

TAB A – FINN CREEK PROVINCIAL PARK

August 2014
Rev. 0

APL-BCMOE-TERA-00009

Prepared for:

TRANSMOUNTAIN

Trans Mountain Pipeline ULC

Kinder Morgan Canada Inc.
Suite 2700, 300 – 5th Avenue S.W. Calgary, Alberta T2P 5J2
Ph: 403-514-6400

Prepared by:

tera
A CH2M HILL Company

CH2M HILL Energy Canada, Ltd.
Suite 1100, 815 - 8th Avenue S.W. Calgary, Alberta T2P 3P2
Ph: 403-265-2885

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

1.0 FINN CREEK PROVINCIAL PARK

Finn Creek Provincial Park, established in 1996, protects the lower Finn Creek and a portion of the North Thompson River lowlands in British Columbia (BC). The 303 ha park is situated approximately 215 km north of Kamloops on Highway 5 and encompasses the braided, lower Finn Creek, a deep meandering channel and islands in the North Thompson River.

Finn Creek Provincial Park's primary role is to protect the ecological integrity of the river riparian and associated upland environments. Spawning and rearing habitats for bull trout, coho and Chinook salmon are of particular importance. The wet bottomlands include old growth cottonwoods, western red cedar, hybrid spruce and birch, while the forested uplands provide a protective buffer to enhance the wetland and spawning values.

A secondary role of the park is to serve local recreation interests for cross country skiing, hiking, nature interpretation and access to the North Thompson River for rafting and canoeing. Along the west side of the park are remnants of the Old Highway No. 5 as well as old homesteads. Surveyors used Pinkie Park adjacent to the east park boundary as a lookout point for up and down the valley.

According to the *Finn Creek Provincial Park Management Direction Statement, 1999*, the management objectives for Finn Creek Provincial Park include: maintaining the natural qualities, conditions and aesthetic beauty of the park; fostering and maintaining relationships with First Nations; maintaining the diverse wildlife species and habitats; limiting the introduction of invasive species; and providing continued recreational opportunities for park users.

This environmental and socio-economic assessment (ESA) took into consideration the management objectives of Finn Creek Provincial Park.

2.0 CORRIDOR SELECTION AND PROJECT ACTIVITIES

Early in 2012, Trans Mountain Pipeline ULC (Trans Mountain) conducted a preliminary route assessment of the existing Trans Mountain Pipeline (TMPL) alignment to identify potential routing options for the Trans Mountain Expansion Project (TMEP or the Project) in Finn Creek Provincial Park. As one of the core routing criteria, Trans Mountain sought to follow the existing TMPL system right-of-way to the maximum extent practical, deviating from the TMPL right-of-way only where necessary to reduce environmental and socio-economic impacts or to address technical or safety issues.

2.1 Existing Trans Mountain Pipeline Route

The existing TMPL, constructed in 1952, crosses Finn Creek Provincial Park (established as a designated Park in 1996) for approximately 0.7 km. Trans Mountain holds Order in Council 2412, describing the status of the existing right-of-way through the park.

2.2 Alternatives Considered

Trans Mountain considered three alternatives in Finn Creek Provincial Park and surrounding area:

- an East Alternative that avoids Finn Creek Provincial Park;
- a TMPL Trenchless Alternative that parallels the existing TMPL right-of-way that involves trenchless pipeline construction through the Park; and
- a TMPL Conventional Alternative (*i.e.*, narrowed pipeline corridor) that parallels the existing TMPL right-of-way that involves conventional pipeline construction through the park.

Initially, the TMPL Trenchless Alternative was the preferred alternative, however, geotechnical studies conducted on this alternative corridor have indicated that this option is not technically feasible and is therefore not considered further as an alternative.

An evaluation of the proposed and alternative corridors alternatives is shown in Table A2.2-1 and on Figure A2.2.1. Figure A2.2.-1 also shows the narrowed pipeline corridor, which identifies the land that would be required for the purposes of constructing the Project within Finn Creek Provincial Park.

TABLE A2.2-1

**EVALUATION OF ALTERNATIVE CORRIDORS –
FINN CREEK PROVINCIAL PARK AND SURROUNDING AREAS
(AK 638.0 TO AK 639.5)[1]**

Factors	Narrowed Pipeline Corridor	East Alternative
LENGTHS		
Length through Finn Creek Provincial Park (km)(name)[1]	0.7 (Finn Creek Provincial Park)	0
Length of pipeline corridor (km)	1.5	2.1
Length following existing TMPL right-of-way (km)	1.4	0.1
Length following other linear features (other pipelines, power lines, highways, roads, FOTS[2], railways, etc.) (km)	0.7	1.3
Length of “new” corridor (km)	0.1	0.7
Total parallels (km)	1.4	1.4
CROSSINGS		
No. of highway crossings	0	0
No. of road (arterial, collector, local) crossings	0	0
No. of railway crossings	0	0
Crossings of named rivers (No.)	0	0
Crossings of named creeks (No.)	1 (Finn Creek)	1 (Finn Creek)
Crossings of other watercourses (No.)	1 (seasonal)	1
Total watercourses (No.)	1	2

TABLE A2.2-1 Cont'd

Factors	Narrowed pipeline corridor	East Alternative
GEOTECHNICAL		
Length crossing slopes > 50% on the fall line (km)	0	0
Length crossing slopes > 50% on sidehill (km)	0	0.1
Natural hazard potential (km)	High: 0.0 Medium: 0.0 Low: 1.5	High: 0.0 Medium: 0.0 Low: 2.1
Length of thin veneer of overburden or exposed bedrock (km)	0.0	0.0
HYDRAULIC ACCEPTABILITY	Yes	Yes
LAND		
Indian Reserve (km) (name)	0	0
Provincial Crown (km)	1.5	2.1
Private (km)	0	0
ENVIRONMENT		
Old Growth Management Area (OGMA) (legal) (km)	0	0.3
OGMA (non-legal) (km)	0.1	0
Late winter or early winter habitat for mountain caribou (km) (Wells Gray or Groundhog)	0.8	0
Length within Riparian Reserve Zone (km), wetlands crossed (km), community forests crossed (km), woodlots crossed (km), designated Ungulate Winter Range (km), and Wildlife Habitat Areas (km) (species)	0	0
SOCIO-ECONOMIC		
Agricultural Land Reserve (km)	0	0
Community watersheds (No.)	0	0
LRMP[2] area (km) (name)	1.5 (Kamloops LRMP)	2.1 (Kamloops LRMP)
LRMP Resource Management Zones crossed (km)(name)	1.5 (Visually Sensitive Areas)	2.1 (Visually Sensitive Areas)
ABORIGINAL AND STAKEHOLDER ENGAGEMENT		
Aboriginal Support	No major comments received to date. Engagement ongoing.	No major comments received to date. Engagement ongoing.
Stakeholder Support	General support for alternatives that avoid or reduce effects on provincial parks.	General support for alternatives that avoid or reduce effects on provincial parks.
CONSTRUCTABILITY AND COST		
Constructability	Flow isolation crossing of Finn Creek and conventional trench construction through the balance of Finn Creek Provincial Park. Relatively flat terrain through the park south of the creek.	Isolated crossing of Finn Creek and conventional trench construction bypassing Finn Creek Provincial Park to the east. Difficult terrain with extensive grade work on steep slopes in close proximity to BC Hydro line.
Estimated Construction Cost ($ millions)	$2.9	$4.9

Notes: 1 The total length of the pipeline corridor denotes a point along the corridor where it would be necessary to deviate to avoid Finn Creek Provincial Park and then rejoin the existing TMPL. It does not represent the total length through Finn Creek Provincial Park. This length is needed to compare the full extent of the route alternatives for comparison purposes.

2 FOTS = Fiber Optic Transmission System; LRMP = land and resource management plan.

Orthomosaic maps that identify the land that would be required in Finn Creek Provincial Park (*i.e,* narrowed pipeline corridor) for the purposes of constructing the Project are provided in Figure A2.2-2.

2.2.1 East Alternative that Avoids the Park

The East Alternative would involve an isolated crossing of Finn Creek and conventional trench construction bypassing Finn Creek Provincial Park to the east. This alternative increases the total pipeline length by 1.5 km when compared to the options that traverse Finn Creek Provincial Park and creates new right-of-way for approximately 1 km for a total length of 2.2 km through forested areas that surround the park. This alternative also follows difficult terrain such as a deep incised valley within which extensive grade work

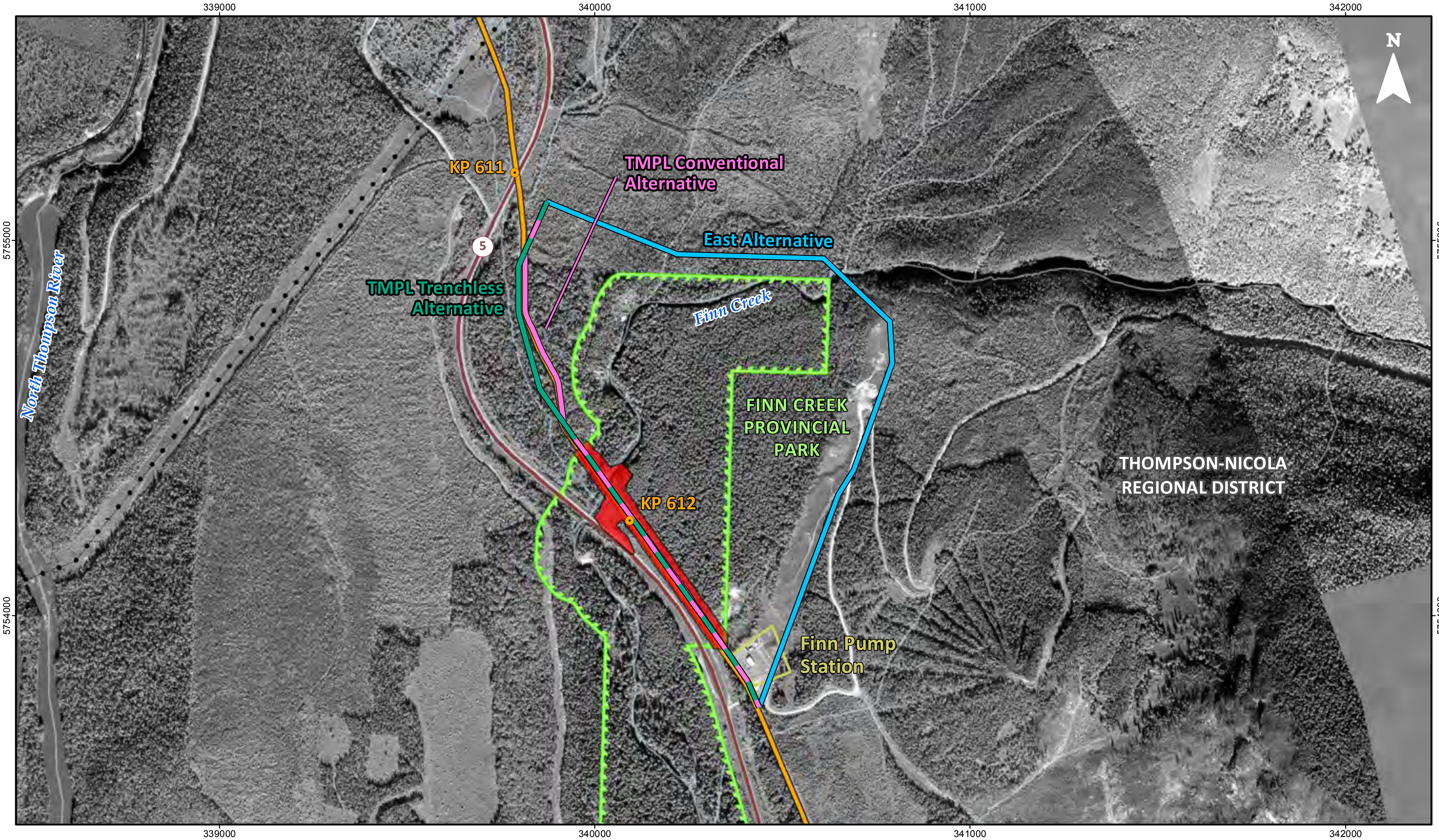
would be required and would create visual impacts not already present. The East Alternative would be located in close proximity to a BC Hydro transmission line and would traverse through an OGMA.

2.2.2 Narrowed Pipeline Corridor (TMPL Conventional Alternative)

The narrowed pipeline corridor parallels the existing TMPL right-of-way and would involve the conventional installation of the pipeline through the park including an isolation pipeline installation technique for the crossing of Finn Creek. This narrowed pipeline corridor crosses less Crown land than the East Alternative and would result in less disturbance to the OGMA. Fewer watercourses would be crossed and by way of following the existing TMPL right-of-way, the visual impacts will be reduced.

2.3 Preferred Alternative

A TMPL Trenchless Alternative was assessed, however, geotechnical investigations have concluded that this trenchless option is not feasible. The narrowed pipeline corridor (TMPL Conventional Alternative) is the preferred alternative which parallels the existing TMPL right-of-way and would entail an isolated watercourse crossing of Finn Creek within Finn Creek Provincial Park. It is the shortest route, parallels an existing right-of-way, avoids an unnamed creek and does not involve a new corridor to the east. Trans Mountain made efforts to further minimize the preferred corridor in Finn Creek Provincial Park (*i.e.,* the narrowed pipeline corridor) in order to reduce the impacts to the park. Trans Mountain will be able to make use of their existing right-of-way through the park for temporary workspace (TWS) during construction, which will further reduce the amount of new disturbance associated with the Project. The terrain encountered within the park is less undulating than would be encountered by the East Alternative, which will result in less grading and overall disturbance during construction of the pipeline.



tera A CH2M HILL Company

0 100 200 300 400 500 m

ALL LOCATIONS APPROXIMATE

MAP NUMBER 201407_MAP_TERA_PER_00594_REV0_01_FINNCREEK		PAGE SHEET 1 OF 1
DATE August 2014	TERA REF. 496781	REVISION 1
SCALE 1:15,000	PAGE SIZE 8.5 x 11	DISCIPLINE RT
DRAWN AJS	CHECKED PS	DESIGN DM

Alternative Routing

- TMPL Conventional Alternative
- TMPL Trenchless Alternative
- East Alternative
- Narrowed Pipeline Corridor within Finn Creek Provincial Park
- Kilometre Post (KP)
- Trans Mountain Pipeline (TMPL)
- Transmission Line
- Watercourse
- Highway
- Railway
- Finn Creek Provincial Park

Projection: NAD 1983 UTM Zone 11N. Baseline TMPL Route Revision 0, provided by KMC, May 2012. Proposed Route Alternates provided by UPI, 2013-2014; Transportation: IHS Inc., 2007, BC FLNRO, 2012; Geopolitical Boundaries: Natural Resources Canada, 2003, IHS Inc., 2011, BC FLNRO; Hydrology: BC FLNRO, 2008; Imagery: Provided by KMC, 2013, NASA Geospatial Interoperability Program 2005.

TRANS MOUNTAIN

FIGURE A2.2.1

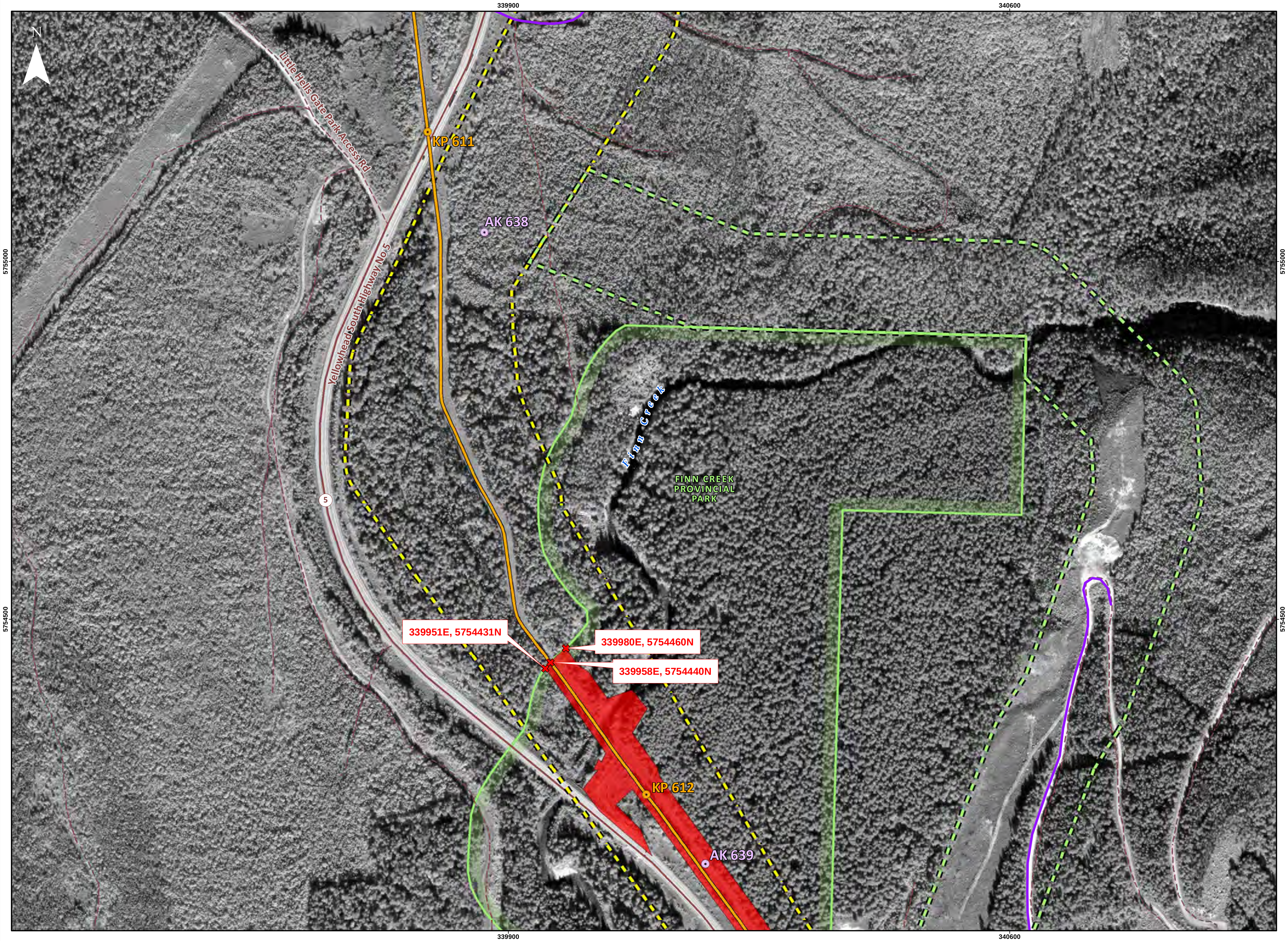
FINN CREEK PROVINCIAL PARK ALTERNATIVE CORRIDORS

TRANS MOUNTAIN EXPANSION PROJECT

201407_MAP_TERA_PER_00594_Rev0_01_FinnCreek.mxd

TRANS MOUNTAIN

FIGURE A.2.2-2
ORTHOMOSAIC MAPPING OF FINN CREEK PROVINCIAL PARK
SHEET 1 OF 5
TRANS MOUNTAIN EXPANSION PROJECT



Start/End UTM Coordinate
Reference Kilometre Post (RK)
Alternate Kilometre Post (AK)
TMPL Kilometre Post (KP)
Existing Major Access
Existing Secondary Access
New Permanent Access
New Temporary Access
Deactivated Overgrown Access
Narrowed Pipeline Corridor within Finn Creek Provincial Park
Trans Mountain Pipeline (TMPL)
Trans Mountain Expansion Project Proposed Revised Pipeline Corridor
Trans Mountain Expansion Project Proposed Alternative Pipeline Corridor
Facility Property Boundary
Highway
Paved Road
Resource Road
Railway
City / Town / District Municipality
Indian Reserve / Métis Settlement
Park / Protected Area

Projection: NAD 1983 UTM Zone 11N. Routing: Baseline TMPL & Facilities provided by KMC, 2012; Proposed Corridor V9.2 provided by UPI, June 5, 2014; RK/AK VF provided by UPI, March 28, 2014; Narrowed Pipeline Corridor provided by UPI, July 24, 2014; Access Roads: UPI, Jan. 24, 2014; Transportation: IHS Inc., 2013, Natural Resources Canada, 2012; Geopolitical Boundaries: IHS Inc., 2013; First Nation Lands: Government of Canada, 2014; Hydrology: Natural Resources Canada, 2007-2011 & BC FLNRO, 2008; Parks and Protected Areas: Natural Resources Canada, 2014, FLNRO, 2008; B/W & Colour Imagery: 2008-2011: Provided by KMC, 2012; NASA Geospatial Interoperability Program, 2005.

tera A CH2M HILL Company

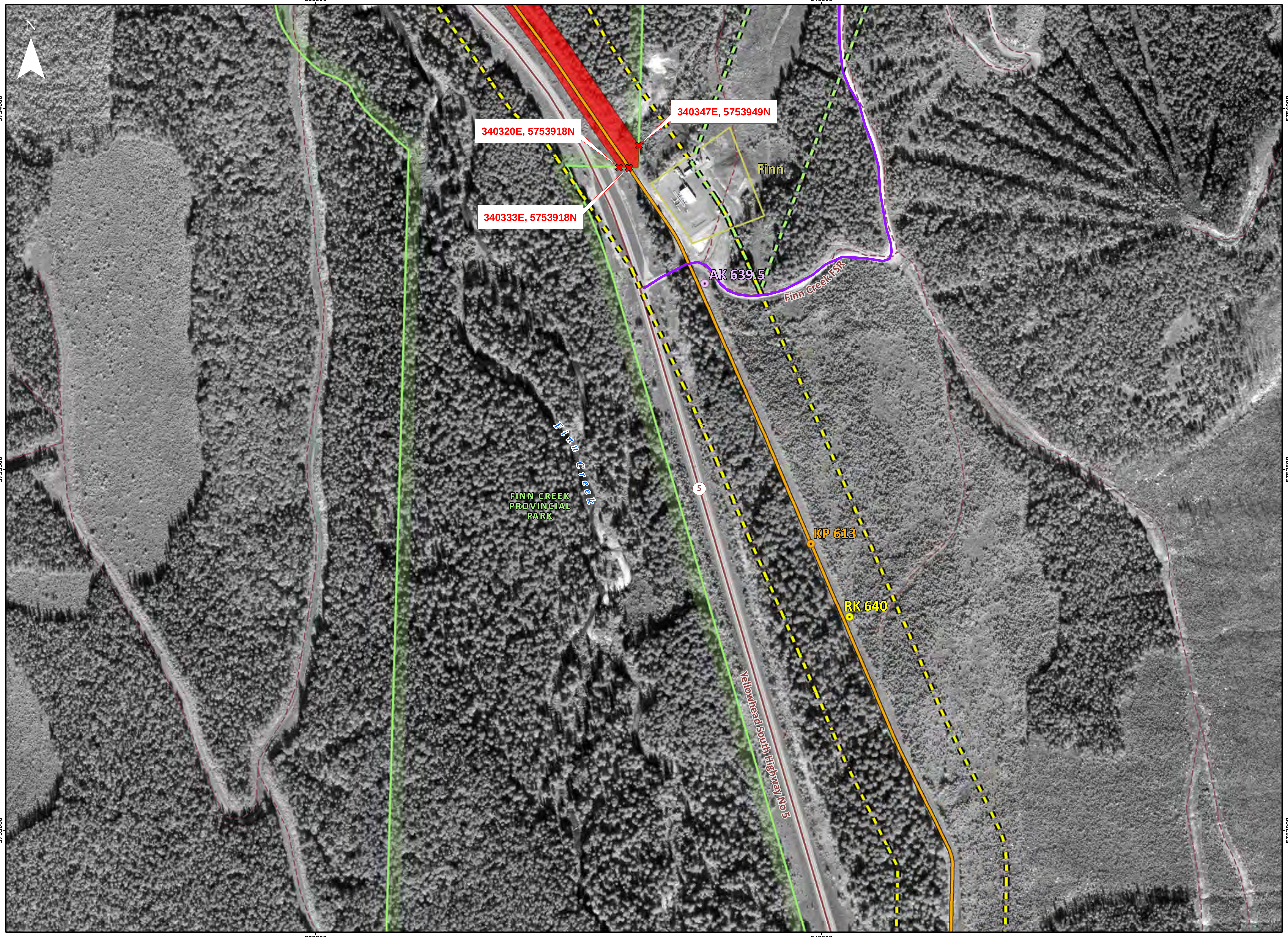
Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

MAP NUMBER		PAGE
201406_MAP_TERA_PER_00592_REV0_01_FINN		SHEET 1 OF 5
DATE August 2014	TERA REF. 7894	REVISION 0
SCALE 1:5,000	PAGE SIZE 11x17	DISCIPLINE PER
DRAWN TPH	CHECKED TGG	DESIGN TGG

0 50 100 150 200 m

ALL LOCATIONS APPROXIMATE

201406_MAP_TERA_PER_00592_Rev0_01_Finn.mxd



TRANS MOUNTAIN

FIGURE A.2.2-2
ORTHOMOSAIC MAPPING OF FINN CREEK PROVINCIAL PARK
SHEET 2 OF 5
TRANS MOUNTAIN EXPANSION PROJECT

- Start/End UTM Coordinate
- Reference Kilometre Post (RK)
- Alternate Kilometre Post (AK)
- TMPL Kilometre Post (KP)
- Existing Major Access
- Existing Secondary Access
- New Permanent Access
- New Temporary Access
- Deactivated Overgrown Access
- Narrowed Pipeline Corridor within Finn Creek Provincial Park
- Trans Mountain Pipeline (TMPL)
- Trans Mountain Expansion Project Proposed Revised Pipeline Corridor
- Trans Mountain Expansion Project Proposed Alternative Pipeline Corridor
- Facility Property Boundary
- Highway
- Paved Road
- Resource Road
- Railway
- City / Town / District Municipality
- Indian Reserve / Métis Settlement
- Park / Protected Area

Projection: NAD 1983 UTM Zone 11N. Routing: Baseline TMPL & Facilities provided by KMC, 2012; Proposed Corridor V9.2 provided by UPI, June 5, 2014; RK/AK VF provided by UPI, March 28, 2014; Narrowed Pipeline Corridor provided by UPI, July 24, 2014; Access Roads: UPI, Jan. 24, 2014; Transportation: IHS Inc., 2013, Natural Resources Canada, 2012; Geopolitical Boundaries: IHS Inc., 2013; First Nation Lands: Government of Canada, 2014; Hydrology: Natural Resources Canada, 2007-2011 & BC FLNRO, 2008; Parks and Protected Areas: Natural Resources Canada, 2014, FLNRO, 2008; B/W & Colour Imagery: 2008-2011: Provided by KMC, 2012; NASA Geospatial Interoperability Program, 2005.

tera | A CH2M HILL Company

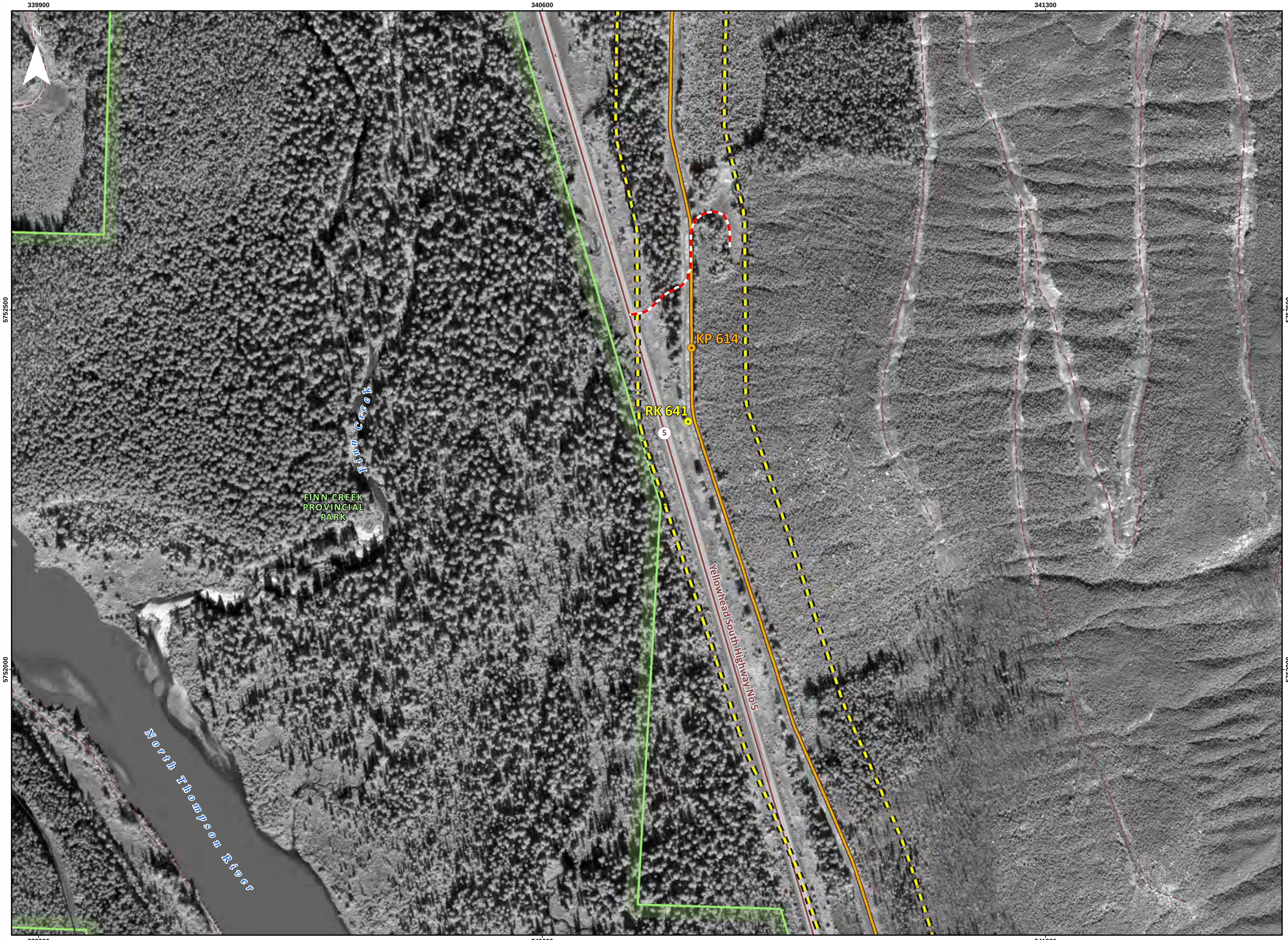
Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

MAP NUMBER		PAGE
201406_MAP_TERA_PER_00592_REV0_01_FINN		SHEET 2 OF 5
DATE: August 2014	TERA REF.: 7894	REVISION: 0
SCALE: 1:5,000	PAGE SIZE: 11x17	DISCIPLINE: PER
DRAWN: TPH	CHECKED: TGG	DESIGN: TGG

0 50 100 150 200 m

ALL LOCATIONS APPROXIMATE

201406_MAP_TERA_PER_00592_Rev0_01_Finn.mxd



201406_MAP_TERA_PER_00592_Rev0_01_Finn.mxd

TRANS MOUNTAIN

FIGURE A.2.2-2
ORTHOMOSAIC MAPPING OF
FINN CREEK PROVINCIAL PARK
SHEET 3 OF 5
TRANS MOUNTAIN EXPANSION PROJECT

- Start/End UTM Coordinate
- Reference Kilometre Post (RK)
- Alternate Kilometre Post (AK)
- TMPL Kilometre Post (KP)
- Existing Major Access
- Existing Secondary Access
- New Permanent Access
- New Temporary Access
- Deactivated Overgrown Access
- Narrowed Pipeline Corridor within Finn Creek Provincial Park
- Trans Mountain Pipeline (TMPL)
- Trans Mountain Expansion Project Proposed Revised Pipeline Corridor
- Trans Mountain Expansion Project Proposed Alternative Pipeline Corridor
- Facility Property Boundary
- Highway
- Paved Road
- Resource Road
- Railway
- City / Town / District Municipality
- Indian Reserve / Métis Settlement
- Park / Protected Area

Projection: NAD 1983 UTM Zone 11N. Routing: Baseline TMPL & Facilities provided by KMC, 2012; Proposed Corridor V9.2 provided by UPI, June 5, 2014; RK/AK VF provided by UPI, March 28, 2014; Narrowed Pipeline Corridor provided by UPI, July 24, 2014; Access Roads: UPI, Jan. 24, 2014; Transportation: IHS Inc., 2013, Natural Resources Canada, 2012; Geopolitical Boundaries: IHS Inc., 2013; First Nation Lands: Government of Canada, 2014; Hydrology: Natural Resources Canada, 2007-2011 & BC FLNRO, 2008; Parks and Protected Areas: Natural Resources Canada, 2014, FLNRO, 2008; B/W & Colour Imagery: 2008-2011: Provided by KMC, 2012; NASA Geospatial Interoperability Program, 2005.

tera | A CH2M HILL Company

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

MAP NUMBER		PAGE
201406_MAP_TERA_PER_00592_REV0_01_FINN		SHEET 3 OF 5
DATE: August 2014	TERA REF.: 7894	REVISION: 0
SCALE: 1:5,000	PAGE SIZE: 11x17	DISCIPLINE: PER
DRAWN: TPH	CHECKED: TGG	DESIGN: TGG

0 50 100 150 200 m

ALL LOCATIONS APPROXIMATE

TRANS MOUNTAIN

FIGURE A.2.2-2
ORTHOMOSAIC MAPPING OF FINN CREEK PROVINCIAL PARK
SHEET 4 OF 5
TRANS MOUNTAIN EXPANSION PROJECT

- Start/End UTM Coordinate
- Reference Kilometre Post (RK)
- Alternate Kilometre Post (AK)
- TMPL Kilometre Post (KP)
- Existing Major Access
- Existing Secondary Access
- New Permanent Access
- New Temporary Access
- Deactivated Overgrown Access
- Narrowed Pipeline Corridor within Finn Creek Provincial Park
- Trans Mountain Pipeline (TMPL)
- Trans Mountain Expansion Project Proposed Revised Pipeline Corridor
- Trans Mountain Expansion Project Proposed Alternative Pipeline Corridor
- Facility Property Boundary
- Highway
- Paved Road
- Resource Road
- Railway
- City / Town / District Municipality
- Indian Reserve / Métis Settlement
- Park / Protected Area

Projection: NAD 1983 UTM Zone 11N. Routing: Baseline TMPL & Facilities provided by KMC, 2012; Proposed Corridor V9.2 provided by UPI, June 5, 2014; RK/AK VF provided by UPI, March 28, 2014; Narrowed Pipeline Corridor provided by UPI, July 24, 2014; Access Roads: UPI, Jan. 24, 2014; Transportation: IHS Inc., 2013, Natural Resources Canada, 2012; Geopolitical Boundaries: IHS Inc., 2013; First Nation Lands: Government of Canada, 2014; Hydrology: Natural Resources Canada, 2007-2011 & BC FLNRO, 2008; Parks and Protected Areas: Natural Resources Canada, 2014, FLNRO, 2008; B/W & Colour Imagery: 2008-2011: Provided by KMC, 2012; NASA Geospatial Interoperability Program, 2005.

tera | A CH2M HILL Company

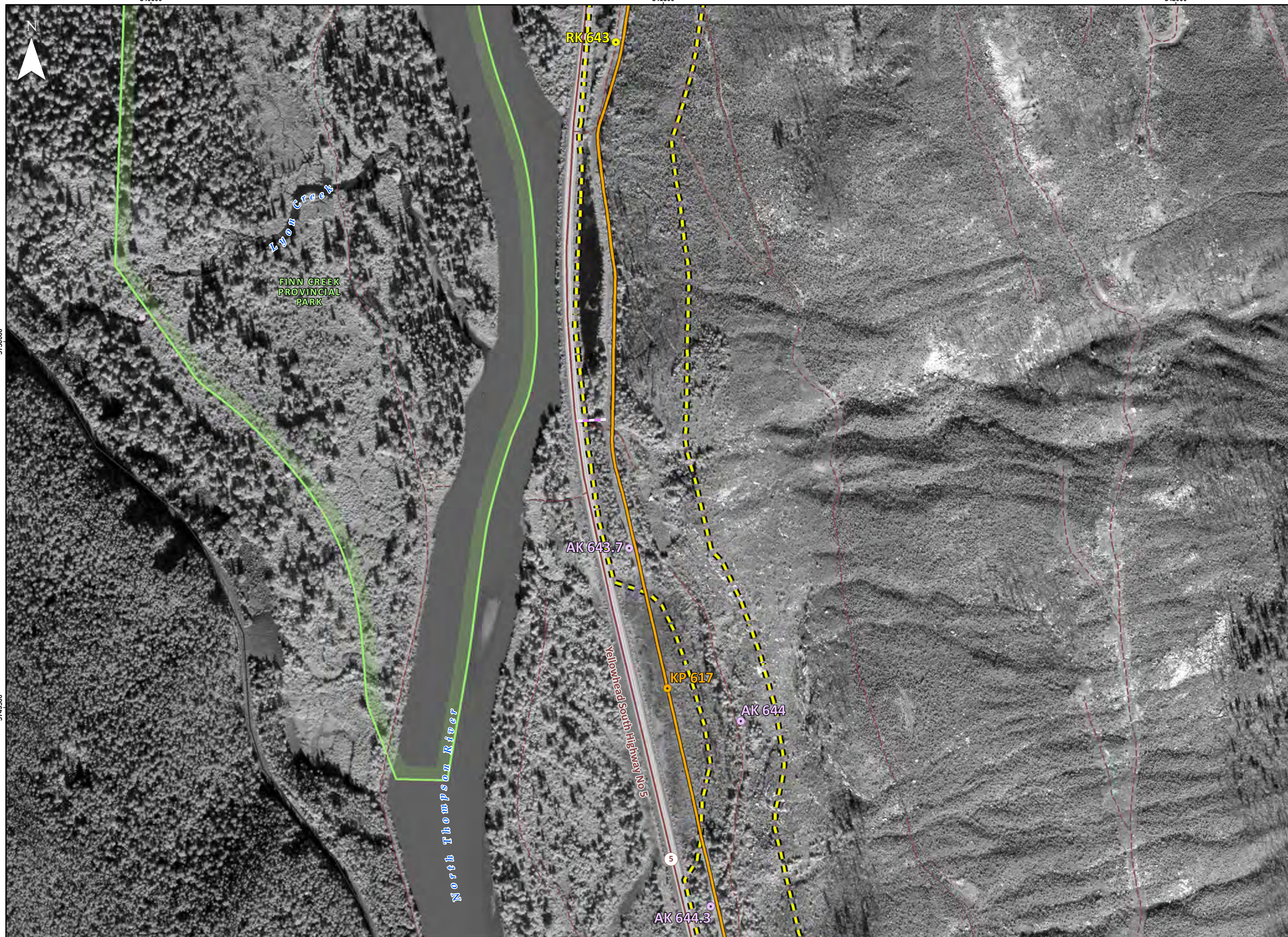
Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

MAP NUMBER		PAGE
201406_MAP_TERA_PER_00592_REV0_01_FINN		SHEET 4 OF 5
DATE: August 2014	TERA REF.: 7894	REVISION: 0
SCALE: 1:5,000	PAGE SIZE: 11x17	DISCIPLINE: PER
DRAWN: TPH	CHECKED: TGG	DESIGN: TGG

0 50 100 150 200 m

ALL LOCATIONS APPROXIMATE

201406_MAP_TERA_PER_00592_Rev0_01_Finn.mxd



TRANS MOUNTAIN

FIGURE A.2.2-2
ORTHOMOSAIC MAPPING OF
FINN CREEK PROVINCIAL PARK
SHEET 5 OF 5
TRANS MOUNTAIN EXPANSION PROJECT

- Start/End UTM Coordinate
- Reference Kilometre Post (RK)
- Alternate Kilometre Post (AK)
- TMPL Kilometre Post (KP)
- Existing Major Access
- Existing Secondary Access
- New Permanent Access
- New Temporary Access
- Deactivated Overgrown Access
- Narrowed Pipeline Corridor within Finn Creek Provincial Park
- Trans Mountain Pipeline (TMPL)
- Trans Mountain Expansion Project Proposed Revised Pipeline Corridor
- Trans Mountain Expansion Project Proposed Alternative Pipeline Corridor
- Facility Property Boundary
- Highway
- Paved Road
- Resource Road
- Railway
- City / Town / District Municipality
- Indian Reserve / Métis Settlement
- Park / Protected Area

Projection: NAD 1983 UTM Zone 11N. Routing: Baseline TMPL & Facilities provided by KMC, 2012; Proposed Corridor V9.2 provided by UPI, June 5, 2014; RK/AK VF provided by UPI, March 28, 2014; Narrowed Pipeline Corridor provided by UPI, July 24, 2014; Access Roads: UPI, Jan. 24, 2014; Transportation: IHS Inc., 2013, Natural Resources Canada, 2012; Geopolitical Boundaries: IHS Inc., 2013; First Nation Lands: Government of Canada, 2014; Hydrology: Natural Resources Canada, 2007-2011 & BC FLNRO, 2008; Parks and Protected Areas: Natural Resources Canada, 2014, FLNRO, 2008; B/W & Colour Imagery: 2008-2011: Provided by KMC, 2012; NASA Geospatial Interoperability Program, 2005.

tera | A CH2M HILL Company

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

MAP NUMBER		PAGE
201406_MAP_TERA_PER_00592_REV0_01_FINN		SHEET 5 OF 5
DATE: August 2014	TERA REF.: 7894	REVISION: 0
SCALE: 1:5,000	PAGE SIZE: 11x17	DISCIPLINE: PER
DRAWN: TPH	CHECKED: TGG	DESIGN: TGG

0 50 100 150 200 m

ALL LOCATIONS APPROXIMATE

201406_MAP_TERA_PER_00592_Rev0_01_Finn.mxd

2.4 Project Components

The technical details of the components of the Project are summarized in Section 2.2.1 of the Introduction to the Stage 2 Detailed Proposal.

The total land required to construct the proposed Project within Finn Creek Provincial Park is approximately 3.27 ha, of which 0.72 ha is disturbance on the existing TMPL right-of-way. Pipeline construction in this area will generally occur on a reduced width right-of-way (*e.g.,* reduced from typical 40 m to 30 m, incorporating an 18 m permanent right-of-way and 12 m temporary workspace) to minimize disturbance. However, approximately 100 m of land would be required in order to support the isolated Finn Creek crossing (see Figure A2.2-1).

Construction equipment will access the proposed construction right-of-way via existing access roads and will travel along the construction right-of-way to the site. No new access will be needed. Design, construction and operation of the pipeline will be in compliance with all applicable codes, standards and regulations.

2.5 Construction Schedule in Finn Creek Provincial Park

Pending regulatory approval of the Project and approval of the Stage 2 Detailed Proposal, mainline construction in Finn Creek Provincial Park is tentatively scheduled to commence in Q2 2017 and extend through Q4 2017, with clearing activities scheduled to commence prior to the start of construction in Q2 2017, but outside of the migratory birds breeding and nesting period. Construction will be conducted as expeditiously as practical in order to avoid the caribou range from November 1 to January 15. Intensive construction activities including trenching, lowering-in and backfilling, will be conducted as quickly as possible in order to reduce the amount of time the trench is open. Proposed construction activities in Finn Creek Provincial Park are expected to take place over a 14 day period including clearing (see Table A2.5-1). However, within that period, the various phases of construction will occur consecutively. A description of the construction activities is provided in Section 2.2.1 of the Introduction of the Stage 2 Detailed Proposal.

TABLE A2.5-1

ESTIMATED PROJECT CONSTRUCTION AND OPERATIONS SCHEDULE

Major Activity	Anticipated Commencement of Major Activity	Estimated Duration of Major Activity
Pipeline Construction	Pending regulatory approval	14 days
Construction Survey	Q2 2017 / Q4 2017 prior to clearing	1 day
Clearing	Q2 2017 to Q4 2017	1 day
Topsoil or Root Zone Material Salvage	Q2 2017 to Q4 2017	1 day
Grading (if required)	Q2 2017 to Q4 2017	1 day
Stringing, Bending and Welding	Q2 2017 to Q4 2017	2 days
Trenching	Q2 2017 to Q4 2017	1 day
Lowering-in	Q2 2017 to Q4 2017	1 day
Backfilling	Q2 2017 to Q4 2017	1 day
Testing	Q4 2017	2 days
Clean-up and Reclamation	Q4 2017	2 days
Operations	In-Service: Q4 2018	Over the first and second complete growing seasons following construction
Post-Construction Monitoring	--	5 years (growing seasons)
Line Patrols	--	Regular intervals
In-Line Inspections	--	As required
Vegetation/Weed Management	--	As required during lifespan
Maintenance Digs	Pending regulatory approval	As required during lifespan

3.0 ABORIGINAL ENGAGEMENT IN FINN CREEK PROVINCIAL PARK

As described in Section 3.0 of the Introduction of the Stage 2 Detailed Proposal, the Aboriginal Engagement Program in Finn Creek Provincial Park included three First Nations groups that are potentially affected by Project activities in the park. Section 3.3 of the Introduction to the Stage 2 Detailed Proposal documents Trans Mountain's engagement efforts with the following Aboriginal communities who have Aboriginal interests potentially affected by the proposed pipeline corridor in Finn Creek Provincial Park:

- Simpcw First Nation;
- Adams Lake Indian Band; and
- Neskonlith Indian Band.

4.0 PUBLIC CONSULTATION IN FINN CREEK PROVINCIAL PARK

As described in Section 4.2.3 of the Introduction of the Stage 2 Detailed Proposal, the public consultation program in Finn Creek Provincial Park consisted of a Community Workshop and a Parks Workshop. The following subsections provide a summary of the attendees invited and interests and concerns raised at the workshops relating to Finn Creek Provincial Park.

4.1 Community Workshop

On May 29, 2013, Trans Mountain held a Community Workshop in Blue River, BC for identified stakeholders to provide an opportunity for local stakeholders to receive updated information and provide feedback on issues and concerns relative to their community especially as it related to routing and environmental studies. Some concerns raised were specific to provincial parks which provided a reference point for those attending Parks Workshops in 2014.

Interested stakeholders were contacted by phone and email and invited to participate. A number of follow-up phone calls were made to encourage invitees to participate. Of the 22 community representatives that were invited, 11 attended. In some cases, organizations were represented by more than one attendee.

Table A4.1-1 provides information on the attendees at the Blue River Community Workshop.

TABLE A4.1-1

PARTICIPANTS IN THE COMMUNITY WORKSHOP – FINN CREEK PROVINCIAL PARK

Group Type	Group
Business	Blue River Powder Packers
	Mike Wiegele Heli-Skiing
	River Safar (Wild Westjets)
Community	Blue River Community Association
Local Government	Thompson Headwaters Services Committee
	Thompson-Nicola Regional District - Director
	Thompson-Nicola Regional District – Services Coordinator

Interested stakeholders that were invited but did not attend the event include:

- Central North Thompson Rod & Gun Club;
- Clearwater Yellowhead Ecological Society;
- Concerned Citizen;
- Cubs and Scouts;
- District of Clearwater;
- Elks;
- Evergreen Anglers (Seniors);
- Grizzly Anglers Society;
- Royal Canadian Legion;
- Thompson Nicola Regional District;
- Vavenby Trail Rides; and
- Wells Gray Outdoor Club.

4.1.1 Summary of Consultation Outcomes at Community Workshop

Table A4.1-2 provides information on key topics, interests and concerns raised relating to Finn Creek Provincial Park at the Blue River Community Workshop.

TABLE A4.1-2

COMMUNITY WORKSHOP – FINN CREEK PROVINCIAL PARK

Topic	Summary of Concern	Finn Creek Provincial Park Detailed Proposal Section
Air	None	N/A
Land	None	N/A
Human Activity and Land Use	Some traplines may be active in Finn Creek near Avola.	Section 7.1.12 of this tab
	There is a large parking lot at Finn Creek Provincial Park that could be used for summer construction.	N/A
Water	Salmon spawning as early as July/August and Chinook in September. There is salmon habitat in Finn Creek Provincial Park.	Section 7.1.6 of this tab

4.2 Parks Workshops

On April 1, 2014, Trans Mountain held a Parks Workshop for selected participants in Clearwater, BC to discuss the proposed routing through both Finn Creek Provincial Park and North Thompson River Provincial Park. Stakeholders were contacted by phone and email and invited to participate. An introductory email was sent to all selected participants on March 17, 2014, and a reminder to RSVP email was sent on March 24, 2014. Interested stakeholders who were unable to attend the event were invited to provide feedback through the online posting of workshop information. An agenda was distributed to all attendees on March 31, 2014.

Attendees consisted of representatives from regional and municipal regulatory agencies, key community and local recreation groups and park users. Of the 20 stakeholder groups that were invited, 10 attended, with some groups having more than one attendee. A total of 26 attendees were present for the event. Local First Nations (Simpcw First Nation, Adams Lake First Nation and Neskonlith First Nation) were provided an opportunity to review and comment on the proposed Parks routing, impacts and benefits through a parallel process, described in Section 3.2.3 of the Stage 2 Introduction. The list of attendees is provided in Table A4.2-1.

TABLE A4.2-1

PARTICIPANTS IN THE PARKS WORKSHOP – FINN CREEK PROVINCIAL PARK

Group Type	Group
Business	Blue River Powder Packers
	Naklin Ltd.
Community	Blue River Community Association
	Little Fort Recreation
	Wells Grey Outdoor Club
Local Government	District of Clearwater
	Thompson Headwaters Services Committee
	Thompson Nicola Regional District
Provincial Government	Ministry of Environment, BC Parks, Thompson Region
	Ministry of Transportation and Infrastructure

Interested stakeholders and Aboriginal communities who were invited but did not attend the event include:

- Adams Lake First Nation;
- Avola Recreation Society;

- Central North Thompson Rod & Gun Club;
- Clearwater ATV Club;
- Clearwater Yellowhead Ecological Society;
- Fisheries and Oceans Canada (DFO);
- Neskonlith Indian Band;
- Simpcw First Nation;
- Tourism Wells Grey; and
- Vavenby Trails Rides.

4.2.1 Summary of Outcomes of Consultation at Parks Workshop

4.2.1.1 Concerns Raised

Table A4.2-2 provides information on the key topics, interests and concerns relating to Finn Creek Provincial Park at the Parks Workshop.

TABLE A4.2-2

PARKS WORKSHOP – FINN CREEK PROVINCIAL PARK

Topic	Summary of Concern	Finn Creek Provincial Park Detailed Proposal Section
Air	None	N/A
Land	Old Growth forests on the east side of the right-of-way in Finn Creek Provincial Park.	Section 7.1.8 of this tab
	Weed introduction in Finn Creek Provincial Park.	Section 7.1.8 of this tab
	Sedimentation and erosion in the valley where the alternate route being proposed through Finn Creek Provincial Park. Soil erosion impacts can already be seen where the power line was placed.	N/A for the purposes of the Stage 2 Detailed Proposal as East Alternate is not being considered in this Proposal.
	Caribou movement extending into Finn Creek Provincial Park from caribou habitat north of the Park.	Section 7.1.9 of this tab
Water	Do not increase drainage into Ministry of Transportation and Infrastructure (MOTI) right-of-way during construction.	N/A for the purposes of the Stage 2 Detailed Proposal as East Alternate is not being considered in this proposal.
	Bull trout are common to Finn Creek in the Park area. Finn Creek Fish study was complete in 1990 by Weyerhaeuser.	Section 7.1.6 of this tab
	The restoration completed in 2012 where a bypass was created and First Nations participated in the mitigation planning should be standard for any mitigation of Finn Creek.	Section 7.1.3 of this tab
Human Activity and Land Use	Need to make clear contractor roles and what materials they can and cannot use around the site. In the past, a contractor had used gravel from Lucerne gravel pit which was not authorized.	Pipeline EPP (Appendix A of this Proposal)
	Alternate route corridor through Finn Creek Provincial Park goes over top of an access corridor to the mountain and groomed trail. They have access agreements between November 15 and April 15.	N/A for the purposes of the Stage 2 Detailed Proposal as East Alternate is not being considered in this proposal.

Trans Mountain will consider all feedback raised to date and will work under the guidance of BC Parks to address concerns through construction, mitigation and reclamation techniques.

4.2.1.2 Park Benefits

Table A4.2-3 provides information on key ideas raised by stakeholders for identifying benefits to Finn Creek Provincial Park. Trans Mountain has submitted this list of possible benefits to BC Parks for consideration against Park management and benefit priorities. Participants were asked to prioritize the benefits that they believed were the most important to the park using a series of criteria which included:

- groups which would benefit (Community, Parks and Trans Mountain);

- impact to ecological value;
- ease of implementation;
- cost effectiveness; and
- ability to partner with existing initiatives.

Based on the number of criteria items the idea applied to, ideas that benefited the greatest number of groups and were easy to implement were determined and are outlined in Table A4.2-3.

TABLE A4.2-3

POTENTIAL PARK BENEFITS – FINN CREEK PROVINCIAL PARK

Summary of Potential Park Benefits	Priority
Restore the old rest area that is unused at the edge of Finn Creek back to a natural area (includes asphalt pad).	High
Signage of right-of-way to notify off highway vehicles of its use.	High
Expansion of snowmobile parking lot by Kinder Morgan Canada Inc. (KMC) Pump Station (KP 612) to get parked vehicles off the highway.	High
Development of walking and biking trails at Little Hell's Gate (outside of Park).	Low

4.3 Other Consultation Activities

4.3.1 Local Government

Trans Mountain shared proposed routing with the Directors for Thompson Nicola Regional District Area B who is responsible for Finn Creek Provincial Park during project and routing briefings. The Area B Director attended, and provided input to, Parks Workshop. Project briefing and proposed routing was provided to Thompson Nicola Regional District staff including the Chief Administrative Officer (CAO) and representatives from Regional Planning, Finance and Emergency Response departments. Through these consultation activities the Thompson Nicola Regional District provided feedback about preferred construction schedules and recreational activity within the park.

While Thompson Nicola Regional District representatives did not take a position in relation to the proposed pipeline route through Finn Creek Provincial Park, no concerns were raised.

Table A4.3.1-1 outlines the Trans Mountain's public consultation activities with the Thompson Nicola Regional District.

TABLE A4.3.1-1

KEY CONSULTATION ACTIVITES WITH LOCAL GOVERNMENT STAKEHOLDERS FROM THOMPSON NICOLA REGIONAL DISTRICT

Stakeholder Group / Agency Name	Title of Contact	Method of Engagement Activity	Date of Consultation Activity	Reason for Engagement
Thompson Nicola Regional District	Chief Administrative Officer	Letter	June 14, 2012	Provide information about the Project
Thompson Nicola Regional District	Chief Administrative Officer	Email	October 22, 2012	Invitation to upcoming public information session in Valemount.
Thompson Nicola Regional District	Chief Administrative Officer	In-person	April 29, 2013	Discuss routing within the Thompson Nicola Regional District
Thompson Nicola Regional District	Chief Administrative Officer	In-person	May 29, 2013	Community Workshop (Refer to Table A4.1-2 for comments provided from stakeholders during this event).
Thompson Nicola Regional District	Chief Administrative Officer	In-person	April 1, 2014	Parks Workshop (Refer to Table A4.2-2 for comments provided from stakeholders during this event).

5.0 ECONOMIC BENEFIT TO FINN CREEK PROVINCIAL PARK

A high level description of economic benefits to the province of BC resulting from the Project is provided in Section 5.0 of the Introduction of the Stage 2 Detailed Proposal.

5.1 Estimated Workforce Requirements

The construction of the Project will involve a workforce of approximately 200 workers onsite at any given time for the duration of construction from Albreda River #2 crossing to the North side of the Thompson River, which includes Finn Creek Provincial Park. The skills of the anticipated workforce will include heavy equipment operators, welders, labourers, mechanics, foremen, surveyors, inspectors and field office support personnel. Generally, during pipeline construction, pipeline crews and workers will use a combination of accommodation resources including: local commercial motels and hotels; private boarding arrangements; temporary work camps; and temporary or permanent RV sites. While a worker accommodation strategy will be developed closer to construction, for workers involved in pipeline construction in Finn Creek Provincial Park, it is anticipated they may stay in a work camp established in the Valemount/Blue River area.

6.0 SETTING OF FINN CREEK PROVINCIAL PARK

The environmental and socio-economic setting along the proposed and narrowed pipeline corridor within Finn Creek Provincial Park is described in Table A6.0-1. Information collected for the setting was obtained both from desktop overviews and field assessments.

