

2.2 Pump Stations

Electrically-powered pump stations located at regular intervals along the pipeline are required. The major components of the pump stations portion of the Project which support mainline operation include:

- adding 12 new pump stations;
- reactivating the existing Niton pump station and adding 1 pumping unit at the Sumas pump station; and
- deactivating some elements of existing Wolf and Blue River pump stations.

A summary of pump stations, and the number and size of the pumps and motors required for the Project is provided on Table 2.2.1, and a typical pump station is illustrated in Plate 2.2.1.

TABLE 2.2.1

SUMMARY OF PUMPS AND MOTORS FOR LINE 1 AND LINE 2 AFTER TMEP

Pump Station	Line 1					Line 2				
	KP	Site Status	kW	#	x HP	KP**	Site Status	kW	#	x HP
Edmonton	0.0	Existing	1,865	4	x 2,500 *	0.0	New	3,730	5	x 5,000 *
Stony Plain	49.5	Existing	3,730	2	x 5,000 *					
Gainford	99.4	Existing	1,492	3	x 2,000 *	117.4	New	3,730	3	x 5,000
Chip	147.0	Existing	3,730	2	x 5,000 *					
Niton ¹	173.4	Reactivated	1,492	2	x 2,000					
Wolf ²	188.0	Deactivated				206.1	New	3,730	2	x 5,000
Edson	228.8	Existing	1,492	3	x 2,000 *	247.2	New	3,730	3	x 5,000
Hinton	317.8	Existing	3,730	2	x 5,000	339.4	New	3,730	3	x 5,000
Jasper ³	369.5	Existing	1,865	2	x 2,500					
Rearguard	476.8	Existing	3,730	2	x 5,000	498.3	New	3,730	2	x 5,000
Albreda ⁴	519.1	Deactivated								
Chappel	555.5	Existing	3,730	2	x 5,000 *					
Blue River ²	588.9	Deactivated				614.6	New	3,730	3	x 5,000
Finn Creek	612.5	Existing	3,730	2	x 5,000 *					
McMurphy	645.0	Existing	1,492	2	x 2,000					
Blackpool	710.0	Existing	3,730	2	x 5,000	736.9	New	3,730	3	x 5,000
Darfield	742.0	Existing	1,492	2	x 2,000					
Black Pines	784.8	New	1,865	2	x 2,500	811.8	New	3,730	2	x 5,000
Kamloops	823.0	Existing	447.6	1	x 600	850.9	New	3,730	4	x 5,000 *
			1,492	4	x 2,000					
			1,865	2	x 2,500					
Stump ⁴	862.7	Deactivated								
Kingsvale	924.9	Existing	1,865	3	x 2,500 *	955.5	New	3,730	2	x 5,000
Hope ⁴	1011.8	Deactivated								
Wahleach ⁴	1045.9	Deactivated								

TABLE 2.2.1

SUMMARY OF PUMPS AND MOTORS FOR LINE 1 AND LINE 2 AFTER TMEP (continued)

Pump Station	Line 1					Line 2				
	KP	Site Status	kW	# x	HP	KP**	Site Status	kW	# x	HP
Sumas	1082.0	Existing	1,492	2 x	2,000					
Sumas Puget Sound ⁵	1082.0	Existing	1,492	2 x	2,000					
	1082.0	New	1,865	1 x	2,500					
Port Kells	1124.3	Existing	3,730	2 x	5,000	*				
Burnaby	1147.1					1179.8				
Total				51					32	

- Notes:**
- * one installed spare unit retained for increased system reliability.
 - ** kilometre posts may differ from Line 1 to Line 2 because of route differences
 - KP = kilometre posts
 - HP = horsepower
 - 1 Reactivate previously deactivated pump station
 - 2 The Existing Line 1 pumps, motors and headers will be deactivated. New Line 2 pumps, motors, header and pump building will be added. The existing electrical infrastructure will be used for Line 2 operation.
 - 3 Pump station will be transferred from the 914.4 mm (NPS 36) line to the 609.6 mm line (NPS 24) line for Line 1 operation.
 - 4 This pump station may not be deactivated subject to the results of a reliability study.
 - 5 Increased flow to the United States (US) Puget Sound line will require additional horsepower at Sumas.



