

1.0 PROPOSED PROJECT OVERVIEW

Prince Rupert Gas Transmission Ltd. (PRGT) proposes to construct and operate a pipeline to transport sweet natural gas from a point near Hudson's Hope, to the proposed Pacific NorthWest LNG natural gas liquefaction and export facility (PNW LNG) near Prince Rupert, at Lelu Island, within the District of Port Edward (the Project). Figure 1-1 and 1-2 show the Project location.

The Project is located entirely within the province of British Columbia (BC) and includes the construction and operation of a pipeline, a metering station at the delivery point to the PNW LNG facility, and three¹ compressor stations with provision for five additional compressor stations to allow for future expansion. The Project consists of both land and marine based sections of pipeline. Depending on the final route, the Project could include up to 780 km of 1,219 mm diameter (NPS 48) of land based pipeline and up to 120 km of twin 914 mm diameter (NPS 36) of marine based pipeline.² The total length will be up to 900 km. The land based pipeline will be buried. The Project will have an initial capacity of approximately 2.0 billion cubic feet per day (bcf/d) (56.6 million cubic metres per day [m³/d]) with the potential for future expansion up to approximately 3.6 bcf/d (101.9 million m³/d). Future expansion scenarios do not require the construction of additional pipeline, but require additional compression facilities which are included in this assessment. The life of the pipeline is expected to be greater than 40 years.

The Project will also require the construction of new permanent and temporary access roads and other temporary infrastructure, such as construction roads, temporary bridges, stockpile sites, borrow sites, contractor yards and construction camps.

1.1 PROPONENT DESCRIPTION

The Project will be designed, owned and operated by PRGT, a wholly owned subsidiary of TransCanada PipeLines Limited (TransCanada). PRGT is the general partner and acts on behalf of Prince Rupert Gas Transmission Limited Partnership. The general partner legally owns and operates the Project assets for the benefit of the limited partnership.

PRGT will draw on TransCanada's expertise, experience and resources in designing, constructing and operating the Project. TransCanada has owned and operated Canada's largest natural gas pipeline system for more than 60 years. Its pipeline systems comprise a network of approximately 57,000 km (35,500 mi.) of wholly owned and 11,500 km (7,000 mi.) of partially owned natural gas pipelines.

¹ Up to nine compressor stations were anticipated, but further project planning has identified the need for eight compressor stations.

² Should the Nass Bay Shoreline or Shoreline Alternative, and the Iceberg Bay routes be selected, construction will consist of one 48" pipeline for this portion of the marine pipeline.

These pipelines connect virtually every major natural gas supply basin and market in North America, transporting 15 bcf/d of natural gas, or 20% of the natural gas consumed in North America. TransCanada continually explores positive ways to help natural gas producers reach their markets. TransCanada has developed and maintained relationships with landowners, Aboriginal communities and other stakeholders across its pipeline systems.

PRGT is committed to designing, constructing and operating the Project in a safe and environmentally responsible manner. PRGT will adopt and implement many of TransCanada's policies, such as the Stakeholder Engagement Commitment Statement, the Health, Safety and Environment Commitment Statement, and the Aboriginal Relations Policy.

1.1.1 Proponent Contact Information

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PRGT has retained Stantec Consulting Ltd. (Stantec) to prepare the majority of the EAC Application for the Project. The key Stantec contact for the Project is:

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Table 1-1 provides a list of the parties involved in the preparation of the Application and the sections for which they are responsible.

Table 1-1: Contributors to the EAC Application

Section	Contributor
All sections except those specified below	Stantec
1 – Project Overview	Stantec / PRGT
13 – Vegetation and Wetland Resources	Environmental Dynamics Inc.
22 – Visual Quality	Stantec / Industrial Forestry Service Ltd.
33 – Aboriginal Consultation	Stantec / Catana
34 – Nisga'a Nation	Stantec / Catana / Habitat Health Impact Consulting
Appendix A – BCEAO Documents	BC Environmental Assessment Office
Appendix B – CEAA Correspondence	Canadian Environmental Assessment Agency
Appendix C – Consultation Materials	PRGT / Edelman / Catana / Stantec
Appendix O – Vegetation and Wetland Resources	Environmental Dynamics Inc.
Appendix S – Visual Quality	Industrial Forestry Service Ltd.
Appendix X – Nisga'a Nation	Stantec / Catana / Habitat Health Impact Consulting

1.1.2 Website

The website for the Project is: www.princerupertgas.com.

1.2 PROJECT DESCRIPTION

This section describes Project components, phases and activities. It also outlines the purpose of the Project, Project location and proximity to communities, and Project history.

1.2.1 Purpose of the Project

In 2013, PRGT, a wholly owned affiliate of TransCanada, entered into commercial agreements with Progress Energy Canada Ltd. (PECL) under which PRGT will build, own and operate the proposed pipeline to transport natural gas from producing areas in northeastern BC to the proposed PNW LNG facility at Lelu Island.

The Project will provide western Canadian gas producers with access to new natural gas markets. Global demand for LNG, particularly in the Asia-Pacific region, is growing rapidly. Due to the recent development of techniques for shale gas production, there is surplus supply in North America, and multiple LNG projects from BC and the US Gulf Coast have been proposed to meet Asia-Pacific demand in 2019 and beyond.

1.2.2 Project Location

The pipeline route extends from near Hudson's Hope to its terminus at Lelu Island, within the District of Port Edward. The pipeline route is located north of Highway 97 and Highway 16 for most of the land based route (Figure 1-1). More detailed geographic coordinates (in UTM and latitude/longitude) of major infrastructure features and pipeline kilometre posts (at 10 km intervals) are provided in Table 1-2 and Table 1-3 for general reference. The regional context is provided in Section 1.3. The Aboriginal and non-Aboriginal communities proximal to the Project are listed in Table 1-8 and further described in Sections 23 and 33.

Table 1-2: Coordinates of Pipeline Start and End Points by Route Name

Pipeline Route		Start		End		Start		End	
	UTM Zone	Easting	Northing	Easting	Northing	Latitude	Longitude	Latitude	Longitude
Land based pipeline route	10	556939	6227204	-	-	56.186397	-122.082616	54.948880	-129.852282
Land based pipeline route	9	-	-	445412	6089435	-	-	-	-
Marine pipeline route	9	431938	6082444	416573	6005902	54.884407	-130.060958	54.194364	-130.278725
Nasoga Tunnel	9	445412	6089435	431938	6082444	54.948880	-129.852282	54.884407	-130.060958
Nass Bay Connector	9	445412	6089435	444131	6090090	54.948880	-129.852282	54.954619	-129.872403
Nass Bay Shoreline	9	443902	6088076	440913	6084375	54.936496	-129.875590	54.902901	-129.921478
Nass Bay Nearshore Marine	9	444119	6090089	440217	6087620	54.954614	-129.872595	54.931977	-129.932998
Nass Bay Nearshore Alternative	9	442311	6088776	440217	6087620	54.942611	-129.900566	54.931977	-129.933013
Iceberg Bay	9	440461	6087708	433688	6083509	54.932796	-129.929214	54.894209	-130.033940

Table 1-3: Coordinates of Compressor Stations and Metering Station (Centre Point)

Compressor Stations	UTM Zone	Easting	Northing	Latitude	Longitude
Johnson Creek ¹	10	558534	6196727	55.912412	-122.063574
Callazon Creek	10	507880	6157376	55.562325	-122.875059
Witter Lake	10	442413	6116193	55.188970	-123.904507
Middle River ¹	10	362871	6084615	54.889734	-125.138006
Morrison Lake	9	676871	6122635	55.218528	-126.219518
Kispiox	9	588261	6147247	55.463414	-127.604057
Borden Lake ¹	9	508204	6150603	55.501461	-128.870123
Ishkeenickh	9	459616	6092431	54.977149	-129.630959
Metering Station	9	416397	6006209	54.197092	-130.281509

Note:

1. Compressor stations required for the initial capacity of 2 bcf/day.

The land based pipeline route starts approximately 20 km northwest of Hudson's Hope and runs south to cross the Peace River between the Peace Canyon Dam and Highway 29. The route continues southwest, crosses the Williston Reservoir north of Mackenzie, and proceeds approximately 20 km west before heading southwest to cross the Middle River, north of Trembleur Lake. From Middle River, the route runs for approximately 22 km west before heading northwest to Fort Babine, then continues northwest to cross the Skeena River and on to Cranberry Junction. After Cranberry Junction, the route heads southwest through Nisga'a Treaty Lands to Nasoga Gulf and transitions to a marine pipeline heading south through Portland Inlet and Chatham Sound to Lelu Island (Figure 1-1).

Several land based and marine alternatives are considered in the EAC Application for routing the pipeline to the Nasoga Gulf area and the marine pipeline route. Further engineering study into the feasibility of these alternatives is required before a single route can be chosen. These are described in Table 1-4, and shown in Figure 1-2.

From the Nasoga Tunnel or Iceberg Bay routes, the marine pipelines enter Portland Inlet at Nasoga Gulf. The route traverses approximately 37 km southwest along Portland Inlet to Chatham Sound, before turning southward for 45 km. The route then takes a southeasterly course as it passes Lucy Islands for another 24 km, before making a sweeping turn across Marcus Passage and reaching Horsey Bank (5 km), where it ascends into shallow water to the landfall at Lelu Island.

The route approaching Lelu Island has been chosen to avoid Prince Rupert Port Authority (PRPA) Anchorage No. 9, Flora Bank and Kitson Island. Nearing Lelu Island, the route avoids the deeper sections of Inverness Passage and the mouth of the Skeena River as much as is practicable, making landfall on Lelu Island on the eastern edge of Leer Point.

Table 1-4: Land Based and Marine Alternatives to Portland Inlet/Chatham Sound

Alternative Name	Description of Route
Nass Bay Connector	An ~2 km land based route to the south shore of Nass Bay, linking the pipeline route (at ~KP 743, approximately 20 km from Laxgalts'ap [Greenville]) and the marine routes through Nass Bay.
Nasoga Tunnel	An ~21 km land based route linking the land based pipeline route (at ~KP 743, approximately 20 km from Laxgalts'ap [Greenville]) with the marine based pipeline route at Nasoga Gulf. The route involves a tunnel through a mountain and avoids another mountain to the south.
Nass Bay Shoreline	An ~8 km land based route that travels along the south shore of Nass Bay before turning south along Flewin Creek near Nass Harbour. The route connects two points on the Nasoga Tunnel route and would avoid the need to tunnel through the mountain. This option would require shoreline blasting and marine in-filling.
Nass Bay Nearshore Marine	An ~5 km marine based route runs southwest through Nass Bay from the south shore of Nass Bay to Echo Cove. This route connects the Nass Bay Connector to the Iceberg Bay route.
Nass Bay Nearshore Alternative	An ~2 km marine based route that travels along the shoreline of Nass Bay from the Nass Bay Shoreline route for approximately 0.6 km before entering the water and crossing Nass Bay to Echo Cove, where it connects with the Iceberg Bay route.
Iceberg Bay	An ~8 km route that crosses a short section of land from Echo Cove to Iceberg Bay, travels across Iceberg Bay (marine), and enters the isthmus separating Iceberg Bay and Nasoga Gulf to connect with the Nasoga Tunnel route. The route connects Nass Bay Nearshore or Nass Bay Nearshore Alternative with Nasoga Tunnel route.

1.2.3 Project Background and History

In 2013, PRGT, a wholly owned affiliate of TransCanada, entered into commercial agreements with Progress Energy Canada Ltd. (PECL) under which PRGT will build, own and operate the proposed pipeline to transport natural gas from producing areas in northeastern BC to the proposed PNW LNG facility at Lelu Island.

PRGT has undertaken studies in the following areas to define the Project and provide information in support of the EAC Application:

- Refinement of the Study Corridor into the current Application Corridor
- Continued assessment and refinement of land and marine based alternatives to reach Lelu Island
- Continued assessment and refinement of route alignments based on input and concerns from Nisga'a Nation, Aboriginal groups and communities
- Location of the delivery metering station
- Preliminary location of compressor stations
- Preliminary location of construction roads, temporary bridges, stockpile sites, borrow sites, contractor yards and construction camps

- Environmental overview (including a review of available information about fisheries, wildlife and vegetation values, and heritage resources)
- Land use and socio-economic overview
- Detailed discussions with government and regulatory agencies
- Ongoing engagement with Nisga’a Nation and Aboriginal groups
- Initiated traditional land use and socio-economic studies with Aboriginal groups
- Ongoing engagement with stakeholders (including landowners, municipal governments, crown tenure holders, and the public)
- Environmental field surveys along route options (including wildlife, vegetation, archaeology, fisheries, heritage, marine, and terrestrial ecosystem mapping surveys)
- Inclusion of Aboriginal groups in environmental surveys
- Initiated front-end engineering design for seabed-installed marine pipelines
- Continued terrestrial survey and geotechnical studies at critical water crossings and locations along the route
- Assessment of Project infrastructure and ancillary facility requirements and continued engagement of local communities on these requirements.

1.2.4 Project Phases

There are two phases of the Project: (1) construction; and (2) operation. Construction is anticipated to take approximately four years, the operational life of the Project is expected to be greater than 40 years.

1.2.5 Project Components

1.2.5.1 Overview

The Project will include up to 900 km of large diameter (NPS 36 and NPS 48) pipeline from a delivery point near Hudson’s Hope to the proposed PNW LNG facility near Prince Rupert, at Lelu Island, within the District of Port Edward (Figure 1-1). The Project also includes the construction and operation of a metering station at the delivery point and three compressor stations, with provision for up to five additional compressor stations to allow for future expansion.

A 2 km wide conceptual corridor was identified early in the route selection process within which pipeline routing options would be explored. This corridor was selected based on technical, environmental and constructability constraints with input from Nisga’a Nation, Aboriginal groups and other stakeholders including public, landowners and regulators. Various field and research-based constraint analyses were conducted within this corridor in order to identify the pipeline route, and land and

marine based alternatives presented in this Application. Additional information on route selection is presented in Section 1.5.

For the purpose of the Environmental Assessment Certificate (EAC) and BC Oil and Gas Commission (OGC) applications, this conceptual corridor was refined to a 500 m wide Application corridor, which encompasses the construction right-of-way (ROW) and additional temporary workspace. Other areas of planned disturbance, such as compressor station sites, and associated temporary ancillary infrastructure (e.g., new access roads, bridges, shoo-flies, temporary storage, and construction camps) may extend beyond the 500 m Application corridor and in some cases are located up to 25 km away from the corridor. The exact placement of this ancillary infrastructure may vary from the figures and maps presented in this EAC Application as engineering details are refined. The potential locations of temporary ancillary sites are shown in Figure 1-3 (and Figures 1-3a-g).

It is anticipated that the construction ROW will be approximately 50 m wide for the land based portion of the pipeline route, and 300 m wide for the marine based portion of the pipeline route. The permanent ROW for the land based pipeline route will be 32 m and 200 m for the marine based pipeline route. These are described in more detail in Section 1.2.5.2 and 1.2.5.3. Figure 1-4 represents the Application corridor, and land based pipeline construction ROW and permanent ROW.

1.2.5.2 Land Based Pipeline Components

Construction ROW

Dimensions of the construction ROW will vary depending on the terrain, construction techniques, access, and the extent and nature of adjacent existing ROWs. Where the Project is beside easements for existing facilities, requests will be made to the easement holder for permission to use existing workspace, where practical and safe, to reduce overall potential disturbance.

Where feasible, the pipeline route will use existing disturbed areas. This may not always be practical or feasible because of routing considerations required to:

- Achieve the shortest practical route and therefore, the smallest overall footprint
- Accommodate pipeline watercourse crossings
- Address input from Aboriginal groups
- Address input from stakeholders, including landowners, Crown tenure holders, and governments
- Avoid sensitive terrain
- Avoid sensitive environmental areas
- Address potential construction issues and requirements, including safety.

Information on PRGT's routing criteria can be found in Section 1.5.2.

It is anticipated that the construction ROW for the land based portion of the pipeline route will be approximately 50 m wide within areas of low or modest relief. The actual width will vary along the route according to terrain, environmental constraints, and need for additional temporary construction workspace. Where additional temporary workspace is required, this width may increase up to 300 m, depending on site characteristics and specific construction activities (Figure 1-5). This additional temporary workspace would accommodate access roads, side bends, pipe and material storage areas, watercourse crossings, timber decking areas, borrow sites, snow removal and equipment laydown areas.

Areas disturbed by construction will be reclaimed and allowed to naturally re-vegetate, where appropriate, after construction.

The Project will use existing disturbed areas where feasible. The proposed pipeline route is adjacent to existing and proposed pipeline, power line, and public highway ROWs to varying extents where possible. A comparison of the portion of the route alternatives paralleling existing disturbances is provided in Table 1-5. Approximately 12 km (1.4%) of the land based pipeline route crosses Anhlut'ukwsim Laxmihl Angwinga'asanskwhl Nisga'a (Nisga'a Memorial Lava Bed Park).

Table 1-5: Overview of Route Options Paralleling Existing Disturbances

Route Option	Distance Parallel Existing Disturbances (km) (total length)	Percentage Parallel Existing Disturbances (%)*
Pipeline Route	247 (743.0)	33.2
Nasoga Tunnel	6.0 (21.4)	28.0
Iceberg Bay	0.7 (3.8)	18.7

Note: * % of length of land based pipeline only

Permanent ROW

PRGT will apply for a 32 m wide permanent ROW. It is anticipated that the edges of the ROW will be allowed to regenerate naturally on either side of a 10 m corridor along the pipeline centerline (Figure 1-4). This 10 m wide corridor will be managed according to OGC guidelines to allow safe access for inspection and maintenance activities and to ensure the visible presence of the permanent ROW.

Pipeline

The land based pipeline will consist of approximately:

- 780 km of 1,219 mm diameter (NPS 48) pipeline from a receipt point near Hudson's Hope, to the marine entry point in Nasoga Gulf

- 1 km of twin 914 mm (NPS 36) diameter pipeline on Lelu Island extending from the landfall of the marine pipelines to the metering station at the delivery point.

Figures 1-1 and 1-2 show the pipeline route, and locations of compressor stations and the metering station. Marine pipeline components are described in Section 1.2.5.3.

Subject to regulatory approval, early construction (including clearing, grading, and ROW preparation) is planned to start in January 2015. Pipeline installation is expected to begin in late 2015, and continue through 2018. Final clean up and reclamation will follow.

Compressor Stations

The initial build-out for the Project will include three compressor stations (Johnson Creek, Middle River and Borden Lake) with provisions for up to five additional compressor stations to allow for future expansion (Callazon Creek, Witter Lake, Morrison Lake, Kispiox and Ishkeenickh). The compressor stations will require all-season access from the nearest existing all-season road.

It is anticipated that the footprint of a typical compressor station will be 9 - 20 ha and each will require the installation of two approximately 30 MW International Organization for Standardization (ISO) rated natural gas fired turbo-compressor packages. These stations include discharge gas coolers for each unit and other auxiliary equipment, including high-pressure yard piping, isolation valves, electrical, control and gas systems, storage facilities, offices, and, if necessary, temporary living quarters. A conceptual layout for the compressor stations is provided in Figure 1-6.

Additional compressor units at the compressor stations and additional compressor stations may be required for future incremental design volumes.

Metering Station

The Project includes the construction and operation of one metering station at the PNW LNG facility on Lelu Island. The metering station footprint will be approximately 0.6 ha and will include metering runs, yard piping, isolation and control valves, separators, and electrical, control and telecommunication systems. See the conceptual layout in Figure 1-7.

It is anticipated that gas delivered at the receipt of the Project will be measured on the Nova Gas Transmission Ltd. Mackie Creek Sales station, which will be located adjacent to the PRGT receipt point near Hudson's Hope.

Watercourse Crossings

The pipeline crosses approximately 1,200 mapped watercourses in five major watersheds: the Peace, Fraser, Skeena, Nass and Coastal. Watercourses will be crossed by open-cut, isolated, or trenchless methods. Trenchless methods may include horizontal direction drilling (HDD), bore, bottom lay, or aerial crossings. Typical crossing drawings are provided in Figures 1-8, 1-9, and 1-10.

Mainline Valves

Mainline valves will be installed at the metering station, compressor stations, and at other locations along the pipeline, as necessary, to comply with Canadian Standards Association (CSA) Z662-11. Mainline valves allow pipeline sections to be isolated and facilitate system operations.

In-line Inspection Launchers and Receivers

In-line inspection launchers and receivers will be installed approximately every 200 km along the pipeline to facilitate pipeline inspection activities, as required by the integrity management plan. The selected locations will be beside existing facilities or accessible from adjacent roadways, where practicable.

Cathodic Protection

Cathodic protection is a common method used to protect the pipeline and facilities from electrochemical corrosion. A cathodic protection system, including anode beds, rectifiers and associated facilities, will be designed and installed.

Supervisory Control and Data Acquisition (SCADA) System

A SCADA system will be installed to link pipeline and compressor facilities to the existing TransCanada Operations Control Centre (OCC) in Calgary, AB. This system will allow for the remote monitoring of operational and measurement data.

The OCC is staffed 24 hours per day and uses a computer-based SCADA system to continuously monitor and control pipeline operation. The OCC provides operational support to the pipelines TransCanada operates in Canada and in portions of the United States.

The pipeline control system will monitor pipeline flows, pressures, temperatures and equipment status on a continuous basis. The SCADA system will alert the OCC operator of significant operational changes in the pipeline system.

Communication Links and Power Supply

The Project will include communication links to service compressor stations, the metering station and other pipeline facilities. In some cases, electrical power will be

supplied by third-party power providers. Where commercial power is not available, the facilities will generate sufficient electrical power with natural gas fueled generators to meet the station loads for pumps, fans, instrumentation and lights. It is anticipated that up to 20 temporary and/or permanent communication towers may be required along the proposed corridor. The exact number and location of the towers has not been determined. To the greatest extent possible they will be located within the project footprint. A review of these sites will be completed through the OGC permitting process, which includes consideration and protection of environmental and archaeological resources.

1.2.5.3 Marine Pipeline Components

Construction ROW

It is anticipated that the width of the construction ROW in the marine environment will be approximately 300 m. This will accommodate both pipes with a maximum separation of 50 m between the two pipes.

Safety Zone

It will be necessary to maintain a temporary safety zone around the construction vessels for the safety of the public and workers, and to safeguard against vessel collisions, particularly when visibility is poor. For the pipelay vessels, this typically extends approximately 500 m around the vessel. The final safety zone will be established by the marine contractor, based on the actual vessel used and following appropriate risk assessment before construction. The safety zone will be subject to agreement with the OGC, the Prince Rupert Port Authority, and the Canadian Coast Guard prior to construction. Support vessels will be used to manage the safety zone.

Permanent Marine ROW

It is anticipated that a permanent marine pipeline ROW of approximately 200 m wide will be required. During construction, and for any major repairs, a wider seabed corridor of 300 m may be required to deploy equipment.

Marine Pipeline

The marine based pipeline route is approximately 120 km long. The majority of the marine portion of the system will be comprised of two 914 mm diameter (NPS 36) pipelines. The Iceberg Bay Marine route alternative would use a single 1,219 mm diameter (NPS 48) pipeline as with the land based route. These are short marine sections under consideration to link the land based pipeline to Nasoga Gulf. The majority of the marine pipeline will be concrete-weight-coated to provide additional weight for stability on the seabed and protection.

The marine pipelines will be installed by a specialist marine contractor. There are a limited number of contractors in the world with the appropriate equipment and experience required to install the PRGT marine pipelines. PRGT has sought advice from these marine contractors in establishing the construction methods described in this Project Overview.

Figure 1-2 shows the marine route and alternatives currently being assessed.

1.2.5.4 Temporary Ancillary Infrastructure – Land Based and Marine

It is anticipated that construction of temporary ancillary infrastructure will be required for both land and marine based pipeline routes. Ancillary infrastructure would include new access roads, bridges, shoo-flies temporary storage and construction camps. The locations of these new roads and ancillary sites are shown in Figure 1-3 (and Figures 1-3a-g).

Construction Access

A preliminary pipeline construction access plan will be designed to establish access to the work areas. This will prioritize the use of existing roads where feasible, including several privately owned all-season and winter roads. Seismic lines and trails may also be used for access.

It is anticipated that approximately 850 km of existing forestry roads may require upgrading, which could include vegetation clearing, resurfacing, watercourse crossing upgrades and, in some cases, widening to allow for safe hauling of materials and travel of personnel. Although some existing all-season roads will not require timber or vegetation clearing, existing seismic lines and trails may require some clearing to improve access so they can be used safely. No Project-related upgrades to existing private roads are expected.

In addition to using existing roads, PRGT will use a temporary travel lane created within segments of the construction ROW. The surface of the travel lane will be prepared to safely accommodate the movement of construction vehicles and equipment. Maintenance of the travel lane will be required throughout the construction period.

Shoo-flies

Shoo-flies will be constructed to facilitate access between segments of the ROW where the grade of the travel lane is too steep or a shoo-fly would provide a smaller and safer watercourse crossing for construction vehicles.

New Access Roads

Two new access roads will be required to connect the Cunningham Forest Services Road and another short segment adjacent to Babine Lake. The total length of new road is anticipated to be approximately 6 km. In addition, the compressor stations will require all-season access from the nearest existing all-season road.

Bridges

Existing bridges will be used, where feasible, by construction vehicles and equipment. In the absence of existing bridges, other techniques, such as snow bridges, timber mats, culverts, and temporary clear-span bridges will be used to cross any watercourses with defined banks that may be encountered along the travel lane. The crossing method will be assessed and determined by the contractor in the field and will reflect the conditions at the time of construction. Appropriate permits and approvals will be sought.

Ancillary Sites

Ancillary sites will be required for temporary storage (temporary staging, stockpile sites, equipment storage, contractor yards, rail sidings) and camps. Existing disturbed areas or areas already designated for these activities, for both land and marine based construction activities, will be used where feasible.

PRGT has identified 32 ancillary sites adjacent to, or a reasonable distance from, the ROW which will be used for temporary storage or as construction camps. These sites range in size from 8 to 58 ha and have been located to avoid environmental and heritage constraints, minimize creation of new access, and require minimal site grading. The locations of these sites are shown in Figure 1-3 (and Figures 1-3a-g). The intended use for each of these sites will be determined by the contractor and have been considered in this Application to be used for any of the above mentioned purposes.

Temporary Storage

Stockpile site(s) will be required to store pipe segments prior to installation. Temporary staging, equipment storage and contractor yards will be used as bases to support construction.

Four to six rail siding sites will be required, likely to be located in Chetwynd, Mackenzie, Fort St. James, and either near New Hazelton or Terrace. Rail sidings will be used to store and transition pipe segments from rail to trucks for transfer to stockpile sites and ultimately the ROW. PRGT's current intention is to use existing siding or industrial sites where practical and feasible.

Construction Camps

Approximately 12 temporary, self-contained construction camps will be used to accommodate the Project's pipeline construction workers. The camps are needed due to the remote work site locations. The camps will also increase worker safety by minimizing travel and reducing potential interaction with local communities and pressure on local infrastructure.

Early construction camps will be required to house up to 400 people involved in early works such as clearing, grading, constructing camps and building access roads. Early construction camps, approximately 2.5 ha in area, may be expanded to stationary camps for the main construction of the pipeline. Early construction camps will be ready for occupation within three to six months, after receipt of appropriate regulatory approvals.

Camps will be required along the pipeline route for between 18 months and 42 months, depending on construction timelines and activities. These will comprise nine main spread camps with up to 1,100 beds each and three compressor station camps with up to 150 beds each. The main construction camps will occupy approximately 20 ha. The compressor station camps will occupy approximately 2.5 ha. The campsite layout and size will be finalized after the prime contractor has been selected.

Start-up of the camp will involve site preparation and mobilization of supplies and material. About six months will be required to prepare the land and to supply and fully construct the camp. An early construction portion of the camp may be in service sooner. Identification of water sources, power supply and waste disposal requirements for camps will be finalized through discussions with camp providers and local governments during construction planning. Permitting of camps will be the responsibility of the camp provider.

The largest element of campsite operations will be catering and housekeeping for the camp residents. Other activities will include:

- Maintenance of the camp;
- Restocking of fuel and supplies by truck; and
- Daily transport of personnel between the camp, muster areas and worksites by multi-passenger vehicles.

Each camp will have medical facilities and personnel available to handle medical problems if they arise. Security will be onsite to ensure orderly conduct.

Accommodation for marine pipeline construction crews will be provided on the construction vessels. The large pipelay vessel may accommodate up to 500 construction personnel.

Community-based accommodations will be required for personnel working at the stockyard and supply bases and during crew changes. The stockyard and supply base are expected to be within existing or expanded marine facilities so these workers will likely be housed within local communities. Crews will work on a rotational basis and may require accommodation during transit.

Borrow Sites

At time of filing, PRGT only anticipates requiring borrow sites for construction of the marine pipelines. For the land based pipeline, PRGT expects to use excess rock materials removed from the ROW and facility sites as fill material. If, at a later date, it is determined that fill is required from outside the project footprint for the land based pipeline route, borrow sites will be assessed in accordance with OGC requirements. Borrow site locations will be dependent on the amount and type of material required. The sites could be pre-existing, owned and operated by others, or new developments. If required, a review of these sites will be completed through the OGC permitting process, which includes consideration and protection of environmental and archaeological resources. Additional information is provided in Section 1.2.9.3.