TABLE A6.0-1

SUMMARY OF BIOPHYSICAL AND SOCIO-ECONOMIC ELEMENTS AND CONSIDERATIONS IN FINN CREEK PROVINCIAL PARK

Biophysical and Socio-Economic Element	Summary of Considerations
Physical and Meteorological Environment	• Finn Creek Provincial Park lies within the Shuswap Highland subregion of the Interior Plateau Physiographic Region (Holland 1976). • Finn Creek Provincial Park lies in the North Thompson River Valley that separates the Cariboo Mountains Physiographic subdivision to west from the Monashee Mountains Physiographic Subdivision to the east (Holland 1976). • The dominant surficial features in the Shuswap Highlands physiographic region are till, fluvial, glaciofluvial, colluviums, bedrock outcrops and glaciolacustrine (Bednarski 2009, Fulton 1984). • The narrowed pipeline corridor is underlain by the Shuswap Assemblage which is characterized by quartzofeldspathic gneiss and biotite-quartz schist, with lesser amounts of amphibolites, quartzites, marbles, skarns and pegmatites. • Topography along the narrowed pipeline corridor is characterized by gently to moderately sloping rolling highland, rounded ridges, incised fluvial channels and plains. The elevation is approximately 100 m above sea level (asl). • The narrowed pipeline corridor does not encounter any areas of permafrost (Natural Resources Canada [NRC] 2003b), ground instability (NRC 2007b, 2008, 2009) or major flooding (NRC 2007a). • Notable watercourse crossings within Finn Creek Provincial Park include Finn Creek with a catchment area of 124 km^2. • NRC has rated the risk of wind erosion in the Physical Environment LSA as low or negligible (NRC 2003a).
Soil and Soil Productivity	• A soils survey was conducted in April 2014 along the narrowed pipeline corridor within Finn Creek Provincial Park. The soils along the narrowed pipeline corridor in Finn Creek Provincial Park are classified as Typic Mesisols, Orthic Regosols and Orthic Dystric Brunisols. Locations of these soils series along the narrowed pipeline corridor area are presented on the accompanying Environmental Alignment Sheets. • Typic Mesisols (Ghita 2) soils are characterized by semi-decomposed moss peat that exceeds a depth of 1 m. The underlying mineral material may still be encountered within trench depth and is likely stone-free silts or sands. These soils occur in very poorly drained to depressional levels; the water table is at or near the surface. • Eluviated and Orthic Dystric Brunisols (Kwikoit 2) soils are mainly loam sand with no topsoil horizon. Instead, there is a thin duff layer overlying a light coloured Ae horizon and a bright coloured Bm horizon. These sandy textured soils lack cohesion properties. • Orthic Regosol (Alluvium) soils are found on the fluvial floodplain of Finn Creek. These soils are usually coarse-textured and lack cohesion properties. • The narrowed pipeline corridor traverses lands the Canada Land Inventory (CLI) has rated as having no capability for arable culture (Class 7) due to topographic and stoniness limitations and non-irrigated farming as Class 4 due to topographic and soil moisture limitations (CLI 1980).
Water Quality and Quantity	• The narrowed pipeline corridor through the park is located in the Upper North Thompson River Watershed of the Fraser River Basin. • The narrowed pipeline corridor crosses one fish-bearing watercourse (Finn Creek) and a single non-classified drainage/wetland. • Finn Creek is provincially rated as an S2 perennial watercourse. During fisheries field studies conducted in August 2012, stream flow at Finn Creek was measured at 1.46 m^3/s and mean channel width and mean bank height was measured at 18.7 m and 0.9 m, respectively. • The least biological risk window for Finn Creek is July 22 to August 15. • No provincial or federal surficial geology mapping is available within Finn Creek Provincial Park. However mapping completed by BGC Engineering (2013) indicates that the surficial material of the North Thompson River valley consists of recent fluvial sediments, whereas the surficial materials on the valley slopes consist of morainal sediments. • The bedrock underlying the pipeline consists of Shuswap Assemblage metamorphic rocks. • No aquifers were mapped by the BC Ministry of Environment (MOE) within the Finn Creek Provincial Park boundaries. • Groundwater flows generally follow local topography with recharge occurring either directly over the unmapped aquifers or from the valley walls (mountain sides) and discharge feeding the North Thompson River and three local tributaries. Groundwater flow within fluvial sediments is likely direct down gradient, sub-parallel to the valley axis. • No major watercourse crossings occur within the park boundaries. Finn Creek is crossed at AK 638.8.

TABLE A6.0-1 Cont'd

Biophysical and Socio-Economic Element	Summary of Considerations
Water Quality and Quantity (cont'd)	• One water well (BC MOE #54357) was noted in the BC WELLs database within the park boundaries and on the edge of the narrowed pipeline corridor. The well was completed in unconsolidated sediments. • The area is susceptible to changes in groundwater flow patterns (*i.e.,* areas where the pipeline cuts across a slope) on the east side of the park (just outside of the park boundary to the east).
Air Emissions and Greenhouse Gas Emissions(GHG)	• There are no known permanent residences within 250 m of the narrowed pipeline corridor in Finn Creek Provincial Park. • Existing factors affecting air quality in Finn Creek Provincial Park include emissions from intermittent vehicle traffic exhaust from Highway 5, nearby forestry roads and use of the site by BC Ministry of Transportation and its contractors and the Finn Creek Pump Station. The Finn Creek Pump Station is electric and, therefore, produces limited emissions. • The primary source of air emissions (criteria air contaminants [CACs]) during construction will be from fuel combustion related to the use of transportation vehicles and heavy equipment. During operation, emissions will be limited to transportation and equipment use during maintenance activities. CACs expected to be emitted from Project-related activities include sulphur oxides, volatile compounds, carbon monoxide and particulate matter. • A temporary increase in airborne emissions is anticipated during pipeline construction but will not result in an increase in airborne emissions during operations and maintenance. Therefore, a detailed assessment of air and GHG emissions is not warranted.
Acoustic Environment	• Current sources of noise emissions in Finn Creek Provincial Park are from intermittent sources such as vehicle traffic on Highway 5, nearby forestry roads and the Finn Creek Pump Station. • There are no known permanent residences within 250 m of the narrowed pipeline corridor in Finn Creek Provincial Park. • Clearing and construction is scheduled between Q2 2017 to Q4 2017, however, construction will occur as expeditiously as practical in order to avoid the caribou range from November 1 to January 15. • A temporary increase in noise levels is anticipated during pipeline construction. Noise from construction activities will be in compliance with the BC Oil and Gas Commission (BC OGC) BC *Noise Control Best Practices Guideline* (BC OGC 2009). • Noise arising from construction activities and the potential effect on wildlife are discussed in Section 7.1.9. • Noise generated during operations is expected to be undetectable and will not contribute to ambient noise levels. A quantitative assessment of the acoustic environment is, therefore, not warranted.
Fish and Fish Habitat	• The narrowed pipeline corridor crosses one fish-bearing watercourse (Finn Creek) and a single non-classified drainage/wetland. Finn Creek has been rated as having moderate to high levels of fish habitat potential for spawning, rearing, overwintering and migration of salmonids. It contains resident populations of rainbow trout and bull trout and provides known spawning habitat for Thompson River coho, Chinook and sockeye salmon species. • Water quality at the proposed crossing was found to be within Canadian Council of Ministers of the Environment (CCME) (2007) guidelines for pH, and exceeded dissolved oxygen requirements for coldwater and coolwater species of all life stages.
Wetlands Loss or Alteration	• Finn Creek Provincial Park is located within the boundaries of the Columbia Mountains and Highlands Ecoregion of the Montane Cordillera Ecozone. Wetlands in this ecoregion tend to be restricted to mountain slopes where non-forested bogs, marshes and swamps occur (Ecological Stratification Working Group 1995). • Finn Creek Provincial Park is located within the South Interior Mountain Wetland Region. Wetlands characteristic of this region include flat bogs, basin bogs and shallow basin marshes. Within alpine areas, small basin fens and basin bogs can be found (Government of Canada 1986). • Finn Creek Provincial Park is located within the Interior Cedar-Hemlock (ICH) Biogeoclimatic (BGC) Zone of BC. In this BGC Zone, wetlands are not common due to the mountainous terrain. However, marshes associated with lakes and streams in valley bottoms tend to be more common along with small swamps and transitional bogs and fens (BC Ministry of Forests [BC MOF] 1996, Meidinger and Pojar 1991). • Wetlands provide habitat for native plants and wildlife species, including nesting and foraging habitat for a variety of bird species, forage and cover for ungulates and fur-bearers and breeding habitat for amphibians. Wetlands provide water storage, groundwater recharge and natural filtering of sediments. • There are no Ramsar Wetlands of International Importance (Bureau of the Convention of Wetlands 2014), Important Bird Areas (Bird Studies Canada and Nature Canada 2012), Western Hemisphere Shorebird Reserves 2014), Migratory Bird Sanctuaries (Environment Canada 2013) or Ducks Unlimited Canada (DUC) Priority Landscapes (DUC 2014). No DUC projects are crossed by the narrowed pipeline corridor within Finn Creek Provincial Park (Harrison pers. comm.); therefore, no additional mitigation or consultation is recommended.

TABLE A6.0-1 Cont'd

Biophysical and Socio-Economic Element	Summary of Considerations
Wetlands Loss or Alteration (cont'd)	• There is one riparian swamp (mixedwood treed swamp), classified according to the Canadian Wetland Classification System (National Wetland Working Group 1997), and one mountain alder-common horsetail flood association encountered by the narrowed pipeline corridor within Finn Creek Provincial Park and were determined through a combination of helicopter reconnaissance, satellite imagery review and ground-based wetland surveys. Flood associations are ecosystems that possess some wetland characteristics but they do not meet the definition of a wetland as they either do not meet the vegetation and/or soil requirements to be considered a wetland. Although these ecosystems are not considered to be wetlands, standard pipeline practices and mitigation will ensure the appropriate recontouring will occur so that hydrology is maintained. Ground-based wetland surveys were conducted on May 5, 2014 within Finn Creek Provincial Park. See Table A6.0-2 for detailed information on the riparian swamp.
Vegetation	• The narrowed pipeline corridor within Finn Creek Provincial Park is located entirely on Crown-owned land in the Thompson Moist Warm Interior Cedar – Hemlock variant (ICHmw3) and parallels existing disturbance for the entirety of the route through the park. Mature zonal sites in this variant are dominated by western red cedar and western hemlock with a moss carpet beneath (Lloyd *et al*. 1990). It is common for a few shrubs to be present. • The narrowed pipeline corridor crosses a forested/shrubby area. • A search of the BC Conservation Data Centre (CDC) database identified no historical observations of rare plants or rare ecological communities within the RSA (BC CDC 2012). There was one rare ecological community within the Vegetation LSA that was observed during the 2013 field surveys; a common cat-tail marsh. • No plant species designated under the BC *Wildlife Act* are identified as potentially occurring in the Thompson Moist Warm Interior Cedar – Hemlock variant (ICHmw3). No previously recorded Element Occurrences of plant species listed pursuant to the BC *Wildlife Act* are known to occur within the Vegetation RSA (BC CDC 2012). There were no rare plant species designated by the BC CDC observed during the biophysical field surveys in 2013 within Finn Creek Provincial Park. • Terrestrial Ecosystem Mapping from the Project identified the following site series within the park that are crossed by the narrowed pipeline corridor: ICHm w3/01, ICHm w3/01ms, ICHmw3/05, ICHm w3/06, ICHm w3/08 as well as Rural and Road site series. • The TMPL Alternative (Conventional) cross 0.1 km of non-legal OGMA and no legal OGMA. The age range of trees in this park area is projected to be between 61 to 250 years old (BC Ministry of Forests, Lands and Natural Resource Operations [BC MFLNRO] 2013b). • BC Parks suggests that Trans Mountain consult with BC MFLNRO regarding the timber salvaged from the OGMA in Finn Creek Provincial Park. • Finn Creek Provincial Park is located within the Salvage/Limited Action Emergency Bark Beetle Management Area for Mountain Pine Beetle and within the Aggressive management areas for Douglas-Fir Beetle and Spruce Beetle (BC MFLNRO 2010).
Wildlife and Wildlife Habitat	• The narrowed pipeline corridor in Finn Creek Provincial Park is located in the Groundhog caribou range for approximately 587 m (BC MOE 2010a). Groundhog caribou are included in the Wells Gray-Thompson local population unit of southern mountain caribou (Environment Canada 2014c). The narrowed pipeline corridor within Finn Creek Provincial Park crosses 650 m of matrix range critical habitat as currently mapped in the Recovery Strategy for Southern Mountain Caribou (Environment Canada 2014c). The matrix range extends beyond the Groundhog caribou range boundary. • Habitat types in the park include wet bottomlands with old growth cottonwoods, western red cedar, hybrid spruce and birch, and riparian areas associated with Finn Creek and the North Thompson River (BC MOE 2013a). • The park contains habitat for a variety of species including grizzly bear and moose (BC MOE 2013a). • The primary management objective of Finn Creek Provincial Park is to protect the ecological integrity of the river riparian and associated upland environments (BC MOE 1999). Other wildlife-related management objectives include maintaining the diversity of wildlife species and habitats and providing for continued recreation use with opportunities for activities such as wildlife viewing (BC MOE 1999).
Species at Risk	• The following wildlife species at risk have the potential to occur in Finn Creek Provincial Park based on range and habitat availability (BC CDC 2014, Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2014, Environment Canada 2014b). Species at risk are defined here to include those species listed federally under Schedule 1 of *Species at Risk Act* (*SARA*) or by COSEWIC. Species of concern that are listed provincially are provided at the end of the list. – Common nighthawk: Threatened by *SARA* and COSEWIC; – Olive-sided flycatcher: Threatened by *SARA* and COSEWIC, Blue-listed; – Grizzly bear, western population: Special Concern by COSEWIC, Blue-listed; – Little brown myotis: Endangered by COSEWIC; – Northern myotis: Endangered by COSEWIC, Blue-listed; – Wolverine: Special Concern by COSEWIC, Blue-listed; – Woodland caribou, southern mountain population: Threatened by *SARA*, Endangered by COSEWIC, Red-listed; and – Western toad: Special Concern by *SARA* and COSEWIC, Blue-listed.

TABLE A6.0-1 Cont'd

Biophysical and Socio-Economic Element	Summary of Considerations
Species at Risk (cont'd)	– Provincially listed species: American bittern (Blue-listed); California gull (Blue-listed); long-tailed duck (Blue-listed); surf scoter (Blue-listed); upland sandpiper (Red-listed); fisher (Blue-listed); and Townsend's big-eared bat (Blue-listed). • The following vegetation species at risk have the potential to occur in Finn Creek Provincial Park based on historical occurrences of the species (BC CDC 2014, COSEWIC 2014, Environment Canada 2014b). Species at risk are defined here to include those species listed federally under Schedule 1 of *SARA* or by COSEWIC. Species of concern that are listed provincially are provided at the end of the list. – Haller's apple moss: Threatened by *SARA* and COSEWIC, Red-listed; and – Mexican mosquito fern: Threatened by *SARA* and COSEWIC, Red-listed. – Provincially listed species: pink Agoseris (Blue-listed) • The following fish species at risk have the potential to occur in Finn Creek Provincial Park based on historical and/or known occurrences of the species (BC CDC 2014, COSEWIC 2014, Environment Canada 2014b). Species at risk are defined here to include those species listed federally under Schedule 1 of *SARA* or by COSEWIC. Species of concern that are listed provincially are provided at the end of the list. – Coho salmon: Endangered by COSEWIC (Interior Fraser River populations); and – Bull trout: Special Concern by COSEWIC (South Coast BC populations), Blue-listed.
Heritage Resources	• There is archaeological potential throughout the narrowed pipeline corridor in Finn Creek Provincial Park due to proximity to Finn Creek and Culturally Modified Trees (CMT) potential. • There are no previously recorded archaeological sites in Finn Creek Provincial Park. • In accordance with provincial legislation, in the event that any historical, archaeological or palaeontological resources are discovered during construction, construction activity in the vicinity of the discovery will be suspended until provincial authorities allow work to resume. • Approval under the BC *Heritage Act* will be acquired prior to commencement of construction.
Traditional Land Use	• Simpcw First Nation winter home sites are located at Finn Creek, located approximately 0.5 km west of AK 641 (outside park boundaries). • Simpcw First Nation traditional hunting sites are located at Finn Creek, located approximately 809 m southwest of AK 641 (outside park boundaries).
Visitor Enjoyment and Safety	• The narrowed pipeline corridor crosses a paved parking lot in Finn Creek Provincial Park (approximately AK 638.8). • Outdoor recreational uses include canoeing, skiing, snowshoeing, wildlife viewing and fishing activities.

TABLE A6.0-2

WETLAND CLASS ENCOUNTERED ALONG THE NARROWED PIPELINE CORRIDOR THROUGH FINN CREEK PROVINCIAL PARK

Wetland Class	Start AK	End AK	Legal Location
Riparian Swamp (mixedwood treed swamp)	638.8	639.0	c-96-F/82-M-14

7.0 ENVIRONMENTAL AND SOCIO-ECONOMIC EFFECTS AND MITIGATION

Using the assessment methodology described in Section 6.1 of the Introduction of the Stage 2 Detailed Proposal of this report, the following subsections evaluate the potential environmental and socio-economic effects associated with construction and operations of the pipeline.

Environmental and socio-economic elements potentially interacting with the construction and operations of the pipeline in Finn Creek Provincial Park are identified in Table A7.0-1.

TABLE A7.0-1

ELEMENT INTERACTION WITH PROPOSED PIPELINE COMPONENT IN FINN CREEK PROVINCIAL PARK

Element	Interaction with Pipeline Component	
	Construction	Operations
Conservational Values of Finn Creek Provincial Park		
Physical and Meteorological Environment	Yes	Yes
Soil and Soil Productivity	Yes	Yes
Water Quality and Quantity	Yes	Yes
Air Emissions	Yes	Yes
Acoustic Environment	Yes	Yes
Fish and Fish Habitat	Yes	Yes
Wetlands	Yes	Yes
Vegetation	Yes	Yes
Wildlife and Wildlife Habitat	Yes	Yes
Species at Risk	Yes	Yes
Heritage Resources	Yes	No – since surface or buried heritage resource sites, if present, would have been disturbed as a result of construction activities, no interaction is anticipated during operations of the pipeline in Finn Creek Provincial Park.
Traditional Land and Resource Use	Yes	Yes
Recreational Values of Finn Creek Provincial Park		
Visitor Enjoyment and Safety	Yes	Yes

The potential environmental and socio-economic effects associated with the pipeline, as well as the accompanying proposed mitigation measures and resulting residual effects are presented for each environmental and socio-economic element. In addition, using the criteria presented in Table 6.2.6-1 of the Introduction of the Stage 2 Detailed Proposal of this report, the evaluation of significance is provided for each potential residual effect associated with the applicable environmental and socio-economic element in the subsections below.

Many of the mitigation measures recommended in Section 7.0 and 8.0 are considered industry accepted best practices in pipeline construction, reclamation and operations. However, a number enhanced measures are also recommended specific for Finn Creek Provincial Park. The measures are discussed further in Sections 7.0 and 8.0, and are summarized in Table A7.0-2. The entirety of the wildlife mitigation presented in Table A7.1.9-2 is intended to be specific to Finn Creek Provincial Park and, therefore, has not been repeated in Table A7.0-2.

TABLE A7.0-2

ENHANCED MITIGATION MEASURES RECOMMENDED IN FINN CREEK PROVINCIAL PARK

Element/Topic	Recommendations	Section Discussed
Wetlands	• As per the *Finn Creek Provincial Park Management Statement Direction*, 1999, a weed management plan will be implemented at all wetlands crossed within the Park.	Section 7.1.7
Reclamation	Natural Regeneration • Allow for natural regeneration in areas where potential soil erosion and non-native invasive species infestation is low, and where it is anticipated that the topsoil or root zone material contains a propagule bank (*e.g.,* seed, stem or root pieces) of suitable species. • Apply a native perennial or non-native annual grass cover crop species in areas with potential erosion and weed concerns. Woody Species Revegetation *Installation of Nursery-Grown Plant Plugs* • Install nursery-grown plant plugs (*e.g.,* rooted stock plugs) in TWS, riparian and special reclamation areas, where suitable levels of naturally regenerating (from seed or vegetative propagules) deciduous or coniferous trees are not observed. • Secure native seed and collect dormant woody species cuttings, as warranted. • Install deciduous and coniferous rooted plugs at pre-selected sites (*e.g.,* TWS, riparian areas or for line-of-sight breaks) as determined in consultation with BC Parks Conservation Specialists. *Installation of Locally Sourced Dormant Woody Species Transplants* • Use plant transplants at pre-determined locations where vegetation is disturbed by construction. • A permit for harvesting transplants from the adjacent plant community will be discussed with the appropriate personnel. Nutrient Management on Disturbed Forested Areas • Apply a slow-release nitrogen fertilizer on lands that contain woody debris and/or wood chips mixed into the salvaged and replaced root zone material or that have been placed on cleared and ungrubbed portions of the construction right-of-way. Seeding of Native Grass Species • Develop seed mixes in consultation with BC Parks and consist of species native to the park or within the vicinity of the park. • Drill or broadcast seed native seed mixes or grass cover crop species on most of the construction right-of-way or at locations indicated on the Environmental Alignment Sheets, unless otherwise requested by BC Parks Area Supervisor or Conservation Specialist. Specific Erosion and Sediment Control • Install coir logs, erosion control blankets and sediment fences following clearing. Monitor and maintain following construction until vegetation establishment occurs. • Install diversion berms to reduce slope length and runoff velocities, and divert runoff away from watercourses/waterbodies and into well-vegetated areas. • Implement rollback using select tree species (*e.g.,* pine) felled during construction (avoid the use of Douglas-fir, grand fir and spruce) within riparian zones and TWS areas to provide erosion control and habitat enhancement. • Seed (drill or broadcast seeded) using an appropriate native grass seed mix, native perennial or annual non-native cover crop, along the disturbed areas following root zone material replacement at an appropriate prescribed rate. Watercourses • Stabilize banks and slopes of watercourse and riparian areas prior to and immediately following construction (crib structures, erosion control matting, revegetation grass rolls, sediment fences, biodegradable coir geotextile wraps, coniferous tree revetments, cobble or riprap armouring). Weed Management • Utilize Trans Mountain's integrated vegetation management (IVM) approach to manage weeds and problem vegetation. • Develop detailed weed and problem vegetation reports for site-specific locations, as required, following a pre-construction weed survey (scheduled for spring 2015) and consultation with BC Parks Conservation Specialists. Weed and problem vegetation infestations and recommended mitigation measures will be incorporated into the Environmental Alignment Sheets.	Section 8.0

7.1 Conservational Values of Finn Creek Provincial Park

7.1.1 Physical and Meteorological Environment

This subsection describes the potential Project effects on the physical environment in Finn Creek Provincial Park. The Physical Environment LSA consists of a 1 km wide band generally extending from the centre of

the proposed pipeline corridor and facilities (*i.e.,* 500 m on both sides of the proposed pipeline corridor centre); as shown on Figure 6.2.2-3 of the Stage 2 Detailed Proposal.

All physical environment indicators (Table 6.2.1-1 of Introduction to Stage 2 Detailed Proposal) were considered in this evaluation, however, only terrain instability was determined to interact with pipeline construction and operations in Finn Creek Provincial Park. There are no sites within Finn Creek Provincial Park with the potential for acid rock drainage. The topography within Finn Creek Provincial Park is relatively stable with no steep slopes along the narrowed pipeline corridor.

7.1.1.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline on the physical environment indicator is listed in Table A7.1.1-1.

A summary of mitigation measures provided in Table A7.1.1-1 was principally developed in accordance with industry accepted best practices as well as industry and provincial regulatory guidelines including BC OGC (2013) and BC Ministry of Energy and Mines (Price and Errington 1998).

TABLE A7.1.1-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECT OF PIPELINE CONSTRUCTION AND OPERATIONS ON PHYSICAL ENVIRONMENT FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1. Physical Environment Indicator – Terrain Instability			
1.1 General Measures	LSA	• Assess the need for special trench compaction measures or equipment prior to commencement of backfilling [Section 8.4]. See additional backfilling measures in Section 8.4 of the Pipeline EPP. • Recontour the construction right-of-way and re-establish the pre-construction grades and drainage channels if frozen soil conditions prevented completion of this task during backfilling [Section 8.6]. • Revegetate as soon as feasible to reduce or avoid soil erosion and establish long-term cover. Seed immediately following root zone material replacement [Section 8.6]. See additional erosion control and revegetation measures in Section 8.6 of the Pipeline EPP.	• Areas of terrain instability may occur as a result of construction activities.

Notes: 1 LSA = Physical Environment LSA.
2 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of this Proposal).

7.1.1.2 Significance Evaluation of Potential Residual Effects

Table A7.1.1-2 provides a summary of the significance evaluation of the potential residual environmental effect of the construction and operations of the proposed pipeline in Finn Creek Provincial Park on the physical environment. The rationale used to evaluate the significance of the residual environmental effect is provided below.

TABLE A7.1.1-2

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECT OF PIPELINE CONSTRUCTION AND OPERATIONS ON PHYSICAL ENVIRONMENT FOR FINN CREEK PROVINCIAL PARK

	Potential Residual Effect	Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
				Duration	Frequency	Reversibility				
1	Physical Environment Indicator – Terrain Instability									
1(a)	Areas of terrain instability may occur as a result of construction activities.	Negative	LSA	Short-term	Isolated	Short to medium-term	Low	High	High	Not significant

Notes: 1 LSA = Physical Environment LSA.
2 Significant Residual Environmental Effect: A high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated.

Physical Environment Indicator – Terrain Instability

Terrain Instability

Minor areas of terrain instability may occur along areas of the narrowed pipeline corridor as a result of the proposed construction activities (*e.g.,* grading, trenching and backfilling). The impact balance of this residual effect is considered negative since terrain instability could affect the safety of the pipe and result in surface erosion. Terrain along most of the narrowed pipeline corridor in Finn Creek Provincial Park is considered to be stable, based on observations and operating experience of the existing TMPL system to date, as well as the results of the Terrain Mapping and Geohazard Inventory (Volume 4A of the Facilities Application).

During construction of the pipeline, removal of vegetation and root mass, grading, cut and fills and runoff controls could lead to localized areas of potential instability. Monitoring during construction will ensure any observed instability issues will be resolved early before potentially severe instability problems arise. Grade material will be replaced to a stable contour that will approximate the pre-construction contour, except where it is not practical or safe from a pipe integrity perspective or for public safety.

Regular aerial and ground patrols will be conducted to examine vegetation establishment and confirm mitigation measures are functioning as intended, as well as identify any new areas of potential instability. At any areas where erosion is observed, appropriate measures will be implemented to clean-up and stabilize the site. Monitoring of the reclaimed sites will continue until the site is determined to be in a stable condition.

The residual effect of terrain instability occurring as a result of planned construction activity is reversible in the short to medium-term and of low magnitude (Table A7.1.1-2, point 1[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Physical Environment LSA - terrain instability as a result of construction activities may extend beyond the construction workspace.
- Duration: short-term – the event causing potential terrain instability is construction of the pipeline (*e.g.,* grading, and rough clean-up).
- Frequency: isolated – the event causing potential terrain instability (*i.e.,* construction of the pipeline) is confined to a specific period.
- Reversibility: short to medium-term – most areas of terrain instability will be remediated within a year, however, some areas may require a second or third year of remedial effort to fully stabilize.

- Magnitude: low – the implementation of the proposed mitigation measures in addition to detailed engineering design is expected to effectively reduce the severity and extent of potential effects on terrain instability within Finn Creek Provincial Park.
- Probability: high – terrain instability is likely to result from pipeline construction at localized areas.
- Confidence: high – based on data pertinent to the Project area and the experience of the assessment team.

7.1.1.3 Summary

As identified in Table A7.1.1-2, there are no situations where there is a high probability of occurrence of a permanent or long-term residual environmental effect on the physical environment indicator of high magnitude that cannot be technically or economically mitigated. Consequently, it is concluded that the residual environmental effects of pipeline construction and operations on conservational values of Finn Creek Provincial Park related to physical environment will be not significant.

7.1.2 Soil and Soil Productivity

This subsection describes the potential Project effects on the soil and soil productivity in Finn Creek Provincial Park. The Soil LSA consists of a 1 km wide band from the centre of the proposed pipeline corridor and facilities (*i.e.,* 500 m on both sides of the proposed pipeline corridor centre); shown on Figure 6.2.2-3 of the Stage 2 Detailed Proposal.

All soil and soil productivity indicators (Table 6.2.1-1 of Introduction to Stage 2 Detailed Proposal) were considered in this evaluation, however, only soil productivity, soil degradation and soil contamination indicators were determined to interact with pipeline construction and operations in Finn Creek Provincial Park. Soils in Finn Creek Provincial Park are not stony and, therefore, pipeline construction and operations does not interact with the bedrock and stone disposal indicator.

7.1.2.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline on soil and soil productivity indicators are listed in Table A7.1.2-1.

A summary of mitigation measures provided in Table A7.1.2-1 was principally developed in accordance with industry accepted best practices as well as industry and provincial regulatory guidelines including BC OGC (2010a) and Canadian Association of Petroleum Producers (CAPP) (1996, 1999, 2008).

TABLE A7.1.2-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON SOIL AND SOIL PRODUCTIVITY FOR FINN CREEK PROVINCIAL PARK

	Potential Effect	Location	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.	Soil Indicator – Soil Productivity				
1.1	Decreased root zone material productivity during root zone material salvaging	Soil series: Ghita 1, Kwikoit 2, Alluvium	Footprint	Root Zone Material Depth • Soils in Finn Creek Provincial Park crossed by the narrowed pipeline corridor lack topsoil, therefore, root zone material (15-20 cm) should be salvaged for replacement. Root Zone Material Salvage (General) • Implement the Wet/Thawed Soils Contingency Plan (See Appendix B of the Pipeline EPP) during wet/thawed soil conditions in the event wet or thawed soils are encountered during construction [Section 8.2]. • Accommodate BC Parks root zone material salvage requests. Record any locations where BC Parks has requested soil handling which differs from the planned method [Section 8.2]. • Salvage root zone material from areas to be graded and windrow to the closest edge of the construction right-of-way. Avoid overstripping. The area salvaged is to correspond to the area to be graded [Section 8.2]. See additional grading measures in Section 8.2 of the Pipeline EPP. • Store root zone material prior to grading along the nearest pipeline construction right-of-way boundary taking into consideration space requirements for grade and trench spoil, local topography and drainage [Section 8.2]. • Keep trench spoil pile separate from root zone material pile [Section 8.3]. Root Zone Material Salvage (Non-frozen) • Salvage root zone material from the entire construction right-of-way (see Drawing [Topsoil or Root Zone Material Salvage in Forest – Full Right-of-Way] provided in Appendix R of the Pipeline EPP) where grading is necessary and at locations indicated on the accompanying Environmental Alignment Sheets [Section 8.2]. • Salvage a blade width of root zone material centered over the trench (see Drawing [Topsoil or Root Zone Material Salvage – Blade Width/Frozen] provided in Appendix R of the Pipeline EPP) at locations indicated on the accompanying Environmental Alignment Sheets. Disc well-sodded lands prior to root zone material salvage in order to facilitate root zone material salvage operations [Section 8.2]. • See additional root zone material salvage measures in Section 8.2 of the Pipeline EPP Root Zone Materials Replacement • Follow mitigation measures for backfilling as outlined in Section 8.4 of the Pipeline EPP. • Postpone replacement during wet conditions or high winds to prevent damage to soil structure or erosion of root zone material [Section 8.6]. • Replace root zone material evenly over all portions of the construction right-of-way that have been stripped. • Revegetate as soon as feasible to reduce or avoid soil erosion and establish long-term cover. Seed immediately following root zone material replacement [Section 8.6]. • See additional root zone material replacement mitigation measures in Section 8.6 of the Pipeline EPP.	• Mixing of root zone material and subsoil.

TABLE A7.1.2-1 Cont'd

Potential Effect	Location	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.2 Decreased root zone material productivity through trench instability during trenching	Soil series: Kwikoit 2, Alluvium	Footprint	• Suspend trenching and salvage a wider area of root zone material if the trench walls slough into the trench and the potential for root zone material/subsoil mixing exists. Backslope the trench walls until stable. Equip backhoe with a swamp bucket, if practical, to avoid or reduce trench sloughing [Section 8.3]. • Weld up pipe prior to trenching at locations with soils prone to sloughing in order to reduce the time the trench is left open [Section 8.3]. • Limit the length of open trench and the time the trench will be left open to reduce the amount of trench sloughing, frost penetration and interference with wildlife and park visitors [Section 8.3]. • Store salvaged root zone material at a sufficient distance from the trench so that root zone material is not lost in the trench, if trench instability is anticipated [Section 8.3]. • Delay trenching until immediately prior to lowering-in at locations with a high water table or where there is a risk of sloughing [Section 8.3].	• Mixing of root zone material and subsoil due to trench instability.
1.3 Decreased soil productivity from trench subsidence	Soil series: Kwikoit 2, Alluvium	Footprint	• Compact the backfill to reduce trench settlement by running a grader wheel over the backfill when the trench has been backfilled to the level of the surrounding ground. Take extra care to compact the trench at banks of Finn Creek [Section 8.4]. • Feather-out existing trench spoil over the salvaged portion of the construction right-of-way to avoid the creation of a permanent trench crown. Excess spoil will not be feathered-out over the salvaged area to an extent that may cause excessive subsidence of the trench [Section 8.4]. • Postpone feathering-out of excess spoil along segments of the route constructed during frozen soil conditions until after the spring breakup and the trench has settled [Section 8.4]. • See additional measures in Section 8.4 of the Pipeline EPP.	• Excessive trench subsidence or known remnant crown.
1.4 Decreased soil productivity from disturbance (*e.g.,* maintenance dig activities) during operations	Soil series: Ghita 1, Kwikoit 2, Alluvium	Footprint	• Implement the recommended soil handling procedures outlined in the Pipeline EPP to reduce the potential for a reduction in soil productivity when construction activities involving soil disturbance are necessary during operations of the pipeline. • Monitor areas along the construction right-of-way that are disturbed during operations and maintenance activities. Implement remedial measures, where warranted.	• Mixing of root zone material and subsoil.
1.5 Decreased soil productivity resulting from changes in evaporation and transpiration rates	Soil series: Alluvium, Ghita 2, Kwikoit 2	Footprint	• Implement mitigation measures provided in points 2.2 of this table to reduce the loss of topsoil/root zone material through wind erosion for Alluvium, Ghita 2 and Kwikoit soils. • Use only Certified Canada No. 1 or best available seed for cover crop. For native seed, the highest seed grade available will be obtained [Section 8.6].	• Reduction in soil productivity on forested areas resulting from changes in evaporation and transpiration rates.

TABLE A7.1.2-1 Cont'd

	Potential Effect	Location	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
2.	Soil Indicator – Soil Degradation				
2.1	Degradation of soil structure due to compaction and rutting	Soil series: Ghita 2, Alluvium, Kwikoit 2	Footprint	• Implement the Wet/Thawed Soils Contingency Plan (see Appendix B of Pipeline EPP) during wet/thawed soil conditions in the event wet or thawed soils are encountered during construction [Section 8.2]. • Determine locations where subsoil compaction has occurred by comparing compaction levels on and off the construction right-of-way. Sites compared will be in close proximity and have similar drainage, soil moisture, aspect and land use, if feasible [Section 8.6]. • Rip compacted subsoils on the construction right-of-way adjacent to the ditchline and along shoo-flies with a multi-shank ripper or breaking disc to a depth of 30 cm or the depth of compaction, whichever is deeper. If soils are moist, postpone ripping of subsoils until soils dry to ensure that the soils fracture when ripped [Section 8.6]. • Employ a subsoiler plow (*e.g.,* Paratiller) along segments of the construction right-of-way adjacent to the ditchline where root zone material salvage did not occur and subsoil compaction is severe [Section 8.6]. • Disc or chisel plow and harrow ripped subsoils to smooth the surface. Limit discing to that necessary to break up clods in order to prevent further compaction of the subsoils or to increase the potential for soil erosion by wind [Section 8.6]. • See additional measures to reduce compaction and rutting in Section 8.6 of the Pipeline EPP.	• Degradation of soil structure and impairment of rooting zone due to compaction and rutting.
2.2	Loss of root zone material through wind erosion	Soil series: Alluvium, Ghita 2, Kwikoit 2	Footprint	<u>General</u> • Tackify or apply water or pack the root zone material windrow with a sheep foot packer or other approved equipment, if the assessment by the Environmental Inspector(s) indicates that soils are likely to be prone to erosion by wind (see Soil Erosion and Sediment Control Contingency Plan in Appendix B of the Pipeline EPP) [Section 8.2]. • Apply water or approved tackifier to exposed soil piles if wind erosion occurs in Finn Creek Provincial Park [Section 8.2]. • Monitor soil windrows during the growing season for wind and water erosion, and weed growth until the soils are replaced. Implement additional mitigation measures to control erosion (see Soil Erosion and Sediment Control Contingency Plan in Appendix B of the Pipeline EPP) and weed growth when warranted (see Weed and Vegetation Management Plan in Appendix C of Pipeline EPP) [Section 8.2]. • Avoid removing excess small diameter slash in wooded areas with erodible soils [Section 8.6]. • Seed disturbed erodible soils on with a mixture of approved native seed and cover crop seed such as fall rye if seeding in late summer or annual oats if seeding in the winter, spring or early summer [Section 8.6]. • See additional measures in the Soil Erosion and Sediment Control Contingency Plan and Soil/Sod Pulverization Contingency Plan in Appendix B of the Pipeline EPP. <u>Highly Erodible Soils</u> • Install erosion control blanket, coir/straw logs or rollback on exposed moderately to highly erodible soils where there is potential for water or wind erosion prior to re-establishment of vegetation (see Drawings [Rollback] and [Erosion Control – Rollback in Riparian Areas] and [Coir/Straw Log Installation] and [Erosion Control Matting/Blanket] provided in Appendix R of Pipeline EPP) [Section 8.6]. • Install temporary fences to restrict trampling of the seeded construction right-of-way until vegetation becomes established or less palatable [Section 8.6].	• Surface erosion of root zone material can be expected until a vegetative cover is established.

TABLE A7.1.2-1 Cont'd

Potential Effect	Location	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
2.3 Loss of root zone material through water erosion	Soil series: Kwikoit 2	Footprint	• Postpone root grubbing until immediately prior to grading along segments of the construction right-of-way where pre-clearing occurred and where there is a potential for soil erosion to occur, due to sloping terrain and erodible soils [Section 8.1]. See additional grubbing measures in Section 8.1 of the Pipeline EPP. • Leave breaks in the trench crown at obvious drainages and wherever seepage occurs to reduce or avoid interference with natural drainage. • Install temporary sediment fences, where warranted, to control sedimentation prior to final clean-up and the establishment of permanent erosion and sediment control measures (see Drawing [Sediment Fence] provided in Appendix R of Pipeline EPP) [Section 8.6.2]. • Implement the Soil Erosion and Sediment Control Contingency Plan [Section 8.0 of Appendix B of the Pipeline EPP]. • Replace grade material to a stable contour that will approximate the pre-construction contour, except where it is not practical or safe to do so [Section 8.4]. • Regrade areas with vehicle ruts, erosion gullies or where the trench has settled [Section 8.6]. • See additional measures to reduce water erosion at watercourses and wetlands in Sections 8.6 and 8.7 of the Pipeline EPP.	• Surface erosion of root zone material can be expected until a vegetative cover is established.
2.4 Degradation of soil structure due to pulverization of soil and sod	Soil series: Ghita 1, Kwikoit 2, Alluvium	Footprint	• Retain sod and the vegetation mat on all lands if a competent sod layer exists. In these areas, grade only where safety considerations dictate in order to reduce disturbance to sod and the vegetation mat. Grading of well-sodded lands will not be permitted on level terrain [Section 8.2]. • Assess the wind erosion hazard, competency of the sod and potential for soil pulverization due to droughty soils. Implement measures applicable to droughty, wind erodible soils to reduce the impact of soil pulverization and wind erosion (see Soil/Sod Pulverization Contingency Plan in Appendix B) [Section 8.2]. • Apply water or approved tackifier to disturbed areas if traffic and wind conditions result in pulverized soils and dust problems [Section 8.2]. • Cultivate or rip the full width of the construction right-of-way on bush or woodlands where poor sod development exists to a depth adequate to alleviate surface compaction and in a manner acceptable to BC Parks. Do not cultivate into the subsoil [Section 8.6]. • Limit cultivation in areas of fine textured soils to prevent pulverization of the soil (see Soil/Sod Pulverization Contingency Plan in Appendix B) [Section 8.6]. • Disc and harrow only if the site is to be seeded immediately; otherwise, leave the ripped topsoil in a rough condition to reduce wind erosion potential [Section 8.6]. • Disc or rip disturbed soils on hay where the sod layer has been broken or where topsoils are compacted and reseeding is warranted [Section 8.6].	• Pulverization resulting in fugitive dust and loss of soil structure can be expected during dry conditions.
2.5 Loss of root zone material from disturbance (*e.g.*, maintenance dig activities) during operations	Soil series: Ghita 1, Kwikoit 2, Alluvium	Footprint	• Implement the recommended soil handling procedures outlined in the Pipeline EPP to reduce the potential for soil degradation when maintenance activities involving soil disturbance are necessary during operations of the pipeline. • Monitor areas along the right-of-way that are disturbed during operations and maintenance activities. Implement remedial measures, where warranted.	• Surface erosion of root zone material can be expected until a vegetative cover is established.

TABLE A7.1.2-1 Cont'd

	Potential Effect	Location	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
3.	Soil Indicator – Soil Contamination				
3.1	Soil contamination due to spot spills during construction	Soil series: Ghita 1, Kwikoit 2, Alluvium	LSA	• Ensure that during construction no fuel, lubricating fluids, hydraulic fluids, methanol, antifreeze, herbicides, biocides, or other chemicals are dumped on the ground or into watercourses/wetlands/lakes. In the event of a spill, implement the Spill Contingency Plan (see Appendix B of the Pipeline EPP) [Section 7.0]. • Place tarps or other impermeable material on the ground to catch drippings from coating application at weld joints and areas where repairs to the coating are made. Dispose of spilled coating at approved locations [Section 8.3]. • Avoid locating test pumps, generators and fuel storage within park boundaries, if feasible. If not feasible, install test pumps, generators and fuel storage tanks with impermeable lined dike or depression to capture and retain any spills of fuels or lubricants [Section 8.5].	• No residual effect identified.

Notes: 1 LSA = Soil LSA.

2 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of this Proposal).

7.1.2.2 Significance Evaluation of Potential Residual Effects

Table A7.1.2-2 provides a summary of the significance evaluation of the potential residual environmental effects of the construction and operations of the proposed pipeline in Finn Creek Provincial Park on the soil and soil productivity. The rationale used to evaluate the significance of each of the residual environmental effects is provided below.

TABLE A7.1.2-2

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON SOIL AND SOIL PRODUCTIVITY FOR FINN CREEK PROVINCIAL PARK

Potential Residual Effects		Impact Balance	Spatial Boundary	Temporal Context			Magnitude	Probability	Confidence	Significance[1]
				Duration	Frequency	Reversibility				
1.	Soil Indicator – Soil Productivity									
1(a)	Mixing of root zone material and subsoil.	Negative	Footprint	Short-term	Periodic	Medium-term	Low	High	High	Not significant
1(b)	Reduction in soil productivity in forested areas from changes in evaporation and transpiration rates.	Negative	Footprint	Short-term	Periodic	Short to medium-term	Low	High	Moderate	Not significant
1(c)	Excessive trench subsidence or a remnant crown.	Negative	Footprint	Short-term	Isolated	Short to medium-term	Low	High	High	Not significant
2.	Soil Indicator – Soil Degradation									
2(a)	Degradation of soil structure and impairment of rooting zone due to compaction and rutting.	Negative	Footprint	Short-term	Periodic	Short to medium-term	Low	High	High	Not significant
2(b)	Pulverization resulting in fugitive dust and loss of soil structure can be expected during dry conditions.	Negative	Footprint	Short-term	Isolated	Short to medium-term	Low	Low to High	High	Not significant
2(c)	Surface erosion of root zone material can be expected until a vegetation cover is established.	Negative	Footprint	Short-term	Periodic	Medium-term	Low	High	High	Not significant
3.	Soil Indicator – Soil Contamination									
No residual effects identified.		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: 1 Significant Residual Environmental Effect: A high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated.

Soil Indicator – Soil Productivity

Root Zone Material and Subsoil Mixing

During the construction of the pipeline and, to a lesser extent, during maintenance activities, it is likely that a minor amount of root zone material and subsoil mixing will occur along the proposed construction right-of-way. The impact balance of this residual effect is considered negative since admixing could decrease soil productivity. A summary of the rationale for all of the significance criteria is provided in Table A7.1.2-2 (point 1[a]) and below.

- Spatial Boundary: Footprint – admixing is confined to the area of disturbance along the construction right-of-way.
- Duration: short-term – the events causing potential admixing are construction of the pipeline and maintenance-related activities, the latter of which are limited to any one year during the operations phase.
- Frequency: periodic – the events causing potential admixing (*i.e.,* construction and maintenance-related activities) occur intermittently but repeatedly over the assessment period.
- Reversibility: medium-term – loss of soil productivity due to minor root zone material and subsoil mixing is expected to be reversed within 10 years given the implementation of mitigation measures during construction and, if necessary, the application of soil amendments post-construction. The results of recent post-construction environmental monitoring (PCEM) programs in forested and mountainous areas demonstrate that root zone material mixing with subsoil is alleviated within a few years post-construction.

- Magnitude: low – given the implementation of industry-standard and provincial regulatory mitigation measures outlined in Table A7.1.2-1 and, if necessary, soil amendments applied post-construction. The results of recent PCEM programs in forested areas demonstrate that root zone material mixing with subsoil is generally minor in severity and limited in extent.

- Probability: high – admixing is a common residual effect of pipeline construction and may also occur during maintenance activities.

- Confidence: high – there is a good understanding by the assessment team of cause-effect relationships between pipeline construction and soil productivity

Evaporation and Transpiration

Loss of vegetation and soil disturbance will result in changes to evaporation and transpiration rates in forested areas following construction potentially reducing soil productivity.

Following tilling and seeding activities, evaporation and transpiration rates on the construction right-of-way will not differ from off the construction right-of-way unless compaction or lower nutrient levels from admixing reduce vegetation yield. Mitigation measures outlined in Table A7.1.2-1 and the Pipeline EPP will reduce the potential for changes of soil structure and available environmental nutrients. Furthermore, any notable decrease in soil productivity will be identified during post-construction environmental monitoring and appropriate procedures will be implemented (*e.g.,* soil compaction alleviation, fertilization, consultation with BC Parks).

The loss of vegetation in forested areas will not result in any considerable alteration of wind patterns and resultant changes in evaporation rates of adjacent vegetation, nor are increased surface temperatures of bare soil resulting from losses in evaporative cooling expected to affect adjacent vegetation. In general, post-construction environmental monitoring reports for a recent large pipeline project on forested areas demonstrate that soil productivity on right-of-way and off right-of-way are comparable with proper revegetation (TERA 2009a,b, 2011a,b,c, 2012a, 2013a,b). Locations along the construction right-of-way where seeding or natural revegetation have not been as successful will be recorded and appropriate measures will be implemented (*e.g.,* fencing to prevent grazing, reseeding, soil decompaction, fertilization).

Through appropriate scheduling and implementation of soil conservation and vegetation management measures in Table A7.1.2-1 and the Pipeline EPP (Appendix A of this Proposal), the magnitude of changes in evaporation and transpiration resulting from pipeline construction is considered to be low. A reduction in soil productivity resulting from changes in evaporation and transpiration rates is considered reversible in the short to medium-term depending on land use, vegetation type and the success of soil handling and revegetation efforts (Table A7.1.2-2, point 1[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – reduction in soil productivity in forested areas resulting from changes in evaporation and transpiration rates are confined to the area of disturbance along the construction right-of-way.

- Duration: short-term – the events causing potential evaporation and transpiration rates are construction of the pipeline and maintenance-related activities, the latter of which are limited to any one year during the operations phase.

- Frequency: periodic – the events causing reduction in soil productivity in forested areas resulting from changes in evaporation and transpiration rates (*i.e.*, construction and maintenance-related activities) occur intermittently but repeatedly over the assessment period.

- Reversibility: short to medium-term – depending on vegetation type and success of soil handling and revegetation efforts, potential reduction in soil productivity resulting from changes in evaporation and transpiration rates may take up to or more than one year but less than 10 years to alleviate.

- Magnitude: low – given the implementation of industry-standard and provincial regulatory mitigation measures outlined in Table A7.1.2-1 and, if necessary, soil amendments applied post-construction. The

results of recent post-construction environmental monitoring programs in forested areas demonstrate that changes in evaporation and transpiration rates are generally minor in severity and limited in extent.

- Probability: high – changes in evaporation and transpiration rates are common residual effects of pipeline construction and may also occur during maintenance activities.
- Confidence: moderate – there is a good understanding by the assessment team of cause-effect relationships between pipeline construction and changes in evaporation and transpiration rates from data outside of the Project area. Since the understanding is not from data within the Project area, the confidence is rated as moderate.

Trench Subsidence or Remnant Crown

Construction activities may result in localized areas of excessive trench subsidence and/or a remnant crown over the trench. The impact balance of this residual effect is considered negative since excessive trench subsidence or a remnant crown may reduce soil productivity through erosion and drainage issues. Trench subsidence and a remnant crown do not always occur during the year following construction and reclamation, and will be greatly influenced by the amount of precipitation. The reversibility of trench subsidence and/or a remnant crown is considered to be short to medium-term since remedial work associated with trench subsidence and/or a remnant crown typically occurs within a year of construction, however, localized trench subsidence may arise 2 to 3 years following construction (TERA 2009a,b, 2011a,h,i, 2012d, 2013c,g). With effective compaction of the backfilled trench and feathering out any remaining material over the trench, the magnitude of the effect of trench subsidence on soil and soil productivity is considered to be low (Table A7.1.2-2, point 1[c]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – trench subsidence or a remnant crown is confined to the trench line within the construction right-of-way.
- Duration: short-term – the event causing potential trench subsidence or a remnant crown is construction of the pipeline which is limited to the construction phase.
- Frequency: isolated – the event causing potential trench subsidence or a remnant crown (*i.e.,* construction activities) is confined to a specified phase of the assessment period.
- Reversibility: short to medium-term – remedial work associated with a remnant crown and trench subsidence typically is conducted within a year of construction, however, localized trench subsidence may also arise 2 to 3 years after construction.
- Magnitude: low – given the implementation of industry-standard and provincial regulatory mitigation measures outlined in Table A7.1.2-1 and, if necessary, soil amendments applied post-construction. The results of recent PCEM programs in forested areas demonstrate that trench subsidence or a remnant crown is generally minor and limited in extent.
- Probability: high – trench subsidence or a remnant crown is a common residual effect of pipeline construction.
- Confidence: high – there is a good understanding by the assessment team of cause-effect relationships between pipeline construction and trench subsidence/remnant crowns.

Soil Indicator – Soil Degradation

Degradation of Soil Structure from Compaction and Rutting

Soil compaction, as a result of construction activities, can result in the reduction of soil pore space and an increase of soil bulk density or mass. Plant roots have greater difficulty penetrating compacted soil which can reduce the productivity of plant communities. Rutting can occur by vehicle traffic during wet conditions. The impact balance of this residual effect is considered negative since compaction and rutting could decrease the structure of the soil and, therefore, reduce soil productivity.

The impact balance of this residual effect is considered negative since compaction and rutting could decrease the structure of the soil and, therefore, reduce soil productivity.

Given the proven effectiveness of the mitigation measures to reduce admixing along the construction right-of-way, it is anticipated that the extent and severity of compaction and rutting will be minor. As a result, this residual effect is considered to be of low magnitude (Table A7.1.2-2, point 2[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – degradation of soil structure from compaction and rutting is confined to the area of disturbance along the construction right-of-way.
- Duration: short-term – the events causing potential degradation of soil structure from compaction and rutting are construction of the pipeline and maintenance-related activities, the latter of which are limited to any one year during the operations phase.
- Frequency: periodic – the events causing potential degradation of soil structure from compaction and rutting (*i.e.,* construction and maintenance-related activities) occur intermittently but repeatedly over the assessment period.
- Reversibility: short to medium-term – degradation of soil structure from compaction and rutting is expected to be reversed within a few years given the implementation of mitigation measures during construction and, if necessary, the application of soil amendments post-construction.
- Magnitude: low – given the implementation of industry-standard and provincial regulatory mitigation measures outlined in Table A7.1.2-1 and, if necessary, soil amendments applied post-construction.
- Probability: high – degradation of soil structure from compaction and rutting is a common residual effect of pipeline construction and may also occur during maintenance activities.
- Confidence: high – there is a good understanding by the assessment team of cause-effect relationships between pipeline construction and soil degradation.

Degradation of Soil Structure from Pulverization

Construction activities during dry conditions may result in pulverization of soil and sod along the narrowed pipeline corridor in Finn Creek Provincial Park. The impact balance of this residual effect is negative since pulverization of soil and sod could lead to increased fugitive dust and loss of soil structure. Given the mitigation measures in Table A7.1.2-1 to reduce soil/sod pulverization, including the Soil/Sod Pulverization Contingency Plan, degradation of soil structure from pulverization is considered to be reversible in the short to medium-term (Table A7.1.2-2, point 2[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – degradation of soil structure from pulverization is confined to the area of disturbance along the construction right-of-way.
- Duration: short-term – the event causing degradation of soil structure from pulverization is construction of the pipeline.
- Frequency: isolated – the event causing degradation of soil structure from pulverization (*i.e.,* construction of the pipeline) is confined to a specified phase of the assessment period.
- Reversibility: short to medium-term – effects related to dust are reversible in less than one year (short-term); while the effects related to loss of soil structure is expected to take more than one year but less than 10 years to reverse the effect (medium-term).
- Magnitude: low – given the implementation of mitigation measures outlined in Table A7.1.2-1 and, if necessary, soil amendments applied post-construction.

- Probability: low to high – degradation of soil structure from pulverization is a common residual effect of pipeline construction but only in dry conditions so the likelihood varies by location along the construction right-of-way and weather conditions.
- Confidence: high – based on data pertinent to the Project area and the professional experience of the assessment team.

Surface Erosion of Root Zone Material

Construction and maintenance activities which disturb the soil will likely result in some surface erosion of root zone material until a stable vegetative cover can be established, particularly on slopes which are more susceptible to water erosion, such as the alluvium soils on the slopes of Finn Creek. The impact balance of this residual effect is considered negative since erosion could decrease soil productivity. Based on the results of post-construction monitoring programs for pipeline projects in forested settings, issues related to erosion can generally be resolved within 2 to 3 years following final clean-up (TERA 2009a,b, 2011a,h,i, 2012d, 2013c,g). Similar measures are planned for the construction of the proposed pipeline. Consequently, minor surface erosion of root zone material is considered to be reversible in the medium-term (Table A7.1.2-2, point 2[c]). A summary of the rationale for all the significance criteria is provided below.

- Spatial Boundary: Footprint – surface erosion is confined to the area of disturbance along the construction right-of-way.
- Duration: short-term – the events causing surface erosion are construction of the pipeline and maintenance-related activities, the latter of which are limited to any one year during the operations phase.
- Frequency: periodic – the events causing surface erosion (*i.e.,* construction and maintenance-related activities) occur intermittently but repeatedly over the assessment period.
- Reversibility: medium-term – surface erosion is generally expected to be reversed within 2 to 3 years given the implementation of mitigation measures during construction and, if necessary, the application of soil amendments post-construction.
- Magnitude: low – given the implementation of industry-standard and provincial regulatory mitigation measures outlined in Table A7.1.2-1 and, if necessary, soil amendments applied post-construction.
- Probability: high – surface erosion is a common residual effect of pipeline construction which can be addressed during PCEM and may also occur during maintenance activities.
- Confidence: high – there is a good understanding by the assessment team of cause-effect relationships between pipeline construction and soil degradation.

Soil Indicator – Soil Contamination

No residual effects of the construction and operations of the proposed pipeline were identified for the soil contamination indicator (Table A7.1.2-2). Consequently, no further assessment is warranted.

7.1.2.3 Summary

As identified in Table A7.1.2-2, there are no situations where there is a high probability of occurrence of a permanent or long-term residual environmental effect on soil and soil productivity indicators of high magnitude that cannot be technically or economically mitigated. Consequently, it is concluded that the residual environmental effects of pipeline construction and operations on conservational values of Finn Creek Provincial Park related to soil and soil productivity will be not significant.

7.1.3 Water Quality and Quantity

This subsection describes the potential Project effects on water quality and quantity in Finn Creek Provincial Park. The Water Quality and Quantity LSA is the area generally extending 100 m upstream of the centre of

the proposed pipeline corridor to a minimum of 300 m downstream of the centre of the proposed pipeline corridor, as well as within 300 m of the proposed pipeline corridor in consideration of surface water drainage patterns along the pipeline corridor; shown in Figure 6.2.2-3 of the Introduction to the Stage 2 Detailed Proposal. The Aquatics RSA includes all watersheds directly affected by the proposed pipeline corridor and applies to surface water; shown in Figure 6.2.2-1 of the Introduction to the Stage 2 Detailed Proposal.