Plate 2.2.1 Typical Pump Station (Chappel)

2.2.1 Pump Station Operations

The TMEP pump stations, like those in the existing TMPL system will be remotely operated and continuously monitored by a CCO using the SCADA system at the Control Centre in Sherwood Park, AB. In the event of an emergency, an emergency shut-down (ESD) can shut down pump units and close the pump station suction and discharge valves.

2.3 Terminals

The major components of the associated facilities of the Project include:

- constructing 20 new tanks at the Edmonton (5), Sumas (1) and Burnaby (14) terminals, preceded by the demolition of 2 existing tanks at Edmonton (1) and Burnaby (1), for a net total of 18 tanks to be added to the system; and
- constructing a new dock complex, with a total of three Aframax-capable berths, as well as a utility dock (for tugs, boom deployment vessels, and emergency response vessels and equipment) at the Westridge Marine Terminal, followed by the deactivation and demolition of the existing berth.

2.3.1 Edmonton, Sumas, and Burnaby Terminals

A summary of numbers and capacities of the existing tanks and the tanks to be added for TMEP is provided in Table 2.3.1. The two active storage tanks at Kamloops are not included in the tank summary as there are no tank changes planned at Kamloops.

Proposed plot plans of Edmonton, Sumas and Burnaby Terminals are shown in Figures 2.3.1, 2.3.2 and 2.3.3, respectively. No additional permanent land is expected to be required at these terminals.

2.3.2 Westridge Marine Terminal

An artistic image of the expanded Westridge Marine Terminal is provided in Plate 2.3.1. A 1.4 ha expansion of the foreshore is required.

The dock complex and berth arrangement has been chosen after an extensive review with PMV, the Pacific Pilotage Authority (PPA), and the BC Coast Pilots Association, and in consideration of local input. The berths will be fitted with berthing assistance, ESD, vapour recovery, and fire-protection systems.

2.3.3 Terminal Operations

All terminals, with the exception of Sumas Terminal, which is designed for fully remote operation, will continue to have operations staff on site at all times. Tanks will be placed within secondary containment areas and be fitted with fire-protection systems. Tanks, pumps, motors, piping, and other components will be protected by sophisticated control and ESD systems.

TABLE 2.3.1

EXISTING AND NEW TANK CAPACITIES

Site	Existing ¹			New ²			Total		
	# Tanks	Capacity (m ³)	Capacity (bbl)	# Tanks ³	Capacity (m ³)	Capacity (bbl)	# Tanks	Capacity (m ³)	Capacity (bbl)
Edmonton, AB	35	1,274,310	8,015,000	5	209,070	1,315,000	39	1,470,660	9,250,000
Sumas, BC	6	113,680	715,000	1	27,820	175,000	7	141,500	890,000
Burnaby, BC	13	267,900	1,685,000	14	639,140	4,020,000	26	894,320	5,625,000
Westridge, BC	3	62,800	395,000	0	0	0	3	62,800	395,000
Total	57	1,718,690	10,810,000	20	876,040	5,510,000	75	2,569,280	16,160,000
Total Increase in Capacity			50%						

- Notes:**
- Existing Capacity include Edmonton Tank 29, 30, Edmonton Terminal Expansion Project Phase I and II, original Tank 9 volume and original Burnaby Tank 74 volume
 - New Capacity includes the new volumes for Edmonton Tank 9 and the new volume for Burnaby Tank 74
 - New # Tanks include rebuilding Edmonton Tank 9 and Burnaby Tank 74