Permanent Disposal Sites

Permanent disposal sites are required for excess grade spoil material, primarily consisting of rock. These sites will be located in previously disturbed areas along the proposed route. Specific locations will be identified by the contractor and are dependent on site-specific conditions. A review of these sites will be completed to ensure that any adverse effects on the environment, social, economic, heritage and health pillars of the site are avoided or appropriately mitigated.

Permanent disposal sites for drilling mud excavated from trenchless watercourse crossings will be either located in existing disturbances on the proposed routes and other temporary workspace or hauled away to suitable disposal sites.

1.2.6 Project Activities

The following sections provide a description of the activities and duration for construction, operations and maintenance of land and marine based pipelines, infrastructure and facilities.

The Project activities include: (1) land based pipeline early construction (including camps, storage yards, clearing, access, ROW preparation); (2) installation of land based pipeline and facilities (including pipeline, compressor stations and the metering station); (3) installation of marine pipeline; (4) commissioning; (5) commencement of operation; and (6) post-construction reclamation.

Subject to receipt of regulatory and Project approvals, construction is scheduled to commence in 2015, with an in-service date of late 2018. Details of the schedule are outlined in Table 1-7.

1.2.6.1 Environmental Monitoring and Inspection

Environmental monitoring refers to the procedures and activities that PRGT will implement as part of its environmental management system to manage the environmental aspects of the Project activities. Environmental monitoring and inspection are key components of the PRGT environmental compliance strategy and will be conducted by qualified personnel (i.e., Environmental Inspectors and resource-specific specialists). The Environmental Inspectors will monitor construction activities and take action with PRGT construction management, as necessary, to ensure continuous and consistent compliance with the environmental protection and socio-economic commitments contained in regulatory applications and approvals, the Environmental Management Plan (EMP), environmental permit/approval conditions and other environmental commitments, as well as applicable environmental laws and regulations throughout all phases of the Project.

Environmental Inspectors are an integral part of the construction management team and provide advice on major decisions or courses of action to address unexpected environmental conditions encountered during construction. The Environmental Inspectors hired for the Project will be required to have experience in environmental inspection and/or planning, have an understanding of pipeline construction techniques and will take a preventative approach to environmental issues.

The Environmental Inspectors will be responsible for monitoring construction activities and taking action with PRGT field management, when necessary, to:

- Ensure compliance with the Project's environmental commitments, approvals, permits and licences
- Document effectiveness of mitigation in reducing potentially adverse environmental effects
- Recommend additional or alternative mitigation measures as appropriate
- Identify resource-specific issues
- Determine the status of environmental issues following pipeline construction.

The Environmental Inspectors will be supported by personnel with expertise in the particular disciplines associated with the Project (e.g., soils, cultural resources, aquatics, rare plants, and reclamation and wildlife specialists) and, depending on the issue, will be available onsite or consulted.

1.2.6.2 Construction – Land Based

This section provides a description and duration of the following land based construction activities. Figure 1-5 presents drawings that illustrate a typical pipeline ROW plan and profile.

Pipeline construction involves several activities listed below that occur sequentially at any one location. The construction ROW will be divided into construction spreads (ranging in length from 15 km to 76 km) to allow multiple construction crews to operate concurrently at various locations.

Survey

Survey work is undertaken throughout the construction process. It is initially undertaken prior to site preparation and construction to gather information for detailed construction planning. Following the clearing activities, surveying is conducted to identify and mark the location of the pipeline trench and engineering features such as heavy wall pipe and screw anchors. This activity continues throughout the construction phase. Following construction, legal surveys may be required to verify the final location of the pipeline and facilities.

Right-of-Way and Site Preparation

Right-of-way and site preparation including pipeline, compressor stations, metering station and ancillary sites is expected to take four to six months per spread and approximately a year in total for the activities described below.

Initial site preparation at compressor station locations will involve surveying, clearing, grading, salvage, and storage of topsoil, excavating and removing unsuitable fill. Preliminary grading of each compressor station will occur during the clearing and grading stage of pipeline construction.

As described in Section 1.2.5.1 and 1.2.5.2, the width of the construction ROW, including temporary workspace, will range from 50 m to 300 m.

Clearing

Trees, brush, and snow will generally be cleared from the construction ROW and extra temporary workspace. Timber assessments have been undertaken to collect detailed information on merchantable and non-merchantable timber on the project footprint. Merchantable timber will be cut, decked, and hauled to local mills where there is a buyer for the logs. All timber plans and harvesting will be carried out in such a way to conform to the terms and conditions of each project-related Master Licence to Cut (MLTC) and Cutting Permit, the *Forest Act* and regulations, OGAA and regulations, current best practice, and OGC advice.

Management of non-merchantable timber, brush, and vegetative debris is described in Section 1.2.8.5. Equipment used during clearing activities will include chainsaws, feller-bunchers or other tree clearing equipment, as well as bulldozers and backhoes.

Topsoil Salvage

In agricultural lands, topsoil will be salvaged to ensure that the soil capability is maintained. The width and depth of topsoil salvage depends on the land use, soil conditions, microtopography, regulatory agency requests, and grading requirements. In forested lands, the organic layer is removed and stockpiled. Soils will be managed to retain soil quality and productivity. Soil handling mitigation measures are described in Section 12. Equipment used during topsoil handling activities includes bulldozers, graders and backhoes.

Grading

Grading requirements along the ROW will vary from no grading in flat or low muskeg areas, to grade cuts in some localized areas. Grading will depend on various factors including slope angles, soil types and season of construction. Grading of the ROW will accommodate field pipe bending and ensure the safe movement of pipe, equipment and personnel along the ROW. Grading plans will be developed during detailed design.

Pipeline Installation

Pipeline installation is expected to take between four and six months per spread over approximately three years. Dedicated crews will complete the stringing, welding, trenching, installation, and backfilling activities.

Stringing and Welding

Pipe will be trucked from nearby pipe stockpile sites and strung along the ROW. The pipeline will be joined by either mechanical or manual welding methods. The pipe will be bent, lined up, welded, joint coated, and inspected before being lowered into the trench. The pipe bending, the joining program and non-destructive examination (NDE) of welds will comply with the requirements of CSA Z662-11 and applicable TransCanada specifications. All welds will undergo NDE. Equipment used during stringing and welding activities includes pipe trucks, booms, pick-up trucks, welding stations, and x-ray or ultrasonic inspection equipment mounted on trucks. During detailed design, precise welding procedures will be determined.

A cathodic protection system, including anode beds, rectifiers and associated facilities, will be installed during this activity.

Trenching

The pipeline will be installed in a single trench using conventional open trench pipeline construction methods. Hydraulic excavators or trenching machines will be used to excavate the trench. In frozen ground or through rocky terrain, the ground surface may be ripped or blasted before trenching can occur.

The trench will be excavated using tracked excavators to a depth that will provide sufficient cover in accordance with, or in excess of, applicable codes, requirements under CSAZ662-11, applicable TransCanada specifications and any applicable crossing permits. Typical depth of cover would be a minimum of 0.9 m and may vary based on land use and soil condition.

Trenching will generally occur after stringing, bending and welding. Major road and railway crossings will be installed by boring method.

The trench bottom will be inspected and any protruding rock or debris will be removed to prevent damage to pipe and coatings before the pipe is lowered into the trench. In areas where abrasive trench materials are present, the bottom of the trench will be bedded with select or processed fine-grained backfill material, or the pipe will be protected with other mechanical protection.

Tunneling

Depending on terrain conditions, micro-tunneling or conventional tunneling may be required. Micro-tunneling uses a drill to excavate a tunnel slightly larger than the diameter of the pipe to be installed. The pipe is then pulled into the tunnel and grouted in place. Conventional tunneling uses traditional techniques to drill and blast a tunnel of sufficient diameter to allow construction personnel access to the tunnel. The pipe is then fabricated in the tunnel.

Lowering In and Backfilling

The pipe will be lowered into the trench using sideboom tractors. Trench dewatering may be necessary at certain locations during lowering in (e.g., to ensure acceptable bedding for pipe, to prevent the pipe from floating, or for performing tie-in welds). After installation, the pipe will be entirely covered with suitable native backfill material.

At any given time, the length of open trench and pipe stringing will be limited to the extent practical, to reduce environmental, social, and safety concerns.

Pipeline Cleaning

The pipeline will be cleaned with foam or rubber tools and soft brushes to remove construction debris. Debris from pipe cleaning will be collected and disposed of following applicable regulations.

The duration of pipeline cleaning (as well as pressure testing and hydrostatic testing listed below) are dependent on the length of the pipeline segment being cleaned, filled, tested and dried. The rate is approximately 800 m per day.

Pressure Testing

Pre-fabricated components, such as above-ground risers, valve assemblies and elbow fittings with associated piping, will be tested in accordance with the pressure testing requirements in Clause 8 of CSA Z662-11 before they arrive onsite. The details around these requirements will be outlined during detailed engineering.

Hydrostatic Testing

Preliminary review indicates there are potential water sources suitable for hydrostatic testing of the pipeline. A hydrostatic test plan will be prepared during detailed design. The test plan will include all water source locations and disposal locations. Regulatory permits for hydrostatic test water sources and disposal locations will be secured as required. Water for hydrostatic testing will be drawn from approved sources and, after use, will be disposed of along the pipeline ROW in accordance with regulatory requirements.

Pneumatic Testing

PRGT is considering pneumatic testing to reduce the number of test sections in areas where long, steep slopes would make hydrostatic testing difficult. Acquiring and moving large volumes of water in these areas will also be difficult, making air testing a more viable option. This is currently being assessed and if it is to be implemented a plan will be submitted to the OGC.

Watercourse Crossing Construction

The project crosses approximately 1,200 mapped watercourses. Depending on the methodology chosen and the nature of the watercourse crossing, the duration of an individual crossing can range from five to seven days for a small crossing to four months or more for an HDD crossing. Instream activities will be minimized. For a complete list of the crossings and crossing methods, refer to Section 10 and Appendix K.

PRGT selected watercourse crossing locations and techniques based on industry accepted design and installation practices. They reflect site-specific assessments and anticipated potential effects to fish and fish habitat. The criteria that PRGT typically considers in selecting a pipeline crossing method include:

- Fisheries, habitat, hydrology and water quality issues
- Approvals, codes and regulations
- Design and constructability issues, and
- Operational requirements.

A variety of crossing techniques may be used during the construction of the pipeline. The most common watercourse crossing methods that will be used on this Project include trenched crossings (e.g., open-cut crossings, isolated crossings), trenchless crossings (e.g., HDD or bore), and aerial crossings. Typical watercourse crossing methods are shown in Figures 1-8, 1-9, and 1-10.

PRGT will obtain all applicable permits and/or authorizations before initiating construction of the crossings and will follow best practices, Letter of Advice, or *Fisheries Act* section 35(2) Authorization conditions. Fisheries and Oceans Canada (DFO) will be notified in accordance with the applicable Letter of Advice or Authorization. The OGC will be notified in accordance with the *Pipeline Associated Watercourse Crossings 3rd Edition* and *BC Water Act* and Water Regulation.

Trenched Crossings

Trenched techniques include open-cut and isolated crossing methods.

Open-cut crossings involve digging an open trench in the bottom of a watercourse, laying the prefabricated pipe in the trench and backfilling. They are the preferred method for crossings where there is little or no flow, or as a contingency for larger watercourses where attempts at trenchless crossing have not been successful. Open-cut crossings require additional temporary work space, but they typically have a smaller footprint compared to other crossing methods. They are not limited by water flow volumes or watercourse widths and can generally be completed more quickly than the other methods.

Isolated crossings are open-cut crossings where water is isolated from the construction area while a trench is excavated and the pipe installed. Isolated methods, using dams and pumps or flumes, divert flow around or across a construction zone to allow trench excavation, pipe installation, and backfilling to occur away from flowing water. Silted water is typically left in the trench during these activities and then pumped onto a nearby vegetated or snow-filled area, rather than back into the watercourse. The stream is stabilized and flow is allowed to return. They are best suited and generally considered for watercourses with open water or under-ice flow, including streams and rivers (less than 2 m) with narrow channels (less than 100 m) and lower flow rates (less than 4 m³/s).

The two main methods of diverting stream flow in an isolation type crossing are:

- Dam the stream and convey the water across the site by pumping
- Dam the stream and install a culvert (flume).

Trenchless Crossings

Where watercourse crossings by trenched methods are deemed to be inappropriate or not feasible a number of trenchless methods would be considered.

HDD crossings involve drilling a 200 mm to 300 mm (nominal) diameter pilot hole using a mud motor along a large radius arc. The large radius is needed to ensure that the pipeline is not overstressed either during installation or operation. The pilot hole is enlarged to a diameter about 300 mm greater than the pipe string, about 1.5 m for an NPS 48 pipeline. The soils along the bore path must be stable (i.e., of sufficient stiffness to ensure a 1.5 m to 1.7 m diameter open borehole remains stable until the pipeline is pulled into place). Additional temporary workspaces at the entry and exit sites may be required to assemble and align the pipe to be pulled through the drilled opening. Temporary workspace of this nature may at times extend beyond the lineal portions of the ROW due to topographical constraints. This is generally located outside of the riparian setbacks.

HDD crossings work best for large waterbodies in areas with exceptionally vulnerable ecosystems (e.g., water quality, fish, and fish habitat) and favourable geotechnical and hydrological conditions exist. Typical criteria for selecting candidate crossings for HDD include:

- Presence of highly sensitive fish species, life stages, or habitats
- Presence of appropriate sub-surface conditions
- Exceptionally steep approach slopes in a river valley
- Presence of extensive existing pipeline infrastructure at the crossing.

A bore is a trenchless crossing method, which involves excavating pits on either side of the watercourse. This method may be used for shorter crossing lengths. A boring machine is placed in one pit and, using an auger inside a casing, is used to bore a hole slightly larger than the pipe diameter through to the other pit. The pipe is installed horizontally below the crossing, between the two pits.

Aerial Crossing

Aerial crossing (pipeline bridges) are structures built to support a pipeline above a sensitive watercourse for which a conventional buried crossing method is not appropriate (e.g., steep narrow ravines) or for which habitat disturbance must be reduced.

Construction of Compressor and Metering Stations

The construction of each compressor station is expected to take approximately one year and the metering station will take approximately six months. Final site preparation will include final grading, site drainage, placement and compaction of a gravel surface on work areas, laying of a foundation and installation of a building support pad. Following these activities, construction of these facilities will include installing new structures, compression, pipe, valves and electronics equipment, tying into the pipeline, pressure testing all piping, testing safety systems and instruments, final commissioning of new equipment and control systems, and constructing perimeter fencing. Equipment used during the construction includes backhoes, cranes and manlifts.

Clean-up and Post-Construction Reclamation

Clean-up and reclamation are important steps in returning construction sites to a condition similar to pre-construction. Final clean-up will generally occur in the following fall and/or winter, or as soon as conditions permit. Reclamation activities will occur within the first two growing seasons following pipeline installation. Initial clean-up and reclamation procedures will begin immediately following construction using bulldozers, backhoes and graders.

For winter construction, clean-up is generally a two-phase process, with rough clean-up being completed immediately following construction and final clean-up occurring the following winter. If clean-up cannot be completed prior to spring break-up, cross ROW drainage will be re-established, and sedimentation and erosion controls will be installed to protect the ROW and sensitive environmental features.

For summer construction, clean-up is generally completed immediately following construction, or as soon as weather and soil conditions permit, subject to relevant wildlife timing restrictions.

Garbage or debris remaining along the ROW will be removed regularly and disposed of in compliance with local regulations. The ROW contours will be returned to a stable and maintenance-free condition. In agricultural soils, compaction in subsoils will be relieved and the topsoil replaced. A Soil Handling Contingency Plan will be developed and specific land reclamation measures will be applied.

Watercourse crossings will be reclaimed in accordance with all applicable regulatory requirements. The ROW and temporary workspace at watercourse crossings will be reclaimed as soon as practical upon completion of final clean-up. Additional details are provided in Section 10.

1.2.6.3 Construction - Marine

The marine pipeline installation activities, described below, occur concurrently and therefore it is difficult to specify durations for each activity. All pipeline construction activities are expected to take approximately two years. Durations for marine entry/exit are provided in Table 1-6.

Marine Construction Survey

A fully equipped survey/remotely operated vehicle (ROV) vessel will be mobilized to perform hydrographic, geophysical and investigative surveys prior to, during and after all phases of the construction program.

Seabed Preparation (Deep-water)

Under-pipe support will be needed in areas where the natural seabed topography would potentially create a freespan (unsupported) section of pipeline when it is installed. In areas where the span is relatively short, a mix of rock and gravel would be placed to fill the gap and support the pipe. Where the span is longer, rock berms may be installed across parts of the freespan to reduce the length of unsupported pipe.

The fill material will be placed with a barge and crane or a side-dumping vessel in shallow water, or by a barge with a long placement chute in deep water. The chute will be lowered towards the seabed and guided into position by an accompanying ROV. This method of installation allows for greater accuracy of fill delivery to the seabed in deep water and limits the footprint of the under-pipe support.

Blasting of rocky areas may be required in intertidal and sub-tidal zones at the marine entry and exit points, such as at Nasoga Gulf or Lelu Island. This activity would only be necessary if the pipeline cannot be routed to avoid such areas, or if rock is encountered in areas where pipeline burial is required. Blasting is unlikely to be required along the majority of the deep water portion of proposed routes.

Marine Pipeline Installation (Lowering In)

Pipeline installation in the marine environment involves welding joints of pipe together on a pipelay vessel and lowering the pipeline to the seabed. As the vessel moves forward, additional pipe sections are welded in place on the vessel to form a continuous string. Construction proceeds in this manner along the majority of the route. In deepwater portions of the route the pipeline will be installed directly on the seabed. In shallow areas (intertidal, shallow sub-tidal zones) and/or where there is potential for anchors and fishing gear to interact with the pipes, the pipelines will be installed inside a trench and covered for protection.

Placement of the pipelines on the seabed will involve lowering the pipeline from the shallow water pipelay barge (SWLB) in water depths of approximately 20 m or less,

and from a deepwater pipelay vessel (DWLV) in water depths greater than approximately 20 m.

The SWLB will use anchors to maintain a position and move along the pipeline route. Specialist anchor handling tugboats will assist in the process. The SWLB requires minimum water depths between 6 m and 9 m (depending on the selected equipment) to operate safely. In waters shallower than this, the pipes will be pulled from the SWLB by a winch set up on the shore.

The DWLV will typically use Dynamic Positioning (DP) to maintain position. DP is a computer-controlled system that automatically maintains a vessel's position and heading by using its own propellers and thrusters. The DP vessels need approximately 20 m of water to operate safely.

For shallow waters and intertidal areas, pipelaying from the SWLB can typically proceed 300 to 500 m per day and would operate 24 hrs a day.

The DWLV will lay the majority of each marine pipeline as a single string and would complete one string of pipe before starting the next. Deepwater pipelaying can typically proceed at a rate of 3 km to 5 km per day and would operate 24 hrs a day. Each pipeline will take approximately 6 weeks to lay depending on the final route and tie-in location of the deep water and shallow water pipelines.

Intertidal Crossings

In shallow water and at intertidal crossings, the pipeline will be buried. Depending on the route chosen, there will be between two and six intertidal crossings. These crossings are at the transition between marine and land based pipeline from the high water mark. These may involve open-cut trenching or HDD for the actual shore crossing.

Trenching

Trenching of the pipeline may be performed before (pre-lay) or after (post-lay) the pipeline is lowered from the pipelay vessel.

Pre-lay trenching can be achieved using barge mounted excavators, clam-shell or dragline dredgers, cutter suction dredgers, trailer suction dredgers or mud or sediment pumps. Once the trench is excavated, the pipe is laid into the trench and then covered using the excavated sediment and/or rock.

Temporary use of sheetpiles on the intertidal crossing may be needed to maintain trench integrity, and reduce or maintain turbidity in the water column by capturing sediment. The sheetpiles would be removed, pipeline protection would be installed, the trench would be backfilled and the shoreline reclaimed.

Post-lay trenching can be done via mechanical trenching, ploughing, jetting or mud or sediment pumps, which move along a previously laid pipeline and create a trench into which the pipe will be lowered. Mechanical trenchers are expected to be able to bury approximately 500 m of pipeline per day while ploughs can install 2 km of pipeline per day. Jetting uses high-pressure water jets to cut or liquefy soils around and in front of the pipeline, allowing the pipe to sink to the desired burial depth. The liquefied material then settles back into the trench.

Generally the preferred method for trenching is pre-lay for shore approaches. After the pipe is positioned in the pre-lay trench, additional lowering within the pre-lay trench may be performed using the sediment/mud pumps or other post-lay trenching methods with the discharge directed back into the pipeline trench. This would be done where the trench may have partially infilled due to the time lag between excavation and pipe installation. Post-lay trenching may also be used in deep-water where appropriate for pipe protection or span correction.

Horizontal Directional Drilling/Microtunnelling

Horizontal directional drilling and microtunnelling involve drilling a hole from onshore seaward to a location where it can be connected to the marine pipeline. Typically, a smaller pilot hole is drilled first and stops short of the breakout point. This technique allows for drill cuttings and fluids to be withdrawn before the final hole is widened and emerges into the marine environment. Excavation at the HDD/microtunnelling exit point is required to connect the marine and land based portions of the pipelines.

Backfilling

The sediment removed from the trench during excavation will be returned over the installed pipeline using barge mounted excavators as part of the overall pipelay process.

Pipe Protection

The marine pipeline may need to be armoured in specific areas to prevent damage from scour, fishing gear, anchors and vessels. To achieve this, engineered rock, pre-cast concrete mats or grout mattresses, or sand or grout bags will be placed over the pipeline wherever it is at risk. Rock protection consists of placing a layer of gravel and coarse rock, approximately 30 cm to 70 cm thick and up to 12 m wide over the buried pipeline. Over time, the rock protection, concrete mats or grout mattresses, or sand or grout bags will become naturally covered with silt.

Construction Methods for Marine Entry/Exit

Table 1-6 describes the current preferred methods and approximate durations for construction of each marine entry/exit location, it is based on the understanding of the preferred construction methods at the time of filing; however, as stated above, engineering studies are still underway which may change or refine the constructions methods for each of these locations.

Table 1-6: Preferred Construction Methods for Marine Entry/Exit

Marine Entry/Exit	Preferred Construction Methods	Approximate Duration ¹
Nass Bay Shoreline	This alternative involves blasting a bench along the steep rocky slope on the south shoreline of Nass Bay for approximately 3.5 km. The blasted material would then be side casted along the shore's edge, will be built up to the level of the bench and incorporated as part of the working surface. This would reduce the amount of material needed to be removed from the slope. Once a level surface, approximately 30 m wide cut into the side of the slope is created, the pipe would be buried to the bedrock along the bench.	4 to 6 months
Nass Bay Nearshore Marine	At the proposed Nass Bay Nearshore Marine, Nass Bay Nearshore Alternative, and Iceberg Bay routes, a combination of open cut excavation and shore pull would likely be used. These three routes 'hug' the shoreline on the south side of Iceberg Bay (Figure 1-2) and are bisected by a peninsula, where the pipeline will cross over land. Unlike other marine routes, these routes will involve a single 48 inch pipe rather than two 36 inch pipes. As each route starts and terminates on land, and is relatively short, the pipe can be pulled from shore and a pipelay barge is not needed. The open-cut trench, therefore, only needs to be 6 m wide and 3 m deep and would be pre-trenched. Excavated material would be sidecast and replaced over the pipe after it is pulled in to place.	10 weeks
Nass Bay Nearshore Alternative	See above.	8 weeks
Iceberg Bay	The shallow portions of this route, approximately 1 km on either end, will be prepared in the same manner as the Nass Bay Nearshore Marine route above. In addition, this route has a deeper section, approximately 1.5 km long, where the pipe is placed on the seabed. This section of the pipe may be stabilized by covering it with rock and gravel.	7 weeks
Nasoga Gulf to Portland Inlet	Open-cut excavation is currently proposed as the marine entry option for the Nasoga Gulf to Portland Inlet. The two pipes would enter the marine environment separately, approximately 6 m apart. The pipes will be placed within a single trench with a bottom width of 10 m and a depth of 3 m out to a water depth of 20 m. This will be excavated by using barge mounted excavators or clam-shell trenching equipment. Sediment will be sidecast. Once the pipes have been installed, engineered rock or pre-fabricated concrete mats will be placed over the pipelines for protection from erosion, or interaction with fishing gear, small anchors and shallow draft vessels. The stored sediment will then be recovered and returned back into the trench. For the first 50 m from shore, the sediment will be placed over the rock or concrete mats. Beyond 50 m, the sediment would be placed back in the trench before rock or mat placement.	10 weeks

Table 1-6: Preferred Construction Methods for Marine Entry/Exit (cont'd)

Marine Entry/Exit	Preferred Construction Methods	Approximate Duration ¹
Approach to Lelu Island	The preferred method for the shore approach and marine exit (shore crossing) at Lelu Island is an open-cut excavation. The shore crossing trench will be approximately 10 m wide and 3 m deep and may extend to an approximate distance of 2 km offshore. The trench will be excavated using a barge mounted excavator, clam shell trenchers and mud/sediment removal pumps. Several options for open cut trenching are being evaluated including a two wall sheetpile cofferdam, a single sheet pile wall and an open cut trench with turbidity fences for sediment containment.	19 weeks
	Beyond the 2 km point, the trench will be extended without the use of piles or cofferdams, to the tie-in point with the deep water segment of the pipeline. Several options are being evaluated to construct this segment including a straight open cut trench, curved open cut trench and access trench for SWLB. The curved open cut trench will be approximately 25 m wide and 3 m deep for a distance of approximately 2.5 km. The approximate volume of sediment removal during trenching ranges from 200,000 m³ to 610,000 m³. During trenching in both segments, the sediment will be side cast and stored near the trench during the pipe-pull operation and returned to the trench when the pulls are completed. For the first 2 km, pipeline installation will be achieved by pulling the pipe to shore from a SWLB. The SWLB will then continue installation by extending the shoreline string of pipe to the tie-in point with the deep-water pipeline segment. Rock or concrete mats may then be placed over the pipelines following installation.	

Notes:

¹ For trenching and backfilling.

² For Nass Bay Shoreline: While this is a land route it may result in interactions with the marine environment.

Although the methods described above represent the preferred methods at time of filing, for the Nasoga Gulf to Portland Inlet portion of the marine pipeline route, HDD/microtunnelling may be used either as an alternative to open-cut excavation or to supplement it. At the approach to Lelu Island, HDD/microtunnelling may be used to transition from the deep water trench to the terrestrial environment.

For an HDD/microtunnelling at either location, excavation at the tie-in points (exit pits) will be required to connect the marine and land based portions of the pipelines. The size of the excavation area depends on the specific substrate in the area and its stability, but is expected to be less than 7,000 m². Displaced material may be temporarily stored underwater adjacent to the exit pit, on barges, or on land. Excavated material will be recovered to its original location as backfill to protect the pipe and reinstate the seabed. In Nasoga Gulf, depending on where the HDD/microtunnelling exits the seabed, the pipes may be trenched out to 30 m or simply placed on the seabed. At Lelu Island, HDD/microtunnelling is expected to be possible up to a distance of 1.5 km from shore, at which point the pipes will be trenched as described above.

HDD/microtunnelling would take approximately three months at each of the Nasoga Gulf entry and Lelu Island exit points, and excavation of the exit pit at each tie-in point would take approximately two weeks.

As described in Table 1-6, large volumes of sediment will need to be excavated and recovered during pipeline installation. Engineering studies, design and construction planning are still underway. The volume of sediment excavated will change through that process. It is currently PRGT's intent to recover excavated sediments to the trench after lowering in. The need for disposal of excess sediment is not anticipated at this time.

Pipeline Cleaning

After the pipe is laid and after post-lay correction activities have been completed (i.e., span correction, post lay trenching and rock placement), the pipelines will be flushed with filtered seawater and cleaned to remove loose debris.

Pressure Testing

The marine pipelines will be pressure tested with filtered seawater. The pipeline will be tested as one complete section from Nasoga Gulf to Lelu Island. Seawater remaining in the pipeline for more than approximately 30 days will be chemically treated to mitigate corrosion. Following successful pressure testing, the pipeline will be dewatered, dried, and stored filled with inert nitrogen gas for later tie-in to the land sections. See Section 1.2.10.4 for details of disposal of hydrotest water.

Marine Clean-up and Post-construction Reclamation

Following construction, a shallow water barge will be located adjacent to the nearshore trench to remove the sheetpiles. The seabed will be restored in accordance with the *Fisheries Act* authorization or applicable governing regulations. Land above low tide will be restored as described above in land based construction (Section 1.2.6.2).

1.2.6.4 Transportation – Land Based and Marine

Transportation of goods, materials, equipment and personnel will be required to support pre-construction and construction activities. Equipment and materials to transport will include:

- pipe segments
- valve assemblies
- diesel fuel
- heavy construction equipment
- directional drilling equipment

- compressors
- camp components
- other materials and consumables.