All water quality and quantity indicators (Table 6.2.1-1 of Introduction to Stage 2 Detailed Proposal) were considered in this evaluation; and all of them were determined to interact with pipeline construction and operations in Finn Creek Provincial Park.

7.1.3.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline on water quality and quantity indicators are listed in Table A7.1.3-1.

A summary of mitigation measures provided in Table A7.1.3-1 was principally developed in accordance with industry accepted best practices as well as industry and provincial and federal regulatory guidelines including BC MOE (2010), BC MOF (1995), BC Ministry of Water, Land and Air Protection (BC MWLAP) (2004), BC OGC (2013), CAPP *et al*. (2012) and DFO (1995, 1999, 2013), as well as groundwater legislation under the *Oil and Gas Activities Act* (*Environmental Protection and Management Regulation*) and the *BC Environmental Assessment Act.* Table A7.1.3-2 provides the pipeline and vehicle crossing methods for watercourses encountered within Finn Creek Provincial Park.

TABLE A7.1.3-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON WATER QUALITY AND QUANTITY FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1. Water Quality and Quantity Indicator – Surface Water Quality			
1.1 Suspended sediment concentrations in the water column during instream activities	LSA	Pipeline Crossing • An isolated watercourse crossing method (*i.e*., if water is present) and open-cut contingency method (*i.e.,* if dry or frozen to the bottom) have been selected in consideration of the size, environmental sensitivities of Finn Creek and the unnamed drainage and the period of construction (see Table A7.1.3-2). • Confirm with the Inspector(s) that all notifications and approvals and/or letters of advice are in place prior to commencing instream construction at Finn Creek and the unnamed drainage [Section 8.7]. • Grade away from the watercourses in Finn Creek Provincial Park to reduce the risk of introduction of soil and organic debris. Do not place windrowed or fill material in the watercourse during grading [Section 8.2]. • Install a temporary sediment barrier (*e.g.,* sediment fences), where warranted, to eliminate the flow of sediment from spoil piles and disturbed areas into Finn Creek [Section 8.7]. • Inspect temporary sediment control structures (*e.g.,* sediment fences, subsoil berms) installed on approach slopes, on a daily basis throughout crossing construction. Repair the structures before the end of the working day [Section 8.7]. • Develop a water quality monitoring plan to monitor for sediment events during the isolated trenched crossing of Finn Creek or during open-cut crossing construction if flow is present. If monitoring reveals that sediment values are approaching threshold values, the water quality monitors will notify the Lead Environmental Inspector and Inspector(s) who, with the Construction Manager and contractor, will develop corrective actions [Section 8.7]. • Construct the crossing in accordance with applicable existing provincial and federal guidelines (*e.g.,* mitigation measures recommended in the *Fisheries Act* self-assessment) as well as the conditions of the *Fisheries Act* authorization, if applicable. • Dewater the segment of the watercourse between the dams, id safe to do so. Pump any silt-laden water out between the dams to well-vegetated lands, away from the watercourse or to settling ponds [Section 8.7]. • Remove any accumulations of sediment within the isolation areas that resulted from crossing construction. Spread all sediment and unused trench spoil removed from the watercourse at a location above the high water mark where the materials will not directly re-enter the watercourse [Section 8.7]. • Install sack trench breakers back from the edge of watercourses where the banks consist of organic material to prevent sloughing of backfill into the channel [Section 8.7]. • Ensure that water from flumes, dam and pumps, diversion or other methods does not cause erosion or introduce sediment into the channel. Place rock rip rap, tarpaulins, plywood sheeting or other materials to control erosion at the outlet of pump hoses and flumes. Supplement the erosion control materials to control any erosion [Section 8.7]. Vehicle Crossing • Finn Creek and the non-classified drainage will be crossed using a clear-span bridge (see Table A7.1.3-2). • Ensure the bridge is clean prior to installation. • Implement erosion control measures as soon as disturbance of the vegetation mat occurs. • Ensure stormwater from the bridge deck, side slopes and bridge approaches is directed away from the watercourse onto a well vegetated area [Section 8.7]. • Stabilize and revegetate areas disturbed during installation and removal of the bridge; install erosion control measures, where warranted, to control surface erosion until vegetation is established.	• Reduction in surface water quality due to suspended sediment during instream activities during construction and site-specific maintenance activities.

TABLE A7.1.3-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.1 Suspended sediment concentrations in the water column during instream activities (cont'd)	See above	Operations • Implement measures similar to construction under direction of Trans Mountain's Environmental, Health and Safety Management System to reduce suspended sediment released during integrity digs conducted instream.	• See above
1.2 Erosion from approach slopes	LSA	Pipeline Crossing • Prohibit clearing of extra TWS within the riparian buffer, only the trench and TWS areas will be cleared. Ensure staging areas for watercourse crossing construction and spoil storage areas are located a minimum of 10 m from the banks of the watercourse boundaries. This distance may be reduced by the Lead Environmental Inspector and the Inspector(s) where appropriate controls are in place [Section 8.1]. • Restrict root grubbing to the area outside of the vegetated riparian buffer adjacent to the watercourse [Section 8.1]. • Install erosion control measures, where warranted, prior to commencing grading in the vicinity of the watercourse crossing [Section 8.2]. • Grade away from the watercourse to reduce the risk of introduction of soil and organic debris. Do not place windrowed or fill material in the watercourse during grading [Section 8.2]. • Install temporary berms on approach slopes to the watercourse and erect sediment fence(s) near the base of approach slopes following grading. Inspect the temporary sediment control structures on a daily basis and repair before the end of each working day [Section 8.2]. • Install sack trench breakers back from the edge of watercourses where the banks consist of organic material to prevent sloughing of backfill into the channel (see Trench Breaker – Watercourse/Wetland Drawing in Appendix R of the Pipeline EPP] [Section 8.4]. • Install temporary erosion and sediment control structures (*e.g.*, sediment fences, coir logs) immediately following the completion of backfilling lands adjacent to the watercourse crossing where the potential for sedimentation of the watercourse exists (see Sediment Fence and Coir/Straw Log Installation Drawings provided in Appendix R of the Pipeline EPP) [Section 8.4]. • Seed riparian areas with an approved annual or perennial grass cover crop or native grass mix as soon as is feasible after construction (see Table A7.1.3-2). • Transplant dormant shrubs, or install dormant willow stakes or commercially grown rooted stock plants (plugs), where warranted, during reclamation of streambanks where riparian vegetation is present prior to construction (see Table A7.1.3-2). • Install permanent erosion control measures, as outlined in Table A7.1.3-2, unless otherwise approved by Trans Mountain to adjust for site conditions and suitability [Section 8.6]. • Install temporary fencing to allow the revegetation treatments to become established and avoid damage to the banks and riparian area by wildlife [Section 8.7]. • Monitor watercourse after construction to assess the success of construction and reclamation mitigation measures following the temporary disturbance. Implement remedial measures, where warranted. Vehicle Crossings • Ensure that equipment used during construction of the vehicle crossing is used in a manner that reduces disturbance of the bed and banks and ensure bridge installation does not alter the stream bed or banks or require infilling of the channel [Section 8.7]. • Seed disturbed areas on the banks and approaches as soon as practical with an approved grass cover crop species or native grass seed mix and implement sediment control measures to stabilize watercourse banks and prevent sedimentation of the watercourse, respectively. Follow measures see Table A7.1.3-2. Operations • Implement measures similar to construction under direction of Trans Mountain's Environmental, Health and Safety Management System for controlling erosion from banks and approach slopes during integrity digs conducted instream or in vicinity to the watercourse.	• Reduction in surface water quality due to erosion from banks and approach slopes.

TABLE A7.1.3-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.3 Reduction of surface water quality due to small spill during construction or site-specific maintenance activities	LSA	• Ensure the following separation distances are maintained between the watercourse when planning and constructing the pipeline, unless otherwise approved: – fuel or hazardous material storage site - 300 m; – burning site - 100 m; and – oil change area - 100 m [Section 7.0]. • Refer to the Pipeline EPP for additional measures for hazardous materials storage, servicing vehicles and spill equipment needs as well as cleaning of equipment. • Ensure that during construction no fuel, lubricating fluids, hydraulic fluids, methanol, antifreeze, herbicides, biocides, or other chemicals are dumped on the ground or into waterbodies. In the event of a spill, implement the Spill Contingency Plan [Appendix B] [Section 7.0]. • Conduct refuelling a minimum of 100 m from any watercourse unless otherwise approved by the appropriate regulatory authority [Section 7.0]. See additional measures for refuelling near waterbodies in Section 7.0 of the Pipeline EPP.	• Contamination of surface water due to a small spill during construction or site-specific maintenance activities.
2. Water Quality and Quantity Indicator – Surface Water Quantity			
2.1 Alteration of natural surface drainage patterns	LSA	• Maintain drainage across the construction right-of-way during all phases of construction [Section 7.0]. • Ensure the potential for soil erosion by water is reduced during construction activities by avoiding ponding of water or the unintentional channelization of surface water flow [Section 7.0]. • Provide surface drainage of adequate capacity across the construction right-of-way [Section 7.0]. • Reduce grading along the construction right-of-way, especially within watercourse/wetland vegetated buffers [Section 8.2]. • Leave breaks in the trench crown at obvious drainages and wherever seepage occurs to reduce or avoid interference with natural drainage [Section 8.4]. • Recontour the construction right-of-way and stabilize approach slopes at watercourse crossings. Where reclamation of the pre-construction grade is not feasible due to risk of failure of fill on slopes or maintenance of an access trail, recontour to grades as directed by the Geotechnical Engineer [Section 8.6]. • Regrade areas with vehicle ruts, erosion gullies or where the trench has settled [Section 8.6]. Implement similar mitigation measures during site-specific maintenance activities during operations.	• Localized alteration of natural surface drainage patterns until trench settlement is complete.
2.2 Disruption or alteration of stream flow	LSA	• Adhere to clearing guidelines for protection of streams provided the Riparian Management Area Guidebook [Section 8.1]. • Fell trees away from the watercourse and away from limits of the construction right-of-way to reduce damage to the streambanks, bed and adjacent trees. Hand clear the area, if necessary, to reduce disturbance. Any trees, debris and soil inadvertently deposited within the ordinary high watermark will be promptly removed in a manner that avoids or reduces disturbance of the bed and banks. Trees will not be stood or hauled across the watercourse [Section 8.1]. • Do not place windrowed or fill material in the watercourse during grading [Section 8.2]. • Ensure stream flow, if present, is maintained at all times when trenching through Finn Creek [Section 8.7]. • Ensure that new vehicle crossing structures are appropriate for the watercourse approaches, channel width and configuration, anticipated stream flow during the period of use, planned vehicle loads, and overall period/duration of use [Section 8.7]. • Re-establish streambanks and approaches immediately following construction of the watercourse crossing as outlined in Table A7.1.3-2.	• Disruption and alteration of natural stream flow from instream activities.

TABLE A7.1.3-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
3. Water Quality and Quantity – Groundwater Quality			
3.1 Shallow groundwater with existing contamination encountered during trench construction	LSA	• Ensure contaminated soil and water are not transported off-site or disposed until analytical results have been received as per federal and provincial regulations. The Construction Manager and Environmental Inspector will provide notification as to when excavations can be backfilled [Section 8.3]. • Notify and adhere to the advice of the Trans Mountain Environment, Health and Safety Department or Trans Mountain's Lead Environmental Inspector and Environmental Inspector(s) at locations where water potentially contaminated with hydrocarbons or other materials is to be discharged from the trench. Measures may include the use of tank trucks to haul discharged water to an appropriate disposal facility/site, ensuring the intake is submerged below the surface sheen, lab testing and use of sorbent booms to hold the sheen away from the pump intake [Section 8.3].	• No residual effect identified.
3.2 Groundwater or wells vulnerable to possible future contamination from a spill during construction	LSA	• Utilize Best Management Practices for spill prevention outlined in the Pipeline EPP including in areas where higher vulnerability wells and aquifers are identified. • Ensure that during construction no fuel, lubricating fluids, hydraulic fluids, methanol, antifreeze, herbicides, biocides, or other chemicals are dumped on the ground or into waterbodies. In the event of a spill, implement the Spill Contingency Plan (see Appendix B of Pipeline EPP) [Section 7.0]. • Re-establish or replace a potable water supply as required should a registered or known water well located within 30 m of the construction right-of-way be damaged (*i.e.,* diminishment in quantity and/or quality) during pipeline installation [Section 7.0].	• Contamination of groundwater as a result of a spill during construction.
4. Water Quality and Quantity Indicator – Groundwater Quantity			
4.1 Areas susceptible to changes in groundwater flow patterns	LSA	• Monitor water encountered in the trench during trenching to determine if groundwater flow is being intercepted. If spring flow has been disrupted, seek and follow the advice of the Hydrogeological or Geotechnical Resource Specialist to maintain cross drainage within the trench (*e.g.,* installation of subdrains, trench breakers, etc.) [Section 8.3]. • Assess the need for well points or other dewatering methods, prior to commencing trenching, to intercept groundwater at site-specific locations before it enters the trench [Section 8.3]. • Prevent the pipeline trench and bedding from becoming a conduit for increased groundwater flow. • Install trench breakers to force groundwater seepage along the pipeline trench to the surface, if springs are encountered along the route. Install subdrains to divert shallow groundwater flow from the right-of-way [Section 8.4]. • Install subdrains in association with trench breakers as directed by Trans Mountain's Engineer where there is evidence of seepage or a flowing spring on a slope once the trench is excavated (see Subdrains Drawing in Appendix R of the Pipeline EPP) [Section 8.4]. • Backfill clay/mineral soil first, if salvaged separately from organic material in shallow peatland areas, to ensure that cross drainage is maintained [Section 8.4].	• Flooding on the up-gradient side of the pipeline may result in creation of wet zones on ground surface. • Reduction of baseflow to local streams.
4.2 Areas where dewatering may be necessary during pipeline construction activities	LSA	• Dewater the trench when laying pipe in areas with high water tables. Place pumps on a tray or within an excavated sump lined with polyethylene sheeting above the ordinary high water level of the watercourse. Pump water onto stable and well vegetated areas, tarpaulins or sheeting at least 50 m from the nearest waterbody in a manner that does not cause erosion or any unfiltered or silted water to re-enter a watercourse [Section 8.3]. See additional dewatering measures in Section 8.3 of the Pipeline EPP. • Use floating suction hose and elevated intake, or other measures approved by Trans Mountain's Environmental Inspector(s), to prevent sediment from being sucked from the bottom of the trench. Secure the pump intake a minimum of 30 cm above the bottom of the trench [Section 8.3].	• Change in natural groundwater levels and stream recharge due to the discharge of groundwater to surface water systems if not practical to discharge trench water to ground.

Notes: 1 LSA = Water Quality and Quantity LSA.
2 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of this Proposal).

TABLE A7.1.3-2

PROPOSED PIPELINE AND VEHICLE WATERCROSSING METHODS ALONG THE NARROWED PIPELINE CORRIDOR THROUGH FINN CREEK PROVINCIAL PARK

Watercourse Name	AK	Fish Presence Captured or Observed (Previously Documented)	Sensitivity Rating	Provincial Instream Work Window	Least Biological Risk Window Proposed	Pipeline Crossing Method		Vehicle Crossing Method		Reclamation
						Recommended Primary	Recommended Contingency	Recommended Crossing Method (Flowing)	Recommended Crossing Method (Dry/Frozen)	
Finn Creek	638.8	RB, BT, (CH, CO, SK, RB, BT, MW/CCG, CAS)	High	July 22 – August 15	Open	Isolation with fish salvage and water quality monitoring during low flow	Open-cut with water quality monitoring inside timing window	Clear-span bridge	Clear-span bridge	*Prior to Instream Work* • Identify any instream site-specific features at the crossing proposed and record their location *(e.g.,* root wad, large woody debris, large boulders). Salvage these for use later. *During Instream Work* • Salvage upper coarse-textured substrate material from the channel and banks, and stockpile separately from lower substrate. *At the Completion of Instream Work* • Return the watercourse (or wetland) bed and banks to their preconstruction configuration and alignment. • Cap disturbed area of the channel and banks with salvaged substrate; extend replacement of cobbles and boulders to the ordinary high water level (OHWL) if adequate material is available. • Replace any site-specific features that are important for fishes or other aquatic organisms (*i.e.,* as initially salvaged or as directed by Trans Mountain's Environmental Inspector). • Install the appropriate temporary erosion and sediment control measures, where warranted (*e.g.,* sediment fence, erosion control blanket, coir logs, etc.). • Seed with an appropriate grass mix and/or cover crop species as directed in the Reclamation Management Plan for the Project.
Unnamed Drainage	639.1	None (None)	Low	None	Open	Isolation if water present	Open-cut if dry or frozen to bottom	Ramp and culvert	Snow/icefill or other regulatory approved crossing method	• Adhere to reclamation measures for Finn Creek above. • Salvage dormant riparian vegetation along the trench line (and vehicle crossing locations, where grading is required), keeping roots intact (*i.e.,* with a sufficient soil root-ball). Store salvaged dormant plants and plant material away from construction activities for replacement or installation during reclamation. Replace salvaged dormant riparian plants and plant material (stakes and brush) during reclamation (see Drawing [Shrub Staking and Transplanting] provided in Appendix R). • Install rooted stock shrubs/trees and/or dormant tree/shrub stakes/brush in disturbed riparian areas to stabilize soils, reduce sedimentation and accelerate vegetation recovery (see Drawing [Shrub Staking and Transplanting] and [Rooted Stock Selection and Installation] provided in Appendix R of the Pipeline EPP).

7.1.3.2 Significance Evaluation of Potential Residual Effects

Table A7.1.3-3 provides a summary of the significance evaluation of the potential residual environmental effects of the construction and operations of the proposed pipeline in Finn Creek Provincial Park on water quality and quantity. The rationale used to evaluate the significance of each of the residual environmental effects is provided below.

TABLE A7.1.3-3

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON WATER QUALITY AND QUANTITY FOR FINN CREEK PROVINCIAL PARK

	Potential Residual Effects	Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
				Duration	Frequency	Reversibility				
1	Water Quality and Quantity Indicator – Surface Water Quality									
1(a)	Reduction in surface water quality due to suspended sediment during instream activities during construction and site-specific maintenance activities.	Negative	LSA	Immediate to short-term	Isolated to occasional	Immediate	Low	High	High	Not significant
1(b)	Reduction in surface water quality due to erosion from banks and approach slopes.	Negative	LSA	Immediate to short-term	Isolated to occasional	Short to medium-term	Low to medium	Low	High	Not significant
1(c)	Contamination of surface water due to a small spill during construction or site-specific maintenance activities.	Negative	LSA	Immediate	Accidental	Short to medium-term	Low to high	Low	Moderate	Not significant
2	Water Quality and Quantity Indicator – Surface Water Quantity									
2(a)	Localized alteration of natural surface drainage patterns until trench settlement is complete.	Negative	LSA	Short-term	Isolated to occasional	Short to medium-term	Low	High	High	Not significant
2(b)	Disruption and alteration of natural stream flow from instream activities.	Negative	LSA	Immediate to short-term	Isolated to occasional	Short to medium-term	Low to medium	High	High	Not significant
3	Water Quality and Quantity Indicator – Groundwater Quality									
3(a)	Contamination of groundwater as a result of a spill.	Negative	LSA	Immediate	Accidental	Short to medium-term	Low to high	Low	Moderate	Not significant
4	Water Quality and Quantity Indicator – Groundwater Quantity									
4(a)	Flooding on the up-gradient side of the pipeline may result in the creation of wet zones on ground surface.	Negative	LSA	Short-term	Periodic	Short-term	Low	Low	Moderate	Not significant
4(b)	Reduction of base flow to local streams.	Negative	LSA	Short-term	Periodic	Short-term	Low	Low	Moderate	Not significant
4(c)	Change in natural groundwater levels and stream recharge due to the discharge of groundwater to surface water systems if not practical to discharge trench water to ground.	Negative	LSA	Short-term	Isolated	Short-term	Low	Low	Moderate	Not significant

Notes: 1 LSA = Water Quality and Quantity LSA.

2 Significant Residual Environmental Effect: A high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated.

Water Quality and Quantity Indicator – Surface Water Quality

Instream Construction

Sediment runoff and increased turbidity/total suspended solids (TSS) from pipeline construction was noted as a concern during many of the stakeholder engagement events for the Project, including the Parks Workshop in Clearwater in April 2014 and the Clearwater Community Workshop in June 2013. The selection of appropriate watercourse crossing techniques designed to meet federal and provincial regulatory requirements, as well as implementation of erosion controls on the approaches to the watercourse crossing and riparian revegetation, are likely to substantially reduce the potential for adverse

effects on surface water quality at Finn Creek and the unnamed drainage. During construction of the trenched crossing, a minor and short-term sediment release is expected during installation and removal of the pipeline crossing structures. Trenched crossings are considered to have a negative impact balance since sediment input can temporarily decrease surface water quality.

Turbidity/TSS guidelines have been established for instream activities. At the federal level, DFO (2000) discusses 'levels of risk' associated with increases in TSS concentration in watercourses and indicates increases of < 100 mg/L above background present low risk to fish and their habitat, while an increase of 100-200 mg/L presents a moderate risk. An excess of 400 mg/L was an unacceptable risk, but duration of exposure also needs to be taken into account (also see Birtwell 1999). The CCME guideline value for protection of aquatic life from short-term (24 hour) exposure is no more than 25 mg/L above existing levels (CCME 2007). Aquatic resources are protected by ensuring that concentration of TSS does not exceed CCME (2007) guidelines. BC guidelines specify that induced turbidity may not exceed background by more than 8 nephelometric turbidity units (NTU) during any 24 hour period or by more than 2 NTU when the duration of sediment input is between 24 hours and 30 days. Where flow is naturally turbid, induced turbidity may not exceed background by more than 8 NTU at any time when background is between 8 and 80 NTU, or by 10% at any time when background is greater than 80 NTU (BC MWLAP 2004).

When compared to the open cut technique, isolated crossing techniques reduce the amount of sediment introduced to flowing watercourses. During a completely isolated crossing by dam and pump or flume, a minor sediment release is expected during installation of the dams prior to the isolation and during removal of the downstream dam at the conclusion of the isolation. Recent evidence demonstrates that smaller watercourses that lack substantial subsurface flow can be readily isolated with minimal sediment introduction when proper design, construction and mitigation measures are applied (CAPP *et al*. 2012, Reid *et al.* 2002). Consequently, it is anticipated that average TSS levels during instream construction at Finn Creek will be below turbidity/TSS guidelines.

Open cut crossings are typically only utilized when a watercourse is dry or frozen to the bottom at the time of construction. Under these conditions, sediment release is not expected to occur, however, in the event the recommended isolated crossing technique is not feasible at Finn Creek, an open cut or partial isolation technique may be required. Monitoring will be conducted under flowing conditions to document downstream turbidity and any exceedances of the relevant guidelines will be reported to the appropriate regulatory authorities.

Partial isolation techniques by coffer dams or partial bypass may release more sediment than a completely isolated crossing, but are more effective than unrestricted open cut crossings in reducing instream sediment loads. For example, at one watercourse crossing during construction of the TMX Anchor Loop Project, upstream pumps were used to redirect a portion of the clean flows around the crossing site, thereby reducing the amount of sediment introduced into the watercourse (TERA 2009a).

Measures in Table A7.1.3-1 and the Pipeline EPP, including continual monitoring of sediment release (*i.e.,* turbidity and TSS), will be implemented during crossing design and construction to reduce the magnitude and duration of the sediment pulse.

Minor releases of sediment may be associated with use of a temporary vehicle crossing (*i.e.,* clear-span bridge) at Finn Creek, if required. However, given the recommended mitigation measures, elevated suspended sediment concentrations will be minimal and since pulses of suspended solids are generally expected to settle out of the water column within the zone of influence (ZOI) in a timeframe measuring from minutes to a few hours (*i.e.,* less than CCME's short-term guideline of 24 hours). Water quality monitoring will be used when activities occur that have the potential to cause events that may exceed the guidelines. Any exceedances of the relevant guidelines will be reported to the appropriate regulatory authorities.

Given that suspended sediments are expected to settle out of the water column within the ZOI in a timeframe measuring from minutes to a few hours (*i.e.,* less than CCME's short-term guideline of 24 hours), residual effects on the surface water quality indicator during the trench crossing and temporary vehicle crossing, if required, are reversible in the immediate-term and of low magnitude (Table A7.1.3-3, point 1[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Water Quality and Quantity LSA – suspended sediments released during construction activities will be carried downstream until they disperse and/or naturally settle out within the predicted ZOI.
- Duration: immediate to short-term – the events causing the release of suspended sediments into surface water are instream construction or maintenance activities (*e.g.,* integrity digs), the latter of which are limited to any one year during the operations phase.
- Frequency: isolated to occasional – the events causing the release of suspended sediments into Finn Creek (*i.e.,* pipeline construction and maintenance activities) occur during construction and, for operations activities, intermittently and sporadically over the assessment period.
- Reversibility: immediate – an increase in suspended sediments is confined to a specific period not exceeding 24 hours after construction.
- Magnitude: low – an increase in suspended sediments is anticipated for a short timeframe and anticipated to be within CCME guidelines given the implementation of mitigation measures to reduce sedimentation.
- Probability: high – a trenched crossing method is recommended during potentially flowing conditions at the time of pipeline construction through Finn Creek.
- Confidence: high – based on available research literature, data pertinent to previous crossings along the existing TMPL right-of-way and the professional experience of the assessment team.

Erosion from Approach Slopes and Banks

Following grading, it is possible for some erosion to occur on approach slopes and banks and cause sediment to enter the watercourse. The impact balance of this potential residual effect is considered negative since sediment input could decrease surface water quality.

The long-term conservation concern of protecting riparian habitat within the park will be supported through proper reclamation and post-construction monitoring. Mitigation measures will be identified on a site-specific basis and may include, for example: installation of temporary erosion control structures (*e.g.,* sediment fences); restoration to stabilize the banks (*e.g.,* soil wraps, brush layers, willow plantings and matting); seeding the disturbed banks and approaches with the appropriate cover crop species and native grass mix; installation of coir or other biodegradable erosion control fabric on the banks of the watercourse; installation of live dormant willow stakes or salvaged willow/shrub transplants or commercially grown rooted stock plugs in the banks of the watercourse; and monitoring to assess the success of construction and reclamation mitigation measures and implementation remedial measures, where warranted.

Proposed mitigation measures are expected to reduce the magnitude of erosion from approach slopes and banks on the surface water quality indicator to low to medium levels. This residual effect is reversible in the short to medium-term (Table A7.1.3-3, point 1[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Water Quality and Quantity LSA – any sedimentation caused by erosion will be carried downstream until it disperses and/or naturally settles out within the predicted ZOI.
- Duration: immediate to short-term – the events causing the erosion and sedimentation of surface water are instream construction or maintenance activities (*e.g.,* integrity digs), the latter of which are limited any one year during the operations phase.
- Frequency: isolated to occasional – the events resulting in sedimentation caused by erosion of approach slopes and banks (*i.e.,* pipeline construction and operations activities [*e.g.,* integrity digs]) occur intermittently and sporadically in the event the crossing is unstable until mitigated.

- Reversibility: short to medium-term – vegetation may be re-established within one year of construction on gentle banks and approach slopes while revegetation of steeper approach slopes and banks may take longer than one growing season.
- Magnitude: low to medium – depending upon the amount of erosion that occurs.
- Probability: low – proven and effective industry standard mitigation measures are expected to control erosion on slopes and banks and prevent sediment from entering the watercourse.
- Confidence: high – based on data pertinent to the proposed crossing location at Finn Creek and the professional experience of the assessment team.

Contamination of Surface Water Due to Small Spills

A spill during construction or site-specific maintenance activities could cause contamination of the surface water and would be considered to have a negative impact balance, however, with proper implementation of industry and government recommended mitigation measures, the effects can be limited. For example, during the construction of the TMX Anchor Loop Project, all fuel trucks, service trucks and pick-ups with box-mounted fuel tanks were required to carry spill prevention, containment and clean up materials. Furthermore, all hazardous material storage and oil changes, refuelling, and lubrication of industrial equipment were required to occur more than 100 m from a waterbody or watercourse except where secondary containment was provided. Spills or accidental release of potentially harmful materials (*i.e.,* oil or diesel fuel) were recorded. The Spill Contingency Plan was implemented on each spot spill and all spills were cleaned up as soon as they were discovered. During the TMX Anchor Loop Project, all spills were terrestrial, and no spills or leaks occurred in, or reached, a waterbody or watercourse (TERA 2009a).

Similar spill prevention mitigation is planned for the Project and spill prevention measures outlined in Table A7.1.3-1 and the Pipeline EPP will be followed. Fuel storage and handling practices will be monitored throughout construction of the Project to reduce spill risk. Should a leak be spotted or detected during construction of the pipeline, Trans Mountain will implement the Spill Contingency Plan. Depending on the nature and volume of a spill, the magnitude of change to water quality could vary from low to high. This residual effect is reversible in the short to medium-term and is of low probability (Table A7.1.3-3, point 1[c]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Water Quality and Quantity LSA – a spill during construction or site-specific maintenance activities may extend beyond the narrowed pipeline corridor and evidence suggests that effect of most minor spills is localized.
- Duration: immediate – the event causing a potential reduction in surface water quality is a spill, the period of which is less than or equal to 2 days.
- Frequency: accidental – a spill into surface water occurs rarely over the assessment period.
- Reversibility: short to medium-term – the effects of a spill are not expected to last beyond one year, but may last longer depending on seasonal conditions and the extent and source of the spill.
- Magnitude: low to high – depending upon the volume, location and contaminant released.
- Probability: low – due to mitigation measures in place to reduce the potential for spills reaching Finn Creek and affecting surface water quality.
- Confidence: moderate – spill location and effects of accidental spills cannot be accurately predicted.

Water Quality and Quantity Indicator – Surface Water Quantity

Alteration of Natural Drainage Patterns

With proper implementation of the industry-accepted standard mitigation practices that are proposed, disruption of surface flow patterns following construction or maintenance activities is expected to be minor through Finn Creek Provincial Park. By paralleling the existing TMPL right-of-way and narrowing the

construction right-of-way to the extent feasible through the park, effects to natural drainage patterns will be further reduced in support of the management objective to maintain the natural qualities and conditions of the park. Nevertheless, construction activities may contribute to some localized alteration of natural surface drainage patterns until trench settlement is complete. The impact balance of this potential residual effect is considered negative since it could alter or disrupt natural above ground hydrologic conditions within the park.

In the event that construction or maintenance activities result in changes in surface water regimes, corrective action, in consultation with the appropriate regulatory authorities, will be implemented to resolve the issue. The PCEM program will identify any locations in the park with altered drainage patterns (*e.g.,* ponded water) and remedial work will be conducted, where warranted. Consequently, the residual effect is reversible in the short to medium-term. Some minor incidents (*e.g.,* ponding, minor flooding, erosion) are expected following construction and are considered to be within environmental standards, and therefore, of low magnitude (Table A7.1.3-3, point 2[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Water Quality and Quantity LSA – although alteration of natural drainage patterns is generally confined to the disturbed portion of the construction right-of-way, potential changes in hydrology may extend beyond the pipeline right-of-way.
- Duration: short-term – the events causing alteration of natural drainage are pipeline construction or maintenance activities (*e.g.,* integrity digs), the latter of which are limited to any one year of the operations phase.
- Frequency: isolated to occasional – the events causing alteration of natural drainage (*i.e.,* pipeline construction and maintenance activities) occur during construction and, for operations activities, intermittently and sporadically over the assessment period.
- Reversibility: short to medium-term – it may take more than one year plus adequate precipitation levels in order for the trench crown to settle and natural drainage patterns to be restored.
- Magnitude: low – the potential for minor ponding, flooding or erosion exists until the natural drainage patterns are restored.
- Probability: high – minor trench settlement or a remnant crown are likely to occur as a result of pipeline construction or site-specific maintenance activities and, consequently, are likely to affect natural drainage patterns in localized areas.
- Confidence: high – based on data pertinent to the Project area and the professional experience of the assessment team.

Alteration of Stream Flow

Trenched pipeline crossing methods (*i.e.,* isolated or open cut) have the potential to result in alterations of natural stream flow.

Crossing activities may contribute to some localized alteration of watercourse bed and banks until complete and stable restoration is achieved following construction. The impact balance of this potential residual effect is considered negative since it could alter or disrupt hydrologic conditions of the watercourse. However, with proper implementation of the industry-accepted standard mitigation practices that are proposed, alteration of natural stream flow resulting from an isolated or open cut pipeline crossing of Finn Creek is expected to be minor.

In the event that construction or maintenance activities result in alterations to watercourse hydrology, corrective action, in consultation with the appropriate regulatory authorities, will be conducted to resolve the issue. The PCEM program will identify locations of altered stream flow (*e.g.,* damaged bed and banks) and remedial work will be conducted. Consequently, the residual effect is reversible in the short to medium-term. Generally, the residual effect of altered bed and banks is considered to be within environmental

standards for pipeline construction and, therefore, is of low to medium magnitude (Table A7.1.3-3, point 2[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Water Quality and Quantity LSA – although alteration of natural stream flow is generally confined to the disturbed portion of watercourse bed and banks, potential changes in watercourse hydrology may extend beyond the pipeline right-of-way.
- Duration: immediate to short-term – the events causing alteration of natural stream flow are pipeline construction or maintenance activities (*e.g.,* integrity digs), the latter of which are limited to any one year of the operations phase.
- Frequency: isolated to occasional – the events causing alteration of natural stream flow (*i.e.,* pipeline construction and maintenance activities) occur during construction and, for operations activities, intermittently and sporadically over the assessment period.
- Reversibility: short to medium-term – it may take more than one year to fully restore and stabilize watercourse channel and associated flow conditions.
- Magnitude: low to medium – the potential for changes to stream flow exists but experience with past projects demonstrates that proper design and remedial work will reduce effect magnitude.
- Probability: high – alteration of bed and banks from an isolated or open cut crossing of Finn Creek will result from pipeline construction or site-specific maintenance activities and, consequently, alteration of natural stream flow is likely to occur.
- Confidence: high – based on data pertinent to the Project area and the professional experience of the assessment team.

Water Quality and Quantity Indicator – Groundwater Quality

Contamination of Groundwater as a Result of a Spill During Construction

Contamination of groundwater may result if the spilled material migrates through the developed soil near the surface through the surficial materials into the first water-bearing unit. The rate of migration is dependent upon the permeability of the materials, presence or absence of fractures, the properties of the spilled contaminant (density, viscosity) and the vertical hydraulic gradients. A spill during the construction phase of the Project is likely to be noted quickly and be of small volume, and evidence suggests that the effects of most minor spills are localized.

The impact balance of this residual effect is considered negative since this could potentially affect groundwater quality. This residual effect is unlikely to extend beyond the Water Quality and Quantity LSA; it is considered to represent a short to long-term influence on the natural groundwater and surface water systems depending upon the volume of the spill, and the properties of the groundwater and overlying material. Spills where the spilled material contaminates groundwater within the Water Quality and Quantity LSA may occur accidentally over the construction phase of the Project (Table A7.1.3-3, point 3[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Water Quality and Quantity LSA – a spill during construction activities may extend beyond the narrowed pipeline corridor but based on professional experience the effects of most minor spills are localized.
- Duration: immediate – the event causing potential contamination of groundwater is a spill, the period of which is less than one day.
- Frequency: accidental – a spill into groundwater during construction is rare.
- Reversibility: short to medium-term – the effects of a spill are not expected to last beyond one year, but may last longer depending upon the extent and source of the spill.
- Magnitude: low to high – depending upon the volume, location and contaminant released.

- Probability: low – due to mitigation measures in place to reduce the potential for spills migrating into the subsurface and affecting groundwater quality.
- Confidence: moderate – spill location and effects of accidental spills cannot be accurately predicted.

Water Quality and Quantity Indicator – Groundwater Quantity

Flooding on the Up-Gradient Side of the Pipeline May Result in Creation of Wet Zones on Ground Surface

A reduction in the permeability of materials along the groundwater flow path may result in a rise in the groundwater table to the extent that ground to surface flooding occurs. This may occur if the trench spoil is not backfilled in the correct order or soils are not properly salvaged resulting in a change in permeability of the upper trench materials and blocking of near surface groundwater flows. The impact balance of this residual effect is considered negative since this could potentially affect recharge to Finn Creek and create permanently wet areas. This residual effect is considered to have a short-term influence on the natural groundwater and surface water systems as long as mitigation measures are applied (Table A7.1.3-3, point 4[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Water Quality and Quantity LSA – depending upon the site-specific conditions, dewatering activities and groundwater discharge away from the Footprint could affect an area within the LSA.
- Duration: short-term – the events causing the potential alteration of groundwater flow are construction of the pipeline and maintenance activities, the latter of which are limited to any one year during operations.
- Frequency: periodic – the events causing alteration of natural groundwater flow (*i.e.,* pipeline construction and maintenance activities) occur intermittently but repeatedly over the assessment period.
- Reversibility: short-term – the effects of pipeline trench construction are not expected to last beyond one year once the trench has been backfilled as long as mitigation measures are applied.
- Magnitude: low – the potential for changes to groundwater flow exists but professional experience demonstrates that proper design and remedial work will reduce the effect.
- Probability: low – the proper construction of the pipeline trench and native backfill will reduce the occurrence of this effect.
- Confidence: moderate – based on previous experience and on data pertinent to the Project area.

Reduction of Base Flow to Local Streams

Dewatering of the pipeline trench during construction may result in lowering of the local water table which in the case of local waterbodies may reduce the groundwater inflow (base flow) to Finn Creek. The impact balance of this residual effect is considered negative due to the potential decrease of groundwater flow into Finn Creek. This residual effect likely will not extend beyond the Water Quality and Quantity LSA to the watershed level, and it is considered to represent a low magnitude, short-term influence on the natural groundwater and surface water systems (Table A7.1.3-3, point 4[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Water Quality and Quantity LSA – depending upon the site-specific conditions, dewatering activities and groundwater discharge away from the Footprint could affect an area within the LSA.
- Duration: short-term – the events causing the reduction in baseflow are the result of discharge during dewatering and occur while the trench is being constructed (either for pipeline installation or for pipeline daylighting during integrity digs).

- Frequency: periodic – the events causing alteration of natural groundwater flow (*i.e.,* pipeline construction and maintenance activities) occur intermittently but repeatedly over the assessment period.
- Reversibility: short-term – the effects of pipeline trench construction are not expected to last beyond one year once the trench has been backfilled.
- Magnitude: low – the potential for changes to groundwater flow exists but professional experience demonstrates that proper design and remedial work will reduce effect magnitude.
- Probability: low – the proper construction of the pipeline trench and the use of native backfill will reduce the occurrence of this effect.
- Confidence: moderate – based on previous experience and on data pertinent to the Project area.

Change in Natural Groundwater Levels and Stream Recharge Due to the Discharge of Groundwater to Surface Water Systems if Not Practical to Discharge Trench Water to Ground

Shallow groundwater will be present in the subsurface in many areas along the narrowed pipeline corridor; at Finn Creek, it is likely to occur within the vicinity of the creek crossing. During pipeline construction, it is common practice to dewater the trench to allow the pipe to be laid down in a dry environment. Extracted groundwater from the dewatering operations will be disposed to ground where possible, but in areas where this is not practical, the water may be discharged away from the area, directly into a water body or vegetated area (post-treatment), or stormwater discharge system causing local groundwater levels and flow patterns to be temporarily disrupted. The impact balance of this residual effect is considered negative since this could potentially affect recharge to Finn Creek. This residual effect is confined to the Water Quality and Quantity LSA and is considered to represent a short-term influence on the natural groundwater and surface water systems. Dewatering activities where the extracted groundwater cannot be returned to ground are unlikely to occur given the proposed mitigation measures in Table A7.1.3-1 and in the Pipeline EPP. The residual effects in areas of discharge of collected groundwater are expected to reverse within one year when seasonal precipitation replenishes groundwater levels (Table A7.1.3-3, point 4[c]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Water Quality and Quantity LSA – depending upon the site-specific conditions, dewatering activities and groundwater discharge away from the Footprint could extend to the LSA.
- Duration: short-term – the event causing the discharge of groundwater from the trench is the construction of the pipeline.
- Frequency: isolated – dewatering activities are expected to occur at specific locations/times over the construction phase of the Project.
- Reversibility: short-term – residual effects are expected to reverse within one year once seasonal precipitation recharges groundwater levels.
- Magnitude: low – it is not expected that dewatering activities will noticeably affect groundwater flow patterns given the implementation of mitigation measures.
- Probability: low – it is unlikely that groundwater flow patterns will be affected by dewatering activities given the implementation of proposed mitigation measures.
- Confidence: moderate – available provincial mapping and existing reports are no completed enough to confirm the presence of shallow groundwater but it is likely to exist within the vicinity of the creek crossing.

7.1.3.3 Summary

As identified in Table A7.1.3-3, there are no situations where there is a high probability of occurrence of a permanent or long-term residual environmental effect on water quality and quantity indicators of high magnitude that cannot be technically or economically mitigated. Consequently, it is concluded that the

residual environmental effects of pipeline construction and operations on conservational values of Finn Creek Provincial Park related to water quality and quantity will be not significant.

7.1.4 Air Emissions

This subsection describes the potential Project effects on the air emissions in Finn Creek Provincial Park. The Air Quality RSA consists of a 5 km wide band generally extending from the Footprint (*i.e.,* 2.5 km on both sides of the Footprint); shown in Figure 6.2.2-1 of the Introduction to the Stage 2 Detailed Proposal.

All air quality indicators (Table 6.2.1-1 of Introduction to Stage 2 Detailed Proposal) were considered in this evaluation, however, only primary emissions of CACs was determined to interact with pipeline construction and operations in Finn Creek Provincial Park. Formation of secondary ozone and emissions which have the potential to cause nuisance odours are associated with facilities, and since there are no Project facilities in Finn Creek Provincial Park, these indicators do not interact with pipeline construction and operations.

7.1.4.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline on air emissions indicators are listed in Table A7.1.4-1.

A summary of mitigation measures provided in Table A7.1.4-1 was principally developed in accordance with industry accepted best practices and accepted pipeline construction methods for construction-related activities.

TABLE A7.1.4-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON AIR EMISSIONS FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1. Air Emissions Indicator – Primary Emissions of CACs and Volatile Organic Compounds (VOCs)			
1.1 Project contribution to emissions	RSA	• Restrict the duration that vehicles and equipment are allowed to sit and idle to less than 1 hour, unless air temperatures are less than 0°C [Section 7.0]. • Ensure equipment is well-maintained during construction to minimize air emissions [Section 7.0]. • Use multi-passenger vehicles for the transportation of crews to and from the job sites, where feasible [Section 7.0].	• Increase in air emissions during construction. • Increase in air emissions during site-specific maintenance and inspection activities.
1.2 Smoke during construction	RSA	• Conduct burning in accordance with burning permit requirements and A Smoke Management Framework for BC, as applicable. Comply with local government bylaws, the *Forest*, *Open Burning Smoke Control Regulation* (BC) and the *Forest Fire Prevention and Suppression Regulation* (BC) when burning slash [Section 7.0]. • Limit smoke production during slash disposal by limiting pile size, reducing fuel moisture content, maintenance of loose burning piles free of soil and by using burning sloops or large capacity shredders [Section 7.1]. • Permit burning only when conditions exist that allow for adequate dispersion of smoke so that high concentrations of smoke do not locally affect human health or wildlife. Avoid burning when temperature inversions are present or predicted [Section 8.1]. • Water down construction sites and access roads, when warranted, as directed by Trans Mountain, to reduce or avoid the potential for dust emissions [Section 8.2].	• Increase in fugitive dust and smoke during construction.

Notes: 1 RSA = Air Quality RSA.
2 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of this Proposal).

7.1.4.2 Significance Evaluation of Potential Residual Effects

Table A7.1.4-2 provides a summary of the significance evaluation of the potential residual environmental effects of the construction and operations of the proposed pipeline in Finn Creek Provincial Park on air emissions. The rationale used to evaluate the significance of each of the residual environmental effects is provided below.

TABLE A7.1.4-2

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON AIR EMISSIONS FOR FINN CREEK PROVINCIAL PARK

Potential Residual Effects		Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
				Duration	Frequency	Reversibility				
1.	Air Emissions Indicator – Primary Emissions of CACs and VOCs									
1(a)	Increase in air emissions during construction.	Negative	RSA	Short-term	Isolated	Short-term	Medium	High	Moderate	Not significant
1(b)	Increase in air emissions during site-specific inspection and maintenance activities.	Negative	RSA	Short-term	Periodic	Short-term	Low	High	Moderate	Not significant
1(c)	Increase in fugitive dust and smoke during construction.	Negative	RSA	Short-term	Isolated	Short-term	Low	High	Moderate	Not significant

Notes: 1 RSA = Air Quality RSA.

2 Significant Residual Environmental Effect: A high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated.

Air Emissions Indicator – Primary Emissions of Criteria Air Contaminants (CACs) and Volatile Organic Compounds (VOCs)

Increase in Air Emissions During Construction

The primary sources of air emissions during construction will be from fuel combustion while transporting crews to and from the work site and along the narrowed pipeline corridor, as well as from the operation of heavy equipment required for construction. Implementation of accepted pipeline construction methods as outlined in Table A7.1.4-1 is the preferred approach to reducing air emissions from pipeline construction.

The amount of CAC and VOC emissions associated with construction activities will be reduced by using multi-passenger vehicles for the transportation of crews to and from the job sites, to the extent feasible, as well as using well-maintained equipment. The residual effects of increased air emissions during construction are considered to have a negative impact balance, but they are expected to dissipate within the Air Quality RSA. Ambient concentrations of CAC and VOC are expected to be within provincial objectives and standards (BC MOE 2013b) and, therefore, of medium magnitude. Air emissions resulting from construction activities are considered to be reversible in the short-term (Table A7.1.4-2, point 1[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Air Quality RSA – potential increases in air emissions resulting from construction activities will dissipate within the Air Quality RSA.
- Duration: short-term – the event resulting in increased air emissions is construction of the pipeline.
- Frequency: isolated – the event resulting in increases in air emissions (*i.e.,* construction of the pipeline) is confined to a specific period.
- Reversibility: short-term – the residual effects are expected to reverse within less than one year for all contaminants after completion of construction.
- Magnitude: medium – an increase in air emissions will occur and may approach but are not expected to exceed environmental or regulatory standards; the increase will be short-lived and localized to the construction area.
- Probability: high – the equipment and vehicles used for construction will emit air contaminants.

- Confidence: moderate – based on a good understanding of the cause-effect relationship but reliant on vehicle and equipment estimates from previous projects.

Increase in Air Emissions During Site-Specific Inspection and Maintenance Activities

The primary sources of air emissions during operations will be from fuel combustion while transporting crews to and from the narrowed pipeline corridor during site-specific maintenance activities. Aerial patrols along the pipeline segments are unlikely to cause measurable increases of near-surface ambient CAC concentrations above background levels. Furthermore, it was assumed that the current frequency and duration of aerial patrols will be sufficient to serve the pipeline expansion associated with the Project.

The amount of air emissions associated with site-specific maintenance activities will be reduced by using multi-passenger vehicles for the transportation of crews to and from the job sites, to the extent feasible, as well as using well-maintained equipment. The residual effects of increased air emissions during site-specific maintenance activities are considered to have a negative impact balance. However, they are expected to dissipate within the Air Quality RSA and be well within provincial objectives and standards (BC MOE 2013b) and, therefore, will be of low magnitude. Air emissions resulting from site-specific inspections and maintenance activities are considered to be reversible in the short-term (Table A7.1.4-2, point 1[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Air Quality RSA – potential increases in air emissions resulting from site-specific maintenance activities (*e.g.,* vegetation management, integrity digs) will dissipate within the Air Quality RSA.
- Duration: short-term – the events resulting in increases in air emissions, are individual maintenance activities (*e.g.,* vegetation management, integrity digs) and each maintenance event will be completed within one year.
- Frequency: periodic – maintenance and operations-related activities (*e.g.,* vegetation management, integrity digs) will occur intermittently but repeatedly over the assessment period.
- Reversibility: short-term – the residual effects are expected to reverse within less than one year for all contaminants after completion of individual maintenance activities.
- Magnitude: low – periodic increases in air emissions during site-specific maintenance will be detectable but within normal variability of existing conditions with the implementation of proposed mitigation measures.
- Probability: high – the equipment and vehicles used for site-specific activities (*e.g.,* vegetation management, integrity digs) will emit air contaminants.
- Confidence: moderate – based on a good understanding of the cause-effect relationship and from current pipeline operations in the same regions, however, detailed information on equipment and vehicle usage for site-specific activities and the duration and frequency of future aerial patrol are not available.

Increase in Fugitive Dust and Smoke During Construction

Emissions of particulate matter related to earth moving activities and use of heavy equipment during pipeline construction are expected to be greater than particulate matter emissions during pipeline operation. Fugitive dust from equipment travelling on disturbed soil can be a major dust contributor during dry periods. Implementing accepted pipeline construction methods as outlined in Table A7.1.4-1 is the preferred approach to reducing air emissions from pipeline construction.

The impact balance of this potential residual effect is considered to be negative since dust could reduce air quality. However, given the short period of construction within Finn Creek Provincial Park and with the implementation of the recommended mitigation measures provided in Table A7.1.4-1, dust during construction will be reduced; therefore, the magnitude is rated as low (Table A7.1.4-2, point 1[c]). A summary of the rationale for all of the significance criteria is provided below.

Smoke will be associated with the burning of slash along discrete segments of the narrowed pipeline corridor. In accordance with applicable provincial legislation pertaining to mulching depth requirements, not all non-merchantable timber can be disposed of by mechanical means; therefore, slash burning is required. Since the maximum depth of mulch will not exceed 5 cm or will be in accordance with the applicable provincial legislation, whichever is less, any remaining vegetation and non-salvageable timber not retained for rollback will be burned. The impact balance of this potential residual effect is considered to be negative since smoke could reduce local air quality. This residual effect is reversible immediately or in the short-term after cessation of burning, depending on the size of the slash piles and conditions during burning, and of medium magnitude given the anticipated volume of slash along the narrowed pipeline corridor.

Larger particles of smoke will settle out via gravitational settling within a relatively short timeframe at any given location, while finer particles might remain suspended for more than 2 days. Therefore, this residual effect is reversible in the short-term. With the implementation of the recommended mitigation measures provided in Table A7.1.4-1, smoke during construction will be reduced and, therefore, the magnitude is rated as low (Table A7.1.4-2, point 1[c]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Air Quality RSA – potential increases in fugitive dust and smoke resulting from construction may extend beyond the Footprint and into the Air Quality RSA.
- Duration: short-term – the event resulting in increases in fugitive dust and smoke is construction of the pipeline.
- Frequency: isolated – the event resulting in increases in fugitive dust and smoke (*i.e.,* construction of the pipeline) is confined to a specific period.
- Reversibility: short-term – the effects are expected to reverse within several days once construction or the maintenance activity is complete.
- Magnitude: low – a small volume of slash along the narrowed pipeline corridor with Finn Creek Provincial Park is expected, and the mitigation measures provided in Table A7.1.4-1 will reduce dust and smoke during construction.
- Probability: high – disposal of slash by burning is planned.
- Confidence: moderate – based on the professional experience of the assessment team.

7.1.4.3 Summary

As identified in Table A7.1.4-2, there are no situations where there is a high probability of occurrence of a permanent or long-term residual environmental effect on air emissions indicators of high magnitude that cannot be technically or economically mitigated. Consequently, it is concluded that the residual environmental effects of pipeline construction and operations on conservational values of Finn Creek Provincial Park related to air emissions will be not significant.

7.1.5 Acoustic Environment

This subsection describes the potential Project effects on the acoustic environment in Finn Creek Provincial Park. The Acoustic Environment LSA consists of a 1.5 km band on both sides of the proposed pipeline corridor (*i.e.,* for a total width of 3.15 km).

All acoustic environment indicators (Table 6.2.1-1 of Introduction to Stage 2 Detailed Proposal) were considered in this evaluation, however, only sound levels was determined to interact with pipeline construction and operations in Finn Creek Provincial Park. There is no blasting proposed for Finn Creek Provincial Park and, therefore, the vibrations indicator is not anticipated to interact with pipeline construction.

7.1.5.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline on acoustic environment indicators are listed in Table A7.1.5-1.

A summary of mitigation measures provided in Table A7.1.5-1 was principally developed in accordance with industry accepted best practices and accepted pipeline construction methods for construction-related activities.

TABLE A7.1.5-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON ACOUSTIC ENVIRONMENT FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1. Acoustic Environment Indicator – Sound levels			
1.1 Changes in sound levels during construction	LSA	• Adhere to all federal (*i.e.*, Environment Canada, *Motor Vehicle Safety Act*, *Oil and Gas Occupational Safety and Health Regulations*, Health Canada) and provincial (*i.e.*, BC *Noise Control Guideline Best Practices Guideline*, *Worker's Compensation Act*, section 7.2 of the *Occupational Health and Safety Regulations* [BC Reg 296/97 as amended] Section 7.2 [BC Reg. 382/2004, s.1]) guidelines and regulations and legislation for noise management [Section 7.0]. • Schedule intermittent noise producing events to avoid, where feasible, important habitat of wildlife species at risk/sensitive species during sensitive periods, where feasible [Section 7.0]. • Enforce vehicle speed limits and inform contractor truck drivers and equipment operators that engine retarder braking in urban areas is prohibited [Section 7.0]. • Maintain equipment in good working condition and in accordance with manufacturer guidelines [Section 7.0]. • Maintain noise suppression equipment on all construction machinery and vehicles in good order [Section 7.0]. • Use only the size and power of tools necessary limit noise from power tool operations. Locate stationary equipment, such as compressors and generators located away from noise receptors, to the extent feasible, and follow applicable municipal, provincial and federal guidelines [Section 7.0].	• Increase in sound levels during construction period.
1.2 Changes in sound level during operation	LSA	• Limit helicopter inspections to weekdays only to the extent practical. • Use of off-road vehicles for inspection should be limited to weekdays if feasible. • Maintain equipment in good working condition and in accordance with manufacturer guidelines. • Maintain noise suppression equipment on all construction machinery and vehicles in good order.	• Periodic noise events due to maintenance and inspections.

Notes: 1 LSA = Acoustic Environment LSA.
2 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of this Proposal).

7.1.5.2 Significance Evaluation of Potential Residual Effects

Table A7.1.5-2 provides a summary of the significance evaluation of the potential residual environmental effects of the construction and operations of the proposed pipeline on the acoustic environment. The rationale used to evaluate the significance of each of the residual environmental effects is provided below.

TABLE A7.1.5-2

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON ACOUSTIC ENVIRONMENT FOR FINN CREEK PROVINCIAL PARK

	Potential Residual Effects	Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
				Duration	Frequency	Reversibility				
1.	Acoustic Environment Indicator – Sound Levels									
1(a)	Increase in sound levels during construction period.	Negative	LSA	Short-term	Isolated	Short-term	Low	High	High	Not significant
1(b)	Periodic noise events due to maintenance and inspections.	Negative	LSA	Short-term	Periodic	Immediate to short-term	Negligible to medium	High	Moderate	Not significant

Notes: 1 LSA = Acoustic Environment LSA.

2 Significant Residual Environmental Effect: A high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated.

Acoustic Environment Indicator – Sound levels

Increase in Sound Levels During Construction

Noise arising from construction and clearing activities will occur along the narrowed pipeline corridor in Finn Creek Provincial Park and this residual effect is considered to have a negative impact balance. Clearing and construction has been scheduled between Q2 2017 to Q4 2017, however, construction will be conducted as expeditiously as practical in order to avoid the caribou range (November 1 to January 15). Clearing activities will also avoid the migratory bird breeding and nesting period.

As described in Section 2.0, construction is expected to last for approximately 14 days along the narrowed pipeline corridor in Finn Creek Provincial Park. In addition, construction equipment and vehicles will be equipped with noise abatement equipment (*e.g.,* mufflers). There may be some situations where after hours noise such as generators or pumps may be used. A summary of the rationale for all of the significance criteria is provided below (Table A7.1.5-2, point 1[a]).

- Spatial Boundary: Acoustic Environment LSA – noise resulting from construction activities may transmit beyond the construction right-of-way;
- Duration: short-term – the events causing changes in sound levels will occur only during the construction phase.
- Frequency: isolated – the event causing changes in sound levels will occur only during the construction phase.
- Reversibility: short-term - the period over which the change in sound level extends is the construction period. However, along the narrowed pipeline corridor, all sound level changes will cease when construction activities have finished.
- Magnitude: low – the increased nuisance noise may affect recreational users.
- Probability: high – heavy machinery and other construction equipment required for construction will produce noise above baseline conditions while in use.
- Confidence: high – based on the professional experience of the assessment team.