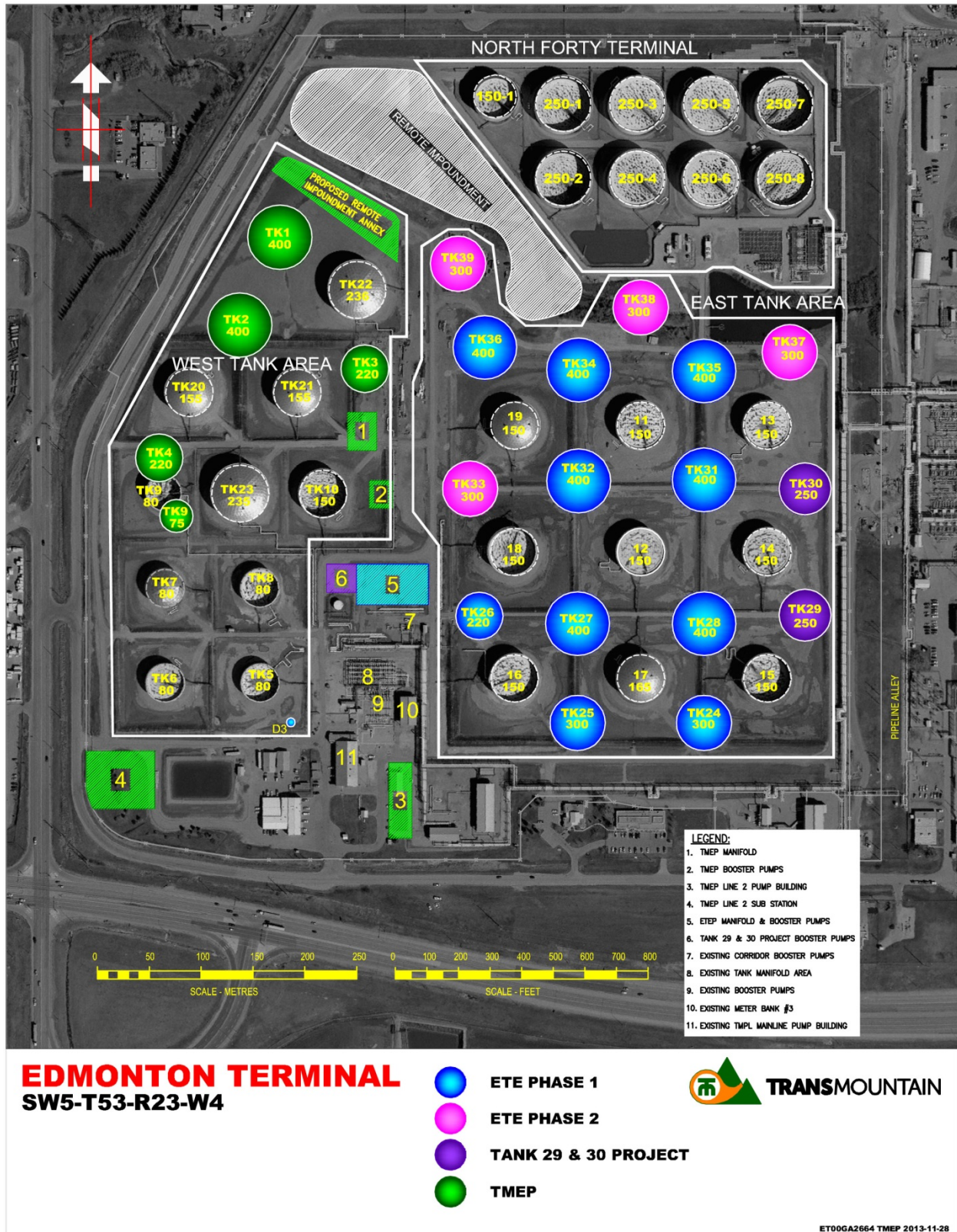


Figure 2.3.1 Edmonton Terminal Proposed Plot Plan

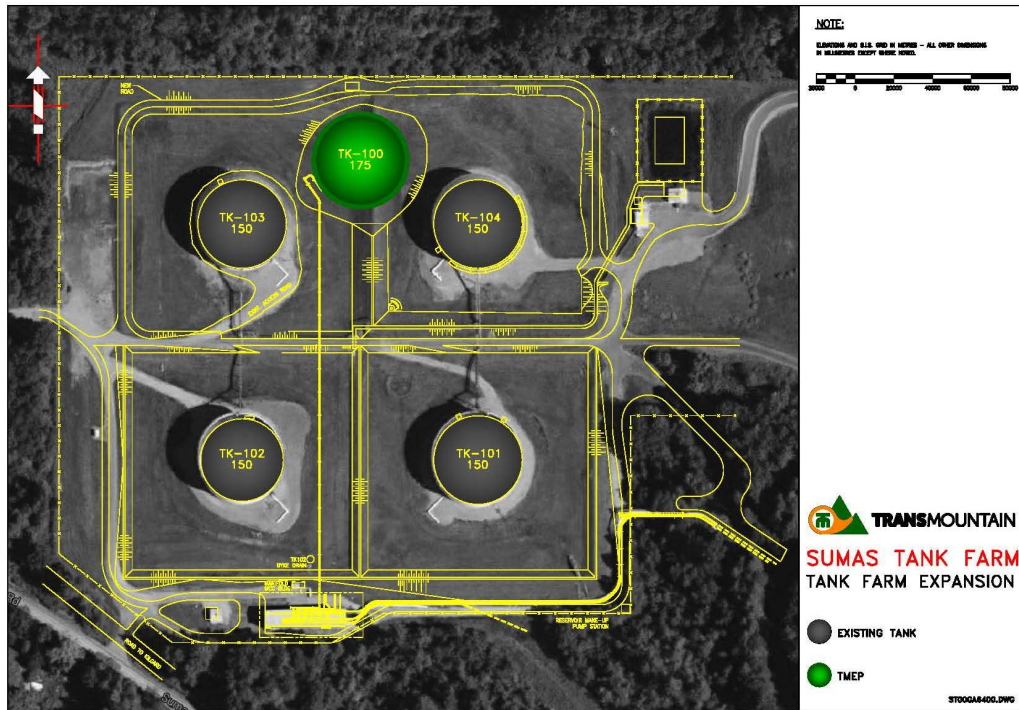


Figure 2.3.2 Sumas Terminal Proposed Plot Plan

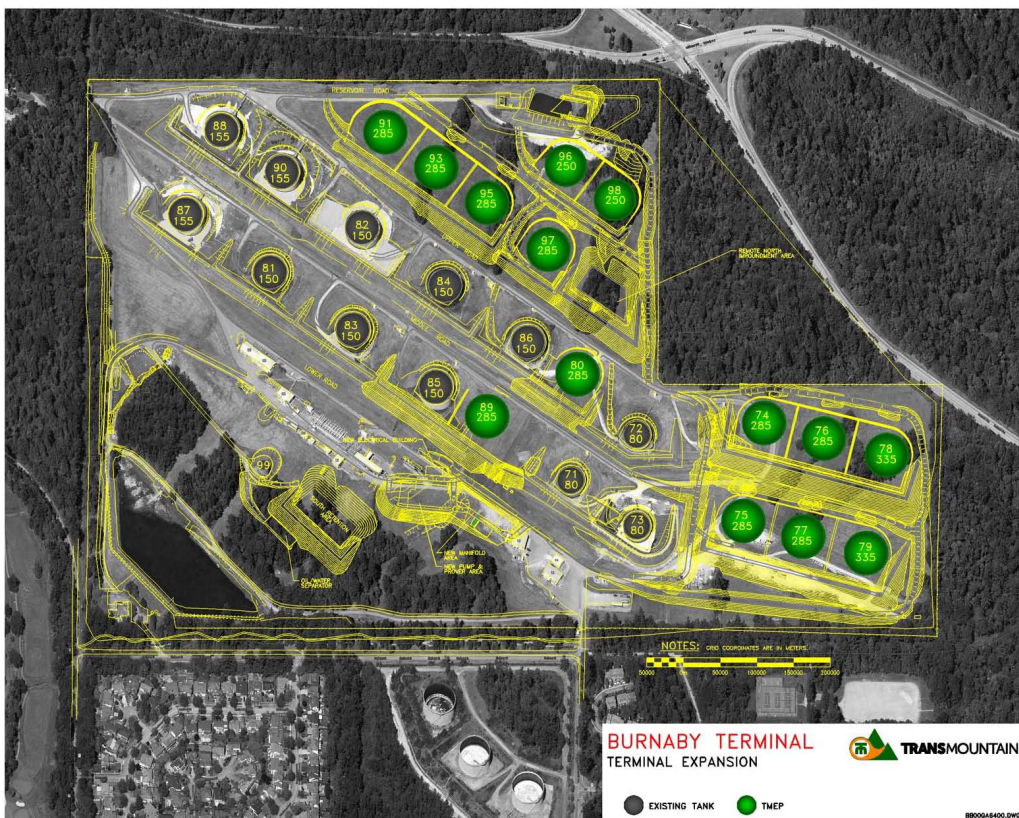


Figure 2.3.3 Burnaby Terminal Proposed Plot Plan

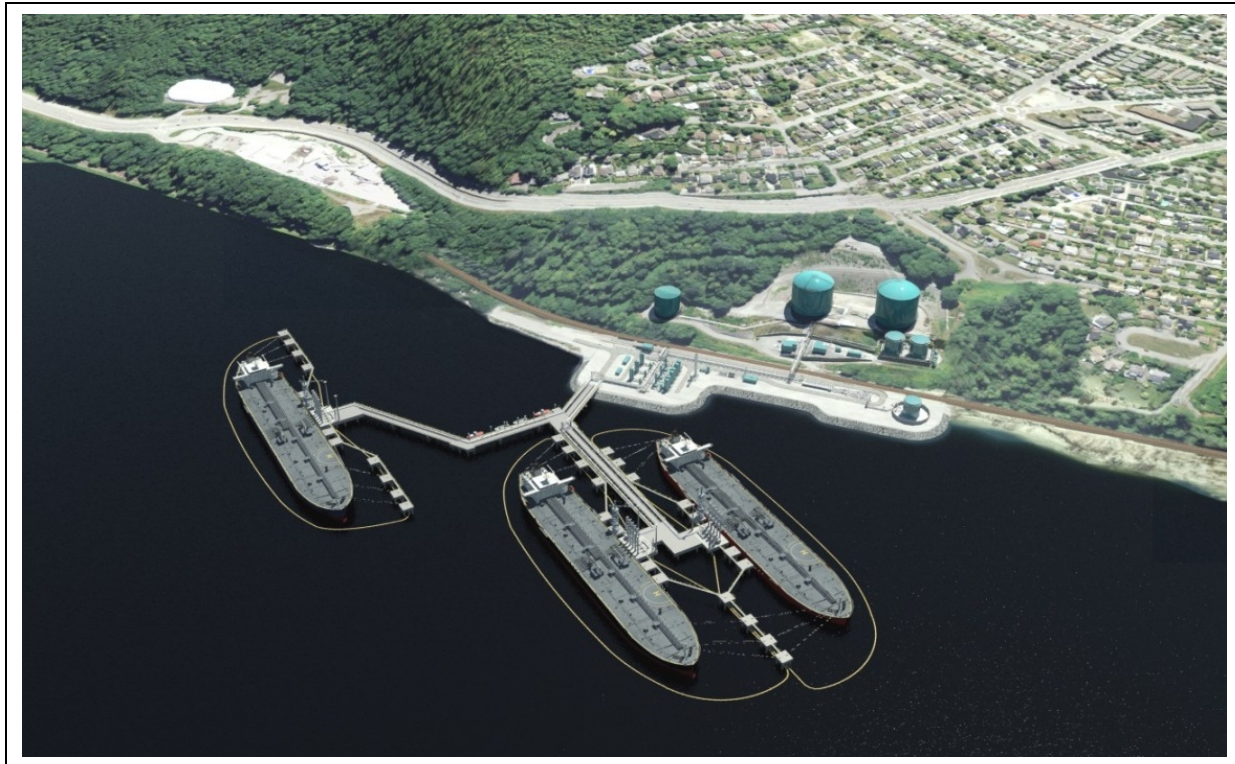


Plate 2.3.1 Westridge Marine Terminal Artistic Image

2.4 Mainline Block Valves and Sending/Receiving Traps

Remote mainline block valves (RMLBVs) and sending/receiving trap facilities are important components for the safe operation and long-term integrity of pipelines. RMLBVs will complement mainline block valves, which are located at the pump stations.

Seventy-two new buried RMLBVs will be installed on Line 2. Valve sites are typically 5 m × 12 m and will be located within the right-of-way. Preliminary valve site locations are identified in Table 5.1.12 in Appendix D of Volume 4A, with final valve site locations to be established during the detailed engineering and design phase.

To limit the volume and consequences associated with a pipeline leak or rupture, the following factors were considered in selecting the RMLBV locations:

- topography;