Rail transport will be the primary transportation mode for pipe segments and valve assemblies. There are two possible scenarios:

- **Scenario 1.** Pipe originates from overseas and arrives coated. It is shipped in through a combination of the Stewart World Port (Stewart), the Fraser Surrey Docks (Surrey), and the Squamish Terminals (Squamish). From Surrey and Squamish, the pipe for the terrestrial portions of the pipeline would be loaded onto rail cars and brought north through Prince George to three or four pre-selected rail siding sites near the ROW. From the rail siding sites, the pipe is transferred onto trucks. From Stewart, the pipe is loaded directly onto trucks because there are no rail services available. The most likely rail siding sites for this scenario are Chetwynd, Mackenzie, and Fort St. James, though other sites may be used.
- **Scenario 2.** Pipe originates from North America. This is equivalent to pipe arriving uncoated from overseas, and having to first be transported to coating facilities within North America. In this case, the pipe is loaded onto rail cars and brought in through Prince George and Chetwynd, and then on to three or four pre-selected rail siding sites. Again, from the rail siding sites, the pipe is transferred onto trucks. The most likely rail siding sites for this scenario are the same as in Scenario 1 (Chetwynd, Mackenzie, and Fort St. James), but with one additional siding site near New Hazelton or Terrace.

Pipe for the marine portions of the pipeline would be transported by barge from one of these port facilities (i.e., Stewart, Squamish or Surrey) to the DWLV.

Truck transport would be required to deliver pipe segments from the rail siding sites to stockpiles or to work sites. It is also expected that diesel fuel, goods, materials, and equipment will be transported by truck.

In addition to transportation of goods, daily transport of personnel between the camps, muster areas, and work sites will be by multi-passenger vehicles.

During marine construction, materials and many of the supplies required to support the construction workers will be supplied through local bases within BC. Smaller supply vessels will transit between the construction vessels and the supply bases at regular intervals. Supply vessels will also refuel the larger construction vessels at sea.

1.2.6.5 Operation and Maintenance – Land Based

This section provides a description of operation and maintenance activities with the potential to interact with environmental components. The following activities will occur throughout the lifetime of the Project and are anticipated to begin in late 2018.

Project Presence

The ROW will be clearly marked with sign and post markings at public roads, railroad and navigable water crossings, and other areas, as required, to reduce the possibility of damage or interference resulting from the activities of third parties. This will also allow the rapid identification of the pipeline during aerial surveillance.

The permanent ROW will be registered with BC One Call to further mitigate the risk of damage or interference resulting from the third party activities.

Prior to commissioning the pipeline, PRGT will develop an Access Management Plan and incorporate it into the Environmental Management Plan. The Access Management Plan will consider current and ongoing discussions with regulatory agencies, Nisga'a Nation, Aboriginal groups, stakeholders, and community groups to ensure consideration of local needs such as use of and access to the ROW or restrictions of such use. Pipeline components and aboveground facilities will be properly secured and protected by suitable fences to prevent tampering by unauthorized parties. The fenced areas will be maintained to ensure safety and an acceptable appearance.

Vegetation and Brush Management

For construction, an Invasive Plant Species Management Plan will be prepared and will provide details on the mitigation measures that will be carried out to prevent, identify, control, and monitor the introduction and/or spread of noxious weeds, or invasive plants. An Integrated Vegetation Management (IVM) approach will be used. The IVM incorporates current knowledge, practices, and actions to achieve management objectives and goals. The level of invasive plants within the project footprint will be maintained at a level that does not exceed the level observed on adjacent lands.

The permanent ROW and facilities sites will be maintained to prevent the introduction or spread of noxious weeds and to avoid negative impacts to sensitive or protected wildlife habitat. Environmentally sound management practices will be employed by staff and contractors. Brush cover will be allowed to regenerate naturally on either side of a 10 m corridor along the pipeline centreline; however, a brush-free corridor must be maintained directly over the pipeline to allow for line-of-sight inspection of the ROW.

Operation and Maintenance Programs

PRGT will operate the pipeline, compressor stations, metering station and associated facilities in accordance with all governing regulatory requirements, permit conditions, and approvals. PRGT will apply TransCanada's comprehensive operating procedures and associated systems to the Project. These operating procedures are designed to:

- Describe how work is to be accomplished, e.g. resources required and work instructions
- Identify specific competency requirements where appropriate
- Identify documentation requirements
- Provide references to applicable health, safety and/or environmental requirements.

Regular preventative maintenance programs will be incorporated into the design and operation of the pipeline, compressor stations, metering station and associated facilities. Facility sites such as compressor and metering stations will be visited weekly. Repairs may be required periodically, which will be accomplished within the permanent footprint.

Monitoring and Surveillance

Regular aerial patrols will be undertaken to monitor conditions on the ROW. The frequency is established in accordance with CSA Z662 and is based on considerations of operating pressure, pipeline size, population density, terrain, weather, and agricultural and other land use.

Ground-based patrols may be performed along the permanent ROW by walking, all-terrain vehicle or motor vehicle as appropriate for the conditions and land use.

The purpose of surveillance and monitoring activities is to assess the general condition of the ROW, and to look for evidence of natural gas leaks, construction or third party activities on or near the ROW, loss of vegetative cover on the pipeline route, un-authorised vehicular traffic, exposed pipe, and erosion and bank stability at river crossings.

In-Line Inspection Facilities

The Project will have facilities for launching and receiving in-line inspection tools (pig barrels). These tools allow for internal examination of the pipeline to monitor pipe integrity. The in-line inspection facilities are typically installed at compressor stations and at mainline valve sites. The facilities generally consist of valves, piping, and launchers or receivers, depending on the location. The precise location of these facilities will be determined during detailed design.

Cathodic Protection

During operation, cathodic protection is continuously managed in accordance to regulatory requirements to protect the pipeline from electrochemical corrosion. This would include regular monitoring, inspection and above-ground surveys, replacing anode beds and maintaining the other cathodic protection components.

SCADA System

The SCADA system is used to continuously monitor and control pipeline operation. It is described further in Section 1.2.5.2.

Marker and Road Maintenance

PRGT will undertake inspection and maintenance of pipeline markers (signage) and access roads along the ROW.

1.2.6.6 Operation and Maintenance – Marine

This section provides a description of operation and maintenance activities with the potential to interact with environmental components. The following activities will occur throughout the life of the Project and are anticipated to begin in late 2018.

Project Presence

The marine pipelines will be marked on the nautical charts issued by the Canadian Hydrographic Service so that other marine users are aware of their presence. Before construction, the location of the pipeline can be added to the nautical charts to increase awareness of the pipeline along the marine route. Notices to mariners are also provided when new pipelines are constructed to make seabed users aware of the pipeline existence and avoid interference or damage.

The PRPA and the Canadian Coast Guard are being consulted on the construction planning and routing of the marine pipeline and will include the presence of the pipeline in their operational planning, where required. For example, the PRPA will incorporate the pipeline route into the management of anchorages within its jurisdiction.

Maintenance Programs

Regular internal and external (where not buried) inspections of the marine pipelines will be conducted.

As per CSA Z662, the pipeline route will be aerially patrolled at regular intervals to observe:

- Surface conditions along the route
- Evidence of leaks, construction, or unusual marine activity; and
- Other factors that can affect the safety and operation of the pipelines.

Internal inspections are anticipated to be conducted by in-line inspection (intelligent pigging) with a baseline survey established before commissioning and regular inspections completed over the life of the pipeline.

Remotely operated vehicle (ROV) inspections, controlled by a support vessel, will be conducted during start-up, immediately after start-up, and periodically to examine deviations to the installed materials and seabed from the baseline survey (e.g., pipeline position, pipeline damage, free spans, hazards).

If a repair is required either as the result of routine inspections or an accident or malfunction, it may be necessary to lower equipment to the seabed to repair or replace sections of the marine pipeline.

Cathodic Protection

Cathodic protection is a common method used to protect the pipeline from electrochemical corrosion. A cathodic protection system, using sacrificial bracelet anodes will be designed and installed on the pipeline. Cathodic protection surveys will be conducted periodically to calculate the remaining life of the sacrificial anodes.

Monitoring System

PRGT continues to consider a number of options for monitoring the marine pipeline, including internal and external monitoring. A leak detection system will be selected based on suitability, readiness of technology, and practicality of its application to the pipelines. As a minimum the SCADA system, in particular the equipment installed at the compressor station immediately upstream of the marine pipelines and at the Lelu Island metering station, will be used to continuously monitor and control marine pipeline operations. The SCADA system is described further in Section 1.2.5.2.

1.2.6.7 Decommissioning

Prior to construction, PRGT will prepare a Conceptual Decommissioning Plan that will meet current, relevant regulatory requirements. The commitment to prepare this plan is restated in Section 36.

1.2.7 Resource and Material Requirements – Land Based

1.2.7.1 Energy Requirements

Where available, the Project will use electrical power supplied by local utilities. Where commercial power is not available, electrical power will be generated at the facilities using natural gas from the pipeline as a fuel source. Typical electrical power required at compressor facilities to meet the station loads would be less than 500 kW (for pumps, fans, instrumentation, and lights). At the metering station, load requirements for lights and instrumentation would be less than 2 kW.

During construction or for communications towers, where commercial power is not available, power will be supplied by diesel generation where needed.

1.2.7.2 Water Requirements

Withdrawal and return of water for hydrostatic testing of the pipeline and construction camps will be undertaken with the approval of appropriate regulators, including DFO and the OGC, and in compliance with all applicable regulations, guidelines, and codes of practice relating to water withdrawal and discharge.

Water requirements at the compressor stations during operation are typically limited to general clean-up. Water wells may be required for non-potable water. Potable water will be trucked in.

1.2.7.3 Excavation and Fill Requirements

In addition to the pipeline trench, excavation for pipeline construction would include grading of steep slopes and uneven terrain, and potentially tunnelling. Fill may be required along the ROW where trench rock cannot be replaced directly over the pipeline. Grading and contouring may also be required at compressor stations, in addition to importing gravel or fill.

PRGT anticipates that fill will be sourced from areas excavated along the ROW. If, at a later date, it is determined that additional fill is required from outside the project footprint, it will be sourced from approved local pits and quarries. Excess excavated material from the ROW will be distributed on the ROW, or at borrow sites if their use is identified in the future. Any local restrictions for use of borrow material or disposal will be followed, including any special measures that may be required in sensitive areas, as outlined in the applicable Land and Resource Management Plan (LRMP).

1.2.7.4 Timber

As part of site preparation and clearing, PRGT will remove timber from the construction ROW. The effects of this activity will be addressed in Section 23 of the Application. As well, in the OGC Application, PRGT will provide detailed forestry

information, including volumes of merchantable timber to be cut for the project. It is PRGT's intention to maximize use of merchantable timber either within the Project or by sending it to appropriate mills. In some cases, timber from clearing activities may be utilized to aid in PRGT project operation. Construction uses for timber include: corduroy road to aid in equipment mobility; roll-back timber, where trees may be placed over the ROW to limit access to specific sensitive areas; wood and debris placed for erosion control; and debris piles constructed and placed to provide habitat and ecosystem functions. As a last resort, excess timber may be burned in accordance with appropriate permits and conditions.

1.2.8 Wastes and Emissions – Land Based

1.2.8.1 Toxic and Hazardous Materials

Use, production, or transportation of toxic and hazardous materials during construction and operation will be minimal. Materials of potential concern primarily include vehicle fuels and hydraulic fluids. Activities associated with Project construction that may involve other substances of concern include welding and weld testing.

Storage and transportation of these materials will be conducted in accordance with the *Transportation of Dangerous Goods Act*, Workplace Hazardous Materials Information System (WHMIS), Hazardous Waste Regulation and any other provincial regulations as applicable. The management of these materials during construction is described further in the Project-specific EMP and Chemical and Waste Management Plan (described in Section 36).

During operation, PRGT will utilize company procedures developed to meet or exceed regulatory requirements for spill response, hazardous materials storage, handling and disposal, and transportation of dangerous goods.

1.2.8.2 Air Emissions

Air emissions, such as dust and equipment exhaust, are associated with construction activities. Sensitive receptors near compressor stations have been identified and included in the assessment of effects on the atmospheric environment. Additional information is provided in Section 5 and Section 6 of the Application.

Air emissions during construction will include combustion by-products from equipment operation and brush burning. These will include criteria air contaminants (CACs) (sulphur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM_{2.5} and PM₁₀)), and greenhouse gases (GHGs). In general, construction activities are expected to be short-term and transient in nature, and environmental effects will be reduced through the use of effective environmental protection practices.

Air emissions from operation of the compressor stations are associated with combustion of natural gas in the turbines and may also include combustion by-products from other intermittent sources, such as generators. Primary emissions from Project operation include NO_x, PM_{2.5}, and CO. Emissions of these substances have been estimated and dispersion modelling conducted for each compressor station in accordance with regulatory guidance. Dispersion modelling results have been compared to relevant Ambient Air Quality Objectives (see Appendix E). Greenhouse Gas emissions for each compressor station have also been estimated and compared to relevant provincial and national totals.

The GHG Management Plan considers carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulphur hexafluoride (SF₆) released during construction and operation of the Project, with a primary focus on the operation of the compressor stations. The Plan identifies measures that will be implemented to mitigate, reduce, or avoid emissions of GHGs.

1.2.8.3 Acoustic Emissions

Noise emissions during Project construction will affect the acoustic environment. Primary noise sources during construction include: construction equipment, machinery, trucks and other site traffic, and blasting. During operation, compressor stations occasional helicopter access, light truck traffic, and periodic maintenance works will also result in periodic noise. Additional information is provided in Section 7.

1.2.8.4 Waste Management

Typical waste generated during Project construction includes construction materials (e.g., wood lathe, flagging tape, hydraulic fluids from equipment maintenance), and domestic products from camp operation. The pipeline construction contractor will collect and dispose of waste appropriately at approved sites.

If HDD is used, drilling muds will be disposed of on land per regulatory requirements.

During the operation phase, the facilities are expected to produce used compressor and generator oil and filters, air filters, refuse and domestic wastewater. Qualified contractors will collect and dispose of waste at appropriate facilities.

To control Project waste, PRGT will apply TransCanada's Chemical and Waste Management Plan (described in Section 36) which meets or exceeds requirements under the BC *Environmental Management Act*. Storage and transportation of waste material will be conducted in accordance with the *Transportation of Dangerous Goods Act*, WHMIS, Hazardous Waste Regulation and any other provincial regulations applicable.

1.2.8.5 Non-Merchantable Wood Fibre Management

Opportunities to utilize non-merchantable timber and debris will be explored. Depending on market conditions at the time of clearing, recovery and transport to processing facilities of non-merchantable wood fibre may be feasible. Non-merchantable fibre and debris may be utilized for Project-related operations, including erosion control, and habitat and ecosystem mitigation. Where it is not possible to utilize non-merchantable wood fibre, it will be disposed of by mulching, and/or piling and burning in accordance with appropriate permits and conditions.

In winter construction areas, minimum surface disturbance techniques will be used to maintain an intact ground surface. This would be implemented by using brush cutters, brushhogs, or other equipment.

1.2.9 Resource and Material Requirements – Marine

1.2.9.1 Energy Requirements

The construction and support vessels will run on marine diesel fuel, which will also generate electrical power for the vessels. No electrical energy will be required for the operation of the marine pipeline.

1.2.9.2 Water Requirements

Potable water will be required for the crew of the construction vessels. Pipelay and supply vessels typically have reverse osmosis plants onboard to desalinize seawater. Commercially available potable water may also be used.

It is anticipated that untreated seawater will be used for hydrostatic testing. However, given uncertainties in the scheduling of construction, pre-commissioning, and commissioning activities, water may need to be treated if it is to be stored for any length of time in the pipeline prior to commissioning. The water will be discharged in accordance with applicable permits and regulatory requirements.

Withdrawal and return of water for hydrostatic testing of the pipeline will be undertaken with the approval of appropriate regulators, including DFO, Environment Canada (EC), OGC, BC Ministry of Environment (MOE), and Nisga'a Lisims Government. PRGT will comply with all applicable regulations, guidelines and codes of practice relating to water withdrawal and discharge. No water is required for the operation of the marine pipeline.

1.2.9.3 Excavation and Fill Requirements

In addition to seabed materials being excavated and then replaced for burial of the marine pipeline, additional rock may be required for seabed preparation to reduce pipeline freespan as described in Section 1.2.6.3. If rock is used, it must be of the

appropriate grade and quality to remain stable and support the pipeline during the full life of the Project. Rock may also be required to protect the pipeline in exposed areas where the pipeline may be at risk from damage from other seabed activities such as anchoring. Detailed engineering will determine the location, quantity and nature of the rock required. It is anticipated that rock will be sourced from approved local pits and quarries.

Specialized rock placement vessels will be used to accurately install the rock fill over the pipeline.

1.2.10 Wastes and Emissions – Marine

1.2.10.1 Toxic and Hazardous Materials

Use, production, or transportation of toxic and hazardous materials during construction and operation will be minimal. Materials of potential concern primarily used during construction and operation include vessel fuels and hydraulic fluids.

Storage and transportation of these materials will be conducted in accordance with the *Transportation of Dangerous Goods Act*, WHMIS, and any other provincial regulations. The management of these materials during construction is described further in the Project-specific EMP and Chemical and Waste Management Plan (described in Section 36).

1.2.10.2 Air Emissions

Construction air emissions will include combustion by-products, primarily criteria air contaminants (CACs) derived from diesel consumption in vessels, barges and marine equipment. Construction vessels will comply with the requirements of Environment Canada's Sulphur in Diesel Fuel Regulations and International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI, which relates to air pollution from vessels, barges and marine equipment. The Project falls within the North American Emission Control Area under MARPOL, which was set up to reduce sulphur emissions.

1.2.10.3 Acoustic Emissions

Marine pipeline construction will generate underwater noise. This will include noise from the construction vessels and dredging activities. The vessels using DP may generate underwater noise at higher levels and over longer periods due to the thrusters that maintain the position of the vessel.

Where the seabed is comprised of rock and the pipeline needs to be buried or the seabed levelled, underwater blasting may be required. Sheet piling, anchor piling, and rock placement may also contribute to localised noise emissions.

It is not anticipated that acoustic emissions will occur during normal pipeline operation.

Additional information is provided in Section 7 and Section 11 of the Application.

1.2.10.4 Waste Management

During marine pipeline construction, typical waste includes domestic products from housing crews. The pipeline construction contractor will collect and dispose waste in accordance with applicable regulations. Operation of the marine pipeline is not expected to generate any waste materials aside from domestic wastes.

Wastewater will be generated on the construction and operation vessels. This will comprise domestic greywater, including sewage, from the accommodation and bilge water. The vessels will have wastewater treatment and management systems on board. Wastewater will not be discharged by the vessels within coastal waters and will be disposed in accordance with applicable regulations.

Seawater will be used for the hydrostatic testing of the marine pipelines. Depending on the time that the seawater will remain in the pipe it may be necessary to chemically treat it to avoid corrosion. These chemicals will be neutralised prior to discharge to mitigate against effects on water quality. Discharge of hydrostatic test water will be undertaken in compliance with the conditions of any approvals. Following testing, the pipe may be dewatered in accordance with applicable permits and regulatory requirements.

If HDD is used, the inert drilling mud will be disposed in accordance with applicable permits and regulatory requirements.

PRGT will apply TransCanada's Chemical and Waste Management Plan (described in Section 36) which meets or exceeds requirements under the BC *Environmental Management Act* to manage Project waste. Storage and transportation of waste material will be conducted in accordance with the *Transportation of Dangerous Goods Act*, WHMIS, and any other provincial regulations.

1.2.11 Project Design Standards and Policies

The Project will be designed, constructed, and operated in accordance with the *Oil and Gas Activities Act*, the Pipeline and Liquefied Natural Gas Facility Regulation (BC Reg 281/2010) and associated standards as described within CSA Z662-11. The Project will also adhere to other applicable CSA standards, Det Norske Veritas (DNV) Standards and the BC Building Code.

TransCanada has developed Environmental Management and Contingency Plans that are implemented for all relevant TransCanada projects and adapted on a project-specific basis. The plans are based on strategies of avoidance, best management practices (BMPs), mitigation, and applicable regulatory guidelines and/or legislation to avoid or reduce potential Project-related effects. The PRGT Environmental Management and Contingency Plans are discussed in Section 36. The detailed plans will be developed during the pre-construction phase and will be updated and adapted as needed and throughout the life of the Project.

Follow-Up Programs (Section 37) provide a description of proposed monitoring programs to be incorporated into each phase of the Project. These programs ensure compliance with management and contingency plans and identify where adaptations are necessary.

1.2.12 Schedule

Subject to receipt of regulatory and Project approvals, ROW clearing and preparation, and construction is scheduled to commence in 2015, with an in-service date of late 2018. It is anticipated that the operation and maintenance phase of the Project would commence in late 2018 following construction. A schedule for Project activities is provided in Table 1-7.

Table 1-7: Project Schedule

Activity	Date
Project announced by TransCanada	January 9, 2013
Project Description filing to initiate federal and provincial environmental assessment processes	May 2013
Submission of Application for Environmental Assessment Certificate to BC Environmental Assessment Office	May 2014
OGC application	Initiate early 2014
Receipt of key regulatory approvals (EAC Certificate/OGC Approval)	Late 2014
Applications for other regulatory approvals (e.g., <i>Fisheries Act</i> Authorization)	Early 2015
Land based pipeline pre-construction (including camps, storage yards, clearing, access and ROW preparation)	Early 2015 to late 2017
Installation of land based pipeline and facilities (including pipeline, compressor stations and metering station)	Late 2015 to mid-2018
Installation of marine pipeline	Early 2016 to mid-2018
Commissioning	2018
In-service	Late 2018
Clean up and post-construction reclamation	Mid 2016 to approximately 2021

1.3 PROJECT SETTING

1.3.1 Regional Development Areas

The Project crosses the Peace River, Fraser-Fort George, Bulkley-Nechako, Kitimat-Stikine, and Skeena-Queen Charlotte Regional Districts of BC within three BC development regions: the Northeast; the North Coast and Nechako; and the Cariboo. A brief overview of the economic activities and employment resources for each region are provided below.

1.3.1.1 Northeast Development Region

The Peace River Regional District includes Fort St. John and Dawson Creek and is located within the Northeast development region of BC. The Northeast development region shares a border with Alberta and Yukon, with approximately 37% of the population living in rural areas. The region's industries include forestry, fisheries, and mining, with 20% of the region's workforce related to the oil and gas sector. Due to the robust job growth in the oil and gas sector, the region has the highest rate of full-time employment of any region in the province. Other industries in the region include construction, manufacturing, and agriculture. The largest service sectors include wholesale and retail trade, health and social services, and education.

1.3.1.2 North Coast and Nechako Development Region

The North Coast and Nechako development region includes the northern coastal areas of BC within the Kitimat-Stikine and Skeena-Queen Charlotte Regional Districts, with the majority of the population residing in Terrace, Kitimat, or Prince Rupert. Primary industry includes forestry, fisheries, mining, and the goods and services sectors. The largest goods sector employers for the region include manufacturing, forestry, fishing, mining, and construction, accounting for a total of 30% of the region's workforce. In the manufacturing sector, the highest employing industries include wood and lumber production, mineral product manufacturing, food processing, and industrial paper production.

1.3.1.3 Cariboo Development Region

The Cariboo development region covers much of BC's northern interior and includes the Regional District of Fraser-Fort George. Forestry, fishing, and mining account for 11% of the region's workforce. The goods-producing industry (i.e., agriculture, utilities, construction, and manufacturing) employs 28% of workers within the region.

1.3.2 Nisga'a Lands, the Nass Wildlife Area and the Nass Area

The Project crosses Nisga'a Lands, the Nass Wildlife Area, and the Nass Area. In 1998, the Nisga'a Nation (Nisga'a) signed the Nisga'a Final Agreement (NFA), a tripartite agreement between the Nisga'a and Governments of BC and Canada. The

NFA establishes Nisga’a’s legal right to self-governance and law-making authority over Nisga’a Lands and rights over land in the K’alii Aksim Lisims (Nass River) system and surrounding drainages. Under the NFA, the Nisga’a owns 1,992 km² of Nisga’a Lands in Fee Simple and are provided with various other rights in the Nass Wildlife Area (16,101 km²) and the greater Nass Area (26,838 km²) (see Figure 34-2).

1.3.3 Regional and Municipal Populations

Communities and Indian Reserves, within 10 km of the pipeline route and route alternatives, and their distance from the pipeline route are listed in Table 1-8 and shown in Figures 1-11 to 1-19.

Table 1-8: Communities within 10 km of the Pipeline Route and Route Alternatives

Overview Route Name	Community	Area Type	Approximate Distance from Pipeline ^{1, 2} (km)
Pipeline Route	Cranberry Junction	Community	5.5
Pipeline Route	Dodge Cove	Community	10.0
Pipeline Route	Fort Babine	Community	2.0
Pipeline Route	Kispiox	Community	8.5
Pipeline Route	Lax Kw’alaams	Community	6.0
Pipeline Route	Metlakatla	Community	8.5
Pipeline Route	Middle River	Community	2.5
Pipeline Route	Nass Camp	Community	0.5
Pipeline Route	Hudson’s Hope	District Municipality	0.5
Pipeline Route	Mackenzie	District Municipality	7.0
Pipeline Route	Port Edward	District Municipality	2.5
Pipeline Route	Agwedin 3	Indian Reserve	6.0
Pipeline Route	Alphonse Tommy 7	Indian Reserve	3.0
Pipeline Route	Andak 9	Indian Reserve	0.5
Pipeline Route	Babine 16	Indian Reserve	2.0
Pipeline Route	Babine 6	Indian Reserve	0.5
Pipeline Route	Babine River 21	Indian Reserve	4.0
Pipeline Route	Babine River 21a	Indian Reserve	4.0
Pipeline Route	Birnie Island 18	Indian Reserve	3.0
Pipeline Route	Burnt Cliff Islands 20	Indian Reserve	4.5
Pipeline Route	Casdeded 8	Indian Reserve	3.0
Pipeline Route	Clotalairquot 4	Indian Reserve	0.0
Pipeline Route	Dashken 22	Indian Reserve	9.0

Table 1-8: Communities within 10 km of the Pipeline Route and Route Alternatives (cont'd)

Overview Route Name	Community	Area Type	Approximate Distance from Pipeline ^{1, 2} (km)
Pipeline Route	Dzin Tl'at 46	Indian Reserve	7.5
Pipeline Route	Dzitline-Lee 9	Indian Reserve	0.0
Pipeline Route	Finlayson Island 19	Indian Reserve	4.5
Pipeline Route	Gul-Mak 8	Indian Reserve	1.0
Pipeline Route	Gun-A-Chal 5	Indian Reserve	3.0
Pipeline Route	Inzana Lake 12	Indian Reserve	8.4
Pipeline Route	Kis-An-Usko 7	Indian Reserve	1.0
Pipeline Route	Kispiox 1	Indian Reserve	5.5
Pipeline Route	Ksabasn 50	Indian Reserve	8.5
Pipeline Route	Ksadagamks 43	Indian Reserve	3.5
Pipeline Route	Ksadsks 44	Indian Reserve	4.0
Pipeline Route	Kshaoom 23	Indian Reserve	10.0
Pipeline Route	Ktamgaodzen 51	Indian Reserve	10.0
Pipeline Route	Lax Kw'alaams 1	Indian Reserve	4.5
Pipeline Route	Mackenzie 19	Indian Reserve	8.0
Pipeline Route	Maklaksadagmaks 41	Indian Reserve	6.0
Pipeline Route	Me-Yan-Law 47	Indian Reserve	7.5
Pipeline Route	No-Cut 5	Indian Reserve	1.0
Pipeline Route	Noo Kat 42	Indian Reserve	7.0
Pipeline Route	O K'ay Wha Cho 26	Indian Reserve	4.5
Pipeline Route	Quan-Skum-Ksin-Mich-Mich 4	Indian Reserve	4.5
Pipeline Route	Red Bluff 88	Indian Reserve	2.0
Pipeline Route	S 1/2 Tsimpsean 2	Indian Reserve	4.0
Pipeline Route	Sidina 6	Indian Reserve	0.5
Pipeline Route	Sik-E-Dakh 2	Indian Reserve	9.5
Pipeline Route	Tahlo Lake 24	Indian Reserve	3.5
Pipeline Route	Teeslee 15	Indian Reserve	7.5
Pipeline Route	Tsay-Cho 4	Indian Reserve	8.0
Pipeline Route	Tsaz Chech 28	Indian Reserve	9.5
Pipeline Route	Tsaz Cheh Koh 24	Indian Reserve	9.0
Pipeline Route	Tugwell Island 21	Indian Reserve	3.0
Pipeline Route	Tutu Creek 4	Indian Reserve	4.5
Pipeline Route	Tymgowzan 12	Indian Reserve	6.5
Pipeline Route	Union Bay 31	Indian Reserve	10.0

Table 1-8: Communities within 10 km of the Pipeline Route and Route Alternatives (cont'd)

Overview Route Name	Community	Area Type	Approximate Distance from Pipeline ^{1, 2} (km)
Pipeline Route	Waulp 10	Indian Reserve	2.0
Pipeline Route	Beryl Prairie	Community	2.0
Pipeline Route	Georgetown Mills	Community	9.0
Pipeline Route	Mill Bay	Community	4.5
Pipeline Route	Osland	Community	9.4
Pipeline Route	Porcher Island	Community	9.0
Pipeline Route	Gitlaxt'aamiks	Nisga'a Village	0.5
Pipeline Route	Gitwinksihlkw	Nisga'a Village	0.5
Pipeline Route	Gingolx	Nisga'a Village	5.5
Pipeline Route	Laxgalts'ap	Nisga'a Village	0.0
Pipeline Route	Tseax	Nisga'a Village	3.0
Coastal Land Alternative	Mill Bay	Community	3.5
Coastal Land Alternative	Gingolx	Nisga'a Village	4.5
Marine Alternative	Ksadagamks 43	Indian Reserve	3.0
Marine Alternative	Ksadsks 44	Indian Reserve	6.5
Marine Alternative	Maklaksadagmaks 41	Indian Reserve	4.5
Marine Alternative	Me-Yan-Law 47	Indian Reserve	6.5
Marine Alternative	Tymgowzan 12	Indian Reserve	10.0
Marine Alternative	Mill Bay	Community	2.5
Marine Alternative	Gingolx	Nisga'a Village	0.5

Notes:

¹ For the Nisga'a communities these distances represent a distance from a polygon.