Periodic Noise Events Due to Maintenance and Inspection

Noise from pipeline operations is limited to regular aerial and ground patrols, vegetation management and integrity digs. Sounds would be similar to those already heard in areas where the narrowed pipeline corridor is adjacent to the existing TMPL right-of-way. Similar to noise during construction, noise resulting from periodic site-specific maintenance will be limited to the same receptors in close proximity to the narrowed pipeline corridor.

The spatial extent of the change in sound levels is limited to the Acoustic Environment LSA. Since maintenance activities are typically completed at any given location within a few minutes to hours (aerial patrols, vegetation management) or within several weeks (*e.g.,* integrity digs), the duration of the maintenance and inspection activities is short-term. The frequency of maintenance activities occur intermittently but repeatedly over the assessment period and, therefore, are considered to be periodic. The effect is reversible in the immediate to short-term as sound level changes due to maintenance activity will cease as soon as the maintenance activity stops.

While aerial patrols or vegetation management during operations may cause momentary sound levels to increase, the day and night average levels are not expected to change due to such short duration events. Although integrity digs may extend over several weeks, the amount and size of the equipment used during this activity is generally smaller than that used during pipeline construction. Nevertheless, the magnitude of the change in sound level during operations of the pipeline is considered to be of negligible magnitude for most operational activities with the exception of integrity digs near residents which may be of medium magnitude. The inspections and maintenance are essential to safe pipeline operations so the probability of occurrence is rated as high. A summary of the rationale for all of the significance criteria is provided below (Table A7.1.5-2, point 1[b]).

- Spatial Boundary: Acoustic Environment LSA – the change in sound level during operations is confined to the Acoustic Environment LSA.
- Duration: short-term – the events causing changes in sound levels during operations (*i.e.,* maintenance activities) are completed within any one year during operations.
- Frequency: periodic – the events causing changes in sound levels during operations (*i.e.,* aerial patrols, vegetation management, integrity digs) occur intermittently but repeatedly over the assessment period.
- Reversibility: immediate to short-term – the changes in sound level associated with maintenance activities at any given location range from a few minutes to hours for aerial patrols and vegetation management (immediate) to a few weeks for integrity digs (short-term). All sound level changes are reversible as the sound will cease when the inspection/maintenance is finished.
- Magnitude: negligible to medium – the sound level events associated with aerial patrols and vegetation management will have a short timeline, so changes to the day or night average levels are not expected. However, integrity digs that occur near residents may result in sound level changes that could affect day or night average levels.
- Probability: high – changes to sound levels will occur since inspections and maintenance are essential to safe pipeline operation.
- Confidence: high – based on the professional experience of the assessment team.

7.1.5.3 Summary

As identified in Table A7.1.5-2, there are no situations where there is a high probability of occurrence of a permanent or long-term residual environmental effect on the acoustic environment indicator of high magnitude that cannot be technically or economically mitigated. Consequently, it is concluded that the residual environmental effects of pipeline construction and operations on conservational values of Finn Creek Provincial Park related to acoustic environment will be not significant.

7.1.6 Fish and Fish Habitat

This subsection describes the potential Project effects on the fish and fish habitat in Finn Creek Provincial Park. The Fish and Fish Habitat LSA consists of the area extending 100 m upstream from the centre of the proposed pipeline corridor to a minimum of 300 m downstream from the centre of the proposed pipeline corridor at defined watercourses. The Fish and Fish Habitat LSA also includes the area of riparian vegetation to a width of 30 m back from each bank edge within the width of the construction right-of-way. The Aquatics RSA includes all watersheds directly affected by the Project; shown in Figure 6.2.2-1 of the Introduction to the Stage 2 Detailed Proposal.

Fish and fish habitat indicators (*i.e.,* riparian habitat, instream habitat and fish mortality or injury) (Table 6.2.1-1 of Introduction to Stage 2 Detailed Proposal) were considered in this evaluation; each of which were determined to interact with pipeline construction and operations in Finn Creek Provincial Park. Fish and fish habitat species indicators (*i.e.,* bull trout, coho salmon, Chinook salmon and rainbow trout) found within Finn Creek Provincial Park were also considered in this evaluation and are discussed in Section 7.1.6.2 Effects to Fish Species of Concern.

7.1.6.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline on fish and fish habitat indicators are listed in Table A7.1.6-1.

A summary of mitigation measures provided in Table A7.1.6-1 was principally developed in accordance with industry accepted best practices as well as industry and provincial regulatory guidelines including BC MWLAP (2004), CAPP (2004), CAPP *et al.* (2012), and DFO (1995, 2013a, 2014).

TABLE A7.1.6-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON FISH AND FISH HABITAT FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1. Fish and Fish Habitat Indicator – Riparian Habitat			
1.1 Riparian habitat loss or alteration during construction	Footprint	• Seed riparian areas with an approved annual or perennial grass cover crop or native grass mix as soon as feasible after construction. Install temporary erosion control measures such as temporary berms, sediment fences, mounds or cross ditches within 24 hours of backfilling banks and approach slopes of water crossings at any location where runoff from the construction right-of-way may flow into Finn Creek or the unnamed drainage in Finn Creek Provincial Park [Section 8.6]. • Seed disturbed areas on the banks and approaches as soon as practical with an approved grass cover crop species or native grass seed mix and implement sediment control measures to stabilize the banks of Finn Creek and the unnamed drainage and prevent sedimentation of these watercourses, respectively [Section 8.7]. • Maintain sediment fences or equivalent sediment control structure in place at the base of approach slopes until revegetation of the construction right-of-way is complete. • Install mounds on contours in riparian areas, to reduce erosion and to enhance woody vegetation establishment [Section 8.6]. • Install rollback on the construction right-of-way within riparian areas to prevent erosion and sedimentation into watercourses and provide micro-sites to enhance woody vegetation establishment [Section 8.6].	• Riparian habitat loss or alteration due to construction activities.
1.2 Riparian habitat alteration during maintenance and operation	Footprint	• See recommended mitigation measures outlined in potential effect 1.1 of this table.	• Clearing or disturbance of riparian habitat during maintenance and operation.

TABLE A7.1.6-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.3 Contamination from spills during construction and maintenance	RSA	• Review and adhere to the general mitigation measures provided in Section 7.0 of the Pipeline EPP related to equipment washing, inspection of hydraulic, fuel and lubrication systems of equipment, equipment servicing and refuelling as well as fuel storage in proximity to watercourses crosses by the narrowed pipeline corridor (*i.e.,* Finn Creek and unnamed drainage) in Finn Creek Provincial Park during water crossing construction [Section 8.7]. • Use non-toxic, biodegradable hydraulic fluids in all equipment that will work instream if/when flowing water will be encountered during construction if requested by the Inspector(s) [Section 8.7]. • Do not store fuel, oil or hazardous material within 300 m of a watercourse [Section 7.0]. • Ensure pump intakes are placed in a manner that reduces or avoids disturbance to the streambed and are screened in accordance with the DFO screening requirements, to prevent the entrapment of fish or wildlife (*Freshwater Intake End-of-Pipe Fish Screen Guideline)* [Section 8.5]. • Utilize screen pump intakes with a maximum mesh size of 2.54 mm and with a maximum approach velocity of 0.038 m/s, where fish habitat is present [Section 8.5].	• Contamination of riparian habitat from spills during construction and maintenance.
2. Fish and Fish Habitat Indicator – Instream Habitat			
2.1 Instream habitat alteration	RSA	<u>General</u> • An isolated watercourse crossing method and contingency open-cut method have been selected for Finn Creek, in consideration of the size, environmental sensitivities and the period of construction. • Trans Mountain will work with regulatory authorities to determine the necessary approvals, licenses and permits needed for construction of the pipeline or associated components prior to the commencement of the permitted activity in Finn Creek Provincial Park. The contractor(s), subcontractors and the Inspector(s) will be provided with copies of all approvals/licenses and permits including the most recent updates and revisions, and will comply with all conditions presented to Trans Mountain. Trans Mountain will resolve any inconsistencies between approval/permit conditions and contract documents prior to commencement of the construction activity [Section 3.0]. • Review and adhere to applicable instream timing constraints (least-risk window) and all resource-specific measures outlined in Table A7.1.3-2. • Follow the DFO Self-Assessment Process and applicable Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013a, 2014) outlining conditions and measures to avoid serious harm to fish or any permanent alteration to, or destruction of, fish habitat when working in or near Finn Creek [Section 8.7]. • Ensure all necessary equipment, personnel and materials are on-site and ready for installation prior to commencing instream work. Complete all work as quickly as practical to limit the duration of disturbance [Section 8.7]. • Re-establish streambanks and approaches of Finn Creek immediately following construction as outlined in Table A7.1.3-2. <u>Pipeline Crossings</u> • At Finn Creek, conduct an isolated crossing if water is present at the time of construction or an open cut if crossing is dry or frozen to bottom (see Drawing [Watercourse Crossing – Open Cut Method for Dry/Frozen Watercourses] provided in Appendix R of the Pipeline EPP) [Section 8.7] (see Table A7.1.3-2). • Dewater the segment of the watercourse between the dams/diversion channel, if safe to do so. Pump any sediment-laden water out between the dams to well-vegetated lands, away from the watercourse or to settling ponds [Section 8.7]. • Remove any accumulations of sediment within the isolation areas that resulted from crossing construction. Spread all sediment and unused trench spoil removed from the watercourse at a location above the high water mark where the materials will not directly re-enter the watercourse [Section 8.7]. • Ensure that water from flumes, dam and pumps, diversion or other methods does not cause erosion or introduce sediment into the channel. Place rock rip rap, tarpaulins, plywood sheeting or other materials to control erosion at the outlet of pump hoses and flumes. Supplement the erosion control materials to control any erosion [Section 8.7].	• Alteration of instream habitat within the ZOI.

TABLE A7.1.6-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
2.1 Instream habitat alteration (cont'd)	See above	Vehicle Crossings • At Finn Creek and the unnamed drainage, install a clear span bridge for vehicle and equipment crossing during construction. Install, use and remove bridges in accordance with the measures identified in the DFO Self-Assessment Process (DFO 2014) [Section 8.7]. • Ensure bridge is clean prior to installation and dispose of soil at an appropriate location [Section 8.7]. • Implement erosion control measures as soon as a disturbance of the vegetation mat occurs [Section 8.7]. • Stabilize and revegetate areas disturbed during installation and removal of a bridge; install erosion control measures, where warranted, to control surface erosion until vegetation is established [Section 8.7].	• See above.
2.2 Contamination from spills during construction	RSA	• Review and adhere to the general mitigation measures in Section 7.0 of the Pipeline EPP related to equipment washing, inspection of hydraulic, fuel and lubrication systems of equipment, equipment servicing and refuelling as well as fuel storage in proximity to watercourses during water crossing construction [Section 8.7]. • Do not store fuel, oil, or hazardous material within 300 m of a watercourse/wetland/lake [Section 7.0]. • Use non-toxic, biodegradable hydraulic fluids in all equipment that will work instream if/when flowing water will be encountered during construction or in wetland and/or lakes if requested by the Inspector(s) [Section 8.7]. • See recommended mitigation measures for potential effect 1.3 of this table.	• Contamination of instream habitat from spills during construction.
3. Fish and Fish Habitat Indicator – Fish Mortality or Injury			
3.1 Fish mortality or injury during construction	RSA	• Determine the presence of any aquatic or riparian plants and pests prior to the commencement of construction activities within the riparian buffer. Notify the contractor of any special measures to be implemented to prevent the transfer of these organisms from one watercourse to another [Section 8.7]. • Follow the DFO Self-Assessment Process and applicable DFO Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2013a, 2014) and measures outlined Section 8.7 of Pipeline EPP, when working in or near Finn Creek. • Prohibit recreational fishing by Project personnel on or in the vicinity of the construction right-of-way. The use of the construction right-of-way to access fishing sites is prohibited [Section 7.0]. • Ensure all water intakes are screened in accordance with the DFO's *Freshwater End-of-Pipe Fish Screen Guideline*. Ensure the screens are free of debris during pumping [Section 8.7]. • Monitor to assess the immediate effects of crossing construction. Also monitor sediment release (*i.e.,* turbidity and TSS) throughout the crossing construction period, if required [Section 8.7]. • Assign a qualified environmental professional (QEP)to salvage fish with an electrofishing unit from the isolated area prior to and during dewatering and trenching at isolated water crossings in accordance the Fish Collection Permit (see Appendix D) if those permits are determined to be necessary. Note that the application for a Fish Collection Permit is to be submitted 10 working days (minimum) prior to the scheduled isolation of the watercourse. Release all captured fish to areas downstream of the crossing that provide suitable habitat [Section 8.7]. • Clean fish salvage equipment (*e.g.,* waders, boots, nets) of soil, and disinfect with 100 mg/L chlorine bleach before using in any watercourse to prevent the spread of pathogens (*e.g.,* whirling disease) and/or invasive plant species. Ensure that washed off soil is disposed of at a location that will prevent the reintroduction of these untreated materials into Finn Creek [Section 8.7]. • See recommended mitigation measures outlined in potential effects 1.3 and 2.1 of this table.	• Increased fish mortality or injury due to construction activities.
3.2 Fish mortality or injury from spills during construction	RSA	• See recommended mitigation measures outlined in potential effect 3.1 of this table.	• Increased fish mortality or injury from spills during construction activities.

TABLE A7.1.6-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
3.3 Increased suspended sediment concentrations within the ZOI during instream construction	LSA	General • Grade away from watercourses/wetlands to reduce the risk of introduction of soil and organic debris. Do not place windrowed or fill material in watercourses during grading [Section 8.2]. • Ensure temporary berms and/or sediment fence installed following grading (see Section 8.2 of the Pipeline EPP) will adequately control runoff from entering the open trench in the vicinity of water crossings [Section 8.3]. • Install a temporary sediment barrier (*e.g.,* sediment fences), where warranted, to eliminate the flow of sediment from spoil piles and disturbed areas into nearby watercourses (see Drawing [Sediment Fence] provided in Appendix R of the Pipeline EPP) [Section 8.7]. • Inspect temporary sediment control structures (*e.g.,* sediment fences, subsoil berms) installed on approach slopes, on a daily basis throughout crossing construction. Repair the structures before the end of the working day [Section 8.7]. • Ensure all necessary equipment, personnel and materials are on-site and ready for installation prior to commencing instream work. Complete all work as quickly as practical to limit the duration of disturbance [Section 8.7]. • Monitor temporary vehicle crossings (*i.e.,* clear span bridge for Finn Creek and ramp/culvert for unnamed drainage) to ensure that erosion control measures are adequate and stream flow is not disrupted [Section 8.7]. • See additional monitoring measures in Section 8.7 of the Pipeline EPP. • Dewater the segment of the watercourse between the dams, if safe to do so. Pump any sediment-laden water out between the dams to well-vegetated lands, away from the watercourse or to settling ponds [Section 8.7]. • Remove any accumulations of sediment within the isolation areas that resulted from crossing construction. Spread all sediment and unused trench spoil removed from the watercourse at a location above the high water mark where the materials will not directly re-enter the watercourse [Section 8.7]. • Ensure that water from flumes, dam and pumps, diversion or other methods does not cause erosion or introduce sediment into the channel. Place rock rip rap, tarpaulins, plywood sheeting or other materials to control erosion at the outlet of pump hoses and flumes. Supplement the erosion control materials to control any erosion [Section 8.7]. Vehicle Crossings • Implement erosion control measures as soon as a disturbance of the vegetation mat occurs [Section 8.7]. • Stabilize and revegetate areas disturbed during installation and removal of a bridge; install erosion control measures, where warranted, to control surface erosion until vegetation is established [Section 8.7]. • See recommended mitigation measures for potential effect 1.2 outlined in Table A7.1.3-1 Water Quality and Quantity.	• Increased fish mortality or injury due to increased suspended sediment concentrations within the ZOI during instream construction.
3.4 Interbasin transfer of aquatic organisms	RSA	• Determine the presence of any aquatic or riparian plants and pests prior to the commencement of construction activities within the riparian buffer. Notify the contractor of any special measures to be implemented to prevent the transfer of these organisms from one watercourse to another [Section 8.7]. • Ensure that test water withdrawn from one drainage basin is not allowed to enter natural waters of another drainage basin [Section 8.5].	• No residual effect identified.
3.5 Blockage of fish movements	LSA	• Ensure maintenance of downstream flow conditions (*i.e.,* quantity and quality) at all times when constructing an isolated crossing at Finn Creek. If a pump-around method is used to maintain downstream flow, back-up pumping capacity must be onsite and ready to take over pumping immediately if operating pumps fail. Pumps are to be continuously monitored to ensure flow is maintained at all times until the dam materials are removed and normal flow is restored to the channel [Section 8.7]. Vehicle Crossings • Ensure temporary vehicle crossing structures do not disrupt fish passage at Finn Creek and do not interfere with or impede flow or navigation at any location [Section 8.7]. • Construct or install temporary vehicle access across Finn Creek in a manner that follows provincial and federal guidelines [Section 8.7].	• Temporary blockage of fish movements.

TABLE A7.1.6-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
3.6 Effects on fish species of concern	RSA	• Implement applicable measures from the Fish Species of Concern Contingency Plan (see Appendix B of the Pipeline EPP) should fish species of concern be discovered during construction [Section 8.7]. • See recommended mitigation measures outlined in potential effects 3.1 to 3.5 of this table. • See recommended mitigation measures outlined in potential effect 2.2 of this table.	• Fish species of concern may be affected by an increase in suspended sediment concentration, habitat alteration within the ZOI and increased potential for mortality and injury.

Notes: 1 LSA = Fish and Fish Habitat LSA; RSA = Aquatics RSA.
2 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of this Proposal).

7.1.6.2 Significance Evaluation of Potential Residual Effects

Table A7.1.6-2 provides a summary of the significance evaluation of the potential residual environmental effects of the construction and operations of the pipeline on fish and fish habitat indicators. The rationale used in the evaluation of significance of each of the residual environmental effects is provided below. An evaluation of significance is not required for those potential effects where no residual effect is identified (*i.e.,* interbasin transfer of aquatic organisms).

TABLE A7.1.6-2

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON FISH AND FISH HABITAT FOR FINN CREEK PROVINCIAL PARK

Potential Residual Effects	Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
			Duration	Frequency	Reversibility				
1 Fish and Fish Habitat Indicator – Riparian Habitat									
1(a) Riparian habitat loss or alteration due to construction activities.	Negative	Footprint	Short-term	Isolated	Medium to long-term	Low	High	High	Not significant
1(b) Clearing or disturbance of riparian habitat during maintenance and operations.	Negative	Footprint	Immediate to short-term	Occasional	Medium to long-term	Low	Low	High	Not significant
1(c) Contamination of riparian habitat from spills during construction and maintenance.	Negative	RSA	Immediate	Accidental	Short to long-term	Low to high	Low	Moderate	Not significant
2. Fish and Fish Habitat Indicator – Instream Habitat									
2(a) Alteration of instream habitat within the ZOI.	Negative	RSA	Short-term	Isolated	Short to medium-term	Low	High	High	Not significant
2(b) Contamination of instream habitat from spills during construction.	Negative	RSA	Immediate	Accidental	Short to medium-term	Low to high	Low	High	Not significant
3. Fish and Fish Habitat Indicator – Fish Mortality and Injury									
3(a) Increased fish mortality or injury due to construction activities.	Negative	RSA	Immediate to short-term	Isolated	Medium-term	Low	Low	High	Not significant
3(b) Increased fish mortality or injury from spills during construction activities.	Negative	RSA	Immediate	Accidental	Short to long-term	Low to high	Low	High	Not significant
3(c) Increased fish mortality or injury due to increased suspended sediment concentrations within the ZOI during instream construction.	Negative	LSA	Immediate to short-term	Isolated	Medium-term	Low to medium	Low	High	Not significant
3(d) Temporary blockage of fish movements.	Negative	LSA	Immediate to short-term	Isolated	Immediate to short-term	Low	Low	High	Not significant

TABLE A7.1.6-2 Cont'd

Potential Residual Effects	Impact Balance	Spatial Boundary[1]	Temporal Context: Duration	Temporal Context: Frequency	Temporal Context: Reversibility	Magnitude	Probability	Confidence	Significance[2]
3(e) Fish species of concern may be affected by an increase in suspended sediment concentration, habitat alteration within the ZOI and increased potential for mortality or injury.	Negative	RSA	Immediate to short-term	Isolated	Short-term	Low	Low	Moderate	Not significant

Notes: 1 LSA = Fish and Fish Habitat LSA; RSA = Aquatics RSA.

2 Significant Residual Environmental Effect: A high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated.

Fish and Fish Habitat Indicator – Riparian Habitat

Riparian Habitat Loss or Alteration Due to Construction Activities

Riparian vegetation within the construction right-of-way and TWS will be disturbed at all trenched (*i.e.,* isolated or open cut) watercourse crossings and watercourses where a temporary vehicle crossing will be installed (*i.e.,* Finn Creek). The impact balance of this residual effect is considered to be negative. During construction, disturbance to riparian vegetation will be kept to a minimum, leaving as much existing riparian vegetation intact as practical and efforts to control erosion and sedimentation in disturbed areas will be implemented. Disturbed riparian areas will be seeded following construction with appropriate native seed mix along with a quick establishing cover crop. Riparian areas of both banks will be re-vegetated with woody plant material to match species found within the park. Grasses are expected to be restored within the growing season following construction, however, canopy restoration will be long-term. Revegetation mitigation measures are presented in the Pipeline EPP.

The maximum potential disturbance would be 2,700 m^2 as a result of pipeline construction if the entire riparian area, to the width of the construction right-of-way and 30 m from the top of the bank was removed at the Finn Creek crossing, however, the actual disturbance to riparian habitat is expected to be less. Clearing of riparian vegetation will only occur within the pipeline easement and TWS will not be cleared within the riparian buffer.

The residual effect of pipeline construction on clearing riparian vegetation, although negative, is considered to be of low magnitude given the implementation of industry standard and provincially and federally recommended mitigation measures and monitoring of revegetation success at water crossings post-construction. The residual effect is considered to be reversible in the medium to long-term, depending on the pre-existing vegetation community (*e.g.,* shrubs regenerate within several years, however, tree regrowth is expected to extend into the long-term) (Table A7.1.6-2, point 1[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – clearing or disturbance of riparian vegetation is confined to the Footprint.
- Duration: short-term – the event causing the alteration of riparian vegetation is construction of the pipeline and temporary vehicle crossings.
- Frequency: isolated – the event causing clearing or disturbance of riparian vegetation (*i.e.,* construction of the pipeline and temporary vehicle crossings) is confined to a specific period.
- Reversibility: medium to long-term – depending upon the pre-existing vegetation community (*e.g.,* grasses, shrubs and/or trees).
- Magnitude: low – based on implementation of mitigation measures, including revegetation, and the results of PCEM programs which demonstrate the effectiveness of the measures proposed.

- Probability: high – alteration of riparian vegetation is expected to occur at both the watercourse crossings and vehicle crossings.
- Confidence: high – based on a good understanding by the assessment team of trenched (isolated) and vehicle crossing methods and associated effects on riparian vegetation.

Clearing or Disturbance of Riparian Habitat During Maintenance and Operations

Routine vegetation control at the proposed crossing along the proposed pipeline right-of-way and during operations will exclude riparian areas. However, a situation may occur during the life of the operating pipeline where riparian vegetation disturbance may be necessary to accommodate maintenance activities (*e.g.,* in the event of a flood event that causes scouring over the pipeline trench that would require measures to restore depth of cover and pipe integrity). The residual effect of clearing riparian habitat during pipeline operations is of low magnitude and reversible in the medium to long-term (Table A7.1.6-2, point 1[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – clearing or disturbance of riparian vegetation is confined to the Footprint.
- Duration: immediate to short-term – the event causing alteration of riparian vegetation during operations is maintenance activities which may take less than 2 days (*i.e.,* immediate) or may take more than 2 days but less than one year (*i.e.,* short-term).
- Frequency: occasional – any maintenance activities required at the watercourse crossing will occur intermittently and sporadically over the assessment period.
- Reversibility: medium to long-term – depending upon the pre-existing vegetation community (*e.g.,* shrubs or trees) and the extent of clearing or alteration of riparian vegetation required for maintenance activities to take place.
- Magnitude: low – based on the implementation of industry standard and provincially and federally recommended mitigation measures during operations phases of the Project and the results of PCEM programs which demonstrate the effectiveness of the measures proposed.
- Probability: low – clearing within the riparian area is not expected to occur during operations.
- Confidence: high – based on the professional experience of the assessment team.

Contamination of Riparian Habitat from Spills During Construction and Maintenance

In the event of a spot spills, or a more serious fuel truck release, the adverse residual effects would, depending on the volume of the spill and the sensitivity of the receiving environment, range from low to high magnitude with potentially long lasting ramifications to riparian vegetation. However, spill contingency and clean up measures would reduce the magnitude and reversibility of the residual effects.

Spills are cleaned up immediately within the construction right-of-way during construction and maintenance activities, and occur even more rarely in riparian habitat, the probability of a significant adverse residual effect is low (Table A7.1.6-2, point 1[c]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Aquatics RSA – spills resulting in the contamination of riparian habitat may extend beyond the construction right-of-way and, consequently, beyond the Fish and Fish Habitat LSA.
- Duration: immediate – the event causing contamination is a spill, the period of which is less than or equal to 2 days.
- Frequency: accidental – contamination from spills occurs rarely over the assessment period.
- Reversibility: short to long-term – depending on the nature and volume of the spill as well as the level of sensitivity of the receiving environment and the pre-existing vegetation community (*e.g.,* shrubs or trees).

- Magnitude: low to high – depending on the sensitivity of the receiving environment and volume of the spill.
- Probability: low – based on established mitigation measures to prevent a spill.
- Confidence: moderate – based on the professional experience of the assessment team.

Fish and Fish Habitat Indicator – Instream Habitat

Alteration of Instream Habitat within the Zone of Influence

The pipeline corridor selection criteria included reducing the number of watercourse crossings to the extent practical, crossing watercourses perpendicular to the banks and paralleling an existing right-of-way. The proposed crossing techniques and mitigation measures have taken into consideration the sensitivity of the watercourse, including habitat characteristics, fish species present, and instream work windows, in addition to the construction schedule, and technical and economic feasibility of the crossing. The introduction of fine sediment to watercourses from instream activities, right-of-way runoff and erosion can have sub-lethal (*e.g.,* irritation of gill tissue) or lethal (*e.g.,* suffocation of developing embryos) effects on fish, and can also cause downstream sediment deposition that alters substrate composition and modifies the availability and suitability of habitat for spawning, overwintering and/or rearing (Anderson *et al.* 1996, Newcombe and MacDonald 1991).

Bank stabilization through the application of native seed mixes with quick germinating cover crops, in addition to enhanced revegetation efforts including geotextiles or biostabilization, will be the preferred methods of stabilizing watercourse banks disturbed as a result of pipeline construction.

The implementation of the proposed mitigation measures, in accordance with the DFO Self-Assessment Process and applicable DFO Measures to Avoid Causing Harm to Fish and Fish Habitat will reduce the potential for serious harm to fish or any permanent alteration to, or destruction of, fish habitat as a result of trenched pipeline crossings and temporary vehicle crossings. Nevertheless, a Section 35 Authorization from DFO will be applied for, and fish habitat compensation/offset will be implemented as defined in the Authorization, should serious harm to fish or any permanent alteration to, or destruction of, fish habitat be expected as a result of construction activities. In the event that serious harm to fish or any permanent alteration to, or destruction of, fish habitat is expected and a fish habitat compensation/offset plan is required, the fish habitat compensation/offset plan will be used to ensure compliance with DFO's Fisheries Protection Policy (DFO 2013a).

The maximum area of instream habitat that may be disturbed by construction of the proposed pipeline in Finn Creek Provincial Park is 748 m^2, however, the actual disturbance to instream habitat is expected to be less. Instream habitat may also be disturbed during the construction of vehicle crossings (clear span bridge) however, the disturbed area is anticipated to be minor.

The residual effects of the Project on instream habitat are expected to be of low magnitude and reversible in the short to medium-term for the watercourse crossings encountered in Finn Creek Provincial Park. In addition, with the successful implementation of mitigation proposed the effects will be reduced to low magnitude (Table A7.1.6-2, point 2[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Aquatics RSA – alteration of instream habitat may extend beyond the Fish and Fish Habitat LSA for some activities (*e.g.,* for hydrostatic testing).
- Duration: short-term– the event causing alteration of instream habitat is watercourse crossing construction.
- Frequency: isolated – the event causing alteration of instream habitat is confined to the construction phase.
- Reversibility: short to medium-term – any sediments that result in deposition on the substrate of a watercourse are expected to be flushed from the system following the first annual flushing event after construction and, if any fish habitat compensation/offset measures are implemented, they should be

implemented during construction and/or within the first year following construction of the watercourse crossing.

- Magnitude: low – based on the effectiveness of the proposed mitigation, the anticipated level of effects of the alteration of instream habitat and the implementation of a compensation/offset plan if serious harm to fish or any permanent alteration to, or destruction of, fish habitat is anticipated.
- Probability: high – watercourses (*i.e.,* Finn Creek) with documented fish presence will be crossed using trenched (*i.e.,* isolated or open cut) crossing methods.
- Confidence: high – based on a good understanding by the assessment team of trenched crossing methods and associated effects on instream habitat.

Contamination of Instream Habitat from Spills During Construction

In the event of spot spills, or a more serious fuel truck release in or near a stream, the adverse residual effects could, depending on the volume of the spill and the sensitivity of the receiving environment, be of high magnitude with potentially long lasting ramifications to the health of the watercourse. Such an event has the potential to occur during any activities in or near a watercourse. Although spill contingency and clean up measures would reduce the magnitude and reversibility of the residual effects, such an incident could be considered of high magnitude due to adverse residual effects if it were to occur in a highly sensitive environment, such as Finn Creek.

Since spills rarely occur within the construction right-of-way during construction activities, and occur even more rarely instream, the probability of a significant adverse residual effect is low (Table A7.1.6-2, point 2[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Aquatic RSA – spills resulting in the contamination of instream habitat may extend beyond the Footprint and the Fish and Fish Habitat LSA.
- Duration: immediate – the event causing contamination is an accidental spill during construction, the period of which is less than or equal to 2 days.
- Frequency: accidental – contamination from spills occurs rarely, if at all, during the assessment period.
- Reversibility: short to medium-term – depending on the nature and volume of the spill as well as the level of sensitivity of Finn Creek to adverse residual effects resulting from contamination.
- Magnitude: low to high – depending on the sensitivity of the receiving environment and the volume of the spill.
- Probability: low – based on established mitigation measures to prevent a spill.
- Confidence: high – based on the professional experience of the assessment team.

<u>Fish and Fish Habitat Indicator – Fish Mortality and Injury</u>

Increased Fish Mortality or Injury Due to Construction Activities

Some construction activities may lead to an increase in fish mortality or injury. Efforts to remove fish from isolated areas prior to construction may contribute to fish injury and lead to increased fish mortality. Increased sedimentation from construction activities may cause behavioural or sub-lethal/lethal effects to fish and is discussed in the subsection Increased Fish Mortality or Injury Due to Increased Suspended Sediment Concentrations Within the ZOI During Instream Construction.

With the successful implementation of the recommended mitigation measures, the residual effects of construction activities on fish mortality and injury is considered reversible in the medium-term, is of low magnitude based upon the extent, timing and duration of construction activities, and is of low probability (Table A7.1.6-2, point 3[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Aquatics RSA – fish mortality or injury may result from watercourse crossing construction activities and fish rescue and from construction of the temporary vehicle crossing, which may occur outside the Fish and Fish Habitat LSA.
- Duration: immediate to short-term – the event causing fish mortality or injury is construction of the watercourse crossing which will take less than one year but may take more than 2 days at the Finn Creek crossing location.
- Frequency: isolated – the event causing fish mortality or injury (*i.e.,* construction of the pipeline) is confined to a specific period.
- Reversibility: medium-term – loss of one or more individuals could affect population scale for several years, or until those individuals can be replaced.
- Magnitude: low – based on the implementation of mitigation measures proven to be effective, extent, timing and duration of construction activities, and with appropriate regulatory authorizations, if applicable.
- Probability: low – mitigation measures will be implemented to prevent fish mortality or injury.
- Confidence: high – based on the professional experience of the assessment team.

Increased Fish Mortality or Injury from Spills During Construction Activities

A potential spot spill, or a more serious fuel truck release at Finn Creek during construction activities, could cause behavioural or sub-lethal/lethal effects on fish within the ZOI. A spill, such as a fuel truck rollover in or near a stream, during construction could cause increased fish mortality or injury and would be considered to have a negative impact balance, however, proper spill contingency and clean up measures would reduce the magnitude and increase the reversibility of the residual effects. Depending on the volume of the spill and the sensitivity of the receiving environment, the adverse residual effects could range from low to high magnitude with potentially increased fish mortality or injury.

Since spills rarely occur within the construction right-of-way during construction activities, and occur even more rarely instream, the probability of a significant adverse residual effect is low (Table A7.1.6-2 point 3[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Aquatics RSA – Depending on the flow conditions of the contaminated water body the effects of a spill could extend beyond the Fish and Fish Habitat LSA.
- Duration: immediate – the event causing increased fish mortality or injury is a spill, the period of which is less than or equal to 2 days.
- Frequency: accidental – fish mortality of injury from spills occurs rarely over the assessment period.
- Reversibility: short to long-term – depending upon the nature and volume of the spill as well as the level of sensitivity of the receiving population.
- Magnitude: low to high – depending on the sensitivity of the receiving indicators and volume of the spill.
- Probability: low – mitigation measures will be implemented to prevent fish mortality or injury.
- Confidence: high – based on the professional experience of the assessment team.

Increased Fish Mortality or Injury Due to Increased Suspended Sediment Concentration Within the ZOI During Instream Construction

Pipeline corridor selection criteria included reducing the number of waterbody crossings, and temporary vehicle crossings, to the extent practical. An evaluation of increased suspended solid concentrations during instream construction is provided in Section 7.1.3 Water Quality and Quantity. Through the selection of appropriate watercourse crossing techniques, vehicle crossing methods and the implementation of surface

erosion controls and riparian area revegetation as outlined in Table A7.1.6-1 and in the Pipeline EPP, the potential for adverse effects on aquatic systems in Finn Creek due to suspended solids in the water column is reduced.

Suspended sediment released at isolated crossings during instream activities could cause behavioural or sub-lethal/lethal effects on fish within the ZOI. Suspended sediment concentrations will, be monitored during instream activity to confirm that TSS averages remain below the CCME standard of 25 mg/L above baseline (CCME 2007). This is the level, based on 24 hours exposure, when mortalities of the most sensitive life history stage can begin to occur (Newcombe 1994).

There is a level of risk to aquatic resources as a result of high levels of sediment discharge caused by instream construction activities. The Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 2002) are often used to ensure aquatic resources are protected during instream activities. These guidelines indicate that a biologically important average increase in TSS concentration over a short-term period (*i.e.,* 24 h) is 25 mg/L above the background level (CCME 2002). DFO (2000) has identified risk levels to protect aquatic resources. The risk levels are determined based on the relationship between increasing suspended sediment concentrations and the level of risk that increasing sediment concentrations can have on fish and fish habitat. DFO (2000) indicates that concentrations < 25 mg/L, 25-100 mg/L, 100-200 mg/L, 200-400 mg/L and > 400 mg/L have very low, low, moderate, high and unacceptable risk, respectively. Additional background on these risk levels is discussed in Birtwell (1999).

Minor releases of sediment may be associated with the use of temporary vehicle crossings. Although elevated suspended sediment concentrations may result from instream construction and vehicle crossing use, pulses of suspended solids are generally expected to settle out of the water column within the ZOI in a timeframe measuring from minutes to a few hours.

With the implementation of mitigation measures outlined in Table A7.1.6-1 and the Pipeline EPP, the likelihood of fish mortality or injury in Finn Creek arising from suspended sediment during instream construction is low (Table A7.1.6-2, point 3[c]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Fish and Fish Habitat LSA – Project activities causing an increase in suspended sediment will be limited to the Fish and Fish Habitat LSA associated with Finn Creek.
- Duration: immediate to short-term – the event causing fish mortality or injury due to suspended sediment is instream construction, the period of which is likely to be of short term duration (several days) due to the assumption that flowing water will be present at time of construction.
- Frequency: isolated – the event causing fish mortality or injury is confined to a specific period.
- Reversibility: medium-term – loss of one or more individuals could affect population scale for several years, or until those individuals can be replaced.
- Magnitude: low to medium – based on the implementation of mitigation measures proven to be effective, regulatory authorizations and, where warranted, the implementation of fish habitat compensation/offset.
- Probability: low – mitigation measures will be implemented to prevent fish mortality or injury and are anticipated to be effective.
- Confidence: high – based on available research literature and the professional experience of the assessment team.

Temporary Blockage of Fish Movements

As a result of construction activities using traditional methods to isolate sections of channel, localized blockage of fish movements may occur for the duration of instream construction. The impact balance of this potential residual effect is considered negative since it could affect the ability of fish species to migrate upstream or downstream of the crossings. The use of a diversion channel would remove any potential barrier to fish movements.

The mitigation measures outlined in Table A7.1.6-1 and the Pipeline EPP will reduce the potential for blockage of fish movements by instream construction. The residual effect of the blockage of fish movements is considered to be reversible in the immediate to short-term and well within environmental standards and, consequently, of low magnitude (Table A7.1-6.2, point 3[d]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Fish and Fish Habitat LSA – blockage of fish movements may extend immediately upstream and downstream of the construction right-of-way during instream construction along the pipeline corridor.
- Duration: immediate to short-term – the event causing blockage of fish movements is pipeline construction (*i.e.,* instream construction of the pipeline), the period of which is less than one year at the Finn Creek watercourse crossing.
- Frequency: isolated – the event causing blockage of fish movements (*i.e.,* construction of the watercourse crossing) is confined to a specific period at a given watercourse.
- Reversibility: immediate to short-term – any blockage due to instream watercourse construction would be removed upon completion of construction of the Finn Creek watercourse crossing, which may take a couple days (*i.e.,* immediate) but may take longer (*i.e.,* short-term).
- Magnitude: low – the implementation of the proposed mitigation measures is expected to effectively reduce the potential effects on fish movements.
- Probability: low – a proposed diversion channel crossing is recommended which would remove any potential temporary fish blockages.
- Confidence: high – based on the professional experience of the assessment team.

Effects to Fish Species of Concern

Several fish species of concern (*i.e.,* federally and/or provincially listed or a fish and fish habitat indicator species) are known to occur in the Finn Creek Provincial Park Aquatics RSA. COSEWIC and provincially listed species within the Aquatics RSA include, bull trout and coho salmon. Fish and fish habitat indicator species within the Aquatics RSA include, bull trout, coho salmon, Chinook salmon and rainbow trout. Bull trout are provincially Blue-listed (BC CDC 2014) as well as listed as a species of Special Concern by COSEWIC (COSEWIC 2014). Coho salmon (*i.e.,* Interior Fraser River population) have been identified by COSEWIC as Endangered (COSEWIC 2014). Chinook salmon and rainbow trout are neither provincially nor federally listed.

Vehicle and pipeline crossing methods have been selected to reduce Project-specific effects in consideration of presence and use by fish species of concern in Finn Creek. The crossing will be conducted using an isolated crossing method (*i.e.,* if water is present) or open cut crossing (*i.e.,* if dry or frozen to bottom). Although not stated in the original application, the use of a diversion channel is being considered to successfully isolate the section of channel at the crossing location. If used during a period of low flow (*e.g.,* fall), a diversion would allow fall spawning species, such as bull trout, to continue a migration upstream to spawning habitat, unaffected by instream construction.

Bull trout are piscivores, distributed in cool waters throughout the interior of BC and are absent from many shorter coastal rivers (McPhail 2007). Bull trout, in particular, are susceptible to degraded water and habitat conditions from land disturbance (*i.e.,* roads, oil and gas developments, forest harvesting, mining developments) (ASRD 2012, Brewin *et al*. 2001, Hammond 2004). Hybridization and competitive interactions with other species (*e.g.,* non-native brook) can also cause declines in bull trout populations (McPhail 2007). Contamination, loss or alteration of instream habitat is the greatest contributor of effects to this indicator.

Coho salmon have an extensive distribution within BC. Coho salmon are susceptible to natural and anthropogenic habitat degradation (COSEWIC 2002a). However, according to TEK participants, coho are more durable than other salmon varieties and are best at adapting to changing conditions. Contamination,

loss or alteration of instream habitat and riparian habitat are both equal contributors of effects to this indicator.

Chinook salmon are the largest anadromous species to complete life-history events (*i.e.,* spawning and rearing) in the Fraser River mainstem and associated tributaries. Chinook may migrate as far as 600 km inland (McPhail 2007). Chinook salmon are susceptible to direct and indirect habitat loss (COSEWIC 2006) which makes contamination, loss or alteration of instream habitat and riparian habitat both equal contributors of effects to this indicator.

Rainbow trout are a cool water salmonid species with widespread distribution throughout BC. Rainbow trout have not been considered a conservation concern (McPhail 2007); however, the species is representative of overall effects to fish and fish habitat. Rainbow trout are migratory in nature and will swim to new areas should habitat conditions change (Natural Resources Conservation Service 2000); however, contamination, loss or alteration of instream habitat would still be the major contributor to effects on this species.

With the successful implementation of recommended mitigation strategies, the residual effect of the construction of the pipeline on fish species of concern is considered to be reversible in the short-term and of low magnitude (Table A7.1.6-2, point 3[e]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Aquatics RSA – fish species of concern may be affected by an increase in suspended sediment concentrations downstream of watercourse crossings or habitat alteration from trenched (*i.e.,* isolated or open cut) crossing methods.
- Duration: immediate to short-term – the event causing fish species of concern to be affected is instream construction of the pipeline.
- Frequency: isolated – the event causing fish species of concern to be affected (*i.e.,* watercourse crossing construction) is confined to a specific period.
- Reversibility: short-term – the residual effects of pipeline construction on fish species of concern is limited to the construction phase and a short time thereafter until habitat conditions are restored to their original state.
- Magnitude: low – the implementation of the proposed mitigation measures is expected to effectively reduce the potential effects on fish species of concern.
- Probability: low – construction timing, the proposed crossing methods and implementation of the mitigation outlined in Table A7.1.6-1 will reduce the probability of effects to fish species of concern.
- Confidence: moderate – based on the professional experience of the assessment team.

7.1.6.3 Summary

As identified in Table A7.1.6-1, there are no situations where there is a high probability of occurrence of a permanent or long-term residual environmental effect on fish and fish habitat indicators of high magnitude that cannot be technically or economically mitigated. Consequently, it is concluded that the residual environmental effects of pipeline construction and operations on conservational values of Finn Creek Provincial Park related to fish and fish habitat will be not significant.

7.1.7 Wetlands

This subsection describes the potential Project effects on the wetland loss or alteration in Finn Creek Provincial Park. The Wetland LSA consists of a 300 m wide band generally from the proposed pipeline corridor (*i.e.,* 150 m on both sides of the proposed pipeline corridor centre); shown in Figure 6.2.2-3 of the Introduction of the Stage 2 Detailed Proposal. The Wetland RSA includes all watersheds affected by the Project; shown in Figure 6.2.2-1 of the Introduction to the Stage 2 Detailed Proposal.

The measurement endpoint for the wetland loss or alteration indicator, wetland function, includes quantitative measurements of potential Project effects. Wetland function was evaluated at each wetland

where ground-based field work was conducted along the narrowed pipeline corridor in 2014 (*i.e.,* one riparian swamp in Finn Creek Provincial Park). The functions of wetlands crossed by the narrowed pipeline corridor are reported on the premise that wetlands temporarily disturbed during construction would be revisited in the years following pipeline construction to document the progress of function returning to the wetland ecosystem and to ensure wetlands are on the trajectory of reaching pre-construction (*i.e.,* existing) conditions. Wetland functions documented during the evaluation of existing conditions (*i.e.,* pre-construction) will be compared to wetland functions observed along the reclaimed (*i.e.,* post-construction) construction right-of-way. The results of this comparison will be used to measure the effectiveness and efficiency of mitigation and reclamation measures, and provide support to the determination of loss or "no net loss" of wetland function. Details on each of the wetland functional categories are as follows.

- High Functional Conditions: wetlands that demonstrate many wetland functions expected for their class, with little to no anthropogenic disturbance, are high functioning wetlands. These wetlands are performing all expected wetland functions for their class (e.g., vegetation and wildlife habitat function, hydrological function as well as water quality and substrate functions). Following construction, these wetlands are likely to recover to their wetland class, and no alterations to the existing wetland function qualities provided are anticipated.
- High-Moderate Functional Conditions: wetlands that demonstrate many wetland functions expected for their class, with light anthropogenic disturbance, are high-moderate functioning wetlands. These wetlands are mildly disturbed, which reduces the efficacy of the wetland to perform all wetland functions expected for the wetland class (e.g., vegetation and wildlife habitat function, hydrological function as well as water quality and substrate functions). Following construction, these wetlands are likely to recover to their wetland class, and no alterations to the existing wetland function qualities provided are anticipated.
- Low-Moderate Functional Conditions: wetlands that demonstrate some the wetland functions expected for their class, with moderate anthropogenic disturbance are low-moderate functioning wetlands. They are moderately disturbed throughout or have considerable disturbance to the wetland margins and riparian area. The disturbance reduces the efficacy of the wetland to perform wetland functions expected for the wetland class (e.g., vegetation and wildlife habitat function, hydrological function as well as water quality and substrate function). Following construction, these wetlands may recover to their wetland class. However, the potential for a land use change (e.g., cultivation) following construction may alter the wetland's ability to recover its wetland function qualities, which may impact the recovery trajectory.
- Low Functional Conditions: wetlands that demonstrate limited wetland functions expected for their class due to severe anthropogenic disturbance. These wetlands are severely disturbed, which impacts the efficacy of the wetland to perform wetland functions expected for the wetland class (e.g., vegetation and wildlife habitat function, hydrological function as well as substrate function). Following construction, these wetlands have unlikely potential to recover to their wetland class, which will alter the type of wetland functions that were documented during existing surveys. Alternatively, these wetlands may not recover as functional wetlands (i.e., necessary hydrology, soil and vegetation characteristics).

7.1.7.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline on the wetland loss or alteration indicator are listed in Table A7.1.7-1.

A summary of mitigation measures provided in Table A7.1.7-1 was principally developed in accordance with industry accepted best practices as well as industry, federal and provincial regulatory guidelines including the Federal Policy on Wetland Conservation (Environment Canada 1991), Wetland Ways (Wetland Stewardship Partnership 2009), as well as learnings from wetland PCEM for previous pipeline projects (*e.g.,* Enbridge Pipelines Inc. [Enbridge] [TERA 2012bc], KMC [Critchley and Foote 2009, TERA 2011a,b,c,d, 2012a, 2013a,b,c] and NOVA Gas Transmission Ltd. [NOVA Gas] [TERA 2011e, 2012c]) and peer-reviewed publications on wetland function (Price *et al.* 2005, Ryder *et al.* 2005, Shem *et al.* 1993, Van Dyke *et al.* 1994).

TABLE A7.1.7-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON WETLAND LOSS OR ALTERATION FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1. Wetland Loss or Alteration Indicator – Wetland Function			
1.1 Loss or alteration of wetlands of High Functional, High-Moderate, Low-Moderate and Low Functional Condition (*i.e.,* habitat, hydrology, biogeochemistry)	LSA	<u>Habitat</u> • Ensure that all applicable approvals, licenses and permits are in place prior to commencing applicable construction activities [Section 6.0]. • Adhere to applicable clearing guidelines for the protection of streams and wetlands provided in the *Forest Practices Code*, Riparian Management Area Guidebook in BC, where riparian management zones (widths) are identified based on stream or wetland class [Section 8.1]. • Follow applicable measures to avoid serious harm to fish or any permanent alteration to, or destruction of, fish habitat when working in or near Finn Creek [Section 8.7.1]. • Fell all timber within the staked construction boundaries during survey line clearing. No fallen or leaning trees will be permitted outside of the staked construction boundaries or into Finn Creek and or the riparian swamp [Section 6.0]. • Protect vegetation mat from construction disturbance. Any TWS located within the boundary of a wetland must be approved by Trans Mountain's Inspector(s) [Section 7.0]. • Reduce the removal of vegetation in the riparian swamp in Finn Creek Provincial Park to the extent practical. Conduct ground level cutting, mowing or mulching or walking-down of wetland vegetation instead of grubbing. The method of removal of wetland vegetation is subject to approval by the Inspector(s) and Resource Specialist [Section 7.0]. • Narrow down the area of disturbance to the extent practical and clearly mark the area to be cleared [Section 7.0]. • Salvage flagged or fenced live trees or shrubs from the banks of the riparian swamp if requested by the Inspector(s) or noted on the Environmental Alignment Sheets. Store salvaged trees and shrubs along the side of the construction right-of-way in a manner such that they do not dry out before replanting during reclamation [Section 7.0]. • Prohibit clearing of extra TWS within the riparian buffer, only the trench and TWS areas will be cleared. Ensure staging areas for Finn Creek and the riparian swamp crossing construction, grade/borrow areas for wetland ramps and spoil storage areas are located a minimum of 10 m from the banks of Finn Creek and the riparian swamp boundaries. This distance may be reduced by the Lead Environmental Inspector and the Inspector(s) where appropriate controls are in place and where no riparian area is present (*e.g.,* disturbed lands that abut the banks of Finn Creek or boundaries of the riparian swamp) [Section 8.1]. • Restrict root grubbing in wet areas to avoid creation of bog holes [Section 8.1].	• Alteration of wetland habitat function during and following construction and maintenance activities until vegetation is re-established. • Alteration of wetland hydrological function during and following construction and maintenance activities until vegetation is re-established. • Alteration of wetland biogeochemical function during and following construction and maintenance activities until sedimentation is controlled and vegetation is re-established.

TABLE A7.1.7-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.1 Loss or alteration of wetlands of High Functional, High-Moderate, Low-Moderate and Low Functional Condition (*i.e.,* habitat, hydrology, biogeochemistry) (cont'd)	See above	• Restrict root grubbing to the area located outside of the vegetated riparian buffer adjacent to Finn Creek and the riparian swamp. There will be no grubbing within vegetated buffers adjacent to Finn Creek and the riparian swamp except along the trench line and, where warranted, at vehicle crossing areas. See additional grubbing measures in Section 8.1 of the Pipeline EPP. • Allow the riparian swamp to recover naturally (*i.e.,* do not seed wetland areas) [Section 8.6.3]. • Replant salvaged trees/shrubs along the disturbed riparian margins of the riparian swamp as directed by Trans Mountain's Inspector(s). • See Weed Management Plan in Appendix C of the Pipeline EPP. • See additional wetland measures in the Pipeline EPP. <u>Hydrology</u> • Install berms and/or cross ditches on approach slopes to the riparian swamp, where warranted [Section 7.0]. • Maintain drainage across the construction right-of-way during all phases of construction [Section 7.0]. • Grade away from Finn Creek and the riparian swamp to reduce the risk of introduction of soil and organic debris. Do not place windrowed or fill material in Finn Creek or the riparian swamp during grading. Keep wetland soils separate from upland soils [Section 8.2]. • Install sack trench breakers back from the edge of Finn Creek where the banks consist of organic material to prevent sloughing of backfill into the channel (see Trench Breaker – Watercourse/Wetland Drawing in Appendix R of the Pipeline EPP) [Section 8.4]. • Do not dewater the riparian swamp during isolated crossing construction [Section 8.7.4]. • Ensure that the riparian swamp is reclaimed to its pre-construction profile. Remove all corduroy and ramps through sloughs or wetlands, in all circumstances [Section 8.4]. • Leave a trench crown during clean-up wetlands to allow for settlement of backfilled material within the trench [Section 8.6.3]. • Re-establish surface drainage patterns in the riparian swamp to as close to the pre-construction contours as practical during reclamation. [Section 8.6.3]. • Excavate the trench with wide pad, low-ground-pressure equipment or operate standard equipment from mats [Section 8.7.4]. • Store excavated material in a manner that does not interfere with natural drainage patterns. If necessary, haul spoil to a nearby location for storage (*e.g.,* for wet spoil that does not stack well) [Section 8.7.4]. • See additional wetland measures in the Pipeline EPP. <u>Biogeochemistry</u> • Install a temporary sediment barrier (*e.g.,* sediment fences), where warranted, to eliminate the flow of sediment from spoil piles and disturbed areas into Finn Creek and the riparian swamp (see Sediment Fence Drawing in Appendix R of the Pipeline EPP) [Section 8.7.1]. • Implement the Wet/Thawed Soils Contingency Plan (see Appendix B of the Pipeline EPP) during wet/thawed soil conditions when wet or thawed soils are encountered during construction [Section 8.2]. • Avoid rutting and admixing of wetland soils during non-frozen soil conditions. Install appropriate ramps using mats (*e.g.,* swamp mats) or geotextile and spoil ramps [Section 8.7.4]. • Salvage the upper layer of root zone material (maximum of 0.5 m) over the trench area and retain for use in capping the trench following backfilling [Section 8.7.4].	• See above.

TABLE A7.1.7-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.1 Loss or alteration of wetlands of High Functional, High-Moderate, Low-Moderate and Low Functional Condition (*i.e.,* habitat, hydrology, biogeochemistry) (cont'd)	See above	• Use salvaged surface material or trench spoil as a containment/barrier (see Watercourse Crossing – Open Cut Method for Flowing Watercourses Drawing in Appendix R of the Pipeline EPP) if deep water is encountered and the trench area warrants isolation. Consider using spoil material from the trench line as a containment barrier where salvaged surface material is primarily composed of organic material and is likely not able to support a berm/barrier. Location to be determined by Inspector(s). Alternate dam devices such as an Aquadam or meter bags may also be used to isolate the trench area. Pump excess water from work area and trench to opposite side of berm or work ramp [Section 8.7.4]. • Pump water into stable and well-vegetated areas. Monitor discharge areas and change the hose discharge location if adequate natural filtration is no longer feasible and sedimentation could occur [Section 8.7.4]. • Backfill the trench with excavated trench spoil. Remove any excess trench spoil to an upland location approved by the appropriate regulatory authorities [Section 8.7.4]. • Replace any remaining salvaged upper soil (root zone) material over the trench area. Reclaim the riparian swamp to as close as feasible to its pre-construction profile and ensure no permanent trench crown is left following trench crown subsidence [Section 8.7.4]. • Install temporary erosion and sediment control structures (*e.g.,* sediment fences, coir logs) immediately following the completion of backfilling lands adjacent to Finn Creek and the riparian swamp where the potential for sedimentation exists (see Sediment Fence Drawing and Coir/Straw Log Installation Drawing in Appendix R of the Pipeline EPP) [Section 8.4]. • See additional measures in the Pipeline EPP. <u>Monitoring</u> • Conduct Wetland Function PCEM to review the recovery of wetland function within the construction right-of-way. <u>Operations</u> • Implement mitigation measures provided in this table during operations activities within a wetland.	• See above.
1.2 Contamination of wetland function (*i.e.,* habitat, hydrology, biogeochemistry) due to a spill during construction	LSA	▪ Bulk hazardous materials in temporary construction yards or other designated areas except for quantities required for the daily construction activities. Wastes will be stored in temporary construction yards or other designated areas and removed during final clean-up. Fuel, oil or hazardous materials required to be stored on-site will be stored within secondary containment that is to be located greater than 300 m from a watercourse, wetland or lake [Section 7.0]. ▪ Ensure that during construction no fuel, lubricating fluids, hydraulic fluids, methanol, antifreeze, herbicides, biocides, or other chemicals are dumped on the ground or into waterbodies. In the event of a spill, implement the Spill Contingency Plan (see Appendix B of the Pipeline EPP) [Section 7.0]. ▪ Do not store fuel, oil or hazardous material within 300 m of a watercourse or waterbody [Section 7.0]. • Do not wash equipment or machinery in watercourses, wetlands or lakes. Control wastewater from construction activities, such as equipment washing or cement mixing, to avoid discharge directly into any body of water [Section 7.0].	• Reduction of wetland habitat, hydrological and biogeochemical function in the event of a spill during construction (depending on the volume and type of substance spilled).

Notes: 1 LSA = Wetland LSA.
2 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of this Proposal).

7.1.7.2 Significance Evaluation of Potential Residual Effects

The quantitative analysis revealed that there are approximately 0.14 ha of wetlands located within the Wetland LSA within Finn Creek Provincial Park. Of this, approximately 0.08 ha of wetlands are encountered by the narrowed pipeline corridor. It is estimated within the narrowed pipeline corridor there are approximately 0.08 ha of wetlands with High-Moderate Functional Condition (*i.e.,* the riparian swamp). Table A7.1.7-2 provides a summary of the area of wetland disturbed by the narrowed pipeline corridor within Finn Creek Provincial Park.