- the location of environmentally sensitive features and terrain, especially water crossings;
- population density;
- accessibility of electrical power;
- maintenance flexibility;
- release volume analysis;

- release volume dispersion modeling; and
- risks to high consequence areas.

A total of 23 new sending or receiving scraper traps for in-line inspection tools will be installed at facility locations along the pipeline.

2.5 Power Lines and Permanent Access Roads

The environmental and socio-economic effects of new utility power lines for the Project have been considered by Trans Mountain but authorizations for construction and operation will be sought from the appropriate provincial authorities. New 25 or 138 kV power lines will be constructed to supplement the electric power supply to three existing pump station sites (Edmonton, Edson, and Kingsvale) and to provide a new power supply to one new pump station site (Black Pines). Electrical power will also be required at each RMLBV site and at cathodic protection system rectifier locations.

The Edmonton power line will originate immediately adjacent to the terminal. The length of the power line to Edson is unknown at this time as several options are being considered by the power utility. The length of the power line to Black Pines will be approximately 4 km, while the length of power line to Kingsvale will be approximately 24 km.

A permanent access road will be required for the new Black Pines Pump Station; which will be located less than 0.5 km from the nearby road. Permanent access roads may also be required for the RMLBV or cathodic rectifier sites and a secondary emergency only access road may be considered for Westridge Marine Terminal.

2.6 Marine Shipping Activities Associated with the Project

Currently, in a typical month, five vessels are loaded with heavy crude oil (diluted bitumen) at the Westridge Marine Terminal. The expanded system will be capable of serving up to 34 Aframax class vessels per month (Plate 2.6.1) with actual demand to be influenced by market conditions. The maximum size of vessels (Aframax class) served at the terminal will not change as part of the Project. Similarly, the future cargo will continue to be crude oil, primarily diluted bitumen. Of the 141,500 m³/d (890,000 bbl/d) capacity of the expanded system, up to 100,200 m³/d (630,000 bbl/d) may be delivered to the Westridge Marine Terminal for shipment.

In addition to tanker traffic, the Westridge Marine Terminal also loads two or three barges with oil per month and receives one or two barges of jet fuel per month utilizing a separate pipeline system that serves Vancouver International Airport. Barge activity is not expected to change as a result of the Project.

While Trans Mountain does not own or operate the vessels calling at the Westridge Marine Terminal, it is responsible for ensuring the safety of the terminal operations. In addition to Trans Mountain's own screening process and terminal procedures, all vessels calling at Westridge must operate according to rules established by the International Maritime Organization, Transport Canada, the PPA, and PMV. Although Trans Mountain is not directly responsible for vessel operations, it is an active member in the maritime community and works with maritime agencies to promote best practices and facilitate improvements to ensure the safety and efficiency of tanker traffic in the Salish Sea. Trans Mountain is a member of the WCMRC, and works closely with WCMRC and other members to ensure that WCMRC remains capable to

respond to spills from vessels transferring product or transporting it within their area of jurisdiction.