² Distances are rounded to the nearest 0.5 km.

1.3.4 Land Ownership and Land Use

An overview of land ownership and land use is set out below. Land use is discussed in detail in Section 23.

The Project traverses some private (freehold) lands (including Nisga'a Lands), but the majority are provincial Crown lands, including forest tenures, mineral tenures, trapping and outfitting concessions, infrastructure rights-of-way, and Timber Sales Business Areas.

The Project passes through areas that support a variety of activities on private and Crown land. These include:

- Forestry
- Commercial fishing
- Agriculture and grazing
- Mining and mineral exploration and development
- Oil and gas
- Public recreation and tourism (i.e., fishing, hunting and guide outfitting)
- Trapping
- Protected and recreational areas.

The Project is located within areas subject to various LRMPs and Sustainable Resource Management Plans (SRMPs). LRMPs are sub-regional integrated resource plans that provide strategic guidance for resource management activities. SRMPs are used to implement strategic land use plans (e.g., LRMPs). These include:

- Bulkley LRMP
- Bulkley Valley SRMP
- Cranberry SRMP
- Coastal Land Use Decision Implementation (CLUDI)
- Dawson Creek LRMP
- Fort St. James LRMP
- Fort St. John LRMP
- Kalum LRMP
- Kispiox LRMP
- Kispiox SRMP
- Lakes District LRMP
- Mackenzie LRMP
- Morice LRMP, and
- Nass South SRMP
- North Coast LRMP
- Peace Moberly Tract SRMP.

The Project also falls under the Central and North Coast Order Boundary and Agricultural Development Areas and Settlement Reserve areas within four Forest Districts.

The Project also falls under Aboriginal land and resource plans and planning/management objectives for a number of groups and communities. Identified plans that may interact with the Project include:

- Gitanyow
- Kitsumkalum First Nation
- Gitxsan
- Kitselas First Nation
- Nisga'a Nation
- Halfway River First Nation
- Blueberry River First Nation
- West Moberly First Nations
- Doig River First Nation
- Saulteau First Nations
- Carrier Sekani Tribal Council
- McLeod Lake Indian Band
- Tl'azt'en Nation
- Lake Babine First Nation
- Nak'azdli Band
- Wet'suwet'en First Nation
- Yekooche First Nation
- Metlakatla First Nation
- Lax Kw'alaams Nation
- Gitxaala
- Prophet River First Nation.

The Fort St. James LRMP includes the territories of the Yekooche, Nak'azdli, Tl'azt'en, and Takla Lake First Nations while the Kispiox LRMP overlaps the traditional territories of the Gitxsan, Gitanyow, and Nisga'a Nation. Additionally, the Cranberry SRMP and Nass South SRMP incorporate considerations of Aboriginal and treaty rights into land use decision-making processes and both plans require consultation with Gitanyow and Nisga'a Lisims Government (NLG).

Where information on these plans is available for discussion by PRGT, they are discussed in detail in Section 23: Land and Resource Use.

Land use designations and guidance within provincial resource management objectives (such as those set under the *Forest and Range Practices Act* and the *Government Actions Regulation*) have also been considered in areas where multiple land uses by various industries are desired, such as:

- Established visual quality objectives or recommended visual quality classes (Section 22)
- Agricultural land tenure (Section 23)
- Timber supply areas, tree farm licences, timber licences, and timber cut blocks (Section 23)
- Wildlife habitat areas and ungulate winter ranges (Section 23).

Local government zoning is guided by Official Community Plans (OCPs); the project footprint crosses the OCPs of the Districts of Mackenzie and Hudson's Hope. The activities of the Project are compatible with the current zoning of these plans (industrial development in the District of Hudson's Hope and utility corridors in the District of Mackenzie).

The marine portion of the Project occurs in areas frequented by commercial, Aboriginal and recreational fisheries, as well as marine and land areas administered by the PRPA.

The Project may be located close to some primary or seasonal residences. As detailed routing progresses, all residences that are potentially in close proximity to the Project will be identified and appropriate consultation undertaken.

1.3.4.1 Forestry

The pipeline route and route alternatives cross seven forest districts: Peace Forest District, MacKenzie Forest District, Fort St. James Forest District, Nadina Forest District, Skeena Stikingi Forest District, Kalum Forest District, and North Coast Forest District. Although forestry is in decline in several regions of the province, it remains one of the primary sectors of employment in the North Coast and Nechako development region. Forest products manufacturing is a major industry in the Bulkley-Nechako Regional District, including pulp and pellet-plant operations, bio-energy facilities, and value-added wood production. Forestry is discussed further in 23.3.2.7

1.3.4.2 Agriculture and Grazing

The Project crosses agricultural lands in the Northeast, the North Coast and Nechako, and the Cariboo development regions. The Project crosses private and public agricultural lands including two segments recognized as Agricultural Land Reserve (ALR) for a total length of 32 km. Use of range land in this area is largely limited to use by wildlife and is discussed in more detail in Section 23.3.2.

1.3.4.3 Mining and Mineral Exploration Development

A wide range of mineral development activities are ongoing within the three development regions crossed by the Project. Mineral tenures are discussed in greater detail in Section 23.

1.3.4.4 Oil and Gas

In recent years, the oil and gas sector has contributed substantially to the economic development of the Northeast and North Coast and Nechako development regions. Oil and gas-related exploration and development activities within these regions include seismic exploration and the construction of pipelines, access roads, well sites, gas processing plants, and related facilities. The number of oil and gas tenures are discussed in greater detail in Section 23.

1.3.4.5 Public Recreation and Tourism

Fishing

A number of lakes and rivers along the Project provide opportunities for recreational fishing. Further detail is provided in Section 23.

Hunting and Guide Outfitting

Hunting and guide outfitting provides outdoor recreational opportunities and contributes to local economies. Further detail is provided in Section 23.

1.3.4.6 Trapping

Approximately 1,500 trapping licences are issued each year in BC; the project footprint overlaps 82 active and inactive trapline tenures. Further detail is provided in Section 23. Trapping by Nisga'a Nation and other Aboriginal groups is also valued culturally, socially, and economically.

1.3.4.7 Protected Areas and Recreation Areas

Parks and protected areas add recreational value to the tourism industry in northern BC. The study corridor crosses the Nisga'a Memorial Lava Bed Provincial Park for approximately 12 km.

Some known recreation areas are located close to the Project. Outdoor recreational activities, such as hunting, hiking, and snowmobiling, are expected to occur throughout the area. Recreational fishing occurs on many watercourses and lakes. Further detail is provided in Section 23.

1.3.5 Relationship Between Project Objectives to any Broader Private or Public Sector Policies, Plans or Programs

The Project has linkages to and supports a number of plans and strategies of the Government of British Columbia. Specifically it aligns with:

- The BC Energy Plan: A Vision for Clean Energy Leadership (February 2007)
- Canada Starts Here: The BC Jobs Plan (September 2011)
- British Columbia Natural Gas Strategy: Fueling B.C.'s Economy for the Next Decade and Beyond (February 2012)
- Liquefied Natural Gas: A Strategy for B.C.'s Newest Industry (February 2012).

These plans and strategies have common themes promoting the development of provincial natural gas resources as an avenue for job creation for BC residents and generating royalty revenue for the province. Some specific highlights from these plans and strategies include:

- Encourage the development of unconventional resources (BC Energy Plan)
- Support the growth of BC's oil and gas service sector (BC Energy Plan)
- Develop the potential of LNG and have three LNG terminals in operation by 2020 (BC Jobs Plan)
- Ensuring a reliable, abundant supply of gas (Natural Gas Strategy)
- Ensure infrastructure is available to encourage investment (Natural Gas Strategy)
- Develop new markets for natural gas (Natural Gas Strategy)
- Keep BC competitive in the global LNG market (LNG Strategy)
- Maintain BC's leadership on climate change and clean energy (LNG Strategy).

The Project will transport natural gas from the North Montney Play region of BC to the PNW LNG facility for export to Pacific Rim markets in Asia. As a result, it aligns with the vision, goals and objectives of these plans and strategies in a number of ways.

If approved, PRGT will:

- contribute to the development of new offshore markets for natural gas by providing the infrastructure necessary to access these markets
- support the growth of BC's oil and gas service sector by providing the infrastructure necessary to access new offshore markets
- create direct, indirect and induced employment for BC residents during construction and operation of the pipeline
- work with local communities and Aboriginal groups to access the employment opportunities created through the development of the Project
- support initiatives that improve the working relationships between industry, Aboriginal groups and local communities.

Through these efforts, the Project will support the Government of British Columbia's energy, jobs, natural gas and LNG initiatives.

1.4 APPLICABLE APPROVALS AND AUTHORIZATIONS

Section 2 of the Application provides an overview of the EAC Application process required for this Project as well as other potential permits, licences, approvals, and authorizations. This includes a list of any approvals or authorizations required from Nisga'a Lisims Government.

Environmental assessment of the Project is required under the BCEAA. Completion of the EAC Application process is required prior to Project construction. The Project is a reviewable project under the Reviewable Projects Regulation pursuant to BCEAA. Concurrent permitting is not being requested under the Act pursuant to the Concurrent Approval Regulation (BC reg. 371/2002).

The Project is not included under the Schedule of Physical Activities in the amended Regulations Designating Physical Activities, under CEAA 2012, which formally came into force on October 24, 2013. The Project is thus not subject to an environmental assessment under CEAA 2012.

1.4.1 Past Submissions to Provincial and Federal Agencies

Table 1-9 summarizes Application-related submissions to provincial and federal agencies.

Table 1-9: Past Submissions to Provincial and Federal Agencies

Milestone	Date	Discussion/Description
Project Description	May 21, 2013	PRGT submitted a Project Description to EAO and CEAA.
Updated Project Description (1)	July 15, 2013	PRGT submitted an update to the Project Description to EAO.
Updated Project Description (2)	August 14, 2013	PRGT submitted an update to the Project Description to EAO.
Valued Component Selection Document (draft)	August 16, 2013	PRGT submitted a draft Selection of Valued Components Document to EAO.
Proposed Pipeline Route Update (3)	September 9, 2013	PRGT submitted a letter and a map outlining the PRGT proposed route update to EAO.
Project Description	October 17, 2013	PRGT submitted a revised Project Description to CEAA.
Project Update (4)	March 24, 2014	PRGT submitted a letter and a map outlining the PRGT proposed route update to EAO.
Draft Application Information Requirements	Various submissions	See Section 2.1, Table 2-1.

1.5 ALTERNATIVE MEANS OF UNDERTAKING THE PROJECT

Alternative means are the various ways that are technically and economically practical to implement and carry out the Project (BC EAO 2013). PRGT considered alternative means through the routing and siting process. In accordance with the Application Information Requirements (AIR), this includes the effects of the alternative routes for the pipeline or locations for the facility sites, methods of construction and mitigation. PRGT has conducted a thorough pipeline route and facility site identification, analysis and evaluation process for the Project that resulted in the identification and evaluation of several potential route and facility site alternatives, and led to the development of the proposed route.

Route alternatives are described in Section 1.5.3.

1.5.1 Route and Facility Site Selection Process

The process of selecting an appropriate pipeline route and facility sites involved collaborating with experts from various disciplines, including land, environmental, engineering and construction, and considering input from potentially affected Aboriginal groups, provincial regulators, municipalities, landowners and the public. The route selection process involved:

- identifying the control points (i.e., the proposed start and end points of the proposed route located near the community of Hudson's Hope, BC and Lelu Island, BC)
- determining the evaluation criteria (see Section 1.5.2 below)

- engaging stakeholders
- conducting engineering and environmental field investigations.

1.5.1.1 Conceptual Corridor

PRGT announced its Project and introduced a conceptual corridor in January 2013. This conceptual corridor resulted from preliminary desktop studies, combined with information from helicopter reconnaissance surveys. It provided for an approximately 750 km route that commenced at a point near Hudson's Hope and continued southwest to a location northeast of Mackenzie, where it continued west to the end point near Lelu Island. However, recognizing that crossing the Coastal Mountains and provincial parks and conservancies before reaching Lelu Island would pose significant construction and permitting challenges, PRGT identified two marine alternatives that would avoid crossing these mountains, parks and conservancies. This conceptual corridor and marine alternatives were described in a Project Description which was filed in May 2013. The conceptual corridor was the basis for initiating consultation, biophysical field investigations, terrain studies and engineering and construction planning.

PRGT then conducted more detailed desktop environmental screening studies of available information, supported by light detection and ranging (LiDAR) and Geographic Information System (GIS) data and aerial photography, to identify known areas with challenging terrain, restricted activity periods and environmental sensitivities. PRGT's geotechnical, pipeline construction, environmental and project management personnel reviewed potential route alternatives by aerial reconnaissance, and conducted environmental field studies and ground-truthing of constructability. These studies, routing activities and consultation were also used to refine the alignment into a study corridor.

At the same time, PRGT used the study corridor, which included subsequent route alternatives as the basis for ongoing engagement with landowners, Nisga'a Nation, other Aboriginal groups, the public, regulatory agencies and other stakeholders.

Throughout the year, PRGT implemented an iterative process of consultation, technical review, re-route, re-consultation and further technical reviews. Major changes were provided to the EAO and in Project newsletters as updates to ensure stakeholders were informed of new alternatives being reviewed and the status of existing segments of the route.

Alternatives were tracked and reviewed through a comprehensive system involving technical, environmental, land, and Aboriginal relation teams. This process supported routing decisions that avoided numerous potential conflicts with large and small scale environmental and socio-economic constraints early in the design process of the pipeline and location of proposed compressor stations and ancillary sites.

1.5.2 Route and Facility Site Evaluation Criteria

PRGT considered a number of factors while evaluating pipeline routing and facility siting options and established criteria that would apply to the route and site refinement process and serve as a framework for considering route alternatives. The proposed route, aligned in consideration of feedback from Aboriginal and stakeholder consultation and baseline studies, is presented in this Application.

The following criteria were considered throughout the route and site refinement process when evaluating alternative routes or sites:

- control points
- land and marine use
- parks and protected areas
- terrain
- constructability
- environmental constraints (e.g., ungulate winter range, old growth management areas)
- Visual Sensitivity Areas
- crossings
- access
- heritage and archaeological resources
- construction timeframe
- future system expansion
- Aboriginal group input
- stakeholder input
- cost
- existing disturbances.

1.5.2.1 Control Points

Route alternatives for the Project were considered between two primary control points: the receipt point near Hudson's Hope and the delivery point at the proposed PNW LNG Project near Prince Rupert, at Lelu Island.

1.5.2.2 Land and Marine Use

The route and facility site selection process considered routes and locations which would minimize disturbance to existing and future land and marine use. The selection

process considered historical use of the land (e.g., industrial) and marine areas, and documented any areas determined to be potentially contaminated. To the greatest extent possible, the pipeline was routed to use areas of existing disturbance, including utility, seismic, pipeline ROW corridors, and cutblocks within the route selection area. This reduces the amount of clearing required and overall Project effects. Through the system for managing routing changes, proposed reroutes are screened for potential land use conflicts with land ownership, land tenures, Indian Reserves, and treaty lands.

1.5.2.3 Parks and Protected Areas

The land based pipeline route and facility site selection process evaluates parks and protected areas, along with areas of special land use along the proposed route to identify potential conflicts with designated land uses, requirements for protecting wildlife resources and their habitat, and stakeholder concerns associated with routing. Where possible, PRGT routed the pipeline and facilities to avoid parks and protected areas.

1.5.2.4 Terrain

The route and facility site selection process begins with an assessment of the topography of the route to determine the shortest, driest, flattest route that possesses the most stable and the least sensitive soils. Various terrain features, such as side slopes, rocky areas, wetland areas, and water crossings are also considered during the terrain assessment. The analysis of these terrain features assists PRGT in determining constructability of the pipeline, safety issues associated with pipeline construction, and identifying potential environmental issues.

For the marine environment, a number of factors are considered in siting the route, including water depth, seabed gradient, slope stability, faulting, seismicity, channels, soil variability, fluid expulsion features, benthic communities, shallow buried or outcropping rock, currents and seafloor debris. These features have been assessed in a number of surveys including aerial, topographic, bathymetric and LiDAR. Analysis of these features assists PRGT in determining constructability of the pipeline and potential safety issues associated with the pipeline construction.

1.5.2.5 Constructability

Throughout the 2013 field season, PRGT routing specialists conducted land based and marine surveys, and where possible ground-truthed the proposed route to assess access, safety and other construction related considerations. This allowed for identification and micro-routing adjustment to avoid certain risks and, in many cases, environmentally sensitive features.

1.5.2.6 Environmental Constraints

Proposed route changes and refinements were screened against publically available environmental constraints data, including: rivers, waterbodies, wetlands, marine habitats, permanent sample plots, water licenses, recreation reserves, biophysical field data, forest cover reserves, old growth management areas, rare plant and animal occurrences, wildlife habitat areas, ungulate winter range, high elevation winter range, karst topography, community watersheds, and aquifers. Environmental conflicts were identified and reviewed. In some cases changes to routing or construction planning were made to minimize environmental conflicts.

1.5.2.7 Visual Sensitivity Areas

During constructability ground-truthing and survey work, visually sensitive areas were identified and in some cases resulted in changes to routing or construction planning.

1.5.2.8 Crossings

The pipeline route alignment crosses both man-made and natural obstacles, including watercourses, railways, roads, other pipelines, transmission lines, and water lines. Wherever possible, the pipeline route and new facilities were located or designed to minimize or avoid these crossings. When a crossing is necessary, the best possible location is selected. This was determined by evaluating environmental, terrain, land use, safety considerations, pipeline corridors at the same crossing, and regulatory requirements.

1.5.2.9 Access

Pipeline routing and siting also considered the extent and suitability of existing access to minimize new disturbance and interference and/or incompatibility with surrounding land uses. The Project route was selected to use existing access as much as possible. Additional temporary access is required in some locations during construction.

1.5.2.10 Heritage and Archaeological Resources

PRGT retained a qualified archaeologist to review the land and marine study areas and facility sites and identify any known heritage resources that would be affected by construction. Potentially affected heritage resources might include archaeological, paleontological, or historical sites. Recommendations to avoid such features resulted in many route adjustments. This process was supplemented by archaeological field data as it became available, and findings of Culturally Modified Trees (CMTs) by field crews on the Project.

1.5.2.11 Construction Timeframe

Construction time frame is not a specific criteria for route selection; it is ultimately determined by the required in-service date of the pipeline. However, construction planning within the time frame considers a number of factors including difficult terrain conditions, variations in land use, timing windows (including migration and spawning events), extreme weather conditions, and cost factors. The final construction schedule will allow for appropriate mitigation measures to be applied to minimize environmental effects.

1.5.2.12 Future System Expansion

PRGT has considered the possibility of future expansion of its system and any constraints that may affect future additional facilities. Site selection for future compressor stations was undertaken as described above.

1.5.2.13 Aboriginal Group Input

PRGT engaged Nisga'a Nation and other Aboriginal groups throughout the Project development. This included meetings with individual groups to review routing and identify rerouting opportunities to reduce impacts or avoid important areas. All input from these groups was evaluated. Changes from the conceptual corridor were significantly influenced by this process.

1.5.2.14 Stakeholder Input

PRGT engaged stakeholders throughout the Project development. All input from these groups was evaluated. Changes from the conceptual corridor were significantly influenced by this process.

1.5.2.15 Cost

In its Project planning, PRGT endeavoured to minimize costs, consistent with prudent pipeline construction. If all other factors were deemed equal, PRGT would choose the least expensive route or construction technique.

1.5.2.16 Existing Disturbances

To the extent practical, PRGT routed the pipeline within or adjacent to existing disturbances to reduce the amount of new disturbance associated with the Project.

1.5.3 Route Alternatives

PRGT has considered various alternatives for the pipeline route (Figure 1-20). Sections 1.5.3.2 to 1.5.3.3 describe the various land and marine alternatives that were considered. The rationale for selecting or rejecting the route alternatives is provided.

1.5.3.1 Conceptual Corridor

As stated in Section 1.5.1.1, the conceptual corridor identified in the May 2013 Project Description provided for a 2 km wide, approximately 750 km corridor, that commenced at a point near Hudson's Hope and continued southwest to a location northeast of Mackenzie, where it continued west to the end point near Lelu Island. The corridor formed the basis for further route evaluation based on the criteria described in Section 1.5.2 above.

1.5.3.2 Land Based Alternatives

Through the route evaluation process several major land based reroutes were reviewed. This section summarizes the key land based route alternatives to the conceptual corridor, from east to west. River crossings became key control points from which routing discussions could occur, because of major technical, and constructability constraints. Table 1-10 describes each alternative and routing evaluation, including potential effects. These are shown on Figure 1-20.

Eastern Segment of the Project

Peace River/ Williston Basin Area

One of the primary drivers of routing in the eastern section of the Project was the crossing of the Peace River. Through 2013, four alternative crossing locations for the Peace River were reviewed, assessed, consulted on and ultimately finalized. This led to changes in routing to get from the start point near Hudson's Hope to the crossing site, and from the crossing site to the next major river crossing. The largest of these reroutes was the Williston Moberly Alternative, which shifted the crossing of the Peace River and subsequently the route from Gething Creek valley, into the Moberly River valley. Several environmental and cultural constraints were identified, and routing adjustments were made. Consultation, desktop and field studies were conducted on all of the route alternatives. See Table 1-10 for routing evaluation.

Central Segment of the Project

The South Central Alternative was introduced as an alternative to the more northerly conceptual corridor based on consultation with Aboriginal groups. The alternative was routed through more existing disturbances, reduced the amount of new and upgraded access required, and would result in a smaller construction footprint due to less challenging terrain.

Two other key changes were made to the original south central alternative based on consultations. The first change resulted from consultations with private landowners in the Kispiox Valley. The route was moved east to avoid a residential area in the Kispiox Valley, and allowed for greater use of existing roads and previously disturbed areas. The second change resulted from workshops with the Gitanyow

Fisheries Authority, leading to a jointly developed route between PRGT and the Gitanyow Hereditary Chiefs office. This PRGT/Gitanyow alternative route follows the Gitanyow Land Use Plan, and was re-aligned to cross less sensitive ecosystems, old growth management areas, and sensitive moose winter range in the Cranberry River Valley.

Western Segment of the Project

Consultation with Aboriginal groups and Nisga'a Nation were key factors in routing alternatives on the western portion of the route. Both land and marine routes were assessed to find a potential corridor that would avoid crossing parks and conservancies. Based on this consultation, and the subsequent verification of constructability in the marine environment, PRGT removed the conceptual corridor that routed through the Gingietl Creek Ecological Reserve, Ksi X'Anmass Conservancy, Khutzeymateen Inlet Conservancy, Khutzeymateen Inlet West Conservancy and Woodworth lake Conservancy. This significantly reduced the route length that crossed through protected areas.

Three other route alternatives in and near the Nisga'a Memorial Lava Bed Park were reviewed, in consultation with the Nisga'a Lisims Government. These include the Alder Peak Route (not mapped), South Lava Bed Alternative and Nisga'a Highway Lava Bed Alternative.

PRGT continues to assess land based alternative routes, that would connect the pipeline from the Nass Bay to Nasoga Gulf. As such, all of these route alternatives are included in the Application (see Table 1-4).

PRGT will finalize routing during detailed engineering and permitting. The detailed route design will reflect engineering, environmental, construction and operations considerations, further site-specific constraint mapping, and further field investigations, as well as input from Aboriginal groups, regulatory agencies, municipalities, landowners and the public.

Table 1-10 below describes the key criteria that provided justification for selection of the alternative.

Table 1-10: Summary of Key Land Based Alternatives, Routing Evaluation and Status

Land Based Alternatives	Routing Evaluation (criteria and/or effects)	Current Status
Eastern Route Segments		
Peace River Crossing Alternatives Four alternative crossings of the Peace River and the associated routes that connected each to the original conceptual corridor were considered: • Conceptual corridor (Alternative #1): Dinosaur Lake Crossing – HDD crossing 5 km downstream of Bennett Dam • Bennett Dam Aerial (Alternative #2) – two section span aerial crossing 3 km downstream of Bennett Dam • Peace (Alternative #3) - parallel to existing spectra pipeline crossing, HDD/contingency bottom lay crossing 14 km downstream of Bennett Dam • Williston/Moberly (at the bridge) (Alternative #4)– HDD crossing 800 m downstream of Peace Canyon Dam and 100 m upstream of Peace Canyon Bridge	These alternatives had a variety of criteria considered including land use, terrain, constructability, environmental constraints, heritage resources, Aboriginal group input and stakeholder input. Key criteria are listed below: • Constructability – Alternatives #1 and #3 – HDD crossing of the Peace River was not feasible at those locations. • Constructability and Environment – Alternative #2 – Geotechnical and environmental constraints including close proximity to occupied eagle nest and crossing of an island in Dinosaur Lake. Dinosaur Lake is also a high-value recreational use area. • Aboriginal input – Alternative #4 reflects engagement with West Moberly and Saulteau First Nations • BC Hydro was also consulted • Environmental and Existing Disturbances – Alternative #4 is located within the existing disturbed western edge of the Peace Moberly Tract and follows existing infrastructure within this area (BC Hydro transmission line) • Environmental – Alternative #4 avoids potential impacts to the channel and banks of the Peace River.	Alternatives #1, 2 and 3 are not being carried forward into the Application Alternative #4 (Proposed Peace River HDD crossing (at the bridge) is currently part of PRGT's proposed route
Williston/Moberly Alternative Approximately 166 km in length, the route begins at ~KP 22 of the original Conceptual corridor and proceeds toward the downstream end of Dinosaur Lake to a crossing of the Peace River (Alternative #4 above). From the Peace River it follows the westerly side of Two Ridge Mountain to the Moberly River Valley, then follows the Moberly River to the Moberly River Headwaters in the Rocky Mountain Foothills. From this point, it proceeds along the Hart Range of the Rocky Mountains then southwest to the Williston Reservoir, then north and west through the Nechako Plateau where it rejoins the Conceptual corridor near Nation River.	• Aboriginal input – Route reflects engagement with West Moberly and Saulteau First Nations • Heritage and Archaeological Resources – Avoids encroachment on the Twin Sisters Mountains, a culturally sensitive area • Heritage and Archaeological Resources – Avoids culturally sensitive areas in the Culture Camp area along the Moberly River Forest Service Road • Environmental – Avoids high elevation winter range (HEWR) within the Moberly caribou herd range • Environmental – Reduces total number of watercourse crossings • Environmental – Avoids further impact on the Doonan watershed which has been subject to previous disturbances and encroachment on an area of interest to a guide outfitter within the Doonan watershed.	Currently part of PRGT's proposed route

Table 1-10: Summary of Key Land Based Alternatives, Routing Evaluation and Status (cont'd)

Land Based Alternatives	Routing Evaluation (criteria and/or effects)	Current Status
Eastern Route Segments (cont'd)		
<i>Williston/Moberly Alternative (cont'd)</i>	• Constructability – Avoids high risk of constructability failures related to watercourse crossings and steep slopes • Environmental – Reduces footprint within the Mackenzie Community Forest • Environmental and Existing Disturbances – Follows existing linear corridors (e.g., forest service roads, electrical transmission line) • Environmental and Existing Disturbances – Reduces the development of new access areas by following existing disturbed corridors associated with the proposed Johnson Creek compressor station (e.g., forest service roads, BC Hydro transmission line) • Stakeholder Input – Reflects engagement with community members from Mackenzie to minimize the potential impacts to the Mugaha Marsh • Environmental and Cost – Adds 20 km to the total pipeline length from the conceptual corridor.	
Central Route Segments		
<i>South Central Alternative</i> This approximately 384 km route diverged south of the conceptual corridor proceeding west around Nation River and across the Nechako Plateau to Inzana Lake. Proceeding west past Trembleur Lake it turns southwest across Middle River and passes on the west side of the Rocky Mountain Hogem Range. It then continues northwest across the Interior Plateau where it crosses Nilkitkwa Lake 7 km north of Fort Babine. From Nilkitkwa Lake, it crests the Suskwa Pass and proceeds to the north side of Nine Mile Mountain then through the Skeena and Kispiox River valleys, it then re-joins the conceptual corridor.	• Environmental and Existing Disturbance – Reduces amount of clearing and grading required by routing through areas of existing disturbance (e.g., logging and other developments) as compared to the conceptual corridor • Environmental and Cost – Reduces the need for new access, road upgrades and rail line upgrades given its location in a more developed area than the conceptual corridor • Environmental and Constructability – Reduces the area of challenging terrain for construction (i.e., less overall surface disturbance) compared to the conceptual corridor • Land Use, Aboriginal Input, Crossings and Environmental – Routed to avoid crossing Lake Babine, Babine Indian Reserve and Rainbow Alley Provincial Park • Aboriginal input – Feedback from Aboriginal groups to avoid areas in conceptual corridor • Environmental and Cost – Adds approximately 60 km of total length compared with conceptual corridor • Crossings and Environmental – Avoids crossing Nation River, Nilkitkwa River, Shelagyote River, Shenismike Creek, Shedin Creek, Sam Green Creek, and Blackstock Creek as compared to the conceptual corridor.	Currently part of PRGT's proposed route