TABLE A7.1.7-2

PROJECT DISTURBANCE OF WETLAND FUNCTION WITHIN THE NARROWED PIPELINE CORRIDOR AND WETLAND LOCAL STUDY AREA IN FINN CREEK PROVINCIAL PARK

Total Wetland Area (Within Corridor and LSA) (ha)	Area of Wetlands within Corridor (ha)	Narrowed Pipeline Corridor (ha)			
		High Functional	High-Moderate Functional	Low-Moderate Functional	Low Functional
0.14 ha	0.08 ha	--	0.08 ha	--	--

Table A7.1.7-3 provides a summary of the significance evaluation of the potential residual environmental effects of the construction and operations of the proposed pipeline in Finn Creek Provincial Park on wetland loss or alteration. The rationale used to evaluate the significance of each of the residual environmental effects is provided below.

TABLE A7.1.7-3

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON WETLAND LOSS OR ALTERATION FOR FINN CREEK PROVINCIAL PARK

	Potential Residual Effects	Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
				Duration	Frequency	Reversibility				
1	Wetland Loss or Alteration Indicator – Wetland Function									
1(a)	Alteration of wetland habitat, hydrological and biogeochemical functions during and following construction and maintenance activities until vegetation is re-established, grade and natural flow patterns are restored and sedimentation is controlled.	Negative	LSA	Short-term	Periodic	Short to long-term	Low	High	High	Not significant
1(b)	Reduction of wetland habitat, hydrological and biogeochemical functions in the event of a spill during construction.	Negative	LSA	Immediate	Accidental	Short to long-term	Low to high	Low	High	Not significant

Notes: 1 LSA = Wetland LSA.
2 Significant Residual Environmental Effect: A high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated.

Wetland Loss or Alteration Indicator – Wetland Function

The evaluation of wetland functional condition was used to assess the level of significance of the potential residual effects associated with the narrowed pipeline corridor. Functional condition (*i.e.,* High Function, High-Moderate Function, Low-Moderate Function or Low Function) was determined based on the level of existing disturbance to the wetland, the class of wetland (*i.e.,* riparian swamp) and its capacity to provide certain functions on a landscape level. The evaluation of significance was based on the anticipated level of residual effect the pipeline construction and operations will have on the wetland based on its pre-construction functional condition. Three components of wetland function (*i.e.,* wetland habitat, hydrological and biogeochemical) were used in this analysis.

Alteration of Wetland Habitat Function

Pipeline construction and maintenance activities within wetlands will likely result in some disruption of the function of wetlands, and this is considered to have a negative impact balance. Examples of potential adverse environmental effects on wetland habitat function are: potential changes in species composition; stress on plant species; interruption of wildlife movements; and fragmentation of natural habitats.

With proper construction methods and mitigation measures (*i.e.,* profile contours returned and the appropriate protection and use of the seedbank), these adverse effects can be successfully reduced. For example, Zimmerman and Wilkey (1992) monitored wetlands for effects on vegetation for 20 years post-disruption from pipeline construction. Findings of these long-term monitoring programs show that:

adjacent natural wetland areas were not altered in type when the proper construction and mitigation measures were carried out (*i.e.,* wetland contours and elevations match those off the construction right-of-way); no non-native plant species invaded natural areas; and the right-of-way increased diversity.

Additional studies on the effects of pipeline construction on wetland vegetation (Shem *et al.* 1993, Van Dyke *et al.* 1994) report the following observations.

- *Wetland community effects*: at most sites, many plants from adjacent natural areas re-establish themselves on the right-of-way. Rights-of-way that have been constructed in a manner that wetland function is not lost (*e.g.,* profile contours returned and the appropriate restoration or maintenance of the seedbank through ensuring equipment arrives on-site clean and kept free of vegetative debris during construction) appear to have little effect on vegetation in the natural areas.

- *Wetland species diversity*: A greater number of wetland plants have been observed on the right-of-way than in the adjacent natural area. Rights-of-way increase the number and types of habitats in wetlands due to the growth of a variety of succession species. Although the impact balance on wetlands resulting from the disturbance created by the pipeline construction is negative (see Table A7.1.7-3), increased biodiversity is viewed positively since the plants that are regenerating on the right-of-way are native species that occur within the natural wetland habitat, and the result is that habitat function is not negatively impacted.

- *Construction and management practices*: Overall, vegetative cover on rights-of-way in wetlands in a variety of control plots (*i.e.,* various wetland types in areas throughout the US) is generally well-established within 1 to 3 years after pipeline construction when mitigation measures included returning wetland contours and elevations to pre-construction conditions. Minor differences in the final right-of-way surface elevation can strongly influence the type of vegetation that re-establishes on the right-of-way. Other examples of construction and management practices that ensure wetland vegetation will re-establish include conducting ground-level cutting, mowing or mulching of wetland vegetation instead of grubbing, directing grading away from wetlands and allowing natural recovery (*i.e.,* not seeding wetlands).

The effects of construction of a pipeline right-of-way on wetland vegetation and bird communities were investigated up to 2 years following construction by Santillo (1993). Results showed that at 2 years post-construction, wetlands were dominated by native hydrophytic graminoids. Also, in wetlands with no standing water, plant community composition and structure were found to be similar at the end of 2 years post-construction to what was observed pre-construction. Finally, results also showed that no new bird species were introduced as a result of the different habitat provided by the right-of-way after pipeline construction was conducted using appropriate mitigation measures (*e.g.,* re-establishing pre-construction contours within wetland boundary to ensure cross right-of-way drainage) that ensured seedbanks were restored on the construction right-of-way.

Increased plant diversity is discussed here as a finding of research presented in peer-reviewed available research literature (Santillo 1993, Shem *et al.* 1993, Van Dyke *et al.* 1994, Zimmerman and Wilkey 1992). The conclusion of the research was that although there was increased native plant diversity as a result of pipeline construction, the overall habitat function of the wetlands was not negatively impacted.

Increased biodiversity is viewed positively since the plants that are regenerating on the right-of-way are native wetland species, therefore, wetland habitat is not substantially altered. By opening up the canopy, plant species that generally cannot grow beneath a tree or shrub overstory will return to begin the plant succession stages and additional species will begin to inhabit the area.

Past construction projects in similar ecoregions have successfully reduced effects on wetlands. PCEM of wetland function (TERA 2011a,b,c,d,e, 2012a,b,c) at wetlands along recent large pipeline projects have shown that mitigation measures implemented during construction (*e.g.,* profile reconstruction, allowing natural regeneration) can be successful; wetlands have proven to be resilient. In addition, the absence of environmental issues pertaining to wetland function restoration has been observed and documented in As-built Environmental Reports for the first, second and third-year Wetland Function PCEM reports for numerous past pipeline projects (TERA Environmental Consultants 2011a,b,c,d,e, 2012a,b,c).

Mitigation measures will be employed to reduce residual effects on wetlands, depending on site-specific conditions and requirements (Table A7.1.7-1 and the Pipeline EPP). With the implementation of the proposed mitigation measures, the potential alteration of wetland habitat function is considered to be reversible in the medium to long-term for wetlands depending on the pre-construction vegetative cover, and of low magnitude. The proposed mitigation measures (*e.g.,* Weed Management Plan in Appendix C of the Pipeline EPP) that will be used to reduce the residual effects on wetlands within Finn Creek Provincial Park aligns with the management objective of the park to maintain the natural quality and existing conditions of the park as the ultimate goal is to return wetlands to their pre-construction functional conditions.

Alteration of Wetland Hydrological Function

Pipeline installation or maintenance may cause potential changes to the hydrologic flow (*i.e.,* surface or groundwater flow) of a wetland by diverting water away from the wetland and/or impeding natural flow through the wetland. Excessive water diversion will result in an unnatural decrease of water flow within the wetland while flow impedance (*i.e.,* inadequate drainage) results in a more saturated wetland habitat.

Each of these alterations is an interruption to the natural hydrologic regime and is considered to have a negative impact balance. The vertical and horizontal water movements in wetlands are readily disrupted by any berm-like structure. For example, linear disturbances, such as pipelines and roads, can impound water on the upstream side of a wetland resulting in drying downstream and flooding upstream. Drying on the downslope face in treed wetlands (*e.g.,* treed swamps) can increase tree productivity, water demand and evapotranspiration, which facilitates further drying (Baisley 2012, Miller *et al. in prep.*). In mineral wetlands, this type of disturbance (*i.e.,* drying downstream) may also result in increases in productivity of drought tolerant wetland plant species (*e.g.,* grasses, some sedges and rushes) and water demand, which, similar to treed wetlands, can lead to further drying. The compounded drying can result in permanent alteration of mineral wetland hydrologic regime, overall wetland function and potentially ecosystem type (*e.g.,* treed wetland to forest or marsh to wet meadow or moist grassland) (Baisley 2012, Miller *et al. in prep.,* Sherwood 2012). On the upstream side, increased saturation from impounded water can result in the loss of trees and other woody vegetation, while allowing for the establishment of emergent vegetation in peatlands (Miller 2011) whereas in seasonal mineral wetlands, increased inundation may result in the decrease of emergent vegetation, the increase in aquatic vegetation and open water characteristics. Prolonged impoundment may potentially convert a treed wetland to an open water or marsh wetland and a more seasonal mineral wetland into a more permanent open water wetland.

The hydraulic conductivity of the wetland's substrate can also be affected by salvaging, compacting or mixing of the soil structure. In mineral wetlands, improper handling (*i.e.,* admixing, salvaged material drying) of salvaged mineral soil and wetland substrate can result in loss of salvaged material through wind erosion (*i.e.,* drying of material while stockpiled). Improper replacement of bottom soils can affect the permeability of the material (*i.e.,* permeable substrate becoming impermeable) as the result of admixing and compaction. These issues can affect a wetland's ability to retain and slowly release flood waters to the groundwater, increase evaporative losses of stored water and limit a wetland's storage capacity (*i.e.,* volume of water a wetland can retain). Storing salvaged material separately (*i.e.,* mineral soil separate from wetland substrate) and maintaining the moisture content can mitigate the effect of wind erosion while replacing salvaged material in the correct order (*i.e.,* mineral soil followed by wetland substrate) following construction can help to maintain bottom soil permeability, therefore, maintaining a wetland's hydraulic conductivity capability.

Among the most important considerations for limiting disturbances to hydrological function are assuring that the restoration of pre-construction elevations and contours are achieved (Gartman 1991), and that there will be no unnatural impedance to flow. Short-term disturbances to wetlands are expected during pipeline construction. Some alteration of hydrological function in wetlands can be expected during trenching, however, the Q4 of 2016 or Q1 of 2017 construction schedule will reduce potential hydrologic changes since water flow is likely to be diminishing from peak levels. Surface materials at shallow depth (*i.e.,* the mineral soil) should be salvaged and stored separately from other material and sequentially replaced. This will reduce potential changes in the hydrological function of wetlands. If the construction right-of-way in the wetland is restored to its pre-construction profile and proper hydrologic throughflow is ensured by replacement of salvaged wetland substrates/upper soils, long-term effects on wetland hydrological function are not expected. Seedbank moisture regime recovery (*i.e.,* vegetation growth due to moisture), however, has proven to occur more slowly since surface material moisture levels are regulated either from vegetation

removal (resulting in a wetter moisture regime than previous) or the drier conditions commonly present at wetland margins.

Standard pipeline construction and operational activities are designed to avoid circumstances that result in diversion and/or natural flow impedance of water in wetlands. With the implementation of the proposed mitigation measures, the residual effect of pipeline construction and maintenance activities on wetland hydrology is considered to be reversible in the medium to long-term and of low magnitude.

Alteration of Wetland Biogeochemical Function

Changes in wetland hydrologic regime can directly and indirectly affect wetland biogeochemical function. Directly, hydrologic regime can affect soil processes, nutrient availability and water chemistry. For example, soil decomposition rates are controlled by microbial respiration, which is affected by temperature and oxygen availability. Microbes preferentially use oxygen, however, under anaerobic, saturated conditions, the rate and type of respiration is altered (McLatchey and Reddy 1998). Additionally, the heat capacity of saturated soils is higher than that of dry soils. Therefore, decomposition rates are maintained by hydrologic regime through saturated conditions.

Impounding water flow due to linear disturbance can also directly impact wetland biogeochemistry. For example, in wetlands that receive nutrient inputs primarily from surface and groundwater sources, impeding water flow can result in nutrient delivery to downstream parts of the wetland being limited. However, recontouring and/or installing trench crown breaks may alleviate some of this nutrient stress.

Activity in or near wetlands during pipeline construction may result in an increased sediment supply and turbidity of surface waters (particularly in mineral wetlands), thereby, affecting biogeochemical function of the wetland. However, given the implementation of sedimentation control mitigation measures (*i.e.,* sediment fencing), the likelihood of alteration in this manner is reduced.

Indirectly, hydrologic regime can impact biogeochemical function by altering wetland habitat function. For example, decreases in water table position can increase tree productivity rates, which could decrease the quality of litter deposited to soil to increase nutrient turnover-times. This can change understory community composition due to nutrient and light limitations, soil processes (*e.g.,* decomposition rates), as well as further stimulating changes in wetland hydrologic regime through increased transpiration and interception by root systems (Baisley 2012, Kotowska 2012, Laiho *et al.* 2003).

Mitigation measures employed during construction and maintenance activities will reduce the residual effect. Consequently, the residual effect of pipeline construction and maintenance activities on wetland biogeochemistry is considered to be reversible in the medium to long-term and is of low magnitude.

A summary of the rationale for all of the significance criteria for all three components of wetland function (*i.e.,* habitat, hydrological and biogeochemical) is provided below (Table A7.1.7-3, point 1[a]).

- Spatial Boundary: Wetland LSA - alteration of habitat (*e.g.,* changes in vegetation species composition, stress on plant species, interruption of wildlife movements and fragmentation of natural habitats), hydrological (*e.g.,* changes in water level, impeded drainage) and biogeochemical function (*e.g.,* water quality, nutrient uptake) resulting from pipeline construction or maintenance activities may extend beyond the construction right-of-way.

- Duration: short-term – the events causing alteration of habitat, hydrological and biogeochemical function are construction of the pipeline and maintenance activities, the latter of which will be completed within any one year during the operations phase.

- Frequency: periodic - the events causing alteration of habitat, hydrological and biogeochemical function (*i.e.,* construction of the pipeline and maintenance activities) occur intermittently but repeatedly over the assessment period.

- Reversibility: short to long-term – depending on the growth time of wetland species (short to medium-term) found along the narrowed pipeline corridor, the time required to reclaim pre-construction elevation and contours (medium-term) and the time for biogeochemical processes to be reclaimed

(medium to long-term), the reversibility of the residual effect may take less than or greater than one year with the possibility of being greater than 10 years.

- Magnitude: low – based on the proposed mitigation measures (*i.e.,* substrate being restored to pre-construction profile and allowing natural regeneration in wetlands) and the PCEM literature demonstrates that wetlands are resilient provided habitat function is not permanently altered. If permanent loss or alteration of wetland habitat function is identified upon completion of the Wetland Function PCEM Program, Trans Mountain will consult with Environment Canada regarding potential remedial or compensatory measures to offset functional loss. However, permanent loss or alteration of wetland function is not anticipated at the riparian swamp crossed by the proposed pipeline construction right-of-way within Finn Creek Provincial Park since pipeline construction through wetlands is considered a temporary disturbance and experience indicates that residual effects on wetland function can be mitigated.
- Probability: high – the narrowed pipeline corridor crosses a riparian swamp within Finn Creek Provincial Park and disturbances within this wetland will likely occur during pipeline construction and site-specific maintenance activities.
- Confidence: high – based on available research literature, results of mitigation measures and PCEM programs of past pipeline projects and the professional experience of the assessment team.

Effects on Wetlands from Spills During Construction

In the unlikely event of a fuel spill from equipment or a fuel truck near a wetland during construction, infiltration of fuel into surficial deposits and surface water is possible, and the effects would be considered to have a negative impact balance. The implementation of prevention measures (Table A7.1.7-1 and Pipeline EPP is expected to mitigate small spills in wetlands. Spill mitigation is expected to result in some loss or disturbance of soil and vegetation. With the implementation of mitigation efforts, the effects of small spills on wetland function (*i.e.,* habitat, hydrological and biogeochemical) are considered to be of low to high magnitude and reversible in the short to long-term (Table A7.1.7-3, point 1[b]).

- Spatial Boundary: Wetland LSA – alteration of wetland function (*i.e.,* habitat, hydrologic and biogeochemical) resulting from a spill during pipeline construction or maintenance activities may extend beyond the construction right-of-way.
- Duration: immediate – the event causing reduction of wetland function is a spill during construction, the period of which is less than or equal to 2 days.
- Frequency: accidental – contamination of wetlands from spills occurs rarely over the assessment period.
- Reversibility: short to long-term – depending on the volume and area affected by the spill.
- Magnitude: low to high – for potential reduction of wetland habitat, hydrological and biogeochemical functions.
- Probability: low – spills are unlikely to occur within the wetland.
- Confidence: high – based on available research literature, results of mitigation measures and PCEM programs of past pipeline projects and the professional experience of the assessment team.

7.1.7.3 Summary

As identified in Table A7.1.7-3, there are no situations where there is a high probability of occurrence of a permanent or long-term residual environmental effect on wetland loss or alteration of high magnitude that cannot be technically or economically mitigated. Consequently, it is concluded that the residual environmental effects of pipeline construction and operations on conservational values of Finn Creek Provincial Park related to wetland loss or alteration will be not significant.

7.1.8 Vegetation

This subsection describes the potential Project effects on vegetation in Finn Creek Provincial Park. The Vegetation LSA generally consists of a 300 m wide band from the centre of the proposed pipeline corridor (*e.g.,* 150 m on both sides of the centre of the proposed pipeline corridor); shown in Figure 6.2.2-3 of the Introduction to the Stage 2 Detailed Proposal. The Vegetation RSA consists of a 2 km wide band generally from the centre of the proposed pipeline corridor centre and facilities (*i.e.,* 1,000 m on both sides of the centre of the proposed pipeline corridor).

All vegetation indicators were considered in this evaluation (Table 6.2.1-1 of the Introduction to the Stage 2 Detailed Proposal); and all of them were determined to interact with pipeline construction and operations in Finn Creek Provincial Park.

7.1.8.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline on vegetation indicators are listed in Table A7.1.8-1.

A summary of mitigation measures provided in Table A7.1.8-1 was principally developed in accordance with industry accepted best practices as well as industry and provincial regulatory guidelines.

TABLE A7.1.8-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON VEGETATION FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1. Vegetation Indicator – Vegetation Communities of Concern			
1.1 Loss or alteration of native vegetation	Footprint	• Confine all pre-clearing/mowing and general clearing activities within the staked/flagged construction right-of-way boundaries. Adhere to clearing/mowing restrictions associated with Finn Creek, the riparian swamp, sensitive environmental features and buffer areas (at Finn Creek and the riparian swamp crossings). • Maintain low vegetation or vegetated ground mat within the riparian buffer zone of Finn Creek and the vegetated buffer zone of the riparian swamp, to the extent practical, by clearing only trees, walking-down low vegetation so low-lying vegetation remains intact. Limit grubbing of cleared/mowed trees/shrubs only to the trench line and work side area needed for the vehicle crossing to protect riparian areas [Section 8.1]. • Use hand clearing methods where directed by Trans Mountain's Lead Environmental Inspector and Inspector(s) to avoid or reduce disturbance to the ground surface on sensitive terrain [Section 8.1]. • Restrict root grubbing to the trench line and restrict root grubbing in wet areas to avoid creation of bog holes, minimize surface disturbance and encourage re-sprouting/natural regeneration of deciduous trees and shrubs. See additional clearing and grubbing measures in Section 8.1 of the Pipeline EPP. • Use natural recovery as the preferred method of reclamation of the riparian swamp [Section 8.6]. • Within the vicinity of the construction right-of-way, collect dormant woody plant material (deciduous stakes/brush) and select suitably sized transplants (small conifer/deciduous trees/shrubs) from a suitable donor site following approval from the applicable land manager [Section 7.0 of Appendix C]. • Use a grass cover crop and/or native grass seed mix that has been developed for use at riparian areas to support the establishment of installed and naturally regenerating native woody plant material and plants and to provide erosion protection in the short-term [Section 7.0 of Appendix C]. • Seed disturbed lands with land uses that support native plant communities with native grass mixtures and rates, respectively, as identified in the Drawing C-01 of the Stage 2 Detailed Proposal. • For native seed, the highest seed grade available will be obtained. Do not accept seed lots that contain any Prohibited Noxious or Noxious weeds as identified in the Certificate of Analysis. Retain the Certificates of Analysis obtained for native seed for future documentation. The Certificates of Analysis will be presented to BC Parks upon request [Section 8.6].	• Alteration of the composition of approximately 2.2 ha of native vegetation.

TABLE A7.1.8-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.1 Loss or alteration of native vegetation (cont'd)	See above	• Minimize foot traffic on newly seeded areas until grass establishment has taken place. Vehicle traffic will be avoided on seeded areas until the sod is re-established [Section 8.6, Section 10.0 of Appendix C]. • Plant native shrub/tree species, where warranted, depending on the site-specific objectives [Section 14.0 of Appendix C]. • Remove problem vegetation (*i.e.,* weeds or invasive species) when adjacent to or crossing the riparian swamp or Finn Creek and replace it with compatible, low-growing plant species that will out-compete problem vegetation [Section 14.0 of Appendix C]. • Refer to the Problem Vegetation Management Plan [Section 14.0 of Appendix C] for management of non-native or invasive species. • See potential effect 3.1 of this table for mitigation regarding non-native or invasive species during construction and operations. • Monitor the effectiveness of revegetation efforts during the post-construction environmental monitoring program of the construction right-of-way. Conduct additional remedial work, where warranted.	• See above.
1.2 Loss or alteration of rare ecological communities	LSA	• See potential effect 1.1 of this table for mitigation regarding alteration of native vegetation. • See recommended mitigation measures for wetland ecological communities of concern outlined in Table A7.1.7-1 Wetland Loss or Alteration. • Supplemental vegetation and rare plant surveys will be conducted prior to construction in Finn Creek Provincial Park in August 2014. • Avoid environmentally sensitive areas, such as areas likely to have rare plant species or rare ecological communities. Where avoidance is impractical, implement site-specific mitigation measures in accordance with the Rare Ecological Community and Rare Plant Population Management Plan [Section 6.0 of Appendix C]. • If previously unidentified occurrences of vegetation communities of concern are found during supplemental rare plant surveys, mitigation will be determined using the Rare Ecological Community and Rare Plant Population Management Plan [Section 6.0 of Appendix C]. • Site-specific mitigation will include avoidance, narrowing the construction right-of-way, fencing or protecting [Section 6.0 of Appendix C, Appendix J]. • Flag or fence-off resource-specific environmental features (*e.g.,* rare plant species, rare ecological communities) prior to commencing construction in the vicinity of the resource site. See additional mitigation in Section 6.0 of the Pipeline EPP. • Implement the resource-specific mitigation measures associated with vascular and non-vascular plant species of concern as well as rare and unique plant communities on or adjacent to the staked construction boundaries. • Suspend activity if previously unidentified rare ecological communities are found on or adjacent to the construction right-of-way. Implement the Rare Ecological Communities or Rare Plant or Species Discovery Contingency Plan [Section 7.0 of Appendix B]. • Recontour the landscape to pre-construction conditions [Section 7.0 of Appendix C]. • Restrict the application of herbicide within 30 m of known rare plant populations or rare ecological communities. Spot spraying, wicking, mowing or hand-picking are acceptable weed control measures in proximity to rare plants, rare lichens and vegetation communities of concern [Section 7.0]. • Monitor the effectiveness of revegetation efforts during the post-construction environmental monitoring program of the construction right-of-way. Conduct additional remedial work, where warranted.	• Some disturbance or alteration of a rare ecological community, if avoidance is not practical and mitigation measures do not completely protect a site. • If rare ecological communities are located adjacent to the construction right-of-way, they may be indirectly affected by changes in hydrology or light levels.
2. Vegetation Indicator – Plant and Lichen Species of Concern			
2.1 Loss or alteration of rare plant and/or lichen occurrences	LSA	• Supplemental vegetation and rare plant surveys will be conducted prior to construction in Finn Creek Provincial Park in August 2014. • See potential effect 1.4 of this table for mitigation applicable to the loss or alteration of rare ecological communities. • Flag or fence-off resource-specific environmental features (*e.g.,* rare plant species, rare ecological communities) prior to commencing construction in the vicinity of the resource site See additional measures in Section 6.0 of the Pipeline EPP. • Recontour the landscape to pre-construction conditions [Section 7.0 of Appendix C]. • Monitor the effectiveness of revegetation efforts during the post-construction environmental monitoring program of the construction right-of-way. Conduct additional remedial work, where warranted.	• Some disturbance or alteration of a rare plant occurrence, if avoidance is not practical and mitigation measures do not completely protect a site.

TABLE A7.1.8-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
2.1 Loss or alteration of rare plant and/or lichen occurrences (cont'd)	See above	• See above.	• Some disturbance or alteration of a rare lichen occurrence, if avoidance is not practical and mitigation measures do not completely protect a site. • If rare plant or lichen sub-populations are located adjacent to the construction right-of-way they may be affected by changes in hydrology or light levels.
3. Vegetation Indicator – Presence of Infestations of Provincial Weed Species and Other Invasive Non-Native Species Identified as a Concern			
3.1 Weed introduction and spread	RSA	• Conduct a pre-construction weed survey and record problem vegetation (designated weeds) infestations on and immediately adjacent to the construction right-of-way [Section 6.0, Section 14.0 of Appendix C]. • Implement weed management in consultation with BC Parks (*i.e.,* using proper application of chemical, mechanical or manual measures, or a combination of all) at locations identified within the pre-construction weed survey to a level that is consistent with weed management observed adjacent to the eventual construction right-of-way to reduce the potential for weed infestations following construction [Section 6.0]. Also refer to the Weed and Vegetation Management Plan [Section 14.0 of Appendix C]. • Ensure equipment arrives at all construction sites clean and free of soil or vegetative debris. Do not allow any equipment arriving in a dirty condition on site until it has been cleaned [Section 7.0]. • Power wash and misting stations will be established, where required, to clean equipment used during clearing and root zone material handling activities [Appendix F]... In addition, shovel and compressed air cleaning stations for root zone material handling equipment will be established at selected locations to prevent the spread of weeds [Appendix J, Section 5.2]. • Restrict all vehicular traffic to the approved and staked construction right-of-way, workspace and access roads [Section 6.0]. • Monitor the root zone material and other soil piles for weed growth frequently during the growing season. Direct the contractor when warranted to take proactive measures to control weed growth [Section 7.0]. • Consider placing mats (*i.e.,* construction mats or swamp mats) over infested areas to reduce construction equipment transporting weed or plant material. Where mats are used, ensure they are free of soil, vegetation and debris prior to removing from the site [Section 7.0]. • Clean equipment (*i.e.,* shovel and sweep, pressurized water or compressed air) involved in root zone material handling at weed-infested sites prior to leaving the location unless full right-of-way root zone material salvage has been conducted. Clean equipment involved in root zone material handling at weed-infested sites prior to leaving the location [Section 7.0]. • For native seed, the highest seed grade available will be obtained. Do not accept seed lots that contain any Prohibited Noxious or Noxious weeds as identified in the Certificate of Analysis. Retain the Certificates of Analysis obtained for future documentation. The Certificates of Analysis will be presented to the Crown land authority upon request [Section 8.6]. • Limit vehicle travel through problem vegetation infested areas [Section 14.0 of Appendix C of the Pipeline EPP]. • The Weed and Vegetation Management Plan consists of vegetation management measures to be implemented in the short-term, during the pre-construction, construction and post-construction environmental monitoring program phases of Project construction and the long-term, during the regular operations and maintenance phase of the Project. Vegetation management measures to be implemented during both short-term and long-term periods in consultation with BC Parks [Section 14.0 of Appendix C of the Pipeline EPP].	• Weed introduction and spread.

TABLE A7.1.8-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
3.1 Weed introduction and spread (cont'd)	See above	• The use of herbicides for problem vegetation management along the construction right-of-way during construction and operations within the province of BC will be conducted in accordance with the *Integrated Pest Management Regulation* of BC as part of the BC *Integrated Pest Management Act* and in consultation with BC Parks [Section 14.0 of Appendix C of the Pipeline EPP]. • Monitor the effectiveness of revegetation efforts during the post-construction environmental monitoring program of the construction right-of-way. Conduct additional remedial work, where warranted. • During regular maintenance and operations activities, incidental ground inspections for problem vegetation along the construction right-of-way may be conducted to determine the extent (percent cover, composition, distribution, location of infestations) of problem vegetation (*i.e.*, presence of mature brush and trees, and weeds). Areas of new infestations, recommended treatment sites and will also be identified and documented during monitoring. To assist monitoring efforts, the baseline data collected during the pre-construction weed survey and the results of the post-construction environmental monitoring program will assist in establishing thresholds and determining if objectives of the Weed and Vegetation Management Plan are being met [Section 14.0].	• See above.

Notes: 1 LSA = Vegetation LSA; RSA = Vegetation RSA.
2 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of the Stage 2 Detailed Proposal).

7.1.8.2 Significance Evaluation of Potential Residual Effects

Table A7.1.8-2 provides a summary of the significance evaluation of the potential residual environmental effects of the construction and operations of the proposed pipeline in Finn Creek Provincial Park on vegetation. The rationale used to evaluate the significance of each of the residual environmental effects is provided below.

TABLE A7.1.8-2

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON VEGETATION FOR FINN CREEK PROVINCIAL PARK

Potential Residual Effects	Impact Balance	Spatial Boundary[1]	Temporal Context: Duration	Temporal Context: Frequency	Temporal Context: Reversibility	Magnitude	Probability	Confidence	Significance[2]
1 Vegetation Indicator – Vegetation Communities of Concern									
1(a) Alteration of the composition of approximately 2.2 ha of native vegetation.	Negative	Footprint	Short-term	Periodic	Medium to long-term	Low to medium	High	High	Not significant
1(b) Some disturbance or alteration of a rare ecological community, if avoidance is not practical and mitigation measures do not completely protect a site.	Negative	Footprint	Short-term	Periodic	Short to long-term	Medium	Low	High	Not significant
1(c) If rare ecological communities are located adjacent to the construction right-of-way they may be indirectly affected by changes in hydrology or light levels.	Negative	LSA	Short-term	Periodic	Medium to long-term	Low	High	Moderate	Not significant
2 Vegetation Indicator – Plant and Lichen Species of Concern									
2(a) Some disturbance or alteration of a rare plant occurrence, if avoidance is not practical and mitigation measures do not completely protect a site.	Negative	Footprint	Short-term	Periodic	Medium to long-term	Medium	Low	High	Not significant
2(b) Some disturbance or alteration of a rare lichen occurrence, if avoidance is not practical and mitigation measures do not completely protect a site.	Negative	Footprint	Short-term	Periodic	Short to medium-term	Medium	Low	High	Not significant

TABLE A7.1.8-2 Cont'd

Potential Residual Effects		Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
				Duration	Frequency	Reversibility				
2(c)	If rare plant or lichen sub-populations are located adjacent to the construction right-of-way, they may be affected by changes hydrology or light levels	Negative	LSA	Short-term	Periodic	Short to long-term	Low	Low	High	Not significant
3	Vegetation Indicator – Presence of infestations of Provincial Weed Species and Other Invasive Non-Native Species Identified as a Concern									
3(a)	Weed introduction and spread.	Negative	RSA	Short-term	Periodic	Short to medium-term	Low to medium	High	High	Not significant

Notes: 1 LSA = Vegetation LSA; RSA = Vegetation RSA.

2 Significant Residual Environmental Effect: A high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated.

Vegetation Indicator – Alteration of Vegetation Communities of Concern

Alteration of Native Vegetation

The Project parallels existing disturbance for the whole of its length of Finn Creek Provincial Park. The proposed route was sited along existing right-of-way to the extent practical. Using a disturbance layer on GIS imagery to calculate undisturbed native vegetation, approximately 2.2 ha of native vegetation may be disturbed or altered on the Footprint during construction and operations of the proposed pipeline crossing Finn Creek Provincial Park. The alteration of native vegetation is considered to have a negative impact balance.

Disturbed areas through native vegetation in parks and protected areas will be seeded with the appropriate native seed mix. Although areas disturbed during construction and periodic maintenance activities will revegetate with the appropriate native species, species composition in the disturbed Footprint will be altered. Clearing of the right-of-way and TWS and the maintenance of the right-of-way will result in the perpetuation of early seral vegetation. The extent of altered vegetation communities will be limited by the implementation of mitigation measures outlined in Table A7.1.8-1 and reclamation measures will speed the recovery.

Specific learnings from the TMX Anchor Loop Project post-construction monitoring (TERA 2013b) relevant to the alteration of native vegetation, such as the native vegetation found within Finn Creek Provincial Park include the following.

- Localized broadcast-seeding of native forb species resulted in limited establishment success.
- Timely salvage, storage and replacement of topsoil/root zone material allowed for the preservation of propagules (*e.g.,* seed, root pieces, spores) located in the surface soil to remain viable.
- Where grubbing was avoided in riparian areas adjacent to crossings of streams and wetlands, native deciduous plants re-sprouted the spring after clearing and native plants established from seed located within the undisturbed surface soil.
- Willow staking was an effective means of re-vegetating the banks of watercourses when coordinated with construction clean-up and reclamation.
- Protection of installed woody plant species from ungulate browsing was achieved through the use of constructive panel fencing.
- The establishment success of installed woody plant species and naturally-regenerating native forb species was observed in riparian areas with limited grass establishment due to dry and/or low nutrient

soils (*i.e.,* gravelly or with high woody debris content) or where a native riparian seed mix was not applied. To improve survival success of installed woody species and to encourage species diversity through the natural regeneration of native plants from the soil seed bank, seed riparian areas with a short-lived perennial native grass species to stabilize surface soils and reduce competition to installed and naturally-regenerating plants.

- Alteration of native vegetation due to competition for light, soil nutrients and moisture may occur while the Footprint is revegetating. However, the establishment of early successional communities during reclamation and operations will resemble revegetation following natural disturbance since the species composition will favour early successional/colonial species, which are adapted for greater competition pressure for light, nutrients and moisture (excepting the competition resulting from weedy non-native species).
- During construction, operations and reclamation of the Project, there will be a decrease in woody species richness and abundance due to site clearing within the Footprint, but due to edge effects there may be increases in woody species richness and abundance in areas adjacent to the Footprint. The extra TWS will be allowed to revegetate after construction. Forb and graminoid species richness and abundance will increase over the operations phase of the Project as natural, low growing vegetation regenerates, but the Footprint will be maintained free of higher growing vegetation. During abandonment, the Footprint will be returned to an equivalent land capability compared to the pre-construction conditions.

No locally or regionally adopted threshold or standard exists against which the incremental change in vegetation composition can be assessed. This residual effect is limited to the Footprint, reversible in the medium to long-term and of low to medium magnitude (Table A7.1.8-2, point 1[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – effects of pipeline construction and operations on the alteration of native vegetation is confined to the construction right-of-way.
- Duration: short-term – the events contributing to the alteration of native vegetation are clearing during construction of the pipeline or maintenance activities (*e.g.,* integrity digs, vegetation management), the latter of which are limited to any one year during the operations phase.
- Frequency: periodic – the events resulting alteration of native vegetation (*i.e.,* pipeline construction and maintenance activities) occur intermittently but repeatedly during the operations phase of the Project.
- Reversibility: medium to long-term – depending upon the associated land use and the growth time required for species in each affected area (*e.g.,* forb versus tree), changes to native vegetation community composition are considered reversible in the medium to long-term. The effects of the proposed pipeline on forb and graminoid species (*e.g.,* grasses, bunchberry) is expected to be reversible in the medium-term, whereas the effects on tree species (*e.g.,* western red cedar, black spruce) are expected to be reversible in the long-term (more than 10 years) because the full right-of-way will be maintained free of higher growing vegetation until abandonment. Therefore, the overall alteration of the composition of vegetation along the Footprint will persist in the medium to long-term.
- Magnitude: low to medium – the narrowed pipeline corridor is located adjacent to existing disturbances for its entire length within the park and the construction of the pipeline will result in the clearing of approximately 2.2 ha of vegetation on the Footprint, which is considered to be within environmental standards given that best practices, objectives and provincial guidelines are being followed. Permanent loss of native vegetation is not anticipated to result from either the construction or operations of the proposed pipeline (low), however, returning the Footprint to an equivalent land capability during the abandonment phase could take years, as discussed under reversibility (medium). The indirect effects of Project construction and maintenance due to edge effects such as changes in light and moisture will be of low magnitude since they will not result in the loss of vegetation but only a localized change in vegetation community composition.
- Probability: high – the Footprint crosses native vegetation.

- Confidence: high – based on past pipeline projects and the professional experience of the assessment team.

Some Disturbance or Alteration of a Rare Ecological Community, if Avoidance is Not Practical and Mitigation Measures Do Not Completely Protect a Site

Rare plant surveys were conducted during the growing season in June 2013 on lands where access was granted as a component of the vegetation surveys. Supplemental ground-based rare plant surveys are planned to be conducted in August 2014. In the event that additional rare ecological communities are identified in the Footprint during supplemental surveys, mitigation will be determined using the Rare Ecological Community and Rare Plant Population Management Plan in Section 5.0 of Appendix C of the Pipeline EPP.

During the 2013 rare plant surveys, no BC CDC-listed rare ecological communities were observed in Finn Creek Provincial Park. Mitigation measures for rare ecological communities generally fall into categories of avoidance, (*e.g.,* realignment, change of work side, narrowing), reducing disturbance (*e.g.,* narrowing, adjusting workspaces, ramping/matting over) and alternative construction/reclamation techniques (*e.g.,* salvaging seed or sod, plant propagation, transplanting component species, separate root zone material salvage, delayed clearing, access management) (Appendix C of the Pipeline EPP for more details). These proposed mitigation measures have been used previously on other major pipeline construction projects with good success.

Learnings from the TMX Anchor Loop Project (TERA 2013b) pertinent to rare ecological communities (including wetland communities of concern) include the following.

- Natural regeneration is an effective means of revegetation in wetlands where construction disturbance is limited to the trench area and where accurate separation and replacement of trench materials is achieved.
- In wetlands, transplanting of sedge and bulrush species from local undisturbed donor sites into construction disturbed areas proved to be an effective method of revegetation as transfers established and spread within their respective habitats.

Mitigation is developed with a number of factors taken into account that include, however, are not limited to:

- component species;
- community size;
- rarity;
- construction timing;
- location of the community with respect to the proposed right-of-way;
- primary mode of component species reproduction;
- habitat and proximity of available habitat; and
- past mitigation success (of the community or similar communities).

Based on the assessment of potential rare ecological communities that will be encountered during construction within Finn Creek Provincial Park, the mitigation measures described above are considered to be appropriate and applicable to the Project. If mitigation measures do not completely protect the site, a disturbance or alteration of a portion of the community may occur and is considered to have a negative impact balance. By basing mitigation on community ranking and abundance, in addition to its location on the construction right-of-way and the community type, any alteration of the local community, particularly S1 communities, will be reduced to a level such that the local community is not placed at risk. Consequently, the residual effect of pipeline construction on rare ecological communities and unique communities are of

medium magnitude (Table A7.1.8-2, point 1[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – the potential disturbance or alteration of a rare ecological community is confined to the construction right-of-way.
- Duration: short-term – the events resulting in potential disturbance or alteration of a rare ecological community are construction of the pipeline or maintenance activities (*e.g.,* integrity digs), the latter of which are limited to any one year during the operations phase.
- Frequency: periodic – the events resulting in potential disturbance or alteration of a rare ecological community (*i.e.,* construction of the pipeline and maintenance activities) occur intermittently, however, repeatedly during the operations phase of the Project.
- Reversibility: short to long-term – depending on the component species, the construction method (*e.g.,* narrowing the right-of-way or matting over) and the landscape. For example, common cattails (common cattail marsh) can recolonize or re-establish in one growing season if the seed bank and habitat is available. Treed communities take more than 10 years to re-establish due to the length of time required for trees to grow to full height which provides the appropriate light for other component species.
- Magnitude: medium – the potential disturbance or alteration of a rare ecological community is of medium magnitude since the effect is still within environmental standards given that best practices, objectives and provincial guidelines are being followed. Returning the footprint to an equivalent land capability and regrowth of a rare ecological community could take more than 10 years, as discussed under reversibility.
- Probability: low – there were no rare ecological communities identified within the narrowed pipeline corridor in Finn Creek Provincial Park during the vegetation survey in June 2013. It is unlikely that rare ecological communities will be found within the Footprint.
- Confidence: high – based on past pipeline projects, the professional experience of the assessment team and the results of PCEM.

Indirect Effects to Rare Ecological Communities

With proper implementation of the industry-accepted standard mitigation practices that are proposed, disruption of surface flow patterns and light levels following construction or maintenance activities are expected to be minor along the narrowed pipeline corridor. However, construction and maintenance activities (*e.g.,* integrity digs) may contribute to some localized alteration of light levels and natural surface drainage patterns until trench settlement is complete and seeded and/or naturally regenerated vegetation has matured. The impact balance of this potential residual effect is considered negative since it could alter the moisture regime and light levels.

Indirect alteration of rare ecological communities adjacent to the Footprint may occur due to soil erosion. Some rare ecological communities may be more susceptible to erosion than others. Since the areas with greatest erosion risk will be seeded with native species or an annual cover crop (or otherwise stabilized with erosion control blankets, coir matting or woody slash, [Section 6.0 of Appendix C and Section 8.6.3 of the Pipeline EPP]), the indirect alteration of native vegetation as a result of erosion will not measurably contribute to the overall effect of pipeline construction on the alteration of rare ecological communities.

Increased distance of light penetration due to clearing will result in an indirect alteration of native vegetation (*i.e.,* the native species making up the rare ecological community). For example, some forested communities are characterized by low light penetration due to dense tree canopy. If part of the community is cleared, the light penetrating to the understory will change the species composition along the edges of the community where clearing occurred. However, this effect will not substantially contribute to the alteration of native vegetation beyond the effects detailed in relation to the clearing of native vegetation. Additionally, during the course of reclamation, as revegetation progresses, light penetration will generally decrease over time.

Given that indirect effects are, in part, caused by disturbance to vegetation structure associated with clearing activities, allowing disturbed areas to naturally revegetate may not alleviate indirect effects where vegetation management is conducted or long-term persistence of the disturbance exists. Consequently, indirect effects to vegetation are expected to persist until the pre-existing vegetation composition and structure is restored for the Footprint.

During the construction and operations of the pipeline, there will be a decrease in woody species richness and abundance due to clearing within the footprint, but due to edge effects there may be increases in woody species richness and abundance in areas adjacent to the Footprint. Forb and graminoid species richness and abundance will increase following construction as natural vegetation regenerates.

Alteration of native vegetation due to competition for light, soil nutrients and moisture may occur while the Footprint is revegetating. However, the establishment of early successional communities following construction will resemble revegetation following natural disturbance since the species composition will favour early successional/colonial species, which are adapted for greater competition pressure for light, nutrients and moisture (excepting the competition resulting from weedy non-native species).

The PCEM program will identify any locations with altered drainage patterns (*e.g.,* ponded water) and remedial work will be conducted. Once pre-construction hydrology regimes are returned to a site, regeneration or revegetation of rare ecological communities will be more likely.

The effect of construction on adjacent rare ecological communities is deemed to have a negative impact balance. This residual effect is limited to the Vegetation LSA, reversible in the medium to long-term and of low magnitude since the narrowed pipeline corridor parallels other pipeline rights-of-way and disturbance for its entire length within the park (Table A7.1.8-2, point 1[c]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Vegetation LSA – although alteration of rare ecological communities is generally confined to the construction right-of-way, potential changes in hydrology, light levels and species composition may extend beyond the pipeline right-of-way.
- Duration: short-term – the events resulting in alteration of adjacent rare ecological communities are clearing during construction of the pipeline or maintenance activities (*e.g.,* integrity digs, vegetation management), the latter of which are limited to any one year during the operations phase.
- Frequency: periodic – the events resulting in alteration of adjacent rare ecological communities (*i.e.,* pipeline construction and maintenance activities) occur intermittently but repeatedly during the operations phase of the Project.
- Reversibility: medium to long-term – it may take more than one year plus adequate precipitation levels in order for the trench crown to settle and natural drainage patterns to be restored, and it could take more than 10 years for vegetation to grow back to former heights depending on the species, which will prevent increased light from reaching surrounding plants in the ecological community.
- Magnitude: low – the narrowed pipeline corridor is located adjacent to existing disturbances to the extent practical and the residual effects are detectable but are still considered to be within environmental standards given that best practices, objectives and provincial guidelines are being followed.
- Probability: high – the narrowed pipeline corridor is adjacent to native vegetation with high potential to support rare ecological communities, including forested areas that will be affected by clearing vegetation during construction.
- Confidence: moderate – based on data pertinent to the Project area and the professional experience of the assessment team.

Vegetation Indicator – Plant and Lichen Species of Concern

Some Disturbance or Alteration of a Rare Plant Occurrence, if Avoidance is Not Practical and Mitigation Measures Do Not Completely Protect a Site

During the June 2013 rare plant surveys conducted in Finn Creek Provincial Park, which were a component of the vegetation surveys, no occurrences of BC CDC-listed rare plant species were observed. Supplemental ground-based rare plant surveys are planned to be conducted in August 2014. In the event that additional rare plant species are identified in the Footprint, during supplemental surveys, mitigation will be determined using the Rare Ecological Community and Rare Plant Population Management Plan (Section 7.0 of Appendix C of the Pipeline EPP). In the event that additional rare plant species are identified on or within 30 m of the construction right-of-way during construction, refer to the Rare Ecological Community and Rare Plant Population Discovery Contingency Plan (Section 7.0 of Appendix B of the Pipeline EPP). Protection measures and environmental management techniques for rare plants are provided in Appendix C of the Pipeline EPP. Mitigation measures for rare plant species generally fall into categories of avoidance, (*e.g.,* realignment, change of work side, narrowing), reducing disturbance (*e.g.,* narrowing, adjusting workspaces, ramping/matting over) and alternative construction/reclamation techniques (*e.g.,* salvaging seed or sod, plant propagation, transplanting, separate strippings salvage, delay clearing, access management). These proposed mitigation measures have been used previously on other major pipeline construction projects with good success.

Based on the assessment of the rare plants with potential to be encountered during construction, the mitigation measures described above are considered likely to be appropriate and applicable to the Project. However, if mitigation measures do not completely protect the site, a disturbance or alteration of a portion of the population or community may occur. Mitigation is developed with a number of factors taken into account that include, however, are not limited to:

- species;
- population size;
- rarity;
- growth form of the plant (*i.e.,* annual, biennial, perennial);
- construction timing;
- location of the population with respect to the proposed footprint;
- primary mode of species reproduction;
- mode and magnitude of propagule dispersal;
- habitat and proximity of available habitat; and
- past mitigation success (of the species or similar species).

By basing mitigation on these factors, any disturbance or alteration of a rare plant population, particularly those ranked S1, would be reduced to a level such that the population is not placed at risk (Table A7.1.8-2 point 2[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – the potential disturbance or alteration of a rare plant population is confined to the construction right-of-way.
- Duration: short-term – the events resulting in potential disturbance or alteration of a rare plant population are clearing during construction of the pipeline or maintenance activities (*e.g.,* integrity digs, vegetation maintenance), the latter of which are limited to any one year during the operations phase.

- Frequency: periodic – the events causing potential disturbance or alteration of a rare plant population (*i.e.,* construction of the pipeline and maintenance activities) occur intermittently but repeatedly at some locations during the operations phase of the Project.
- Reversibility: medium to long-term – depending on the species, the construction method (*e.g.,* narrowing the right-of-way or matting over, compared to transplanting) and the landscape.
- Magnitude: medium – the potential disturbance or alteration of a rare plant population is of medium magnitude since the effect is considered to be within environmental standards given that best practices, objectives and provincial guidelines are being followed.
- Probability: low – there were no rare plant populations identified within the narrowed pipeline corridor in Finn Creek Provincial Park during the rare plant surveys in 2013. It is unlikely that rare plant populations will be found within the Footprint.
- Confidence: high – based on past pipeline projects, the experience of the assessment team and the results of the rare plant surveys.

Some Disturbance or Alteration of a Rare Lichen Occurrence, if Avoidance is Not Practical and Mitigation Measures Do Not Completely Protect a Site

During the June 2013 rare plant surveys in Finn Creek Provincial Park, which were a component of the vegetation surveys, no BC CDC-listed rare lichen populations were observed. Supplemental ground-based rare plant surveys are planned to be conducted in August 2014. In the event that rare lichen species are identified in the Footprint, during supplemental surveys, mitigation will be determined using the Rare Ecological Community and Rare Plant Population Management Plan (Section 7.0 of Appendix C of the Pipeline EPP). In the event that additional rare lichen species are identified on or within 30 m of the construction right-of-way during construction, refer to the Rare Ecological Community and Rare Plant Population Discovery Contingency Plan (Section 7.0 of Appendix B of the Pipeline EPP). Protection measures and environmental management techniques for rare lichens are provided in Appendix C of the Pipeline EPP. Mitigation measures for rare lichen species generally fall into categories of avoidance, (*e.g.,* realignment, change of work side, narrowing), reducing disturbance (*e.g.,* narrowing, protective matting) and alternative construction/reclamation techniques (*e.g.,* relocation of substrates, transplanting of thalli or peds, inoculation using vegetative fragments). These proposed mitigation measures have been used previously on other major pipeline construction projects with good success, but in general, fencing and avoiding is the mitigation that has the greatest likelihood of success, as compared to transplanting, and is the preferred conservation strategy.

Avoidance was highly successful in protecting rare species along the TMX Anchor Loop Project. Of the sites monitored in 2010 where fence and avoid procedures were employed, 93% had retained the rare lichen species targeted for mitigation (TERA 2011a).

Based on the assessment of the rare lichens with potential to be encountered during pipeline construction, the mitigation measures described above are considered likely to be appropriate and applicable to the Project. However, if mitigation measures do not completely protect the site, a disturbance or alteration of a portion of the population may occur. Mitigation is developed with a number of factors taken into account that include, but are not limited to:

- species;
- population size;
- rarity;
- construction timing;
- location of the population with respect to the proposed footprint;
- preference substrate and proximity of available substrates; and

- past mitigation success (of the species or similar species).

By basing mitigation on these factors, any disturbance or alteration of a rare lichen population, particularly those ranked S1, would be reduced to a level such that the population is not placed at risk.

The effect of construction on rare lichen populations is deemed to have a negative impact balance. This residual effect is limited to the Footprint, reversible in the short to medium-term and of medium magnitude since the narrowed pipeline corridor parallels other pipeline projects and disturbance for its entire length within the park (Table A7.1.8-2, point 2[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – the potential disturbance or alteration of a rare lichen population is confined to the construction right-of-way.
- Duration: short-term – the events resulting in potential disturbance or alteration of a rare lichen population are construction of the pipeline or maintenance activities (*e.g.,* integrity digs), the latter of which are limited to any one year during the operations phase.
- Frequency: periodic – the events resulting in potential disturbance or alteration of a rare lichen population (*i.e.,* construction of the pipeline and maintenance activities) occur intermittently but repeatedly during the operations phase of the Project.
- Reversibility: short to medium-term – depending on the species and the mitigation measures applied. Based on PCEM results from TMX Anchor Loop, effects on rare lichens were generally resolved in 3 to 5 years (*i.e.,* it was apparent in 3 to 5 years of PCEM whether the population would survive or not) (TERA 2011b).
- Magnitude: medium – the potential disturbance or alteration of a rare lichen population is of medium magnitude since the effect is still within environmental standards given that best practices, objectives and provincial guidelines are being followed.
- Probability: low – there were no rare lichen populations identified within the narrowed pipeline corridor in Finn Creek Provincial Park during the rare plant surveys in 2013 and it is unlikely that rare lichen populations will be found within the Footprint.
- Confidence: high – based on past pipeline projects, the experience of the assessment team and the results of the rare plant surveys.

Indirect Effects to Rare Plant and Lichen Sub-Populations

With proper implementation of the industry-accepted standard mitigation practices that are proposed, disruption of surface flow patterns and light levels following construction or maintenance activities is expected to be minor along the narrowed pipeline corridor. However, construction activities may contribute to some localized alteration of light levels and natural surface drainage patterns until trench settlement is complete and vegetation has matured. The impact balance of this potential residual effect is considered negative since it could alter the moisture regime and light levels. In addition, dust deposition and the chemicals used to suppress dust have the potential to impact rare plants and lichens.

Indirect alteration of rare plant and lichen populations adjacent to the Project may occur due to soil erosion. Since the areas with greatest erosion risk will be seeded with native species or an annual cover crop (or otherwise stabilized with mulch, straw, crimping), the indirect alteration of native vegetation as a result of erosion will not measurably contribute to the overall effect of the Project on the alteration of rare plant populations.

Increased distance of light penetration due to clearing will result in an indirect alteration of native vegetation (*i.e.,* the native species making up the habitat for rare plant populations). For example, some rare species are only found in forested communities characterized by low light penetration due to dense tree canopy and a specific amount of humidity. If part of the treed community is cleared, the light penetrating to the understory will change the species composition along the edges of the community where clearing occurred and the increased air flow will alter humidity within the area. However, this effect will not substantially

contribute to the alteration of native vegetation beyond the effects detailed in relation to the clearing of native vegetation. Additionally, during the course of reclamation, as revegetation progresses, light penetration and air flow will generally decrease over time.

Given that indirect effects are, in part, caused by disturbance to vegetation structure associated with clearing activities, allowing disturbed areas to naturally revegetate may not alleviate indirect effects where vegetation management is conducted or long-term persistence of the disturbance exists. Consequently, indirect effects to rare plant and lichen populations are expected to persist until the pre-existing vegetation composition and structure is restored for the Footprint.

Alteration of native vegetation due to competition for light, soil nutrients and moisture may occur while the Footprint is revegetating. However, the establishment of early successional communities following construction will resemble revegetation following natural disturbance since the species composition will favour early successional/colonial species, which are adapted for greater competition pressure for light, nutrients and moisture (excepting the competition resulting from weedy non-native species).

Many rare species inhibit areas with specific hydrology and light regimes. If hydrology of an area is altered, rare plant or lichen species located adjacent to the construction right-of-way may be affected. For example, golden saxifrage requires moist but not submerged substrate to grow on. The PCEM program will identify any locations with altered drainage patterns (*e.g.,* ponded water) and remedial work will be conducted. Consequently, the residual effect is reversible in the short to long-term. This residual effect is of low magnitude since the narrowed pipeline corridor parallels other pipeline rights-of-way and disturbance for its entire length within the park (Table A7.1.8-2, point 2[c]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Vegetation LSA – although alteration of rare plant and lichen populations is generally confined to the disturbed portion of the construction right-of-way, potential changes in hydrology, dust and light levels may extend beyond the pipeline right-of-way.
- Duration: short-term – the events resulting in alteration of rare plant and lichen populations are clearing during construction of the pipeline or maintenance activities (*e.g.,* integrity digs, vegetation management), the latter of which are limited to any one year during the operations phase.
- Frequency: periodic – the events resulting in alteration of rare plant and lichen populations via disruption of drainage patterns and altered light levels (*i.e.,* construction of the pipeline and maintenance activities) occur intermittently but repeatedly during the operations phase of the Project.
- Reversibility: short to long-term – it may take more than one year plus adequate precipitation levels in order for the trench crown to settle and natural drainage patterns to be restored and along extra TWS it will take years for vegetation to grow back to former heights, which is what affects the light levels reaching surrounding plants. The full right-of-way will be maintained free of higher growing vegetation until abandonment (long-term). The potential for effects from dust and dust suppressants exist until construction and reclamation activities are completed.
- Magnitude: low – the narrowed pipeline corridor is located adjacent to existing disturbances. Residual effects are detectable, but are still considered to be within environmental standards given that best practices, objectives and provincial guidelines are being followed.
- Probability: low – there are no rare plant or rare lichen species historically known to occur within 5 km of the proposed pipeline corridor in Finn Creek Provincial Park. Given the distance and size of the footprint and based on the results of the 2013 surveys, it is not expected that populations of rare plant or lichen species will be encountered.
- Confidence: high – based on past pipeline projects, the experience of the assessment team and the results of the rare plant surveys.

Vegetation Indicator – Presence of Infestations of Provincial Weed Species and Other Invasive Non-Native Species Identified as a Concern

Weed Introduction and Spread

Non-native and invasive species tend to be pioneer species with characteristics that can exploit recently disturbed ecosystems. Non-native and invasive species that occur at high densities on the landscape can exert competitive pressure on native vegetation and result in alteration of native vegetation.

In general, invasive species are most prevalent where the ground has been disturbed by anthropogenic activity. During the 2013 vegetation surveys, any weed species encountered were noted and their density/distribution was recorded. The information collected during the vegetation surveys allows for an understanding of baseline weed conditions and the magnitude of weed infestations encountered in areas supporting native vegetation along the narrowed pipeline corridor.