To understand the potential effects of the Project-related increase on marine traffic, Trans Mountain undertook an ESA, as well as a quantitative marine risk assessment of the potential for oil spills in the marine environment. The results of these activities are incorporated in Volume 8A, Marine Transportation, and address the requirements of the NEB's List of Issues (July 29, 2013), the *CEA Act, 2012*, and the NEB's Filing Requirements Related to the Potential Environmental and Socio-Economic Effects of Increased Marine Shipping Activities, Trans Mountain Expansion Project (September 10, 2013). Trans Mountain is also participating in the TERMPOL Review Process under Transport Canada's jurisdiction. TERMPOL is a federal review process focusing on safety and marine transportation components of a project (Section 1.4).

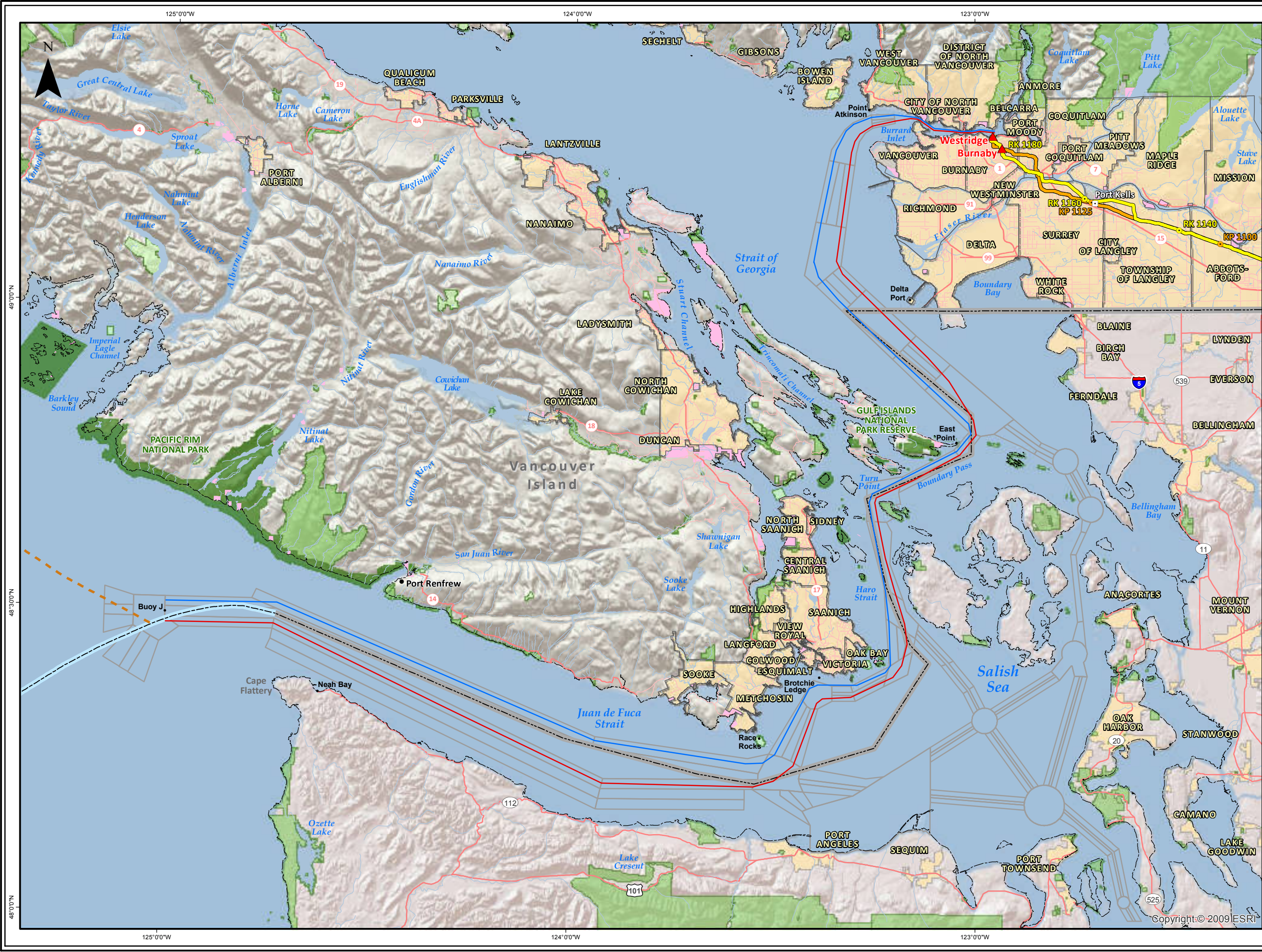
Trans Mountain has contracted a number of studies, including the previously mentioned quantitative risk assessment, to provide recommendations to Transport Canada, the TERMPOL Review Committee, and other relevant responsible authorities to improve the safety of marine transportation related to the Project. These studies were also used as the basis for Volume 8A, Marine Transportation. All supporting studies for the ESA are provided in Volume 8B. All of the TERMPOL related technical studies are provided in Volume 8C.