Table 1-10: Summary of Key Land Based Alternatives, Routing Evaluation and Status (cont'd)

Land Based Alternatives	Routing Evaluation (criteria and/or effects)	Current Status
Central Route Segments (cont'd)		
<i>South Central Alternative (cont'd)</i>	• Environmental - Crosses more old growth management areas (OGMAs) than the conceptual corridor • Environmental – Crosses fewer wetlands than the conceptual corridor • Environmental – Avoids crossing the Wolverine caribou herd range and the overall crossing of all caribou herd range by about 50% as compared to the conceptual corridor • Heritage and Archaeological Resources – Avoids more known archaeological sites than the conceptual corridor including two CMT clusters (one is very large and contains thousands of modified trees); a portion of the “Yukon Telegraph Trail” and an old village site • Heritage and Archaeological Resources – Crosses known archaeological sites including two sites on the Grease Trail, an unnamed trail and a large CMT cluster • Land Use – Additional route adjustments were made to avoid encroachment on Cliffs Mine and Mulligan Mine • Crossing and Environmental – Allows for the most environmentally suitable and constructible crossing of the Skeena River • Land Use – Crosses ALR Lands whereas the conceptual corridor did not cross any ALR lands.	
<i>East Kispiox Valley Alternative</i> Deflects off the South Central Alternative and travels northeast along the east side of the Skeena River. The route then deflects northwest to connect with the conceptual corridor.	All of the advantages for the South Central Alternative compared with the conceptual corridor also apply to this route. • Land Use – Avoids an Indian Reserve on the initial alignment of the South Central Alternative and all residences and private parcels in the Kispiox Valley • Stakeholder input – Community input at open houses requested route avoid private lands.	Currently part of PRGT's proposed route

Table 1-10: Summary of Key Land Based Alternatives, Routing Evaluation and Status (cont'd)

Land Based Alternatives	Routing Evaluation (criteria and/or effects)	Current Status
Central Route Segments (cont'd)		
<i>PRGT/Gitanyow Alternative</i> This route deflects off of the conceptual corridor from a point 14 km east of Cranberry Junction, extends to the north and then proceeds west on the south side of the Nass River valley. The route then proceeds along the Nass River valley, crossing the Cranberry River north of the confluence with the Kiteen River then continues southwest, intersecting with the conceptual corridor near the northeast side of Nisga'a Lands.	• Aboriginal Input – Reflects outcomes of PRGT/Gitanyow routing workshops and the Gitanyow Hereditary Chiefs Office • Environmental and Land Use – Minimizes impacts to ecosystem network and ecosystem buffer networks outlined in the Gitanyow Land Use Plan (Cranberry SRMP) • Aboriginal Input and Crossings – Incorporates a change to the Cranberry River crossing that was selected in consultation with Gitanyow Hereditary Chiefs Office • Existing Disturbance – Located within an area already heavily fragmented by industrial development including main logging roads, cutblocks and block roads, and a transmission line • Environmental and Land Use – Utilizes a common corridor with the proposed Westcoast Connector Gas Transmission Project that minimizes fragmentation of the landscape and impacts to the Gitanyow Land Use Plan (Cranberry SRMP) zonations • Environmental and Land Use – Utilizes a common corridor with the proposed Westcoast Connector Gas Transmission Project on upland slopes and ridgetops that will focus clearing and disturbance of moose winter range onto lower-value secondary forage created by timber harvest on cutblocks, rather than on the primary forage and shelter areas of lower elevation wetlands, floodplains and adjacent slopes • Environmental and Land Use – Avoids fragmentation of a forested unit that supports an OGMA and a Special Habitat For General Wildlife zones as identified in the Gitanyow Land Use Plan (Cranberry SRMP) • Environmental and Land Use – Maintains a localized area that is currently unfragmented and supports important Gitanyow Land Use Plan (Cranberry SRMP) zone • Aboriginal Input and Environmental – Minimizes impacts to wildlife and other resources used by Gitanyow for hunting, fishing, botanical plant gathering	Currently part of PRGT's proposed route

Table 1-10: Summary of Key Land Based Alternatives, Routing Evaluation and Status (cont'd)

Land Based Alternatives	Routing Evaluation (criteria and/or effects)	Current Status
Western Route Segments		
Coastal Mountain Alternative This route option was part of the conceptual corridor, extending from the Ksi Hlginx (Ishkeenickh) River on Nisga'a lands, heading southwest through Ksi X'Anmaas Conservancy, the Khutzeymateen Inlet Conservancy, Khutzeymateen Inlet West Conservancy, Work Channel, Woodworth Lake Conservancy, and continuing on to Lelu Island.	• Parks and Protected Areas – Routing through four conservancies (land and marine), effect to visual quality within the conservancy • Terrain and constructability – Challenging terrain requiring a long tunnel • Environmental constraints – Traverses protected wildlife habitats for grizzly bear • Marine inlet crossings – Steep submarine terrain creating construction challenges for crossings • Access – Increases access into protected areas • Land and Marine Use – Reduces marine pipeline length with this more direct route over land • Construction Timeframe – Timelines would be greatly affected given predictable public concern over conservancies	Not being carried forward into the Application
Nisga'a Land Alternatives		
North Route Alternative (Park Avoid) This option for alignment begins north of the Nass Camp. It then continues westward crossing both the K'alii Aksim Lisims and Ksga'maal rivers, crossing the K'alii Aksim Lisims River again near the Gingietl Creek (Environmental Reserve) and aligning close to the Nisga'a Highway.	• Parks – Avoids the Nisga'a Memorial Lava Bed Park; does not require a BC Legislative Amendment to cross the Park • Future System Expansion – There is room to expand the system • Aboriginal Input – Involves potential impact on Nisga'a interests as outlined in the NFA, including areas where Nisga'a citizens harvest mushrooms. Support for this route has not been shown • Crossings and Constructability – Involves two technically challenging crossings of the K'alii Aksim Lisims River which is an important cultural resource and source of income for the Nisga'a Nation • Potential impact to the K'alii Aksim Lisims River, primary source of water for the village of Gitwinksihlkw • Involves technical engineering challenges regarding the diameter, depth, length, width and soil type of those crossings that would challenge the capabilities of current HDD equipment • Access – Currently no access to the north side of the Nass River • Construction Time Frame – Avoidance of the Park lessens the approval process timeline and associated risks	Not being carried forward into the Application

Table 1-10: Summary of Key Land Based Alternatives, Routing Evaluation and Status (cont'd)

Land Based Alternatives	Routing Evaluation (criteria and/or effects)	Current Status
<i>Nisga'a Land Alternatives (cont'd)</i>		
<i>Kiteen Valley Alternative (Park Avoid, not mapped)</i> A more southerly route around the Nisga'a Memorial Lava Bed Park was assessed during the initial route planning stages. This alternative travels along the Nass Forestry Service Road, heads south down the Kiteen Valley, crosses north of Kitsumkalum Lake and ends up in the Ishkinish Valley where it joins up with the Coastal Mountain Alternative.	• Parks – Avoids the Nisga'a Memorial Lava Bed Park; does not require a BC Legislative Amendment • Parks and Protected Areas – Routing through four conservancies (land and marine), effect to visual quality within the conservancy • Constructability – Numerous construction and geotechnical challenges involving several steep granite faces and the need for large difficult tunnels where the route heads west from Lava Lake • Future System Expansion – Challenging due to route through conservancies • Cost – Higher costs than other routes because of multiple tunnels and overall route length	Not being carried forward into the Application
<i>Alder Peak Alternative (not mapped)</i> In the initial stages of route assessments, an option was considered that split off of the conceptual corridor northeast of Gitlaxt'aamix headed south, crossing the Nisga'a Memorial Lava Bed Park to the west side of Lava Lake. Near the south end of Lava Lake the route headed west down a narrow valley south of Alder Peak until it intersected the Ksi Matin valley where it turned north until intersecting with the current proposed route.	• Parks – Crosses through the Nisga'a Memorial Lava Bed Park • Constructability – Traverses steep vertical slopes, narrow valleys with steep side slopes. Required major geotechnical engineering design as it crosses by multiple debris slides, rock slides and avalanche areas • Environmental – Crosses through approximately 1.5 km of OGMA and 2.9 km of ungulate winter range that are not avoidable due to space constraints in the narrow valleys. • Timeframe and Cost – Extends the length of the route by approximately 25 km impacting the construction schedule as well as cost	Not being carried forward in the Application
<i>South Lava Bed Alternative</i> PRGT considered an optional route on the south edge of the Nisga'a Memorial Lava Bed Park. The alignment splits off east of Gitlaxt'aamix, crosses the Nisga'a Highway through the Nisga'a Memorial Lava Bed Park, and continues westward south of the highway, dipping in and out of the Nisga'a Memorial Lava Bed Park at four locations.	• Parks – Avoids the most visible part of the lava flow of the Park to tourists and Nisga'a's citizens • Crossings – Requires more water course crossings than Nisga'a Highway Lava Park Alternative • Crossings and Safety – Presents significant geotechnical hazards. The Vetter Creek crossing is a high-gradient stream channel with an active floodplain and debris flood potential. This puts the pipeline at risk of being washed out during times of floods and high water flows as river banks can erode, potentially exposing and impacting the integrity of the pipeline • Crossings and Safety – West of Vetter Creek the pipeline would cross a series of colluvial cones and debris flow fans at the base of a very steep slope that have the potential to generate large rock slides and falls	Not being carried forward in the Application

Table 1-10: Summary of Key Land Based Alternatives, Routing Evaluation and Status (cont'd)

Land Based Alternatives	Routing Evaluation (criteria and/or effects)	Current Status
<i>Nisga'a Land Alternatives (cont'd)</i>		
<i>South Lava Bed Alternative (cont'd)</i>	• Community Constraints – Potential for impacts on the Gitlaxt'aamiks community watershed which provides the village's water • Environmental Constraints – Disturbance of multiple wetlands and high value fisheries habitat; potential effects to an ancient Nisga'a village impacted by the lava flow • Heritage and Archaeological Resources – Potential disruption of a cultural site where the Nisga'a believe there is a Sbinaxnok	
<i>Nisga'a Highway Lava Bed Alternative</i> The proposed route enters the Nisga'a Memorial Lava Bed Park 270 m north of the Nisga'a Highway, crossing the Ksi Sii Aks (Tseax River). From this point, the corridor follows the south limit of the Nisga'a Highway ROW for approximately 10 km. Approximately 700 m east of the Nisga'a Memorial Lava Bed Park 's west boundary, the Project ROW crosses under the Nisga'a Highway ROW and continues almost due west.	• Existing Disturbance – Parallels other linear developments that cross the Park, including the Nisga'a Highway ROW • Nisga'a Input and Heritage and Archaeological Resources – Avoids any potential effects to an ancient village that was destroyed by lava flow (along north and west side of Spencer Lake) located south of the Nisga'a Highway at the eastern end of the Park • Environmental – Avoids a wetland associated with Ksi Ts'oolh Ts'ap adjacent to the Nisga'a Highway • Crossing – Preferable crossing location for a tributary of the Ksi Ts'oolh Ts'ap at a place where the watercourse is narrower and the adjoining banks are higher and drier than the crossing further south and adjacent to the Nisga'a Highway (i.e., better constructability and fewer potential impacts to fish habitat) • Parks – Class A Park, requires a Park Boundary Adjustment	Currently part of PRGT's route

1.5.3.1 Marine Alternatives

As stated, marine alternatives were originally conceived as a means to avoid the technically, socially and environmentally challenging route through the Coastal Mountains and conservancies (Coastal Mountain Alternative). Once the initial marine alternatives were identified, a number of surveys were undertaken to assess technical feasibility, environmental constraints, and constructability criteria including seabed gradient, slope stability, faulting, seismicity, channels, soil variability and benthic communities. An analysis of construction techniques were undertaken, and then reviews of the potential environmental effects based on the construction method were undertaken.

A summary of the marine alternatives and the related advantages and disadvantages are summarized in Table 1-11 (shown on Figure 1-20).

Several marine alternatives are being carried forward into the Application and require further investigation for engineering feasibility before selecting the final route. Routes are described in Section 1.2.2, Table 1-4. PRGT will determine the final right of way alignment through geotechnical investigations (with appropriate permitting) and detailed engineering. The detailed route design will reflect engineering, environmental, construction and operations considerations, further site-specific constraint mapping and field investigations, as well as input from Aboriginal groups, regulatory agencies, municipalities, landowners and the public.

Table 1-11: Summary of Key Marine Alternatives, Routing Evaluation and Status

Marine Route Alternative	Routing Evaluation (criteria and/or effects)	Current Status
Alice Arm Alternative The Alice Arm Alternative was part of the original conceptual corridor, travelling northwest from the Nass River, around the north side of Nisga'a lands and continuing overland to the town of Kitsault where it enters into the marine environment. Here it travelled south down Alice Arm to connect to Portland Inlet.	• Parks and Protected Areas – Avoids routing through Nisga'a Memorial Lava Bed Park and the coastal conservancies • Crossings – Avoids two crossings of the Nass River, which has ecological, cultural, and economic importance to Nisga'a Nation • Terrain and Constructability – Technically challenging which affects constructability • Cost – Long route with technical and environmental challenges (e.g., pre-existing contaminated marine sediments) • Aboriginal Input – Aboriginal groups have expressed concern over management of contaminated sediments during construction	Not being carried forward into the Application
Nass Bay Alternatives <i>Nass Bay Alternative</i> This alternative includes a land portion along the north side of the Nass River valley and enters the marine environment 13 km inward from the mouth of the bay. The route continues along the seabed to Portland Inlet, joining a similar route as Alice Arm and Nass Bay North Marine alternatives. <i>Nass Bay North Marine</i> This route option extends from the land-based Nass Bay Connector, entering the marine environment approximately 13 km inward from the mouth of the Nass Bay. From here, it travels through Nass Bay, heading northward in proximity to Kinkolith and then out to Portland Inlet.	• Protected Areas – Routing avoided conservancies • Constructability – Challenging construction due to shallow mudflats, Nass River channel within the estuary, sediment management during construction • Environmental Constraints – Environmentally sensitive mudflats, important Dungeness crab habitat, cultural and biologically important fishery in Nass River with spawning corridor in area of construction • Aboriginal Input – Route concerns raised during consultation with NLG regarding environmental sensitivity, economic crab fishery • Cost – A direct route from Nisga'a lands into the marine environment and into Portland Inlet	Not being carried forward into the Application
Nass Bay Nearshore/Iceberg Bay Central Route The Nass Bay-Iceberg Bay option starts at the Nass Bay Connector and travels through Nass Bay along the southern shoreline, going overland and then into the center of Iceberg Bay. The pipe was to be pulled from either side of Iceberg Bay, to meet in the middle at a tie-in point mid-bay, and connect with pipeline entering into the Nasoga Gulf.	• Protected Areas – Avoid conservancies • Aboriginal Input – Reflects engagement with First Nations and Nisga'a • Cost – Shorter route than some other alternatives • Environmental Constraints – Better avoids environmentally sensitive habitat for crustaceans and fish in Nass Bay • Constructability – Challenging construction methods for the tie-in of the pipeline at the center of Iceberg Bay	Not being carried forward into the Application

Table 1-11: Summary of Key Marine Alternatives, Routing Evaluation and Status (cont'd)

Marine Route Alternative	Routing Evaluation (criteria and/or effects)	Current Status
Work Channel and Steamer Passage This route option connected Portland Inlet south down the Work Channel, continuing overland, and eventually crossing Porpoise Harbour to Lelu Island. To avoid the highly sensitive area at the mouth of Work Channel, PRGT then considered routing through Steamer Passage, then overland entering Work Channel southeast of the mouth.	• Environmental Constraints (positive) – Route proposed to avoid a Chatham Sound approach to Lelu Island and proximity to Flora Bank • Protected Areas – Avoided routing through conservancies • Constructability – Involved technically challenging construction methods through steep submarine terrain • Environmental Constraints (negative) – Potential effects to environmentally sensitive areas in mouth of Work Channel • Aboriginal Input – Engagement with First Nations supported rerouting around the Work Channel mouth to avoid environmentally important area. • Heritage and Archaeological Resources – Depending on route from Steamer to Work Channel, crossed multiple registered heritage sites	Not being carried forward into the Application
Nasoga Gulf Alternative This marine alternative was identified early in the routing process and forms the basis for the multiple options between Nass Bay and Nasoga gulf being carried forward in this Application.	• Cost – Shorter marine pipeline than Alice Arm and Nass Bay alternatives • Constructability – Marine/land pull process; shore-crossing length reduces trenching requirements (less volume) and minimizes sediment transfer to adjacent areas • Terrain – Shore crossing location is protected from extreme seas thus minimizing construction risks and reduces the period of occupation by the DWLV at the shore site • Environment – In close proximity to, but routes around, environmentally sensitive features (e.g., important salmon rearing habitat, biogenic sponge reef) • Route – Deeper water along with a relatively flat seabed reduces overall risk of the pipe-lay operation • Geo-hazards – Detailed route surveys identified areas in Nasoga Gulf that are characterized by landslides or sliding slopes. A pipeline protection program will be implemented in this area • Currents – Studies indicate seabed currents will have minimum effect on the pipeline	Currently part of PRGT's route

Table 1-11: Summary of Key Marine Alternatives, Routing Evaluation and Status (cont'd)

Marine Route Alternative	Routing Evaluation (criteria and/or effects)	Current Status
Nasoga Gulf Alternative (cont'd)	• Aboriginal Input – Location selected avoids known bivalve harvest area. Addresses concerns raised by Aboriginal groups of routing through Nass Bay to Portland Inlet • Construction Timeframe – Shorter timeframe with fewer construction challenges • Visual Impact – Reduces visual impact to local communities relative to other options; no established settlements in the area • Operations – Relatively easy access for future maintenance or repairs	
Nass Bay Nearshore Marine This alternative starts at the Nass Bay Connector and travels through Nass Bay along the southern shoreline, going overland and then into Iceberg Bay along the southern shoreline. It will continue overland to join the Nasoga Gulf alternative to Lelu Island.	• Constructability – Construction is accomplished through land/marine based operations and shore pulls. Majority of work may be conducted during low tides, where possible • Environmental (positive) – Avoid more environmentally sensitive environments of other more central routes through Nass Bay (e.g., Nass River channel). Installation of a single 48 inch pipe versus two 36 inch pipes reduces overall environmental footprint and disturbance of sea bed • Construction Time Frame – Relatively shorter construction as compared to other Nass Bay route alternative and can be timed around sensitive environmental windows • Aboriginal Input – Addresses concerns expressed by NLG regarding routing out through Nass Bay, close to Gingolx, and affecting Nass River and crab fishery • Visual Impact – Reduces visual impact to local communities relative to other options • Operations – Relatively easy access for future maintenance or repairs • Environmental (negative) – In general, Nass Bay is important habitat for salmon rearing and migration, eulachon migration and Dungeness crab	Currently part of PRGT Route

Table 1-11: Summary of Key Marine Alternatives, Routing Evaluation and Status (cont'd)

Marine Route Alternative	Routing Evaluation (criteria and/or effects)	Current Status
Nass Bay Nearshore Alternative This alternative travels southwest from the Nass Bay Connector overland for a short distance on the Nasoga Tunnel route and then along the Nass Bay Shoreline route. It enters the marine environment of Nass Bay and stays directly adjacent to the shoreline as it proceeds toward the Iceberg Bay route. From this point, it follows the same pathway as described for Nass Bay Nearshore Marine.	• Constructability – Construction is accomplished through land/marine based operations and shore pulls. Majority of work may be conducted during low tides, where possible • Environmental (positive) – Avoid more environmentally sensitive environments of other more central routes through Nass Bay (e.g., Nass River channel). Installation of a single 48 inch pipe versus two 36 inch pipes reduces overall environmental footprint and disturbance of sea bed • Construction Time Frame – Relatively shorter construction as compared to other Nass Bay route alternative and can be timed around sensitive environmental windows • Aboriginal Input – Addresses concerns expressed by NLG regarding routing out through Nass Bay, close to Gingolx, and affecting Nass River and crab fishery • Visual Impact – Reduces visual impact to local communities relative to other options • Operations – Relatively easy access for future maintenance or repairs • Environmental (negative) – In general, Nass Bay is important habitat for salmon rearing and migration, eulachon migration and Dungeness crab	Currently part of PRGT Route

1.5.4 Alternative Facility Sites

Facility sites are selected to optimize pipeline system operations, reduce power requirements and decrease overall emissions. The final location of a compressor station considers suitable terrain, accessibility, and environmental constraints. A number of compressor station locations were considered based on input from local Aboriginal groups, municipalities, communities and landowners. Site selections have been finalized, however on-going consultation with Aboriginal communities is continuing to ensure concerns are understood and addressed, as practical through station design.

1.5.4.1 Compressor Station Alternatives

In order to reduce the area disturbed by the project, compressor stations are located on the pipeline corridor. The primary objectives in site selection are to minimize overall disturbance, optimize power requirements and reduce overall emissions.

Site locations are initially determined through a hydraulic model of the pipeline which identifies the optimal kilometer post along the pipeline for each facility. By optimizing the use and location of the compressors stations, power requirements and, hence, emissions resulting from the operation of the pipeline are minimized. The compressor stations can be sited within a 5 km band along the pipeline without impacting the optimization of the system. Once these kilometer posts are identified, they are screened for environmental, archeological and geotechnical constraints through a desktop analysis to determine specific locations within this band which may then be assessed in more detail. Using the criteria identified in Section 1.5.2, engineering field assessments and environmental field studies are conducted to assess environmental suitability, accessibility and constructability constraints. Aboriginal input from on-going engagement is used to inform the suitability and to identify potential effects and mitigation.

PRGT originally defined a conceptual corridor that considered nine compressor station sites. Through the process of route refinement and system optimization, this number was reduced to eight compressor stations. These locations are identified in Figure 1-3.

Three of the eight compressor station sites will be built during the construction phase of the pipeline; alternatives considered for these sites, evaluation criteria, and their status are described in Table 1-12. The Application also considers the remaining five sites proposed as part of a future build and assessments have been completed on these. If and when these facilities become necessary, the locations will be subject to further engineering design and consultation but will remain within the five kilometer boundary described above. No alternatives have been identified for these five stations at this time.

Table 1-12: Summary of Compressor Station Alternatives

Compressor Station Alternative	Siting Evaluation	Status
Johnson Creek	• Adjacent to an existing road • Suitable terrain • Environmentally suitable site (e.g., not located within wetlands, ungulate winter range, etc.) • Located within Moberly Herd range but avoids ungulate winter range • Partially located within Agricultural Land Reserve lands • No identified heritage sites • Aboriginal input suggested moving site although no suitable alternative has been identified (see below).	Currently part of PRGT's proposed project Additional mitigation being discussed with Aboriginal groups as part of on-going engagement
Johnson Creek (Alternative 2 C)	• Aboriginal Input – location suggested by West Moberly First Nation • Partially located within Agricultural Land Reserve • Located within the Moberly Herd Range but not within winter ungulate range • Watercourse traverses northeast corner of the site • Environmentally suitable site (e.g., not located within wetlands, ungulate winter range, etc.) • Significant terrain stability and slope concerns • Significant erosion associated with the watercourse • Access to site requires construction of new road • Located within BC Hydro's Peace River Site C flooding area.	On-going engagement with Aboriginal groups. Not carried forward into assessment.
Johnson Creek (Alternative 2 D)	• Wholly located within Agricultural Land Reserve • Access to site requires construction of new road (difficult, steep terrain) • Located within BC hydro's Peace River Site C flooding area • Located within the Moberly Herd Range but not within winter ungulate range • Environmentally suitable site (e.g. not located within wetlands, ungulate winter range, etc.).	Not carried forward into assessment.
Middle River	• Aboriginal input - requested relocation due to proximity to community, future community expansion and proximity to Middle River • Watercourse crossing in northwest corner • Avoids Wildlife Tree Patch • Terrain is relatively hummocky • Environmentally suitable site.	Currently assessed as part of PRGT's project.

Table 1-12: Summary of Compressor Station Alternatives (cont'd)

Compressor Station Alternative	Siting Evaluation	Status
Middle River Alternative	• Environmentally suitable site • Relatively flat terrain • Preferred site for Tl'azt'en.	PRGT is further considering this site based on on-going engagement with Aboriginal groups
Borden Lake (no suitable alternatives were identified)	• Environmentally suitable site • Orientation of site modified to avoid potential effects to nearby watercourses • Suitable terrain • Access to existing roads.	Currently part of PRGT's proposed route

1.5.5 Alternative Construction Methods

The Project considered alternative construction methods for the watercourse crossings and the required number of pipes for the marine route. This section presents the different options considered and the criteria used to assess the alternatives and select the preferred option.

1.5.5.1 Alternative Construction Methods for Pipeline Installation at Watercourses

Alternative watercourse crossing methods considered for the Project are summarized below and are detailed in Section 1.2.6.2, and in Section 10.

There are approximately 1,200 watercourse crossings along the proposed route. Fish-bearing stream classification has been assigned to 730 of them.

Two main alternatives are considered for watercourse crossings: conventional trench (open-cut and isolated crossings) and trenchless crossings. A crossing method is selected for each watercourse based on the following criteria:

- Time of construction
- Size of the crossing
- Width of the channel
- Depth of the watercourse
- Flow rate of the watercourse
- Stream class.

Further information about crossing method selection is described in Section 10. The preferred method for each watercourse crossing is identified in Appendix K – Proposed Watercourse Crossing Methods.

1.5.5.2 Alternative Mitigation

The proposed mitigation included in each VC section and summarised in Section 38, is considered by PRGT to be the most appropriate means of mitigation for the planned activities. While there may be slight variations on the mitigation measures available, there is not a broad class of alternative mitigation available to mitigate these types of activities.

1.5.5.3 Alternative Number of Marine Pipes

PRGT considered the installation of a single or multiple pipelines for the marine components of the Project. Two NPS 36 (914 mm) diameter pipelines were selected to meet specific volume and pressure requirements. The following outlines reasons for this decision.

To meet the throughput requirements with a single pipeline, additional compression and a pipeline with a diameter greater than NPS 42 (1,067 mm) would be required. A single marine pipeline of this diameter poses significant technical and construction risks. There are also a limited number of vessels worldwide capable of laying such a pipeline at the depths encountered along the marine route. The construction of two pipelines reduces associated technical and construction risks and provides the benefit of supply security, if damage were to occur to one pipeline during operation.

1.5.6 Summary of Selected Alternatives

In summary, the major route alternatives that have ultimately formed the Application Corridor are, from east to west:

- Williston/Moberly Alternative
- South Central Alternative
- East Kispiox Valley Alternative
- PRGT/Gitanyow Alternative
- Nisga'a Highway Lava Bed Alternative
- Nasoga Gulf Alternative (and sub-alternatives described in Table 1-4).

The selected alternatives are a result of technical and economic feasibility assessments, along with the environmental and social factors described above and provided in Tables 1-10 and 1-11.

1.6 PROJECT BENEFITS

Construction and operation of the Project is critical to supporting the Government of British Columbia's LNG strategy and its goal to have three liquefied natural gas (LNG) export facilities in operation by 2020 (Ministry of Energy and Mines 2012). The Project will transport natural gas from northeast BC to the PNW LNG Project (currently under regulatory review) near Prince Rupert, where the natural gas will be liquefied and exported to countries in Asia. The resulting benefits to BC and Canada include economic development and diversification and job creation.

Over its operating life, the Project will provide tax revenue for the municipalities and regional districts crossed by the pipeline, as well as for the provincial and federal governments. The Project will also help support the upstream exploration and production sector and this, in turn, will generate substantial royalty revenue for the provincial government and create additional employment. This revenue can then be used to support public services, such as health care, education and infrastructure.

PRGT estimates that it will spend \$5 billion on construction and another \$1.3 billion (undiscounted) on operating costs during 30 years of operations.³ The Project will create 42,060 person years⁴ (PYs) of employment (including direct, indirect, and induced effects) in Canada during construction and over 30 years of operation and generate \$1.6 billion in tax revenues for the Government of Canada. PRGT estimates 38% of total construction and operating costs (\$2.7 billion) will be spent in BC, and this will create 13,170 PYs of employment and provide an estimated \$2.4 billion in tax revenues for the provincial, regional and local governments in BC.

PRGT has initiated a number of programs to enhance benefits for local communities and Aboriginal groups with respect to direct and indirect employment, contracting opportunities, skills training and education as well as community investment initiatives aligned with priorities along the Project corridor. These programs include specific measures to encourage and increase Aboriginal and local participation. PRGT will continue to contribute to community capacity building initiatives particularly that which builds skills, enhances educational capacity and access, and creates partnerships that enhance quality of life in the communities in which PRGT works and operates. Some specific examples of these programs are cited in Section 1.6.6.

