financial structure.

Table 2.2.1 Current VAFFC Member Airlines (as of January 2011)

1. Air Canada	2. China Airlines Ltd.	3. Korean Air
4. Air China International Corp.	5. Continental Airlines Inc.	6. Sunwing Airlines Inc.
7. Air North Charter & Training Ltd.	8. Delta Air Lines Inc.	9. Philippine Airlines Inc.
10. Air Transat A.T. Inc.	11. Deutsche Lufthansa AG	12. Skyservice Airlines Inc.
13. Alaska Airlines Inc.	14. Eva Air Corp.	15. United Airlines Inc.
16. U.S. Airways	17. Globespan Airways Ltd.	18. WestJet Airlines
19. American Airlines Inc.	20. SkyWest Airlines	21. CargoJet Canada Ltd.
22. British Airways PLC	23. Japan Airlines Company Ltd.	24. KLM Royal Dutch Airlines
25. Jazz Air Limited Partnership		

2.2.2 Responsibilities

VAFFC's fuel facilities at YVR include a four-tank storage facility and tanker truck off-loading rack system, an airside tanker truck loading compound, an extensive underground pipeline hydrant system to transfer fuel from VAFFC's tanks to airside fuelling aprons, and a maintenance and administration facility (see **Figure 2.2.1**). The VAFFC fuel storage tanks receive fuel from two separate upstream delivery modes: a pipeline and storage delivery system owned and operated by Trans Mountain (Jet Fuel) Inc.; and from daily tanker truck deliveries from the Cherry Point Refinery, located in Washington State (see **Section 2.3.2**).

VAFFC operates the only fuel facility system servicing YVR's main domestic and international terminals and therefore provides fuel delivery service to all airlines using those terminals. Non-member airlines receive fuel delivery service from VAFFC on a fee-for-service basis. Each member airline purchases fuel for its own use and arranges delivery to the VAFFC fuel facilities at YVR, either through the existing Trans Mountain (Jet Fuel) Inc. delivery pipeline system or via tanker trucks. VAFFC manages the storage and handling of each airline's fuel and ensures its delivery to the airline's respective aircraft. On behalf of its member airlines, VAFFC is responsible for:

- Operating and maintaining its fuel facility system at YVR;
- Working with Vancouver Airport Authority and Transport Canada to develop fuel demand forecasts;
- Directing new investment, maintaining insurance, and structuring debt;
- Planning, constructing and operating safe, reliable and cost-effective fuel infrastructure to meet near and long-term demand projections; and
- Obtaining regulatory permits, approvals and authorizations as they relate to fuel system expansion and/or development.

VAFFC is currently in the process of expanding fuel storage capability at YVR (see **Figure 2.2.1**), which is necessary to increase the on-airport reserve capacity from less than two days to over five days during peak demand periods (i.e., during the summer months and over the December holiday period). New fuel storage at YVR is expected to be operational in mid-2011. VAFFC has also recently expanded its underground fuel hydrant system in step with Vancouver Airport Authority's expansion of YVR's domestic terminal.

2.2.3 Project Representatives

The Project is managed by FSM Management Group Inc. FSM is responsible for administrating the day-to-day operation of VAFFC's activities and facilities at YVR. FSM specializes in the planning and management of fuel-related projects and infrastructure across Canada. FSM is the Proponent contact for the Project.

The Technical Lead for the Project, Hatch Ltd., is responsible for managing and coordinating the environmental assessment requirements for the Project on behalf of VAFFC, and for preparing this Application.

In the context of this Application, the primary contacts for the Project are:

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Table 2.2.2 lists key expert consultants that have assisted with the preparation of the Application, specifically the discipline-specific environmental, social, economic, heritage and health effects studies, and other discipline and technical studies, in support of this Application.

Table 2.2.2 Key Professional and Technical Contributions to the Application

Discipline Area	Primary Consultant	Application Chapter
Marine Terminal Conceptual Design	Moffatt and Nichol http://www.moffattnichol.com	**Chapter 2**
Fuel Receiving Facility Conceptual Design	Chinook Engineering http://www.chinookengineering.ca	**Chapter 2**
Fuel Pipeline Conceptual Design	Chinook Engineering	**Chapter 2**

Discipline Area	Primary Consultant	Application Chapter
Public Consultation and Information Distribution	NATIONAL Public Relations http://www.national.ca	**Chapter 3**
Fisheries, Aquatic Resources and Surface Water Quality	Hatfield Consultants http://www.hatfieldgroup.com	**Chapter 5**
Vegetation, Wildlife and Wildlife Habitat	Robertson Environmental http://www.robertsonenvironmental.com	**Chapter 5**
Air Quality	RWDI Air http://www.rwdi.com	**Chapter 5**
Noise	BKL Consultants Ltd. http://www.bkl.ca	**Chapter 5**
Contaminated Sites	Pottinger Gaherty Environmental Consultants http://www.pggroup.com	**Chapter 5**
Social and Economic	Pierce Lefebvre Consulting	**Chapter 6**
Heritage	AMEC Earth and Environmental (formerly Arcas Consulting Archeologists) http://www.arcas.net	**Chapter 7**
Human Health	AMEC Earth and Environmental http://www.amec.com	**Chapter 8**
Environmental Management	Hatch Ltd. www.hatch.ca	**Chapter 9**
First Nations Consultation and Information Requirements	Cornerstone Planning Group http://www.cornerplan.com	**Chapter 3**, and **Chapters 10** to **14**
Accidents or Malfunctions	Hatch Ltd.	**Chapter 15**
Spill Probability and Risk	S.L. Ross Environmental Research http://www.slross.com Hatch Mott MacDonald	**Chapter 16**

Discipline Area	Primary Consultant	Application Chapter
	http://www.hatchmott.com Chinook Engineering	
Spill Prevention, Preparedness and Emergency Response	EmergWest Consulting http://www.emergwest.com Hatch Mott MacDonald Chinook Engineering	**Chapter 17**
Fire Prevention, Preparedness and Emergency Response	Hatch Mott MacDonald Chinook Engineering	**Chapter 18**
Spill Modelling for a River Spill	Hay and Company Consultants (now EBA Engineering Consultants) http://www.eba.ca	**Chapter 19**
Fate and Effects of a River Spill	Coastal and Ocean Resources http://www.coastalandoceans.com Archipelago Marine Research http://www.archipelago.ca Robertson Environmental Hay and Company Consultants (now EBA Engineering Consultants)	**Chapter 19**
Navigation	Moffatt and Nichol	**Chapter 20**
Effects of the Environment	Hatch Ltd.	**Chapter 21**
Cumulative Environmental Effects	Hatch Ltd.	**Chapter 22**

2.3 Project Background and Rationale

2.3.1 Introduction

YVR has experienced tremendous growth over the last two decades, driving an increase in the demand for aviation fuel. Over the same period of time, local fuel refining capacity has declined from four refineries to one, and is at the point where international sources now supply the majority of fuel for YVR.

Aviation fuel forecasts are an important component of airport planning as well as fuel facility planning and design. In planning for the future, VAFFC bases its fuel forecasts on Vancouver Airport Authority and Transport Canada high-range passenger forecasts to predict long-term fuel demand growth because passenger traffic is strongly correlated to fuel consumption at YVR. Further discussion on fuel demand at YVR is provided in **Section 2.3.3**.

To remain competitive on the West Coast and maintain YVR's position as Canada's Pacific Gateway, it is critical that airlines operating out of YVR have access to globally competitive and secure fuel supply sources. YVR is Canada's second largest airport, with well in excess of one million passengers relying on aircraft operations each month. The airport is also a significant employment generator (approximately 360 employers and 26,700 direct jobs) and economic contributor to the City of Richmond, Metro Vancouver, B.C., and Canada. According to a 2005 independent study of YVR's economic impact, direct and indirect employment contributes approximately $3.1 billion in total Gross Domestic Product value to the province.

Development of a new fuel delivery system is essential to secure access to flexible and competitive offshore fuel supply sources and address the critical needs of current and future fuel demand at YVR. Marine transportation offers the most economic means to access a broad range of flexible, competitively priced and secure fuel supply sources. Since YVR is located in an international port, marine transport represents a key component in VAFFC's long-term planning of fuel delivery to YVR.

2.3.2 Existing Fuel Delivery System

The pipeline system is able to supply approximately 80% of YVR's fuel requirements with the remaining 20% supplied by tanker trucks (see **Figure 2.3.1**). This ratio fluctuates on a daily and seasonal basis depending on actual demand for fuel at YVR (i.e., the percentage of fuel delivered by tanker trucks increases during periods of peak demand).

<u>Overview</u>

The existing pipeline system is not owned or operated by VAFFC; it is owned and operated by Trans Mountain (Jet Fuel) Inc. It was constructed in the late 1960s to connect YVR with the four refineries that operated in the Lower Mainland at that time. Three of these refineries have since closed and only the Chevron Refinery located in Burnaby remains in operation.

The approximately 35-kilometre long mainline pipeline connects the Trans Mountain (Jet Fuel) Inc. pump station in Burnaby with their receiving and storage facilities located at YVR. Additional spur lines connect the pump station to the Chevron Burnaby refinery, Westridge Marine Terminal located on Burrard Inlet east of the Iron Workers Memorial Bridge, Petro-Canada Burrard Products, and Shell Canada Products Ltd. processing terminals located in Port Moody and Burnaby. The cumulative length of the existing pipeline delivery system is approximately 41 kilometres.

The existing pipeline system currently provides the airlines operating at YVR with access to two significant sources of fuel: the Chevron Burnaby Refinery and the Cherry Point Refinery.

About half of the pipeline's fuel shipments are supplied directly from Chevron's Burnaby Refinery with a similar amount supplied from Westridge Marine Terminal, which receives its fuel via marine shipments from offshore sources such as the Cherry Point Refinery. The current frequency of marine shipments to Westridge Marine Terminal is in the range of two to three vessels per month. Fuel is off-loaded from vessels berthed at Westridge Marine Terminal and transferred into nearby storage tanks before being delivered to YVR through the pipeline system. A negligible quantity of fuel is supplied into the pipeline system from the spur lines that connect to the Shell and Petro-Canada processing terminals.

Fuel delivered through the pipeline system enters the Trans Mountain (Jet Fuel) Inc. receiving and storage facilities at YVR and is then transferred to the nearby VAFFC facilities. Fuel is dispensed from the VAFFC tanks directly into the underground pipeline system which transports the fuel to the airport terminal area and aircraft.

Since VAFFC does not own the existing fuel delivery system, it is not in a position to determine what will happen with the pipeline component. Based on information provided by Trans Mountain (Jet Fuel) Inc., however, VAFFC understands that the company would seek to abandon the operation of the existing pipeline when the shippers either formally indicate that they will no longer ship on the line or when a determination is made that the tolls are unlikely to produce a positive cash flow. Based on it's analysis of the competitiveness and economic viability of the proposed VAFFC Project and the existing pipeline, Trans Mountain (Jet Fuel) Inc. has indicated that it would seek to abandon operations within a few years of the proposed VAFFC Project coming into operation. VAFFC expects the proposed delivery system operation to eliminate the need for continued use of the existing pipeline system.

Pipeline Capacity

The pipeline cannot meet peak daily fuel demand at YVR, which typically occurs in July and August (December is also a month of high fuel demand). This issue dates from summer 1996 when, although operating at maximum capacity, the pipeline was unable to deliver enough fuel to meet peak daily demand at YVR. Several airlines had to supplement fuel inventory by tanker truck.

In 1997, pumping units on the pipeline system were upgraded to increase fuel pressure and delivery capacity. Since that time, however, no significant upgrades have been made to enhance the delivery capacity. In recent years, growth in passenger and airline traffic at YVR has increased to the point where the pipeline cannot deliver sufficient fuel to meet YVR's fuel requirements during peak demand periods. The daily tanker truck deliveries are required to keep pace with demand and ensure adequate on-airport fuel supplies.

If Vancouver Airport Authority's high-range passenger forecast is realized (see **Section 2.3.3.2**), the limitations of the existing pipeline system are expected to become critical as early as 2013 (**Figure 2.3.2**). Fuel shortages would restrict the overall competitiveness of YVR, with a corresponding loss of economic benefit to the region.

Tanker Truck Deliveries

On average approximately 1,000 round-trips are needed each month (i.e., between 25 and 35 deliveries each day) to supplement the pipeline and meet demand. During the Vancouver 2010 Winter Olympics up to 45 deliveries per day were experienced. Most of these deliveries originate from the Cherry Point Refinery, which equates to approximately 150 kilometres round-trip for each delivery to and from VAFFC's fuel off-loading facility.

Without a new fuel delivery system, any incremental growth in fuel demand at YVR will need to be met by additional tanker truck deliveries.

2.3.3 Fuel Supply and Demand

2.3.3.1 Access to Markets and Fuel Supply

The most critical limitation of the existing pipeline delivery system is the restriction on available fuel supply sources. The Chevron Burnaby and Cherry Point refineries combine to provide almost 100% of YVR's fuel requirements. The Chevron Burnaby Refinery has reached its maximum aviation fuel supply capability and VAFFC understands that Chevron has no plans to increase production. Westridge Marine Terminal, which can receive fuel shipments from both local and international sources, has limited berthing and storage capacity to receive more fuel because it is a multi-product facility. Westridge Marine Terminal is also owned and operated separate from the pipeline system, which limits guaranteed long-term access to a fixed deep water berth.

Without additional supply options, a supply disruption at either the Chevron Burnaby or Cherry Point refineries would effectively cut the supply of aviation fuel to YVR in half. The aviation fuel supply market is vulnerable to the economics of production. For example, one of the refineries could choose to discontinue production of aviation fuel because market demand is higher for low sulphur diesel. Furthermore, the Cherry Point refinery could be deemed critical infrastructure by the U.S. Government and production redirected to other fuels. Within days of such decisions, YVR would experience significant supply shortages and flight cancellations.

Aviation fuel is purchased directly by the individual airline members of VAFFC. Producers arrange delivery by shippers into the pipeline system or by tanker trucks to YVR. Access to the international market would offer greater purchasing flexibility, redundancy and security of long-term fuel supplies than the current fuel delivery infrastructure, which offers only two significant sources. Since YVR is located in an international port, airlines could have access to a wide range of international fuel sources if the airport was connected to a marine terminal that could receive the international fuel deliveries. Access to deep-sea marine shipments is, therefore, a critical component of the future supply of aviation fuel to YVR.

2.3.3.2 Fuel Demand

Fuel demand at YVR varies from month to month and during different times of the day, and fuel facilities must be designed to accommodate the maximum peak demand to avoid disruption in service.

The recent Vancouver Airport Authority and Transport Canada passenger forecasts (i.e., June 2010; **Figure 2.3.3**) reflect the potential for increased growth in long-range markets, resulting in longer flights with higher fuel demand, particularly for flights to the Asia-Pacific Region. The 19-year forecast range (i.e., to 2028), which includes adjustments for significant events such as the 2010 Olympic and Paralympic Winter Games, indicates that fuel consumption will increase faster than the historic fuel growth pattern. This trend may be partially offset by improved fuel efficiency as newer aircraft enter the fleet and older aircraft are retired. The trend may also be temporarily affected by periodic downturns in economic growth, or one-time events or outbreaks that deter air travellers. The price of fuel, fewer flights, possible carbon taxes or surcharges, and other greenhouse gas/climate change initiatives, policies or regulations could also have a reducing effect on future growth trends. However, on balance, the average rate of growth in fuel demand at YVR is expected to steadily continue over the long-term.

Between 1990 and 2009 YVR experienced an average annual passenger increase of close to 3%. This growth history and the future growth forecasted by YVR and Transport

Canada, indicate that fuel demand at YVR is expected to continue to increase by an average of 2 to 4% per year over the next 19 years (i.e., to 2028). Also, the B.C. Government announced in September 2010 that it will introduce legislation to eliminate the provincial tax on fuel for international flights beginning April 1, 2012, and Vancouver Airport Authority announced a five-year freeze on landing and terminal fees to 2015. Both of these measures are designed to assist in attracting additional flights to YVR.

The limitations of the existing pipeline delivery system, coupled with diminished refining capacity and supply options in the Lower Mainland, has made access to competitive offshore sources of fuel supply critical to supply the expected growth of airline activity at YVR.

2.3.4 Project Benefits

The Project will result in significant economic, social and environmental benefits to the region. Some of the key benefits include:

(a) Access to more dependable, diverse and competitive offshore fuel supply sources to meet YVR's long-term fuel requirements

The Project will provide airlines with access to a wide range of dependable, diverse and competitive offshore fuel supply sources throughout the world. As long as the fuel source has access to tide water, then it has the potential to ship fuel to YVR. Access to this global market will greatly improve the economics, reliability and security of fuel supply to YVR.

With the exception of storage expansion at the fuel-receiving facility, the Project will accommodate future growth in fuel demand without the need to upgrade or construct additional infrastructure. The storage and pipeline systems will be designed so that the fuel supply rate can be increased or decreased by adjusting the marine deliveries. This flexibility will serve YVR's needs over the long-term.

(b) Enhanced global competitiveness of YVR for airlines and travelers which will assist YVR in continuing its important economic contribution to the region and the Province

YVR is a major economic contributor to B.C., and is Canada's gateway airport to the Asia-Pacific Region. According to the most recent YVR economic impact study (conducted in 2005 and released in 2006), the airport generates $1.7 billion in Gross Domestic Product and $3.4 billion in total economic output each year (direct economic impact). The 360 companies and organizations based at YVR support 26,700 direct jobs. Approximately 6,000 airport employees live in the City of Richmond. Every new international long-haul flight generates between $5 and $8 million in wages annually and contributes between $8 and $15 million to the Province's Gross Domestic Product. The Project will provide the airlines serving YVR with greater access to competitive offshore fuel supply sources, thereby contributing to the airport's continued growth, strengthening its position as a gateway of choice for airlines, and enhancing its position as a powerful economic generator.

(c) Economic contribution during construction and operation

The Project represents a significant investment in important infrastructure in the Province. It is being funded entirely by VAFFC on behalf of the airlines who use YVR. The primary economic development effect of the Project during operations is not limited to direct jobs created. The Project will assist YVR in remaining a competitive, world-class airport and is expected to indirectly help with the general economic development of Greater Vancouver, the province and Canada.

As the second busiest airport in Canada and the second largest international passenger gateway on the west coast of North America, YVR is a very important economic driver for Greater Vancouver, the Province and Canada.

Section 2.12 presents a summary of the capital investment required for construction of the Project. A discussion of the Project effects on labour force are discussed in **Section 2.13** and the direct and indirect business opportunities associated with the Project including provincial, federal and municipal tax revenues are discussed in **Section 2.14**.

(d) Modernization of the fuel receiving, storage and delivery infrastructure to YVR, which will enhance the performance of fuel delivery in all respects, including: operational, maintenance, reliability, safety and environmental

The new fuel delivery infrastructure (marine terminal, the receiving facility and pipeline to YVR) will be constructed and operated to meet BMPs for materials, safety and reliability. The use of industry leading materials, design, technology and construction techniques will result in enhanced performance of the system overall. Operations and maintenance will be more efficient because of the design, materials and technology that will be used. In the event of a problem, the pipeline will be easier to locate and access because of the modern mapping techniques and the proposed route alignment.

The combined effect of this modernization will be a more reliable pipeline that is safer and has less environmental risk than the current delivery system. Based on a comparison with the existing system, the existing fuel delivery infrastructure and related activity have an environmental footprint and effects profile that will be displaced by the Project.

(e) Greatly reduce or eliminate the use of tanker trucks to transport aviation fuel along Highway 99 and City streets, with a corresponding reduction in the related safety and environmental impacts

Tanker truck deliveries produce significant GHG emissions and other emissions compared with bulk transport modes, such as pipelines and marine vessels. Not only will the Project eliminate the need for tanker trucks, it will allow larger, less frequent deliveries of aviation fuel and reduce the length of vessel transit distance in Canadian waters. As reported by the Fraser River Estuary Management Program (FREMP), barging represents approximately one-tenth of transport costs and one-twentieth the environmental costs compared to an equivalent volume of trucking (FREMP 2006).

2.3.5 Fuel Delivery System Options

2.3.5.1 Background

Fourteen potential fuel delivery system options were identified to meet the long-term demand for fuel at YVR (see **Figure 2A.1**, **Appendix 2A**). Each option was evaluated at a screening level for potential economic, environmental, social and regulatory effects associated with their construction and operation/maintenance. After weighing the relative merits of the various options, the Project emerged as VAFFC's preferred option. The other options that warranted further study involved delivery of fuel via rail from refineries located in Alberta or Washington State, delivery of fuel via vessel to a fixed marine terminal berth or floating mooring facility west of Sea Island and Sturgeon Bank, and upgrade or replacement of the existing pipeline system.

These top-ranked options are summarized below together with a description of the key challenges involved with each, and the rationale for selecting the preferred option. See **Appendix 2A** for a more detailed overview of these options.

2.3.5.2 Railcar Delivery from Alberta or Washington State

In this option, fuel would be delivered using existing rail networks originating from refineries in Alberta or Washington State. A new receiving facility would be required in Richmond or South Vancouver. A pipeline would be required to deliver fuel from the receiving facility to YVR.

Since conducting the evaluation, Alberta has become a net importer of aviation fuel due to limited refining capacity, and a surge in demand for other refined products in the province. While this is not the case for Washington State, a number of challenges were identified with this option. The Cherry Point Refinery does not have rail loading facility for aviation fuel. To satisfy long-term demand for fuel at YVR, 60 to 100 railcars of fuel would be required each day depending on the time of year. Railway infrastructure constraints, such as other users on the rail network, single-track bridge crossings and resulting bottlenecks, would result in an individual rail shipment transit and cargo off-loading time frame of several days. A receiving facility capable of handling this number of railcars would require a very large tract of suitably-zoned industrial land. In addition, this option would not provide access to offshore fuel supply sources.

2.3.5.3 Vessel Delivery to a Marine Terminal or Floating Mooring Facility Located Off Sea Island

Three potential options for a marine terminal were considered west of Sea Island: a floating Single Point Mooring facility, also called a “mono-buoy”; a deep-water fixed marine terminal berth supported on piles; and a near-shore fixed marine terminal berth with dredged deep-sea access. Each of these would face major environmental, regulatory and cost challenges, and would require disturbance of the environmentally sensitive Sturgeon Bank and associated ecosystem. It is doubtful that Fisheries and Oceans Canada would approve any facility within the footprint of Sturgeon Bank. These issues are elaborated on.

Single Point Mooring Facility

No Single Point Mooring terminals currently operate in B.C., so a considerable amount of training would be required for vessel and tug crews, pilots, operators, and other personnel before such a facility could be put into operation.

Three possible locations were identified: two within the relatively narrow 1- to 2-kilometre strip of water situated between the main shipping lanes to the west and Sturgeon Bank to the east and one approximately six kilometres further offshore. Wind speeds greater than 25 knots typically occur about 3% of the year, which would equate to approximately 11 days each year when such a facility would not be operational. A Single Point Mooring would, therefore, experience a greater degree of weather-related downtime compared with a facility located in more sheltered waters, such as the Fraser River option being proposed by VAFFC.

The depth of each offshore location poses cost, construction, maintenance and operational challenges. In addition, all the options would require a pipeline (of varying lengths up to 15 kilometres) that would cross the environmentally sensitive Sturgeon Bank.

Deep-Water Fixed Terminal

A fixed marine terminal located west of Sturgeon Bank would introduce man-made structures to an area well out into the Strait of Georgia, an area which currently appears “natural”, and is widely appreciated for its scenic and recreational values.

To accommodate fully-laden Panamax-class tankers, and potentially larger Aframax- and Suezmax-class tankers, a fixed terminal would require water depth of approximately 18 to 22 metres. Without dredging, such a terminal would need to be located at least 6 kilometres west of Sea Island to reach water of adequate depth. An access trestle would lead to shore, supporting a pipe rack and providing shore access to personnel and maintenance vehicles. The trestle would cross the environmentally sensitive Sturgeon Bank and have adverse effects on the intertidal ecosystem.

This option would also conflict with Vancouver Airport Authority's Master Plan, which includes an option for an additional 4,270-metre runway within an airside reserve extending 5,500 metres west from the existing west dike out into the ocean for the entire width of Sea Island.

Operational costs associated with access and maintenance for this type of facility would be comparatively very high due to the remote location and sea conditions.