Mitigation measures outlined in Table A7.1.8-1 and in the Pipeline EPP are effective industry standard measures to reduce the potential for the introduction and spread of weeds. These measures will be implemented during both construction and maintenance of the Project. All problem vegetation along the construction right-of-way will be monitored during all pipeline construction phases (*i.e.,* pre-construction and construction) and the operations phase (*i.e.,* PCEM) (Section 12.0 of Appendix C of the Pipeline EPP).

Experience during past pipeline construction programs has shown that, while weed infestations were encountered, the implementation of appropriate mitigation measures during construction resulted in limited weed issues (Alliance 2002, Interprovincial Pipe Line Inc. [IPL] 1995, Enbridge 2000, 2002, TERA 2012a).

Specific learnings from the TMX Anchor Loop Project (TERA 2013a) regarding weed introduction and spread include:

- chemical and mechanical weed treatments were effective at controlling or suppressing non-native invasive broadleaf species of concern along and off the right-of-way, at temporary facilities and permanent facilities; and
- hand (manual) removal of vegetation in riparian areas (areas where chemical treatment was not allowed due to proximity to water) was effective in controlling or suppressing non-native broadleaf weeds.

In addition, the final PCEM report for the TMX Anchor Loop Project indicated that after 5 years, the post-construction vegetation management program had effectively controlled or suppressed non-native invasive broadleaf species of concern, identified during the pre-construction survey, along the right-of-way (TERA 2013a).

The potential introduction or spread of Noxious weeds and invasive, non-native species may vary in the period required to reverse the effect depending on the land use affected and the species. Consequently, the residual effect is considered to be reversible in the short to medium-term and of low to medium magnitude (Table A7.1.8-2, point 3[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Vegetation RSA – potential weed introduction and spread resulting from pipeline construction and maintenance activities may extend beyond the Footprint and Vegetation LSA to the Vegetation RSA.
- Duration: short-term – the events resulting in potential weed introduction and spread are construction of the pipeline or site-specific maintenance activities (*e.g.,* integrity digs), the latter of which are limited to any one year during the operations phase.
- Frequency: periodic – the events resulting in potential weed introduction and spread (*i.e.,* pipeline construction, operations and maintenance activities) occur during construction and intermittently, but repeatedly over the assessment period.

- Reversibility: short to medium-term – depending on the weed species, the size/location of the weed occurrence and the associated land use.
- Magnitude: low to medium – the narrowed pipeline corridor parallels existing disturbances for its entire length within the park boundaries and weeds are known to be widespread throughout the park. Based on consultation, weeds are a concern in populated areas. Magnitude varies from low to medium depending on the weed or invasive plant species, affected land use and density/distribution of associated weed occurrences.
- Probability: high – pipeline construction is expected to cause some weed introduction and spread.
- Confidence: high – based on past pipeline projects, the professional experience of the assessment team and PCEM results.

7.1.8.3 Summary

As identified in Table A7.1.8-2, there are no situations where there is a high probability of occurrence of a permanent or long-term residual environmental effect on vegetation indicators of high magnitude that cannot be technically or economically mitigated. Consequently, it is concluded that the residual environmental effects of pipeline construction and operations on conservational values of Finn Creek Provincial Park related to vegetation will be not significant.

7.1.9 Wildlife and Wildlife Habitat

This subsection describes the potential Project effects on wildlife and wildlife habitat in Finn Creek Provincial Park. The Wildlife LSA is defined as the area within a 1 km buffer of the centre of the proposed pipeline corridor; shown in Figure 6.2.2-3 of the Introduction to the Stage 2 Detailed Proposal. The Wildlife RSA is defined as the area within a 15 km buffer of the centre of the proposed pipeline corridor; shown in Figure 6.2.2-1 of the Introduction to the Stage 2 Detailed Proposal

Wildlife and wildlife habitat indicators (Table 6.2.1-1 of the Introduction to Stage 2 Detailed Proposal) were considered in this evaluation and the following indicators may occur in Finn Creek Provincial Park: grizzly bear, woodland caribou, moose, forest furbearers, bats, mature/old forest birds, early seral forest birds, riparian and wetland birds, great blue heron, bald eagle, common nighthawk, olive-sided flycatcher and pond-dwelling amphibians.

7.1.9.1 Identified Potential Effects

Project construction and operational activities have the potential to affect wildlife and wildlife habitat through changes to habitat, movement and mortality risk. A summarized discussion of potential Project effects on wildlife and wildlife habitat specific to Finn Creek Provincial Park is provided below. Potential effects associated with the construction and operations of the proposed pipeline on wildlife and wildlife habitat are listed in Table A7.1.9-1.

TABLE A7.1.9-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATION ON WILDLIFE AND WILDLIFE HABITAT FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures	Potential Residual Effect(s)
1 Change in habitat	LSA	• Refer to Table A7.1.9-2 below: habitat loss/alteration, wildlife disturbance and attraction of wildlife during construction, sensory disturbance, mammal dens, species with special conservation status, mountain caribou range, mineral licks, bats, migratory birds, raptor/owl nest, amphibian breeding pond, reptiles, beaver dams/lodges.	• Combined Project effects on wildlife and wildlife habitat in Finn Creek Provincial Park.

TABLE A7.1.9-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures	Potential Residual Effect(s)
2 Change in movement	LSA	• Refer to Table A7.1.9-2 below: habitat loss/alteration, access and line-of-sight management, barriers to wildlife movement, wildlife disturbance and attraction of wildlife during construction, mountain caribou range, mineral licks, mammal dens, bats, migratory birds, raptor/owl nest, amphibian breeding pond, reptiles, beaver dams/lodges.	• See above
3 Increased mortality risk	LSA	• Refer to Table A7.1.9-2 below: habitat loss/alteration, access and line-of-sight management, disturbance and attraction of wildlife during construction, mammal dens, species with special conservation status, mountain caribou range, bats, migratory birds, raptor/owl nest, amphibian breeding pond, reptiles, beaver dams/lodges.	

Notes: 1 LSA = Wildlife LSA.

Mitigation measures (as shown in the Pipeline EPP) that are particularly relevant to potential Project effects on wildlife and wildlife habitat in Finn Creek Provincial Park are identified in Table A7.1.9-2. The mitigation measures were principally developed in accordance with industry accepted best practices, as well as industry and provincial regulatory guidelines.

TABLE A7.1.9-2

RECOMMENDED MITIGATION FOR WILDLIFE AND WILDLIFE HABITAT FOR FINN CREEK PROVINCIAL PARK

Concern	Recommended Mitigation[1]
Habitat Loss/Alteration	• Avoid activity during sensitive time periods for wildlife species to the extent feasible. • Share workspace with the adjacent existing TMPL right-of-way or other existing rights-of-way to reduce the construction right-of-way-width. • Do not clear timber, stumps, brush or other vegetation beyond the marked construction right-of-way boundary. • Where grading is not required, cut/mow/walk down shrubs and small diameter deciduous trees at ground level to facilitate rapid regeneration. • Use natural recovery as the preferred method of reclamation on level terrain and at the riparian swamp unless otherwise requested by the regulator and where bio-engineering (*e.g.,* shrub staking/planting) will be conducted. • Plant native tree seedlings and/or shrubs at select locations to be determined in the field by the Environmental Inspector, in consultation with the Wildlife Resource Specialist. • Avoid the use of pesticides (except for herbicides to control invasive plants or noxious weeds; only use as spot treatments and outside the migratory bird breeding season) (BC MOE 2012a). • Reduce the width of grubbing near Finn Creek and the riparian swamp and through other wet areas to facilitate the restoration of shrub communities. • Reduce disturbance at riparian areas or cut/mow/walk down shrubs and small diameter deciduous trees at ground level to facilitate rapid regeneration. • Limit vegetation control along the right-of-way and allow natural regeneration during the operations phase to the extent feasible. • Conduct pre-construction surveys to identify site-specific habitat features (*e.g.,* mineral licks) and implement the appropriate setbacks and/or timing windows.
Access and Line-of-Sight Management	• Implement the measures included in the Traffic and Access Control Management Plan prepared for the Project (Appendix C of the Pipeline EPP). • Implement measures to reduce access (human and predator) along the right-of-way following construction. Measures may include but are not limited to planting tree seedlings and/or shrubs in select locations to facilitate rapid regeneration of natural vegetation, and blocking access entry points by mounding, rollback, boulder barriers, earth berms or locked gates. The locations of access control measures along the right-of-way will be determined in consideration of consultation with provincial regulatory authorities. • Where rollback and coarse woody debris are needed for access management, erosion control and habitat enhancement, ensure that a sufficient supply of suitable material is set aside for this purpose (Douglas-fir, grand fir and spruce will not be used for rollback in Finn Creek Provincial Park). • Consider the following at the proposed crossing of roads, railways, other pipelines or watercourses: extend the length of an HDD or bored crossings where this crossing technique has been proposed to leave a vegetated screen and/or narrow the right-of-way width.

TABLE A7.1.9-2 Cont'd

Concern	Recommended Mitigation[1]
Access and Line-of-Sight Management (cont'd)	• Use existing roads to access the pipeline right-of-way. Deactivate and reclaim any temporary roads that are no longer needed with native vegetation. Implement measures to reduce access (human and predator) along these temporary roads, as required. • Install educational signs as needed at selected locations.
Barriers to Wildlife Movement	• Conduct work as expeditiously as practical (*i.e.,* interval between front-end work activities such as grading and back-end activities such as clean-up) to reduce the length and duration of the open trench and to reduce potential barriers and hazards to wildlife. Refer to Table A2.5-1 for the length and duration of the construction activities. • Locate gaps in pipe to allow wildlife movement in places that also facilitate construction such as at slope changes, crossings (*i.e.,* watercourse, road, pipeline right-of-way) and bends. The locations of the gaps should coincide with gaps in spoil and slash piles. The locations can be determined in the field by the Environmental Inspector. • Restore habitat connectivity by redistributing large-diameter slash (rollback) over select locations on the pipeline right-of-way (e.g., where high levels of coarse woody debris occur prior to construction), to provide cover and facilitate movement of wildlife (e.g., furbearers). Specific locations are to be determined in the field by the Environmental Inspector and Wildlife Resource Specialist in discussion with provincial regulatory authorities. Trans Mountain will avoid the use of Douglas-fir, grand fir and spruce for rollback within Finn Creek Provincial Park.
Wildlife Disturbance and Attraction of Wildlife During Construction	• Schedule clearing and construction activities to avoid sensitive wildlife timing windows wherever feasible. • Minimize traffic and prohibit recreational use of all-terrain vehicles or snowmobiles by construction personnel on the pipeline right-of-way and at facilities. • Prohibit personnel from having pets on the pipeline right-of-way and at facilities. • Prohibit personnel from feeding or harassing wildlife. • Obey speed limits along access roads and the right-of-way. • Ensure that food waste and industrial waste are disposed of properly. • Report any issues related to wildlife encountered during construction and operations to the Environmental Inspector, who will report it to the appropriate regulatory authorities. • Implement the measures in the Wildlife Conflict Management Plan to prevent human/wildlife conflict and wildlife mortality (Appendix C of the Pipeline EPP).
Migratory Birds	• The migratory bird nesting period within Finn Creek Provincial Park is identified as the end of March to mid-August (Environment Canada 2014). • In the event that clearing or construction activities are scheduled during the migratory bird nesting period conduct nest sweeps within 7 days of activity. Use non-intrusive methods to conduct an area search for evidence of nesting (*e.g.,* presence of singing birds, territorial males, alarm calls, distraction displays). In the event an active nest is found, it will be subject to site-specific mitigation measures (*i.e.,* clearly marked protective buffer around the nest and/or non-intrusive monitoring).
Mountain Caribou Range	• Align route to parallel existing corridors to the extent feasible to reduce habitat disturbance. • BC MFLNRO recommends that activity within caribou range be avoided during early to mid-winter (i.e., November 1 to January 15) (Surgenor pers. comm.). Construction is scheduled to occur between Q2 to Q4 of 2014. However, construction will be conducted as expeditiously as practical in order to avoid the caridou range.. Any activities that occur within the period of November 1 to January 15 will be discussed with BC MFLNRO. • Implement line-of-sight breaks along segments not sharing a right-of-way boundary with another linear corridor such as a road or power line. Line-of-sight measures may include: bends in the right-of-way; doglegs at intersections with access roads; woody debris or earth berms; tree or shrub planting to create vegetation screens across the right-of-way. • Avoid creating early seral habitat that will provide forage for moose (*e.g.,* do not plant willow or red osier dogwood) (Surgenor pers. comm.). • Avoid creation of new access within caribou range. Use existing roads/linear corridors for access (BC OGC 2013). • Conduct work expeditiously to maintain a tight construction spread (*i.e.,* interval between front-end work activities such as grading and back-end activities such as clean-up) to reduce the duration of the open trench and to reduce potential barriers and hazards to wildlife. Refer to Table A2.5-1 for the length and duration of the construction activities. • Locate gaps in pipe to facilitate wildlife movement in places that also facilitate construction such as at slope changes, crossings (*i.e.,* watercourse) and bends. The locations of the gaps should coincide with gaps in spoil and slash piles. The locations can be determined in the field by the Environmental Inspector. • Where segments of the right-of-way require rollback for access management or erosion control, ensure sufficient timber is set aside for this purpose during final clean-up. • Implement minimum surface disturbance construction techniques that will facilitate natural revegetation in areas where grading or blasting is not required in areas of upland deciduous and mixedwood forests and in graminoid and shrub-dominated wetland communities.

TABLE A7.1.9-2 Cont'd

Concern	Recommended Mitigation[1]
Mountain Caribou Range (cont'd)	• Minimize the width of the pipeline right-of-way to the extent practical by utilizing shared workspace, avoiding clearing large diameter trees on the edge of the right-of-way; minimizing extra temporary workspace (*e.g.,* place log decks, storage areas, other temporary construction areas outside of caribou range). • Maintain root layer integrity on the right-of-way by clearing vegetation above ground level and restricting grubbing to the trench width. • Avoid using seed mixtures that will attract other ungulates (deer, moose) during reclamation (Hoekstra pers. comm.), to reduce potential effects associated with predator-prey interactions with caribou. • Implement measures to reduce access (human and predator) along the pipeline right-of-way following construction. Measures include using woody debris as rollback, mounding, planting trees and/or shrubs for visual screens, and rock piles or berms across the right-of-way. The locations of access control measures along the pipeline right-of-way will be determined in consideration of consultation with provincial regulatory authorities. • Monitor the effectiveness of access control measures and reclamation during post-construction environmental monitoring. Implement remedial measures. Schedule remedial work outside of the period of early to mid-winter when caribou are more likely to be in the area • Limit vegetation control along the right-of-way and allow natural regeneration during the operations phase to the extent feasible. • Limit operational access along the pipeline right-of-way within caribou range. • Report any sightings of caribou during construction and operations to Trans Mountain's Lead Environmental Inspector or Environmental Inspector(s).
Raptor Nest	• Schedule clearing and construction activities outside of sensitive time periods for raptors (generally March to August), to the extent feasible. • In the event clearing is scheduled at a time when raptor nests will be active, in areas of suitable habitat conduct raptor nest searches prior to clearing to locate active raptor nests. In the event an active raptor nest is discovered, consult with the appropriate regulatory authorities to discuss practical options and mitigation measures. • Eagle, peregrine falcon, gyrfalcon, osprey and burrowing owl nests are protected year-round by the BC W*ildlife Act* and may not be cleared. The Guidelines for Raptor Conservation (BC MOE 2013e) provides information on sensitive breeding and nesting time periods and buffers for raptor nests according to their tolerance to human disturbance. These buffers range from 50 m to 500 m depending on the surrounding land use and species. During the breeding season, an additional 100 m "quiet" buffer is recommended. Clearly mark the appropriate buffers with fencing to prevent access to the nest. • If construction is unavoidable within the recommended year-round and breeding buffers, a Nest Management Plan addressing various mitigation (including nest monitoring during the breeding period) is recommended. • If construction activities require the removal of a raptor nest that is protected year-round under the BC *Wildlife Act* (*i.e.,* eagle, peregrine falcon, gyrfalcon, osprey and burrowing owl), Trans Mountain will work with the appropriate regulatory authorities to develop a Nest Removal Management and Compensation Plan. Upon confirmation the nest is inactive, nest removal should occur during the least risk window of August through December. When a nest is removed the installation of a replacement structure (*i.e.,* a platform on a pole or transplanted tree) should be erected in nearby suitable habitat (BC MOE 2013e).
Amphibian Breeding Pond	• Clearing and construction activities have been scheduled outside of the breeding and seasonal migration periods for amphibians (mid-April to mid-June). • Protect identified amphibian breeding ponds by implementing appropriate buffers (150 m undeveloped; 100 m rural; 30 m urban) (BC MOE 2012a). • If the proposed pipeline right-of-way is located within the recommended setback distance of an amphibian breeding pond, consult with the appropriate regulatory authorities to discuss practical options and mitigation strategies. • Apply standard wetland construction and reclamation mitigation (*e.g.,* minimal disturbance, recontouring, reclamation, monitoring and remedial measures) to support habitat reclamation as needed. • Use mats to avoid excessive soil compaction in the proximity of the riparian swamp, Finn Creek and the unnamed drainage. • Maintain natural hydrology of streams and wetlands during clearing, construction and clean-up activities. • Do not mow/brush vegetation within wetland riparian (fringe) areas during operation. • Conduct an amphibian salvage prior to clearing and construction activities at known amphibian breeding pond locations. Ensure the appropriate permit is obtained.
Reptiles	• In the event an active snake hibernacula is identified, implement a 150 m buffer (BC MOE 2012a), and avoid activity during the period of April 15 to September 30 (BC MWLAP 2004b), to the extent feasible. • Consult with BC MFLNRO to determine the location and need for additional site-specific mitigation measures (*e.g.,* exclusion fencing for the open trench or along vehicle travel lanes) at identified locations. • All workers will receive education prior to commencing work, which will include best practices for avoiding snakes and appropriate protocols in the event a snake is detected at the work site. Refer to the Wildlife Conflict Management Plan in Appendix C of the Pipeline EPP.

TABLE A7.1.9-2 Cont'd

Concern	Recommended Mitigation[1]
Bats	• Protect bat roosts from disturbance by humans and other sensory disturbances (BC MOE 2012a). Implement a 125 m buffer from bat hibernacula (from October 1 to April 30 or maternity roost (from May 1 to August 31) (BC MWLAP 2004b). Consult with BC MFLNRO where disturbance of a hibernacula or maternity roost is unavoidable to discuss practical options and mitigation strategies.
Mammal Dens	• Contact provincial regulatory authorities to discuss the appropriate mitigation in the event an active den is discovered on or near the work site. Mitigation may include establishing protective buffers, monitoring the den and/or modifying the construction schedule to avoid activity until the den is inactive. • A setback of 50 m from active bear dens is recommended (BC OGC 2013).
Mineral Licks	• Implement a 100 m setback in the event a mineral lick is identified (BC OGC 2013). In the event that shifting/narrowing the pipeline right-of-way is not feasible to maintain the minimum setback from a mineral lick, consult with BC MFLNRO to discuss practical options and mitigation strategies. • Do not block well-used game trails to/from a mineral lick. • Avoid activities (*i.e.,* clearing, construction, helicopter overflights) near mineral licks during critical periods (May to November) (BC MWLAP 2004b), to the extent feasible. • Leave a gap in set-up pipe within the area of the mineral lick to allow wildlife to access the mineral lick. The locations of the gaps in strung pipe should coincide with gaps in strippings, spoil, and rollback windrows.
Beaver Dams/Lodges	• In the event that beaver dams or lodges will be disturbed, submit a notification to the appropriate regional Habitat Officer of the BC MFLNRO at least 45 days prior to beaver dam removal, as per Section 40 of the Water Regulation. Following this notification, obtain a Ministry of Natural Resource Operations Wildlife Sundry Permit to remove a beaver dam. Standards and best practices for beaver dam removal identified in the BC Standards and Best Practices for Instream Works (BC MWLAP 2004a) will be applied.
Species with Special Conservation Status	• In the event that a species with special conservation status is observed during construction, the appropriate regulatory authorities will be contacted to determine if additional mitigation measures are warranted. • Implement the Wildlife Species of Concern Discovery Contingency Plan in the event that wildlife species of concern are identified during construction.

Note: 1 Detailed mitigation measures are outlined in Table L-2 of Appendix L in the Pipeline EPP (Appendix A of this Proposal).

7.1.9.2 Significance Evaluation of Potential Residual Effects on Wildlife and Wildlife Habitat

The assessment of the residual combined effect on wildlife and wildlife habitat in Finn Creek Provincial Park considered all of the assessment criteria defined in Table 6.2.1-1 of the Introduction to the Stage 2 Detailed Proposal. The significance determination incorporates professional judgment, which allows integration of all of the effects criteria ratings to provide relevant significance conclusions that are sensitive to context and facilitate decision-making (Lawrence 2007).

The sensitivity of wildlife species that may occur in or near the park was considered in the determination of magnitude. In the absence of biological thresholds or standards, the magnitude evaluation also considered relevant land use planning objectives and strategies, and previous environmental assessments reviewed and approved under provincial and federal environmental regulatory processes, where appropriate. These sources provide useful information on social values and risk tolerance, which are an essential component of significance determination.

Table A7.1.9-3 provides a summary of the significance evaluation of the potential residual environmental effects of the construction and operations of the proposed pipeline in Finn Creek Provincial Park on wildlife and wildlife habitat. The rationale used to evaluate the significance of the residual effect on wildlife and wildlife habitat in Finn Creek Provincial Park is provided below.

TABLE A7.1.9-3

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON WILDLIFE AND WILDLIFE HABITAT FOR FINN CREEK PROVINCIAL PARK

Potential Residual Effects	Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
			Duration	Frequency	Reversibility				
1[a] Combined Project effects on wildlife and wildlife habitat in Finn Creek Provincial Park.	Negative	LSA	Short-term	Periodic	Long-term	Medium	High	Moderate	Not significant

Notes: 1 LSA = Wildlife LSA.

2 Significant Residual Environmental Effect: A high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated.

Change in Habitat

Finn Creek Provincial Park comprises various habitat types that support wildlife, including wet bottomlands with old growth cottonwoods, western red cedar, hybrid spruce and birch, and riparian areas associated with Finn Creek and the North Thompson River (BC MOE 2013a). The Project will change the amount of available effective habitat for wildlife in Finn Creek Provincial Park. The likely mechanisms for changes in effective wildlife habitat include vegetation clearing, sensory disturbance (*e.g.,* human activity and noise), the crossing of Finn Creek, and soil handling (including trenching). The Project will increase the existing corridor width (since it parallels the existing TMPL right-of-way within Finn Creek Provincial Park) and require ongoing clearing as part of vegetation management during operations. Habitat loss and reduced habitat effectiveness can cause displacement of wildlife, and potentially result in the use of less suitable habitat, reduced foraging ability (Bird *et al.* 2004), increased energy expenditure (Jalkotzy *et al.* 1997) and lower reproductive success (Habib *et al.* 2007).

Clearing activities during construction of the Project will alter habitat structure, and result in direct habitat loss or alteration. Operations of the Project will also require ongoing vegetation management, resulting in the maintenance of forest habitat in earlier seral stages (herbaceous and shrub stages) until the pipeline is abandoned and the disturbed areas are reclaimed. Clearing of the construction right-of-way and TWS will reduce cover habitat and temporarily reduce forage availability. As cleared areas regenerate with early seral vegetation, forage availability will increase for some species (*e.g.,* browse for moose and deer; increased forage for bears and early seral habitat species). Vegetation clearing for the Project will decrease available habitat for forest and shrub-reliant species over the medium to long-term. The openings created by the Project may increase certain habitat types for species that use open areas (*e.g.,* common nighthawk foraging) and for habitat generalists (*e.g.,* corvids, some songbirds such as dark-eyed junco) (Jalkotzy *et al.* 1997). Vegetation clearing for the Project will disturb both wetland and terrestrial amphibian habitat. Possible mechanisms for changing effective amphibian habitat include site clearing (wetland and terrestrial habitats), watercourse crossings and soil handling (including trenching).

Indirect habitat loss or alteration occurs when habitat is available but the quality or effectiveness of the habitat is changed such that wildlife avoid the habitat or reduce their use of it. Reduced habitat effectiveness can occur as a result of fragmentation, creation of edges, or sensory disturbance (*e.g.,* noise, artificial light, proximity to facilities and infrastructure, human activity and traffic). Habitat fragmentation can cause habitat to become unsuitable for species with large territories or home ranges, alter predator-prey dynamics and allow for increased invasive or parasitic species abundance (*e.g.,* cowbird parasitism of songbird nests near forest edges). Changes in habitat suitability may also result from changes in vegetation communities due to increased light penetration at clearing edges that causes increased understory vegetation growth, or from changes in water quality (*e.g.,* sedimentation, deposition of airborne contaminants).

Within Finn Creek Provincial Park, the Project crosses critical habitat for southern mountain caribou in Wells Gray-Thompson local population unit of southern mountain caribou, as mapped by the Recovery Strategy for the Woodland Caribou, Southern Mountain Population (*Rangifer tarandus caribou*) in Canada

(Environment Canada 2014c). Within this local population unit, the proposed corridor crosses the Groundhog caribou range. Long-term reduction in habitat effectiveness adjacent to linear features may occur as caribou have been shown to partially avoid habitats near rights-of-way (Dyer 1999, Oberg 2001). The current habitat value of the proposed corridor within Finn Creek Provincial Park for caribou is reduced by the existing TMPL right-of-way, Highway 5, and the recreational use of the park. Supplemental field surveys will be completed for the Project within the park, which will allow for an evaluation of the biophysical attributes of the habitat within the proposed corridor, as it relates to the attributes of critical habitat defined in the federal Recovery Strategy. This information will be used to inform mitigation planning.

Snowmobilers use the existing TMPL right-of-way to access areas surrounding the park, including higher elevation areas that are used by caribou (BC Parks 2013). During operations, the Project is not expected to measurably change snowmobile use of the area, since the proposed corridor is adjacent to the existing TMPL right-of-way.

To minimize vegetation clearing and reduce the fragmentation and isolation of habitat patches, the narrowed pipeline corridor parallels the existing TMPL right-of-way within Finn Creek Provincial Park. The proposed mitigation measures (Table A7.1.9-2 and the Pipeline EPP) are expected to reduce residual Project effects on wildlife and wildlife habitat. The proposed crossing of Finn Creek will be designed to limit disturbance to the stream channel and riparian area to the extent feasible, and to prevent erosion and sedimentation.

Change in Movement

Project construction and operations can alter wildlife movement by reducing habitat connectivity and creating barriers or filters to movement. A disturbance is considered a barrier when no movement occurs across it, or a filter if the rate of movement through the disturbance is less than it would be through intact habitat (Jalkotzy *et al.* 1997). Habitat fragmentation results when barriers to movement cause functional separation of habitats into smaller, isolated habitat patches (Andrén 1994, Jalkotzy *et al.* 1997). Species that have late age of first reproduction, low population densities, low reproductive rates, large home ranges, low fecundity, and move over large distances to disperse, find food and mate, display low resilience to habitat fragmentation (Dunne and Quinn 2009).

The increased corridor width may cause an incremental barrier effect for some wildlife species. In some cases, linear developments have been shown to block, delay or deflect ungulate movements, potentially restricting or reducing access to some parts of their range (Harper *et al.* 2001). However, studies have concluded that buried pipelines do not create a movement barrier to boreal caribou (Carruthers and Jakimchuk 1987 in Dyer *et al.* 2002, Joint Pipeline Office 1999), except where they parallel roads with traffic (Curatolo and Murphy 1986 in Dyer *et al.* 2002). Studies on small mammal movements in the boreal forest have concluded that pipeline rights-of-way may act as barriers or filters to movement of flying squirrels, red squirrels and marten (Marklevitz 2003). Forest gaps have been shown to affect movements of forest birds (Bayne *et al.* 2005, Desrochers and Hannon 1997, Fleming and Schmiegelow 2002) and owls (COSEWIC 2008). Wider corridor widths increase barrier effects on bird movements more than narrower corridors (Desrochers and Hannon 1997), and parallel forest openings can cause a cumulative barrier effect at the landscape scale for some species (Bélisle and St. Clair 2001). Construction of the Project may create barriers to amphibian movement (*e.g.,* spoil piles, brush piles, traffic, strung pipe, open trench).

Changes in movement patterns can also occur since some species may be attracted to the rights-of-way. The Footprint will create increased forage availability for some wildlife species once vegetation communities regenerate to early seral vegetation after reclamation (*e.g.,* grasses/shrubs and potential for greater berry productivity at clearing edges). This may attract some wildlife to the right-of-way and, therefore, affect their normal movement patterns. For example, moose have been shown to select habitat based on forage over security, often preferring early seral, shrub dominated habitats (Wasser *et al.* 2011) with lower densities of coniferous tree cover (Hebblewhite *et al.* 2010, Rempel *et al.* 1997, Schwartz and Franzmann 1991). Deer are also known to be attracted to recently cleared, linear disturbances (Lyons and Jensen 1980) given the increased production of forage (Wallmo *et al.* 1972). Rights-of-way may also provide travel routes for predators such as wolves (James 1999, Stuart-Smith *et al.* 1997, Thurber *et al.* 1994) and grizzly bears (McKay *et al.* 2013).. Bats have also been shown to use linear landscape features for movement, which provide navigational references and flight corridors for some bat species (Hein *et al.* 2009, Verboom and Huitema 1997). Birds that use open spaces for hunting, foraging or nesting may also benefit.

Application of the proposed mitigation measures (Table A7.1.9-2 and the Pipeline EPP) is expected to reduce the magnitude of potential residual effects of Project construction and operations on wildlife movement. Limiting the length of open trench, and maintaining periodic gaps in soil, slash, and pipe, where feasible, will limit barriers to wildlife movement during construction. Limiting the construction right-of-way by utilizing shared workspace on the existing TMPL right-of-way will reduce the Project's potential for habitat fragmentation. Redistributing large-diameter slash (coarse woody debris) over select locations on the right-of-way and promoting regeneration of native vegetation, including shrubs and trees, will contribute to maintaining habitat connectivity by reducing limitations to movement of wildlife across the right-of-way. The Project is expected to result in a filter, but not complete barrier to movement of some wildlife species.

Increased Mortality Risk

The Project has potential to increase wildlife mortality risk during construction as a result of loss or disruption of habitat (*e.g.,* nests, dens), changes to predator/prey dynamics (*i.e.,* attracting prey species to early seral vegetation establishing on the disturbance), wildlife collisions with vehicles or equipment, and sensory disturbance (*e.g.,* nest abandonment).

Project construction (clearing, soil handling) may affect the mortality risk of some wildlife species. Pre-construction surveys will identify any site-specific habitat features (*e.g.,* active dens) that warrant additional mitigation to avoid disruption or mortality of wildlife. Scheduling of clearing activities will consider the migratory bird breeding season. Otherwise, potential effects of clearing and construction on bird mortality risk during the nesting period will be mitigated by conducting non-intrusive area searches for evidence of nesting (*e.g.,* presence of singing birds, territorial males, alarm calls, distraction displays). Any active nests will be subject to site-specific mitigation measures.

Linear corridors create improved access for predators, and may increase ungulate predation risk, since both prey and predators may be attracted to revegetating linear corridors. Linear corridors can potentially affect wildlife mortality risk from trapping, hunting and poaching due to access development, since these activities are often associated with roads or other linear corridors that create access (Collister *et al.* 2003, Wiacek *et al.* 2002). The Project does not create a new linear corridor within the park.

Vehicle traffic due to construction and operations of the Project may increase the risk of wildlife mortality due to vehicle collisions. With posting of low traffic speeds, signage and education of construction and operations contractors and employees, risk of wildlife injury or mortality associated with vehicle collisions is not expected to increase substantially as a result of the Project. Wildlife conflicts with personnel may occur during construction and operations of the pipeline, such as wildlife attraction to garbage and debris, and human encroachment. Trans Mountain has developed a Wildlife Conflict Management Plan (see Section 15 of Appendix C of the Pipeline EPP to reduce and address the potential conflict between Project personnel and the wildlife species most likely to be encountered along the Project and associated facilities.

Artificial night-time light sources attract songbirds that migrate at night and can increase bird mortality risk from collisions, excessive energy expenditure and predation (Jones and Francis 2003, Poot *et al.* 2008). The possible use of artificial night-time light sources within Finn Creek Provincial Park will be short-term in duration and occur either during construction or during site-specific operations and maintenance activities. There are no permanent facilities planned within Finn Creek Provincial Park that would require permanent artificial night-time light.

Summary of Effects Characterization Rationale for Wildlife and Wildlife Habitat

The following provides the evaluation of significance of potential residual effects on wildlife and wildlife habitat within Finn Creek Provincial Park (Table A7.1.9-3, point 1[a]).

- Spatial Boundary: Wildlife LSA – habitat changes (*e.g.,* clearing), alteration of movement (*e.g.,* barriers during construction) and mortality risk (*e.g.,* disturbance of occupied habitat feature) are primarily limited to the Wildlife LSA.
- Duration: short-term – the events causing effects are construction and operational activities (*e.g.,* monitoring, vegetation management and site-specific maintenance), the latter of which are limited to any one year during operations.

- Frequency: periodic – the events causing effects (*i.e.,* clearing of the Footprint, traffic and activity) will occur during construction and intermittently during operations for monitoring, vegetation control and maintenance.

- Reversibility: long-term – effects are reversible in the long-term following decommissioning and abandonment, once native vegetation regenerates over the Project Footprint. Herbaceous and shrub-dominant habitats are expected to regenerate to similar ecological stages and habitat function in the medium-term following completion of reclamation. However, restoration of forested habitat will take longer than 10 years (*i.e.,* long-term). Sensory disturbance and mortality risk associated with construction is reversible immediately upon completion of activities.

- Magnitude: medium – regulatory and ecological context are key considerations in the characterization of magnitude for residual effects of the Project on wildlife in Finn Creek Provincial Park. The stated management objectives of the park relevant to wildlife include protection of the ecological integrity of the river riparian and associated upland environments, maintaining the diversity of wildlife species and habitats, and providing for recreational opportunities such as wildlife viewing. Residual effects on ecological integrity (*e.g.,* habitat intactness and connectivity) are reduced by paralleling the existing TMPL right-of-way, minimizing the footprint, and reclamation of the footprint to native vegetation. The park has potential to provide habitat for wildlife species at risk, which, in general, often have low resilience to habitat disturbance. Most notably, the narrowed pipeline corridor crosses critical habitat for southern mountain caribou in the Wells Gray-Thompson local population unit (Groundhog caribou range). The current habitat value of the narrowed pipeline corridor in Finn Creek Provincial Park for caribou is reduced by the existing TMPL right-of-way, Highway 5, and the recreational use of the park. Trans Mountain will use information from field surveys and consultation with provincial regulatory authorities to develop appropriate mitigation, including a caribou habitat restoration plan, to reduce the Project's residual effect on caribou. Through development of mitigation in consultation with regulatory authorities, and implementation of mitigation and monitoring, including adaptive measures where warranted, the residual Project effects on wildlife in Finn Creek Provincial Park are expected to remain within regulatory and ecological tolerance. Therefore, the magnitude of the residual effect is concluded to be medium.

- Probability: high – the Project will affect wildlife in the park through changes in habitat, movement and mortality risk.

- Confidence: moderate – the assessment is based on a good understanding of cause-effect relationships and relevant data. Limitations and uncertainty associated with available data pertinent to the Project area reduce the confidence level to moderate.

7.1.9.3 Summary

As identified in Table A7.1.9-3, there are no situations where there is a high probability of occurrence of a permanent or long-term residual environmental effect on wildlife and wildlife habitat indicators of high magnitude that cannot be technically or economically mitigated. Consequently, it is concluded that the residual environmental effects of pipeline construction and operations on conservational values of Finn Creek Provincial Park related to wildlife and wildlife habitat will be not significant.

7.1.10 Species at Risk

For the purpose of the assessment, species at risk are considered to include all federally-listed species of conservation concern (*i.e.,* COSEWIC or *SARA* Schedule 1 designation) (COSEWIC 2013, Environment Canada 2014b). Species identified as having the potential to occur along the narrowed pipeline corridor and in the element-specific RSAs are based on previous field assessments and existing data.

This subsection discusses the species at risk that have been identified as likely to occur within each element-specific RSA. The list of federal species at risk in the vicinity of Finn Creek Provincial Park includes two fish species within the Aquatics RSA, two vegetation species within the Vegetation RSA and eight wildlife species within the Wildlife RSA.

The two fish species include:

- coho salmon: Endangered by COSEWIC (Interior Fraser River populations); and
- bull trout: Special Concern by COSEWIC (South Coast BC populations) (Blue-listed).

The two vegetation species include:

- Haller's apple moss: Threatened by *SARA* and COSEWIC, Red-listed; and
- Mexican mosquito fern: Threatened by *SARA* and COSEWIC, Red-listed.

The eight wildlife species include:

- Common nighthawk: Threatened by *SARA* and COSEWIC;
- Olive-sided flycatcher: Threatened by *SARA* and COSEWIC, Blue-listed;
- Grizzly bear, western population: Special Concern by COSEWIC, Blue-listed;
- Little brown myotis: Endangered by COSEWIC;
- Northern myotis: Endangered by COSEWIC, Blue-listed;
- Wolverine: Special Concern by COSEWIC, Blue-listed;
- Woodland caribou, southern mountain population: Threatened by *SARA*, Endangered by COSEWIC, Red-listed; and
- Western toad: Special Concern by *SARA* and COSEWIC, Blue-listed.

Potential effects of the Project on these species are assessed through the use of indicators in Sections 7.1.6, 7.1.8 and 7.1.9, respectively.

7.1.11 Heritage Resources

This subsection describes the potential Project effects on the heritage resources in Finn Creek Provincial Park. The Heritage Resources RSA consists of the broader landscape context extending beyond the Project Footprint, defined as an area of intersecting Borden Blocks (Borden and Duff 1952); shown in Figure 6.2.2-2 of the Introduction to the Stage 2 Detailed Proposal. A Borden Block measures 10 minutes of latitude by 10 minutes of longitude.

Trans Mountain recognizes that a long term cultural issue and concern with Finn Creek Provincial Park includes the inventory and protection of archaeological sites (BC MELP 1999). The potential for encountering heritage resources in Finn Creek Provincial Park has been reduced by aligning the narrowed pipeline corridor to parallel the existing TMPL right-of-way. Qualified archaeologists commenced an Archaeological Impact Assessment (AIA) for the BC portion of the narrowed pipeline corridor in July 2013 under Archaeological Research Permit 2013-165. The AIA within Finn Creek Provincial Park is expected to be conducted in October 2014. For the AIA, background data is reviewed and then complemented with ground reconnaissance with targeted areas for more intensive visual inspection, and where warranted, shovel testing. The ground reconnaissance and shovel testing programs focus on areas along the narrowed pipeline corridor that are of moderate to high potential for archaeological, historic and palaeontological sites.

7.1.11.1 Identified Potential Effects

The potential effects associated with pipeline construction and operations on heritage resources indicators are listed in Table A7.1.11-1. A summary of mitigation measures provided in Table A7.1.11-1 was principally developed in accordance with industry accepted best practices as well as industry and provincial regulatory guidelines including BC OGC (2010) and CAPP (1999, 2001).

TABLE A7.1.11-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON HERITAGE RESOURCES FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary	Key Recommendations/Mitigation Measures [EPP Reference][1]	Potential Residual Effect(s)
1. Heritage Resources Indicator – Archaeological Sites			
1.1 Disruption to previously unidentified archaeological sites during AIA.	Footprint	• Follow any conditions or recommendations identified in the permits for the AIA for BC. • Suspend work in proximity (*i.e.*, within 30 m) to archaeological, palaeontological or historical sites (*e.g.*, modified bone, pottery fragments, fossils) discovered during construction. No work at that particular location shall continue until permission is granted by the appropriate regulatory authority. Follow the contingency measures identified in the Heritage Discovery Contingency Plan [Appendix B of the Pipeline EPP]. • Arrange for emergency archaeological excavation of previously unidentified sites endangered by pipeline construction wherever such sites warrant attention and can be excavated without interfering with the construction schedule. When for practical reasons, the sites cannot be investigated, map and suitably flag these sites for later investigation [Section 7.0]. • Prohibit the collection of any historical, archaeological or palaeontological resources by Project personnel [Section 7.0]. • Avoid, where possible, disturbance of geodetic or legal survey monuments, to the extent feasible during construction of the pipeline, Trans Mountain's Construction Manager will immediately report such disturbance to the appropriate regulatory authority. The contractor will restore or re-establish the monument, where feasible, in accordance with the instructions of the Dominion Geodesist [Section 7.0].	• No residual effect identified.
1.2 Disturbance to known archaeological sites during AIA.	Footprint	• See recommended mitigation measures outlined in potential effect 1.1 of this table.	• No residual effect identified.
1.3 Disturbance of previously unidentified archaeological sites during construction.	Footprint	• See recommended mitigation measures outlined in potential effect 1.1 of this table.	• No residual effect identified.
2. Heritage Resources Indicator – Historic Sites			
2.1 Disturbance to previously unidentified historic sites during AIA.	Footprint	• See recommended mitigation measures outlined in potential effect 1.1 of this table.	• No residual effect identified.
2.2 Disturbance of previously unidentified historic sites during AIA.	Footprint	• See recommended mitigation measures outlined in potential effect 1.1 of this table.	• No residual effect identified.
3. Heritage Resources Indicator – Palaeontological Sites			
3.1 Disturbance of previously unidentified palaeontological sites during construction.	Footprint	• See recommended mitigation measures outlined in potential effect 1.1 of this table.	• No residual effect identified.

Note: 1 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of this Proposal).

7.1.11.2 Potential Residual Effects

Heritage resources provide a window into past human experiences and the geological record, and by their very nature, are non-renewable. Once disturbed, the resource may be altered or even lost. Consequently, the primary mitigation measure in protecting heritage resources is avoidance, and secondly, site-specific mitigation developed in consultation with appropriate provincial regulatory authorities and approved by these authorities in fulfillment of Permit obligations may also be used. In order to better understand heritage resources and the historical information associated with these resources, disturbing the resource through excavations is an acceptable practice and, in many cases, the only method to collect in situ information to add to the archaeological record. Regardless of whether the excavation of the site is for academic or development purposes, the loss of heritage resource sites is generally offset by the recovery of knowledge about the site gained through meticulous identifying, cataloguing and preserving of artifacts and features in compliance with provincial guidelines.

7.1.11.3 Summary

Given that disturbances to heritage resources by the Project in Finn Creek Provincial Park are effectively offset by knowledge gained through the mitigation approved by the provincial regulatory authorities, no residual effects on heritage resource indicators have been identified and, consequently, no further evaluation of the effects of the Project on heritage resources is warranted.

7.1.12 Traditional Land and Resource Use

This subsection describes the potential Project effects on potential traditional land and resource use (TLRU) sites in Finn Creek Provincial Park. The TLRU LSA includes the zones of influence of water quality and quantity, air emissions, acoustic environment, fish and fish habitat, wetland loss or alteration, vegetation, wildlife and wildlife habitat and heritage resources since TLRU is dependent on these resources; shown in Figure 6.2.2-3 of the Introduction to the Stage 2 Detailed Proposal. The TLRU RSA includes the RSA boundaries of water quality and quantity, air emissions, acoustic environment, fish and fish habitat, wetland loss or alteration, vegetation, wildlife and wildlife habitat and heritage resources; shown in Figure 6.2.2-2 of the Introduction to the Stage 2 Detailed Proposal.

7.1.12.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline on subsistence activities and sites and cultural sites indicators are listed in Table A7.1.12-1.

To date, no TLRU sites have been identified along the narrowed pipeline corridor in Finn Creek Provincial Park. However, Trans Mountain will continue to engage Aboriginal communities through all phases of the Project. TLRU information received from participating communities will be reviewed in order to confirm literature results and mitigation measures including those found in the Pipeline EPP. Any additional site-specific mitigation measures resulting from these studies will be provided in the updated Pipeline EPP to be filed with the NEB 90 days prior to construction.

The construction of the Project has the potential to directly and indirectly disrupt subsistence sites and activities, as well as the broader ecological system, through the temporary physical disturbance of land or resources. Subsistence sites and activities may also be affected by Project activities resulting from limited access and/or increased public access to traditional harvesting areas and increased pressure on environmental resources.

The operations phase of the Project will affect TLRU primarily through disturbances related to site-specific maintenance.

A summary of mitigation measures provided in Table A7.1.12-1 was principally developed in accordance with industry accepted best practices as well as industry accepted best practices and procedures and provincial regulatory authority guidelines related to specific elements such as fish and fish habitat, vegetation, wetland loss or alteration, wildlife and wildlife habitat, and heritage resources.

TABLE A7.1.12-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON TRADITIONAL LAND AND RESOURCE USE FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1. Traditional Land and Resource Use Indicator – Subsistence Activities and Sites			
1.1 Disruption of use of trails and travelways	Footprint	• Provide Aboriginal communities with the anticipated construction schedule and pipeline route maps, a minimum of two weeks prior to the start of construction in the vicinity of their respective communities [Section 4.0]. • Install signage notifying of construction activities in the area [Section 4.0]. • Work with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members [Section 4.0]. • Upon Footprint finalization, applicable mitigation options listed below for previously identified trails and travelways within the narrowed pipeline corridor will be confirmed based on the following criteria: the location of the site with respect to the proposed area of development, the relative importance of the site to the community, and the potential for an alternative mitigation strategy to reduce or avoid sensory disturbance. • Should additional trails and travelways be identified during ongoing engagement with Aboriginal communities, implement the TLU Sites Discovery Contingency Plan [Appendix B]. Mitigation may include one or more of the following measures: – detailed recording and mapping to within 100 m on both sides of the pipeline right-of-way; in partnership with community representatives, a decision is then made about the relative importance of the trail and how best to maintain and control access; – signage or scheduling construction during periods of least impact; and/or – alternative site-specific mitigation strategies recommended by participating Aboriginal communities. • Implement appropriate measures identified in the Heritage Resources Discovery Contingency Plan [Appendix B]. • Implement applicable mitigation measures listed above during maintenance activities (*e.g.,* integrity digs).	• Disturbance of trails and travelways during construction and site-specific maintenance.
	RSA	• Provide Aboriginal communities with the anticipated construction schedule and pipeline route maps, a minimum of two weeks prior to the start of construction in the vicinity of their respective communities [Section 4.0]. • Install signage notifying of construction activities in the area [Section 4.0]. • Work with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members [Section 4.0]. • Implement applicable mitigation measures listed above during maintenance activities (*e.g.,* integrity digs).	• Sensory disturbance for Aboriginal and non-Aboriginal local residents and land users (from nuisance air emissions and noise) during the construction and site-specific maintenance activities (refer to Section 7.2.1).

TABLE A7.1.12-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.2 Alteration of plant harvesting sites	RSA	• Provide Aboriginal communities with the anticipated construction schedule and pipeline route maps, a minimum of two weeks prior to the start of construction in the vicinity of their respective communities [Section 4.0]. • Install signage notifying of construction activities in the area [Section 4.0]. • Work with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members [Section 4.0]. • Ensure equipment arrives at all construction sites clean and free of soil or vegetative debris. Inspect and identify equipment deemed to be acceptable with a suitable marker, such as a sticker. Do not allow any equipment arriving in a dirty condition onsite until it has been cleaned [Section 7.0]. • Should additional plant harvesting sites be identified during ongoing engagement with Aboriginal communities, implement the TLU Sites Discovery Contingency Plan [Appendix B]. Mitigation may include one or more of the following measures: – limiting the use of chemical applications; – replacement of plant species during reclamation; – avoidance of the site; and/or – alternative site-specific mitigation strategies recommended by participating Aboriginal communities. • See Section 7.1.8 Vegetation for additional mitigation measures. • Implement applicable mitigation measures listed above during maintenance activities (*e.g.,* integrity digs).	• Alteration of subsistence resources. • Disruption of subsistence activities during construction and site-specific maintenance.
1.3 Disruption of subsistence hunting activities	LSA	• Provide Aboriginal communities with the anticipated construction schedule and pipeline route maps, a minimum of two weeks prior to the start of construction in the vicinity of their respective communities [Section 4.0]. • Install signage notifying of construction activities in the area [Section 4.0]. • Work with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members [Section 4.0]. • See Section 7.1.9 Wildlife and Wildlife Habitat for mitigation relevant to sensory disturbance, loss or alteration of wildlife habitat, injury and mortality. • Should additional hunting sites be identified during ongoing engagement with Aboriginal communities, implement the TLU Sites Discovery Contingency Plan [Appendix B]. Mitigation may include one or more of the following measures: – adhering to species specific timing constraints to the extent feasible; – leaving breaks in the pipeline trench to allow animals to cross; – limiting the use of chemical applications; and/or – alternative site-specific mitigation strategies recommended by participating Aboriginal communities. • See Section 7.1.5 Acoustic Environment for additional mitigation measures. • Implement applicable mitigation measures listed above during maintenance activities (*e.g.,* integrity digs).	• Alteration of subsistence resources. • Disruption of subsistence activities during construction and site-specific maintenance.

TABLE A7.1.12-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
1.4 Disruption of subsistence trapping activities	LSA	• Provide Aboriginal communities with the anticipated construction schedule and pipeline route maps, a minimum of two weeks prior to the start of construction in the vicinity of their respective communities [Section 4.0]. • Install signage notifying of construction activities in the area [Section 4.0]. • Work with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members [Section 4.0]. • Prohibit the vandalism or theft of trapper equipment or trapped animals if they are observed on the construction right of way or the construction site prior to clearing [Section 7.0]. • Should additional trapping sites or trap line equipment be identified during ongoing engagement with Aboriginal communities, implement the TLU Sites Discovery Contingency Plan [Appendix B]. Mitigation may include one or more of the following measures: – maintaining access to the trap line; – moving of trap line equipment by the trapper prior to construction; and/or – alternative site-specific mitigation strategies recommended by participating Aboriginal communities. • See Section 7.1.5 Acoustic Environment for additional mitigation measures. • See Section 7.1.9 Wildlife and Wildlife for mitigation relevant to sensory disturbance, loss or alteration of wildlife habitat, and wildlife mortality. • Implement applicable mitigation measures listed above during maintenance activities (*e.g.*, integrity digs).	• Alteration of subsistence resources. • Disruption of subsistence activities during construction and site-specific maintenance.
1.5 Disruption of subsistence fishing activities	LSA	• Provide Aboriginal communities with the anticipated construction schedule and pipeline route maps, a minimum of two weeks prior to the start of construction in the vicinity of their respective communities [Section 4.0]. • Install signage notifying of construction activities in the area [Section 4.0]. • Work with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members [Section 4.0]. • Prohibit recreational fishing by Project personnel on or in the vicinity of the construction right of way. The use of the construction right of way to access fishing sites is prohibited [Section 7.0]. • Should additional fishing sites be identified during ongoing engagement with Aboriginal communities, implement the TLU Sites Discovery Contingency Plan [Appendix B]. Mitigation may include one or more of the following measures: – recording and mapping of fishing locales; – strict adherence to the legislation, standards and guidelines set by provincial and federal regulatory authorities for watercourse crossings; and/or – alternative site-specific mitigation strategies recommended by participating Aboriginal communities. • See Section 7.1.3 Water Quality and Quantity for mitigation measures relevant to potential effects on water quality and quantity. • See Section 7.1.6 Fish and Fish Habitat for mitigation measures relevant to potential effects on fish and fish habitat. • Implement applicable mitigation measures listed above during maintenance activities (*e.g.*, integrity digs).	• Alteration of subsistence resources. • Disruption of subsistence activities during construction and site-specific maintenance.

TABLE A7.1.12-1 Cont'd

Potential Effect	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [EPP Reference][2]	Potential Residual Effect(s)
2. Traditional Land and Resource Use Indicator – Cultural Sites			
2.1 Disturbance of gathering places	RSA	• Provide Aboriginal communities with the anticipated construction schedule and pipeline route maps, a minimum of two weeks prior to the start of construction in the vicinity of their respective communities [Section 4.0]. • Install signage notifying of construction activities in the area [Section 4.0]. • Work with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members [Section 4.0]. • See Section 7.1.4 Air Emissions and Section 7.1.5 Acoustic Environment for measures pertaining to nuisance air and noise emissions, respectively. • Implement applicable mitigation measures listed above during maintenance activities (*e.g.*, integrity digs).	• Sensory disturbance for Aboriginal and non-Aboriginal local residents and land users (from nuisance air emissions and noise) during construction and site specific maintenance activities (refer to Section 7.2.1).
2.2 Disturbance of sacred sites	RSA	• Provide Aboriginal communities with the anticipated construction schedule and pipeline route maps, a minimum of two weeks prior to the start of construction in the vicinity of their respective communities [Section 4.0]. • Install signage notifying of construction activities in the area [Section 4.0]. • Work with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members [Section 4.0]. • See Section 7.1.4 Air Emissions and Section 7.1.5 Acoustic Environment for measures pertaining to nuisance air and noise emissions, respectively. • Implement applicable mitigation measures listed above during maintenance activities (*e.g.*, integrity digs).	• Sensory disturbance for Aboriginal and non-Aboriginal local residents and land users (from nuisance air emissions and noise) during construction and site specific maintenance activities (refer to Section 7.2.1).

Notes: 1 LSA = TLRU LSA; RSA = TLRU RSA.
2 Detailed mitigation measures are outlined in the Pipeline EPP (Appendix A of this Proposal).

7.1.12.2 Significance Evaluation of Potential Residual Effects

To date, Trans Mountain has not been made aware of any use of the lands within Finn Creek Provincial Park for traditional activities. Nevertheless, Trans Mountain assumes that TLRU activities could be potentially practiced within the park.

Table A7.1.12-2 provides a summary of the significance evaluation of the potential residual socio-economic effects of the construction and operations of the proposed pipeline in Finn Creek Provincial Park on TLRU indicators. The rationale used to evaluate the significance of each of the residual socio-economic effects is provided below.

TABLE A7.1.12-2

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON TRADITIONAL LAND AND RESOURCE USE FOR FINN CREEK PROVINCIAL PARK

Potential Residual Effects	Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
			Duration	Frequency	Reversibility				
1 Traditional Land and Resource Use Indicator – Subsistence Activities and Sites									
1(a) Disturbance of trails and travelways during construction and site-specific maintenance.	Negative	Footprint	Short-term	Periodic	Short-term	Medium	Low	Moderate	Not significant

TABLE A7.1.12-2 Cont'd

Potential Residual Effects		Impact Balance	Spatial Boundary[1]	Temporal Context			Magnitude	Probability	Confidence	Significance[2]
				Duration	Frequency	Reversibility				
1(b)	Alteration of subsistence resources.	Negative	RSA	Short-term	Periodic	Long-term	Medium	Low	Moderate	Not significant
1(c)	Disruption of subsistence activities during construction and site-specific maintenance.	Negative	RSA	Short-term	Periodic	Long-term	Medium	Low	Moderate	Not significant
1(d)	Sensory disturbance for Aboriginal and non-Aboriginal local residents and land users (from nuisance air emissions and noise) during construction and site-specific maintenance activities.	Negative	RSA	Short-term	Periodic	Short-term	Low	High	High	Not significant
2	Traditional Land and Resource Use Indicator – Cultural Sites									
2(a)	Sensory disturbance for Aboriginal and non-Aboriginal local residents and land users (from nuisance air emissions and noise) during construction and site-specific maintenance activities.	Negative	RSA	Short-term	Periodic	Short-term	Low	High	High	Not significant

Notes: 1 RSA = TLRU RSA.

2 Significant Residual Socio-economic Effect: A residual socio-economic effect is considered significant if the effect is predicted to be:

- high magnitude, high probability, short to medium-term reversibility and regional, provincial or national in extent that cannot be technically or economically mitigated; or
- high magnitude, high probability, long-term or permanent reversibility and any spatial boundary that cannot be technically or economically mitigated.

Traditional Land and Resource Use Indicator – Subsistence Activities and Sites

Disturbance of Trails and Travelways During Construction and Site-Specific Maintenance

Disturbance of trails and travelways during construction is anticipated to result from short-term physical disturbance of land and access limitations that may affect the practice of traditional activities by Aboriginal communities. Similar effects of reduced access may occur during periods of site-specific maintenance.

To date, no trails and travelways have been identified along the narrowed pipeline corridor within Finn Creek Provincial Park. If trails and travelways are identified along the narrowed pipeline corridor within Finn Creek Provincial Park during ongoing engagement with Aboriginal communities, the proposed mitigation measures described in Table A7.1.12-1 will be implemented to mitigate the potential adverse effects of the Project on these site types and will be dependent upon the type of site identified.

Additional measures to reduce the disruption of trails and travelways include notification regarding construction schedules and pipeline route maps, installing signage notifying of construction activities in the area and working with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members.