The following sections describe the economic benefits from constructing and operating the Project. Estimates of the Project's influence on employment, income, economic output (gross domestic product or GDP) and government revenues are

³ Although the life of the PRGT project is anticipated to be greater than 40 years, 30 years of operation has been assumed for assessing the economic impacts of the Project because this is the minimum operating life for the PNW LNG project. The resulting estimates of the Project's influence on the economy are considered conservative because the Project is expected to operate for more than 30 years.

⁴ A person year is the equivalent of one person being employed full time for one year.

based on custom (project-specific) runs of the Statistics Canada Interprovincial Input/Output Model (SCIPIOM) using project construction and operating cost information or from economic multipliers for the natural gas transportation industry in Canada for 2009 (Statistics Canada 2012).

1.6.1 Capital Costs

Construction of the Project is estimated to cost \$5 billion in 2013 dollars, and it consists of the following three components. First, the land-based portion of the pipeline consists of up to 780 km from northeast BC to the Pacific coast and is estimated to cost \$3.66 billion. Second, the marine portion of the pipeline consists of up to 120 km of twin pipelines and is estimated to cost \$937 million. Third, construction of three compressor stations is estimated to cost \$406 million⁵. All construction for the Project will be new and will not use any existing facilities. PRGT does not anticipate purchasing land for the Project. The cost of buildings is included within the estimated construction spending on compressor stations (Table 1-13). The cost of equipment is included in the total Project costs (Table 1-13). Table 1-15 provides additional detailed information on the anticipated spending in Canada on equipment and materials.

Project construction will draw labour, goods and services from sources inside and outside Canada. Preliminary estimates suggest that Canadian labour, goods and services will account for about 70% of construction costs.

As shown in Table 1-13, about 83% of the cost of constructing the land-based pipeline will be spent to procure labour, goods and services from Canadian sources. This is based on the assumption that approximately one-third of pipeline for the land-based pipe, will be purchased from Canadian sources and the remainder will be imported.

It is estimated that 17% of the costs of constructing the marine portion of the pipeline will be spent in Canada. This is based on the assumption that the specialized pipe required for the marine portion of the line will be purchased from overseas suppliers, coated overseas, and transported to Canada. It also assumes that the specialty pipe-laying vessels and labour required to install the marine pipelines will be provided by an overseas contractor.

About 75% of the costs of constructing three compressor stations will involve labour, goods and services from Canadian suppliers. It is estimated that 25% of costs will be spent outside Canada and this will involve the purchase of engineering services and compression equipment.

⁵ The assessment of Project effects on employment is based on initial construction of three compressor stations. Ultimately, the throughput of the pipeline could be expanded by adding another five compressor stations. Consequently, the overview of Project benefits provided in this assessment can be considered conservative because it does not include the effects of spending to construct and operation the five additional compressor stations.

Table 1-13: Estimated Construction Spending in Canada and Foreign Countries

		Land-Based Pipeline	Marine Pipelines	Compressor Stations	Total
Canada	Value (\$ millions)	3,045	160	304	3,508
	Percent (%)	83	17	75	70
Foreign	Value (\$ millions)	612	778	102	1,492
	Percent (%)	17	83	25	30
Total Cost (\$ millions)		3,657	937	406	5,000

Source: Data provided by PRGT

Note: Values may not sum to totals shown because of rounding

Construction of the Project will draw labour, goods and services from across Canada. Table 1-14 shows that companies in BC are expected to provide 43% of the Canadian labour, goods and services and 57% will come from other parts of Canada. BC companies will account for 100% of the Canadian spending associated with the compressor stations, 85% of Canadian spending associated with the marine pipelines, and 36% of the costs associated with the land-based pipeline.

Table 1-14: Estimated Construction Spending within Canada by Project Component

		Land-Based Pipeline	Marine Pipelines	Compressor and Metering Stations	Total
British Columbia	Value (\$ millions)	1,085	136	304	1,525
	Percent (%)	36	85	100	43
Other Canada	Value (\$ millions)	1,960	24	0	1,984
	Percent (%)	64	15	0	57
Total Cost (\$ millions)		3,045	160	304	3,508

Source: Data provided by PRGT

Note: Values may not sum to totals shown because of rounding

Table 1-15 lists the major types of construction cost components sourced from Canada and how these costs will be distributed between BC and other parts of Canada.

Table 1-15: Estimated Construction Spending within Canada by Service and Commodity

Construction Costs	Canadian Content		Source within Canada		
	Value (\$ millions)	Percent of Total (%)	British Columbia		Other Canada (%)
			Value (\$ millions)	Percent of Canada (%)	
Construction Contracts	2,285	65	722	32	68
- Direct labour	1,141	33	407	36	64
- Equipment and materials	1,144	33	315	28	72
Goods and Services	1,223	35	803	66	34
- Engineering services	320	9	181	57	43
- Head office services	165	5	77	46	54
- Other engineering construction	163	5	158	97	3
- Iron and steel pipes	130	4	0	0	100
- Transportation	107	3	89	84	16
- Camps	90	3	84	93	7
- Machinery	85	2	85	100	0
- Concrete	65	2	58	90	10
- Other materials	22	1	12	54	46
- Pipe coating	18	1	18	100	0
- Other services	58	2	40	70	30
Total	3,508	100	1,525	43	57

Source: Data provided by PRGT

Contracts for constructing the pipeline and compressor stations, including site clearing and installing the facilities (\$2,285 million), will account for 65% of total expenditures in Canada. Of this amount, \$722 million will be spent in BC (32% of spending in Canada) and the other goods and services (68%) will be purchased from companies in other parts of Canada.

The major goods and services to be purchased from companies in BC include engineering services, which includes contracts for engineering, procurement and construction management (\$181 million) as well as other engineering construction contracts (\$158 million), transportation services (\$89 million), machinery (\$85 million) and construction camps (\$84 million).

1.6.2 Operating Costs

Table 1-16 shows that the annual cost of operating the Project will be \$42.9 million for a system throughput of 2 bcf/d. Of this, an average of \$14.7 million per year will be spent in BC. Over 30 years of operations, total operating costs will be \$1.3 billion (undiscounted 2013 dollars) of which \$441 million will be spent in BC.

The estimate of \$15.1 million for operating and maintenance costs includes an allowance of \$3.1 million for wages and salaries for the operations labour force. Most of the costs described as “shared services and corporate overhead” relate to various services that will be provided by PRGT’s head office, which is located outside BC. Most other costs will occur in BC, although some goods and services could be brought from other parts of Canada and elsewhere.

Table 1-16: Estimated Annual Operating Costs

Item	Total ^a (\$ millions)	British Columbia (\$ millions)	Other Canada (\$ millions)
Operating and maintenance costs	15.1	10.1	5.0
Corporate overhead	12.3	0.6	11.7
Shared services costs	12.1	0.6	11.5
Insurance	2.6	2.6	-
Marine pipeline integrity costs	0.8	0.8	-
Total	42.9	14.7	28.2

Note: Undiscounted 2013\$

^a Not including interest, other taxes, depreciation, or fuel gas costs

Source: Data provided by PRGT

The natural gas required as fuel for the compressor stations is not included as an operating cost because it is assumed that the shipper transmitting gas through the pipeline will supply the fuel to operate the compressor stations. For the 2.0 bcf/d initial volume, the fuel gas needed for PRGT will be 0.74% of throughput with a value of about \$28.2 million per year, based on an average cost of \$5.20 per gigajoule. The use of natural gas as fuel for the compressor stations will generate revenues for the Government of BC (carbon tax – see Table 1-24) and will create indirect employment in the upstream natural gas industry (see Table 1-21). When the cost of fuel gas is added, the overall cost of operating the pipeline and three compressor stations will be \$71.1 million per year.

1.6.3 Employment

Since the announcement of the Project, TransCanada’s presence in BC has expanded. TransCanada has opened offices in Vancouver and Prince George, providing long-term employment opportunities for local residents. Employment by PRGT currently consists of 21.5 full-time-equivalent positions in BC, with this number expected to grow during Project construction and operation.

1.6.3.1 Construction

Direct Employment

Direct employment during construction is estimated to be 8,570 PYs⁶. This includes 7,100 PYs of labour needed to construct the land-based pipeline and 1,470 PYs to construct three compressor stations. This is an approximate total labour force of 2,140 PYs per year over the four-year construction period. PRGT expects that 96% of labour (8,215 PYs) will be Canadian workers; the other 4% will consist of workers from outside Canada (355 PYs). Workers from BC will account for 39% of the direct construction workforce (3,370PYs) and 57% will be residents of other parts of Canada (4,845PYs). This breakdown is shown in Table 1-19.

Table 1-17 shows the composition of the construction labour force by trade and qualifications for the land-based portion of the pipeline and the compressor stations. It shows that equipment operators will be 32% of the overall labour. Most construction workers will work on a rotational basis (six days on, one day off, 12 hours per shift) and will work for as long as is required to complete specific construction tasks.

Table 1-17: Estimated Composition of the Direct Land-Based Pipeline and Compressor Station Construction Labour Force

Position	Land-Based Pipeline		Compressor Stations		Total	
	Number (PYs)	Percent of Total (%)	Number (PYs)	Percent of Total (%)	Number (PYs)	Percent of Total (%)
Supervisors	1,000	14	145	10	1,145	13
Welder	1,030	15	295	20	1,325	15
Equipment Operator	2,520	35	220	15	2,740	32
Labourers	1,360	19	220	15	1,580	18
Drivers	1,125	16	75	5	1,200	14
Mechanics	-	-	220	15	220	3
Electricians	-	-	220	15	220	3
Other	65	1	75	5	140	2
Total	7,100	100	1,470	100	8,570	100

Source: Data provided by PRGT

⁶ Employment impacts during construction are described in terms of PYs or person-years. However, the construction employment estimates include people working on a full-time, part time and seasonal basis.

Table 1-18 summarizes the range of wage rates, by skill, for workers directly employed for construction.

Table 1-18: Hourly Wage Rates during Project Construction

Job Category	Approximate Wage Level (\$ per Hour)
Supervisors and field administration	20 – 140
Welders and pipefitters	45 – 75
Equipment operators	45 – 70
Labourers	35 – 55
Drivers	40 – 60
Building trades: (Boilermakers, Carpenters, Electricians)	45 – 75

Source: Data provided by PRGT

The percentage of the construction labour force that will be hired from communities and regions along the pipeline route will depend on: 1) the number of workers who have experience and skills that are directly applicable to pipeline construction, and 2) the demands of other projects that are underway at the same time.

As described in Section 17, the Local Assessment Area (LAA) for assessing project employment effects consists of the five regional districts (Skeena-Queen Charlotte, Kitimat-Stikine, Bulkley-Nechako, Fraser-Fort George, and Peace River) and Nisga'a lands crossed by the pipeline route, and include all urban centres and Aboriginal communities in the six sub-regions that are located within 100 km of project infrastructure. The Regional Assessment Area (RAA) includes the LAA and three large communities (Prince George, Terrace and Smithers) that may serve as staging areas for construction activities.

Communities along the pipeline route have a relatively small number of construction workers who are equipment operators or tradespeople. According to the 2011 National Household Survey (SC 2013), there were 5,720 persons in the RAA who had experience in the construction industry and, of these, 1,320 (23%) were residents of the LAA. The others (77%) were residents of the three large communities within the RAA. Based on the results of the 2006 census (SC 2007), it was determined that 78% of the construction labour force consisted of people with occupations in the trades or were transportation and equipment operators.⁷ The remainder were people in the construction industry with occupations in management, finance and administration, and sales and service.

⁷ Detailed breakdowns of the construction industry by occupation based on the 2011 National Household Survey are not yet available for all communities. However, the results from the 2006 census are assumed to be relevant because data available for the large communities indicate that the mix of occupations changed very little between 2006 and 2011.

Thus, the potential RAA construction labour force in 2011 (workers with appropriate occupations) is estimated to consist of about 4,510 workers of whom 1,090 were residents of the LAA. Because a large proportion of the construction workforce in communities along the pipeline route are expected to be already employed on other major projects that are underway or proposed for the RAA (see Section 17), it is estimated that about 10% of the PRGT direct construction workforce from BC will consist of local and regional residents. This is about 340 PYs of construction labour. PRGT's strategy for encouraging the regional construction labour force and regional businesses to participate in project construction are described in Section 1.6.3.3.

Indirect Employment (Contractor Supply Services)

Additional employment will result from purchases of the other goods and services needed to construct the Project; these are referred to as indirect employment effects. The results of SCIPOM suggest that Project purchases of goods and services from Canadian sources will generate 13,460 PYs of indirect employment in BC and elsewhere in Canada. It is estimated that 36% of indirect project employment will occur in BC.

Based on the information in Table 1-15, it is estimated that the value of contracted goods and services required for construction, other than the direct construction contracts (\$722 million), will total about \$803 million in BC. Businesses in communities along the pipeline route are expected to provide some of the goods and services required for construction. Such businesses could provide all or most of the Project demands for clearing, logging and salvage activities, construction of access roads, construction camps and catering, reclamation, air charters, and maintenance and security. It is estimated that about \$224 million in goods and services required for construction could be purchased from local and regional businesses. This is 20% of BC purchases of goods and services associated with pipeline construction. It is expected that most purchases of engineering services, machinery, head office costs and the costs of coating the pipes will occur outside of local communities.

Induced Employment

Direct and indirect Project construction employment will also create induced employment, which occurs when the Project workforce purchases consumer goods and services. Based on the results of the SCIPOM, it is estimated that consumer spending will generate 14,955 PYs of induced employment in Canada, with 19% occurring in BC (2,895 PYs) and 81% in other parts of Canada (12,060 PYs). The largest amount of induced employment will be in retail trade, accommodation and food services, finance, insurance and real estate.

Total Employment from Construction

Overall, Project construction is expected to create 36,630 PYs of employment for residents of Canada. Total employment effects during the construction period are summarized in Table 1-19. Approximately 41% of total employment will come from induced Project employment, 37% from indirect employment, and 22% from direct Project employment. About 30% of total employment in Canada will occur in BC.

Table 1-19: Estimated Construction Employment in Canada

Construction Employment (PYs)	British Columbia (PYs)	Other Canada (PYs)	Total Canada (PYs)
Direct Employment	3,370	4,845	8,215
Indirect Employment	4,865	8,595	13,460
Induced Employment	2,895	12,060	14,955
Total Employment	11,130	25,500	36,630

Source: Custom runs of SCIPOM 2014

1.6.3.2 Operation

Direct Employment

Project operation will directly employ 23 people per year in full time positions. The types of positions required for pipeline operations and the estimated hourly wages for these workers is provided in Table 1-20.

Table 1-20: Estimated Annual Operation Labour Force

Positions	Number of Positions	Approximate Wage (\$ per Hour)
Field technicians, mechanics, instrumentation and controls	14	30 - 45
Facility technicians	3	25 - 35
Administration	1	20 - 30
Community and Aboriginal relations, land and environment	3	40 - 65
Supervisor	1	80 - 110
Total	23	

Source: Data provided by PRGT

Operational staff will be located in BC, residing in various communities along the pipeline route and near compressor stations. While some local residents may be trained to occupy these positions, there will be requirements for some highly specialized workers, who will be brought in from elsewhere.

Indirect Employment

As noted in Section 1.6.2, direct labour costs for operations are estimated to be \$3.1 million per year, which is 7% of the total cost of operating the pipeline. The other \$39.8 million consists of various contractor supplied services that will generate indirect employment in BC and Canada. Of this, an estimated \$12.8 million will be spent on maintenance contracts. Approximately 70% of maintenance expenditure will occur in BC. The extent to which local companies will provide such services will depend on the results of a competitive bidding process.

Another \$24.4 million will be spent on shared services and corporate overhead, including \$23.2 million for the head office in Calgary and \$1.2 million in BC. Included in these head office services are wages and salaries for staff in Calgary and across BC. Expenditures on insurance will account for the remaining \$2.6 million.

Based on multipliers for the natural gas pipeline transportation industry in Canada, it is estimated that Project operations will create the equivalent of 113 indirect jobs (measured as full-time equivalents or FTEs) in Canada, with 34 in BC and 79 in other parts of Canada.⁸ These numbers include jobs in companies in the upstream natural gas industry that provide the natural gas needed as fuel gas for three compressor stations and companies that will provide contracted maintenance.

Induced Employment

Spending on consumer goods and services by workers directly or indirectly employed by the Project will create induced employment in Canada and BC. Based on multipliers for the natural gas pipeline transportation industry in Canada, it is estimated that operations will create 45 induced jobs (FTEs) in Canada, of which 11 will be in BC and 34 in other parts of Canada. The largest amount of induced employment will be in retail trade, accommodation and food services, finance, insurance, and real estate.

Total Employment from Operation

Table 1-21 summarizes total employment associated with operations. In total, operations will create 181 jobs (FTEs) for the Project's operating life. The majority of these jobs (62%) will consist of indirect jobs resulting from spending on contracted goods and services, including head office services.

⁸ Indirect and induced employment impacts during operations are described in terms of full time equivalent jobs or FTEs and include a mix of people working on a full-time, part time and seasonal basis.

Table 1-21: Estimated Operation Employment in Canada

Operation Employment (FTEs)	British Columbia (FTEs)	Other Canada (FTEs)	Total Canada (FTEs)
Direct Employment	23	0	23
Indirect Employment	34	79	113
Induced Employment	11	34	45
Total Employment	68	103	181

Source: Economic multipliers for the natural gas transportation industry in Canada for 2009 (Statistics Canada 2012)

Over 30 years, operations will create 5,430 PYs of direct, indirect and induced employment in Canada.

Labour Income

Direct labour income generated by the Project workforce in Canada during the construction phase is estimated to be \$1,141 million, with 36% or \$407 million to be generated in BC. During the operations phase, direct labour income is estimated to be \$3.1 million. Direct, indirect and induced project effects on labour incomes are summarized in Table 1-22.

Table 1-22: Estimated Labour Income in British Columbia and Canada

Impact	Construction (\$million)			Operations – Annual (\$ million)		
	British Columbia	Other Canada	Total Canada	British Columbia	Other Canada	Total Canada
Direct	407	735	1,141	3.1	0	3.1
Indirect	294	764	1,058	2.4	5.5	7.9
Induced	135	481	617	0.7	2.5	2.9
Total	816	1,980	2,816	6.2	7.7	13.9

1.6.3.3 Aboriginal and Local Contracting

Over the past 10 years, TransCanada's Aboriginal contracting program has delivered over \$300 million dollars in subcontracting and employment opportunities to Aboriginal communities; this has been accomplished largely through its prime contractors. In 2013, PRGT estimates it spent over \$9 million in subcontracting and employment opportunities with BC Aboriginal communities.

PRGT adheres to TransCanada's Aboriginal relations policy, which supports meaningful inclusion and engagement of Aboriginal communities whose lives are

affected by project activities. The Project will be consistent with this policy, particularly the following two guidelines:

- PRGT strives to create short and long-term employment and business opportunities for Aboriginal people affected by its activities
- PRGT supports learning opportunities for Aboriginal people to provide a well-trained source of Aboriginal employees and to build capacity within Aboriginal communities.

To this end, the PRGT Aboriginal and Local Contracting Strategy aims to facilitate Aboriginal and local business opportunities.

The PRGT Aboriginal and Local Contracting Strategy includes:

- designating services that will be conducted only by Qualified Aboriginal Businesses (should such businesses exist), including medical and security services, ROW clearing, camps and catering services
- conducting information sessions to explain contracting practices and employment opportunities on the Project
- assessing community capacity and identifying work packages for Aboriginal and local businesses and workers
- providing contractor qualification information in advance of Project construction
- implementing an Aboriginal participation component in the Request For Proposals relating to prime contractors and consideration of this criteria in the evaluation of those proposals
- providing successful prime contractors with a list of the Aboriginal and local contractors that PRGT is aware of to be considered for work on the Project
- participating in community meetings with prime contractors to discuss how Aboriginal and local companies and residents can participate
- informing Aboriginal groups of who the successful prime contractor is, after contractor award
- offering de-brief meetings with unsuccessful Aboriginal and local contractors to explain the reasons for selection.

The type and number of opportunities will vary depending on the project phase.

PRGT recognizes that, similar to TransCanada as a whole, the vast majority of its Aboriginal and local spending will be through its prime contractors. Therefore, as part of its Aboriginal and Local Contracting Strategy, PRGT requires that its prime contractors adopt Aboriginal and local contracting approaches. These approaches may include initiatives such as the development of work packages that reflect the capabilities of Aboriginal and local businesses. Consistent with TransCanada policies, PRGT's practice in selecting its contractors is to consider such characteristics as

quality, competitive pricing, timely supply, dependability, community and regional content, safety and environmental performance.

Planning phase opportunities have included Aboriginal participation in engineering and environmental studies, land and survey services, specialized consulting activities and helicopter support.

Construction phase non-subcontracting opportunities are expected to include provision of non-camp related lodging (e.g., hotels, motels and campgrounds), restaurants, recreational facilities, helicopter support and local service stations.

Construction phase subcontracting opportunities related to pipeline and associated facility construction are expected to include⁹:

- clearing and grading
- road access clearing
- gravel processing
- hauling materials and products (e.g., water, equipment and pipe)
- site cleanup and reclamation
- monitors
- hydrovac (crossings)
- trenchless crossings (e.g., HDD)
- fuel supply
- flag personnel
- equipment rental and lease (e.g., generators, lighting towers and pumps)
- security and medical services
- pressure testing
- recycling services
- storage sites providers
- preparation and management of construction camps (e.g., catering, office supplies, janitorial, waste and sewage services, and housekeeping).

PRGT expects to provide employment, contracting and business development opportunities for Aboriginal and local businesses and individuals and is currently engaging both Aboriginal and non-Aboriginal BC companies to provide various services related to the Project, such as survey, forestry, road design, pipeline bridge design, helicopter services, legal and professional consulting services. For example, of the \$24 million spent on land surveying in 2013, about \$17 million was spent on contracts in BC. Of that BC spend, Aboriginal businesses and workers accounted for

⁹ Includes designated and non-designated services.

about \$6 million, local non-Aboriginal businesses and workers accounted for \$3 million and other BC based contractors and suppliers accounted for approximately \$8 million.

During the construction phase, PRGT intends to undertake initiatives that it expects will increase the value of goods and services procured from Aboriginal and local businesses. At the time of Application submission, PRGT has purchased \$10 million in goods and services from Aboriginal suppliers, through its prime contractors, and anticipates this number will increase during the construction phase.

PRGT will continue to engage with Aboriginal groups and local communities through the life of the Project to help identify meaningful economic opportunities that will reflect the specific interests of each Aboriginal group and local community.

1.6.4 Government Revenue

1.6.4.1 Construction

During construction, sources of government revenue will include corporate income taxes on contractors' profits and supplier industry profits, income taxes paid by workers directly or indirectly employed on project construction, and net sales taxes paid on goods and services. Table 1-23 summarizes the expected tax revenues for Canada and BC. Estimates of direct provincial sales tax revenues for BC are provided by PRGT on the assumption that the provincial sales tax will be applied on all materials directly imported for use in, or consumed in, the Province of BC. Input tax credits will be claimed on all federal sales tax charged by contractors and other suppliers.

The values for other sources of government revenues are based largely on the results of the SCIPOM. Sales taxes related to indirect and induced economic activity are estimated using data from the SCIPOM. Corporate income taxes on contractor's profits are estimated by assuming a federal corporate tax rate of 15% and a BC corporate tax rate of 11% applied against estimated corporate profits, which are assumed to be 60% of the 'other operating surplus' (generally calculated as gross domestic product (GDP) minus labour income minus taxes). Personal income taxes are estimated using the SCIPOM estimates of labour income multiplied by average federal and provincial income tax rates that reflect the average rates of taxation per unit of total income in 2011 (Canadian Revenue Agency 2013).

Over the four-year construction period, the Government of Canada will receive approximately \$500 million in revenues, of which 64% will come from personal income taxes, 20% will come from corporate income taxes, and 10% will come from sales taxes. Other tax revenue, which includes gas, excise, environmental, and air transportation taxes, will account for the remaining 6%.

Table 1-23: Estimated Government Revenue during Construction (2013 \$ millions)

Government	Revenue Type	Direct	Indirect	Induced	Total
Municipal and Regional	Property Taxes	36.8	NA	NA	\$36.8
British Columbia	Corporate income tax	10.9	8.0	12.0	30.9
	Personal income tax	18.7	13.5	6.2	38.4
	Sales taxes	303.8	12.7	15.2	331.7
	Other taxes		15.4	23.9	39.3
	Other government levies and lease payments ¹	1.7	NA	NA	1.7
	Total	335.1	49.6	57.3	442.0
Federal	Corporate income tax	34.2	28.5	39.4	102.1
	Personal income tax	128.9	119.6	69.7	318.2
	Sales taxes		5.7	44.4	50.1
	Other taxes		9.0	20.1	29.2
	Total	163.1	162.8	173.6	499.6

¹ Other government levies and lease payments include estimated lease, levies and other payments to government; numbers are estimated as some fees have not been levied yet.

Source: PRGT and custom runs of SCIPIOM 2013; calculations based on Canadian Revenue Agency 2012.

Tax revenues from direct and indirect sources will each account for about 33% of total Federal government revenues, while revenues from induced project effects will be 35%. On average, the Government of Canada will receive \$125 million in revenues for each year of the construction period.

Total revenues for the Government of BC during construction will be \$440 million, with 75% from the provincial sales tax (PST), 9% from personal income taxes, 7% from corporate taxes, and 9% from other provincial taxes (environment, fuel, amusement and other consumption taxes). About 76% of provincial tax revenues will come from direct project expenditures. On average, the Government of BC will receive \$110 million in annual revenues from project-related economic activities during construction.

Property taxes for municipal and regional governments will amount to \$36.8 million over the four-year construction period, with the annual amount paid increasing each year based on the percentage of Project construction that was completed in the previous year.

1.6.4.2 Operation

Government revenue during the operation phase will come from property taxes, corporate and personal income taxes, sales and other taxes, and taxes on the fuel used for the compressor stations. Table 1-24 summarizes the estimated annual tax revenues for the three levels of government during operation.

Table 1-24: Estimated Annual Government Revenue during Operations (2013 \$ millions)

Government	Revenue Type	Direct	Indirect	Induced	Total
Municipal and Regional	Property Taxes	\$24.5	NA	NA	\$24.5
British Columbia	Corporate income tax	25.4	NA	NA	25.4
	Personal income tax	0.1	0.1	0.0	0.3
	Carbon tax	12.3	NA	NA	12.3
	Compressor fuel tax	5.1	NA	NA	5.1
	Other government levies and lease payments ¹	2.0	NA	NA	2.0
	Total	44.9	0.1	0.0	45.1
Federal	Corporate income tax	34.6	NA	NA	34.6
	Personal income tax	0.4	0.9	0.3	1.6
	Total	35.0	0.9	0.3	36.2
Total		\$104.4	\$1.0	\$0.3	\$105.8

¹ Other government levies and lease payments include estimated lease, levies and other payments to government; numbers are estimated as some fees have not been levied yet.

Source: PRGT; economic multipliers for the natural gas transportation industry in Canada for 2009 (Statistics Canada 2012; calculations based on Canadian Revenue Agency 2012.

Note: Numbers may not add due to rounding. NA – Not available.

The largest component of government revenues will be corporate income taxes. On average, PRGT will pay about \$34.6 million per year in federal corporate taxes and \$25.4 million per year in provincial corporate tax. In combination, corporate income tax will be 58% of total annual revenues for all levels of government.

Other major sources of government revenue are regional and municipal property taxes and the carbon tax and compressor fuel taxes that would be collected by the Province of BC.

Nisga'a Lisims Government (NLG) has the right under the Nisga'a Final Agreement to direct taxation of Nisga'a Citizens on Nisga'a Lands. Taxation authority over persons other than Nisga'a Citizens on Nisga'a Lands must be delegated by the governments of Canada and BC. At the time of the Application submission, these taxation powers have not been drawn down by NLG. The amount of any other payments to the NLG by the Project is currently being negotiated.

Over 30 years, the Project will contribute \$1.1 billion (undiscounted) in revenues to the federal government, \$1.3 billion to the BC provincial government, and \$0.7 billion to municipal and regional governments.

1.6.5 Contribution to the British Columbia Economy

Table 1-25 provides an estimate of the Project's influence on economic output in BC and Canada as measured in terms of GDP, described in terms of basic prices (i.e., less taxes and subsidies) and based on the results of the SCIPIOM.

Table 1-25: Project's Influence on Gross Domestic Product in British Columbia and Canada

Impact	British Columbia			Canada		
	Construction (\$ millions)	Operations		Construction (\$ million)	Operations	
		Annual (\$ million)	Over 30 years (\$ million)		Annual (\$ million)	Over 30 years (\$ million)
Direct	510	31.7	951	1,455	31.7	951
Indirect	420	2.7	81	1,380	8.7	261
Induced	320	1.1	33	1,060	4.7	141
Total	1,250	35.5	1,065	3,895	45.1	1,353

Source: Custom runs of SCIPIOM 2013; economic multipliers for the natural gas transportation industry in Canada for 2009 (Statistics Canada 2012)

It is estimated that PRGT purchases of labour, goods and services needed for construction, valued at \$1,525 million, will increase GDP in BC by \$1.25 billion over the four-year construction period. This is an average of about \$312 million per year.

During operation, the Project is expected to contribute about \$35.5 million per year to provincial GDP. Over 30 years, the total (undiscounted) additions to GDP in BC will be \$1,065 million.

