MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

ISLAND RAIL CORRIDOR CONDITION ASSESSMENT

SUMMARY REPORT

wsp

SIGNATURES

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DEFINITIONS

Abbreviation	Definition
AC	Alternative Current
AREMA	American Railway Engineering and Maintenance-of-Way Association
BIL	Base Insulation Level
Cumulative	Total sum amount of previous and current costings
DC	Direct Current
DMU	Diesel Maintenance Unit
E&N	Esquimalt and Nanaimo
EMC	Electromagnetic Compatibility
ICF	Island Corridor Foundation
IRC	Island Rail Corridor
LRT	Light Rail Transit
LRV	Light Rail Vehicle
kip	Kilopound
MoTI	Ministry of Transport and Infrastructure British Columbia
MTPA	Mega Tonnes per Annum
MUP	Multi-Use Path
OCS	Overhead Contact System
OCCS	Occupancy Control System
PMP	Pest Management Plan
Rail Defect	An identifiable imperfection of the internal structure or surface of the rail section
RDC	Rail Diesel Car
ROW	Right of Way
RTC	Rail Traffic Controller
SVI	Southern Railway of Vancouver Island
t/an	Tonnes per Annum
TPDS	Traction Power Distribution System
TPSS	Traction Power Supply system

1 EXECUTIVE SUMMARY

The British Columbia Ministry of Transportation and Infrastructure (MoTI) engaged WSP Canada Group Ltd. (WSP) to conduct a detailed evaluation of the base asset condition of the Island Rail Corridor on Vancouver Island. The assessment scope included the entire length of the rail corridor, Victoria to Courtney (Victoria subdivision), Parksville to Port Alberni (Port Alberni subdivision), Wellcox Spur and Wellcox Yard. The assessment of the corridor covered railway infrastructure, grade crossings, bridges and rockfall activity.

As part of the condition assessment MoTI also requested that WSP examine the cost to upgrade infrastructure to resume normal rail freight and passenger service. This includes the cost of upgrading the rail line to meet the standards needed to implement a Commuter Service with frequent train service between Victoria and Langford as well as Inter-City service between Victoria and Courtney. This information is contained in the separate Island Rail Corridor Commuter Rail Assessment Report.

The corridor is owned by the Island Rail Corridor Foundation (ICF) and operated by Southern Railway of Vancouver (SVI). SVI operates the freight corridor within 10 miles (16 km) of Nanaimo. No passenger service currently operates on the corridor.

The MoTI does not own the corridor but wants to understand its current condition and anticipated costs associated with various improvements. No commitments have been made to advance the improvements discussed in this report. If these improvements were to proceed, it has not been established if the MoTI or another party would deliver the work.

Corridor Condition

The corridor condition assessment builds upon previous studies, and in particular the 2009, Hatch Mott MacDonald, Evaluation of the E&N Rail Corridor: Baseline Report (HMM report) to reduce duplication and to focus on an updated assessment of the corridor. The HMM report concluded that the condition of the Island Rail Corridor was not in compliance with BC Safety Authority Railway Regulations and Rules respecting Track Safety. VIA passenger rail service was discontinued in 2011.

Between June and August 2019, site investigations were undertaken to assess the condition of the Island Rail Corridor. The inspections on the Victoria subdivision (including Wellcox spur) were completed by a hi-rail vehicle, while walking inspections were primarily employed on the Port Alberni Subdivision due to accessibility and safety concerns ranging from vegetation growth to downed trees along the subdivision. During the site investigation a Good/Fair/Poor rating was applied at each inspection element to grade the overall condition of each component of the railway.

Overall summarized results indicate that the railway corridor is in Poor to Fair condition, with the Victoria subdivision in a Poor to Fair condition and the Port Alberni in a Poor condition. The main issues contributing to the condition of the railway include but are not limited to:

- Uncontrolled vegetation within and adjacent to the rail corridor;
- Number of decayed ties exceed Transport Canadas "Rules Respecting Track Safety - 2012" regulations for Class 2 and Class 3 Track; and
- Single shoulder plates and angle joint bars are older technology and negatively impact track performance.

In summary, the road bed and track structure of the corridor is generally in a Poor to Fair condition. Bridges along the corridor range between Poor to Good depending on the age, location and type of bridge. At-grade crossings are in a Fair condition, however in some cases, crossings are overgrown with vegetation and/or require improved warning systems.

Improvements

Identified improvements are recommended based on a phased approach developed as part of this study. The phased approach entails three improvement phases:

- **Initial:** Re-establishes minimum freight and passenger service
- **Intermediate:** Upgrades higher freight loading for increased freight and passenger volumes and speeds
- **Ultimate:** Supports higher freight and passenger volumes

The phasing rational is based on carrying out improvement works on the railway to meet Technical Safety BC and Transport Canada maximum allowable operating speeds. In each phase, a rail traffic volume Use Case is assigned and provides a corresponding track class speed and load characteristics. Furthermore, breaking the corridor into six different segments allows flexibility for phased improvements to be implemented based on demand changes. Each phase is summarized below:

Initial Phase Improvement: includes costs to upgrade infrastructure to re-establish a minimum rail freight and passenger service along the rail corridor.