Despite the implementation of the proposed mitigation measures, traditional land and resource users may still be unable to use, or be deterred from using, certain areas at times during construction and periods of site-specific maintenance and consequently, the magnitude of the residual effect is considered to be medium (Table A7.1.12-2, point 1[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Footprint – trails, and travelways may be physically disturbed if occurring within the construction right-of-way and TWS.
- Duration: short-term – events causing the effects will be construction activity or site-specific maintenance that would occur within any one year period during operations.

- Frequency: periodic – construction and site-specific maintenance activities will occur intermittently but repeatedly throughout the assessment period.
- Reversibility: short-term – effects will be focused on the construction phase or site-specific maintenance that would occur within any one year period during operations.
- Magnitude: medium – it is expected that Project-related disturbances would be temporary through the implementation of the proposed mitigation measures during construction and operations to reduce, but not eliminate, potential effects on disturbance of trails and travelways. Mitigation strategies are also in place in the event any unidentified subsistence sites are discovered.
- Probability: low - to date no trails and travelways have been identified within the narrowed pipeline corridor in Finn Creek Provincial Park.
- Confidence: moderate – based on Project information and the professional experience of the assessment team.

Alteration of Subsistence Resources

Subsistence resources may be disturbed or altered during construction and operations of the Project. The alteration of subsistence activities could manifest itself through changes to local harvesting locales, behavioral alteration or sensory disturbance of environmental resources or increased public access to traditional harvesting areas and increased pressure on environmental resources. The operations of the proposed pipeline will affect subsistence resources primarily due to temporary disturbances related to maintenance activities.

To date, no subsistence harvesting sites have been identified within the narrowed pipeline corridor in Finn Creek Provincial Park. If subsistence harvesting sites are identified in Finn Creek Provincial Park during ongoing engagement with Aboriginal communities, the proposed mitigation measures described in Table A7.1.12-1 will be implemented to mitigate the potential adverse effects of the Project on these site types and include measures outlined under the assessment of relevant environmental resources (*e.g.,* air emissions, acoustic environment, fish and fish habitat, wildlife and wildlife habitat, vegetation, wetlands).

Despite the implementation of the proposed mitigation measures, traditional land and resource users may still be unable to use, or be deterred from using, certain areas at times during construction and periods of site-specific maintenance. Changes to the distribution and abundance of resources could in turn result in loss or alteration of harvesting areas, which could result in indirect effects such as harvesters having to spend more time and money to travel further for subsistence activities. Therefore the magnitude of the residual effect is considered to be medium (Table A7.1.12-2, point 1[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: TLRU RSA – potential effects may extend beyond the Footprint into ZOI of target environmental resources.
- Duration: short-term – events causing the effects will be construction activity or site-specific maintenance that would occur within any one year period during operations.
- Frequency: periodic – construction and site-specific maintenance activities will occur intermittently but repeatedly throughout the assessment period.
- Reversibility: long-term – the effects of disturbance to traditionally harvested resources will be dependent on each target species' sensitivities and could extend greater than 10 years following decommissioning and abandonment, once native vegetation regenerates over the Footprint.
- Magnitude: medium – the effects assessment results for fish and fish habitat, wildlife and wildlife habitat, vegetation, wetlands indicates that effects to traditionally harvested resources may be detectable and is dependent on each target species' sensitivities.

- Probability: low – to date no subsistence resources have been identified by Aboriginal communities within the narrowed pipeline corridor in Finn Creek Provincial Park.
- Confidence: moderate – based on Project information and the professional experience of the assessment team.

Disruption of Subsistence Activities During Construction and Site-Specific Maintenance

The disruption of subsistence hunting, fishing, trapping and plant gathering activities is a potential residual effect of interactions between traditional resource users and construction and operations activities of the Project. In the event that subsistence activities are disrupted by the construction or operations of the Project, the interruption could mean that the traditional resource user misses the harvest opportunity or that their participation is curtailed. The disruption of subsistence activities also refers to the possibility that traditional resource users could be prevented from accessing key harvesting areas resulting from limited access or increased public access to traditional harvesting areas. The operations of the proposed Project will affect subsistence activities primarily due to temporary disturbances related to site-specific maintenance.

To date, Trans Mountain has not been made aware of any subsistence activities along the narrowed pipeline corridor within Finn Creek Provincial Park. Nevertheless, Trans Mountain assumes that subsistence activities could be potentially practiced within the park, although of low probability (Table A7.1.12-2, point 1[c]).

Aboriginal communities will be provided with the anticipated construction schedule and pipeline route maps, a minimum of two weeks prior to the start of construction in the vicinity of their respective communities. Signage will be installed, notifying of construction activities in the area. Trans Mountain will work with Aboriginal communities to develop strategies to most effectively communicate the construction schedule and work areas to its members. A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: TLRU RSA – the proposed Project may affect subsistence activities beyond the construction footprint and may also indirectly affect the distribution of traditional resource users in other areas of the TLRU RSA.
- Duration: short-term – events causing the effects will be construction activity or site-specific maintenance that would occur within any one year period during operations.
- Frequency: periodic – construction and site-specific maintenance activities will occur intermittently but repeatedly throughout the assessment period.
- Reversibility: long-term – the disruption of subsistence hunting, trapping, fishing and plant gathering activities during construction is limited to the construction phase of the Project, however, changes to preferred harvesting locales could result in indirect effects such as harvesters having to spend more time and money to travel further for subsistence activities, and could extend greater than 10 years following decommissioning and abandonment, once native vegetation regenerates over the Footprint.
- Magnitude: medium – mitigation measures are in place in the event any unidentified subsistence activities and land users are discovered and given that the effects assessment results for fish and fish habitat, vegetation, wetlands, and wildlife and wildlife habitat demonstrate that equivalent land use capability will be maintained by the application of the mitigation strategies described in Table A7.1.12-1 and in the Pipeline EPP. It is expected that Project-related disruptions would be temporary through the implementation of the proposed mitigation measures during the construction and operations phases to reduce, but not eliminate, the potential effects on subsistence activities.
- Probability: low – to date no subsistence activities and land users have been identified along the narrowed pipeline corridor within Finn Creek Provincial Park.
- Confidence: moderate – based on Project information and the professional experience of the assessment team.

Sensory Disturbance for Aboriginal and Non-Aboriginal Local Residents and Land Users (from Nuisance Air Emissions and Noise)

The construction and site-specific maintenance of the Project may result in the sensory disturbance for Aboriginal and non-Aboriginal local residents and land users (Table A7.1.12-2, point 1[d]). This potential residual effect is assessed under the Visitor Enjoyment indicator of Recreational Values in Section 7.2.1. The significance evaluation of this residual effect is provided in Section 7.2.1 which includes all land and resource users, provides an explanation of the rationale and significance criteria.

Traditional Land and Resource Use Indicator – Cultural Sites

Sensory Disturbance for Aboriginal and Non-Aboriginal Local Residents and Land Users (from Nuisance Air Emissions and Noise)

The construction and site-specific maintenance of the Project may result in the sensory disturbance for Aboriginal and non-Aboriginal local residents and land users (Table A7.1.12-2, point 2[a]). This potential residual effect is assessed under the Visitor Enjoyment indicator of Recreational Values in Section 7.2.1. The significance evaluation of this residual effect is provided in Section 7.2.1 which includes all land and resource users, provides an explanation of the rationale and significance criteria.

7.1.12.3 Summary

As identified in Table A7.1.12-2, there are no situations for TLRU indicators that would result in a significant residual socio-economic effect. Consequently, it is concluded that the residual socio-economic effects of Project construction and operations on conservational values of Finn Creek Provincial Park related to TLRU will be not significant.

7.2 Recreational Values of Finn Creek Provincial Park

As per the *Finn Creek Provincial Park Management Direction Statement, 1999*, Finn Creek Provincial Park has many viewing spots for wildlife and Chinook spawning. Canoeing, kayaking and fishing are some of the recreational opportunities that are offered by the park. Permitted winter recreational opportunities include back country skiing and snowshoeing. Snowmobiling is permitted on the existing TMPL right-of-way.

7.2.1 Visitor Enjoyment and Safety

This subsection describes the potential Project effects on visitor enjoyment and safety values within Finn Creek Provincial Park. This refers to the use of the land and resources by people, in both a consumptive and non-consumptive manner. Aesthetic attributes of human use areas are also considered in this discussion (*e.g.,* sensory disturbance, changes in viewshed).

Visitor enjoyment and safety amalgamates relevant components from the human occupancy and resource use (HORU) and infrastructure and services elements in Volume 5B of the Facilities Application, particularly indicators related to parks and protected areas, outdoor recreation use and transportation infrastructure. Spatial boundaries for visitor enjoyment follow the spatial boundaries outlined for the HORU element. Spatial boundaries for visitor safety follow the spatial boundaries outlined for the infrastructure and services element; shown in Figure 6.2.2-2 of the Introduction to the Stage 2 Detailed Proposal.

7.2.1.1 Identified Potential Effects

The potential effects associated with the construction and operations of the proposed pipeline in Finn Creek Provincial Park on visitor enjoyment and safety indicators are listed in Table A7.2.1-1.

A summary of mitigation measures provided in Table A7.2.1-1 was principally developed in accordance with industry accepted best practices and industry best practices. A full list of socio-economic mitigation measures is found in the Socio-Economic Management Plan (SEMP) (Section 8.0) of the Pipeline EPP.

TABLE A7.2.1-1

POTENTIAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON VISITOR ENJOYMENT AND SAFETY FOR FINN CREEK PROVINCIAL PARK

Potential Effect	Spatial Boundary	Key Recommendations/Mitigation Measures [EPP Reference][1]	Potential Residual Effect(s)
1. Visitor Enjoyment and Safety Indicator – Visitor Enjoyment			
1.1 Physical disturbance to Finn Creek Provincial Park	Footprint	• Minimize disturbance of valued natural features with a non-traditional human use (*e.g.*, recreational trails, recreational use areas, key use areas within Finn Creek Provincial Park) during final route refinement to the extent practical [SEMP Section 8.4.6]. • Provide provincial and federal regulatory authorities, municipal/regional governments; Aboriginal communities; BC Parks and recreational organizations with final routing information, including maps, as well as construction schedule information [SEMP Section 8.4.6]. • Install signs in Finn Creek Provincial Park and known recreational use areas in the vicinity notifying users of construction activities and timing [SEMP Section 8.4.6]. • Develop and implement a communication plan for sharing information about key Project construction milestones and information with the general public in affected areas [SEMP Section 8.4.6]. • Ensure any changes in planned timing or location of construction activities is communicated to the public, relevant municipal and regional governments, Aboriginal communities, BC Parks and formal recreation organizations in affected areas [SEMP Section 8.4.6]. • Apply all measures pertaining to HORU in the SEMP and all measures pertaining to notification and vegetation in the Pipeline EPP.	• Physical disturbance to natural and built features in protected areas during construction and site-specific maintenance.
1.2 Physical disturbance to facilities, including trails and trailheads, parking lot, within Finn Creek Provincial Park	HORU RSA	• Avoid disturbance of built features during final route refinement, to the extent practical [SEMP Section 8.4.6]. • Narrow the construction right-of-way at key locations to avoid valued built or natural features, to the extent practical [SEMP Section 8.4.6]. • Ensure closure signage is placed on affected established trails or trailheads. • Contact appropriate regulatory authorities and municipal tourism offices prior to construction activities and provide maps and schedules of the proposed construction activities to enable them relay information about possible trail and recreational use area closures [SEMP Section 8.4.6]. • Develop and implement a communication plan for sharing information about key Project construction milestones and information with the general public in affected areas [SEMP Section 8.4.6]. • Apply all measures pertaining to HORU in the SEMP and all measures pertaining to notification and vegetation in the Pipeline EPP.	• Decrease in quality of the outdoor recreational experience of Aboriginal and non-Aboriginal resource users during construction.
1.3 Change to access of protected area	HORU RSA	• Maintain access to established recreation features, through the clearing, construction and reclamation period [SEMP Section 8.4.6]. • Place signage on access roads in the vicinity of construction activities to ensure users are aware that construction activities are taking place [SEMP Section 8.4.6]. • Bore under paved and high use roads [SEMP Section 8.4.6]. • Where minor roads are crossed that may affect established community use/access routes, complete an open cut crossing within one day, to the extent practical [SEMP Section 8.4.6]. • Provide provincial and federal regulatory authorities, municipal/regional governments; Aboriginal communities; BC Parks and recreational organizations with final routing information, including maps, as well as construction schedule information [SEMP Section 8.4.3]. • Develop Traffic Control Plans for site specific sections of roads affected by the Project [SEMP Section 8.4.3]. • Develop a communication plan for activities that impact normal traffic flow, such as road closures, detours [SEMP Section 8.4.3]. • Develop and implement a communication plan for sharing information about key Project construction milestones and information with the general public in affected areas [SEMP Section 8.4.6]. • Ensure any changes in planned timing or location of construction activities is communicated to the public, relevant municipal and regional governments, Aboriginal communities, BC Parks and formal recreation organizations in affected areas. • Apply all other measures pertaining to notification and access in the SEMP.	• Change in land use patterns during construction and site-specific maintenance.

TABLE A7.2.1-1 Cont'd

Potential Effect	Spatial Boundary	Key Recommendations/Mitigation Measures [EPP Reference][1]	Potential Residual Effect(s)
1.4 Sensory disturbance of land and resource users	HORU RSA	• Adhere to all federal and provincial guidelines and legislation for noise management. • Use only the size and power of tools necessary to limit noise from power tool operations. Ensure stationary equipment, such as compressors and generators, will be located away from noise receptors, to the extent feasible. • Maintain noise suppression equipment (*e.g.*, silencers) on all construction machinery and vehicles. • Enclose noisy equipment and use baffles such as material storage and subsoil piles, where and when feasible, to limit the transmission of noise beyond the construction site. • Restrict the duration that vehicles and equipment are allowed to site and idle to less than 1 hour, unless air temperature is less than 0°C. • To reduce air and noise emissions from Project-related vehicles, use multi-passenger vehicles for the transportation of crews to and from the job sites, where feasible. Actively encourage car-pooling when shuttle bus services are not practical.	• Sensory disturbance for Aboriginal and non-Aboriginal local residents and land users (from nuisance air emissions, noise and visual effects) during construction and site-specific maintenance activities.
2. Visitor Enjoyment and Safety Indicator – Visitor Safety			
2.1 Increased traffic due to transportation of workers and supplies	Socio-economic RSA	• Develop estimates of Project-related traffic volumes associated with all Project components, related to both the movement of workers and the movement of equipment and materials. • Continue to consult with the BC Ministry of Transportation and relevant municipalities regarding traffic volumes anticipated and the traffic management protocols. • Develop a traffic and Access Control Management Plan for the Project and Traffic Control Plans for particular contracts. • Where possible, provide daily shuttle bus service from designated staging areas to work sites. • Actively encourage carpooling for times when shuttles/buses is not practical or available. • Communicate with local police and emergency services personnel to keep these organizations informed of traffic schedules. • Develop a communication plan for activities that impact normal traffic flow, such as road closures, detours. • Apply all other transportation and traffic related measures outlined in the Pipeline EPP.	• Increase in traffic on highways and access roads during construction. • Sensory disturbances for Aboriginal local residents and land use (refer to potential effect 1.4 of this table). • Increase in traffic related injury and mortality.

Note: 1 Detailed mitigation measures are outlined in the SEMP and the Pipeline EPP (Appendix A of this Proposal).

7.2.1.2 Significance Evaluation of Potential Residual Effects

Table A7.2.1-2 provides a summary of the significance evaluation of the potential residual effects of the construction and operations of the Project on visitor enjoyment and safety indicators. The rationale used to value the significance of each of the residual socio-economic effects is provided below.

TABLE A7.2.1-2

SIGNIFICANCE EVALUATION OF POTENTIAL RESIDUAL EFFECTS OF PIPELINE CONSTRUCTION AND OPERATIONS ON VISITOR ENJOYMENT AND SAFETY FOR FINN CREEK PROVINCIAL PARK

Potential Residual Effects	Impact Balance	Spatial Boundary	Temporal Context			Magnitude	Probability	Confidence	Significance[1]
			Duration	Frequency	Reversibility				
1. Visitor Enjoyment and Safety Indicator - Visitor Enjoyment									
1(a) Physical disturbance to natural and built features in protected areas during construction and site-specific maintenance.	Negative	Footprint	Short-term	Periodic	Short to medium-term	Medium	High	Moderate	Not significant

TABLE A7.2.1-2 Cont'd

Potential Residual Effects	Impact Balance	Spatial Boundary	Temporal Context: Duration	Temporal Context: Frequency	Temporal Context: Reversibility	Magnitude	Probability	Confidence	Significance[1]
1(b) Decrease in quality of the outdoor recreational experience of Aboriginal and non-Aboriginal resource users during construction.	Negative	HORU RSA	Short-term	Isolated	Short-term	Low	High	High	Not significant
1(c) Change in land use patterns during construction and site-specific maintenance.	Negative	HORU RSA	Short-term	Periodic	Short-term	Low	High	High	Not significant
1(d) Sensory disturbances for Aboriginal and non-Aboriginal local residents and land users (from nuisance air emissions, noise and visual effects) during construction and site-specific maintenance.	Negative	HORU RSA	Short-term	Periodic	Short-term	Low	High	High	Not significant
2. Visitor Enjoyment and Safety Indicator – Visitor Safety									
2(a) Increase in traffic on highways and access roads during construction.	Negative	Socio-economic RSA	Short-term	Isolated	Short-term	Moderate	High	High	Not significant
2(b) Increase in traffic related injury and mortality.	Negative	Socio-economic RSA	Short-term	Isolated	Short-term	Negligible to medium	Low	High	Not significant

Note: 1 Significant Residual Socio-economic Effect: A residual socio-economic effect is considered significant if the effect is predicted to be:

- high magnitude, high probability, short to medium-term reversibility and regional, provincial or national in extent that cannot be technically or economically mitigated; or
- high magnitude, high probability, long-term or permanent reversibility and any spatial boundary that cannot be technically or economically mitigated.

Visitor Enjoyment and Safety Indicator – Visitor Enjoyment

Physical Disturbance to Natural and Built Features in Protected Areas During Construction and Site-Specific Maintenance

Finn Creek Provincial Park will be crossed by the narrowed pipeline corridor during construction activities, as well as during periods of site-specific maintenance (*i.e.*, integrity digs).

Natural and built features within Finn Creek Provincial Park - such as interpretive signs, parking lots, picnic areas, trees, rocks, watercourses and trails - may have intrinsic, interpretive and recreational value, which may be disturbed as a result of pipeline construction and site-specific maintenance. The narrowed pipeline corridor crosses a paved parking lot in Finn Creek Provincial Park (approximately AK 638.8) and a snowmobile route that uses the existing TMPL right-of-way (approximately AK 638.7 to AK 639.3).

Mitigation measures related to vegetation, wetlands, wildlife and wildlife habitat and fish and fish habitat have been designed to reduce the amount of land disturbed in any park or protected area. Other key mitigation measures includes avoiding key valued natural or built features during right-of-way finalization, narrowing the right-of-way in certain areas, and restoring any trails or other valued features that may be disturbed. Even with the implementation of mitigation measures to reduce land disturbance, certain natural features with intrinsic value may be disrupted depending on the final right-of-way selection, resulting in a residual adverse effect. Assuming the implementation of all mitigation measures, the residual effect of the Project on natural and built features in protected areas is considered to be reversible in the short to medium-term (*i.e.*, residual effects will primarily occur during construction, but restoration of valued features or areas may extend into the first several years of operations). The magnitude of the effect is considered medium; though the effect may be primarily that of an inconvenience or nuisance, parks and protected areas have an intrinsic value to many users (Table A7.2.1-2, point 1[a]). A summary of the rationale for all of the significance criteria is provided below

- Spatial Boundary: Footprint – natural and built features within parks and protected areas will be directly affected by construction of the pipeline.

- Duration: short-term – the residual effect will be caused by construction and site-specific maintenance that may occur within any one year during operations.
- Frequency: periodic – the disturbance to natural and built features in parks and protected areas will be caused by construction and periods of site-specific maintenance that would occur intermittently but repeatedly during the assessment period.
- Reversibility: short to medium-term – disturbance to natural and built features will be primarily limited to the construction phase and periods of site-specific maintenance; but post-construction restoration of natural areas and features may extend into the first several years of operations.
- Magnitude: medium – given the intrinsic value of parks and protected areas, disruptions are considered a moderate modification in the socio-economic environment.
- Probability: high – construction activities will take place through parks and protected areas; therefore, disturbance of natural features with intrinsic value is likely.
- Confidence: moderate – particular valued built or natural features potentially disturbed will depend on right-of-way finalization.

Decrease in Quality of the Outdoor Recreational Experience of Aboriginal and Non-Aboriginal Resource Users

The outdoor recreational experiences of Aboriginal and non-Aboriginal resource users, such as canoeing, skiing, snowshoeing, wildlife viewing and fishing activities may be affected by the physical disturbance of outdoor recreation areas during pipeline construction. Nuisance air emissions, noise and visual effects may also occur during the construction of the Project and affect all land users living, working or recreating in the vicinity of the final right-of-way.

The impact balance of this residual effect is considered negative, however, mitigation measures designed to communicate construction locations and timing to the users in the vicinity of the narrowed pipeline corridor will lessen the effect, since users will have the opportunity to choose an alternate location for recreational pursuits. Given the short construction period within Finn Creek Provincial Park, use of well-maintained equipment and limiting idling of equipment, the residual effect is considered to be of low magnitude and reversible in the short-term (Table A7.2.1-2, point 1[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: HORU RSA – sensory disturbances caused by construction can extend into the HORU LSA and HORU RSA.
- Duration: short-term – the event causing the effect is construction activity.
- Frequency: isolated – the event causing the effect is confined to a specific period (*i.e.*, construction).
- Reversibility: short-term - the residual effect is limited to the construction phase.
- Magnitude: low – change may be detectable, but will primarily be that of an inconvenience or nuisance.
- Probability: high – Project construction activity will occur in areas used for outdoor recreation within Finn Creek Provincial Park.
- Confidence: high – based feedback from stakeholders, location of the Project, and the professional experience of the assessment team.

Change in Land Use Patterns During Construction and Site-Specific Maintenance

Change in land use patterns in the HORU RSA during construction is anticipated to result from short-term physical disturbance of land, access roads and/or from alteration of traffic patterns, movements and volumes along highways and roads. A short-term disruption to access and use patterns could affect recreational users who are deterred from visiting Finn Creek Provincial Park. Similar effects regarding

reduced access to land due to disturbances for all use types would occur during periods of site-specific maintenance (*i.e.*, integrity digs). Changes to land use patterns in the HORU RSA during operations are not anticipated since the pipeline corridor does not deviate from the existing TMPL right-of-way within the park.

Trans Mountain will employ mitigation measures that will assist in minimizing the above effects. Mitigation measures to reduce Project-related traffic (such as using multi-passenger vehicles and obeying traffic, road-use and safety laws) as well as low-impact road crossing construction methods will be implemented during Project construction activities, and will also minimize access and use disruptions. However, residual effects are still anticipated, as land disturbance within the park and increased traffic on select access routes are unavoidable during specific times of the Project.

The impact balance of this residual effect is considered negative, but these residual effects of disruption to access and use patterns within the park is considered to be reversible in the short-term (*i.e.*, limited to the construction phase or periods of site-specific maintenance that would occur within any one year during operations). Even after the implementation of proposed mitigation measures, users may still be unable to use, or be deterred from using, certain areas at certain times. Recreationalists within Finn Creek Provincial Park may alter their use destinations away from areas that interface with Project construction. Magnitude is considered low because change may be detectable, but will primarily be that of an inconvenience or nuisance (Table A7.1.1-2, point 1[c]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: HORU RSA – access roads to use areas in the HORU RSA may be physically disturbed by construction activity and disrupted by construction-related traffic.
- Duration: short-term – the event causing the disruption to access and use is the construction phase and site-specific maintenance during operations.
- Frequency: periodic – the event causing the disruption to access and use would occur intermittently but repeatedly (*i.e.*, specific months of construction and during site-specific maintenance that would occur during any one year of operations).
- Reversibility: short-term – the residual effect is limited to the construction phase or periods of site-specific maintenance occurring within any one year during operations.
- Magnitude: low – change may be detectable, but will primarily be that of an inconvenience or nuisance.
- Probability: high – Project activities will disturb land use areas and may impede access to specific areas at select times.
- Confidence: high – based on Project information, regional land use and access patterns, and the professional experience of the assessment team.

Sensory Disturbance for Aboriginal and Non-Aboriginal Local Residents and Land Users (From Nuisance Air Emissions, Noise and Construction-related Visual Effects) During Construction and Site-Specific Maintenance

Nuisance air emissions and noise will occur during the construction of the Project and may at times affect land users living, working or recreating in the vicinity of Project components. Possible effects may include air emissions and noise from construction equipment and vehicles, and dust from vehicles (related to activities during non-frozen conditions such as reclamation). Also, equipment, areas of land disturbance, and the activity of construction workers will be visible to nearby land and resource users during periods of construction and site-specific maintenance. There may also be periods of night lighting around construction sites. Consequently, the visual quality of the landscape adjacent to the right-of-way or other construction areas may be adversely affected by the Project over the short-term related to construction or maintenance activity.

The implementation of the proposed mitigation measures will reduce the effects of noise and air emissions on land users. Nuisance air and noise emissions will also occur for isolated periods of time at specific

locations during periodic site-specific maintenance activities (*e.g.*, aerial patrols, vegetation management, integrity digs) during the operations phase of the Project. Potential effects on the acoustic environment and air emissions are assessed in Sections 7.1.4 and 7.1.5.

A wide range of mitigation measures will be in place to manage air and noise effects. These include consideration of noise abatement and construction scheduling at noise sensitive locations and during noise-sensitive times, to limit disruption to sensitive receptors; and by limiting the idling of equipment.

However, even with Trans Mountain's commitment to mitigation measures, some residual sensory disturbance is anticipated. The impact balance of this residual effect is considered negative, as it will likely be undesirable for nearby residents or land/resource users. Given the successful implementation of the mitigation measures, the residual effect of nuisance air emissions, noise and visual disruption is deemed low in magnitude, as it would be limited primarily to that of a nuisance of inconvenience. The effect would be short-term in duration and periodic in frequency, as sensory disturbance would be primarily caused by construction and intermittent but repeated periods of site-specific maintenance. The potential effect is considered reversible in the short-term (Table A7.1.2-2, point 1[d]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: HORU RSA – noise and air emissions emanating from the construction can extend into the HORU LSA and HORU RSA.
- Duration: short-term – the event causing the sensory disturbance is construction activity or site-specific maintenance that would occur within any one year during operations.
- Frequency: periodic – the event causing the sensory disturbance would be focused during construction, but would occur intermittently but repeatedly due to site-specific maintenance.
- Reversibility: short-term – the residual effect is limited to the construction phase or site-specific maintenance activities that would occur within any one year during operations.
- Magnitude: low – the implementation of the proposed mitigation measures would effectively reduce the effects of noise and air emissions to that of a nuisance or inconvenience.
- Probability: high – construction and site-specific maintenance activities will involve the use of heavy equipment and vehicles.
- Confidence: high – based on a good understanding of cause-effect relationships and the professional experience of the assessment team.

Visitor Enjoyment and Safety Indicator – Visitor Safety

Increase in Traffic on Highways and Access Roads During Construction

During construction, there will be an increase in traffic on highways and access roads due to Project-related vehicles. Construction-related traffic will include vehicles used for the transportation of equipment, supplies and workers to various locations along the narrowed pipeline corridor. Highway 5 will be the major highway most likely to be used during construction within Finn Creek Provincial Park.

Ground transport to the Finn Creek Provincial Park construction spread and accommodation hub (Village of Valemount) would be primarily via Highway 5. It is anticipated that most regionally-based personnel would use ground transport from their home community to work locations. Pipeline staging areas will have a combination of work vehicles and crew buses. Existing Annual Average Daily Traffic (AADT) varies in the Project regions. Overall Monthly Average Daily Traffic (MADT) volumes have slightly increased from 2010 to 2012 and throughout the Fraser-Fort George/Thompson-Nicola Region, MADT volumes are highest during the summer months. The addition of several hundred Project-related vehicles will more likely be perceptible on highways or highway sections with lower AADT values.

At the time of writing, detailed traffic estimates and logistics plans were not available for the proposed movement of Project workers, equipment and materials. Project effects on regional highway traffic, and how Project traffic compares to overall daily traffic volumes, will ultimately depend on the source of

construction equipment, construction camp modules and other supplies and materials (especially pipe), as well as the methods used to transport these items to construction sites. Pipe and other materials obtained from Canadian or North American suppliers can be transported by rail, offloaded at rail sidings at key points within the Socio-economic RSA and transported relatively short distances by truck to construction sites.

Trans Mountain will develop detailed traffic estimates as construction and Project planning related to the movement of people, materials and equipment continues. Trans Mountain will also develop further logistics information on transportation modes and routes to be used during the construction phase, as well as timing transportation movements to each construction spread and/or facility location. This information will be further evaluated in the context of existing regional traffic volumes, and will become part of the overall information that is shared with local governments, Aboriginal communities, resource users, BC Parks and other stakeholders. This information will also be discussed with provincial transportation authorities during the course of the ongoing consultation planning and construction.

Trans Mountain will employ a number of measures to reduce Project-related vehicles and limit the effects associated with construction-related traffic, including providing daily shuttle bus services from staging areas to work sites and for local workers from pre-determined regional staging areas. It is anticipated that many major equipment deliveries will come to the region via rail to temporary stockpile sites along the narrowed pipeline corridor which will limit the distances travelled by heavy loads on regional highways. The increase in traffic will occur during the construction phase and the residual effect is considered to be reversible in the short-term (*i.e.*, limited to the construction phase). An increase in traffic over current operational movements related to workers and maintenance is not anticipated during the operations phase.

The impact balance of an increase in traffic during construction is considered to be negative, as it may contribute to disruption of existing traffic movement patterns and highway/road users. Highway 5 is one of the main access routes for Finn Creek Provincial Park. An increase in traffic on this Highway 5, particularly during summer months when there is a noticeable increase in traffic in some communities due to the tourist season, would be more than a nuisance or inconvenience to residents, travelers and other road users. It was noted during the Valemount Community Workshop that traffic congestion during construction was a concern, as Highway 5 is the only road in and out of the community. Highway 5 is also heavily used by several river rafting companies in the summer, which already creates some traffic congestion in Valemount. Concerns about traffic congestion were also raised in the Blue River Community Workshop, where it was noted that traffic is already congested at times around a scenic lookout point on the highway. Trans Mountain will employ mitigation measures to ensure the effects are reduced. The magnitude of the residual effect is anticipated to be moderate since construction in Finn Creek Provincial Park will occur during the summer/fall months and may coincide with an increase in traffic related to summer tourists. Traffic disruptions could be more than a nuisance or inconvenience to residents, travelers and other road users in some areas. The disruption could result in the need for detours or the inability to access particular locations. Therefore, the magnitude of the residual effect is anticipated to be medium. Disruption to existing traffic movement on single-lane sections of highways, could also result in a disruption to residents, travelers and other road users such as delays due to the presence of larger, slower vehicles and temporary road closures resulting in single-lane traffic movement.

The probability of occurrence of the residual effect is high, since daily travel will be required to and from the work sites and materials, equipment and workers must be brought to work sites at key points during construction. The level of confidence in the prediction is also high based on the limited number of alternative transportation routes in the Socio-economic RSA and since daily travel will be required to and from work sites. (Table A7.1.1-2, point 2[a]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Socio-economic RSA – highways and access roads anticipated to be used by Project vehicles are located in various locations across the Socio-economic RSA.
- Duration: short-term – the movement of Project-related equipment, materials and workers during construction will cause the effect; no perceptible increases in traffic are anticipated during the operations phase.

- Frequency: isolated – the movement of equipment, materials and workers on regional highways resulting in increases in traffic is confined to a specific phase of the assessment period (*i.e.*, construction phase).
- Reversibility: short-term – the Project-related increase in traffic is limited to the construction phase.
- Magnitude: moderate– construction within Finn Creek Provincial Park is planned for summer/fall, therefore, construction traffic may coincide with summer tourist months.
- Probability: high – Project-related traffic on highways and access roads will be present during construction.
- Confidence: high – transporting equipment and supplies will result in an increase in traffic, assuming that non-Project related traffic will remain constant.

Increase in Traffic-Related Injury and Mortality

Since the number of traffic collisions in a given area is associated with traffic volumes, an increase in Project-related traffic could be expected to result in a higher number of collisions, and with it an increase in the risk of traffic-related injuries or fatalities. It is not possible to quantify the extent of a potential increase or whether there would be a measureable increase because the numbers of proposed Project-related vehicles in the area of Finn Creek Provincial Park are not currently known. However, there are several factors that may modify the frequency or severity of those collisions and injuries and that suggest approaches for Trans Mountain to use in minimizing the potential impacts on public safety. These factors are: numbers of vehicles; location of vehicles; and driver behaviour.

Number of Vehicles

Safety performance functions that have been developed for different roadway types confirm that the number of collisions expected in a given area relates directly to the volume of traffic on that roadway segment. In other words, more traffic equates with more collisions (Parisien 2012). By limiting or minimizing the additional traffic put onto a road, the risk of collisions and traffic injuries is also reduced.

Project traffic will comprise both vehicles used to transport equipment and supplies, and also vehicles used to transport workers. Of these, worker transport is more amenable to being reduced, through the use of buses or vans to transport workers rather than private vehicles.

Driver Behaviour

A number of driver behaviours can contribute to the risk and severity of collisions. Driver inattention was the number one contributing factor to collisions in BC in 2007 according to the BC Motor Vehicle Branch (Motor Vehicle Branch 2007); excessive speed was the second most frequent contributing factor.

The development and strict enforcement of policies on driver behaviour, among both employees and contractors, is essential for minimizing potential effects on traffic safety. These policies will include screening of driver abstracts, provisions on observance of posted speed limits, a ban on cell-phone or tablet use, mandatory seatbelt use, fatigue management, no driving while impaired and other behaviours that can influence safety.

Concerns around traffic volume, congestion and safety have been raised as an issue in the context of the Project by a number of key informants (Hanlan, Hannah, Humphreys, Kreiner pers. comm.). The Project will increase the amount of traffic on public roads because of the need for transportation of equipment, supplies and workers to various locations along the narrowed pipeline corridor. Trans Mountain will develop detailed traffic estimates as construction and project planning continues; these detailed traffic estimates are not currently available. The increase in traffic is projected to occur mainly during the construction phase; little Project-related traffic is anticipated for the operations phase.

Mitigation measures include the development of site-specific Traffic Access and Control Plans; the use of shuttle buses, where feasible, to reduce the volume of traffic on the road; communication with local police

and emergency services; the development and enforcement of mandatory minimum driving standards; and development of a driving complaint mechanism.

In summary, the Project will increase the number of vehicles in the Socio-economic RSA including Finn Creek Provincial Park, both in terms of Project-related construction vehicles and vehicles used to transport workers. Evidence from the literature shows that an increase in traffic volumes results in an increased risk of traffic collisions. This in turn increases the risk of collision-related injuries and fatalities. The impact balance of this effect is characterized as negative since vehicle collisions pose a detriment to community health. The effects would extend throughout the Socio-economic RSA, and would manifest in those locations in which the Project uses vehicles on public roadways. Risk will be particularly high in collision "hot-spots" – locations (usually intersections) which have pre-existing high rates of traffic collisions. The duration is characterized as short-term and the frequency as isolated since the effect is primarily linked to the construction phase when the Project workforce will be large and when the movement of heavy machinery and vehicles is required. An increase in traffic-related injury and mortality is unlikely for the operations phase since there will be fewer workers and equipment requiring transport. The reversibility is similarly characterized as short-term since any effect would mainly be observed during the construction phase. The increase in risk of traffic-related injury and mortality is highly dependent upon the number and types of additional vehicles, the current road conditions and capacity of the roadways, driver behaviour, and the characteristics of the areas through which traffic will travel. While the addition of Project-related traffic creates an increase in collision risk, traffic-related collisions, injuries and fatalities are rare events; therefore, even though the risk increases, there is no certainty that any traffic-related injuries or fatalities will result from the increase in traffic. In addition, no regulatory standards exist for this area. The magnitude of effect is characterized as negligible to medium (Table A7.2.1-2, point 2[b]). A summary of the rationale for all of the significance criteria is provided below.

- Spatial Boundary: Socio-economic RSA – effects extend throughout the Socio-economic RSA wherever worker and Project-related traffic exists and would be a primary concern in current traffic accident hot-spots.
- Duration: short-term – the event causing the potential increase in traffic-related injury and mortality is the construction phase, when the Project workforce will be large and when heavy machinery and vehicles are required.
- Frequency: isolated – the event causing the potential increase in traffic-related injury and mortality is confined to the construction phase.
- Reversibility: short-term – residual increases in traffic related injury and mortality are considered to be limited to the construction phase.
- Magnitude: negligible to medium – no regulatory standards exist for this area. While the addition of Project-related traffic creates an increase in risk, traffic-related collisions, injuries and fatalities are rare events.
- Probability: low – the probability of occurrence is rated as low since traffic collisions, injuries and fatalities are rare events.
- Confidence: high – the literature showing this cause-effect relationship relates to other areas in BC and internationally, and some stakeholders are concerned about traffic accidents.

7.2.1.3 Summary

As identified in Table A7.2.1-2, there are no situations for visitor enjoyment and safety indicators that would result in a significant residual socio-economic effect. Consequently, it is concluded that the residual socio-economic effects of pipeline construction and operations on recreational values of Finn Creek Provincial Park related to visitor enjoyment and safety will be not significant.

7.3 Synopsis

The impacts of TMEP's construction and operation on the social and environmental values of Finn Creek Provincial Park will be minimized through mitigation and reclamation. Based on the Stage 2 Detailed Proposal prepared for BC Parks, Trans Mountain has concluded that the TMEP:

- is consistent with the 1999 Finn Creek Provincial Park Management Direction;
- allows for operational efficiencies of an existing pipeline system that has been operating for over 60 years in what is now Finn Creek Provincial Park;
- will result in no significant adverse residual environmental and socio-economic effects;
- will conserve the biological diversity of natural ecosystems and maintains the recreational values within Finn Creek Provincial Park;
- compensation offsets will maintain, and in some instances enhance, the objectives of the park management plans; and
- will provide positive overall economic benefit to BC.

8.0 RECLAMATION IN FINN CREEK PROVINCIAL PARK

The Reclamation Plan is built upon the Pipeline EPP and environmental surveys and identifies additional measures and activities to re-establish the ecological integrity of Finn Creek Provincial Park during Project construction. The measures and other work described in the Reclamation Plan will generally apply to the Project Footprint within Finn Creek Provincial Park. Ongoing consultation with BC Parks may entail further mitigation measures and revisions to the Reclamation Plan and as such, the final Reclamation Plan will be completed prior to construction. Additional site-specific reclamation plans (*i.e.,* riparian reclamation plans) may be required and involve further consultation with BC Parks, Aboriginal groups, stakeholders and the general public. Implementation of the measures included in the Reclamation Plan will commence during the construction phase and continue into the operations phase. Where warranted, follow-up plans will be developed to ensure that the mitigation measures, activities and other works identified in the Reclamation Plan are effective.

8.1 Reclamation Consultation

The development of the Reclamation Plan has been a collaborative effort between Trans Mountain, government agencies and interested stakeholders. In particular, input regarding reclamation measures was solicited and received from the Project environmental team (including fish, wetland, vegetation and wildlife experts) and BC Parks. Additional comments have been solicited from ENGOs and will continue throughout the preparation of the Reclamation Plan (Table 8.1-1).

TABLE A8.1-1

CONSULTATION CONTACTS

Stakeholder Group	Date of Contact	Method of Contact	Items Discussed
BC Parks	May 26, 2014	Phone conversation	Finn Creek, re-vegetation, old growth forest, seed mixes, weed and problem vegetation control and erosion.

8.2 General Reclamation Measures

Reclamation activities will be in keeping with the *Finn Creek Provincial Park Management Direction Statement, 1999* and particular consideration will be given to the ecological integrity of the riparian area of Finn Creek and associated upland environments.

8.2.1 Natural Regeneration

Where the potential for soil erosion and non-native invasive species infestation is low, and where it is anticipated that the topsoil or root zone material contains a propagule bank (*e.g.,* seed, stem or root pieces) of suitable species, it may in some instances be preferable to not reseed the disturbed area. This revegetation method will facilitate the establishment of pre-disturbance vegetation through native propagules establishment on the disturbed area following clean-up and topsoil/root zone material replacement. In areas with potential erosion and weed concerns, a native perennial or non-native annual grass cover crop species will be applied. The grass cover crop species will establish rapidly to control erosion and limit weed growth while pre-disturbance vegetation establishes.

Natural regeneration is preferred over seeding with commercially available native seed where practical and where it is anticipated that the pre-disturbance vegetation will re-establish on the disturbed area. However, care must be taken when using natural regeneration techniques to avoid invasion of non-native invasive species, as is often the case when paralleling other linear disturbances. Moist riparian and wetland environments that will regenerate easily in a short time frame are prime candidates for natural regeneration.

8.2.2 Woody Species Revegetation

Revegetation using native tree and shrub species will occur in select areas (*e.g.,* TWS and riparian zones) in accordance with Trans Mountains operations and maintenance procedures (*i.e.,* revegetation is allowed

as long as the trench line is not obscured from aerial monitoring or access to the pipeline right-of-way for maintenance and regular inspections is not compromised).

Installation of Nursery-Grown Plant Plugs

TWS, riparian and special reclamation areas will be surveyed for evidence of naturally regenerating trees, specifically sites that are cleared of coniferous vegetation. If suitable levels of naturally regenerating (from seed or vegetative propagules) deciduous or coniferous trees are not observed, then these and other areas will be considered for the installation of nursery-grown plant plugs (*e.g.,* rooted stock plugs). Native seed will be secured and dormant woody species cuttings will be collected, as warranted. Deciduous and coniferous rooted plugs will be installed at pre-selected sites (*e.g.,* TWS, riparian areas or for line-of-sight breaks) as determined in consultation with BC Parks Conservation Specialists. Under the guidance of a Reclamation Specialist (or other qualified professional), planting crews will install the rooted stock plugs using standardized silviculture planting equipment and techniques. The rooted stock plugs will be installed at a specified density/distribution with the purpose of initiating an early ecological recovery trajectory that will, in time, emulate the adjacent undisturbed vegetation in form and function where not influenced by Trans Mountains operation and maintenance procedures.

Where it is determined that ungulate species may damage (browse or up-root) newly installed deciduous plants within riparian zones, protection of the trees via chemical (*e.g.,* animal repellent [DeerGuard]) or mechanical (*e.g.,* tree shields) methods may be warranted at the time of installation.

Installation of Locally Sourced Dormant Woody Species Transplants

At pre-determined locations where vegetation is disturbed by construction, the use of plant transplants may be considered. The use of dormant woody transfers is a cost effective and efficient method of re-establishing vegetation to disturbed locations. Unlike salvaging and storing dormant woody material during construction, transfers are dug when dormant, where warranted, from a location adjacent to the reclamation site that contains select plant species of a suitable size (conifers < 45 cm in height, deciduous trees < 2 cm stem calliper at ground level or 90 cm in height). Where a donor plant community is located adjacent to a potential reclamation site outside of park boundaries, a survey of the donor plant community will be completed to determine the level of plant extraction that could be achieved without affecting the form and/or function of the donor plant community.

A permit for harvesting transplants from the adjacent plant community will be discussed with the appropriate personnel.

8.2.3 Nutrient Management on Disturbed Forested Areas

A slow-release nitrogen fertilizer is proposed for application on lands that contain woody debris and/or wood chips mixed into the salvaged and replaced root zone material or that have been placed on cleared and ungrubbed portions of the construction right-of-way. The nitrogen fertilizer will serve to adjust the carbon-nitrogen ratio in these carbon rich environments to a level that will be conducive to the establishment of seeded grass species and naturally regenerating vegetation.

To avoid deposition or leaching of applied nutrient into Finn Creek, nitrogen fertilizer will not be applied within a 30 m buffer to the riparian swamp and Finn Creek. In addition, the fertilizer application rate will vary based on the level of woody debris and/or wood chips encountered within or on the surface of the root zone material, the soil texture and the slope of the land adjacent to Finn Creek to ensure nutrient movement is minimized.

8.2.4 Seeding of Native Grass Species

Seed mixes were developed in consultation with BC Parks and consist of species native to the park or within the vicinity of the park (Dwg. A-1 of the Stage 2 Detailed Proposal). Seeding will be conducted as soon as practical following topsoil/root zone material replacement. Drill or broadcast seeding of native seed mixes or a grass cover crop species will be conducted on most of the construction right-of-way. Seed mixes will be installed at locations indicated on the Environmental Alignment Sheets, unless otherwise requested by BC Parks Area Supervisor or Conservation Specialist.

8.2.5 Erosion and Sediment Control

Erosion and sediment control (ESC) measures will be implemented to: maintain soil conservation along the proposed right-of-way, preserve existing vegetation on the adjacent land use, reduce the risk of sedimentation of Finn Creek during and following construction activities, and facilitate the establishment of permanent vegetation along the proposed disturbance.

General ESC Measures

- Woody vegetation located on TWS areas will be cleared and not grubbed where root zone material salvage is not anticipated.
- Root zone material will be stored on cleared/ungrubbed TWS areas adjacent to the proposed right-of-way.
- Subsoil will be stored on geotextile when placed over ungrubbed TWS areas.
- Root zone material and grading material (subsoil) will be stored in separate piles so as not to admix.
- Following the replacement of trench and grade subsoil, recontour the area to match the adjacent landscape profile prior to root zone material replacement. Avoid, to the extent feasible, mixing of subsoil and root zone material during materials replacement.
- Install/re-establish coir logs, erosion control blanket or sediment fencing within the riparian area of Finn Creek.
- Install a non-native annual or native perennial grass cover crop species in the riparian zone to minimize competition to regenerating and installed woody vegetation and a prescribed grass seed mix through broadcast or drill seeding methods on all other exposed soils. Ensure any seed mixes or cover crop species used are approved by BC Parks.

Specific ESC Measures

ESC measures that will be considered for use on the proposed construction right-of-way are described in the following subsections:

Coir Log, Erosion Control Blanket and Sediment Fence Installation

Coir logs composed of natural fibers are designed to reduce slope length and surface water velocities (Dwg. A-02 of the Stage 2 Detailed Proposal). Erosion control blankets prevent scour of surface soils, conserves soil moisture and promotes vegetation establishment (Dwg. A-03 of the Stage 2 Detailed Proposal). Sediment fencing filters sediment from surface water that has the potential to discharge into Finn Creek (Dwg. A-04 of the Stage 2 Detailed Proposal). These measures should be installed following clearing and monitored and maintained following construction until vegetation establishment occurs.

Diversion Berms

Diversion berms are intended to reduce slope length and runoff velocities, and divert runoff into well-vegetated areas. Diversion berms will be designed with a suitable spacing, slope gradient and berm height to effectively convey overland water flow, originating on the construction disturbance, away from Finn Creek and other waterbodies (Dwg. A-05 of the Stage 2 Detailed Proposal).

Rollback

Trans Mountain will avoid the use of Douglas-fir, grand fir and spruce for rollback within Finn Creek Provincial Park. Select tree species (*e.g.,* pine) felled during construction will be used for rollback within riparian zones and TWS areas to provide erosion control and habitat enhancement. The woody material felled during construction will be used as rollback within the Finn Creek riparian zone and TWS area to provide erosion control and habitat enhancement. The woody rollback will provide microsites to aid in the re-establishment of woody vegetation and assist in the control of soil erosion along the proposed right-of-way where woody vegetation was cleared. To obtain material required for rollback, woody slash will be

salvaged during construction clearing activities in suitable quantities to allow for the placement of rollback at select locations onto the construction right-of-way following root zone material replacement (Dwg. A-06 of the Stage 2 Detailed Proposal).

Grass Seeding

Native seed mixes have been developed and native perennial and non-native annual cover crop species selected for use on construction disturbances within Finn Creek Provincial Park. An appropriate native grass seed mix, native perennial or annual non-native cover crop will be sown (drill or broadcast seeded) along the disturbed areas following root zone material replacement at an appropriate prescribed rate. Disturbed areas containing wetland vegetation will be left to natural regeneration (Dwg. A-01 of the Stage 2 Detailed Proposal).

8.3 Specific Reclamation Issues

The biophysical features listed below warrant special consideration due to the difficulty in reclaiming and/or managing them. Specific reclamation and/or management plans will be developed from ongoing consultation with BC Parks personnel as well as field surveys.

8.3.1 Watercourses

Stabilization of the banks and slopes of Finn Creek and riparian areas prior to and immediately following construction is critical to the restoration of the habitat at watercourses. Mitigation measures have been developed to enhance the reclamation of Finn Creek. These measures involve the installation of numerous bank and slope protecting structures including:

- log crib structures (Dwg. A-07 of the Stage 2 Detailed Proposal);
- erosion control matting (Dwg. A-03 of the Stage 2 Detailed Proposal);
- revegetation grass rolls (Dwg. A-08 of the Stage 2 Detailed Proposal);
- sediment fences (Dwg. A-04 of the Stage 2 Detailed Proposal);
- biodegradable coir geotextile wraps (Dwg. A-09 of the Stage 2 Detailed Proposal);
- coniferous tree revetments (Dwg. A-10 of the Stage 2 Detailed Proposal); and
- cobble or riprap armouring (Dwg. A-11 of the Stage 2 Detailed Proposal).

In recognition of the fish-bearing status of Finn Creek and the disturbance to watercourse bed, bank and riparian area that will be created during the crossing of this watercourse, reclamation of watercourse features will be completed as per the guidelines identified in the DFO Measures to Avoid Causing Harm to Fish and Fish Habitat.

A detailed riparian reclamation plan will be developed for Finn Creek within Finn Creek Provincial Park prior to construction, and will provide measures that contribute to the reclamation of the watercourse banks and riparian areas disturbed by construction of the proposed Project (*i.e.,* erosion and sediment control measures and the planting of trees and shrubs).

8.3.2 Weed and Vegetation Management Plan

Management of weeds and problem vegetation is essential to maintaining the ecological integrity of Finn Creek Provincial Park during and after Project construction. Trans Mountain will use an integrated vegetation management (IVM) approach that includes non-chemical, cultural and chemical methods to control and reduce the spread of weeds and problem vegetation. The non-chemical, cultural or chemical treatment methods used will vary with life-form and mode of reproduction of the species targeted and the location and extent of the infestation. Non-chemical and cultural treatments include hand-pulling, cultivation, mowing, burning, mulching and active restoration of native plant communities. Chemical treatments include

either selective herbicides (*i.e.*, target specific plant species) or non-selective herbicides (*i.e.*, target all vegetation).

Trans Mountain will work with BC Parks and other stakeholders to implement an IVM approach to weed and problem vegetation management as outlined in KMC's Integrated Vegetation Management Plan and the Weed and Vegetation Management Plan provided in Section 14.0 in Appendix C of the Pipeline EPP. Accurate records of weed infestations, management measures conducted and the success of these measures will be maintained so that weed and vegetation management plans can be modified as necessary from year to year.

Specific weed and problem vegetation management measures for pre-construction, construction and post-construction are provided in the aforementioned Weed and Vegetation Management Plan. Further measures involving monitoring and control measures following construction are provided in Dwg. A-12 of the Stage 2 Detailed Proposal.

Detailed weed and problem vegetation reports will be developed for site-specific locations, as required, following a pre-construction weed survey (scheduled for spring 2015) and consultation with BC Parks Conservation Specialists. Weed and problem vegetation infestations and recommended mitigation measures will be incorporated into the Environmental Alignment Sheets.

DRAWINGS

LIST OF DRAWINGS

CRITERIA FOR IMPLEMENTATION

Seed mixes (see tables below) will be installed at locations indicated on the Environmental Alignment Sheets, unless otherwise requested by BC Parks Area Supervisors or Conservation Specialists.

Notes:

1. Species cultivars, where applicable, will be determined at the time of procurement based on availability and suitability as determined by Trans Mountain.
2. Native seed species will be obtained from local genomes to the extent feasible.
3. All seed mix species must have Certificates of Analysis to allow for the determination of weed and undesirable species content, and germination for each species seed lot in the mix.
4. Certificates of Analysis for each seed mix species will be reviewed by Trans Mountain prior to purchase. Any lot with unacceptable weed contamination or viability will be rejected.
5. Seed mix species that are unavailable in sufficient quantity or quality at a reasonable cost as determined by Trans Mountain at the time of procurement will be eliminated from the mix and the proportions of other species in the mix increased.
6. Drill seeding will be used on all segments to be seeded with the exception of slopes which are too steep to safely operate the tractor and seed drill, areas too wet to access with a tractor and seed drill without causing rutting and poor seed placement, stony areas which could cause damage to the equipment or impede the ability of the drill to properly place the seed, and any other areas which cannot be feasibly reached with the seed drill.
7. Broadcast seeding will be used on lands where drill seeding cannot be conducted.
8. All seed drills and broadcast seeders will be calibrated for each seed mix using the manufacturer's recommended procedures; alternate calibration procedures may be used if approved by the Environmental Inspectors.
9. The seeding contractor will develop appropriate seeding procedures to ensure even distribution of all species in each seed mix and have these procedures approved by the Environmental Inspector. This may involve, but not be limited to:
   - using seed box agitators to prevent stratification of large and small seeds;
   - seeding large and small seed species from separate seed boxes, or in separate passes with the seeder; or
   - using an inert filler agent with the seed mix.
10. Seeding depth with seed drills will be 1-2 cm in fine textured soils and 1-3 cm in sandy soils.
11. Where site and safety conditions allow, broadcast seed will be harrowed into a depth of 1-3 cm, using standard agricultural harrows or other approved equipment. Harrowing will be conducted immediately following broadcasting. Steep slopes that cannot be safely harrowed will be hand raked, if feasible, to incorporate seed.
12. Only the salvaged or cultivated width of the construction right-of-way will be seeded with minimal overlap onto undisturbed areas. Swing-out passes will be made to seed scalped areas adjacent to the cultivated portion as needed.
13. Complete coverage of the stripped area will be ensured by using a sufficient number of passes. Damage to the native sod adjacent to the disturbed portion of the construction right-of-way will be avoided.
14. Broadcast seeding will be delayed during high wind conditions, as directed by the Environmental Inspector.

SEED MIXES

Cover Crop
A cover crop is a fast-germinating and establishing annual/biennial or short-lived perennial grass species that is seeded to quickly stabilise topsoil, control erosion and limit weed growth while pre-disturbance vegetation is restored. Short-lived perennial grass cover crop species include slender/awned wheatgrass or Canada wild rye. Short-lived annual/biennial cover crop specie includes annual ryegrass. Broadcast short-lived perennial grass species seed at 10 kg/ha or 100 grams/100 m^2 and annual/biennial cover crop species at 8 kg/ha or 80 grams/100 m^2.