For Canada, the effect of construction on GDP will be \$3.9 billion over the four-year construction period. Operations will contribute \$45.1 million per year, or \$1.4 billion over 30 years.

1.6.6 Community and Social Benefits

To date PRGT has established several partnerships with key stakeholders and Aboriginal groups. These initiatives foster capacity building and improve the quality of life in these communities. PRGT will continue to work with stakeholders and Aboriginal groups to share in the benefits and opportunities provided by the proposed Project. In addition to economic and employment benefits, PRGT will also invest in local programs which create benefits throughout the lifecycle of the construction and operation of the Project and beyond.

1.6.6.1 Training and Education

A key benefit from the Project is local employment. PRGT recognizes that maximizing local employment is contingent upon the availability of workers with the appropriate skills and training. PRGT will work with educational institutions to provide training and education opportunities for local communities, including Aboriginal groups. Training opportunities will focus on skills required for Project-specific employment during construction and operation. These skills would be transferrable to other future construction related projects and developments.

PRGT's training plan will focus on developing Project-specific employment and increasing local skills capacity. To support our training strategy, labour force research and engagement with educational institutions and communities, as well as Aboriginal groups, is already underway.

PRGT also recognizes the need for the development of community capacity beyond the short-term nature of the pipeline construction opportunities. PRGT will support long-term community education capacity and accessibility initiatives, based on community needs and priorities. PRGT has, and will continue to, work with communities to identify their needs and support the required education necessary to help address community-specific priorities.

1.6.6.2 Aboriginal Employment and Training

PRGT also recognizes the unique barriers for employment within Aboriginal communities. PRGT will build on TransCanada's robust series of programs that assist Aboriginal people and communities in achieving their education and training goals. These programs include literacy and numeracy, career path workshops, Native Ambassador partnerships, environmental monitoring programs and Aboriginal human resources and skill-building initiatives. PRGT will explore the need for these programs in specific communities.

Training initiatives and partnerships to date have included:

- University of Northern British Columbia (UNBC): TransCanada Corporation Carrier Sekani Award
- Metlakatla First Nation UNBC Environmental Technician Program
- Lax Kw'alaams Band BCIT Domestic Masters Tickets
- Facilities Technician Apprenticeship program.

PRGT will continue to engage with Aboriginal groups along the proposed route to discuss each community's training and education interests and work together on initiatives that meet each community's needs.

1.6.6.3 Community Investment

TransCanada has supported community investment initiatives, fostering partnerships and meaningful engagement in the communities where it operates or proposes to operate. As of 2013, TransCanada has invested approximately \$2 million in communities.

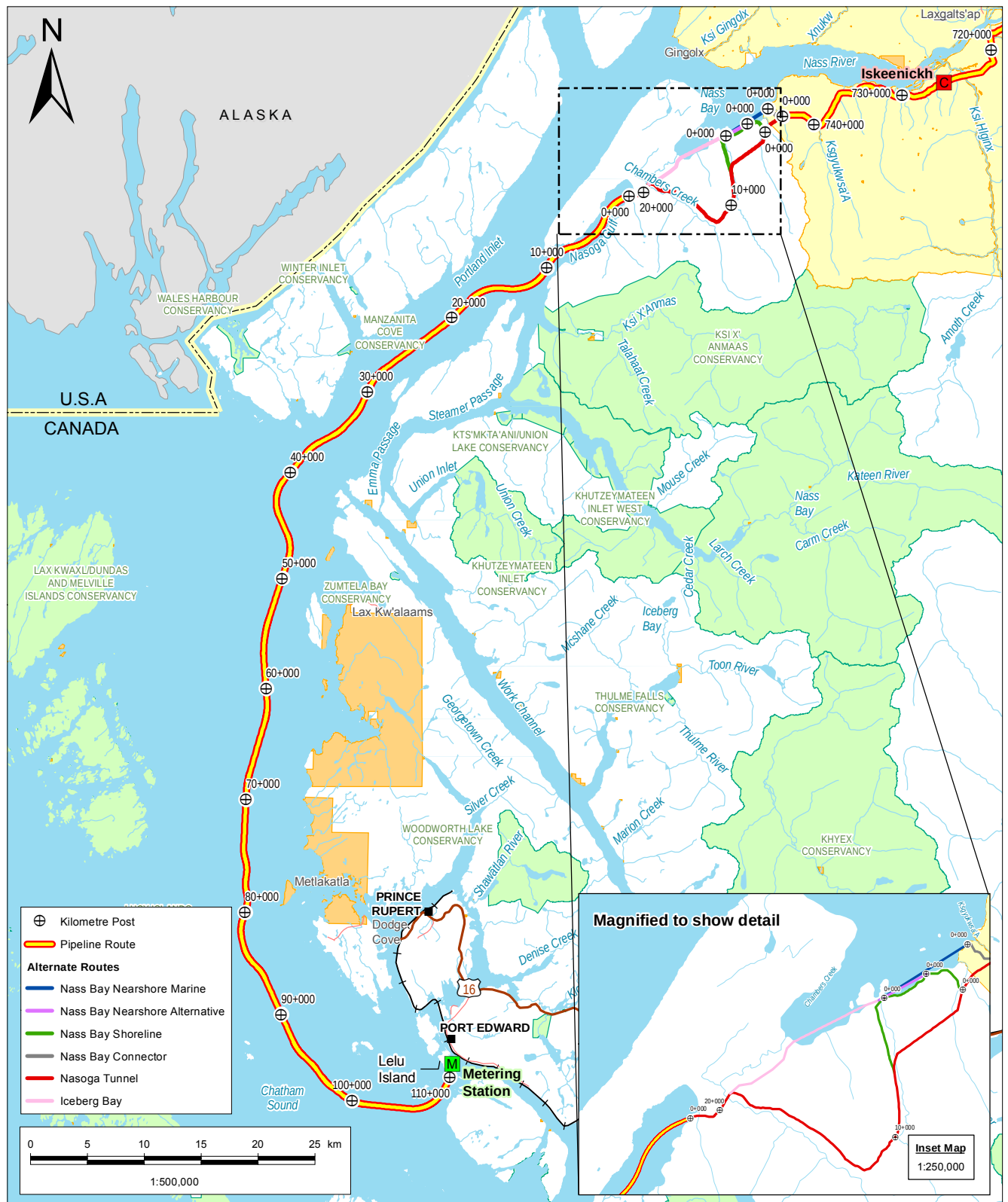
Since PRGT's Project announcement in early 2013, the Project team has regularly met with stakeholders and Aboriginal groups along the pipeline route to understand community needs and priorities. PRGT's community investment strategy and approach has aligned with those stated needs. PRGT has sought, and will continue to seek partnerships and opportunities to support initiatives that are responsive to community needs directed to three focus areas: safety, community and environment.

Examples of community investments along the Project corridor include:

- Partnerships with several school districts across the Project area - equipment and technology purchases for students to support literacy, skills training, education in industry based software, activities, etc.
- Mackenzie Recreation Centre – equipment to enable access for community members
- Invasive Species Council of BC - support training program for natural resource workers in northern BC
- Chetwynd Communications Society - equipment to facilitate emergency broadcasting
- Hope Air - supports flights to health centres for those financially-disadvantaged people in northern BC to receive the care needed
- Encouraging healthy and active living through TransCanada-sponsored events in the communities
- Supporting community events
- Sponsoring dancers and cultural activities
- Partnership in moose collaring programs
- Learning centre upgrades
- Summer student programs
- Other partnerships focused on capacity building and community identified needs.

1.7 FIGURES

Please see the following pages.



- City, Town, Village, or District Municipality
- Highway
- Road
- Railway
- Watercourse
- International Boundary
- Indian Reserves
- Nisga'a Lands
- Parks, Protected Areas, Ecological Reserves, and Conservancies
- Waterbody
- Compressor Station
- Metering Station

Data Sources: DataBC; Government of British Columbia (GovBC); Terrain Resource Information Management; GovBC; National Topographic System; GovBC; BC Stats; GovBC; BC Oil & Gas Commission; GovBC; CanVec v12; Government of Canada (GC); National Hydrology Network; GC; Atlas of Canada National Framework; GC; Fisheries and Oceans Canada; GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; InterSea; Focus Corporation

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Prince Rupert Gas Transmission Project

MARINE ROUTE ALTERNATIVES

ENVIRONMENTAL ASSESSMENT PROJECT OVERVIEW

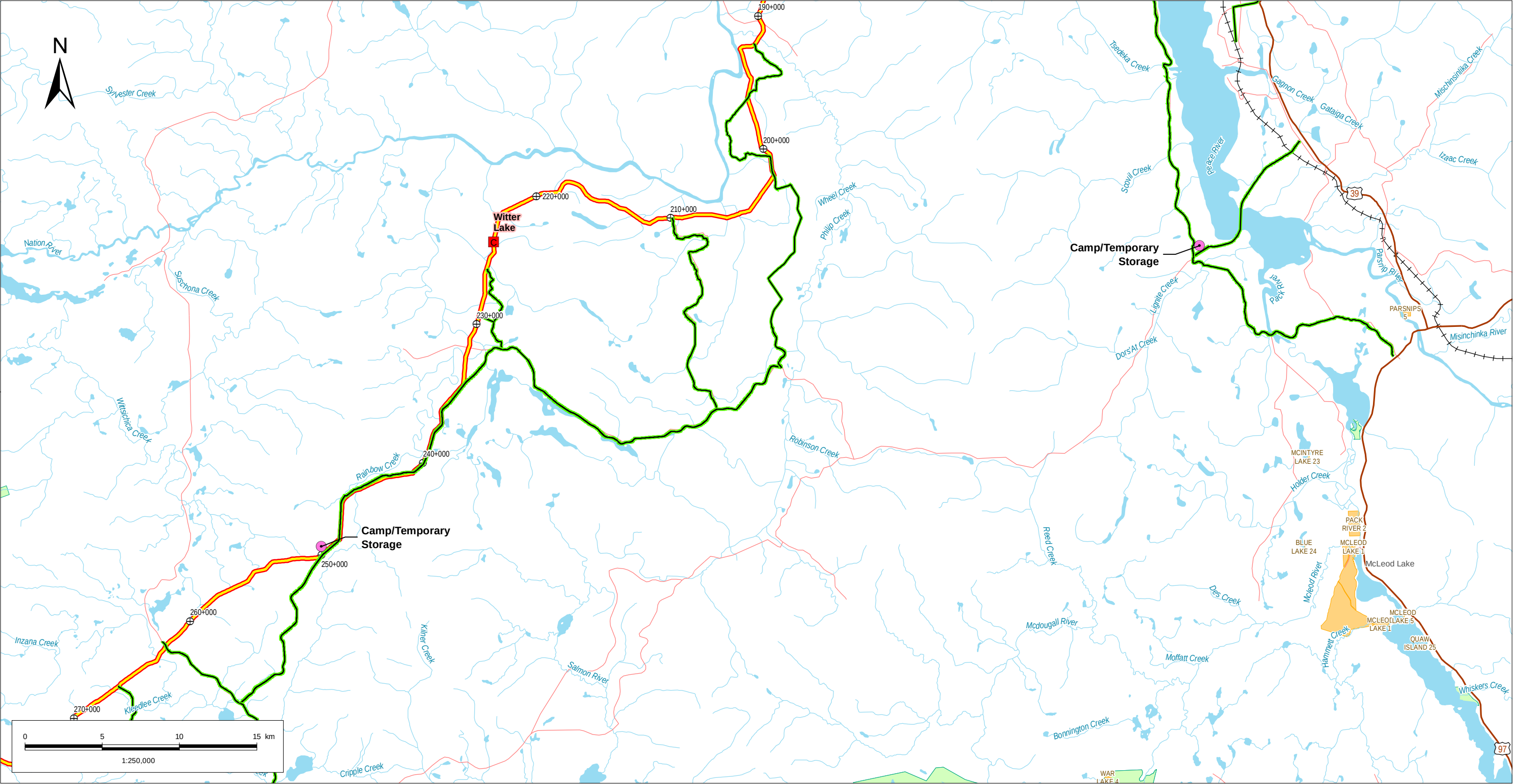
Prince Rupert Gas Transmission Project

DATE: 05-MAY-14
FIGURE ID: 123110628
DRAWN BY: R. COATTA

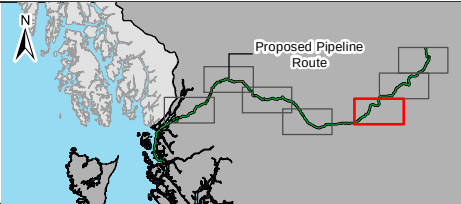
PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: K. FRASER

FIGURE NO:

1-2



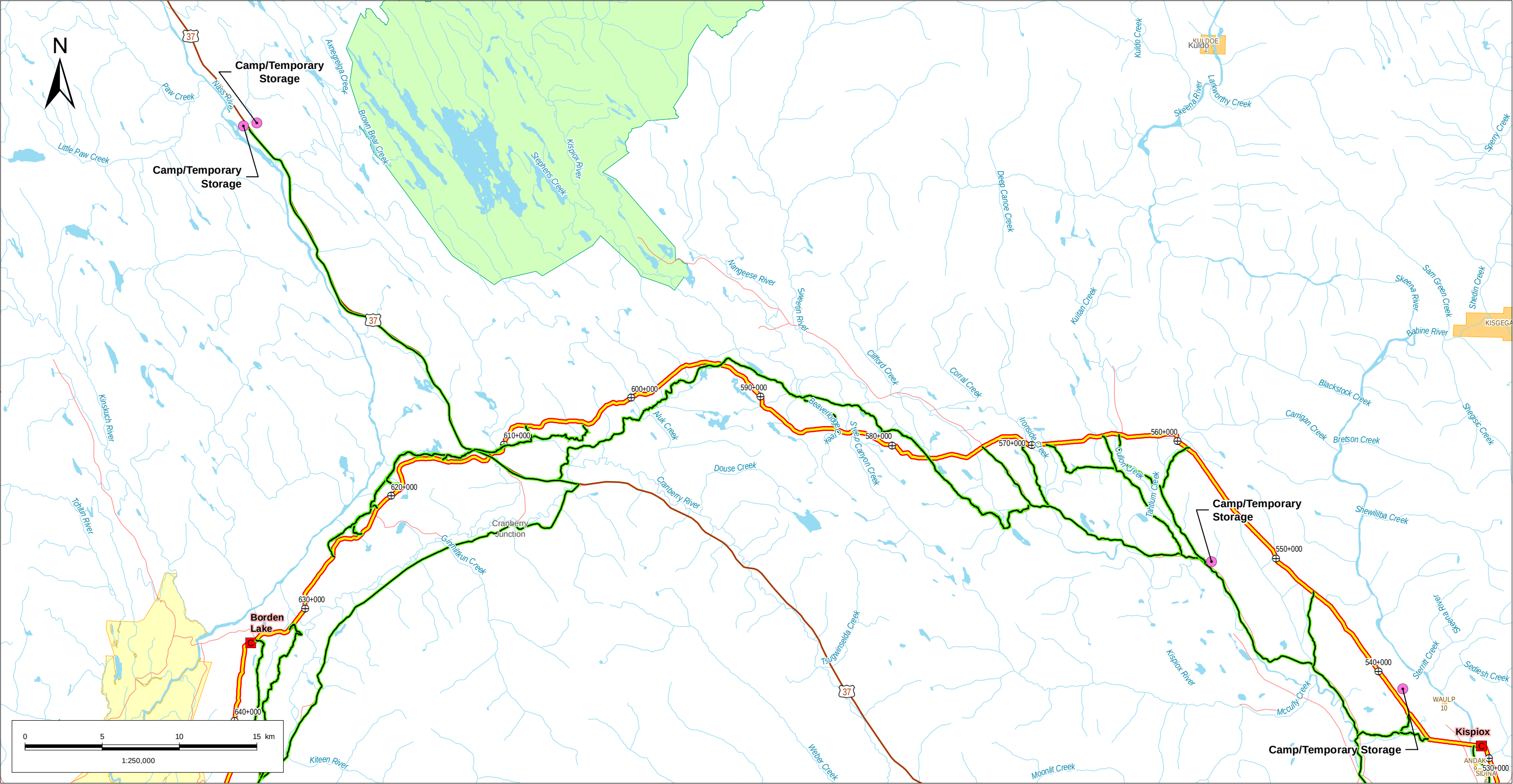
- | | | | |
|---|--|----------------------|----------------------------|
| ■ City, Town, Village, or District Municipality | — Watercourse | ⊕ Kilometre Post | ● Potential Ancillary Site |
| — Highway | ■ Indian Reserves | — Pipeline Route | — New Access Road |
| — Road | ■ Parks, Protected Areas, Ecological Reserves, and Conservancies | ■ Compressor Station | — Existing Access Road |
| — Railway | ■ Waterbody | | |



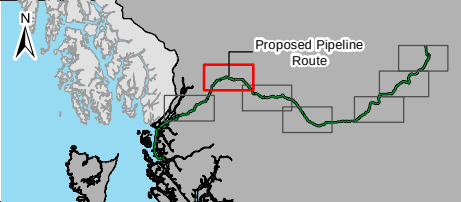
Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation

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Prince Rupert Gas Transmission Project				Prince Rupert Gas Transmission Project
ACCESS ROADS AND ANCILLARY SITES MAPBOOK				
ENVIRONMENTAL ASSESSMENT PROJECT OVERVIEW				
DATE:	02-MAY-14	PROJECTION: BC ENVIRONMENTAL ALBERS	DRAWN BY: R. COATTA	FIGURE NO: 1-3c
FIGURE ID:	123110628	DATUM: NORTH AMERICAN DATUM 1983	CHECKED BY: M. DOUCET	



- | | | | |
|---|--|----------------------|----------------------------|
| ■ City, Town, Village, or District Municipality | — Watercourse | ⊕ Kilometre Post | ● Potential Ancillary Site |
| — Highway | ■ Indian Reserves | — Pipeline Route | — New Access Road |
| — Road | ■ Nisga'a Lands | ■ Compressor Station | — Existing Access Road |
| | ■ Parks, Protected Areas, Ecological Reserves, and Conservancies | | |
| | ■ Waterbody | | |



Data Sources: DataBC; Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation

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Prince Rupert Gas Transmission Project				Prince Rupert Gas Transmission Project
ACCESS ROADS AND ANCILLARY SITES MAPBOOK				
ENVIRONMENTAL ASSESSMENT PROJECT OVERVIEW				
DATE:	02-MAY-14	PROJECTION: BC ENVIRONMENTAL ALBERS	DRAWN BY: R. COATTA	FIGURE NO: 1-3f
FIGURE ID: 123110628		DATUM: NORTH AMERICAN DATUM 1983	CHECKED BY: M. DOUCET	

500 m Application Corridor

50 m Typical Project Construction ROW

32 m Permanent ROW

10 m Vegetation Management Required for Line-of-Sight

Prince Rupert Gas Transmission Project

**CORRIDOR AND
RIGHT-OF-WAY WIDTHS**

*ENVIRONMENTAL ASSESSMENT
PROJECT OVERVIEW*

Prince Rupert
Gas Transmission Project

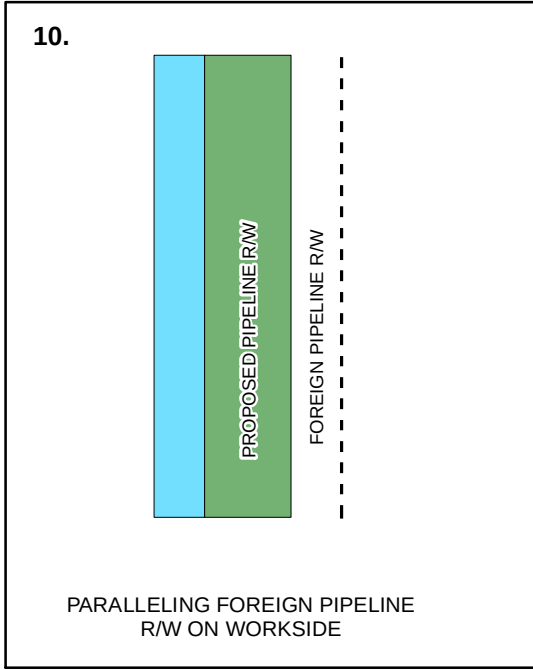
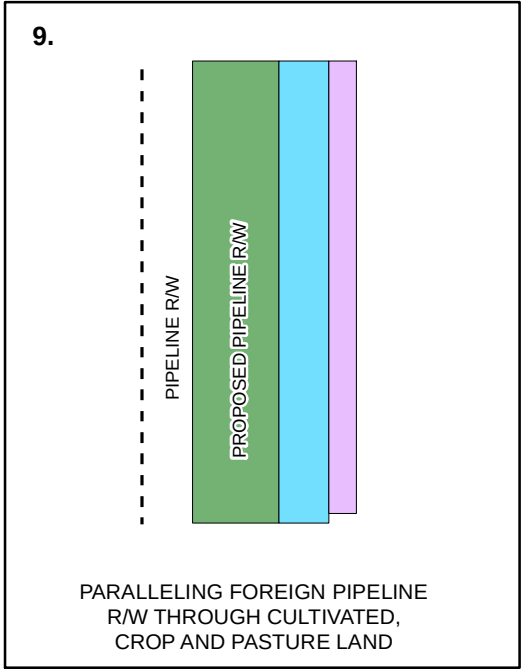
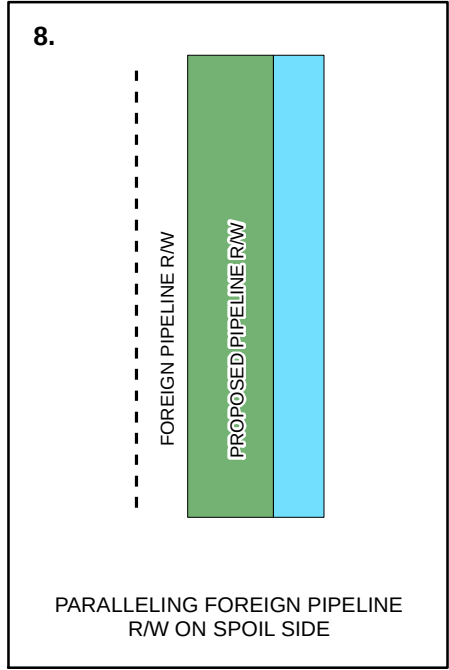
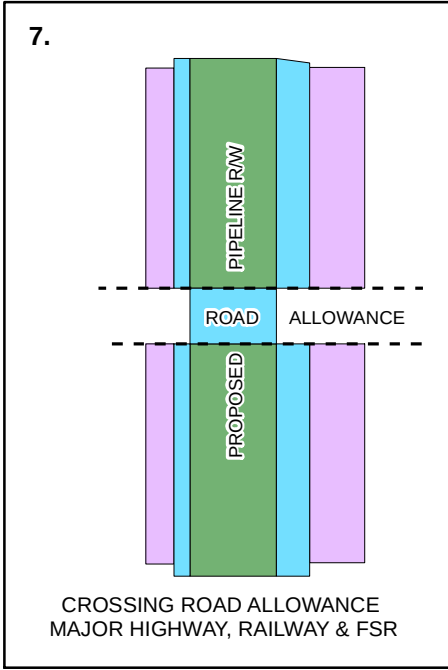
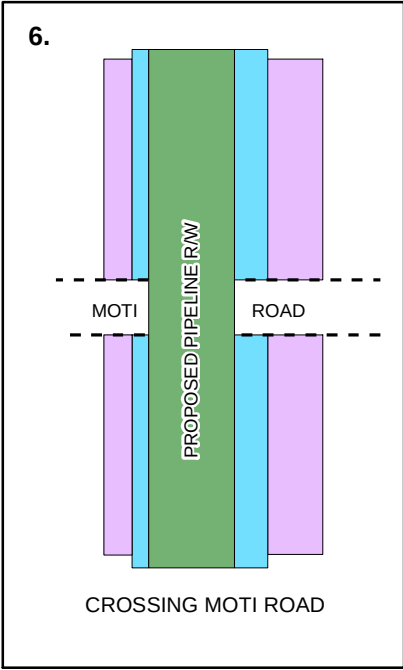
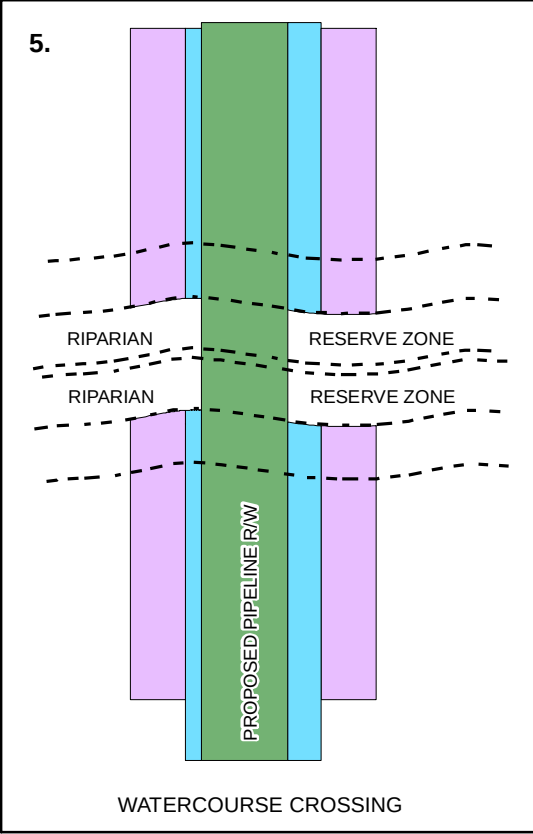
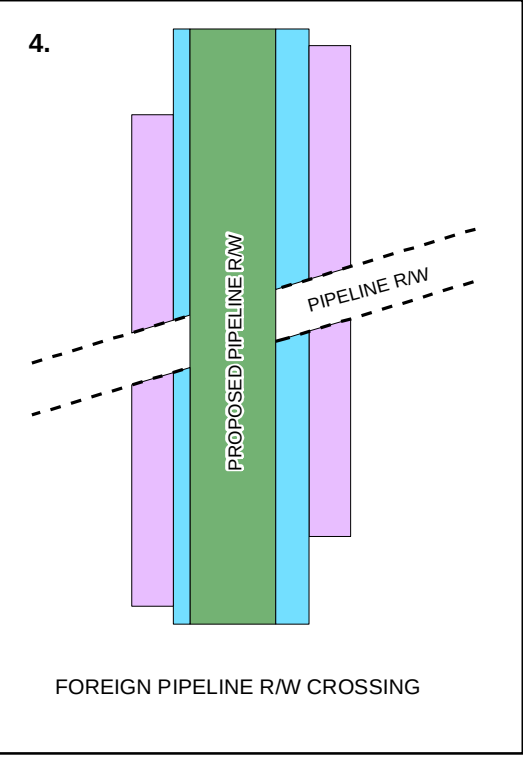
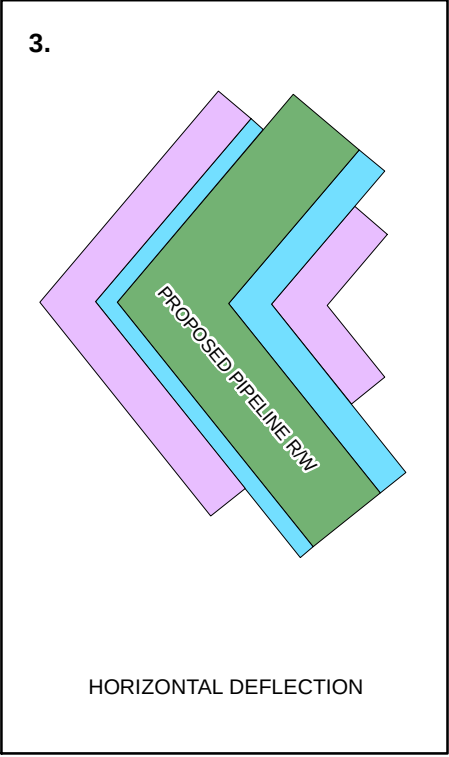
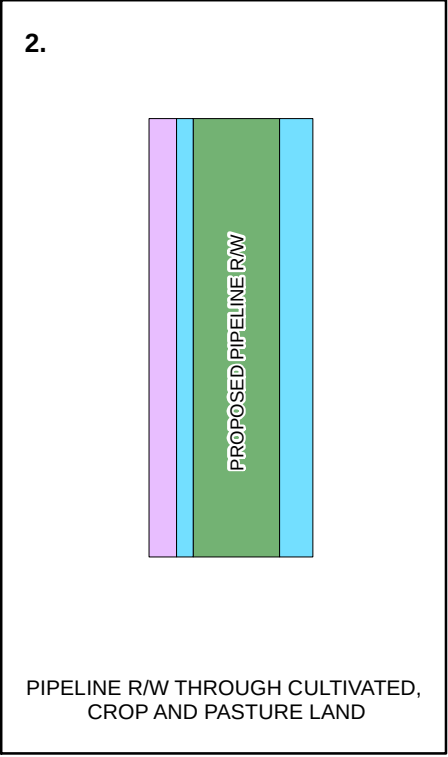
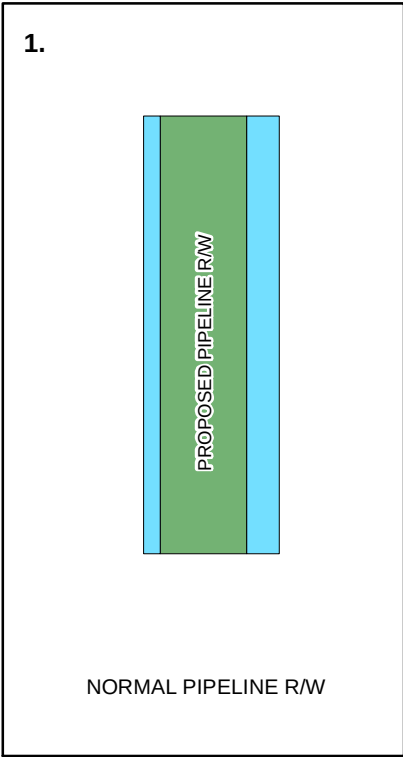
Data Sources: DataBC; Government of British Columbia (GovBC); Terrain Resource Information Management; GovBC; National Topographic System; GovBC; BC Stats; GovBC; BC Oil & Gas Commission; GovBC; CanVec v12; Government of Canada (GC); National Hydrology Network; GC; Atlas of Canada National Framework; GC; Fisheries and Oceans Canada; GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; Interleaves; Focus Corporation
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DATE: 21-MAR-14
FIGURE ID: 123110628
DRAWN BY: A. BOONE