Near-Shore Fixed Terminal

A fixed marine terminal berth located closer to Sea Island would require extensive dredging of Sturgeon Bank to create a navigable channel of suitable width and depth. Given the ecological sensitivities of Sturgeon Bank, this option would face significant regulatory challenges. The dredged channel would offer better access and lower exposure, however an analysis of dredging costs for access by deep-sea vessel make this sub-option prohibitively expensive.

2.3.5.4 Upgrade or Replacement of the Existing Pipeline Delivery System

This option would require a major upgrade or complete replacement of the existing 41-kilometre long pipeline system to meet the long-term fuel requirements at YVR. The pipeline is owned by Trans Mountain (Jet Fuel) Inc., a subsidiary of Kinder Morgan Canada, so an upgrade is not within VAFFC's control. A partial upgrade or addition of pumping stations would only provide a short-term solution and full replacement of its 41-kilometre length would be cost prohibitive compared with VAFFC's proposed delivery system. Even if the pipeline system was upgraded or replaced, it would not provide the necessary secure access to the offshore fuel supply market. In addition, the marine terminal and storage facilities located on Burrard Inlet are owned by a third party and not part of the delivery system, adding another degree of uncertainty.

In 2007, Trans Mountain (Jet Fuel) Inc. applied to the B.C. Utilities Commission to increase its rates. The company was seeking to almost double its rates so it could recover its invested capital in the system and abandonment costs over a five-year time frame, which it believed was the remaining economic life of its pipeline system. This application was filed because Trans Mountain (Jet Fuel) Inc. believed the Project proposed by VAFFC would be built within this time frame and that it represented a superior delivery system option from several perspectives, including economics and access to fuel sources (see also the independent consultant report undertaken on behalf of Trans Mountain (Jet Fuel) Inc. in **Appendix 2B**).

2.3.5.5 Vessel Delivery to a Marine Terminal Located on the South Arm of the Fraser River (the Preferred Option and the Project)

This option would require a marine terminal and fuel receiving facility located on the South Arm of the Fraser River, and a pipeline to deliver fuel to YVR. In addition to vessels from offshore sources, existing vessels would be redirected from their current transit route in the Strait of Georgia to Burrard Inlet to a fixed deep-water marine terminal berth on the Fraser River. Fuel would be off-loaded and transferred via pipeline to tanks at a new fuel receiving facility nearby. From there, fuel would be delivered to YVR via a new purpose-built underground pipeline. Based on the outcome of the screening level evaluation, the Fraser River marine terminal, fuel receiving facility and pipeline option emerged as VAFFC's preferred option primarily based on environmental and cost considerations, and on access to deep water.

In 2005, VAFFC initiated preliminary consultation with the Fraser River Port Authority (now amalgamated into the Vancouver Fraser Port Authority) to explore potential opportunities for the Fraser River option in more detail. During this time, VAFFC also held direct communications with operators and owners of existing berthing and docking facilities located on the Fraser River (see **Section 2.6.1.2**).

In 2007, the opportunity arose for VAFFC to preserve the Fraser River option through the acquisition of a waterfront property on the north shore of the river. An important component of the property was an existing deep water dock facility and Water Lot. Opportunities to purchase properties of this type and in this location are extremely rare. This acquisition followed an extensive survey of potential terminal sites on the South Arm of the Fraser River, conducted in 2006. VAFFC purchased the property for the following reasons:

- The deep-water available at this location on the Fraser River affords a full range of vessel sizes to provide maximum flexibility and security for sourcing aviation fuel;
- Navigability within the Fraser River is well-proven based on existing shipping traffic, and the Fraser River Pilots indicate that the marine terminal is located in one of the widest sections of the river;

- The marine terminal property is relatively sheltered, with reduced risk of vessel delays or operational downtime caused by inclement weather;
- The marine terminal property is already an industrial development with existing marine infrastructure, requiring considerably less new development, capital cost and operating costs compared to other options; and
- The marine terminal property is surrounded by industrial lands suitably zoned for locating a fuel receiving facility, and Lulu Island provides a range of existing transportation and/or utility corridors suitable for pipeline routing.

2.3.6 Comparison of Net Effects - Existing Fuel Delivery System versus the Project

Overview

In analyzing the effects of the Project, it is essential to consider that the Project will replace an existing delivery system. Rather than an incremental activity, the Project represents an alternative means of supplying the fuel demand at YVR – a modernization of the fuel delivery system that better fits the logistics of the current fuel supply market.

As discussed in **Section 2.3.4,** the Project will have significant benefits, many of which relate to enhanced performance of fuel delivery, including operational, maintenance, reliability, safety and environmental attributes. Specifically, the existing fuel delivery infrastructure and related activity have an environmental footprint and effects profile that will be displaced by the Project. Consequently, to determine the net effect of the Project, the effects of the Project must be assessed based on a comparison with the existing system.

This section summarizes the net effect of continuing with the existing fuel delivery system versus VAFFC's proposed delivery system. The comparison includes a brief description of potential environmental and social issues with and without the Project. Both scenarios assume the same future fuel demand conditions. Some of the information presented below is also discussed in **Sections 2.3.1** to **2.3.5** in the context of Project justification and delivery system options. Where appropriate, these sections are referenced.

Continuation of the Existing Fuel Delivery System

As described in **Section 2.3.2**, the existing fuel delivery system involves the use of both pipeline and tanker truck delivery modes to supply YVR with sufficient fuel inventory. Given the limits of the domestic aviation fuel supply, any increase in the demand for aviation fuel at YVR will need to be supplied from international sources. The existing pipeline cannot meet current peak demand and will be unable to meet future fuel requirements at YVR. As described in **Section 2.3.5.4**, VAFFC has determined that major upgrade or complete replacement of the existing pipeline system is not a viable option (see also the independent consultant report undertaken on behalf of Trans Mountain (Jet Fuel) Inc. in **Appendix 2B**). Consequently, any increase in fuel demand at YVR would need to be met by increasing marine vessel shipments and truck deliveries.

Operation of the existing infrastructure without a major upgrade of the Trans Mountain (Jet Fuel) Inc. pipeline would not be viable in the long term. Significant issues associated with the continued operation of the existing fuel delivery system include the following:

(a) Existing pipeline limitations

As described in **Section 2.3.2**, Trans Mountain's pipeline system was constructed in the late 1960s. Given its length (i.e., approximately 41 kilometres cumulative length), location and age, the costs involved in operating, maintaining and repairing the pipeline would be significantly greater than those of the proposed new pipeline. Ongoing operational issues are also complicated by the level of development, overgrowth and urban encroachment along the pipeline right-of-way.

The delivery capacity of the existing pipeline cannot meet peak demand at YVR. The ability to increase pumping pressure to deliver more fuel is also limited.

(b) Increased reliance on tanker truck deliveries

Currently, about 1,000 tanker truck round-trips, each totalling approximately 150 kilometres, are made each month between Washington State and YVR. Total distance travelled on Canadian roads is approximately 90 kilometres on each round trip (i.e., currently approximately 1 million kilometres are travelled each year by tanker trucks on Lower Mainland highways and roads).

Given the limits on the existing pipeline and the need to deliver fuel from international supply sources, continued use of the existing fuel delivery system will inevitably lead to a dramatic increase in tanker truck deliveries. The rate of tanker truck deliveries could be expected to increase about 120% within the next 10 years (i.e., to approximately 2,200 round-trips per month by 2020). This would represent approximately 2.4 million kilometres travelled each year by tanker trucks on Lower Mainland highways and roads. By 2028, this is forecast to reach approximately 3,300 tanker round-trips per month and 3.6 million kilometres travelled each year.

Increasing the tanker truck deliveries will add to the environmental and social footprint effects of the existing delivery system, including: public safety issues; traffic congestion; wear and tear on roads; noise; and exhaust (Criteria Air Contaminants (CAC); GHG) emissions. The emissions issue is particularly important because the truck deliveries would peak during the peak fuel demand period in the summer, which is when exhaust emissions are of most concern in the Lower Mainland airshed.

The tanker truck receiving capacity at YVR would also have to be expanded substantially to accommodate the offloading and traffic congestion associated with increase truck movements. Opportunities for expansion at this site are limited.

(c) Viability of a major pipeline upgrade

As described in **Section 2.3.5.5**, a major upgrade or complete replacement of the existing pipeline system is not a viable option (see also the independent consultant report undertaken on behalf of Trans Mountain (Jet Fuel) Inc. in **Appendix 2B**). Further, given the footprint of the existing pipeline from Burnaby to YVR, a major upgrade of the pipeline would involve a significantly larger undertaking than the proposed Project in terms of complexity, environmental and community impacts, costs and time. VAFFC has not assessed these impacts in detail, but has considered them on an order of magnitude basis.

(d) Other environmental and economic considerations

Approximately 70% of the existing pipeline right-of-way traverses the densely populated residential neighbourhoods and built-up urban surroundings of Burnaby, and industrially/commercially developed areas of northwest Lulu Island. The balance of the right-of-way traverses a combination of industrial lands located in Burnaby and agricultural lands in north Richmond, and crosses under the North and Middle arms of the Fraser River. The right-of-way also crosses a number of major trunk roads and smaller arterial connectors, several railway tracks, parks and trails, more than 18 watercourses in addition to the two crossings of the Fraser River, and a large number and a complex network of utility corridors and other utility rights-of-way. Considering the pipeline's length and complex routing, its physical footprint would be almost three times larger than that of the proposed pipeline.

Currently, two to three marine shipments per month are made between the Cherry Point Refinery and Westridge Marine Terminal in Burrard Inlet. These vessels transit the Juan de Fuca Strait and Strait of Georgia, pass by the mouth of the Fraser River, Roberts and Sturgeon banks, YVR and Stanley Park before passing through First and Second narrows. Total distance travelled in Canadian waters is approximately 120 kilometres round-trip (i.e., currently approximately 3,600 kilometres are travelled each year by vessels in Canadian waters to meet approximately 40% of YVR's fuel requirements).

Construction and Operation of the Proposed Fuel Delivery System

On a comparative basis, the operational performance of the Project would be superior to that of the existing fuel delivery system, with a smaller environmental and social footprint. The following points elaborate on this comparison:

(a) Pipeline performance after modernization

The proposed fuel delivery system will be designed, constructed and operated in accordance with current regulations and BMPs. The ability to design and construct a new system will allow the system to be built to specifically meet the needs of YVR and to incorporate current technology and components. The outcome will be reflected in the superior performance of the fuel delivery system with respect to operational, maintenance, reliability, safety and environmental aspects.

The pipeline route will follow existing utility rights-of-ways and transportation corridors. As described in **Section 2.1.1.3**, based on the preferred alignment, VAFFC proposes to install a large section of the pipeline within the existing CNR railway corridor, which runs parallel to Shell Road between Williams Road and the Bridgeport Trail. The pipeline will be well marked and mapped using GPS technology for ease of location. Access to the pipeline right-of-way will be significantly less challenging and complex compared to that of the existing pipeline.

Maintenance of the entire fuel delivery system will be significantly easier to manage due to new components, the single ownership structure, shorter pipeline and less complex right-of-way access. Maintenance will be infrequent and less costly compared with that of the existing system operation.

All buried sections of pipeline will be protected from corrosion using modern cathodic protection systems and extremely resilient coatings. Properly protected pipelines can have an indefinite lifespan. The entire pipeline system will be constructed to current Canadian and international standards using high-strength, thick-walled piping, and will include leak detection and locating systems. The comparative risk of third-party damage will be low.

(b) Elimination of the need for tanker truck deliveries

Up to 35 tanker trucks a day currently pass through or adjacent to five municipalities in the Lower Mainland. In the absence of the Project, that rate of traffic is predicted to increase to over 120 trucks a day within 20 years.

The Project will eliminate the need for tanker truck deliveries. Transportation by marine vessels for the international deliveries is far superior to truck deliveries. As reported by FREMP, barging represents approximately one-tenth of the transportation costs and one-twentieth of the environmental costs compared to an equivalent volume of trucking (FREMP 2006).

Large marine vessels release fewer emissions into the atmosphere compared with tanker trucks carrying the same volume of fuel spread over numerous trips. In fact, analysis indicates that, in 2016, the GHG emissions associated with the Project would be approximately 70% less than the emissions generated by the existing system (see **Section 5.4**).

(c) Viability of a new fuel delivery system

The Project will be able to accommodate future growth in YVR fuel demand without the need for additional infrastructure. The fuel receiving and pipeline systems will be designed so that the fuel supply rate can be increased or decreased by adjusting the number of marine deliveries. This flexibility will serve YVR's needs over the long term.

(d) Other environmental and economic considerations

The physical characteristics of the Project sites and pipeline route are described in more detail in subsequent chapters of this Application. The key comparative distinction is that the new pipeline route will be about one third the length of the existing pipeline system.

The proposed fuel delivery system will eliminate the need for tanker trucks, the single largest visible component of the current fuel delivery system. The only visible activity of the proposed Project will be the marine vessels travelling on the lower Fraser River. Vessel transit distance in Canadian waters will be half that of the current distance to the Westridge Marine Terminal. Distance travelled in Canada per litre of fuel will be significantly shorter compared with the existing system.

Eight municipalities (i.e., Delta, Richmond, Vancouver, Bowen Island, West Vancouver, North Vancouver, Burnaby and Port Moody) have shorelines located along the current vessel transit route, whereas only Delta and Richmond will have shorelines along the proposed vessel transit route. The shorelines and biophysical, socio-economic and heritage resources associated with the lower South Arm of the Fraser River will have a new risk of exposure to accidents or malfunctions from vessel movements and marine terminal operations in the river. This risk will essentially be transferred from Burrard Inlet where these movements of fuel will be discontinued.

The Project will allow YVR to access a worldwide range of dependable, diverse and competitive offshore fuel supply sources. As long as the fuel supplier has access to tide water, it will be able to ship fuel to YVR. Access to this global market will greatly improve the economics, reliability and security of fuel supply to YVR.

2.4 Project Description

2.4.1 Project Design Suitability

The basis of this Project is to establish a deep-water marine terminal to allow ocean-going vessels to arrive from international sources. The selected location for the marine terminal on the Fraser River was identified as optimal when considering the river depth is maintained for deep draft vessels, the river is a relatively calm body of water for vessel transit and mooring, and the distance to facilities at YVR is minimized.

The marine terminal and fuel receiving facility will be designed and sized to accommodate the cargo loads of a typical range of vessels carrying aviation fuel. The size and draft of vessels will not likely change significantly over the life of the Project; hence the marine terminal and fuel receiving facility are expected to be suitable for these vessels for their lifespan.

The pipeline to YVR will be designed not only for robustness to protect against seismic and third-party damage, but for long-term growth and increases in fuel flow rates. A properly designed and protected pipeline can last indefinitely assuming it continues to meet the performance criteria. This pipeline will be designed to carry many times the current and forecast capacity requirements of airlines at YVR.

The use of aviation fuel for flying aircraft is not expected to change significantly in the foreseeable future. The use of biofuels and biofuel blends will eventually become commonplace and has been considered in the overall Project plan. The current biofuel options for aviation fuel are all in liquid form and will be compatible with a delivery system designed for the current standard of aviation fuel.

2.4.1.1 Project Design Life

There is no clear end to the need and use of liquid aviation fuel at YVR, and a delivery system will be required well beyond the design life of the proposed Project. However, design life is a term which considers how maintenance, repair, revenue or other factors make it uneconomical to continue operating. With an indefinite need for the Project, VAFFC expects the design life to be as long as possible. The design life for facilities of this nature is dictated by corrosion rates of the marine terminal structure, steel tanks and pipeline. Controlling corrosion is therefore of paramount importance and the focus of design, operation, and inspection over the life of the system.

All new structures will be designed for a minimum service life of 60 years, which includes consideration of significant maintenance items such as:

- Routine inspection for deterioration and damage;
- Replacement of fender system on marine terminal (every 20 years);
- Repair and repainting of above ground tanks at fuel receiving facility (every 25 years);
- Ultrasonic inspection and spot repair of pipeline (every 5 to 10 years); and
- Pump system overhaul (every 10 years).

Notwithstanding a seismic or other natural disaster, maintenance items such as repair/replacement of the entire pipeline, repair/replacement of all aboveground tanks, or replacement of the terminal wharf structure are considered beyond the service life of the Project and not expected to occur within the 60 year design life.

2.4.2 Engineering and Design Criteria

VAFFC will use BMPs and modern design principles in developing the detailed design and operating parameters for the Project. This chapter elaborates on the design methodology.

The design of all Project infrastructure and associated ancillary equipment will be carried out by qualified Professional Engineers. Performance criteria of the proposed marine terminal, fuel receiving facility and fuel pipelines will be tested, evaluated and audited to ensure their design, construction and operation/maintenance are suitable for the intended use, and public and environmental safeguards are met.

Fundamental components of the design, review and audit process are:

- Design and Maintenance record-keeping;
- Quality Assurance and Quality Control program during construction and third-party inspection program during operations; and
- Process for management and response of deficiencies and inspection findings.

In Canada no explicit design code or standard applies to the design and construction of marine facilities, including “oil and gas handling facilities” such as the proposed marine terminal. Engineering of such facilities is generally carried out using a combination of existing Canadian codes (i.e., those developed for other purposes), supplemented by internationally recognized codes and standards developed in other jurisdictions. The primary relevant Canadian codes include the National Building Code of Canada (2005), and the Canadian Highway Bridge Design Code (CAN/CSA S6), developed for buildings and bridges respectively.

The largest component of the proposed fuel receiving facility is the aboveground tank system which will be designed, constructed and operated in accordance with the Canadian Standards Association (CSA Z662), the American Petroleum Institute (Standard 650) and the National Fire Code of Canada. There are a number of other components at the facility requiring other design and operating codes, such as the National Building Code.

The pipeline system will be designed, installed, tested, operated and maintained in compliance with the *Oil and Gas Activities Act*, current Canadian Standards Association standards (e.g., CSA-Z662: Oil and Gas Pipeline Systems; CSA-Z245.1 and CSA-245.20/21, and CSA-B836: Storage, Handling, and Dispensing of Aviation Fuels at Aerodromes) and applicable Reference Publications such as the "Pipeline Associated Watercourse Crossings, 3rd Edition (2005)" and the City of Richmond Riparian Management Area protocols. The work will also conform to other relevant acts, regulations, codes and standards, as well as Vancouver Airport Authority's standards and procedures.

All materials (i.e., steel pipe-piles, concrete and metal fabrications) and testing will conform to the latest editions of relevant codes and standards published by the Canadian Standards Association and the American Society for Testing and Materials. All existing and new steel pipe-piles will be cathodically protected with an impressed current or sacrificial anode system to inhibit corrosion.

A list of codes and standards that will be utilized during engineering and design of the Project is included in **Appendix 2C**. This list has been developed so that there is one location within the Application (a master list) for all applicable codes and standards. This list includes codes and standards discussed in other chapters, which address, for example, fire and spill prevention and preparedness. In some instances it is also necessary to describe relevant codes and standards in the text of some chapters, particularly **Chapters 16**, **17** and **18**.

A suite of engineering and design features will be implemented for the Project that relate to spill and fire prevention and preparedness (see **Chapters 17** and **18**, respectively). Examples include fuel unloading arms, secondary containment of fuel storage and handling areas, fire hydrant systems, cathodic protection systems and emergency shut-off valves for fuel pipelines.

Chapter 17 describes spill prevention, preparedness and emergency response facilities and planning for Project operations. Similarly, **Chapter 18** describes fire prevention, preparedness and emergency response facilities and planning for Project operations.

2.4.3 Construction and Operations Plans and Programs

Project construction and operations will be guided by environmental and engineering plans and procedures that meet all relevant regulatory requirements (**Figure 2.4.1**).

Construction activities will be guided by the Construction Environmental Management Plan (CEM Plan), the Traffic Management Plan and the Construction Site Safety Manual. The CEM Plan is described in detail in **Chapter 9**. Traffic management will be addressed separately from the CEM Plan within the Traffic Management Plan, and site-specific health and safety management will be covered in the Construction Site Safety Manual (see **Chapter 9**).

Operations and maintenance activities will be guided by the Marine Terminal Operations and Maintenance Manual and the Pipeline System Operations Manual, which will conform to all relevant requirements, including those of the B.C. Oil and Gas Commission.

The Marine Terminal Operations and Maintenance Manual will cover all aspects of marine terminal and will include the following:

- Pre-Arrival and Tanker Vetting Procedures (including a Tanker Acceptance Program);
- Berthing, Mooring and Bunkering Procedures;
- Fuel Cargo Transfer Operations Plan;
- Marine Terminal Arrival Plans;
- Marine Terminal Departure Plans;
- Marine Terminal Facility Security Plan;
- Oil Pollution Emergency Plan; and
- Operator Safety Procedures.

The Pipeline System Operations and Maintenance Manual will include the following:

- Pipeline Damage Control Program;
- System Integrity Management Program;
- Pipeline System Operations and Maintenance Procedures;
- Operator Safety Procedures; and
- Administrative and Engineering Procedures.

A detailed description of the components of the Pipeline System Operations and Maintenance Manual that will include all aspects of the pipeline system is provided in **Chapter 17**. The System Integrity Management Program will conform to the requirements of the Canadian Standards Association (i.e., CSA-Z662, Annex N) and will provide comprehensive management of the pipeline system in its entirety, from the fuel unloading arm at the marine terminal (at the entry to the fuel transfer pipeline) to the fuel receiving facility and the terminus of the fuel delivery pipeline at YVR.

Operations and maintenance activities will also be guided by the Operations Environmental Management Plan (OEM Plan), which is described in detail in **Chapter 9**. The OEM Plan is expected to include the Spill Prevention, Preparedness and Emergency Response Plan as a subcomponent. The Spill Prevention, Preparedness and Emergency Response Plan will meet all Transport Canada requirements for spill response and all B.C. Oil and Gas Commission requirements for emergency response, and will address fire safety in accordance with the National Fire Code.

2.4.4 Project Component Details

The following subsections provide detailed preliminary design descriptions of Project components, and typical construction and operations activities associated with each. An overview of the location of Project components is provided in **Figure 2.4.2**.

2.4.4.1 Marine Terminal

Introduction

The existing wharf structure was constructed in the 1990s by a previous owner and was intended to accommodate vessels up to 30,000 deadweight tonnes, but has been largely unused for the past several years (see **Photos 2.4.1** and **2.4.2**). The wharf was constructed using closely-spaced steel pipe piles driven side-by-side into the river bottom. Tie-back rods were installed connecting the steel piles to concrete anchors buried in the fill behind the wall.

Photo 2.4.1 View of West (Downstream) End of the Existing Bulkhead Wharf

Photo 2.4.2 View Southwest (Downstream) along the Existing Bulkhead Wall

The major components of the marine terminal upgrades are expected to include:

- structural strengthening of the existing bulkhead wharf and replacement of fill material;
- construction of new pipe-pile self-supporting breasting dolphins and mooring structures;
- construction of a self-supporting central cargo unloading platform to accommodate fuel unloading arms, transfer pipeline and fire suppression equipment;

- dredging and scour protection works on the riverbed at the face and sides of the existing bulkhead perimeter wall; and
- construction of self-supporting emergency/utility boat launch facility.

Marine terminal upgrades will provide a modern and secure facility to safely berth, moor, and off-load fuel cargo. **Chapter 20** assesses vessel navigation and the potential interference of the marine terminal structure on navigation in the river.

Reference Footprint – Location and Mapping

The marine terminal is located on the north shore of the South Arm of the Fraser River at the foot of Williams Road, City of Richmond, B.C., approximately 21 kilometres upstream from Sand Heads (Latitude: 49°08.36' North, Longitude: 123°03.33' West) (see **Figure 2.4.3**).

The 4.1 hectare (10 acre) triangular-shaped waterfront parcel[1] is owned by VAFFC and comprises approximately 3.1 hectares (7.7 acres) of upland and 1 hectare (2.3 acres) of riverbed. A separately owned 0.53 hectare (1.3 acre) railway land parcel and City of Richmond dike right-of-way bisect upland areas of the property (see **Figure 2.4.4**).

Facilities and Design Parameters

The terminal wharf and associated infrastructure will be upgraded, constructed and operated in accordance with current accepted BMPs applicable to marine structures of this nature. Engineering and design criteria are described in **Section 2.4.2**.