Non-attractant Seed Mix for Highways/Railways	
Mix #1	%WT
Rocky Mountain fescue	30
rough hair grass	40
spike trisetum	15
June grass	15
<u>seeding rate</u> broadcast seed at 18 kg/ha drill seed at 12 kg/ha	

Seed Mixes - Finn Creek Provincial Park						
	Closed Coniferous - Upland		Closed Coniferous – Moist		Riparian	
Biogeoclimatic Zone	Mix #2	%WT	Mix #3	%WT	Mix #4	%WT
interior cedar hemlock/ engelmann spruce-subalpine fir	smooth wild rye	35	smooth wild rye	30	slender wheatgrass	75
	Rocky Mountain fescue	25	slender wheatgrass	25	rough hair grass	25
	slender wheatgrass	20	tufted hair grass	15		
	rough hair grass	10	rough hair grass	15	<u>seeding rate</u> broadcast seed at 5 kg/ha	
	alpine bluegrass	10	alpine bluegrass	15		
	<u>seeding rate</u> broadcast seed at 18 kg/ha drill seed at 12 kg/ha		<u>seeding rate</u> broadcast seed at 18 kg/ha drill seed at 12 kg/ha			

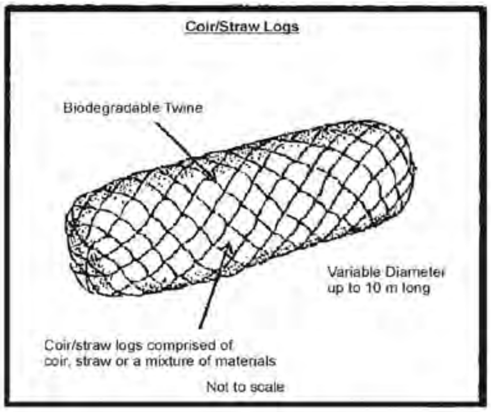
tera ENVIRONMENTAL CONSULTANTS

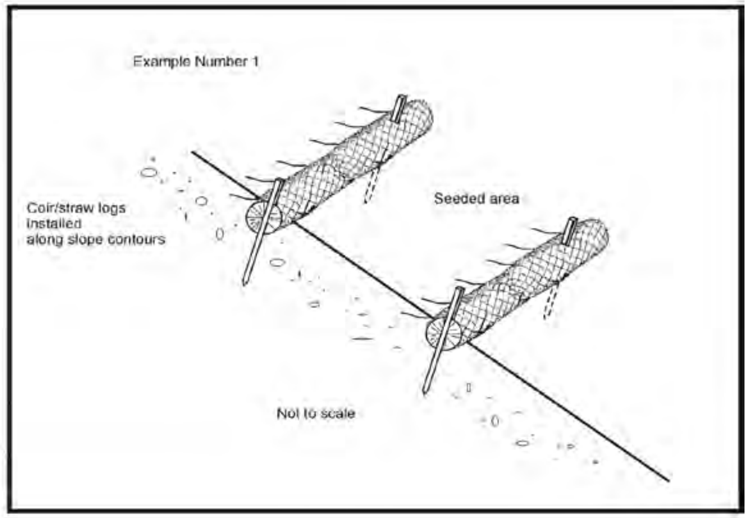
TRANS MOUNTAIN EXPANSION PROJECT

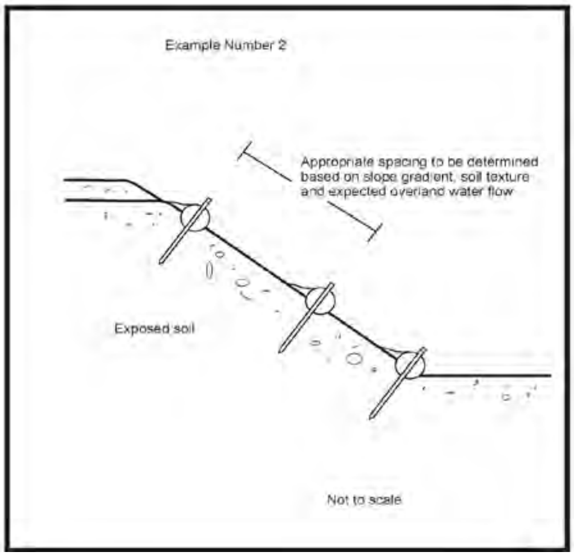
TRANSMOUNTAIN

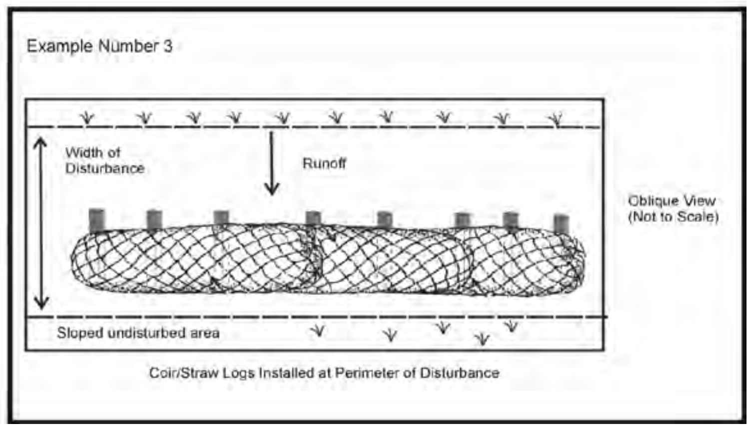
SEED MIXES

7894	August 2014	Drawing A-01









Notes:

1. Proper placement and design is critical and qualified specialists should be involved.
2. Install coir/straw logs in a shallow trench (~5-7.5 cm (2"-3") deep), perpendicular to the direction of flow and across the entire width of the disturbance. Each end of the coir/staw log should be turned slightly up slope to help retain water and prevent flow along the outside of the coir/straw log.
3. Each coir/straw log should be secured into the ground by wooded stakes spaced every 0.9-1.2 m (3'-4') across the length of the log. Stakes should be approximately 45 – 60 cm (18"-24") in length and should be driven through the centre of the coir/straw log and into the ground with approximately 5 cm (2") remaining above the coir/straw log. Stakes installed at each end of the coir/straw log should be placed approximately 5-15 cm (2"-6") from the outer edge of the log.
4. When joining two coir/straw logs together, either tightly abut both ends or overlap each log approximately 15 cm (6").
5. Store, move and install when dry.
6. Coir/straw logs may be seeded or dormant cuttings may be inserted.
7. Typical spacing is indicated below.

Slope Gradient (°)	Typical Spacing (approximate m (ft))
≥1:1	1.5 m (5')
2:1<1:1	3.0 m (10')
>4:1<2:1	5.2 m (17')
6:1-4:1	7.6 m (25')
<6:1	15.0 m (50')

Adapted from CAPP *et al.* (2005)

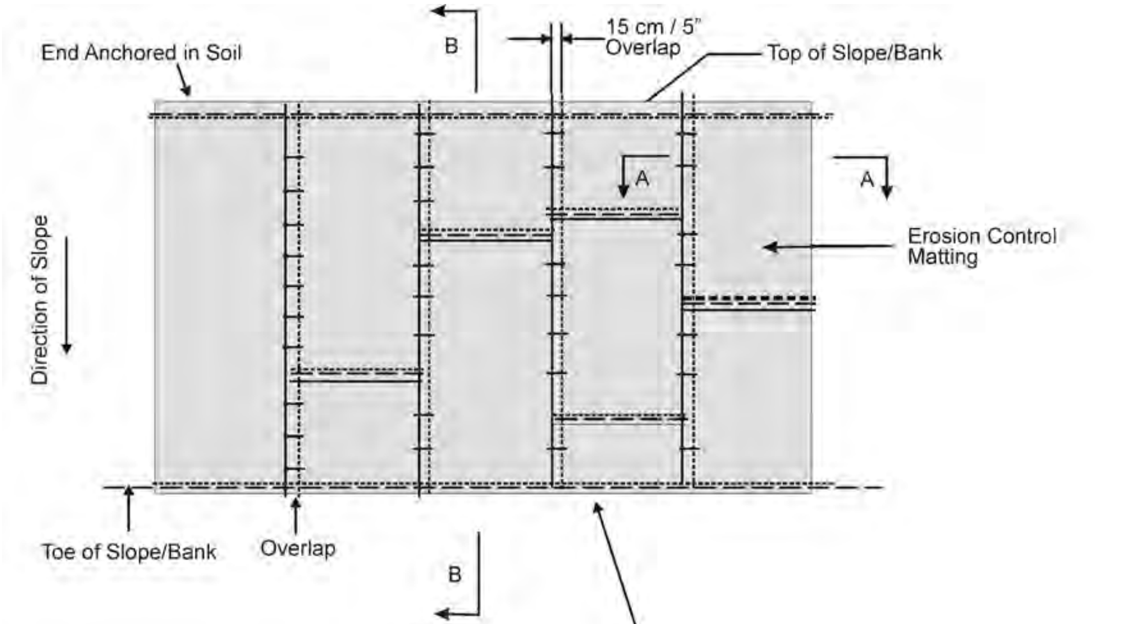
tera ENVIRONMENTAL CONSULTANTS

TRANS MOUNTAIN EXPANSION PROJECT

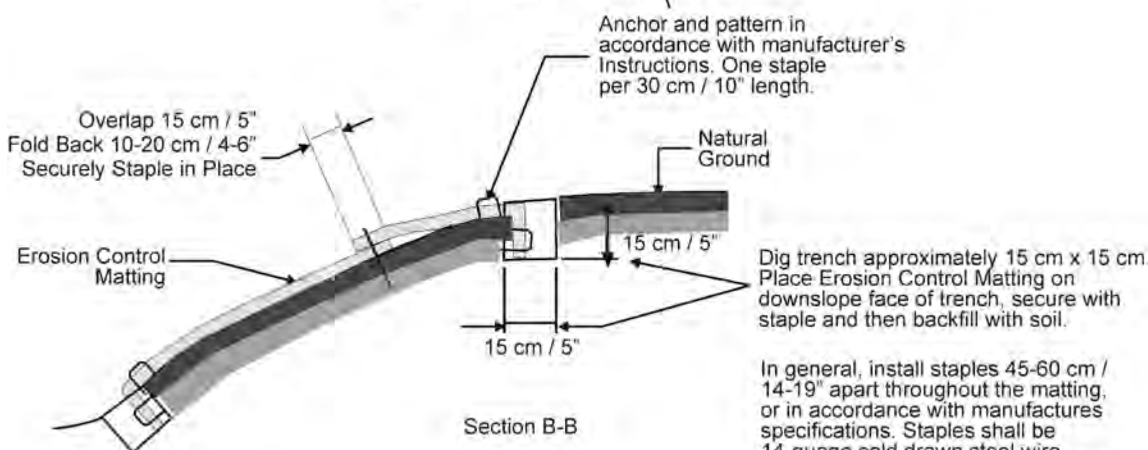
TRANSMOUNTAIN

COIR/STRAW LOG INSTALLATION

7894	August 2014	Drawing A-02

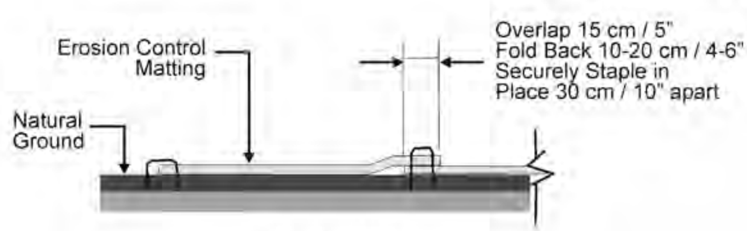


Plan View
(Not to Scale)



Section B-B

In general, install staples 45-60 cm / 14-19" apart throughout the matting, or in accordance with manufactures specifications. Staples shall be 14-guage cold drawn steel wire formed in a "U" shape not less than 30 cm / 10" length.

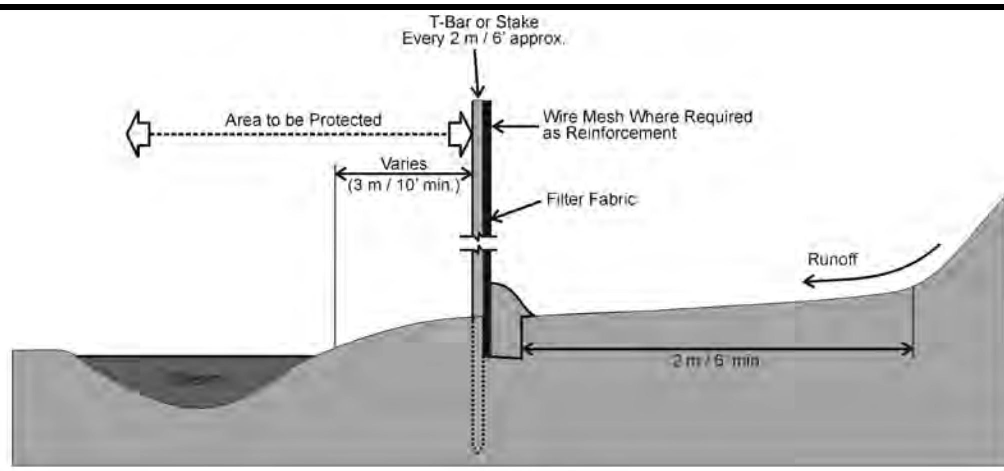


Section A-A

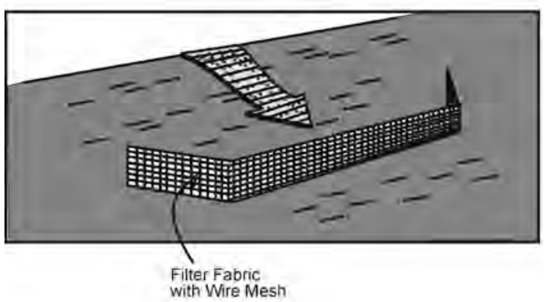
Note: When used at streambanks, erosion control matting should be secured to the bank using willow cuttings rather than staples.

Representation Only

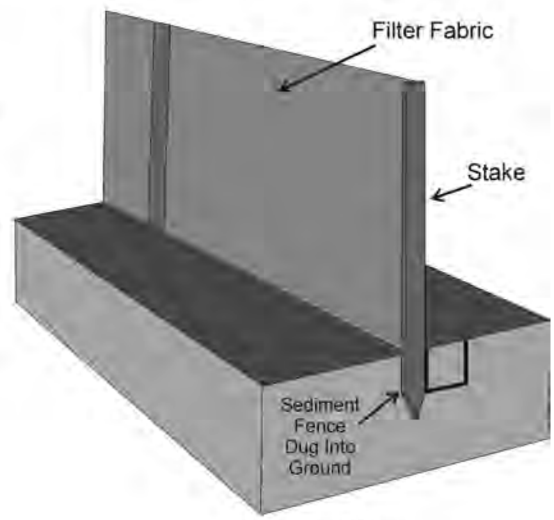
tera ENVIRONMENTAL CONSULTANTS	**TRANS MOUNTAIN EXPANSION PROJECT** TRANSMOUNTAIN		
	EROSION CONTROL MATTING/BLANKET		
	7894	August 2014	Drawing A-03



Profile View
(Not to Scale)



Oblique View
(Not to Scale)



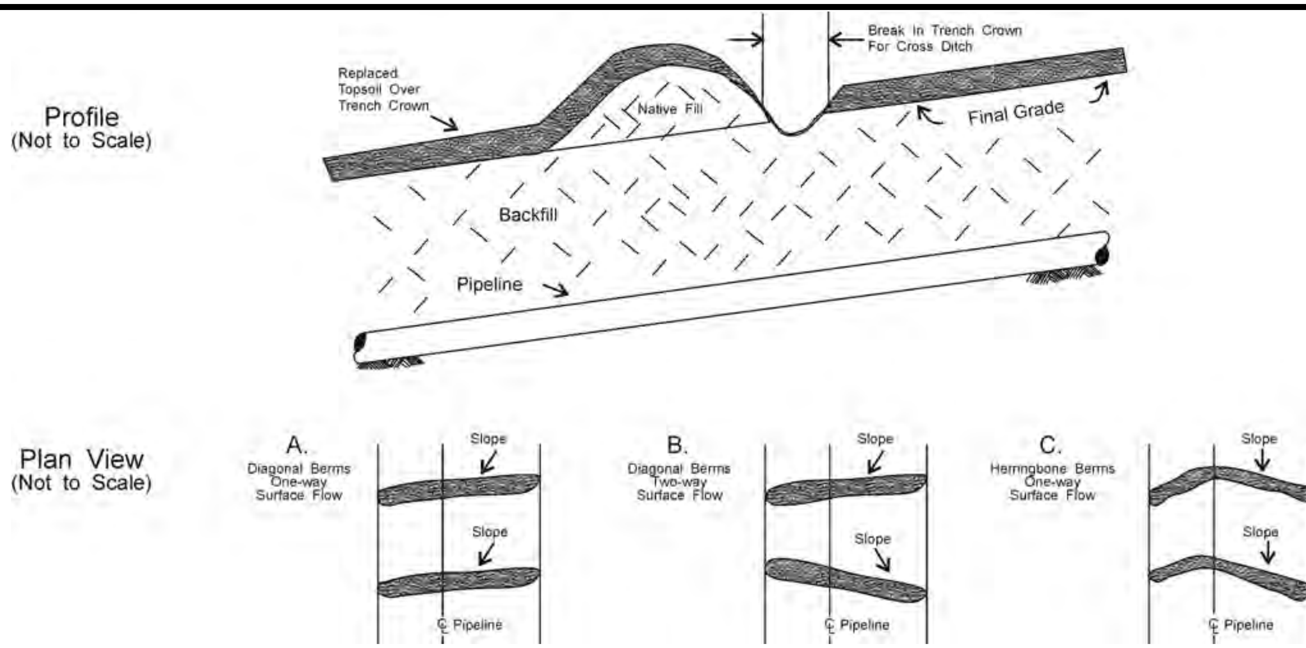
Oblique View
(Not to Scale)

Representation Only

Notes:

1. Watercourses that have moderate to high sensitivity of fish habitat and/or have steep approach slopes at the proposed crossings may need sediment fences during construction, as determined by Trans Mountain's Environmental Inspector(s).
2. Install sediment fences at the base of approach slopes to watercourses prior to clearing and grading using the method and materials above or other approved designs.
3. Ensure sediment fence is keyed into the substrate. Excavate a narrow trench, place the base of the sediment fence in the trench and place the fill back into the trench, securing the sediment fence in place.
4. Place sediment fences a minimum 2 m (6 feet), if feasible, from the toe of the slope in order to increase ponding volume.
5. Maintain sediment fences in place at the base of the approach slopes until revegetation of the construction right-of-way is complete.
6. In areas with frequent traffic, install two or more sediment fences in a staggered and overlapped configuration to allow vehicle passage without removal or opening of the sediment fence.
7. Ensure that sediment fences, if removed or damaged, are reinstalled or repaired prior to the end of the work day.
8. Install sediment fences, where warranted, to eliminate the flow of sediment from clean subsoil piles and disturbed areas into nearby wetlands.
9. Remove any sediment fences around wetlands that remain after the disturbed area is revegetated and the area is stable.

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN		
	SEDIMENT FENCE		
	7894	August 2014	Drawing A-04



Notes:

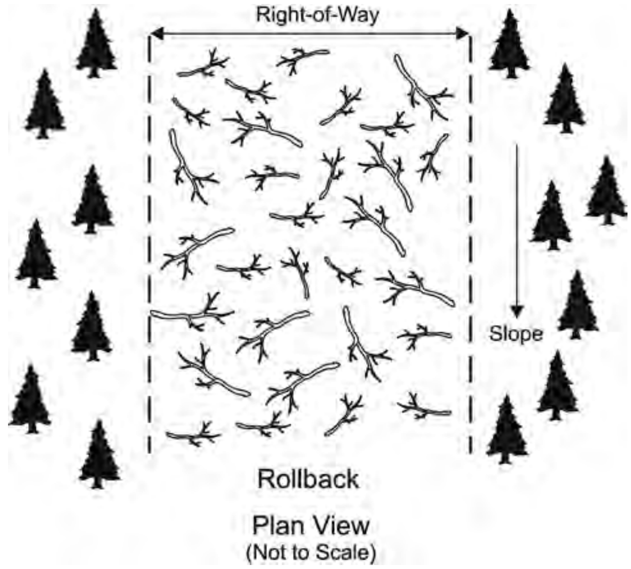
Representation Only

1. Install diversion berm and cross ditch on moderate and steep slopes on non-cultivated lands to divert surface water off the construction right-of-way. Install berms immediately downslope of trench breakers to collect seepage forced to the surface.
2. Skew berm across the construction right-of-way at downhill gradient of 5-10%.
3. Construct diversion berm of compacted native subsoils where extensive disturbance of the sod layer has occurred. Diversion berms should be constructed of timbers, imported logs or sandbags if disturbance of the sod layer is limited. Avoid use of organic material. Where native material is highly erodible, protect upslope of berm and base of cross ditch by burying a geotextile liner approximately 20 cm below the surface or armour upslope face of berm with earth-filled sand bags.
4. Typical diversion berm height and widths are approximately 0.75 m for summer construction and 1.0 m for winter construction. Trans Mountain shall inspect berms after heavy rains and the first spring following construction; replace or restore berms, if warranted.
5. Tie berms into existing berms on adjacent rights-of-way, where applicable.
6. Leave a break in trench crown immediately upslope of diagonal berm and cross ditch to allow passage of water across the construction right-of-way.
7. Use diagonal berms where direction of slope and surface water movement is oblique to construction right-of-way.
8. Use herringbone berm and cross ditch where direction of slope and surface water movement is parallel to construction right-of-way so runoff does not cross ditchline.
9. Determine location and direction of berm based on local topography and drainage patterns. Typical diversion berm spacing is indicated below.

Slope Gradient (° ;%)	Typical Spacing (m) Erosion Hazard*		
	High	Medium	Low
<7; <12	30-45	45-60	60 or more
7; 12	25	38	51
8; 14	22	33	44
9; 16	19	29	38
11; 19	16	24	32
14; 25	12	18	24
18; 33	9	14	18
27; 50	6	9	12

* High = fine sand and silts; medium = clays and coarse sands; low = rock or gravel.

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN		
	CROSS DITCHES AND DIVERSION BERMS		
	7894	August 2014	Drawing A-05



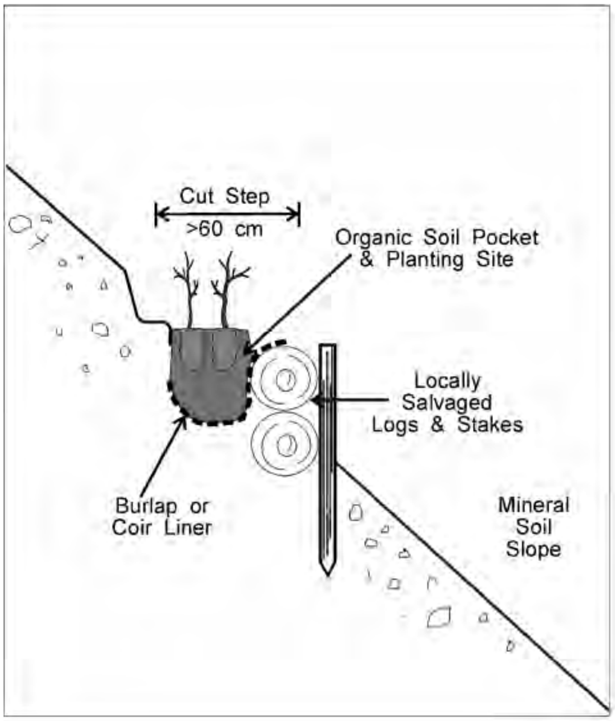
CRITERIA FOR IMPLEMENTATION

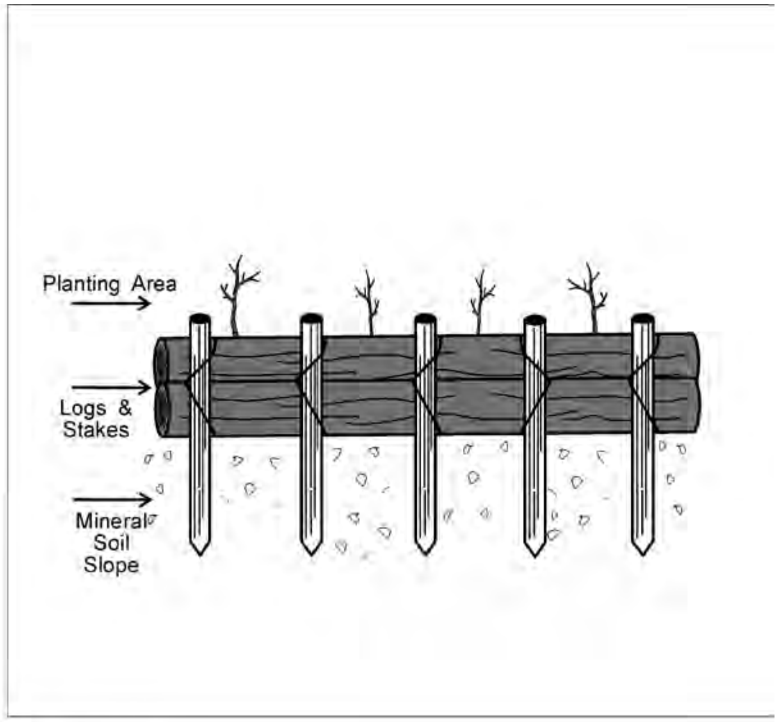
Slash and nonsalvageable timber may be used as rollback for erosion control where available and acceptable to the appropriate authority, as well as at strategic locations along the right-of-way for access control. Specific locations will be determined by Trans Mountain's Environmental Inspector(s) at the time of clearing. Do not use Douglas-fir, grand fir and spruce for rollback.

Notes:

1. Retain slash and nonsalvageable timber, where required, for use as rollback.
2. Larger diameter slash (*e.g.,* 10 cm in diameter or larger) should be used for rollback intended for riparian area access control, plant micro-sites establishment or as soil erosion control.
3. The amount of timber retained for use as rollback will be determined by Trans Mountain's Construction Supervisor(s) in consultation with Trans Mountain's Environmental Inspector(s) and the appropriate authority. Store material for rollback along the edges of the right-of-way.
4. Walk down rollback with a dozer on steep slopes, if safe to do so.
5. Spread slash and nonsalvageable timber evenly over the right-of-way where access is a concern. Do not walk down rollback.
6. Leave gaps in the rollback at obvious wildlife trails.

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN		
	ROLLBACK		
	7894	August 2014	Drawing A-06



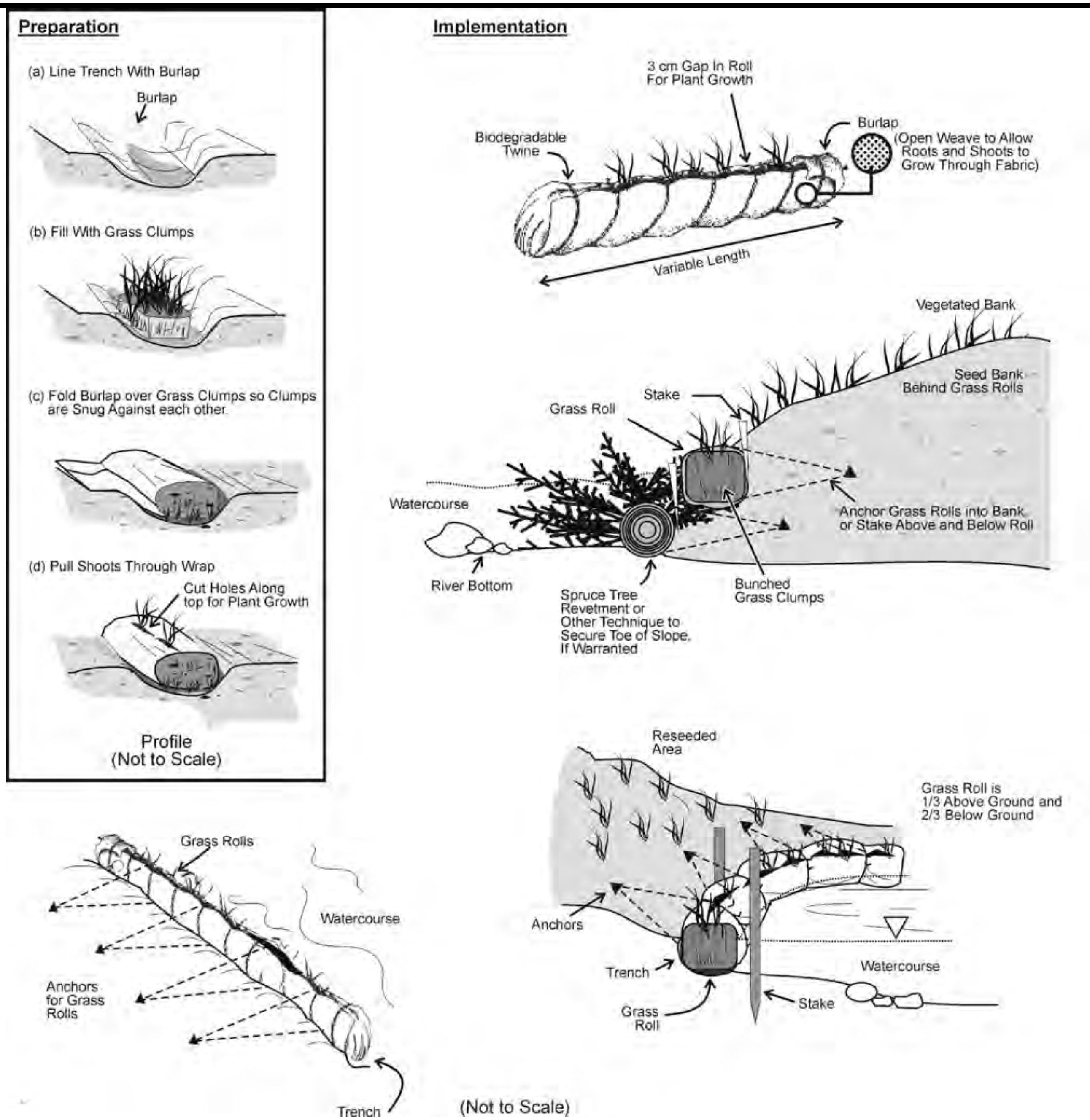


(Not to Scale)

At sites where erosion is a concern and where shrub plantings are required for reclamation, locally salvaged logs may be used to secure slopes and provide planting sites.

1. Sites where staked logs are to be installed will be selected by Trans Mountain's Environmental Inspector(s). When possible, sites will be selected prior to clearing and suitable local logs will be salvaged and stockpiled for later use.
2. Install staked logs during clean-up or reclamation phase. Where possible, use a backhoe to cut a step into the slope and push in a line of wood stakes. Note: take all necessary safety measures when working in proximity to pipeline.
3. With a qualified chainsaw operator, select and cut to fit suitable logs for horizontals. If necessary, the logs may be secured to the stakes using biodegradable rope.
4. Create a pocket behind the horizontally staked logs. The pocket can be used to install live shrub stakes and backfilled with topsoil/root zone material.
5. Where the planting pocket is required for rooted plugs or salvaged plantings, line the pocket with biodegradable fabric (burlap or coir). Bring the fabric over the top log. Fill the lined pocket with topsoil/root zone material or duff and tamp down. Install plants in pockets as directed by Trans Mountain's Environmental Inspector(s).

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN		
	STAKED LOGS/LOG CRIBWALL FOR EROSION CONTROL		
	7894	August 2014	Drawing A-07

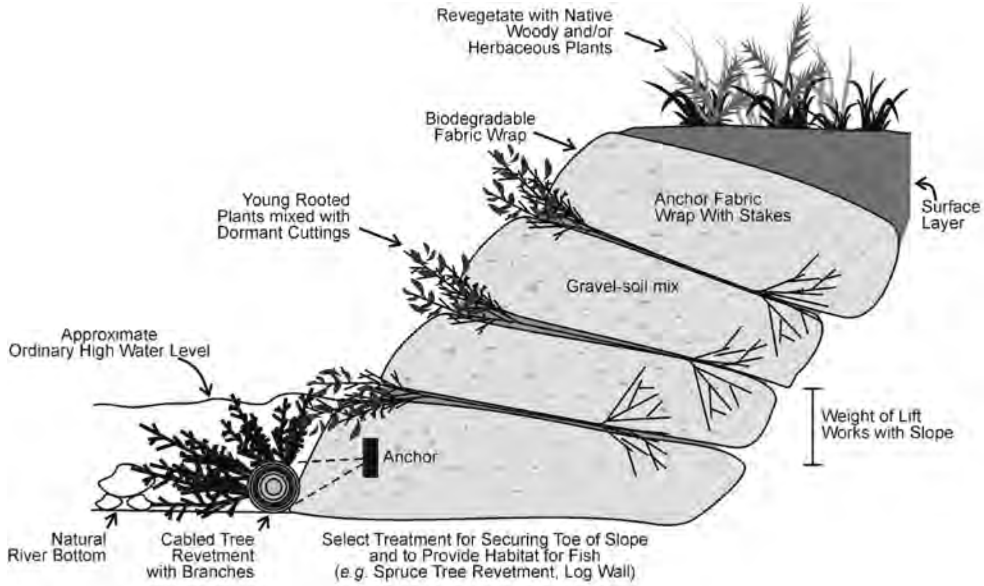


Notes:

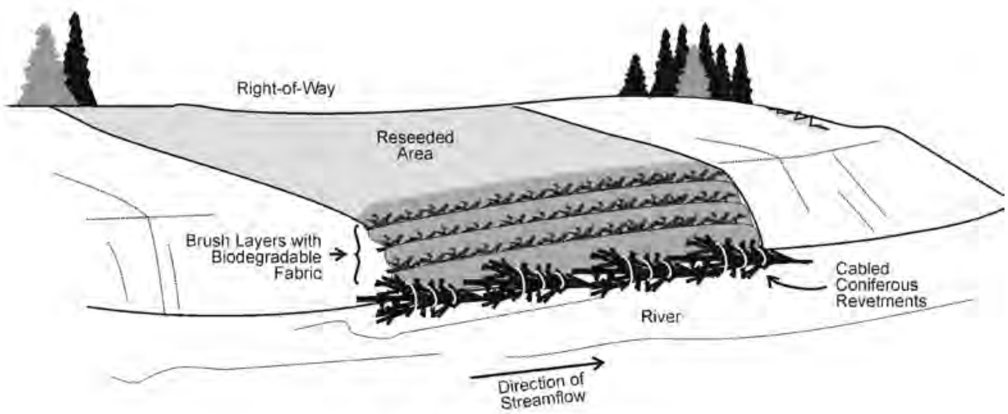
1. Proper placement and design is critical and qualified aquatics or reclamation resource specialists should be involved.
2. Excavate a shallow trench along the ordinary high level watermark parallel to the toe of the bank and line with burlap.
3. Install sod in the middle of the roll and wrap with burlap covers. Tie with twine and cut slits to expose sections of sod.
4. Stake or anchor firmly, ensuring up and downstream ends are secured to prevent washing out.

Adapted from CAPP *et al.* (2005)

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN	
	STREAMBANK PROTECTION – GRASS ROLL	
	7894	August 2014	Drawing A-08



Profile
(Not to Scale)



Oblique View
(Not to Scale)

Notes:

1. Proper placement and design is critical and qualified specialists should be involved.
2. Secure the toe of the slope with appropriate technique (coniferous tree revetments, log wall, riprap, etc.).
3. Begin layering at the bottom of slope with first hedge/brush layer situated at the approximate ordinary high water level or lower. Select plant species suitable for site conditions.
4. To establish banks, install layers of soil filled biodegradable fabric (coir or equivalent) wraps. To make each layer, roll out the fabric parallel with the bank with one-third into the bank and two-thirds out (streamside). Form a step of soil approximately 30-40 cm (1-1.3 feet) high over the bank side fabric. Fold the stream side fabric over the soil step and firm into place.
5. Arrange locally salvaged live shrubs with roots (alder, rose ssp., etc.) with live stake material (willow, poplar, red osier dogwood) over the fabric wrap at 20 stems per metre, incorporate topsoil and firm into place.
6. Continue building layers of fabric soil wraps and live shrubs until original bank height is reached.
7. Use only dormant live shrub material. Keep transplants moist and install as soon as feasible following salvage. A mixture of plant species can mimic adjacent undisturbed vegetation.

Adapted from CAPP *et al.* (2005)

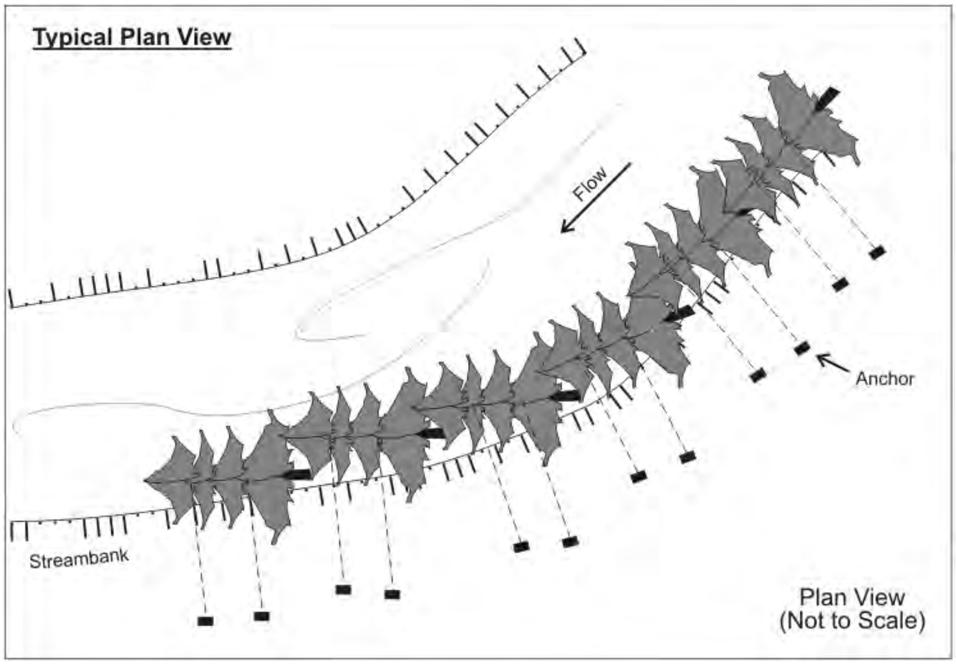
tera ENVIRONMENTAL CONSULTANTS

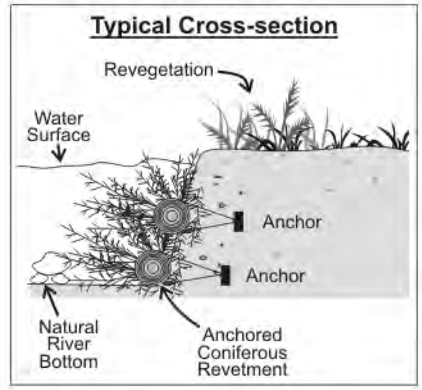
TRANS MOUNTAIN EXPANSION PROJECT

TRANSMOUNTAIN

STREAMBANK PROTECTION – HEDGE/BRUSH LAYERING

7894	August 2014	Drawing A-09



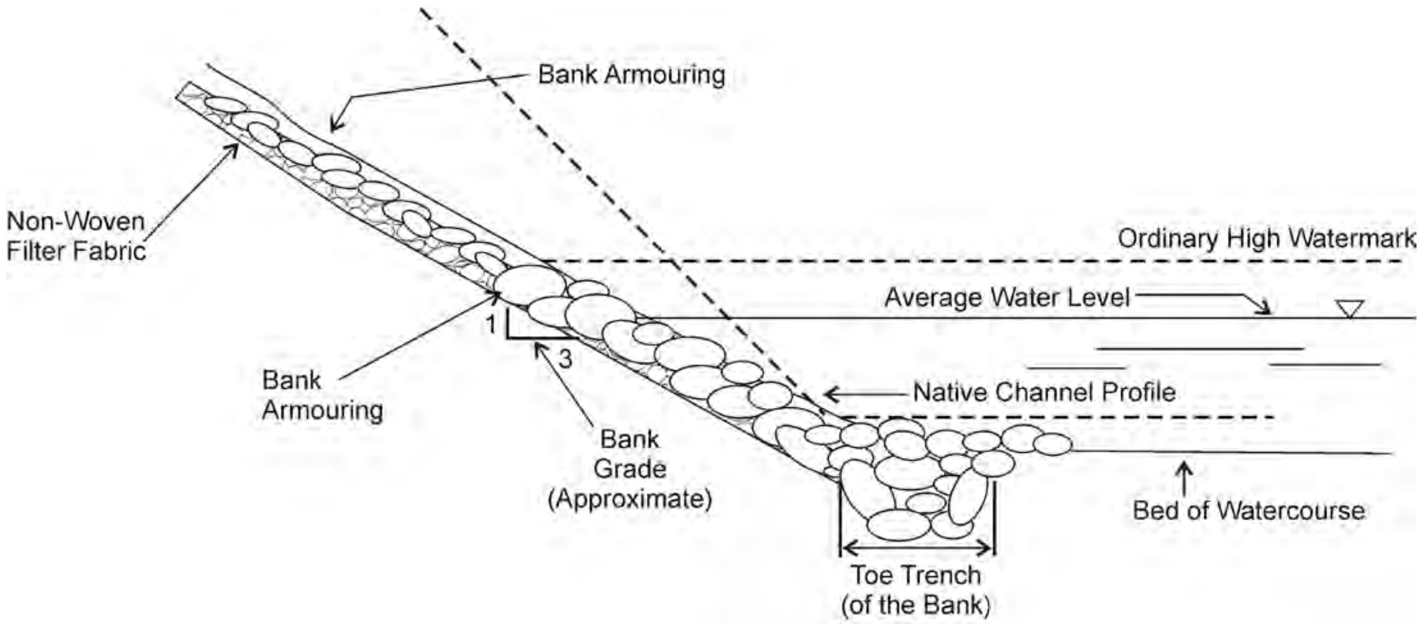


Notes:

1. Proper placement and design is critical and qualified specialists should be involved.
2. Select only good, sound, straight coniferous trees with adequate branches and a minimum length of 10 m.
3. Do not trim any branches and handle with care. Leave root ball intact if possible and transport the trees to the site with a minimum of handling to reduce damage to the branches. To the extent practical, remove soil material from the rootball before placing the tree instream. Place the trees lengthwise along or across the eroding bank to be protected beginning at the downstream end with the tips of the trees pointed in the downstream direction.
4. Begin assembly of the tree revetment at the downstream end and place tie back cable on the tree butt (largest end). Attach the cable to a suitable deadman or large armour rock with a drilled hole. Bury the anchor securely in the adjacent bank.
5. Place the butt of the next tree one-half the length of the previous tree or less upstream along the bank, so there is an overlap of the trees. If possible, cable the trees together in addition to cabling to an anchor buried in the bank.
6. Rock armour may be added along the toe of the slope, beneath the trees to reinforce the level of protection provided.
7. Maintenance, consisting of replacing severely damaged trees, will extend the life span.
8. Coniferous tree revetments also may be used as instream cover.

Adapted from CAPP *et al.* (2005)

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN		
	STREAMBANK PROTECTION – CONIFEROUS TREE REVETMENT		
	7894	August 2014	Drawing A-10



Profile
(Not to Scale)

Notes:

1. Proper placement and design is critical and qualified specialists (*i.e.*, hydrotechnical engineers) should be involved.
2. Remove all stumps, organic matter and work material, and grade/prepare banks to a maximum slope as directed by a geotechnical engineer (≥ 45º).
3. Construct toe trench to key in bottom of armour protection into the bed and bank of the watercourse bank or adopt thickened toe option.
4. Install non-woven filter fabric or gravel filter layer at the ordinary high water level and above where cobble or riprap bank armouring will be implemented.
5. Place cleaned cobble or riprap on slope to be protected such that a well-interlocked, smooth layer is produced.
6. Key in up and downstream ends of the armoured bank in a manner such that it will not be outflanked.
7. Cobble/riprap should extend 0.5 m (min) above design flood level. If design flood level is above the top of the bank, cobble/riprap should be placed to the top of the bank.
8. Cobble/riprap should be flush with bank adjacent to the right-of-way.
9. Cobble/riprap placement should not compromise bed elevation.

Adapted from CAPP *et al.* (2005).

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN	
	STREAMBANK PROTECTION – COBBLE OR RIPRAP ARMOURING	
7894	August 2014	Drawing A-11

CRITERIA FOR IMPLEMENTATION:

Management of weeds and non-native plant species is of paramount concern to Trans Mountain. The goal of non-native species management for the Trans Mountain Expansion Project is to prevent the introduction and spread of non-native plants to control them, to the extent feasible, along the existing TMPL system. Accurate records of weed infestations, control measures undertaken and the success of control measures will be maintained so that weed management and control plans can be modified as necessary to ensure an effective program of ongoing weed monitoring and control.

Following are measures to be implemented during the reclamation and post construction monitoring of the Trans Mountain Expansion Project.

1. All reclamation equipment shall arrive for project work in a clean condition to minimize the risk of weed introduction. Any equipment which arrives in a dirty condition will not be allowed to work until it has been cleaned off at a suitable location.
2. Equipment passing through areas identified as having a weed problem will be cleaned prior to continuing work on the right-of-way.
3. Equipment clean-off stations will be established by the main pipeline contractor under the direction of the Trans Mountain's Environmental Inspector(s). The preferred method of clean-off will be pressurized water, weather permitting.
4. Weed growth will be specifically monitored by personnel trained in weed identification walking the right-of-way and recording the density and species of all weeds observed. Weed monitoring will be conducted by teams in a timely manner so that weed control plans can be developed.
5. Monitoring will be conducted prior to, during and as per PCEM requirements.
6. Frequency of monitoring may be increased where: high potential for weeds of management concern was identified prior to, during or following construction. Weeds will generally be monitored in the spring when weed seedlings can be identified and subsequently controlled, if warranted. Additional weed monitoring in the late summer prior to setting seed will be conducted where high weed concerns exist or where spring surveys identify the need for follow-up.
7. Areas of poor plant cover will be reseeded and weed control measures applied as required.
8. The equipment cleaning station will be assessed in fall, late spring and mid-summer for at least three growing seasons following construction. Subsequent monitoring will be at least once per season, depending on weed issues identified during previous years. Weed species of concern that are identified at the sites will be treated. Manual removal of plants or chemical treatment will occur. If weeds are manually removed when in flower, the weed material will be disposed of in an approved land-fill facility.

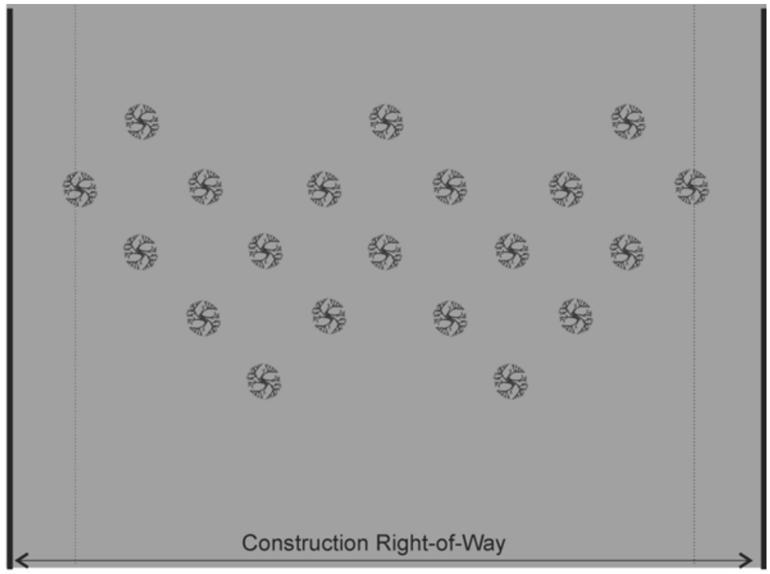
CRITERIA FOR IMPLEMENTATION

Live plant material salvage will generally be used for one of two reasons:

- salvage of shrubs with rootball; and
- salvage and transplant of rare plants.

All collection, salvage and transportation of live plant material will be conducted following approval by the appropriate regulatory authority.

Profile View
(Not to Scale)



Plan View
(Not to Scale)

Representation Only

SALVAGE OF SHRUBS WITH ROOTBALL

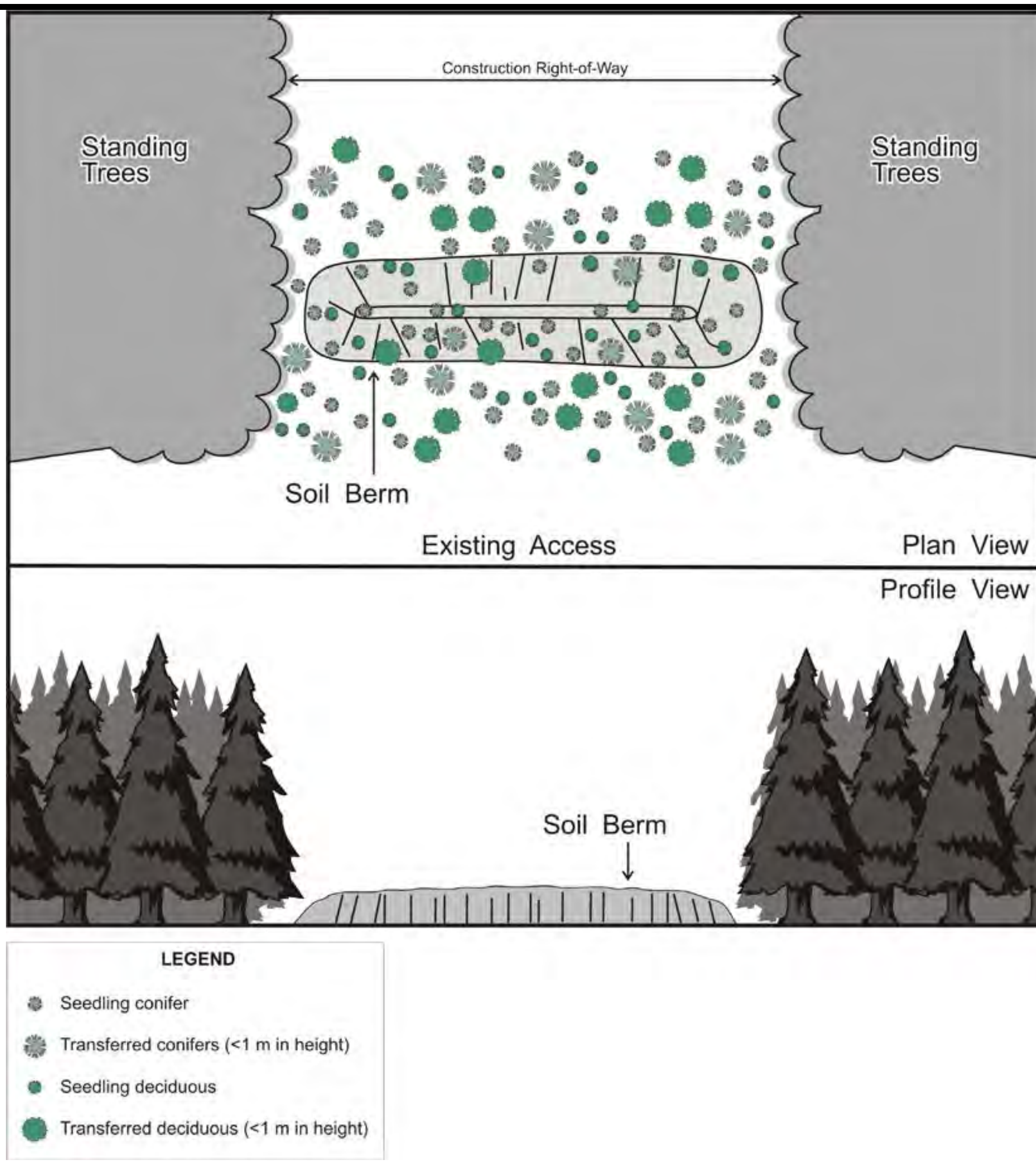
Shrubs for salvage will be selected by a qualified botanist/biologist and flagged prior to construction activities in that area.

1. To the extent possible, shrub salvage will be conducted during dormancy (senescence to bud break).
2. Shrub salvage will be timed to minimize period between salvage and restoration planting.
3. Prior to salvage, prune back shrub top growth as instructed by a qualified botanist/biologist. Salvage shrubs using a backhoe. Remove as large a rootball as feasible.
4. Cover the rootball of the salvaged plants with burlap or geotextile. Keep the covered rootball slightly moist (but not saturated) until the plants are replanted.

RARE PLANTS

1. Rare plants located along the construction right-of-way that require transplanting will be identified by a qualified botanist/biologist and will be flagged prior to clearing.
2. A qualified botanist/biologist will select a suitable receiving site for the plant(s). Ideally, the receiving site should be adjacent to the construction right-of-way, in an area having a similar microsite to where the rare plant(s) had been growing.
3. Delay salvaging activities until immediately prior to construction. Cut back or prune plants to be salvaged as recommended by Trans Mountain's Environmental Inspector(s) in consultation with a qualified botanist/biologist. Salvage designated plants using a shovel or backhoe. Remove as large a rootball as feasible. Cover the rootball of the salvaged plants with burlap or geotextile. Keep the covered rootball slightly moist (but not saturated) until the plants are replanted.
4. Replant the salvaged plant(s) in the receiving site as soon as feasible following salvage.

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN		
	LIVE PLANT SALVAGE AND TRANSPLANT		
	7894	August 2014	Drawing A-13

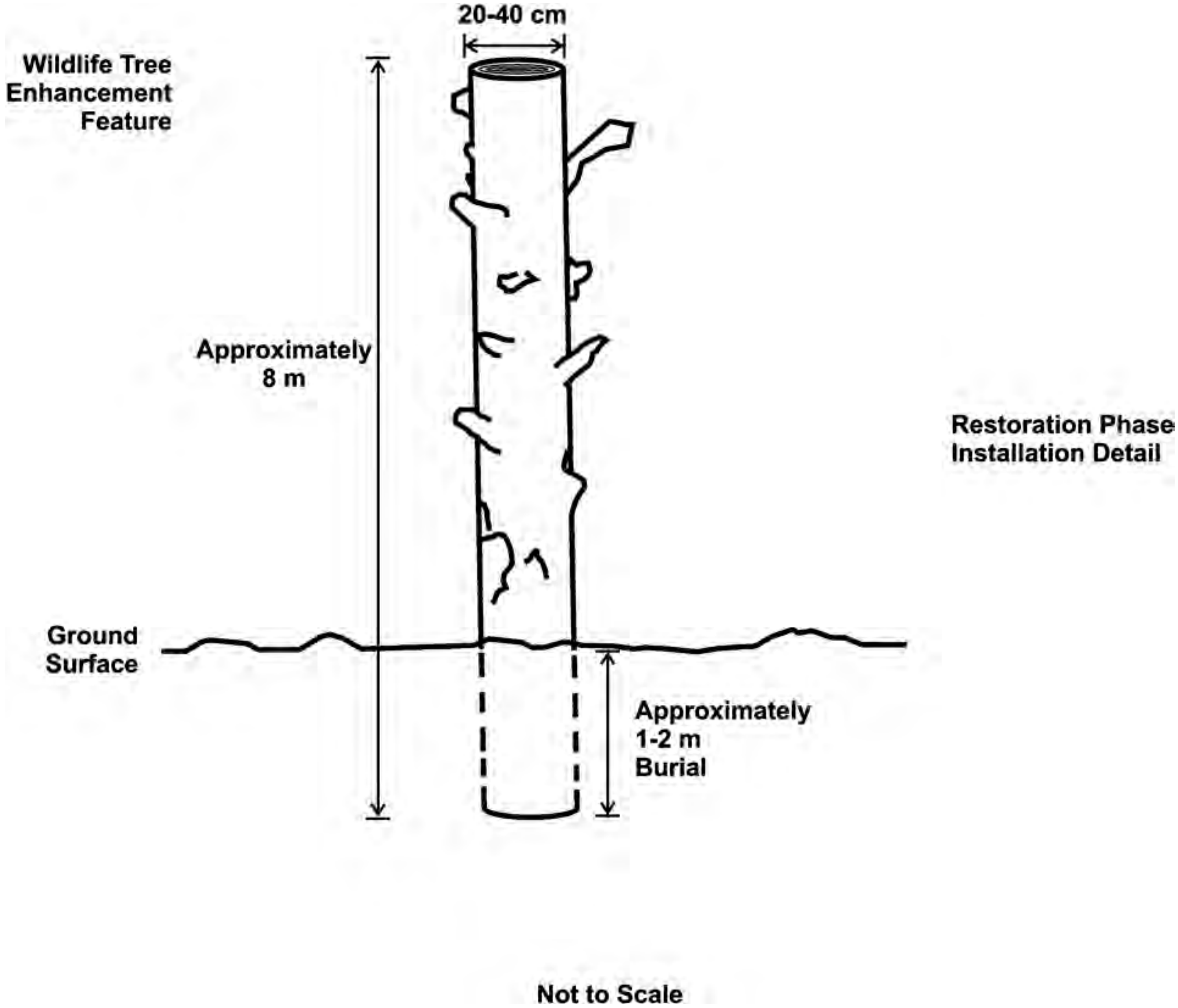


Representation Only

Notes:

1. Use subsoil to construct berm.
2. Locate berm across the entire width of the construction right-of-way.
3. Cover constructed berm with topsoil/root zone material.
4. Do not locate berm in drainages or depressions.
5. Ensure soil berm is of sufficient height to restrict line of sight down the construction right-of-way from existing access.
6. Plantings adjacent the berm on each side will be established no less than the width of the berm.
7. Plant suitable early and late seral plants together, adjacent, on the sides and top of the berm.
8. Transfer dormant, woody plant s <1 m in height from adjacent vegetated areas onto sides and adjacent areas of the berm.
9. Transfer dormant, woody plants at a density of 0.35 plant / m^2.
10. Plant seedling woody plants at a density of 1 plant / m^2.

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN	
	VEGETATION AND SOIL BERM - LINE-OF-SIGHT BREAK	
7894	August 2014	Drawing A-14



Notes:

1. Salvage and store sound deciduous or coniferous tree trunks at the edge of the cleared right-of-way for use as wildlife tree enhancement features.

2. Tree trunks should be delimbed, but can have 10-30 cm long branch remnants protruding from the trunk.

3. Approximate tree size: 20-40 cm diameter and 8 m long.

4. During restoration phase, the trunk will be “planted” to a depth of approximately 1-2 m in temporary workspace to serve as an artificial snag (wildlife tree).

5. Location of enhancement feature to be determined by Environmental Inspector.

tera ENVIRONMENTAL CONSULTANTS	TRANS MOUNTAIN EXPANSION PROJECT TRANSMOUNTAIN		
	TYPICAL WILDLIFE TREE ENHANCEMENT FEATURE		
	7894	August 2014	Drawing A-15