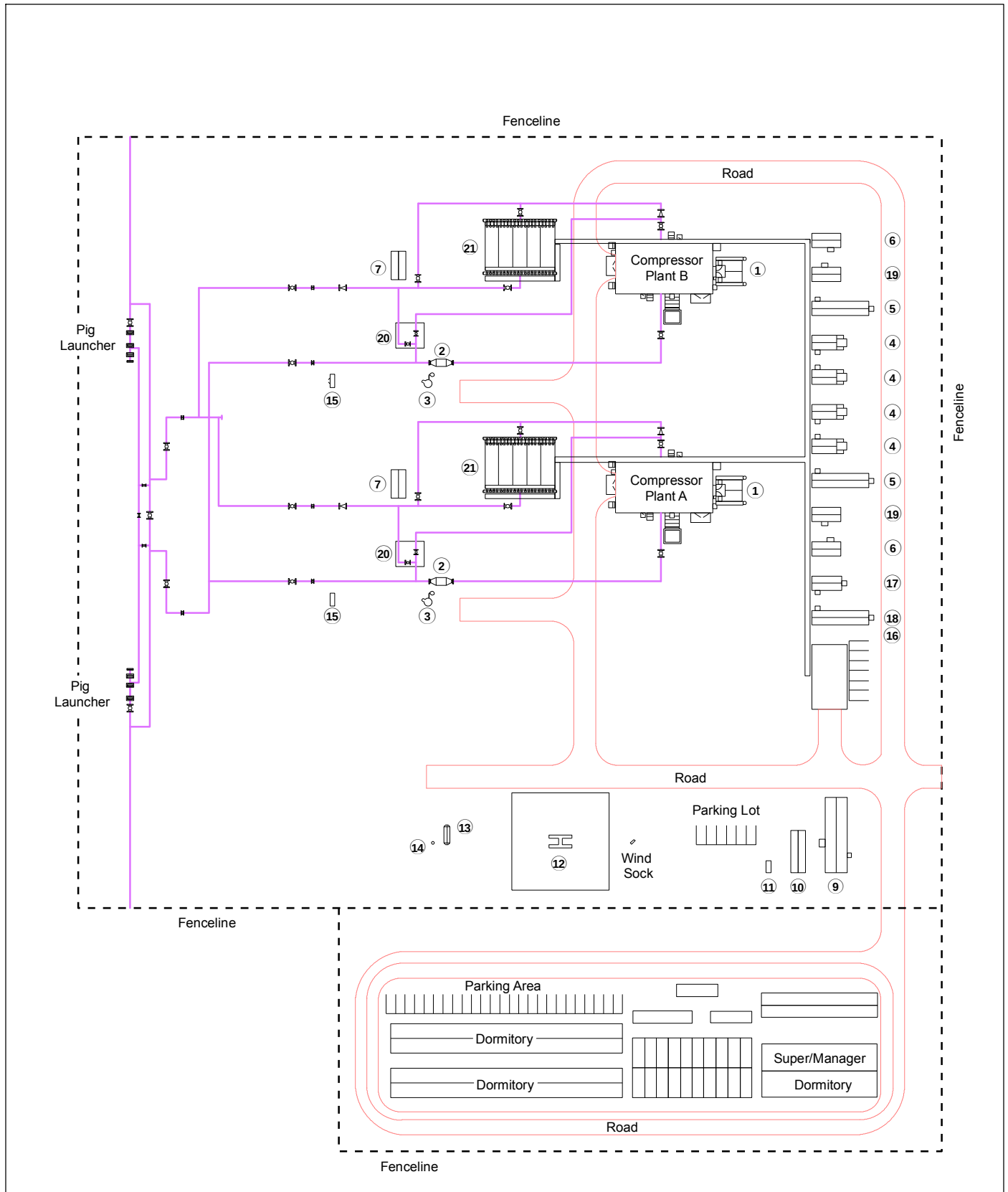
PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: L. HARRISON

FIGURE NO:

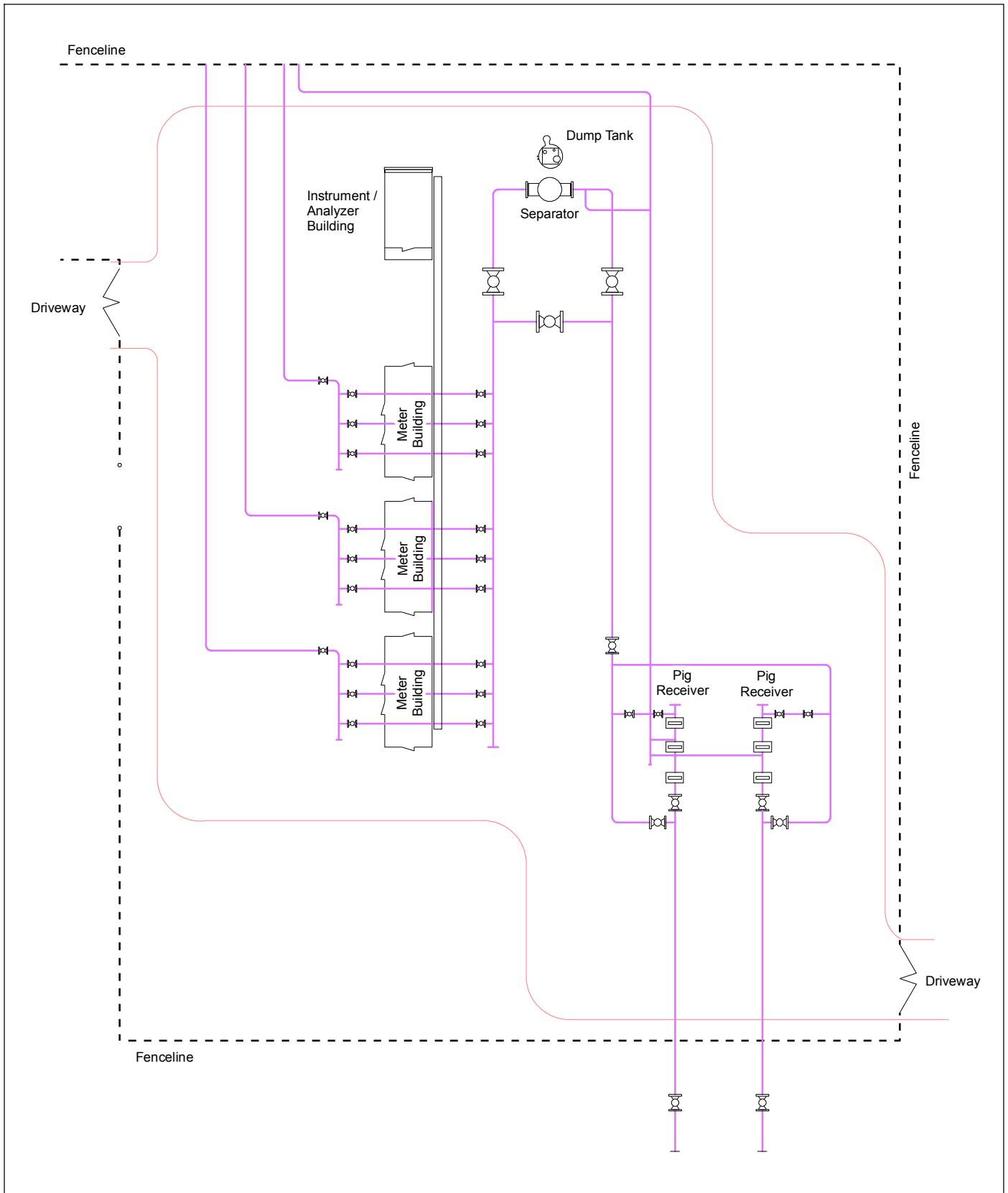
1-4



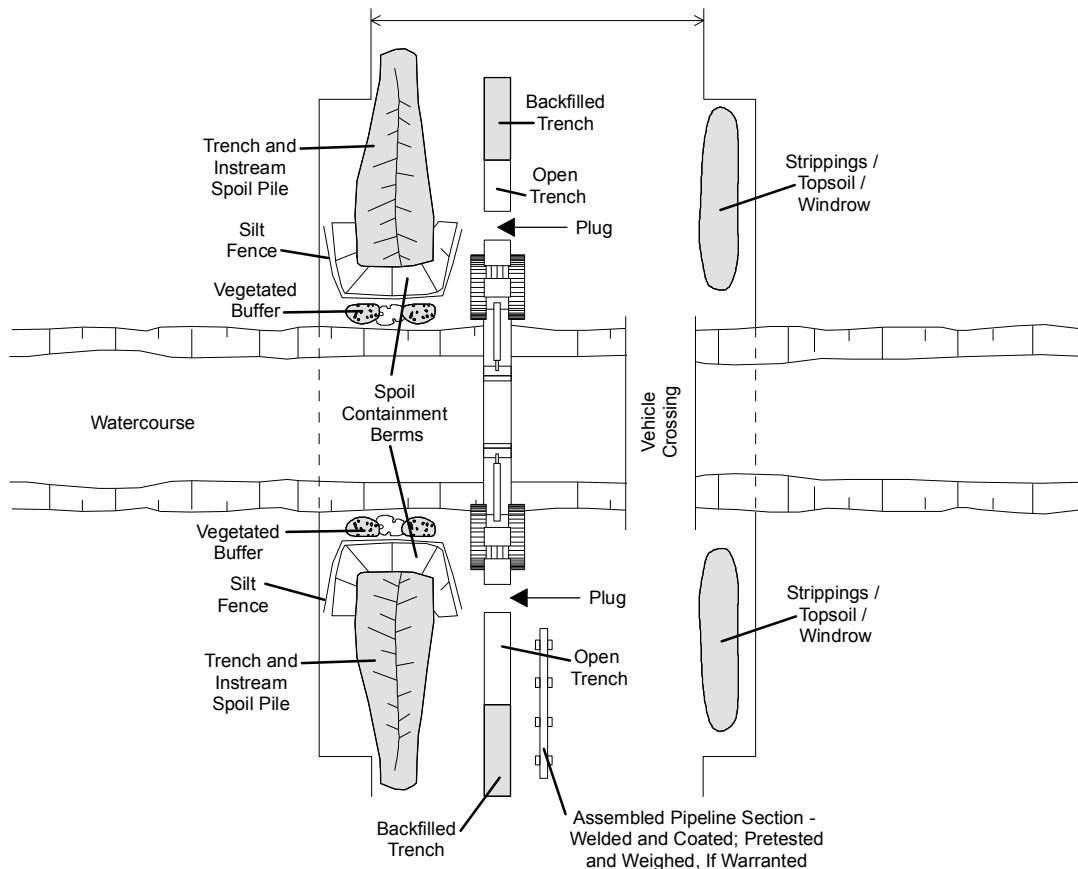
Pipeline Right-of-Way Temporary Workspace Proposed Temporary Workspace	Prince Rupert Gas Transmission Project TYPICAL RIGHT-OF-WAY PLANS ENVIRONMENTAL ASSESSMENT PROJECT OVERVIEW			Prince Rupert Gas Transmission Project			
Data Sources: DataBC; Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; IntecSea; Focus Corporation Disclaimer: Contains information licensed under the Open Government License - British Columbia, Canada. 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.	DATE:	21-MAR-14	PROJECTION:	BC ENVIRONMENTAL ALBERS	DRAWN BY:	N. PUREWAL	FIGURE NO:
	FIGURE ID:	123110628	DATUM:	NORTH AMERICAN DATUM 1983	CHECKED BY:	K. FRASER	1-5



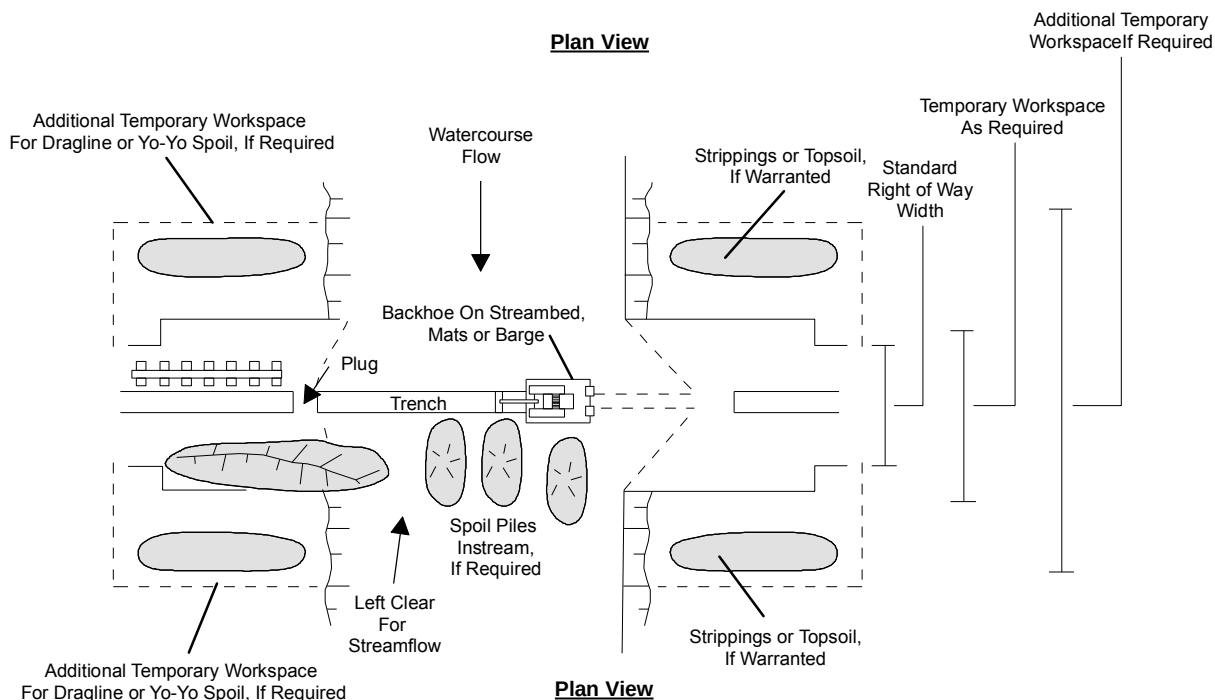
① Compressor Building 2x (26000mm x 19000mm) ② Suction Scrubber ③ Cyclone Separator and Drain Tank ④ PPU Building 4x (11082mm x 4572mm) ⑤ Plant Electrical Building 2x (17500mm x 4500mm) ⑥ Heat Medium Building 2x (9000mm x 4500mm) ⑦ Aftercooler MCC Building 2x (8750mm x 4500mm) ⑧ Heated Storage Building 20000mm x 10973mm ⑨ Living Quarters Building 23165mm x 6707mm ⑩ Potable & Grey Water Building 13000mm x 4500mm ⑪ Waste Handling-Incinerator 3650mm x 1520mm ⑫ Helicopter Pad 30000mm x 30000mm ⑬ Aviation Fuel Tank 1828.8mm OD x 4876.8mm ⑭ Gasoline Tank 914.4mm OD x 1524mm ⑮ Utility Gas Enclosure 2x (7620mm x 4877mm) ⑯ Communication Tower 45720mm Tall ⑰ Station Electrical Building 9250mm x 4500mm ⑱ Personal Building ⑲ Instrument Air Mechanical Building 2x (9000mm x 4500mm) ⑳ Hot/Cold Recycle Building 2x (6300mm x 6300mm) ㉑ Gas Aftercooler		Prince Rupert Gas Transmission Project CONCEPTUAL LAYOUT FOR COMPRESSOR STATIONS ENVIRONMENTAL ASSESSMENT PROJECT OVERVIEW	Prince Rupert Gas Transmission Project FIGURE NO: 1-6
Data Sources: DatabC, Government of British Columbia (GovBC), Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada, Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; Interflex; Focus Corporation Disclaimer: Contains information licensed under the Open Government License – British Columbia, Canada. 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.		DATE: 21-MAR-14 FIGURE ID: 123110628 DRAWN BY: D. COOK	PROJECTION: UTM - ZONE 9 DATUM: NAD 83 CHECKED BY: K. FRASER



Data Sources: DataBC; Government of British Columbia (GovBC); Terrain Resource Information Management; GovBC; National Topographic System; GovBC; BC Stats; GovBC; BC Oil & Gas Commission; GovBC; CanVec v12; Government of Canada (GC); National Hydrology Network; GC; Atlas of Canada National Framework; GC; Fisheries and Oceans Canada; GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; Interleaves; Focus Corporation Disclaimer: Contains information licensed under the Open Government License – British Columbia, Canada. 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.	Prince Rupert Gas Transmission Project CONCEPTUAL LAYOUT FOR METERING STATION <i>ENVIRONMENTAL ASSESSMENT PROJECT OVERVIEW</i> DATE: 21-MAR-14 FIGURE ID: 123110628 DRAWN BY: D. COOK PROJECTION: UTM - ZONE 9 DATUM: CHECKED BY: K. FRASER	Prince Rupert Gas Transmission Project FIGURE NO: 1-7
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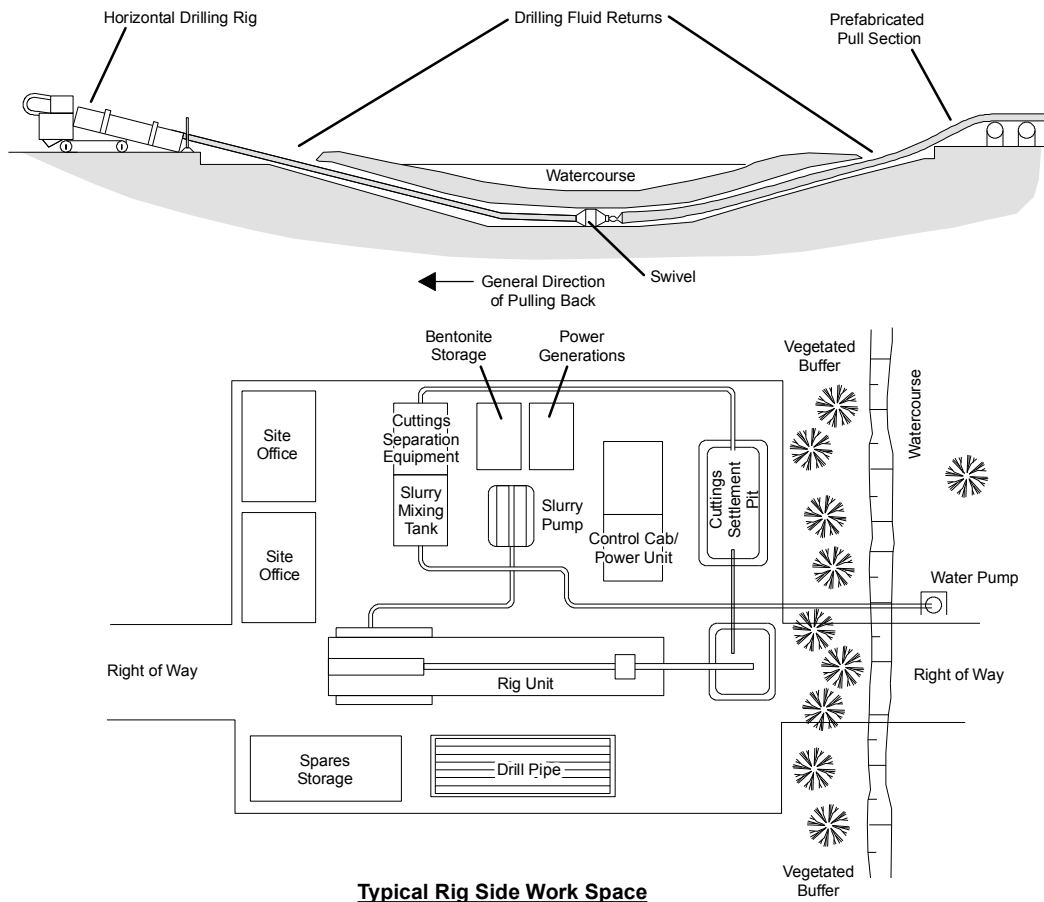


Plan View

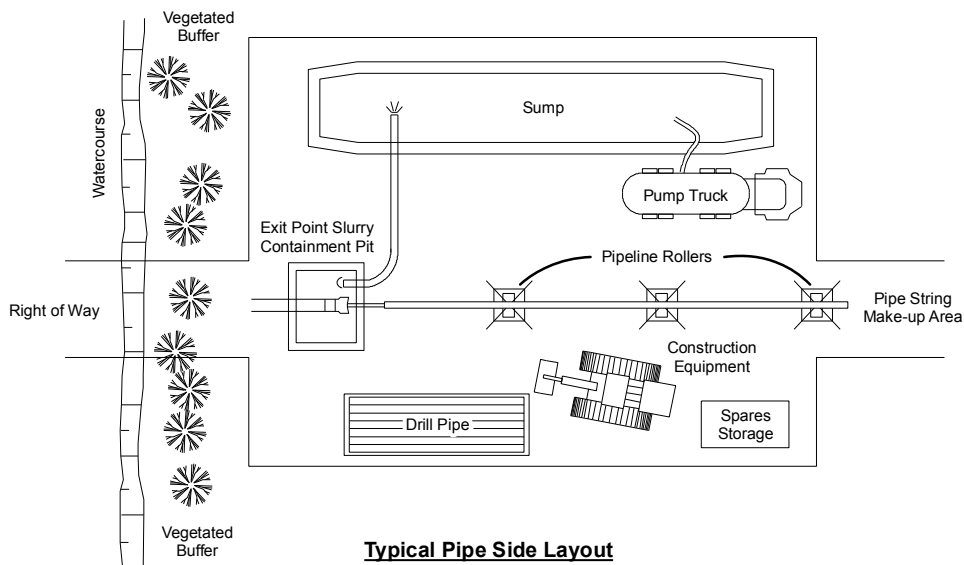


Plan View

Prince Rupert Gas Transmission Project TYPICAL WATERCOURSE CROSSING METHOD - WET CROSSING ENVIRONMENTAL ASSESSMENT PROJECT OVERVIEW Data Sources: DataBC, Government of British Columbia (GovBC), Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada; Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; Interleaves; Focus Corporation Disclaimer: Contains information licensed under the Open Government License - British Columbia, Canada. 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.	DATE: 21-MAR-14 FIGURE ID: 123110628 DRAWN BY: D. COOK PROJECTION: DATUM: CHECKED BY: S. WALLACE	Prince Rupert Gas Transmission Project FIGURE NO: 1-8
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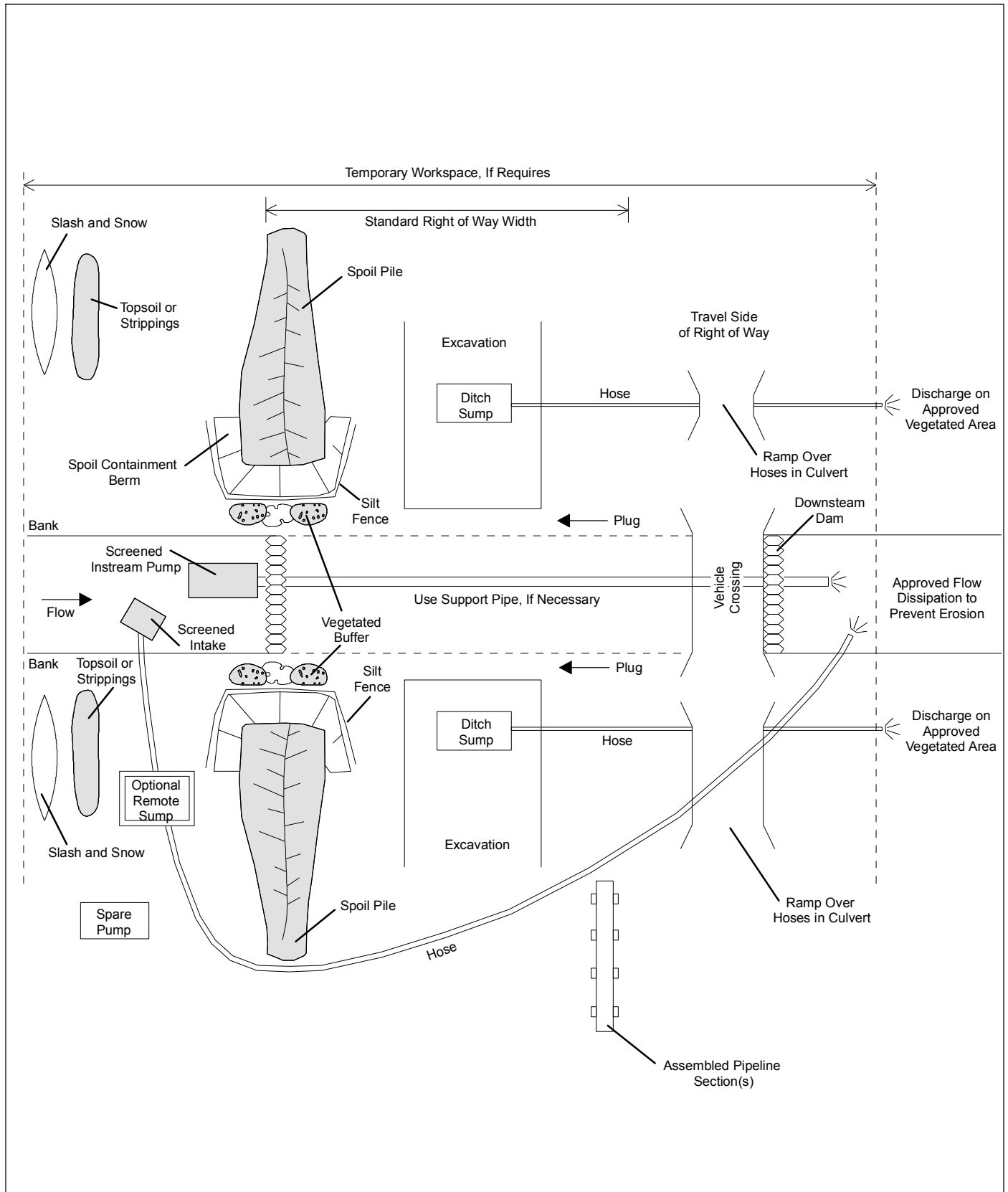


Typical Rig Side Work Space



Typical Pipe Side Layout

	<i>Prince Rupert Gas Transmission Project</i> TYPICAL WATERCOURSE CROSSING METHOD – HDD <i>ENVIRONMENTAL ASSESSMENT PROJECT OVERVIEW</i>		Prince Rupert Gas Transmission Project
Data Sources: DataBC, Government of British Columbia (GovBC); Terrain Resource Information Management, GovBC; National Topographic System, GovBC; BC Stats, GovBC; BC Oil & Gas Commission, GovBC; CanVec v12, Government of Canada (GC); National Hydrology Network, GC; Atlas of Canada National Framework, GC; Fisheries and Oceans Canada, GC; Environmental Canada, Natural Resources Canada; TransCanada Corporation; UniversalPegasus International; InterSea, Focus Corporation Disclaimer: Contains information licensed under the Open Government License – British Columbia, Canada. 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.	DATE: 21-MAR-14 FIGURE ID: 123110628 DRAWN BY: D. COOK	PROJECTION: DATUM: CHECKED BY: S. WALLACE	FIGURE NO: 1-9



Data Sources: DataBC, Government of British Columbia (GovBC), Terrain Resource Information Management, GovBC, National Topographic System, GovBC, BC Stats, GovBC, BC Oil & Gas Commission, GovBC, CanVec v12, Government of Canada (GC), National Hydrology Network, GC, Atlas of Canada National Framework, GC, Fisheries and Oceans Canada, GC, Environmental Canada, Natural Resources Canada, TransCanada Corporation, UniversalPegasus International, Interleaves, Focus Corporation Disclaimer: Contains information licensed under the Open Government License – British Columbia, Canada. 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.	Prince Rupert Gas Transmission Project TYPICAL WATERCOURSE CROSSING METHOD – DAM AND PUMP ENVIRONMENTAL ASSESSMENT PROJECT OVERVIEW DATE: 21-MAR-14 FIGURE ID: 123110628 DRAWN BY: D. COOK PROJECTION: DATUM: CHECKED BY: S. WALLACE	Prince Rupert Gas Transmission Project FIGURE NO: 1-10
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