General Arrangement

A plan view of the proposed layout is shown in **Figure 2.4.5**. Four new mooring dolphins and a central off-loading platform are expected to be installed off the existing face of the pipe-pile bulkhead wall. The resultant new berthing face will extend approximately 12 metres out into the river from the existing berthing face. The new mooring dolphins and central unloading platform will each be supported by approximately six in-water steel pipe-piles driven into the riverbed. The mooring dolphins will likely be accessed by a catwalk. The unloading platform is expected to be supported by an additional three steel pipe-piles driven into the material located inside (i.e., land-side) of the existing bulkhead face (see **Figure 2.4.5**).

[1] Legal Description: Section 34, Block 4 North, Range 5 West Except: Part (1.41 acres) shown coloured pink on Plan 4933; Secondly: Parcel A (Plan with Bylaw filed A32824); Thirdly: Parcel B (Plan with Bylaw filed A32824) New Westminster District.

Fuel cargo transfer from vessel to shore will be accomplished using hydraulically-operated and articulated unloading arms that connect to a vessel's manifold (see **Figure 2.4.6**). The unloading arms will be designed to accommodate horizontal and vertical movements (i.e., as the vessel's draft changes during the off-loading process). The arms will also be designed to follow the vessel as it moves slightly under the influence of the winds, tides, and currents. If for any reason the amount of movement approaches the maximum allowable limit, visual and audible alarms will be triggered to allow the operators to take the necessary action. If the movement envelope is exceeded, the fuel cargo transfer process will be automatically halted and the arms disconnected using leak-free emergency release couplings (see **Chapter 17**). Remotely-operated foam spray fire monitor towers will also be located on the off-loading platform in the unlikely event of a fire during the unloading process.

The new berthing dolphins will be equipped with double quick-release mooring hooks and fenders. The unloading platform is expected to accommodate the hydraulic arms, transfer pipeline, dock shelter and fire monitoring equipment, and will be designed with a perimeter spill containment curb (**Figure 2.4.7**).

Four new mooring structures are also expected to be installed in upland areas of the marine terminal property, each equipped with quick-release mooring hooks (see **Figure 2.4.5**).

The fuel transfer pipeline will likely be situated on a pipe rack in the upland areas of the marine terminal property. To cross the existing dike right-of-way on the marine terminal property without impeding surface access, the pipeline will pass underground through a purpose built encasement and resurface on the other side (see **Figure 2.4.5**). From there it will connect with a purpose built processing unit situated near the relocated entrance to the property on the northeast side (see **Figure 2.4.5**). The processing unit will accommodate various ancillary components, such as the transition valves, auxiliary pumps, cathodic protection system and a pipeline “pig” launch.

Other general features of the marine terminal include an operations building and staff parking area (see **Figure 2.4.5**), a waterfront emergency/utility boat launch facility (see **Figure 2.4.8**), boom and skimmer deployment systems (see **Chapter 17**), perimeter security fencing and closed-circuit television cameras, high-mast lighting towers, and upland landscaping.

A conceptual rendering of the proposed marine terminal is provided in **Figure 2.4.9**. A publicly accessible trail adjacent to the rail right-of-way, connecting the Richmond dike trail system on either side of the property, is currently envisioned.

Construction-Phase Activities

Construction of the marine terminal upgrades will involve both on-land and over-water activities. These activities will involve the use of standard construction equipment including excavators, dump trucks, concrete mixer trucks, mobile cranes, and pile-drivers. All in-water works will be undertaken using equipment and machinery located on a spud-anchored barge (see **Chapter 9**). The marine terminal upgrades are expected to take approximately eight months, including approximately four months for in-water works.

The property is accessible by barges and is close to existing transportation routes and utilities, providing the construction Contractor(s) with a number of options regarding material deliveries and supply of the necessary power and water. It is expected that some equipment and material will be delivered to the site by barge, but the majority will be delivered by road. Certified traffic control people and other standard traffic control measures will be implemented as needed (see **Chapter 9**).

Construction power and potable water will likely be obtained through temporary tie-ins to the local B.C. Hydro and municipal water grids, respectively. Sanitary wastewater from the site will likely be collected in tanks and removed from site by pump trucks for appropriate disposal. Storm water runoff from the site will be managed to control sediment erosion (see **Chapter 9**).

Excavation and Backfill

Landside

The area located behind (i.e., landside) of the existing perimeter pipe-pile bulkhead wall requires structural strengthening to conform to current seismic design criteria, and accommodate increased berthing loads from the maximum design vessel (i.e., Panamax-class). The existing fill material footprint inside the perimeter pipe-pile bulkhead wall will be excavated and disposed of to an appropriate offsite receiving facility on land (see **Chapter 9**), and backfilled using clean and appropriately engineered imported rock/gravel material. The backfilled area will undergo ground densification to improve the seismic capacity of the fill and structure (see **Figure 2.4.10**). The total volume of material to be removed and disposed of is estimated at 39,000 cubic metres. A similar volume is expected for replacement material.

Waterside

Where scour protection (i.e., rip-rap) is currently in place at the base of the bulkhead perimeter wall, this material will be removed and disposed of to an appropriate offsite receiving facility (see **Figure 2.4.11** and **Chapter 9**). Following the removal of scour protection, the existing riverbed profile will be dredged to provide consistent elevation below the high-high-water-level. The total plan area to be dredged is estimated at 2,800 square metres and the total volume of material to be removed estimated between 3,000 and 5,000 cubic metres. Dredged material will be disposed of to an appropriate offsite receiving facility on land. No dredged material will be disposed of at sea (see **Chapter 9**).

Following dredging and in-water pile-driving (see Pile-Driving below), new scour armour protection will be installed on the riverbed at the base of the perimeter pipe-pile bulkhead wall (see **Figure 2.4.11**). The total plan area to receive new scour protection and the total volume of material to be removed are estimated at 3,100 square metres 6,500 cubic metres, respectively. Areas of existing rip-rap along the property shoreline may be replaced or re-graded to improve shoreline stability and facilitate water access for a utility boat launch.

Pile-Driving

Landside

A short pile-driving program will be required in upland areas of the property to install the new mooring structures. The ground beneath each structure will undergo densification. Each mooring will be supported on approximately four concrete-filled steel pipe-piles, driven into the ground, and capped with concrete. Approximately three concrete-filled landside steel pipe-piles will be required to support the central unloading platform. These will be located inside of the existing bulkhead perimeter face.

Waterside

A pile-driving program will also be required for the installation of in-water steel pipe-pile supports. It is currently expected that a total of approximately 36 concrete-filled steel pipe-piles will likely be required to support the new mooring dolphins (e.g., six pipe-piles each), central unloading platform (e.g., six pipe-piles) and emergency/utility boat launch facility (e.g., six pipe-piles). Installation of these piles will be undertaken following the removal of existing riverbed scour protection and dredging, and new scour protection will be installed following the pile-driving works (see Excavation and Backfill above).

Structural Strengthening

The existing perimeter pipe-pile bulkhead wall will undergo structural strengthening upgrades. The top of the steel pipe-piles will likely be fitted with shear connectors and lined with steel reinforcement. A new reinforced continuous concrete cope beam is expected to be installed along the top of the face and sides of the perimeter bulkhead wall to provide structural rigidity. The cope beam will also provide a uniform surface for locating the access catwalks and the central unloading platform.

Construction Utility and Services Requirements

Temporary facilities including a site office, washrooms and onsite kitchen will be required during the construction upgrades, along with portable or temporary connections to potable water, sewage and electrical power. Radio communications systems are expected to be used onsite. In addition, temporary fuel storage facilities and the associated spill prevention and emergency response equipment, which will be detailed in the CEM Plan (see **Chapter 9**), are also expected to be onsite.

Site Demobilization

The Contractor will be responsible for the transportation of personnel, and removal of equipment and operating supplies from the site under the overall direction of VAFFC. This will include the removal of temporary offices, fencing and any other general facilities erected or placed by the Contractor.

Operations Phase Activities

The marine terminal will experience intermittent operations (i.e., it will only be operating when a vessel is berthed and off-loading its cargo). Initially, vessel traffic is expected to include one to two barges every two weeks with an off-loading time of approximately 12 hours, and one larger tanker vessel every month with an off-loading time of between 24 and 36 hours. Operations will commence when vessels are berthed at the marine terminal. Tug boats will be used to assist vessels in berthing and deberthing manoeuvres (see **Section 2.4.4.4**). Shore-based terminal operations staff will assist vessels in securing their mooring lines to the berthing and mooring dolphins.

Once the unloading arms are connected to the vessel's manifold, a series of pre-cargo transfer operational checks, including sampling and testing of the fuel, will be completed prior to the commencement of off-loading. Terminal operations staff will monitor the cargo transfer operation using instruments as well as visual observations to ensure the equipment is operating normally (see **Chapter 17**).

Electronic monitoring systems, visual and audible alarms and equipment interlocks will also be in place to trigger an automatic shut-down of pumping activities in the event conditions are detected outside of normal operating limits (see **Chapter 17**). Once the cargo off-loading and transfer operations are complete, the vessel will commence its pre-departure checks and then de-berth (see **Section 2.4.4.4**). Terminal operations staff will be present for the duration of off-loading activities.

Routine maintenance activities will include pre-arrival and periodic inspection and testing to ensure all equipment is in proper working order. Less frequent maintenance will include corrosion inspections above and below the waterline, depth surveys, and fender system repair and replacement.

Operations Utility and Services Requirements

Electrical power to the marine terminal will be provided through connections to the nearest B.C. Hydro distribution grid. The specific electrical requirements (i.e., power, voltage, etc.) to meet the site needs will be developed during detailed design. Routine telephone, data, closed-circuit television cameras, fibre optics, and other communications services will also be developed during detailed design.

Potable water and sanitary sewer connections will be required for the operations building. It is expected that a new water-looping project being undertaken by the City of Richmond and the Port will provide access to potable water from Williams Road or Dyke Road. Washroom facilities are expected to be connected to the City of Richmond's existing sanitary sewer system.

2.4.4.2 Fuel Receiving Facility

Introduction

The fuel receiving facility will consist of six receiving tanks, secondary containment, transfer pump system, filtration system, storm water management system, and operations building. Fuel cargo will be received into the tanks from vessels off-loaded at the marine terminal through a short underground transfer pipeline. Fuel will then be delivered to the fuel storage and dispensing facilities at YVR through an approximately 15-kilometre long delivery pipeline using the transfer pump system.

The following permanent utility and auxiliary systems are expected to be associated with the facility:

- Electrical Power Generation and Distribution, including: Transformers, Switchgear, Multiple Voltage Distribution, Emergency Generation and Uninterruptible Power Supply Systems;
- Potable and Service Water;
- Mechanical Handling Systems including Fixed Cranes and Lifting Devices;
- Sanitary Sewer Connection;
- Storm Sewer Containment and Treatment;

- Waste Oil/Fuel Collection System;
- Utility Air and Instrument Air; and
- Diesel Fuel Oil Storage (for back-up systems).

Reference Footprint – Location and Mapping

VAFFC proposes to locate the fuel receiving facility on approximately 4.8 hectares (12 acres) of industrial zoned land that VAFFC would lease from the Port (Latitude: 49°08.32’ North, Longitude: 123°03.18’ West, at an approximate elevation of 2.4 metres above sea level). The proposed lease area is situated in Section 27 at the southwest corner of the larger parcel of Port lands identified as “Lot #1, Plan 74529”[2], which covers approximately 19 hectares (47 acres) in total.

The lease area is suitably sized to accommodate an additional two tanks in the event that future fuel storage is required, as determined by future fuel demand at YVR. An overview of the proposed location for the fuel receiving facility is provided in **Figure 2.4.12.**

Facilities and Design Parameters

The fuel receiving facility and associated infrastructure will be constructed and operated in accordance with current accepted BMPs applicable to facilities of this nature. Engineering and design criteria are described in **Section 2.4.2**.

General Arrangement

The six tanks will be above ground vertical carbon steel single wall tanks, each approximately 33.5 metres in diameter and 14.6 metres high. The tanks will provide a combined total capacity of approximately 80 million litres (e.g., 500,000 barrels) (**Figure 2.4.13**). The tanks will be situated in, surrounded and confined by impermeably lined and bermed secondary containment (see **Chapter 17**).

The tanks will:

- Be fitted with a primary and secondary level control system, which will include monitoring and overfill protection (see **Chapter 17**);
- Incorporate a pressure/vacuum venting system to control emissions;

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[2] Legal Description: Lot 1, Sections 27 and 23, Block 4, North Range 5 West New Westminster District, Plan 74529.

- Be designed to accumulate water at the bottom, which will be removed through a quick flush system designed to separate fuel from water; and
- Be fitted with automatic motorized valves to control the receiving and dispensing of product. Valves will also be designed to close when commanded by the "Emergency Shut-Down" system and fire detection equipment (see **Chapter 17**).

Fuel received from the marine terminal will go through an inbound filtration system prior to entering the tanks. The filtration system will be located on a concrete containment pad outside of the secondary containment area. On the tanks outbound system, three transfer pumps are expected for the transfer of fuel to the storage facilities at YVR, with one pump designed as an auxiliary back-up. A simplified process flow diagram of the fuel receiving facility is shown in **Figure 2.4.14**. The pump system will be installed on a concrete containment structure.

The operations building will house offices for facility operations staff, a control room for the facilities, a motor control centre and a maintenance shop.

An access road will likely follow the inner perimeter of the fenced area with space set aside for vehicle parking.

Other key elements of the facility are expected to include:

- Stop valve to be located upstream of the oil/water separator system to provide protection against a large fuel release that could be capable of overwhelming the oil/water separator system (see **Chapter 9**);
- Perimeter fire hydrant system to provide access to water at key locations for the purposes of fire fighting (see **Chapter 18**);
- Automatic leak detection system to monitor pressure and flow rate on the incoming (i.e., transfer) and outgoing (i.e., delivery) pipelines (see **Chapter 9**);
- Cathodic protection system to inhibit corrosion of tank bottoms and underground fuel pipelines;
- Foam storage and distribution system for protecting tank contents against fires; and
- Fire water storage and spray monitor system to suppress fires and protect adjacent tanks from a tank fire.

Drainage from the secondary containment area will be isolated using a normally closed valve. The valve will remain closed during normal operations and opened intermittently to release surface water that collects inside the secondary containment area. An oil/water separator system will be incorporated into the drainage system in all fuel handling areas outside of the secondary containment area.

Each tank will have a high-expansion foam-rim fire-protection system that will be designed for connection to a portable foam trailer in the event of a fire. **Chapter 18** describes fire prevention, preparedness and emergency response facilities and planning for Project operations.

A conceptual rendering of the proposed fuel receiving facility is provided in **Figure 2.4.15**.

Construction-Phase Activities

Construction of the fuel receiving facility is expected to take approximately 18 to 24 months depending on the approach used for ground improvements.

Site Mobilization and Preparation

Mobilization and preparation will include transportation of Contractor personnel, equipment and materials to the site, and set-up of temporary site offices, power, lighting, fencing, material lay-down and storage areas and other necessary general facilities.

Temporary access roads, signage, and traffic control may also be necessary to provide contractors and suppliers efficient access to the site. Temporary roads using asphalt millings and granular sub-base are typical. These materials are often re-used as permanent structural fill later in the construction.

Preparation of the site for ground improvements will involve levelling to a working elevation typically around the base elevation of the future secondary containment area. Site preparation will also include sand base installation as a working surface for ground improvement and for establishing a perimeter drainage and sediment control system.

Earthworks and Ground Improvements

Ground improvement is required to provide the facility with the necessary stability to withstand a major seismic event. The area of the tanks and fuel handling equipment will either first be preloaded or over-excavated to mitigate settlement of the underlying shallow clayey silts.

Preloading could be achieved with river sand from the adjacent dredging operations. Preload is estimated to require 150,000 cubic metres of material to achieve the required ground response prior to construction. The preload would require placement for at least

12 months, and undergo continuous settlement monitoring by qualified geotechnical expertise, until sufficient settlement is achieved.

Over-excavation of the soft clayey silts and peat is expected to generate an estimated 100,000 cubic metres of unwanted spoil material. This would be replaced with dredged river sand as quality backfill material and compacted to the desired strength. Over-excavation and replacement of sub-base materials could take as little as three months and accelerate the remaining construction phases.

Typical to the deltaic soils of Richmond, ground improvement will consist of densification of the ground below the tanks to a depth of up to approximately 20 metres. The method most commonly used is vibro-replacement, or stone columns, where columns of native soils are replaced with columns of dense and compacted granular fill (**Figure 2.4.16)**. A crane mounted system injects water to effectively drill a hole down through the layers of soft clays, silts and sands. Coarse gravel is poured down the hole and collects at the bottom (**Photo 2.4.3**). The column is slowly compacted back to the surface leaving an almost uniform column of coarse gravel approximately 20 metres deep. This process is repeated as necessary to cover the area required to support the tanks.

Water and sediment control are important environmental aspects of this work and will be managed accordingly (see **Chapter 9**). Poor quality silty soils are expected to be produced during this process, which will be disposed of at a suitable land-based facility.

Photo 2.4.3 Typical Vibro-replacement Method of Ground Improvement

Trenching will be required to accommodate underground services and structures including electrical, water, telecommunication, sanitary sewer, surface water drainage, oil/water separator system, and the incoming and outgoing pipelines. Information indicates that municipal services are located along Williams Road and Dyke Road. Trenching across and possibly along sections of Williams Road near the facility will also be required for the pipelines.

Facility Access Road Construction

Paving will be required to provide an inner perimeter road for vehicle access, parking and walkways. A perimeter access road will be installed around the facility to provide vehicular access to fire hydrants and a ramp accessing the inside of the secondary containment area. Access road construction will require machine grading and compaction of the common fill or native base, and import and compaction of crushed gravel of varying grades in layers. Certain access roads may be covered with asphalt or concrete.

Preparation of Infrastructure Foundations

Seismic considerations (see **Chapter 21**) also likely require the tanks to be placed on solid concrete foundations placed above the soils previously densified during the ground improvement work. If required, each tank foundation will consist of a circular pan of concrete over 1 metre thick and 1 metre larger in diameter than the tank itself. The foundation will be reinforced with steel, and sloped to allow the tank bottom to drain to a center sump (**Photo 2.4.4**). The installation of concrete tank foundations is expected to take several months including curing of the concrete (**Photo 2.4.5**). Heavy trucks hauling forms, steel, and concrete will be required for the duration of this work.

Photo 2.4.4 Typical Tank Foundation Installation

Photo 2.4.5 Typical Completed Tank Foundation

<u>Fuel Receiving Tanks</u>

Each tank will be welded plate steel, which will be delivered to the site by truck or barge. The bottoms of the tanks will be constructed first, followed by up to five or six courses of rolled steel plate to form the cylindrical shape of the tanks (**Photo 2.4.6**). The tank roofs and various nozzles and connection points will be completed last (**Photo 2.4.7**).

The tanks, once completed, will be strengthened and leak-tested by filling with water prior to sand-blasting and epoxy painting (see **Section 5.4**).

Photo 2.4.6 Typical Tank Construction

Photo 2.4.7 Typical Tank Construction (2)

Perimeter Dike and Secondary Containment System

Once the tanks and foundations are in place, perimeter drainage, impermeable liner, and dike structures will be installed around the tanks. The tank area will drain to a central storm line controlled with a valve. This line will run to an oil/water separator system which will collect all runoff from areas where fuel handling and transfer activities occur.

The secondary containment area will be designed to current seismic standards. Because the containment area will be exposed to rain, the capacity will also include a volume allowance for rain events as well as the defined minimum fuel containment (see **Chapter 17**).

Process, Transfer, and Operations Areas

Outside of the secondary containment area will be the operations area where fuel will be processed through the inbound system or outbound system of pipes, valves, pumps, and testing equipment (**Photo 2.4.8**). The following is a list of ancillary equipment typical to fuel handling facilities:

- Perimeter fire main, hydrants and spray monitors;
- Pump and filter area;
- Foam connection station and distribution piping;
- Fuel quality testing station;
- Fuel recertification filtration system;
- Operations building;
- Leak detection system;
- Pipeline “pig” launching system;
- Oil/water separator;
- Storage building;
- Staff and maintenance parking areas; and
- Back-up generator system.

Photo 2.4.8 Typical Fuel Handling and Pump/Filter Areas.

Construction Utility and Services Requirements

Temporary facilities including a site office, washrooms and onsite kitchen will be required, along with portable or temporary connections to potable water, sewage and electrical power. Radio communications systems are expected to be used onsite. In addition, temporary fuel storage facilities and associated spill and fire prevention and response equipment, which will be detailed in the CEM Plan (see **Chapter 9**), are also expected to be onsite.

Commissioning and Site Demobilization

Commissioning

Commissioning of the various components will take place towards the end of construction when all major equipment items including tanks, pumps, filters and piping have been installed and tested. Commissioning procedures will be developed during detailed design, and typically include:

- Roles and responsibilities;
- Detailed sequence of facility checks and inspections;
- Detailed sequence of components and systems to be commissioned;
- Completion of Pre-start-up Safety Review by facility operations personnel;

- System checks including radio, telephone and fibre optic cable (if installed) to verify operational communications between all delivery system components;
- Instrumentation readings and calibration;
- Testing of fire alarms, alarm sensors, emergency shut-off devices and control valves;
- Testing of the fire water system to confirm flow volume and static head;
- Testing of Programmable Logic Control system;
- Testing of facility lighting; and
- Testing of Uninterruptible Power Supply and other emergency power systems.

Site Demobilization

Demobilization will occur in phases as site work progresses. Demobilization will, in general, be a reversal of the sequence of mobilization activities. The Contractor will be responsible for the transportation of personnel, and removal of equipment and operating supplies from the site under the overall direction of VAFFC. This will include the removal of temporary offices, fencing and any other general facilities erected or placed by the Contractor.

Operations Phase Activities

Overview

The fuel receiving facility will be operated from a new Programmable Logic Control system installed in the operations building. The new control system will communicate with the existing storage facilities at YVR.

The receiving tanks will require annual maintenance including draining, inspection of internal components and coating, and cleaning. Fuel will be transferred from one tank to another using the pump system for this maintenance.

Pumps will require regular maintenance to ensure performance and protect against deficiencies. The pump system will be designed to allow pumps to be removed from service without interrupting operations.

Similar to existing facilities at YVR, fuel filter elements will be replaced on a regular basis. These are generally considered hazardous material and will be disposed of accordingly.

Operations Utility and Services Requirements

Electrical power will be supplied from the B.C. Hydro grid. It is estimated that the facility will use 1,250 kilowatt hours per day or 456 megawatt hours per year.

Potable and utility water will be used for kitchen, bathroom and general purposes at the facility. Under normal operation, water will not be used as part of the process operations at the facility and usage will be very low. Washroom and kitchen facilities will be connected to the City of Richmond's existing sewer system.

2.4.4.3 Fuel Pipelines

Introduction

Fuel pipelines are required to transfer off-loaded fuel cargo from vessels at the marine terminal to the new fuel receiving facility nearby, and then deliver fuel from the new fuel receiving facility to YVR. A short transfer pipeline (approximately 0.5 kilometres long) will connect the hydraulic unloading arms at the marine terminal to the fuel receiving facility. A longer delivery pipeline (approximately 15 kilometres long) will connect the fuel receiving facility to the VAFFC fuel facilities at YVR.

Permanent ancillary facilities associated with the pipelines are expected to include the following:

- Four "pig" launching/receiving assemblies at either end of each pipeline;
- Six emergency shutdown valve stations:
    - One station at the marine terminal;
    - Two stations at the proposed fuel receiving facility (at the exit point of the short fuel transfer pipeline and the entry point of the longer fuel delivery pipeline);
    - One station at the VAFFC fuel facilities at YVR; and
    - Two stations at either end of the proposed crossing under the Moray Channel (i.e., one on Lulu Island and on Sea Island).

Reference Footprint – Location and Mapping

The source control points of the pipeline system will be where the fuel transfer pipeline connects with the hydraulic unloading arms at the marine terminal (Latitude: $49^{o}08.37'$ North, Longitude: $123^{o}03.33'$ West) and where the fuel delivery pipeline connects with the proposed fuel receiving facility. The source end points will be where the fuel transfer pipeline connects with the proposed fuel receiving facility and where the fuel delivery pipeline connects with the VAFFC fuel facilities located at YVR (Latitude: 49°12.18' North, Longitude: 123°09.40' West) (see **Figure 2.4.2**).

The delivery pipeline is expected to be constructed under existing transportation and/or utility corridors located in the City of Richmond. VAFFC identified a preliminary pipeline reference alignment and routing alternatives for the 15-kilometre fuel delivery pipeline to YVR. The alignment options are assessed in each of the discipline-specific effects assessments in **Part B**. Since these assessments were undertaken, VAFFC has refined the pipeline alignment and identified more specific sections of the assessed route for consultation. The preferred pipeline route on Lulu Island is shown in detail on **Figure 2.4.17**.