Figure 2.6.1 illustrates the location of the Westridge Marine Terminal and the route inbound and outbound marine vessels would continue to travel after the Project is in operation.



Plate 2.6.1 Aframax Class Tanker Zaliv Amurskiy (Approaching Second Narrows From the East)
(<http://www.shipspotting.com/gallery/photo.php?lid=1312298>, accessed: November 2013)

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TRANS MOUNTAIN

FIGURE 2.6.1

REGIONAL LOCATION OF MARINE SHIPPING LANES

TRANS MOUNTAIN EXPANSION PROJECT

- Reference Kilometre Post (RK)
- Kilometre Post (KP)
- Trans Mountain Pipeline (TMPL)
- Trans Mountain Expansion Project Proposed Pipeline Corridor
- Terminal
- Existing Pump Station
- Highway
- Road
- 12 Nautical Mile Limit (Territorial Sea)
- Limit of Exclusive Economic Zone (EEZ)
- International Boundary
- Marine Vessel Outbound Shipping Lane
- Marine Vessel Inbound Shipping Lane
- Traffic Separation Scheme
- City / Town / District Municipality
- Indian Reserve / Métis Settlement
- National Park
- Provincial / State Park
- Protected Area/Natural Area/ Provincial Recreation Area/Wilderness Provincial Park/Conservancy Area

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Projection: UTM Zone 10N.
Routing: Baseline TMPL & Facilities: provided by KMC, 2012;
Proposed Pipeline Corridor V6: provided by UPI, Aug. 23, 2013;
Facilities: provided by KMC, 2012; Transportation: BC Forests, Lands and Natural Resource Operations, 2012 & ESRI, 2005; Geopolitical Boundaries: IHS Inc., 2011, BC FLNRO, 2007 & ESRI, 2005, Natural Resources Canada, 2012; First Nation Lands: Government of Canada, 2013 & IHS Inc., 2011; Hydrology: IHS Inc., 2004; United States National Imagery and Mapping Agency, 2000, Natural Resources Canada, 2010; Parks and Protected Areas: Natural Resources Canada, 2013, BC FLNRO, 2008; CHS: provided by KMC, 2013; Marine Shipping Lanes: Moffatt and Nichol, 2013; Hillshade: TERA, derived from Geobase; US Hillshade: ESRI, 2009.

tera
ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

MAP NUMBER	PAGE
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DATE	TERA REF.	REVISION
December 2013	7894	0

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ALL LOCATIONS APPROXIMATE