Preliminary analysis has been completed based on site investigations and previous studies. Geotechnical investigations have not been conducted. VAFFC will consult with the City and the public on the preferred pipeline route and possible routing alternatives during Application Review prior to selecting a final pipeline route for detailed design.

Preferred Pipeline Route

The preferred route runs west from the proposed fuel receiving facility approximately 3.5 kilometres along Williams Road to reach the south-to-north CNR railway corridor, crossing No. 6 Road, Palmberg Road, Sidaway Road, Highway No. 99 and No.5 Road.

The route runs north along the CNR railway corridor for approximately 6 kilometres to reach the Bridgeport Trail, crossing Blundell Road, Granville Avenue, Westminster Highway, Alderbridge Way, Highway No. 99 (under an overpass), Cambie Road, Bamfield Gate/Shellbridge Way and Bridgeport Road. The CNR railway corridor would account for approximately 40% of the entire pipeline route.

From the north end of the CNR railway corridor, the route runs west approximately 2.5 kilometres along a combination of the Bridgeport Trail and City roads to reach the proposed crossing of the Moray Channel. Along the Bridgeport Trail, the route crosses McLennan Avenue, No. 4 Road and Highway No. 99 (under an overpass) to reach Van Horne Way.

The route continues southwest along Van Horne Way, crossing Great Canadian Way, then west along Charles Street and under the Canada Line bridge. It then runs southwest along River Road and northwest along No. 3 Road before reaching the crossing of the Moray Channel (exact location to be determined).

The crossing of the Moray Channel is estimated at 500 metres. On Sea Island, the route runs west for approximately 1.5 kilometres along Grauer Road before crossing the airside boundary and following an airside service road to reach the VAFFC fuel facilities at YVR. The section of the route on Sea Island has been developed in preliminary consultation with Vancouver Airport Authority.

Possible Pipeline Routing Alternatives

As discussed above, several possible pipeline routing alternatives exist within the general corridor of the preferred route.

To reach the CNR railway corridor from the proposed fuel receiving facility it may be possible to run the pipeline along the Francis Road right-of-way corridor instead of using the Williams Road corridor. This would require a north-south segment, located either immediately adjacent to the fuel receiving facility, or on one of the road or road right-of-ways located between the fuel receiving facility and the CNR railway corridor.

A possible option to the north-to-south CNR railway corridor could be to use the parallel Shell Road/Shell Road right-of-way or the Shell Road Trail. Alternatively, it may be possible to use the No.5 Road corridor. In the case of the No.5 Road corridor, the alignment would run north and connect with the Shell Road corridor (i.e., Shell Road or the Shell Road Trail) via either Francis Road right-of-way, Blundell Road, Granville Avenue or Westminster Highway. The alignment would then continue north along Shell Road or the Shell Road Trail to reach Bridgeport.

A possible alternative to the east-to-west Bridgeport Trail corridor could be Bridgeport Road. In this case the alignment would run west along Bridgeport Road, and then north along either No.3 Road or possibly River Road to reach the Moray Channel crossing.

Facilities and Design Parameters

The pipelines and associated infrastructure will be constructed and operated in accordance with current accepted BMPs applicable to pipelines of this nature. Engineering and design criteria are described in **Section 2.4.2**.

General Arrangement

The pipelines are expected to have the following general characteristics:

Characteristic	Fuel Transfer Pipeline	Fuel Delivery Pipeline
Length	0.5 kilometre	15 kilometres
Material	Steel (API 5L, ASTM A53)	Steel (API 5L ASTM A53)

Characteristic	Fuel Transfer Pipeline	Fuel Delivery Pipeline
Outside Diameter	400 millimetres	300 millimetres
Wall Thickness	12 millimetres	10 millimetres
Design Flow Rate	25,000 litres/minute	12,500 litres/minute
Design Pressure	3,000 kilopascals	5,000 kilopascals

The entire pipeline system will be located within Class 3 and Class 4 locations as defined by the Canadian Standards Association (CSA-Z662: Oil and Gas Pipeline Systems standards, clause 4.3.2). Class 3 locations are defined as areas with more than 46 dwellings and Class 4 locations are defined to have a prevalence of buildings intended for human occupancy with four or more stories above ground (CSA 2007). Pipeline design and safety factors were applied as stipulated for that class location.

Currently, it is expected that the crossing of Highway No. 99, located between Sidaway Road and No. 5 Road, will be achieved by horizontal directional drilling underground. All other secondary road crossings and utility crossings are expected to be achieved by trenching and employ appropriate safety measures, such as fences and traffic control barriers, typical to pipeline construction projects in an urban/suburban setting.

All construction materials will be taken to the construction site(s) by truck using existing roadways. Street rubble and excavation spoils will be hauled offsite to approved facilities using existing roadways.

Construction-Phase Activities

Currently, there is no finalized construction schedule detailing the specific activities related to pipeline construction. It is expected that pipeline construction will be completed in phases and take approximately 12 months to complete overall.

The construction footprint for the pipeline corridor is expected to be as little as 10 metres wide in highly constrained areas. Ideally, the construction footprint for the corridor will be between 15 and 18 metres wide. When constructing on or under city streets, it is expected that the construction footprint will require the equivalent of two lanes of traffic. The following describes standard pipeline construction activities and typical equipment requirements.

Site Preparation

Prior to construction, all required surveys and acquisitions including land boundary surveys and land and easement acquisitions will be completed. Boundaries will be established for work areas (i.e., the construction right-of-way boundaries, facility sites, and temporary extra workspaces), pipeline centreline, and location of approved access roads, as well as on-site identification of sensitive areas.

Immediately before construction, temporary gates will be installed to allow passage of vehicles and construction equipment. Top soil stripping and soil salvage will occur where appropriate to ensure that the soil capability is maintained. The width and depth of stripping/salvage will depend on the soil conditions, micro-topography, agency requests and minor grading requirements.

Following top soil stripping and salvage, grading will be conducted on irregular ground surfaces, including temporary workspaces to provide a safe work surface. Since construction will occur almost exclusively on level corridors, extensive grading is not expected. Surface preparation typically includes grinding, breaking and removing pavement with pavement grinders, concrete saws, pavement breakers, and where necessary, jack hammers.

Temporary facilities may be installed and may include staging areas for pipe laydown areas and decking sites, temporary access for construction equipment and personnel, facilities for construction site office, and fuel storage and waste facilities.

Pipe Handling and Preparation

Conventional pipe-stringing trucks are typically used to transport pipe sections from the factory shipment point or designated staging and storage yards directly to the pipeline right-of-way. Sideboom tractors or cranes unload sections of pipe from the trucks in preparation for in-situ welding.

Epoxy coating is expected to be applied to all pipeline segments before delivery to the construction site. In situ coating will be applied on all weld joints made at the site to provide a continuous coating along the pipeline. Before and after pipe placement, tests will be conducted to locate any potential coating discontinuities such as thinning, or other mechanical damage that could permit moisture to reach the pipe and create a potential corrosion hazard.

Individual sections of pipe may be bent where necessary to fit the contours of the trench, then aligned, welded together into long strings, and placed on temporary supports along the edge of the trench. Welding processes will be monitored and inspected, and weld specifications will undergo rigorous metallurgical testing to ensure structural integrity and compliance with welding specifications.

Pipe Installation

Trenching

The majority of pipeline is expected to be laid using a trenching or plowing method of construction. Using this method, a continuous open cut is created in the surface material and the pipe is welded, placed within the excavated area and covered. This method of construction is very cost effective and efficient along main runs on level ground. In combination with directional drilling underground, trenching forms an integral part of any utility construction process. See Pipeline Crossings for techniques to be employed for watercourse crossings, and dewatering activities.

Trenching will generally occur after stringing, bending and welding. Trenches will be excavated using tracked excavators and backhoes to a depth sufficient to ensure the depth of cover is achieved. Spoil piles will be kept separate from topsoil piles and are typically stored on the opposite side of the trench from the non-equipment working side, or placed directly into dump trucks for hauling.

Lowering-In

Prior to lowering the pipeline, the trench will be inspected to ensure that it is free of rocks and other debris that could potentially damage the pipe or its coating. Padding material such as sand screened soil will be placed in the bottom of the trench. The pipeline will be lowered into the trench, and trench breakers will be installed at specified intervals to prevent water movement along the pipeline. Trench dewatering may be necessary at watercourse crossings or other locations during lowering-in to ensure acceptable bedding for pipe, to prevent the pipe from floating or for performing tie-in welds (see Pipeline Crossings for more information).

Backfilling

The trench will be backfilled using excavated materials where appropriate, as per specifications. Local borrow pits or commercial aggregate stockpiles will likely be used to source padding and backfill materials. Backfilled materials will be compacted prior to site-specific surface restoration and the buried pipeline will be marked, as required. At locations along the pipeline that require additional structural support, or to prevent the pipeline from movement, the trench may be filled with cement slurry.

Pipeline Crossings

Major and Minor Watercourse Crossings

The techniques for crossing watercourses will be selected based on a combination of environmental, technical and economic feasibilities. Criteria for evaluating crossings include:

- Environmental sensitivity and riparian management requirements;
- Fisheries presence and watercourse timing restrictions;
- Physical characteristics of the crossing;
- Stability of banks;
- Currents;
- Scour potential;
- Navigable waters;
- Surface and sub-surface soil conditions;
- Constructability; and
- Schedule constraints and cost.

All crossing designs, including material and equipment staging areas, will be compliant with all permits, approvals and authorizations, and other government requirements. Crossing design will consider buoyancy, buckling stresses and pipeline impact strength. Watercourse crossings will be designed to meet a 1-in-200 year flood event and a 1-in-2,475 year seismic event.

The Moray Channel crossing will be the only major watercourse crossing along the length of the pipeline. This crossing, which is expected to be north of the existing Canada Line Middle Arm bridge crossing, will be achieved using a horizontal directional drilling technique. The exact location is subject to completion of a geotechnical assessment. Horizontal directional drilling is an alternate method of utility construction where a surface launched drilling rig bores a prescribed underground path to install pipes, conduits or cables.

Horizontal directional drilling is generally a three-stage process where an initial pilot hole is drilled, a second large hole is cut depending on the diameter of the pipe and finally, the utility infrastructure is then pulled or pushed through the drilled hole. Entry and exit points may require an excavated pit for the boring machine. Throughout the process of drilling and hole enlargement, drilling mud, a slurry of naturally occurring, non-toxic chemicals such as bentonite clay and water, is circulated through the drilling tools to lubricate the drill bit, remove drill cuttings and hold the hole open. This method is entirely trench-less, not associated with significant ground disturbance, and minimizes environmental and road/river traffic disruption. Horizontal directional drilling at the Moray Channel crossing is expected to take approximately six weeks.

Minor surface water drainage ditches located along the pipeline will also be crossed during construction. The crossing method for minor surface water drainage ditches will be site-specific, determined in consultation with engineering and environmental specialists, with guidance from the Pipeline Associated Watercourse Crossings, 3rd Edition (2005) and chosen based on the physical constructability constraints, allowable fisheries timing windows, where applicable, and other Project-related or environmental constraints.

Generally, it is expected that most minor surface water drainage crossings will involve flow isolation and dewatering construction techniques during low flow periods. Using this technique, the trenched area is isolated from the main drainage ditch to prevent construction materials and sediment from entering the drainage ditch outside of the isolated area. Flow isolation construction techniques include the temporary diversion of water around the worksite via pumping or temporary dam construction. After the surface water drainage ditch is isolated, salvage of fish may occur, the area is dewatered and trenched, and a prefabricated section of pipe lowered in the trench. Following pipe installation and backfilling, the surface water drainage ditch banks and channel will be re-established and stabilized and the site revegetated. Substantial surface water drainage ditches, such as No. 6 Road, may be crossed using the horizontal directional drilling technique.

Major and Minor Road, Rail and Utility Crossings

Construction will require crossing of Highway No. 99 in vicinity to the existing undeveloped Williams Road right-of-way corridor located between Sidaway Road and No. 5 Road. Following geotechnical assessment, this crossing is expected to be completed in approximately four weeks using the horizontal directional drilling method described above.

Table 2.4.1 indicates the number of possible pipeline crossings, major highway crossings, secondary road crossings, railway crossings and city of Richmond utility crossings, which will depend on the final route selected.

Table 2.4.1 Possible Pipeline, Road, Rail and Utility Crossings for the Preferred Pipeline Route

Crossing Description	Number of Possible Crossings
Pipeline Crossings	2
Major Highway Crossings	1
Secondary Road Crossings	22
Bridge Underpass Crossings	2
Railway Crossings	3
City Utility Crossings	24
Natural Gas Utility Crossings	17
Cable and Fibre Crossings	TBD
Powerline Crossings	TBD
Total Crossings	TBD

There is a possibility of additional utility crossings depending on the final route. Construction techniques and crossing methods used for secondary road crossings will be site-specific. Generally, it is expected that the majority of secondary road crossings will be constructed utilizing the open-cut/trenching technique. Completion of typical open-cut road crossings is expected to require approximately three days. Utility crossings that occur in vicinity to roadways will proceed in a manner that involves appropriate traffic control measures such as safety fences and traffic control barriers (see **Chapter 9**). In some cases, to prevent additional construction disturbance, pipeline construction may use horizontal directional drilling techniques to cross certain utilities or roads. It is expected that horizontal directional drilling under existing utility corridors or secondary roads would take approximately two weeks per crossing. Construction activities are expected to proceed in a manner that minimally disrupts adjacent traffic patterns and land use.

Horizontal Directional Drilling Feasibility and Contingency Plans

Land requirements, final footprint and geotechnical assessment for the major watercourse crossing of the Moray Channel and the major road crossing at Highway No. 99 are still be determined. Studies will be undertaken prior to drilling activities that will include:

- Review of background geological and geotechnical data including soil exposures;
- Drilling and sampling of boreholes to obtain site specific soil and ground water conditions at each proposed horizontal directional drilling crossing;
- Drill string technical and stress/strain analysis for each crossing, including:
    - Drill fluid hydraulic analysis;
    - Drill hole and casing requirements based on subsurface conditions;
    - Drill length calculations based on pipeline specifications; and
    - Geotechnical conditions, and cost estimating.

Once the assessment of each of the crossings has been determined, drill execution plans will be developed.

<u>Pipeline Testing</u>

In addition to the standard mill testing of all pipe and fittings, hydrostatic testing will be performed after installation and construction and prior to commencement of operations, in accordance with CSA Standards (i.e., CSA-Z662 Standard), relevant provincial regulations and Project-specific construction and engineering procedures. A detailed hydrostatic test procedure will be developed and reviewed prior to the start of a hydrostatic pressure testing program. This test is designed to prove that the pipe, fittings, and weld sections will maintain mechanical integrity without failure or leakage under the operating pressure for which it is designed.

Water from the municipal water system will be used for pressure testing. If leaks are found, the leaks will be repaired, the cause investigated and fixed, and the segment of pipe will be retested until specifications are met. After completion of hydrostatic testing, the pipeline will be cleaned and dried using internal tools (i.e., “pigs”) that are propelled through the pipeline. Once cleaned, completely dried, and purged of air, the pipeline will be ready for receipt of product and commissioning.

Restoration

Restoration of disturbed areas will occur as set out in the CEM Plan (see **Chapter 9**).

Pipeline Emergency Shutdown Valve Facility

As described above, four emergency shutdown stations are expected in the vicinity of each "pig" sender and receiver site on the pipelines, along with two additional stations on either side of the Moray Channel. Excavations and earth disturbance will be required at each site within the proposed valve station compounds.

At the marine terminal, earth disturbance will be necessary for the installation of a section of pipeline that will connect to the pumping system, and for the installation of an isolation valve, over pressure protection, and "pig" launcher. For connection at the fuel receiving facility, shallow earth disturbance activities will be required for the installation of an isolation valve and to install the "pig" receiver.

Construction Utility and Services Requirements

Utilities

For the majority of pipeline construction, utility services will be from portable sources supplied by the contractor. Pipeline construction equipment will require both gasoline and diesel fuel. Estimated consumption per day may be up to 900 litres of gasoline and up to 3,375 litres of diesel fuel.

Water will be used as necessary to control fugitive dust and to wash streets, as a supplement to sweeping (see **Chapter 9**). A peak total use of approximately 22,500 litres of water per day is estimated for these purposes. In addition to the daily construction water needs, hydrostatic testing of the pipeline will also require the use of water. The estimated volume of water required to test the proposed pipeline is estimated at approximately 1.3 million litres in total. Where possible, water will be accessed through the municipal fire hydrant system along the pipeline corridor.

Pipeline construction will not require significant electrical power source or the use of natural gas. Where needed, portable generators may be used onsite for power. Welding rigs and pipe preparation tools are typically operated from truck mounted power sources.

Communications during construction activities will be handed using cellular telephones or radio system. The contractor may choose to license a temporary radio system for communications.

Workforce and Traffic

The pipeline construction is expected to generate an estimated 25 to 30 vehicles to transport equipment and workers to and from the sites each day to service the construction activities. The movement of crew traffic will follow a pre-developed Traffic Management Plan (see **Chapter 9**).

Site Demobilization

The Contractor will be responsible for the transportation of personnel, and removal of equipment and operating supplies from the site under the overall direction of VAFFC. This will include the removal of temporary offices, fencing and any other general facilities erected or placed by the Contractor.

Operations Phase Activities

Overview

Prior to operation of the pipelines, routine maintenance programs and other monitoring and emergency response systems and plans will be in place and activated (see **Chapter 17**). These will be developed in consultation with the relevant agencies, authorities and organizations prior to the commencement of operations. The activities required for general operation and maintenance of the pipelines are summarized below.

Routine Pipeline Maintenance

Regular preventative and operational maintenance activities will be scheduled according to the System Integrity Management Program, which will keep records of all maintenance and repairs. Inspection and calibration activities will be associated with routine operations and maintenance of the pipelines.

Where applicable, vegetation may be periodically cut back along sections of the pipeline right-of-way and adjacent to Project facilities to maintain visibility and security, facilitate access during inspection patrols and maintenance, eliminate nuisance trees and noxious weeds, and reduce fire risk.

Operations Utility and Services Requirements

Electrical power for the ongoing monitoring and maintenance of the fuel pipelines will be provided from the fuel receiving facility and the existing VAFFC fuel storage facilities at YVR. Power required along the pipeline corridor (e.g., a powered rectifier as part of the cathodic protection system) is expected to be provided by the nearest B.C. Hydro distribution grid (i.e., Power pole).

2.4.4.4 Vessels Movements

Introduction

Aviation fuel cargo vessels currently pass Roberts and Sturgeon banks, the mouth of the Fraser River, YVR, English Bay and Stanley Park, and the First and Second Narrows areas of Burrard Inlet to off-load and transfer fuel cargo at Westridge Marine Terminal. This route is similar to other types of petroleum hydrocarbons shipped into and out of the Lower Mainland (see **Section 2.3.2**).

During Project operations, these existing aviation fuel cargo shipments will be redirected from their transit route in the Strait of Georgia to the marine terminal via the Fraser River's deep-sea navigation channel. These articulated barges will be used for the foreseeable future. Handysize and Panamax-class vessels are also expected less frequently.

Reference Footprint – Location

The scope of the Project includes the transportation of aviation fuel on vessels within the South Arm of the Fraser River, specifically from Sand Heads at the river mouth, upriver to the marine terminal berth, and includes all areas of the river where vessel movements and turning manoeuvres will be required. However, VAFFC will not own or operate vessels calling at the marine terminal and vessel owners and operators will be responsible for vessel activities and movements including transit of the lower Fraser River to the marine terminal.

General Requirements, Specifications and Characteristics

Since vessel trade is open to the world fleet, specific plans and characteristics for a particular design vessel cannot be provided. The characteristics indicated in **Table 2.4.2** are approximate for the purposes of comparing relative sizes of vessels that will be delivering product to the marine terminal. The dimensions are considered generally representative of vessels in that class, although the specific measurements of any particular vessel within that class would be expected to vary somewhat from the values shown.

General descriptions can be provided of certain characteristics that tanker vessels have in common. These characteristics are reasonably representative of the types of vessels expected to call at the proposed marine terminal.

A typical Panamax-class tanker vessel is shown in **Figure 2.4.18**. The navigating bridge, crew accommodations, engine room, auxiliary generators, propulsion, steering, and cargo pumps are all located aft. The center portion of the vessel is occupied by the cargo and ballast tanks, while the forward part contains additional storage spaces. Located on the top deck are the cargo manifolds (i.e., pipe connections and control valves), mooring winches, lights, and similar equipment.

Figure 2.4.19 shows a typical integrated tanker barge and tug unit. The navigational control, crew accommodations, propulsion, and steering are all located on the tug. The tug is positioned in a notch in the stern of the barge where it propels and manoeuvres the barge. The actual connection between the tug and barge may be either articulated, allowing hinged movement or rotation for fore and aft pitch, or fixed where the tug and barge are locked together in a rigid connection. The center portion of the barge is the same as described above for the tanker vessel. Located on the top deck of the barge are the cargo pumps, cargo manifolds, mooring winches, lights, and similar equipment. Towed barges are similar to integrated barges except the tug pulls the barge from the bow using towing cables.

Table 2.4.2 Typical Design and Characteristics for Vessels Expected to Service the Marine Terminal

Vessel Type	Cargo Capacity (barrels)	Displacement (tonnes)	Deadweight (tonnes)	Length Overall (metres)	Beam (metres)	Laden Draft (metres)	Approach Velocity Perpendicular to Berth Face (m/s)	Impact Point (pt)	Angle of Approach
Towed Barge	35,000	5,000	4,200	78.0	20.1	4.5	0.30	¼	0° to 10°
Barge and Tug	140,000	25,000	20,000	184.4	24	8.4	0.30	¼	0° to 10°
Handysize[3]	300,000	60,000	46,000	193	32.2	11.4	0.15	¼	0° to 10°
Panamax Tanker[4]	400,000	77,000	60,000	228	32.2	11.50	0.15	¼	0° to 5°

[3] Vessels in the "Handysize" classification can range from 10,000 to 60,000 deadweight tonnes. The vessel shown is in the middle of this range and represents one of the largest Handysize vessels which when fully loaded is not draft-limited in the Fraser River.

[4] Figures for deadweight tonnes, displacement and draft are based on partly-laden conditions due to the maximum draft limit of 11.5 metres on the Fraser River

Existing Vessel Traffic Density and Frequency in the River

It is difficult to estimate vessel traffic density and frequency in the Fraser River. There are three classes of existing marine traffic that are expected to be encountered by the Project vessels travelling to and from the marine terminal:

- Piloted/Reporting Traffic – Vessels over 350 gross registered tonnes and Canadian registered ships over 10,000 gross registered tonnes are required to carry a local marine pilot and to comply with the Canadian Coast Guard's Marine Communication and Vessel Traffic Services reporting requirements. The Pacific Pilotage Authority may waive compulsory pilotage for vessels of up to 10,000 gross registered tonnes, provided that all members of the crew in charge of the deck watch possess the proper competency certificates and have adequate prior experience on the river.
- Non-Piloted Reporting Traffic – Vessels that are not required to carry a pilot, but are in excess of certain size restrictions for their type, and are also required to comply with Vessel Traffic Services reporting requirements. In general, vessels greater than 20 metres in length, or tugs towing barges longer than 20 metres are required to report.
- Non-Reporting Traffic – Vessels under specific size restrictions are not required to make any reports to Vessel Traffic Services. These include:
  - Pleasure craft less than 30 metres in length;
  - All vessels less than 20 metres in length;
  - Tugs with tow, where combined length is less than 45 metres, or where the object towed or pushed is less than 20 metres;
  - Fishing vessels in transit that are less than 24 metres in length and less than 150 gross registered tones; and
  - Fishing vessels when engaged in fishing activities.

Of these classes, only records of piloted traffic are available. According to the Pacific Pilotage Authority, the yearly totals for piloted vessels on the Fraser River have been fairly constant for the last ten years with the number of vessels per year varying between approximately 1,200 and 1,600.

Currently, there are no piloted vessels carrying fuel cargo on the Fraser River, however there are a number of towed and articulated barges providing bunker fuel service on the river. Although the Port keeps data on the total amount of various commodities shipped on the river, records of individual tugs and barge transits are not kept and there is no single comprehensive database on the numbers of tug/barge transits in the river.

Proposed Vessel Traffic Density and Frequency

The current frequency of marine shipments of aviation fuel to Westridge Marine Terminal is in the range of 2 to 3 vessels per month. As described in **Section 2.4.4.1**, initially, vessel traffic frequency for the Project is expected to be in the order of one to two barges every two weeks, and one larger tanker vessel every month (i.e., in the range of three to five vessels per month). Barges will likely consist of larger pull-barges and integrated tug and barge units. Larger tanker vessels may include Handysize or Panamax-class, depending on their source of origin.

Vessel frequency will increase with increased fuel demand at YVR, with an estimated four to six visits per month expected in 2016 based on forecast fuel demand.

Transit Speeds and Times

Larger vessels typically transit the Fraser River at speeds of up to 10 to 12 knots (18.8 to 22 kilometres per hour). As the marine terminal is located approximately 21 kilometres upstream from Sand Heads, the transit time for large vessels to reach the terminal will be a little over an hour in most cases. The final approach, berthing and mooring process will take approximately 30 minutes. Most arriving vessels will be moored facing upstream.

Upon departure, the process will be reversed. The harbour tugs will guide the vessel into the river, turning it 180 degrees so that it is facing downstream. The vessel will travel downstream, again at speeds of 10 to 12 knots, requiring a little over an hour to reach Sand Heads.

Delays en Route

Large vessel movements in Canadian waters are planned well in advance, with vessels required by law to report their position and estimated arrival times beginning 72 hours in advance of actual arrival. This advance notice is intended to provide adequate warning to arrange for the necessary pilotage, tug support, customs and immigration procedures, and vessel inspections. From time to time, vessels are delayed en route by a variety of factors, such as weather, delays leaving their prior port, waiting for a suitable tidal window, or waiting for space to be available at the arrival port. If an arriving vessel experiences delays and does not arrive at the Sand Heads pilot boarding station at the intended time, it may anchor in English Bay or “slow steam” in the Strait of Georgia until the next available transit window. Once vessels have committed to entering the Fraser River, there are unlikely to be any delays in arriving at the marine terminal at the appointed time, due to river traffic controls and predictable transit conditions.

Vessel Crew and Training Requirements

The vessel crew will be required to operate the vessel in accordance with international standards including the Standards of Training, Certification and Watchkeeping (1995). This standard requires worldwide sea-going personnel to meet standardized regulations including competencies for each position onboard a ship. It also stipulates that an individual seeking employment onboard a vessel must possess and demonstrate the appropriate skills for the specific position and requires periodic updating of knowledge and re-validation.

Navigation, Safety and Communications Equipment

The primary function of a vessel's navigation equipment is to ensure safe vessel passage across the oceans and into port facilities. On vessels there are two main types of electronic navigation systems consisting of Radio Detection and Ranging (Radar) and Global Positioning Systems. These are active sensor-based systems which aid in navigation by determining the vessel's position in relation to other vessels, as well as charted positions for land, shoals, reefs, and other potential navigation hazards.

These systems are typically supplemented with other electronic navigation systems such as Electronic Chart Display and Information Systems, Automatic Identification Systems, and Computerized Collision Avoidance Systems, such as Automatic Radar Plotting Aids. Electronic Chart Display and Information Systems are computer-based navigation information systems that display information from electronic navigation charts and can integrate position information from the radar and Global Positioning Systems to provide an overview of the vessel's position and heading. Automatic Identification Systems uses Very High Frequency radio to automatically transmit the vessel's identification signal which includes information about the ship's identity, type, position, course, speed, navigational status and other safety-related data. The signal from every vessel can be received by shore stations, other ships and aircraft which allow navigation officers to identify proximate vessels accurately and to determine quickly the heading and speed necessary for collision avoidance.

Vessel safety equipment includes systems such as inert gas systems, fire fighting systems, life safety systems, and emergency towage systems. Inert gas systems are a requirement for all vessels, and protect the vessels from explosion by reducing the oxygen content in the cargo tank void space to a level that does not allow combustion. An inert atmosphere is created by pumping inert gas into the cargo tanks during cargo discharge. The inert gas is created by either an independent inert gas generator, or is derived as cleaned flue gas from the vessel's boiler unit.

Fire fighting systems are also a requirement for all vessels and are typically approved by the various classification societies. The fire fighting systems distribute water, foam or other chemicals and then dispense them through water monitors located strategically throughout the vessel (see **Chapter 18**).

The vessels are also equipped with life safety equipment including life boats, life rafts and personnel life saving gear.

Panamax-class vessels greater than 50,000 deadweight tonnes are required to have an emergency towage system capable of handling a minimum Safe Working Load of 200 tonnes. This system is deployed in any situation where the vessel needs to be towed.

The vessels communication equipment will consist of radio and internal communications equipment including dedicated satellite communication systems. These systems allow the vessel anywhere in the world to communicate with home offices, authorities, charters, port authorities, coast guard, other vessels and Vessel Traffic Management agencies. During any shipboard emergency, vessels can communicate with other vessels and authorities using the Global Maritime Distress and Safety System.

Marine Terminal Arrival Plans

Pre-arrival Procedures

The procedures for initiating a fuel shipment will begin several months in advance of the shipment arrival date. A specified amount of fuel will be determined for delivery to the marine terminal and a nomination system will be used to reserve a place for the shipment in the overall transhipment schedule. During this lead time a specific vessel will be proposed and vetted through the marine terminal's Tanker Acceptance Program (see **Chapter 17**). If the proposed vessel is accepted, the vessel will be allowed to berth at the marine terminal. If not, the vessel will not be permitted, and another vessel will need to be nominated.

Once a vessel has been accepted by the Tanker Acceptance Program, it will be entered into the marine terminal's scheduling system. At this time, copies of the Port Information Booklet and the Terminal Regulations Manual will be made available to the vessel and its owner/operator. These two documents will contain information about such subjects as pilots, tugs, weather, references to Canadian regulations, and mandatory procedures and regulations for the vessel to follow while berthed at the marine terminal. If these procedures are not followed, the vessel may be ordered to leave the marine terminal.

Vessels will begin preparations for berthing/mooring and cargo transfer operations prior to arrival at the marine terminal. These preparations include checking and adjusting the inert gas pressure and oxygen levels in the cargo tanks to ensure they are at the proper levels; warming-up the cargo steam boilers in preparation for cargo transfer operations; and preparing the vessel's cargo transfer plan.

Prior to commencement of the berthing and mooring operations, a conference will be held between the vessel's master, deck officers and the Fraser River Pilot(s) to prepare the vessel's mooring plan. The mooring plan will include positioning of tugs, mooring line sequencing, and mooring position. The mooring plan will then be communicated to marine terminal personnel and the assisting tug boats prior to the vessel berthing.

Berthing, Mooring and Bunkering Procedures

The maximum safe operating limits of the proposed marine terminal will be determined through further simulation and analysis during the detailed design phase. Preliminary estimates of the limiting operating values are shown in **Table 2.4.3**.

Table 2.4.3 Preliminary Estimates of the Marine Terminal Limiting Operating Values

Limiting Operating Criteria	Preliminary Estimate
Maximum Wind Speed, Tug Assisted Berthing	20 metres per second (40 knots) sustained
Maximum Wind Speed, Unloading Shutdown	25 metres per second (50 knots) sustained
Maximum Wind Speed, Unloading Arm Disconnect	30 metres per second (60 knots) sustained
Maximum Wind Speed for Safe Moorage	35 metres per second (70 knots) sustained
Maximum Current, Vessel Manoeuvring	1.5 metres per second (3 knots)
Minimum Visibility, Tug Assisted Berthing	1.0 kilometre

Berthing Manoeuvres

All vessels calling on the proposed marine terminal will require tug assistance while berthing or deberthing. Typically, one to three tugs may be required depending on the size and type of the vessel and local meteorological and oceanographic conditions. The actual number of tugs will be determined by the Fraser River Pilots based on factors affecting each particular vessel transit.

Inbound Handysize and partly-laden Panamax-class vessels will typically receive a B.C. Coast Pilot based out of the Pilot Boarding Station off Victoria for navigation into the Strait of Georgia. When the vessel arrives in the Strait of Georgia, a transfer will be made from the Coast Pilot to a Fraser River Pilot for the final leg of the transit up the Fraser River to the marine terminal. Tugs will take their positions according to the Fraser River Pilot's direction and prepare to assist in the mooring operation by making lines fast and manoeuvring as required (see **Chapter 20**). Inbound vessels will be fully loaded (Panamax-class will be partly-laden) and will approach the marine terminal to berth portside-to (i.e. facing upstream). This will allow the vessels to enter the berth directly without having to the make a 180 degree turn while in the loaded condition. Under direction of the Fraser River Pilot, the tugs will manoeuvre the vessel alongside the dock and push the vessel against the berth's fender units. Towed barges and integrated barge and tug units will be brought to the berth by a single tug and may require a second tug to assist them into the berth.

Mooring Procedure

Once the berthing manoeuvres are complete and the vessel is alongside the breasting dolphins, the vessel's mooring lines will be secured. The transfer of mooring lines may either be done manually from vessel personnel to terminal personnel or with the use of a small utility boat depending on the vessel and the marine terminal's operating procedures. The number and placement of mooring lines will depend on the size and type of vessel being berthed (see **Chapter 20**).

Bunkering Procedures

Bunker refuelling activities are permitted and routinely undertaken at marine terminal facilities located on the Fraser River. The dominant supplier of this service in the Metro Vancouver region is Marine Petrobulk. Similar to the other terminals operating on the Fraser River, bunker refuelling will be permitted and undertaken as required at the proposed marine terminal. Bunker refuelling will only be permitted once vessels have successfully berthed and moored. Similar to the other terminals that load and/or off-load liquid petroleum hydrocarbon products in the Vancouver area (e.g., Westridge Terminal and Shellburn), bunker fuelling will not be permitted during cargo off-loading. Bunker fuelling will be undertaken in accordance with the regulations, standards and codes that currently govern this activity in the river.

Fuel Cargo Transfer Operations Plan

Cargo transfer operations will commence once a vessel is secured at the berth and the spill containment boom and skimmers have been deployed (see **Chapter 17**).

Safety Monitoring and Alarm Systems

If for any reason the amount of movement approaches the maximum allowable limits for the arms, visual and audible alarms will be triggered which allow the operators to take the necessary action. If the movement envelope is exceeded, the cargo transfer will be automatically halted and the arms disconnected using leak-free Emergency Release Couplings.

Canadian Customs and Custody Transfer

When the vessel has finished berthing and is securely moored at the marine terminal, Canada Customs officials will access the vessel to finalize the “entering and clearing” process. Before the cargo transfer process begins, it is routine for Canada Customs agents to examine the vessel’s papers, obtain signatures on required documentation, review the crew manifest and collect any duties and fees necessary from any non-Canadian registered vessels.

For custody transfer, measurement of the amount of cargo to be transferred is critical, since it involves the changing of legal custody of the cargo between parties. It is also important for the collection of taxes and fees by the government.

Preparation for Fuel Off-loading and Transfer

After clearing Canada Customs, preparations for fuel off-loading and transfer will begin. These preparations include several concurrent activities consisting of cargo measurement, connection of cargo unloading arms, pre-transfer conference, vessel readiness inspection and a pre-cargo transfer circulation test.

Cargo measurement and sampling is typically conducted by an independent inspector in conjunction with the vessel’s officer to ensure both parties are in agreement with the amount of fuel cargo to be transferred. Cargo measurement is also important for detecting leaks in the off-loading system.

The cargo unloading arms are typically powered by hydraulics (see **Section 2.4.4.1**) and equipped with automatic couplers. A marine terminal employee usually boards the vessel and via remote control manoeuvres the unloading arms into position so that they may be coupled to the vessel’s manifold.

The pre-transfer conference is very important as this is where the transfer plan will be worked out to ensure a safe transfer operation. The conference is typically attended by the vessel's master, chief engineer, senior cargo operations officer, and marine terminal personnel, and includes discussions of overall cargo transfer operations, the marine terminal's requirements and emergency procedures.

After the pre-transfer conference is completed, the parties will conduct a readiness inspection of the vessel and complete and sign documentation declaring the vessel ready for cargo transfer operations to begin.

Just prior to cargo transfer, communications between personnel on the vessel and the marine terminal will be confirmed and agreement will be made via radio that all systems are ready. Upon initiation of cargo transfer, the pre-cargo transfer circulation test will be conducted. This test involves the initial transfer of the cargo at a very slow rate, while the system is checked for leaks and confirmation is given that the cargo is being transferred to the appropriate storage tank at the fuel receiving facility. Once confirmation is obtained, the discharge pumping rate will be slowly increased under the marine terminal's direction until the maximum flow rate is achieved.

Off-loading and Transfer of Fuel

It will typically take approximately 12 hours to complete cargo transfer operations from a barge and between approximately 24 and 36 hours for a larger tanker vessel, depending on volume of shipment, vessel pump size, pipeline size, etc. During the cargo transfer, all aspects of the transfer system will be monitored to ensure there are no leaks and that the operation is proceeding normally. Vessel and marine terminal personnel will also exchange and verify hourly values for the volume of cargo transferred. If there are significant discrepancies, the cargo transfer operation will be stopped and the differences reconciled.

An extremely important safety aspect of the cargo transfer operation is the injection of inert gas into the vessel's cargo tanks during the discharging process. This procedure involves pumping inert gas into the air space of the tank(s) as the tank(s) are emptied thereby keeping oxygen levels in the tank(s) atmosphere below combustible levels, typically 5% by volume. The inert gas pressure and oxygen levels are typically monitored on an hourly basis throughout the transfer operation. In addition to inert gas injection, ballasting operations may be conducted throughout the cargo transfer operation where sea/river water is pumped into the vessel to maintain its stability while it is at the berth and for its outbound voyage.

As the cargo transfer operation nears completion, the process of "stripping" (i.e., discharging the last remaining amounts of the cargo from the vessel's tanks) will begin.

The stripping process involves slowing the pumps as the last bit of cargo is discharged from the vessel's cargo tank(s). For vessels with multiple tanks, stripping may be conducted internally within a vessel where each tank is successively emptied into the next until only one tank remains for discharging to shore. This process ensures maximum transfer efficiency. Once the "stripping" process is finished, the cargo transfer operation is complete.

Marine Terminal Departure Plans

Pre-departure Procedures

Once the off-loading and transfer of fuel is complete, the pre-departure procedures will begin. These typically include a series of activities consisting of:

- Emptying and draining of cargo unloading arms: To prevent cargo spillage the unloading arms are typically vented and drained before they are disconnected from the vessel's manifold.
- Disconnecting and stowing of cargo unloading arms: Similar to the connection process, a marine terminal employee typically boards the vessel and disconnects the unloading arms from the vessel's manifold using a remote control. Once disconnected, the remote control is used to guide the unloading arms to their stowed position on the marine terminal.
- Retracting of spill containment boom: The boom will be retracted once the cargo operations are complete. Marine terminal personnel will use utility boat(s), if required, to retract the boom and stow it in its designated stowage area.
- Inspecting cargo tanks and cargo measurement: Both an independent inspector and the vessel's personnel will inspect each tank on the vessel to ensure all of the cargo has been discharged and compare quantities to ensure both parties are in agreement. Discrepancies in the cargo transfer amounts are noted.
- Providing clearance and concluding Terminal/Agency/Vessel business: Once the necessary papers and documents are signed involving the transfer of ownership of the cargo, Canada Customs will give the vessel clearance to sail.
- Preparing vessel for departure: Just prior to departure, various components and pieces of equipment on the vessel will be tested and brought online including engines and their ancillary equipment, rudder, navigation systems and communication equipment.

Deberthing Manoeuvres

Fraser River Pilots and tug operators are typically given advanced notice by the vessel's agent regarding the scheduled departure time when the vessel will require assistance out of the berth. When the vessel is ready for departure, the Fraser River Pilot will instruct the assist tugs to take their positions and proceed to unmoor and deberth the vessel. The mooring lines will be released one by one as directed by the Fraser River Pilot and the tugs will manoeuvre the vessel away from the berth by pulling the vessel away from the fender units. Once the vessel is clear of the marine terminal, the tugs will assist the vessel in turnaround manoeuvres.

Turning Procedure

Wind, waves and river currents can all have an effect on the manoeuvrability of a vessel. Within the Fraser River, the river currents are expected to have the greatest influence on the handling of a vessel. The amount of influence the current has is dependent on the draft of the vessel as well as the water depth. When the vessel is fully loaded, it will sit deeper in the water and the effects of the current forces will be higher than when the vessel is in the unloaded or "light" condition.

As described, most inbound vessels will typically be brought straight into the marine terminal and will berth facing upstream, with their port (left) side next the berth. This means that the vessel will be required to make the 180-degree turn to transit back down the river after it has been off-loaded and departs the marine terminal. Since the off-loaded vessel will have less draft, it will typically be easier to turn due to the smaller current forces acting on its hull.

Regardless of whether the vessel is in an empty or loaded condition, the effects of wind, wave, or current can be effectively counteracted by proper positioning of the tugs during the berthing or deberthing manoeuvres. The turning procedure will be initiated once the tugs have cleared the vessel from the berth. To execute the turn the tugs will take their positions according to the Fraser River Pilot's direction and prepare to assist by making lines fast and manoeuvring as required by the pilot.

2.5 Project Scope

2.5.1 B.C. Environmental Assessment Office

As described in the order issued by the EAO under section 13 of the BCEAA on December 15, 2009, amending the order issued under section 11 on November 18, 2009 (see **Chapter 1**), the provincial scope of the Project includes the following on-site and off-site components and activities:

a) Upgrade of an existing marine terminal;

b) Construction and operation of facilities at the marine terminal for off-loading aviation fuel;

c) Construction and operation of an aviation fuel receiving facility;

d) Construction and operation of a pipeline to transfer aviation fuel from the marine terminal to the aviation fuel receiving facility;

e) Construction and operation of a pipeline to deliver aviation fuel from the aviation fuel receiving facility to YVR; and

f) Movement of vessels transporting aviation fuel within the South Arm of the Fraser River to and from the marine terminal, including fuel off-loading and transfer at the marine terminal.

Decommissioning or abandonment of permanent infrastructure is not within the scope of the Project or the scope of the environmental assessment (see **Section 1.1**). The information in the Project scope table included in the AIR (Table 6 p.32 to p.39) is updated and fully reflected within the text described for each Project component in **Section 2.4.4**.

2.5.2 Canadian Environmental Assessment Agency

Pursuant to the CEAA and as described in the CEA Agency's "Operational Policy Statement Establishing the Project Scope and Assessment Type under the *Canadian Environmental Assessment Act*", the federal scope of a project includes a project in its entirety as proposed by a proponent. As confirmed by the CEA Agency and the Port (the sole responsible federal authority), the federal scope of the Project includes all on-site and off-site components and activities as described under the provincial scope in **Section 2.5.1**.

2.6 Alternative Means of Undertaking the Project

This section assesses alternative means of undertaking the Project in accordance with the CEA Agency "Operational Policy Statement" and as per the requirements confirmed in a letter received by VAFFC from the CEA Agency dated May 26, 2010.

Section 16 of the CEAA specifies that, in certain instances, assessment of alternative means of carrying out a project is required. Alternative means are defined as the various technically and economically feasible ways that a project can be carried out.

Under the CEAA, in certain instances, an assessment of "alternatives to" a Project is also required. "Alternatives to" a Project are functionally different ways of meeting the Project need and achieving the Project purpose, which is an entirely separate assessment from the "alternatives means" assessment completed here.

The process used to determine the preferred Project means is described below. Environmental and economic factors evaluated with respect to each alternative means are identified. In cases in which an alternative means was deemed not to be technically or economically feasible, no further assessment was completed.

2.6.1 Alternative Means Considered

Within the context of a new fuel delivery system consisting of a marine terminal on the South Arm of the Fraser River and a delivery pipeline to YVR, this section describes the various potential means for undertaking the Project that were considered by VAFFC. In achieving the goal of providing access to an expanded fuel market and a sustainable fuel delivery system, the alternative means were required to provide adequate water depth on the Fraser River to allow for berthing of Panamax-class vessels, access to adjacent properties of sufficient size to accommodate an off-loading marine terminal and tank facilities for received product, and a pipeline route by which the product can be delivered to the airport.

Several alternative means to the following are discussed below:

- Methods of fuel transportation on the Fraser River;
- Development of a marine terminal on the Fraser River and design configurations;
- Location of the fuel receiving facility; and
- Pipeline system to YVR.

The rationale for selection of the preferred Project means is presented, together with consideration of key environmental and economic issues that can be identified based on a high level assessment.

2.6.1.1 Alternative Means of Transporting Fuel on the Fraser River

The improvement of access to offshore supplies of aviation fuel is contingent on a marine-based mode of fuel delivery. To access supplies beyond those available in local markets (i.e., B.C., Washington State), the airlines at YVR must be able to ship fuel product in ocean-capable vessels. Restriction of access to local markets and reliance on barges as the primary means of fuel transport would not be economically feasible and would defeat the intent of the Project. Consequently, this option was not assessed further.

Other options for transporting fuel via the Fraser River, discussed below, included trans-loading of product from tankers to barges in a location outside of the river, or using the full range of vessels capable of transiting the river.

Trans-Loading Option

This option would involve the use of larger ocean-going tankers to transport fuel long distances and the trans-loading of this cargo into smaller barges at an offshore site prior to transit up the Fraser River. Due to the need to provide up to four barges during trans-loading, the economic costs associated with this option would be significant. Further, given the potential environmental risks involved, it is considered unlikely that an acceptable and approved location for this type of activity could be identified.

Use of a Full Range of Allowable Vessels

This option would involve the use of a full range of vessels capable of safely transiting the Fraser River to transport fuel cargo from local and international markets direct to the marine terminal. Most importantly, this option would enable YVR to receive aviation fuel shipments from a variety of local and international sources.

Preferred Alternative

As a result of the increased economic costs, greater environmental risk and logistical difficulties associated with the trans-loading option, the use of a full range of allowable vessels was selected as the preferred Project option. This option aligns with the intent of the Project and, due to access to competitively priced aviation fuel supplies, will contribute to the long-term economic security of YVR.

2.6.1.2 Alternative Location of the Marine Terminal

While sites on the south shore of the river were initially considered, closer examination based on existing land use, availability of I-1 Industrial District zoned land, economic costs, and environmental and navigational issues associated with an additional fuel pipeline crossing of the Fraser River combined to make a south shore location both technically and economically unfeasible. As a result, only locations on the north shore of the river were considered.

In 2006, VAFFC commissioned a study to review all potential vacant and occupied sites along the north shore of the Fraser River. Site requirements for a proposed marine terminal included:

- Location on the north shore of the Fraser River, accessible from the deep-sea navigation channel and endorsed by the Fraser River Pilots from a navigability perspective;
- Minimum capability to accommodate 11.5 metre draft vessels for all manoeuvres and berthing throughout the year;
- Presence of a basin that is at least two Panamax-class vessel lengths in width near to the berth with a wide, straight approach for vessels;
- Sufficient area to accommodate one berth for vessels up to Panamax-class;
- Exclusive use or guaranteed access for off-loading fuel;
- Land compatibly zoned for marine terminal use (i.e., I-1 Industrial District); and
- Proximity to vacant or available land of suitable size and zoning to permit construction of the fuel receiving facility.

Based on the above, several sites were identified, which merited further review.

Deas Pacific Marine Inc., 12800 Rice Mill Road, Richmond, B.C.

VAFFC considered a location in the vicinity of the north portal of the George Massey Tunnel, between kilometre marks 17 and 18 of the Woodward Reach portion of the Fraser River. The site was owned by B.C. Ferries and operated by its subsidiary, Deas Pacific Marine Inc. which used this site (Deas Dock site) to refit and upgrade the vessels operated by B.C. Ferries and to store these vessels when not in use. The Deas Dock site had an existing marine facility that included seven berths capable of accommodating a variety of vessels. VAFFC entered into preliminary discussions with Deas Pacific Marine Inc. to determine the feasibility of the site for its use.

The Deas Dock site met a number of key requirements and had several additional benefits, including:

- Basin and berth area sheltered from prevailing weather conditions;
- Existing 24-hour security at the site and an experienced marine terminal work force;
- Lagoon formation offered natural containment and facilitated boom deployment in the unlikely event of an accidental spill; and
- The facility was part of the larger transportation infrastructure of Metro Vancouver and was a long-term operation, which aligned with VAFFC’s objectives.

The greatest drawback to the site was the limited draft, and the need for significant development of the site to provide access for Panamax-class vessels. A number of operational constraints associated with use of the Deas Dock site as a "shared-facility" were also identified:

- "Shared-facility" arrangement would cause scheduling limitations; and
- Incompatible uses (such as welding activities and fuel off-loading activities) could cause delays and conflicts.

Gateway 2000 Site, 16080 Portside Road, Richmond, B.C.

VAFFC considered a location at the south terminus of No. 8 Road, upstream of the George Massey Tunnel and downstream of Annacis Island, between kilometre marks 23 and 24 of the Gravesend Reach portion of the river. The site (Gateway 2000 site) was owned and operated by Coast2000 Terminals Ltd. and its subsidiary, Fraser River Terminal.

The site consisted of a warehouse facility, a barge dock and 24-hour alarm and video monitoring. The container yard was approximately 12 hectares (30 acres) in size and contained both loaded and empty container storage, washing bays and three-lane road access.

This site met all the requirements mentioned above with the exception of proximity to vacant or available land for the fuel receiving facility. The site also provided some additional benefits, including significant existing infrastructure and 24-hour security. The site contained an existing wharf structure which would require complete replacement to meet the vessel requirements.

Williams Road Site, 15040 Williams Road, Richmond, B.C.

VAFFC considered a location at the foot of Williams Road approximately 2 kilometres east of Highway No. 99, between kilometre marks 18 and 22 of the Gravesend Reach portion of the river. The Williams Road site was privately owned and had an existing marine terminal wharf facility originally designed to accommodate vessels up to 30,000 deadweight tonnes, which would require upgrading.

The Williams Road site met all of the above specified criteria including industrial zoning (I-1) and location in vicinity to existing shipping channels. In addition, the Williams Road site had the following advantages:

- Could be owned and operated exclusively by VAFFC;

- Possessed an existing Water Lot lease with the Port; and
- Located close to YVR, approximately 10 kilometres direct line distance.

Preferred Alternative

Due to the industrial nature of the three potential alternative sites, at a high screening level, the local terrestrial, wildlife, aquatic habitat, and fisheries values were expected to be similar in nature. Since the water depth at all three sites was insufficient for berthing of Panamax-class vessels, the need for initial dredging and the potential need for maintenance dredging during operations was assumed. As described below, following a review of all three sites, the Williams Road site was selected as the preferred alternative for a variety of reasons.

First and most significantly, unlike the Deas Dock site and the Gateway 2000 site, the Williams Road site could be exclusively owned and operated by VAFFC. This exclusive ownership is expected to provide long-term security for the facility and ultimate flexibility of operations. For example, the timing, method and frequency of fuel deliveries will not be constrained by the priorities of a landlord or other tenants. Similarly, due to exclusive ownership, there will be no possibility of encountering other incompatible uses of the site that would conflict with the off-loading of aviation fuel. Second, unlike the Gateway 2000 site, the Williams Road site was located in proximity to vacant land that could potentially be used as a location for the fuel receiving facility.

As a result of these considerations and the outcome of preliminary engineering, environmental, and navigational evaluations undertaken by VAFFC prior to purchase, VAFFC secured this option as the preferred marine terminal location in 2007.

2.6.1.3 Alternative Means of Structural Design for the Marine Terminal

The Williams Road site has an existing wharf facility that requires upgrades prior to use to meet the Project need. Specifically, engineering evaluations have concluded that the facility requires structural upgrades to satisfy seismic design criteria and accommodate the necessary range of vessel types and sizes, and construction of fuel off-loading and transfer facilities.

Alternative means considered for the structural design of the marine terminal included an option to demolish the existing structure and rebuild a new terminal facility and two potential upgrade options: integrating a new berthing face into the existing bulkhead wall or constructing a new berthing face off of the existing bulkhead wall.

Integrated Berthing Option

An integrated berthing concept would be technically and economically feasible. For this concept, berthing dolphins would be placed adjacent to the face of the existing bulkhead wall, with most of the supporting piles located within the fill behind this wall.

The use of existing infrastructure to support the berthing dolphins would reduce the economic costs associated with this option. This option, however, would rely on the integrity of the existing structure, particularly from a seismic event perspective, and could require the complete removal and replacement of this structure (i.e., construction of a new marine terminal facility could be required as described below).

The integrated berthing concept would require an initial and relatively extensive operational dredging program to ensure sufficient underkeel clearance for partially-laden Panamax-class vessels. While the riverbed in this location is generally considered to be self-scouring (i.e., due to the physical characteristics of the riverbed and currents, significant deposition of sediment does not generally occur in this area), continuous in-shore dredging during operations would likely be required over the lifetime of the Project.

A conceptual rendering of the integrated berthing configuration option is provided in **Figure 2.6.1**.

Independent Berthing Configuration

An independent berthing option would also be technically and economically feasible. This concept would result in a new berthing face off of the face of the existing bulkhead wall. The new berthing face would be supported by steel pipe piles, most of which would be driven into the riverbed. Compared to the integrated berthing configuration, this option might require more capital investment, but would be technically and environmentally superior. The incremental shift of the berthing terminal face closer to the navigation channel would not be expected to significantly impede vessel movement within the river, if at all.

The engineering and design of a new berthing face would be associated with fewer variables than reconstruction of the existing infrastructure. In addition, the location of the breasting dolphins in deeper water would necessitate less dredging compared with the integrated berthing option to provide adequate underkeel clearance for all vessels. A conceptual rendering of the integrated berthing configuration option is provided in **Figure 2.6.1**.

Construction of a New Marine Terminal Facility

Construction of a new marine terminal facility was considered during the preliminary design stage. A new structure would provide expanded design flexibility and reduce design complications. There were, however, economic and environmental costs associated with this design option. First, the doubling of construction activities to include both decommissioning of the existing structure and construction of a new facility would increase economic costs significantly.

Similar to the economic costs, the environmental footprint and potential effects associated with decommissioning of the existing structure and construction of a new facility would increase. Removal of the existing structure would require significantly more in- and over-water construction, including the need for pile-driving activities that could increase short-term sedimentation and noise levels in the river. It was assumed that these expected environmental effects could be associated with more complex permitting requirements and time delays.

Preferred Alternative

The independent berthing option was selected as the preferred alternative as a result of preliminary engineering, environmental and economic considerations. Compared with the option of constructing an entirely new marine terminal facility, the independent berthing option has significantly lower environmental and economic costs due to the lack of a decommissioning phase and a shorter construction period. The independent berthing configuration will require less maintenance dredging during operations and is considered superior from an engineering design perspective when compared to the integrated berthing option.

2.6.1.4 Alternative Location of the Fuel Receiving Facility

As discussed in **Section 2.6.1.2**, one criterion for selecting a location for the marine terminal was proximity to vacant or available land for the fuel receiving facility. During preliminary design, VAFFC evaluated the possibility of locating the receiving tanks at YVR, essentially adjacent to existing fuel storage areas. This would have resulted in significant design and operational changes to the marine terminal and pipeline systems, with attendant additional cost and operational risk. For example, the diameter of the 15-kilometre pipeline would need to be increased in size from 300 millimetres to 500 or 600 millimetres to allow for doubling of the flow rate and achievement of the desired vessel turn-around times. Consequently, VAFFC eliminated this option in favour of a receiving facility site close to the marine terminal.

Several options for the location of the proposed fuel receiving facility were identified in proximity to the proposed marine terminal on Williams Road. Site size and configuration were evaluated as outlined below.

Site Requirements

Optimal site requirements for the proposed fuel receiving location included:

- Approximately 4 to 5 hectares (10 to 12 acres) of vacant land to accommodate at least six aboveground tanks and provide a total storage capacity of up to 80 million litres;
- Suitably zoned industrial land;
- Located within 1 kilometre of the Williams Road site; and
- Geotechnically capable, or suitable for ground improvements.

15040 Williams Road, Richmond B.C.

An early option, considered when the waterfront marine terminal property was initially purchased, involved the construction of the tanks and other receiving facility components on that property. This option would have allowed for the optimization of resources, site services, safety and security, and costs, as well as a reduction in the overall environmental footprint of the Project. The marine terminal site, however, is bisected by both a dike right-of-way and a railway right-of-way, severely reducing the contiguous land areas suitable for a fuel receiving facility. The maximum capacity that could be achieved on the site would be in the order of 15 to 20 million litres. As a result, this option would require either immediate transfer of fuel to the airport or development of additional tank capacity on an adjacent site within which to receive the balance of fuel delivered by a vessel.

VAFFC also considered additional issues at this site, including its intersection with a dike trail and the limited space available for a spill response station and operations buildings. Following the evaluation of all of the above factors, VAFFC decided to look for a separate land parcel for the fuel receiving facility.

14960 Triangle Road, Richmond, B.C.

Immediately adjacent to the marine terminal is a property at 14960 Triangle Road which is zoned as Light Industrial (I2). The site consists of approximately 3 hectares (7 acres) of privately owned land that is currently used to store and distribute dredgate sand retrieved from the Fraser River. This parcel of land is located within 100 metres of the marine terminal and inland of the Richmond South Dike. The current and historical industrial use of the property indicate that terrestrial habitat and wildlife values are likely minimal.

VAFFC has discussed and will continue to discuss the availability of this property with its owners. While the property is of sufficient size to accommodate an 80-million litre capacity fuel receiving facility, it cannot be expanded and would also require that the pipeline from the marine terminal cross a railway right-of-way.

Port Metro Vancouver Lands, Lot #1, Plan 7452, Richmond, B.C.

A portion of Port-owned lands located north and adjacent to the marine terminal was identified as potentially suitable for the fuel receiving facility. The 4.8 hectares (12 acres) Industrial zoned (I1) site would provide adequate space for at least six aboveground tanks with the possibility of expansion to a total of eight tanks depending on distant future fuel demand at YVR. The industrial zoning of this property and its previous use for industrial applications indicate that terrestrial habitat and wildlife values are likely minimal. This location is approximately 0.5 kilometres away from the Williams Road site/marine terminal and is situated inland of the Richmond South Dike.

Preferred Alternative

The Port Metro Vancouver Lands (Lot #1, Plan 7452) site was selected as the preferred option for locating the fuel receiving facility due to its zoning and size/configuration compatibility, and its proximity to the marine terminal. Unlike the use of the marine terminal property, the Port Metro Vancouver Lands allow sufficient space for the storage tanks and any required spill response station or operations building.

VAFFC has entered into an understanding with the Port regarding the use of the land for the fuel receiving facility. The Triangle Road property remains a potentially suitable alternative, however, subject to obtaining land use approvals and an agreement with the current owners.

2.6.1.5 Alternative Means of Delivering Fuel from the Fuel Receiving Facility to YVR

There are no practical alternatives to using a pipeline to regularly deliver aviation fuel to YVR from the fuel receiving facility. The only other option would be to deploy tanker trucks which would be uneconomical, unsustainable, and socially and environmentally unacceptable. As a result, a fuel transfer pipeline and delivery pipeline are required.

Route Evaluation Criteria

Pipeline route selection is a complex multi-disciplinary process involving the evaluation of many factors including:

- Stakeholder input;
- Potential locations for primary and secondary routing control points and stable watercourse crossings;
- The need to minimize overall pipeline length and the extent of disturbance to vegetation, wildlife and third-party infrastructure;
- Establishment of appropriate setback distances from residences and businesses;
- Requirements for right-of-way access; and
- The safety and security of the pipeline and the surrounding population.

Primary and Secondary Control Points

Pipeline route selection begins with the identification of primary and secondary control points. Primary control points are locations where the pipeline must connect. The primary control points for the proposed pipelines are listed in **Table 2.6.1**.

Table 2.6.1 Primary Control Points for the Proposed Fuel Pipelines

	Fuel Transfer Pipeline	Fuel Delivery Pipeline
Source Control Point	Proposed marine terminal facility located at 15040 Williams Road (and Triangle Road), Richmond, B.C.	Proposed fuel receiving facility, located at Port Metro Vancouver Lands, Lot #1, Plan 7452, Richmond, B.C.
End Control Point	Proposed fuel receiving facility, located at Port Metro Vancouver Lands, Lot #1, Plan 7452, Richmond, B.C.	VAFFC fuel facilities, located at YVR on Sea Island, Richmond, B.C.

During the route selection process, consideration is also given to secondary control points, such as stable watercourse crossings. Secondary control points are expected to include the crossing under the Middle Arm of the Fraser River (Moray Channel) and the crossing under Highway 99.

Other routing criteria include:

- Complying with regulatory requirements;
- Minimizing disruption to environmentally sensitive, socially and culturally important areas;
- Minimizing crossings of existing infrastructure; and
- Costs.

With the exception of the crossing under Williams Road, all sections of the transfer pipeline will be located on VAFFC property or property that VAFFC proposes to lease from the Port, both of which are industrially zoned. As such, and given the close proximity of the pipeline source and end control points, there are no reasonable route alternatives available for the transfer pipeline.

Two primary south-to-north route options were identified for further investigation to connect the delivery pipeline with the fuel receiving facility and YVR: the Shell Road corridor and No. 5 Road. Both routes are approximately the same length and traverse areas characterized by very similar environmental settings and land use patterns. Although neither route would require the crossing of any major watercourses on Lulu Island, both would run adjacent to drainage ditches classified as Riparian Management Areas with 5-metre or 15-metre buffer zones. They would both follow existing transportation corridors and avoid any environmentally sensitive areas. In both cases, adjacent land use includes Neighbourhood Residential/Community Institutional and Agricultural areas.

Shell Road Corridor

This route heads west from the proposed fuel receiving facility towards the Shell Road corridor via Williams Road. It then heads north along either the Shell Road/Shell Road right-of-way, Shell Road Trail or a soon-to-be-decommissioned railway corridor to Bridgeport, and west along the Bridgeport Trail and City streets to the Moray Channel crossing and YVR.

No.5 Road Corridor

This route follows the Shell Road corridor described above with the following exception. Instead of extending along the Williams Road corridor west of No. 5 Road to reach the Shell Road corridor, the route extends north on No. 5 Road, then west on Westminster Highway to connect with the Shell Road corridor.

Possible Routing Alternatives

Several other possible routing alternatives were identified within the general corridor described above:

- It may be possible to align the pipeline along the Francis Road right-of-way instead of Williams Road to reach the No. 5 Road or Shell Road corridor from the proposed fuel receiving facility.
- A possible alternative to the east-to-west Bridgeport Trail could be along Bridgeport Road. In this case, the alignment would head west along Bridgeport Road from the Shell Road corridor, and then north along either No. 3 Road or River Road to reach the directional drilling entrance location for the Moray Channel crossing.

Similar to the Shell Road and No.5 Road Corridor options, these routes would run adjacent to drainage ditches with Riparian Management Areas with 5-metre or 15-metre buffer zones and would not cross any environmentally sensitive areas. Generally, all routes are also surrounded by a combination of Neighbourhood Residential/Community Institutional areas, Agricultural areas and Parks/Conservation areas.

Preferred Option

The Shell Road Corridor was selected as the preferred option for routing the delivery pipeline. The potential exists to locate approximately 6 kilometres of the pipeline along a soon-to-be-decommissioned railway corridor within the Shell Road corridor between Williams Road and Bridgeport. Based on environmental, social and economic criteria, this would be preferential to a road alignment.

Since the Shell Road Corridor was selected as the preferred option, VAFFC has been consulting with CNR about the potential to reach an agreement for use of the railway corridor for the pipeline.

When compared with the No. 5 Road Corridor option, the preferred option is surrounded by areas with lower population levels. As a result, the extent of disturbance associated with construction and operations/maintenance access is expected to be less for the preferred pipeline route. In addition, this route will be associated with less risk of third-party damage during operations as it uses and/or parallels fewer City roads.

It is important to note, however, that many existing pipelines parallel City roads without incident and the possibility of a No.5 Road Corridor option for the pipeline route remains.

During the pipeline route selection process, VAFFC will seek input from the City of Richmond, Vancouver Airport Authority and the public regarding the preferred option and possible routing alternatives within this general corridor.

Each of the discipline-specific chapters in **Part B** provides more detailed assessments regarding the potential environmental, social, economic, and heritage effects of the various pipeline routes and routing options described above.

2.7 Project Setting and Land Use

2.7.1 General Setting

The Project is located on Lulu Island and Sea Island in the City of Richmond. The City is one of 22 municipalities, one electoral area and one treaty First Nation (Tsawwassen First Nation) comprising the federation of Metro Vancouver (Metro Vancouver 2010a). The City is an urban centre that includes land use regimes such as residential, commercial, agricultural, industrial, and natural areas.

The marine terminal and proposed location for the fuel receiving facility are both situated on the north shore of the South Arm of the Fraser River. The proposed fuel delivery pipeline will cross Lulu Island and the Moray Channel before reaching the existing VAFFC fuel facilities located at YVR.

The marine terminal is located on land owned by VAFFC, and the fuel receiving facility is proposed on land that VAFFC plans to lease from the Port. A large portion of the preferred fuel delivery pipeline will be located on land which, subject to agreement, will be purchased from CNR. The balance will be on land owned by the City. Further information on land ownership and/or land use regime, and resource management plans is described as appropriate within **Section 2.7.4** and **2.7.5**, including environmentally protected areas and environmentally sensitive areas in the Project area.

All portions of the Project footprint are located in urban areas that have been previously altered by development. The marine terminal is located on land significantly altered by industrial activities and development. Specifically, the lands were filled in the early 1990s to raise the elevation of the property and accommodate the existing wharf. **Photos 2.7.1** to **2.7.3** show the condition of the marine terminal property and shoreline.

Photo 2.7.1 View of Marine Terminal Wharf and Shoreline on the South Arm of the Fraser River from Upstream (June 22, 2010)

Photo 2.7.2 Marine Terminal Wharf on the South Arm of the Fraser River (May 8, 2009)

Photo 2.7.3 Marine Terminal Wharf from Downstream on the South Arm of the Fraser River (May 8, 2009)

The proposed location for the fuel receiving facility is on lands that have been heavily altered by industrial development and which were used in recent history for depositing dredged materials from the Fraser River. Currently the site is owned by Port Metro Vancouver and ACME Landfill & Peat Ltd. carry on soil/dredgate operations. **Photos 2.7.4** to **2.7.8** show the current land use activities on the proposed fuel receiving facility site.

Photo 2.7.4 Entrance from Triangle Road to ACME Landfill & Peat Ltd. (the proposed fuel receiving facility site), across the road from the proposed marine terminal site (June 22, 2010)

Photo 2.7.5 Standing water in ditch between Triangle Road and entrance to ACME Landfill & Peat Ltd. (the proposed fuel receiving facility site) (June 22, 2010)

Photo 2.7.6 View east along drainage channel between north toe of pre-load and ACME Landfill & Peat Ltd. (the proposed fuel receiving facility site) (June 22, 2010)

Photo 2.7.7 View northeast across the ACME Landfill & Peat Ltd. property (the proposed fuel receiving facility site) from the surface of the Dyke Road pre-load (June 22, 2010)

Photo 2.7.8 Drainage and standing water in the ACME Landfill & Peat Ltd. Property (the proposed fuel receiving facility site), on the north side of the Dyke Road pre-load (June 22, 2010)

The preferred pipeline route and possible routing alternatives follow existing transportation corridors including roads, rail lines and trail systems, and do not pass through undeveloped lands.

The adjacent upland to the east side of the Moray Channel is subject to industrial aggregate storage and handling. The west shore of Moray Channel along northeast Sea Island in the vicinity of the proposed pipeline crossing is highly modified, with steep banks armoured with rip-rap and concrete construction debris.

Vessels delivering fuel will travel from the Strait of Georgia, through the Fraser River estuary, up the South Arm of the Fraser River to the marine terminal. The Fraser River is already currently used by commercial and industrial vessel traffic.

2.7.2 Regional and Local Geology

Geotechnical investigations and engineering will be performed during the detailed design phase. These studies will include site specific subsoil and groundwater investigations, seismic modeling for liquefaction analysis, ground settlement potential, temporary and permanent ground movements including lateral spreading, and any specific ground preparations required for minimizing potential effects.

2.7.2.1 Physiographic Setting

The Project is situated within the Georgia Depression in the Georgia Lowland physiographic region. Within the Georgia Lowland is a smaller region called the Fraser Lowland that differs from the rest of the region, as it is a low-lying area formed through deposition (Holland 1976).

The City of Richmond is located in the Fraser Lowland physiographic region, which was created through sedimentary deposition from the Fraser River onto the Fraser River Delta from the late Cretaceous onwards. The approximately 2,600-square kilometre area stretches from Hope westward about 105 kilometres to the Strait of Georgia and has low relief. The area is bordered to the north by the Coast Mountains, to the west by the Strait of Georgia and to the southeast by the Cascade and Chuckanut Mountains (Holland 1976; Dakin no date). The Fraser Lowland physiographic region is comprised of both lowlands underlain by modern sediment deposited by the Fraser River and uplands underlain by sediments of glacial origin from the last ice age. Underneath modern sediment (i.e., lowlands) and glacial sediment (i.e., uplands) is sandstone bedrock from the Quaternary Period, which is 300 metres thick in some places and overlies older granitic bedrock.

The Fraser River Delta is a geologically young feature that was created over the last 10,000 years through sedimentary deposition of sands and silts from the Fraser and Stave rivers. As a result of this sedimentary deposition, Richmond, Delta and Mission are composed of largely alluvial sediments (also known as fluvial sediments). The Fraser River Delta is generally composed of a thick sequence of unconsolidated silts, sands and clayey silts overlying dense to very dense Pleistocene glacial sediments. The City of Richmond is entirely comprised of lowlands ranging in elevation from sea level to about 15 metres (Holland 1976, Natural Resources Canada 2008).

Lulu Island was formed by fluvial sediments deposited by the Fraser River with fine silty clays overlain with sand. Much of Lulu Island is below sea level and surface water is regulated by dikes, channels and pump stations. Both Lulu and Sea Islands are now entirely encircled by dikes. Elevations recorded on Lulu and Sea Islands during the 2009 wildlife habitat field assessment ranged from between –4 metres below sea level to +10 metres.

2.7.2.2 Surficial Geology

Near surface soil layers in the vicinity of the marine terminal, at the intended location for the proposed fuel receiving facility and the south end of the pipeline alignment are largely composed of several meters of floodplain silts, sands, and peats, and have a high water table (Chinook Engineering 2009). The floodplain near surface soils typically overlays a layer of sand about 10 to 30 metres thick. Another layer of unconsolidated clayey silt, which is interbedded with silty sands, may be up to 300 metres thick before encountering the very dense glacial deposits. Bedrock may not be encountered for up to 800 metres (Chinook Engineering 2009).

Surface soils at the north portion of the preferred pipeline corridor tend to be sands that are sometimes mixed with clayey silt, and often seen in conjunction with a high water table. A layer of sand up to 20 metres thick generally overlies a thinner layer of the deltaic unconsolidated clayey silt, typically only 20 to 40 metres thick, before encountering the denser glacial deposits (Chinook Engineering 2009). These types of soils are known to respond to seismically induced vibrations and ground movements by liquefaction. Previous seismic studies indicate that much of Richmond is underlain by liquefaction-susceptible soils. See **Chapter 21** for an assessment of seismic events on the Project.

2.7.2.3 Groundwater Conditions

Lulu Island and Sea Island are underlain by one sand and gravel aquifer. A search of the B.C. Water Resources Atlas (2010) revealed a relatively small number of water wells and no artesian wells in this area. GeoBC has recorded the presence of 10 groundwater wells within Lulu Island and four groundwater wells within Sea Island. All recorded wells are in excess of 500 meters from the preferred pipeline corridor (GeoBC 2010). In Richmond, the groundwater table is generally high and typically located 1.5 to 3 metres below ground, therefore drainage is a significant issue. However, Richmond's Agricultural Land Reserve lands have undergone significant improvements for drainage, and are now considered prime agricultural land.

The sand and gravel aquifer is composed of Fraser River sediments and is designated as a "non-drinking water" aquifer. The unnamed aquifer is classified as a Class IIIA aquifer with low demand, moderate productivity and high vulnerability. In B.C., aquifer classification is derived using seven criteria including: aquifer productivity, aquifer vulnerability to surface contamination, aquifer area, demand on the resource, type of groundwater use and known documented groundwater concerns related to quality and quantity. A class IIIA aquifer is a lightly developed, high vulnerability aquifer, which means, despite its high vulnerability, it has a low to medium priority in terms of aquifer protection as a result of the low levels of development (GeoBC 2010).

Groundwater sampling at a site slightly north-west of the proposed Moray Channel crossing indicates that seawater moves up the Fraser River with a rising tide and infiltrates permeable deltaic sediments adjacent to the river channel, forming a saline wedge of water or saline intrusion that may extend as far as 500 metres inland from the river. The observed transition zone between fresh and saltwater starts around 10 metres below ground and had observed peak salinity values between 15 and 20 metres below ground (Neilson-Welch and Smith 2001).

2.7.3 Biophysical Setting

2.7.3.1 Biophysical Classifications of the Project Area

In 1985, the B.C. Ministry of Environment adopted the Ecoregion Classification System. This system characterizes B.C.'s marine and terrestrial ecosystems into five levels, each progressively more detailed: Ecodomains, Ecodivisions, Ecoprovinces, Ecoregions and Ecosections. The system stratifies areas of similar climate, physiography, oceanography, hydrology, vegetation and wildlife potential (Demarchi 1996). Lulu Island lies within the Lower Mainland Ecoregion and the Fraser Lowland Ecosection of B.C. (Demarchi *et al.* 1990), an area of reduced rainfall where the rain shadow effect is most prevalent in the Fraser Delta.

B.C.'s Biogeoclimatic Ecosystem Classification system is an established and widely-used system developed by the B.C. Ministry of Forests and Range, which describes landscape ecology in B.C. The Project is located almost entirely within the Coastal Douglas-fir biogeoclimatic zone, specifically its Moist Maritime subzone (CDFmm). This subzone comprises the Gulf Islands, low elevations of southeastern Vancouver Island south of Bowser, a narrow coastal strip of the Sunshine Coast, and the extreme southwestern corner of the Lower Fraser Valley. Although most of the area is composed of riverine sediments, the peatlands of Richmond represent a unique exception. A small segment of the Coastal Western Hemlock biogeoclimatic zone (CWHxm1) overlaps the study area in northern Richmond (B.C. Ministry of Forests and Range 2008).

The Coastal Douglas-fir biogeoclimatic zone is generally characterized by warm, dry summers and mild, wet winters. Mean annual temperature is approximately 10°C and mean annual precipitation varies from approximately 647 to 1,263 millimetres, with very little precipitation in the form of snow (i.e., approximately 5%) (Meidinger and Pojar 1991). The Coastal Western Hemlock biogeoclimatic zone is generally characterized by cool summers and mild winters. Mean annual temperature is approximately 8°C and mean annual precipitation totals about 2,230 millimetres, but can range from 1,000 to 4,400 millimetres (Meidinger and Pojar 1991). In the southern extent of this zone, which includes the City of Richmond, less than 15% of total precipitation falls as snow (Meidinger and Pojar 1991). The total annual precipitation at YVR is about 1,000 millimetres, which increases with proximity to Vancouver's North Shore (i.e., to 2,700 millimetres at the headwaters of Mosquito Creek), and to a lesser extent, to the east. The weather pattern is characterized by two types of systems, the dominant of which is the more or less continual procession of Pacific westerlies that flow over the coast creating wet, cool weather typically from October to March. This system breaks down during the summer when a high pressure zone establishes itself off the coast and precipitation is reduced. During this period, particularly July to September, droughts can extend for up to 50 days.

The City of Richmond is situated within the Georgia Depression Ecoprovince, the Georgia Lowland Ecoregion and more specifically, the Fraser Lowland Ecosection. The Georgia Depression Ecoprovince supports the highest diversity of avifauna in B.C. This includes 90% of all species in B.C. and 60% of all breeding bird species in B.C. The Fraser River Delta wetlands are the single largest wetland habitat area in B.C., and as such are critically important to migratory and wintering water birds (Demarchi 1996).

2.7.3.2 The Fraser River

The Fraser River delta is the largest estuary on the Pacific coast of North America (Flynn *et al.* 2006). The delta is bound by the U.S. – Canada border to the south, Burrard Peninsula to the north, Surrey uplands to the east, and the Strait of Georgia to the west (Butler and Campbell 1987). From New Westminster in the east to the mouth of the river near Sand Heads to the west, the estuary covers an area of approximately 681 square kilometres (Butler and Campbell 1987).

In New Westminster, just upstream of Annacis Island and Lulu Island, the mainstem of the river divides into the North Arm and the South Arm. The South Arm, which flows past the marine terminal property, carries about 88% of this flow (Butler and Campbell 1987). Before reaching the Strait of Georgia, the South Arm divides again, creating Canoe Pass, which carries about 5% of the river flow along the south side of Westham Island (Butler and Campbell 1987). The North Arm splits into the Middle Arm just upstream of Sea Island.

Environmental conditions along the lower Fraser River are strongly influenced by the semi-diurnal tides and seasonal river flows. Maximum river discharge occurs between May and July during spring freshet. On Roberts Bank, the influence of Fraser River flows is reduced with distance from the mouth, resulting in less turbid and higher salinity conditions that favour the establishment of intertidal seagrass (*Zostera* spp.) communities. The intertidal wetlands of the Fraser River estuary cover approximately 17,000 hectares (Flynn *et al.* 2006).

The Fraser River is the largest producer of salmon on the Pacific Coast of North America. The estuary provides a critical feeding and rearing area for salmon and other anadromous fish during their transition from freshwater to marine life stages. It contains marshes, mudflats, floodplains, sloughs, and river channels which provide critical habitat to fish during life stage transitions.

The coastal lowland, marsh and intertidal habitat of the Fraser River also provide important refuge and feeding areas for avian migrants along the Pacific Flyway. The estuary has the largest concentrations of wintering waterbirds and raptors in Canada, and over 400 species of vertebrates (British Columbia Waterfowl Society 2010). During periods of peak migration, as many as 1.4 million birds move through the estuary (Butler and Campbell 1987).

The lower Fraser River has been heavily modified due to extensive shoreline development, diking and dredging. The Fraser River is utilized extensively as a major marine transportation route by local and international barges and deep-sea vessels, including container ships and bulk carriers. The river is also used recreationally by boaters, and used by First Nations, commercial, and recreational fishermen. To maintain the navigation channel, the riverbed undergoes regular dredging by the Port. This dredging adheres to the Dredge Management Guidelines developed by the Fraser River Estuary Management Program (FREMP). As well, a Sediment Management Budget was developed by FREMP to ensure that any sediment removed from the river bed over a five to ten year time-span will not alter the profile of the river bed (FREMP 2003). Areas enclosed by the dikes support agricultural land use, suburban residential, commercial and industrial developments, woodlots and bogs (Butler and Campbell 1987). Outside the dikes, as described above, the aquatic environment includes estuarine, marine and riverine components (Butler and Campbell 1987).

2.7.4 Project Area Land Use

This section describes land use within the vicinity of the Project footprint. Property requirements, such as lease agreement with the Port and municipal access agreement with the City of Richmond, are described in **Section 2.11**. First Nations land use activities are described in **Part C**.

2.7.4.1 City of Richmond Land Use Zoning

Lulu Island has a diverse mix of land uses, as described in the City of Richmond's Official Community Plan (see **Figure 2.7.1**). Within the City, land is zoned for:

- Agriculture (as designated by the Agricultural Land Commission, see **Section 2.7.4.3** below);
- Agriculture and Open Space;
- Public and Open Space Use;
- Conservation Area (e.g. the Richmond Nature Park, see **Section 2.7.5.6** below);
- Airport (see **Section 2.7.4.2** below);
- Business and Industry;
- Commercial;
- High-density Mixed Land Use;
- Mixed Use;
- Neighbourhood Service Centre;
- Community Institutional; and
- Neighbourhood Residential (City of Richmond 2010b).

Sea Island is predominately zoned for airport use, with small portions of zoned for commercial, neighbourhood residential, conservation and public and open space use.

2.7.4.2 Vancouver International Airport (YVR)

YVR is located in the City of Richmond on Sea Island, and has been managed by Vancouver Airport Authority since 1992, when it was transferred from Transport Canada. YVR is the second busiest airport in Canada and is an important employer and the largest in the City of Richmond. It generates a total of 26,700 direct jobs. The airport has an important role in international trade and commerce and has 360 associated businesses and organizations (City of Richmond 2010c). Refer to **Section 6.3.3** for a more detailed description of YVR.

2.7.4.3 Agricultural Land Reserve

This provincial zoning classification recognizes agriculture as a priority use and controls non-agricultural uses. Lands designated within the Agricultural Land Reserve include private and public lands that have the potential for agricultural production. Lands can be farmed, forested, or left vacant, and can vary in size from a few hectares to thousands of hectares. Currently, lands within the Agricultural Land Reserve total approximately 4.7 million hectares in B.C. Areas of Lulu Island are designated as Agricultural Land Reserve land. Lands close to both the marine terminal and the proposed fuel receiving facility location are within the Agricultural Land Reserve. However, these Project locations are not within or directly adjacent to any Agricultural Land Reserve lands (Agricultural Land Commission 2002). The preferred pipeline and possible routing alternatives are all located within existing transportation corridors and are not on Agricultural Land Reserve lands.

Figures 2.7.1 and **2.7.2** denote land that is located within the Agricultural Land Reserve.

2.7.4.4 Port Metro Vancouver Lands

The jurisdiction of the Port covers "nearly 600 kilometres of shoreline and extends from Point Roberts at the Canada/U.S. border through Burrard Inlet to Port Moody and Indian Arm, and from the mouth of the Fraser River, eastward to the Fraser Valley, north along the Pitt River to Pitt Lake, and includes the north and middle arms of the Fraser River" (Port Metro Vancouver 2010). The Port manages shoreline, marine and freshwater, and land within its jurisdiction. Lands managed by the Port are not only industrial, but also include conservation areas and recreational waterfront. A number of terminals and facilities are operated on Port lands, including deep sea and domestic marine terminals for a variety of business sectors including automotive, breakbulk, bulk, containers and cruise.

The proposed site for the fuel receiving facility is located on Port lands. This site is currently occupied by ACME Landfill and Peat Ltd. **Photos 2.7.1** to **2.7.10**

(**Section 2.7.1**) show that the site is highly disturbed and is currently used for storage of materials dredged from the Fraser River, as well as peat.

2.7.4.5 Richmond Landfill

The Richmond Landfill is owned and operated by Ecowaste Industries Ltd. and is located next to ACME Landfill and Peat Ltd., across from the proposed marine terminal property. The landfill mainly accepts inert refuse from construction and demolition activities, but also recycles other waste streams including yard waste. There is also a facility that bioremediates contaminated soil and manufactures soil from wastewater treatment plant biosolids (Ecowaste Industries Ltd. 2010).

2.7.4.6 Lulu Island Wastewater Treatment Plant

The Lulu Island Wastewater Treatment Plant is operated by Metro Vancouver and provides secondary treatment to wastewater from the western portion of Richmond. Secondary treatment involves the biological treatment of wastewater. The treatment facility produces Class B biosolids and treated wastewater. Treated wastewater is released into the Fraser River. The plant is located at 13500 Gilbert Road near Dyke Road on the banks of the South Arm of the Fraser River (Metro Vancouver 2010b).

2.7.5 Environmentally Protected Areas and Environmentally Sensitive Areas

This section describes environmentally protected areas and environmentally sensitive areas in the vicinity of the Project.

2.7.5.1 Western Hemisphere Shorebird Reserve Network

The Fraser River delta is an internationally significant habitat for shorebird populations, acting as a key stopover habitat during their migrations. The Western Hemisphere Shorebird Reserve Network identifies and protects habitats for migratory shorebirds in the Western Hemisphere, and has identified the Fraser River Delta as a Western Hemisphere Shorebird Reserve Network site because of its importance to migratory shorebirds. This area is particularly critical to western sandpipers; nearly the entire world's population uses this area during their migration between North and South America (B.C. Parks 2010a, B.C. Waterfowl Society 2010).

2.7.5.2 Important Bird Areas of Canada

Important Bird Areas of Canada has designated a 400-square kilometre area which includes Boundary Bay (marine), Roberts Bank (estuarine) and Sturgeon Bank (estuarine) in the Fraser River Delta area. The area extends as far as Point Roberts in the U.S. and includes Mud Bay and Semiahmoo Bay. The area also includes the Fraser River and mudflats, intertidal marshes, and farmlands of Richmond, Delta and South Surrey.

The designation reflects the importance of the area for migrating and wintering birds species including; Western sandpiper, Trumpeter swan, Snow goose, Western grebe, Great blue heron, American bittern, Bald eagle, Peregrine falcon, Short-eared owl, Red-tailed hawk, and Rough-legged hawk (Important Bird Areas of Canada 2009).

2.7.5.3 Alaksen National Wildlife Area/George C. Reifel Migratory Bird Sanctuary

The Alaksen National Wildlife Area is a 586-hectare area located on Westham Island, at the mouth of the South Arm of the Fraser River near Ladner. The Alaksen National Wildlife Area is owned by the federal government and managed by the Canadian Wildlife Service, and protects important habitat for migratory birds. The George C. Reifel Migratory Bird Sanctuary is a 300-hectare protected area that is managed by the B.C. Waterfowl Society and which makes up part of the Alaksen National Wildlife Area. The George C. Reifel Migratory Bird Sanctuary is open to the public and helps finance local waterfowl research, habitat enhancement projects and community-based farm and wildlife initiatives. Both areas consist of managed wetlands, natural marshes and low dikes, and are protected under the *Migratory Birds Convention Act* (B.C. Waterfowl Society 2010).

The Ramsar Convention (also called the Convention on Wetlands of International Importance) is an international intergovernmental treaty that provides the conservation framework for wetlands and their resources. Wetlands designated under the Ramsar Convention are selected “on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology” (Ramsar 2010). The Alaksen National Wildlife Area was designated a Ramsar Site in 1982, and is one of 37 such sites across Canada.

2.7.5.4 Wildlife Management Areas

Wildlife Management Areas are managed by the B.C. Ministry of Environment and are designated when an area has wildlife values of regional, provincial or national significance. These areas enable site-specific objectives and management strategies to be implemented and are useful when a standard “protected area” designation is not possible or would be too restrictive. The Wildlife Management Area designation allows certain activities or developments which may not be permitted in a “protected area”, depending on the particular Wildlife Management Area (B.C. Parks 2010c).

South Arm Marshes

This 937-hectare Wildlife Management Area is located in the South Arm of the Fraser River, and is managed by the B.C. Ministry of Environment for critical habitat of waterfowl, shorebirds, raptors, songbirds, small mammals and wetland dependant species. This area is estimated to be used by as many as 1.4 million birds annually, and supports the highest densities of waterbirds and shorebirds in Canada. This area was established in 1991 as a Wildlife Management Area and was also designated under the Western Hemisphere Shorebird Reserve Network (B.C. Parks 2010a).

Sturgeon Bank

Sturgeon Bank Wildlife Management Area is also a designated site under the Western Hemisphere Shorebird Reserve Network. All five species of salmon and 27 non-salmonid fish species are known to utilize Sturgeon Bank, as well as 47 species of shorebirds. This area is critical to wintering migratory shorebirds, waterfowl and raptors (B.C. Parks 2010b).

2.7.5.5 Fraser River Estuary Management Program Designations

The FREMP Atlas (hosted by the Community Mapping Network)[5] displays habitat information for the Fraser River Estuary using the FREMP Habitat Classification System. The FREMP Habitat Classification System has three habitat designations; “low productivity” (green), “medium productivity” (yellow) and “high productivity” (red). The Atlas displays these habitat designations and information on the type of habitat (e.g., intertidal; riparian; trees and shrubs; grasses and forbs; mosses; lichens and algae; unvegetated; other; and null).

Figure 2.7.3 shows the shoreline habitat around Lulu Island as designated by the FREMP Habitat Classification System. As shown in **Figure 2.7.3**, the majority of shoreline habitat is classified as “high productivity” (red) or “moderate productivity” (yellow).

South Arm of the Fraser River

FREMP has classified the shoreline habitat of the marine terminal property as “low productivity” (green) (FREMP 2003). The shoreline habitat directly upstream and downstream of the marine terminal property is classified as “moderate productivity” (yellow) and “high productivity” (red), respectively.

[5] Located online at: http://www.cmnbc.ca/atlas_gallery/burrard-inlet-environmental-action-program-fraser-river-estuary-management-plan-atlas

Photo 2.7.9 Yellow-coded FREMP Habitat Upstream of Marine Terminal Property on the South Arm of the Fraser River (June 22, 2010)

Moray Channel

In the vicinity of the proposed pipeline crossing under the Moray Channel, the shoreline habitat associated with Sea Island is classified as "moderate productivity" (yellow). On the other side of the channel along the shoreline of Lulu Island, habitat is classified as "moderate productivity" (yellow) or "high productivity" (red) close to the Moray Channel Bridge, and "low productivity" (green) close to the North Arm of the Fraser River (FREMP 2003).

2.7.5.6 City of Richmond Environmentally Sensitive Areas

The City of Richmond has a number of designated Environmentally Sensitive Areas (ESA) which are of ecological importance to the City and include marshes, beaches, open spaces, and natural areas. Developments that are within designated ESAs require a permit to be issued, before construction activities or land subdivisions take place, as those activities can alter natural features. Other activities on ESA-designated land that do not involve construction or land subdivision do not require a development permit, but are advised to follow the "Criteria for the Protection of Environmentally Sensitive Areas" guide, published by the City of Richmond's Urban Development Division in 2001. Designated ESAs are often linked to one another, to increase natural corridors within Richmond. Areas designated as ESAs within the City of Richmond which may have interaction with the Project include the Shell Road corridor between Williams Road and

Westminster Highway, portions of the Francis Road right-of-way, the Richmond Nature Park, and shorelines of the South Arm and Middle Arm of the Fraser River (City of Richmond 2001).

It is important to note that pursuant to Section 9.1.2 of the City of Richmond Official Community Plan and Appendix D of the "Criteria for the Protection of Environmentally Sensitive Areas," new construction on sites designated as ESAs that will not result in damage to the sensitive features within the ESA (such as trees, shrubs, wetlands, marshes or fish habitat) is exempt from needing a development permit (City of Richmond 2001).

A portion of the property waterside of the railway easement was originally designated as an Environmentally Sensitive Area by the City in 1999. Most of the site is devoid of vegetation, however, and significant modification to the site has greatly diminished the natural attributes of the site that led to its Environmentally Sensitive Area designation. The Environmentally Sensitive Area designation has subsequently been removed and is expected to be reflected in the next update of the Environmentally Sensitive Area map attachment to the City of Richmond Official Community Plan (D. Brownlee 2009, pers. comm.). A revised Environmentally Sensitive Areas map is being created as part of the Official Community Plan (2041) Update (City of Richmond 2010d, J. Christy pers. comm. 2010). The ESA mapping and identification update will be undertaken using a “Green Infrastructure” methodology that utilizes the principles of landscape ecology and conservation biology to identify a connected network of natural and semi-natural lands most critical for the area’s long-term ecological health (City of Richmond 2010e).

Shell Road Trail

The Shell Road Trail is a dedicated walking and cycling trail. The trail runs north to south from Alderbridge Way to Williams Road and passes through the Richmond Nature Park (City of Richmond 2010f). A portion of the preferred pipeline route follows the length of the Shell Road corridor between Williams Road to the south and the Bridgeport Trail to the north. Depending on the exact location of the pipeline right-of-way in this corridor, the trail could be affected during construction.

Francis Road Trail (Extension of Shell Road Trail)

The Francis Road Trail is sometimes referred to as Shell Road Trail and is situated between No.4 Road and Shell Road and connects to the Shell Road Trail from the west. East of Shell Road and west of No.4 Road the trail becomes the Francis Road Trail. The Francis Road trail is enclosed by agricultural fields on the north and residential areas to the south (City of Richmond 2001).

Richmond Nature Park

The Richmond Nature Park is an 80-hectare (200-acre) area that has walking trails and an interpretive centre for visitors. The park consists of raised peat bog, mixed forest and freshwater habitat and is an important area for more than 100 species of resident and migratory birds. The park itself encompasses the largest undeveloped portion of the Greater Lulu Island Bog. The Richmond Nature Park is located between Westminster Highway and Alderbridge Way and between No.4 Road and No.5 Road (intersected by the Shell Road corridor) (City of Richmond 2010g). Construction of the proposed fuel delivery pipeline is not expected to affect this park.

South Arm and Middle Arm of the Fraser River

The out-of-date 1999 ESA mapping designates the entire Lulu Island shoreline and Sea Island shoreline as ESAs. Many areas included as ESAs designated in 1999 have a history of industrial development and are not considered natural or semi-natural areas. As part of the 2041 Official Community Plan Update, a ‘green infrastructure’ approach to mapping ESA is expected to take place. Using this methodology, it is not expected that the marine terminal or the proposed location for the fuel receiving facility, both of which are situated on lands heavily altered by industrial development, will be included as ESAs (D. Brownlee 2009, pers. comm.) (see **Section 2.7.1**).

2.7.5.7 City of Richmond Riparian Management Areas

The Riparian Areas Regulation, part of the provincial *Fish Protection Act*, was enacted in July 2004 to protect riparian areas during residential, commercial or industrial activities. The City of Richmond adopted a Richmond-specific Riparian Management Approach in 2006 in response to the Riparian Areas Regulation. Areas within the City where the Riparian Areas Regulation is applicable include areas that are adjacent to ditches, streams, lakes and wetlands. Two different categories of Riparian Management Areas have been created; 15 metres for major canals and sloughs, and 5 metres for minor watercourses (City of Richmond 2010h).

To obtain any necessary City permits, developers must show that they are not within a Riparian Management Area of a property, or are conducting an activity exempt from the requirements of the Riparian Areas Regulation (City of Richmond 2010h).

2.7.6 Existing Marine Shipments of Bulk Petroleum Hydrocarbons in Local Waters

2.7.6.1 Overview

The coastal waters off B.C.'s Lower Mainland are renowned for large numbers of transiting vessel traffic. Jurisdiction of the former three local ports – Port of Vancouver, Fraser River Port and North Fraser Port – amalgamated on January 1, 2008, to continue under the single jurisdiction of the Vancouver Fraser Port Authority, now doing business as Port Metro Vancouver.

Port of Vancouver handles the vast majority of coastal and deep-sea movements of bulk petroleum hydrocarbons on the west coast of Canada, including crude oil and refined petroleum products. More than 6.3 million tonnes of petroleum hydrocarbons were handled in 2007, which increased to over 7.2 and 8.3 million tonnes in 2008 and 2009, respectively, representing a yearly increase of approximately 14% (Port of Vancouver 2008, Port Metro Vancouver 2009a, 2010a). Crude oil, which is received from Alberta via the Trans Mountain Pipeline, is transported from Vancouver by tanker vessels to primarily U.S. west coast markets (Natural Resources Canada 2008, Port Metro Vancouver 2008, 2009b, 2010b). Refined petroleum products are obtained to meet market demand in the Lower Mainland from the Chevron Burnaby Refinery, refineries in Edmonton, Alberta, and from refineries in the United States (Natural Resources Canada 2008). Refined petroleum products are both imported and exported in the Vancouver market, primarily by barges and tanker vessels (Port Metro Vancouver 2008, 2009b, 2010b). From the Vancouver market, barges carry refined petroleum products to B.C.'s coastal communities (Natural Resources Canada 2008, Port Metro Vancouver 2008).

Within the jurisdiction of Port of Vancouver, the vast majority of petroleum hydrocarbon products are loaded and off-loaded by five terminals located in inner Burrard Inlet (i.e., Shellburn, Stanovan, Westridge, Petro-Canada, and Imperial Oil-IOCO). Westshore Terminals, located at Roberts Bank south of the mouth of the Fraser River, handles all petroleum coke products in Port Metro Vancouver. In recent years, an estimated average volume of 20,000 tonnes per year is shipped to foreign ports (Westshore Terminals 2010).

Fraser River Port handled an annual average of approximately 15,000 tonnes of petroleum hydrocarbon products, primarily fuel oils, in 2004 and 2005 (Statistics Canada 2007, 2008). In 2007, 219,000 tonnes of diesel and fuel oils were loaded at Fraser River Port bound for other B.C. ports (Port of Vancouver 2008, Port Metro Vancouver 2009a,b, 2010b). An annual average of 80,000 tonnes (with the exception of bunker fuels to refuel ships at Fraser River Port) was loaded and transported along the South Arm of the Fraser River in recent years. Petroleum hydrocarbon products loaded at Fraser River Port are predominantly destined for ports located on Vancouver Island (Port Metro Vancouver 2009b).

Refined petroleum hydrocarbon products are also shipped between Washington State and Alaska, which requires transit through the Strait of Georgia (EnviroEmerg Consulting Services 2008).

2.7.6.2 Bunkering Traffic

Bunkering traffic is a significant portion of petroleum hydrocarbon movements in local waters. “Bunker fuel” refers to any fuel oil used by ships. Bunker C, a residual/heavy fuel oil, is the most common and is generally referred to as bunker fuel. There are several major bunker fuel suppliers servicing the local market, including Marine Petrobulk Ltd., ICS Petroleum Ltd., and Imperial Oil-IOCO (Bunkerworld 2008, Ocean Intelligence 2009).

The Ministry of Energy, Mines and Petroleum Resources estimated that 2.6 million litres of bunker fuel were used each day in the Port of Vancouver in 2004 (Neufeld 2004), which translates into approximately 950,000 tonnes per year. Around the same time, Marine Petrobulk, the prominent bunker fuel provider in local waters, estimated a monthly demand of over 50,000 tonnes over the winter months and over 75,000 tonnes during the summer cruise season in the Port of Vancouver (Marine Petrobulk 2008), which translates into approximately 750,000 tonnes of bunker fuel per year. Local bunker suppliers indicated that the west coast bunker fuel market remained healthy and comparable to previous years (Portworld 2008).

Based on the bunker estimates discussed above, recent consultation with local bunker suppliers, and in consideration of changes in port traffic statistics, it is currently estimated on an annual basis that approximately 940,000 tonnes of bunker fuel are delivered to Port of Vancouver to refuel ships, approximately 240,000 tonnes are delivered to Fraser River Port (i.e., through the South Arm of Fraser River), and approximately 100,000 tonnes are delivered to areas outside of Port Metro Vancouver’s jurisdiction.

2.7.6.3 Summary

Port statistics and bunkering traffic estimates are summarized in **Table 2.7.1**. Approximately 8.52 million tonnes per year of petroleum hydrocarbon products are transported by marine vessels as cargo in the coastal waters off the Lower Mainland, among which approximately 320,000 tonnes are transported in the South Arm of Fraser River (i.e., approximately 240,000 tonnes of bunker fuel transit the river to refuel ships and 80,000 tonnes transit the river destined for other local ports).

Table 2.7.1 Summary of Average Annual Movements of Petroleum Hydrocarbons in Local Waters (2007 – 2009) (Unit: '000 tonnes)

Area	Port Inbound			Port Outbound			Bunkering	Total
	Domestic	Foreign	subtotal	Domestic	Foreign	subtotal		
Port of Vancouver – Burrard Inlet	300	2,070	**2,370**	1,420	3,350	**4,770**	940	**8,080**
Port of Vancouver – Roberts Bank	0	0	**0**	0	20	**20**	0	**20**
Fraser River Port	0	0	**0**	80	0	**80**	240	**320**
North Fraser Port	0	0	**0**	0	0	**0**	0	**0**
Vancouver Island, mid- and north-coasts	–	–	–	–	–	–	100	**100**
Total	**300**	**2,070**	**2,370**	**1,500**	**3,370**	**4,870**	**1,280**	**8,520**

2.8 Project Delivery Mechanism

The Project will most likely use a design-bid-build process. However a design-build method of Project delivery is also possible. The design-bid-build process provides competitive procurement of design, construction and third-party services. VAFFC will have separate contractual relationships with both the design entity and the contractor, and for each design package, there is a corresponding contractor. Each phase of the Project is therefore subject to a separate procurement process. Using a design-build mechanism of Project delivery, VAFFC contracts with a single entity or point of responsibility to provide both design and construction services. This method of Project delivery has only one procurement process and leaves all of the responsibility of the design and building of the structure up to one entity.

2.9 Project Constraints / Challenges

2.9.1 Marine Terminal

There are physical constraints and/or challenges that apply to the development of the marine terminal property. **Section 2.16** describes permits, approvals or authorizations that are expected for the Project, some of which are mentioned below in the context of possible constraints.

2.9.1.1 Property Boundaries

It will be necessary to increase the size of the existing Water Lot lease with the Port so that the full range of vessel types and sizes can be berthed at the marine terminal. VAFFC will submit an application to the Port for an amendment to the size of the Water Lot (see **Section 2.11**).

The size and configuration of the marine terminal property precludes the construction of fuel receiving and storage facilities on the marine terminal property itself. Separate land is required for the development of the proposed fuel receiving facility.

A City dike and a rail right-of-way bisect upland areas of the marine terminal property. The design of the marine terminal property will, therefore, need to account for and accommodate these constraints. VAFFC will consult with the City and the Inspector of Dikes, and the owner of the rail right-of-way during detailed design (**Section 2.11**).

2.9.1.2 Geotechnical

The existing soils underlying the marine terminal property are known to be relatively loose and compressible, and subject to liquefaction during a moderate earthquake. To prevent damage to the marine terminal under static (i.e., normal) or dynamic (i.e., seismic) conditions, it will be necessary to improve the properties of the soil through a process of ground improvements and densification.

2.9.1.3 Navigation

In-water upgrade activities and the use of equipment, including staging barges, during construction are expected to marginally impinge on the Navigation Channel Safety Setback zone.

As described in **Chapter 20**, this zone was established by the Port to provide additional clearance between moving vessels and the closest fixed object along the shore. The width of the safety zone is not an absolute limitation, but is used by the Port as a means of screening proposed developments and identifying areas where particular attention is warranted. Transport Canada has determined that the marine terminal component should not substantially interfere with navigation, but requires VAFFC to obtain an Approval under Section 5(3) of the *Navigable Waters Protection Act*.

Underkeel clearance at the marine terminal berth is insufficient for deeper draft vessels (i.e., partly-laden Panamax-class). The portion of the river between the navigation channel and the marine terminal berth may also have insufficient depth to account for the required underkeel clearance of these larger vessels, which will be determined during detailed design. VAFFC will undertake a relatively minor one-time dredging effort at the base of the marine terminal during the construction phase. Due to the self-scouring nature of the riverbed in this location, and the subsequent installation of scour protection on the riverbed, future dredging activities at the marine terminal are expected to be minimal. VAFFC expects any dredging requirements to coincide with the routine dredging activities currently undertaken by the Port.

2.9.2 Fuel Receiving Facility

There are physical constraints and/or challenges that apply to the development of the proposed fuel receiving facility as follows.

2.9.2.1 Land Use

VAFFC proposes to lease a parcel of Port lands for the construction and operation of the fuel receiving facility. As such, VAFFC will require a Lease Agreement with the Port before construction can commence. VAFFC has and will continue to consult with the Port in this regard.

The land VAFFC proposes to lease from the Port for developing the fuel receiving facility has been extensively developed over the years and is currently used for storage of stockpiled soils and sand. A considerable volume of this material exists on the site which will need to be removed prior to commencement of construction.

VAFFC is aware of interests in the Port lands by some of the First Nations participating in the review of the Project (**Part C**). VAFFC will continue to consult with these First Nations through the environmental assessment review process to determine the extent of these interests, the effects that the Project may have on these interests, and to identify possible resolutions. During all construction activities involving ground disturbance, VAFFC proposes to implement an archaeological monitoring program in accordance with the permitting requirements of the B.C. Archaeological Branch and First Nations, and under the management and supervision of an experienced professional archaeologist, to mitigate the potential for archaeological concerns.

2.9.2.2 Geotechnical

Similar to the marine terminal property, the existing soils underlying the proposed location for the fuel receiving facility are known to be relatively loose and compressible, and subject to liquefaction during a moderate earthquake. To prevent damage to the facility in the event of seismic activity, it will be necessary to improve the properties of the underlying soils through a process of ground improvements (i.e., preloading or over-excavation) and densification.

2.9.3 Fuel Pipelines

The physical constraints and/or challenges that apply to the development of the proposed fuel delivery pipeline are as follows.

2.9.3.1 Alignment

VAFFC does not have a final alignment for the proposed fuel delivery pipeline. VAFFC has identified a preferred corridor and possible alternatives that require further refinement, assessment and consultation.

2.9.3.2 Major Crossings

Regardless of the final alignment selected, the pipeline will require a crossing of Highway No. 99 and the Moray Channel. Interference of road and waterway traffic, and effects on archaeological and sensitive environmental resources (see **Section 2.9.3.3**), are the key concerns. To achieve these crossings and avoid or mitigate concerns, VAFFC expects to use a horizontal directional drilling technique underground. VAFFC will undertake a detailed geotechnical assessment during detailed design to determine the appropriate locations for directional drilling entrance and exit points. Based on a general understanding of underground conditions in these areas, VAFFC does not expect significant challenges for this method of crossing. VAFFC will consult with the Ministry of Transportation and Infrastructure and Transport Canada for the crossing of all highways and major watercourses. Interference of road or waterway traffic is not expected.

2.9.3.3 Land Use

For sections of pipeline requiring use of or access to City owned property, VAFFC will require a Municipal Access Agreement with the City. The terms of this agreement will be determined between VAFFC and the City.

Directional drilling for the Moray Channel crossing has the potential to affect archaeological resources (e.g., on Sea Island) or sensitive shoreline areas. The directional drilling exit or entrance locations for the Moray Channel crossing (to be determined) will be selected so as to avoid or minimize the potential for effects on archaeological resources, and avoid sensitive shoreline areas.

2.9.4 Vessel Movements

The physical constraints and/or challenges that apply to the movement of vessels on the river are as follows.

2.9.4.1 Navigation

Due to the draft limitations in the Fraser River, the largest design vessel for the Project, Panamax-class, will only be allowed to transit the river under partly-laden conditions. This constraint may also apply to the smaller Handysize vessel class depending on the dimensions and load conditions of a specific vessel transit.

Partly-laden Panamax-class vessels, and possibly some in the Handysize class, will be required to transit the river during high tide conditions due to the draft limitations. This places a constraint on the scheduling of these vessels and in-river segment transit timings. Vessel operators will be required to work with the Port and the Fraser River Pilots to ensure optimum conditions are present for river transit.

During operations, vessels calling at the marine terminal will impinge on the Navigation Channel Safety Setback zone while at berth. The amount of encroachment will range from approximately 5 to 25 metres depending on the specific vessel and the final design of the marine terminal. The larger the vessel the greater will be the impingement (see **Section 2.9.1.3** for discussion on concerns and mitigation).

2.10 Project Security

2.10.1 Vessel and Marine Terminal

Vessel and marine terminal security will need to comply with international and Canadian laws and regulations. This includes the International Maritime Organization International Ships and Port Facility Security Code, which is regulated by Transport Canada.

Vessels are required to have a Ship Security Plan which is documented and verified through an International Ship Security Certificate. The marine terminal is also required to have a security plan based on an assessment of potential threats, vulnerabilities and available countermeasures. The marine terminal's security plan may include measures such as perimeter fencing, intrusion alarms, surveillance systems and yard lighting. Sufficient lighting will also be required to allow operations to be conducted during periods of darkness. Standby diesel electric generators may be installed to provide emergency power in the event of a mainline power outage.

2.10.2 Fuel Receiving Facility and Pipelines (Pipeline System)

A security management program will be implemented prior to pipeline system operations. The security management program is expected to include:

- Security policies and procedure manuals;
- Regional security response plans;
- Security vulnerability assessments;
- Threat monitoring and analysis;
- Physical security measures;
- Monitoring, tracking and trending of security incidents; and
- Training and support of operations personnel.

Physical security measures to be used at the fuel receiving facility include perimeter fencing, vehicle and traffic barriers, intrusion alarms, surveillance systems and lighting. The facility will be incorporated into the existing VAFFC security management program and assessment process at YVR. Personnel gates will be installed to provide emergency exits. A double gate is expected at each road access point. Security closed-circuit television monitoring with digital video feed and recording capabilities will also be provided.

Physical security measures used at above ground pipeline facilities include perimeter fencing, vehicle and traffic barriers, intrusion alarms, surveillance systems and lighting.

The pipeline system will be incorporated into the existing VAFFC security management program and assessment process in place at YVR.

2.11 Property Requirements

Marine Terminal

VAFFC owns the waterfront property located at 15040 Williams Road, on which the proposed upgraded marine terminal will be located. Associated with this property is a Water Lot, which VAFFC has leased from the Port. This encompasses foreshore and riverbed areas, but an application will be made to increase the size to accommodate larger vessels at the marine terminal.

CNR owns a rail right-of-way which bisects the waterfront property. The City of Richmond holds a covenant on the waterfront property, requiring the construction of diking works and granting the City access for ongoing inspection and maintenance of the diking works. VAFFC will consult with CNR, the City and the Inspector of Dikes during detailed design of the property layout, as appropriate to mitigate effects on the property rights of CNR and the City.

Fuel Receiving Facility

VAFFC will require a lease agreement with the Port to locate the proposed fuel receiving facility on Port lands. The Port has agreed in principle to lease a portion of such lands for this purpose. A development permit will be required by VAFFC from the Port prior to the commencement of construction of the proposed fuel receiving facility.

VAFFC has had discussions, which are ongoing, with the private owners of another site located at 14960 Triangle Road about the availability of the property. The property is zoned as Light Industrial (I2) and is a potentially suitable alternative, subject to obtaining land use approvals and an arrangement with the current owner.

Fuel Pipelines

VAFFC will require Municipal Access Agreement(s) from the City of Richmond for the construction and operation of sections of pipeline to be located on City streets and other City property. If the selected route of the delivery pipeline utilizes the railway corridor (following commercial arrangements between VAFFC and CNR), the Municipal Access Agreement(s) will need to cover approximately 40% of the entire length of the pipeline alignment. The agreement(s) will exclude the CNR railway corridor and the Sea Island section. If the pipeline cannot be located along this railway corridor, the Municipal Access Agreement(s) is expected to cover up to 80% of the entire length of the pipeline alignment. VAFFC has obtained a conditional agreement with CNR for locating a portion of the pipeline along the Shell Road railway corridor.

Depending on the final selection of underground horizontal directional drilling entrance and exit points (i.e., for the crossing of Highway No. 99 and the Moray Channel), VAFFC may need to negotiate temporary construction access to privately owned property.

For the sections of pipeline located on airport property, VAFFC will require development and facility permits from Vancouver Airport Authority.

2.12 Capital Costs and Financing

The Project's capital cost is expected to range from approximately $93 to $108 million as shown in the breakdown estimate below.

Project Component	**Capital Cost ($ Million)**
Marine Terminal	13
Fuel Receiving Facility	50
Pipeline	30 to 45
Total	**93 - 108**

The Project will be funded entirely by VAFFC and will not require external market financing. Capital financing of over $100 million is attainable and made possible by VAFFC's business model. As stated in **Section 2.2.1,** VAFFC is a not-for-profit company owned by a consortium of international and domestic commercial airlines that operate at YVR. The Project's business model is based on VAFFC's consortium structure, which provides efficient sharing of costs and risk between member airlines. Although membership may vary with the airlines serving YVR, the VAFFC structure remains stable over time as airlines join or leave. Financing payments are shared among the member airlines based on a formula proportional to their fuel usage. Financing allows for large expenditures to be paid off over time, which enables VAFFC to contract out the management, construction and operation of large infrastructure projects, including the proposed Project. Additionally, the Project will utilize either a design-bid-build or design-build mechanism of project delivery. Regardless of the project delivery method selected for the Project, the contractor(s) will be required to compete in a competitively run procurement process. Similar project business models are used at other international airports across Canada where airport fuel facilities corporations are set up.

2.13 Labour Force

As discussed in detail in **Chapter 6**, construction of the Project is expected to result in an estimated 762 person years of direct, indirect and induced employment in B.C. Employment associated with the Project is expected to represent less than 1% of the Richmond labour force and less than 0.07% of the Metro Vancouver labour force. All positions are expected to be filled by members of the existing local labour force, with few associated population or demographic affects, if any.

The Project will create approximately 14 full-time equivalent jobs during the operations. This excludes person years of employment required for off-loading vessels at the marine terminal and also excludes any potential negative effects to jobs from reduced trucking deliveries. Employment directly associated with Project operations is not likely to have any noticeable effect on local community demographics.

The primary economic development effect of the Project during operations is not limited to direct jobs created. The Project will assist YVR in remaining a competitive, world-class airport and is expected to indirectly help with the general economic development of Metro Vancouver, the province and Canada. This is discussed further below in **Section 2.14**.

2.14 Business Opportunities

Similar to other construction projects, business opportunities exist for local contractors to participate in construction of the Project. While more indirect than the labour force estimates discussed above, the operational business opportunities associated with the Project are expected to be greater in magnitude and duration. As the second busiest airport in Canada and the second largest international passenger gateway on the west coast of North America, YVR is a very important economic driver for Greater Vancouver, the province and Canada.

The Project and the associated access to safe, reliable and economic aviation fuel will indirectly assist with job creation, provincial, federal and municipal tax revenue and other indirect business opportunities associated with the operation of an efficient international airport. Construction of the Project alone is expected to generate $25.8 million in Gross Domestic Product, $6 million in federal taxes and $6 million in provincial taxes (see **Chapter 6**).

Increased international ridership, via YVR, benefits Richmond companies in addition to a variety of other industries that rely on access to international travellers, including tourism, real estate, international business and other shipping businesses.

2.15 General Project Scheduling and Sequencing

The general schedule and sequence for the Project is based on the commencement of the 180-day Application Review stage in mid-February 2011, following acceptance of the Application for review in early February 2011. This being the case, the EAO's 45-day public review and comment period for the Application is expected to be held over late-February to early April 2011, with public open houses scheduled early on in the review and comment period. Technical Working Group review and consultation on the Application is expected to take place during March and April. VAFFC expects to submit the First Nation Consultation Report in early May. The EAO's Final Assessment Report is expected by early August with a Ministerial decision on whether to issue an Environmental Assessment Certificate arriving at the end of September 2011. In its Application submission cover letter to the EAO, VAFFC will identify the permits, approvals and authorizations it is requesting for concurrent review during the Application Review stage.

Subject to the timing for the acquisition of regulatory permits, approvals and authorizations, construction is expected to begin late 2011. The Project construction phase is expected to last approximately 18 to 24 months, depending on the method selected for ground improvement at the fuel receiving facility.

It is expected that marine terminal construction will take approximately eight months to complete, including four months for in-water works. Construction at the fuel receiving facility is expected to take approximately 18 to 24 months, depending on the method of ground improvement selected. Pipeline construction is expected to take approximately 12 months to complete overall. Following system testing and commissioning, Project operations are expected to commence late summer/fall 2013. A detailed construction schedule chart will be developed during the detailed design phase.

2.16 Applicable Permits, Approvals and Authorizations

Chapter 1 describes the relevant provincial and federal legislative and policy requirements for the harmonized provincial/federal environmental assessment review for the Project.

The Project will also require the acquisition of several other federal, provincial and municipal permits, approvals or authorizations (or notifications or agreements) prior to the commencement of construction and operations. Applications for most permits, approvals and authorizations will be made following completion of detailed Project design, but prior to the commencement of the relevant phase. Applicable local government official planning and zoning requirements are described in **Section 2.11**.

The Concurrent Approval Regulation allows for the concurrent review of provincial permits, approvals and authorizations at the time of filing the Application. The regulation applies to all provincial permits, approvals and authorizations necessary to undertake works that are within the scope of the assessment under the *Act*. Under the Concurrent Approval Regulation, provincial ministries must issue a decision on any applications for permits, approvals and authorizations applied for concurrently with an Application within 60 days of the date the Environmental Assessment Certificate is issued for a project, as long as the proponent follows the required procedures for soliciting concurrent permitting. VAFFC has requested approval from the EAO for concurrent review of a Project permit application to the B.C. Oil and Gas Commission under the Concurrent Approval Regulation, section 23 of the BCEAA. The B.C. Oil and Gas Commission will accept a partial application at the same time as the end of the EAOs screening review period, with more detailed engineering information to follow.

Table 2.16.1 lists permits, approvals or authorizations VAFFC expects to acquire.

Table 2.16.1 Summary of Expected Permits, Approvals or Authorizations for the Project

Permit / Approval / Authorization / Etc.	Issuing Body	Government Level	Legislative Mandate	Project Trigger	Project Stage
Environmental Assessment Certificate	EAO	Provincial	*B.C. Environmental Assessment Act*	Overall Project approval	Prior to Construction
Environmental Assessment Decision	Port Metro Vancouver	Federal	*Canadian Environmental Assessment Act, Canada Port Authority Environmental Assessment Regulations*	Overall Project approval	Prior to Construction
Project Permit	Port Metro Vancouver	Federal	*Canada Marine Act,* *Canadian Environmental Assessment Act,* *Canadian Environmental Protection Act,* and *Fisheries Act*	Marine terminal upgrades In-river dredging Fuel receiving facility construction	Construction
Building Permit	Port Metro Vancouver	Federal	*Canada Marine Act,* *National Building Code of Canada,* and *the National* or *B.C. Fire Code*	Marine terminal upgrades Fuel receiving facility construction	Construction
Water Lot Lease Amendment	Port Metro Vancouver	Federal	*Canada Marine Act*	Size increase to existing Water Lot lease	Construction / Operation
Lease Agreement	Port Metro Vancouver	Federal	*Canada Marine Act*	Fuel receiving facility construction and operation	Construction / Operation
Notification for In-Stream Works	Fisheries and Oceans Canada	Federal	*Fisheries Act*	In-river works during marine terminal construction	Construction
Approval for Potential Navigation Interference	Transport Canada, Navigable Waters Protection Program	Federal	*Navigable Waters Protection Act Section 5(3)*	Marine terminal upgrades and operations	Construction / Operation
Development Permit	Vancouver Airport Authority	Federal	*National Airports Policy*	Pipeline located on Airport property	Construction
Facility Permit	Vancouver Airport Authority	Federal	*National Airports Policy*	Pipeline located on Airport property	Construction

Permit / Approval / Authorization / Etc.	Issuing Body	Government Level	Legislative Mandate	Project Trigger	Project Stage
Electrical Installation Permit	B.C. Safety Authority	Provincial	*Safety Standards Act,* and *Electrical Safety Regulation*	Installing new electrical systems	Construction
Statutory Right-of-Way Tenure	Ministry of Agriculture and Lands	Provincial	*Land Act*	Use of Crown land for the pipeline component of the Project	Construction
Fish and Wildlife Collection Permit	Ministry of Environment, Environmental Stewardship Division	Provincial	*Wildlife Act*	Salvage of fish, amphibians or other wildlife prior to in-stream construction	Construction
Notification for Changes In and About a Stream	Ministry of Environment, Water Stewardship Division	Provincial	*Water Act (Section 9),* and *Water Regulation (Part 7)*	In-stream works during marine terminal construction	Construction
Approval for On-Site Fuel Storage	Ministry of Public Safety and Solicitor General, Office of the Fire Commissioner	Provincial	*Fire Services Act*	Onsite fuel storage and dispensing	Construction
Permit for Works on Highway Right-of-Way	Ministry of Transportation and Infrastructure	Provincial	*Transportation Act*	Construction activity within the Right-of-Way of a provincial road or highway	Construction
Heritage Inspection/Investigation Permit	Ministry of Natural Resource Operations, Archaeology Branch	Provincial	*Heritage Conservation Act*	Undertake heritage inspection or investigation prior to construction	Prior to Construction
Permit for Works under Highway	Ministry of Transportation and Infrastructure	Provincial	*Transportation Act*	Directional drilling below a provincial road or highway	Construction
Approval for Maintaining Dike Safety and Integrity	Ministry of Environment, Deputy Inspector of Dikes Office	Provincial	*Dike Maintenance Act*	Pipeline installation – marine terminal property	Construction
Permit to Construct and Operate	Oil and Gas Commission	Provincial	*Oil and Gas Activities Act*	Pipeline system construction and operation (i.e., from the unloading arms at the marine terminal to the downstream pipeline connection point at YVR, including the fuel receiving facility)	Prior to Construction
Development Permit	City of Richmond	Local	*Local Government Act*	Pipeline located on City property and marine terminal upgrades	Construction

Permit / Approval / Authorization / Etc.	Issuing Body	Government Level	Legislative Mandate	Project Trigger	Project Stage
Municipal Access Agreement	City of Richmond	Local	*Local Government Act*	Pipeline located on City property	Construction
Wastewater Discharge Permit	Greater Vancouver Sewerage and Drainage District	Regional	*Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007*	Discharge wastewater to the sewer system	Construction

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