Initial Phase: Class 2 Track Standard Restoration	
Use Case:	• 2-4 passenger trains per day • 2-4 freight trains (10-20 car trains) per day
Track Characteristics:	Class 2 Track Standard (25 mph Freight, 30 mph passenger). *
Load Case:	Not suitable for sustained 286k lb car loading

*Speeds refer to maximum safe allowable operating speed as per Technical Safety BC and Transport Canada's regulations

Intermediate Phase Improvement: includes costs to upgrade infrastructure beyond the Initial Phase. This phase will support higher freight loading (286k lb rail car loading) which will accommodate increased freight and passenger volumes and increased speeds.

Intermediate Phase: Class 3 Track Standard Restoration and 286lb Upgrade	
Use Case:	• 4 passenger trains/d up to 8 trains/d • 4 freight trains (10-20 car trains)/d up to 4 million tonnes per annum (MTPA) or 133 cars/d total. • Once passenger/freight train volumes increase above Initial Phase Use Case or, • Higher operating speeds are desired. • Assumes improvements for Initial Phase have already been completed.
Track Characteristics:	Class 3 Track Standard (40 mph Freight, 60 mph passenger). *
Load Case:	Suitable for sustained 286k lb car loading

*Speeds refer to maximum safe allowable operating speed as per Technical Safety BC and Transport Canada's regulations

Ultimate Phase Improvement: includes costs to upgrade infrastructure beyond the Intermediate Phase. This phase will support higher freight and passenger volumes than the Intermediate Phase. This phase is optimal for the implementation of a commuter rail service. Further information on commuter rail is provided in the Island Rail Corridor Commuter Rail Assessment Report.

Ultimate Phase: Ballast Program	
Use Case:	• To be implemented during higher passenger volumes at or above 8 trains/d and • Higher freight volumes. If current volumes increase above 4MTPA or 133 cars/d. (Current freight volumes assumed to be 110,000t/yr or 4 cars/d). • Assumes improvements for Intermediate Phase have already been completed.
Track Characteristics:	Class 3 Track Standard (40 mph Freight, 60 mph passenger). *
Load Case:	Suitable for sustained 286k lb car loading

*Speeds refer to maximum safe allowable operating speed as per Technical Safety BC and Transport Canada's regulations

Cost Estimate

Conceptual cost estimates were developed in support of the three Improvement Phases evaluated: Initial, Intermediate, and Ultimate. These phased cost estimates are separated between Victoria Subdivision and Port Alberni Subdivision and further divided into six geographical segments.

Table 1: Cost for Combining Sequential Phases, shows WSP's 2020 Cost Estimate breakdown for the Improvement Phases combined sequentially (in 2020 dollars). The estimate provides costs to rehabilitate the corridor with phased approach. Further information on commuter rail costs for reinstatement is provided in the Island Rail Corridor Commuter Rail Assessment Report.

Table 1: Cost for Combining Sequential Phases

Costs for Combining Sequential Phases (includes MoTI contingencies)								
	Segment 1 (Victoria to Langford)	**Segment 2 (Langford to Duncan)**	**Segment 3 (Duncan to Nanaimo)**	**Segment 4 (Nanaimo to Parksville)**	**Segment 5 (Parksville to Courtenay)**	**Sub Total (Victoria Subdivision)**	**Sub Total (Port Alberni Subdivision, Segment 6)**	**Island Rail Corridor Total**
Initial Phase	$14,513,749	$47,748,423	$64,038,799	$32,611,106	$68,397,313	**$227,309,391**	$99,139,001	**$326,448,391**
Intermediate = Initial + Intermediate	$28,281,783	$81,035,713	$114,912,185	$60,376,966	$121,031,367	**$405,638,013**	$146,385,919	**$552,023,932**
Ultimate = Initial + Intermediate + Ultimate	$35,469,950	$114,569,344	$150,660,506	$82,979,158	$164,694,045	**$548,373,004**	$180,405,300	**$728,778,304**
Commuter Rail Service	$595,029,867	N/A						**$595,029,867**

2 BACKGROUND

The Southern Railway of Vancouver Island (SVI), is a short line railway in British Columbia, Canada. It consists of two subdivisions (track sections) illustrated in Figure 1: Island Rail Corridor Subdivision Map:

- Victoria Subdivision a 225 km (139.8 mi) track between Victoria and Courtenay, with a short spur from just south of Nanaimo to Wellcox Yard and barge ramp on the Nanaimo waterfront; and
- Port Alberni Subdivision a 64 km (39.7 mi) branch line from Parksville to Port Alberni.

The corridor is owned by the Island Corridor Foundation (ICF) and operated under contract by the Southern Railway of Vancouver Island (SVI). The barge ramp is owned by Seaspan Ferries Corporation (Seaspan). Both SVI and Seaspan are part of the Washington Group of Companies.

SVI currently connects with two main marine facilities in the Vancouver Lower Mainland. They connect to CPR via rail barge between Nanaimo and Tilbury (Lower Mainland) which has interchange capability with three other North American Class 1 railways (Canadian National Railway, Burlington Northern Santa Fe Railway and Union Pacific Rail Road). The second main rail marine connection is with the Annacis Rail Marine Terminal (ARMT) located on Annacis Island in Delta, BC and serviced by Southern Railway of BC (SRY). SRY, a sister company of SVI has interchange capability and with the three Class 1 railways previously mentioned plus Canadian Pacific Railway. VIA Rail passenger services along the Victoria subdivision ceased operation in 2011. Subsequent to the termination of the service, some railway assets were sold or leased to the public (stations, yard & property). No passenger trains currently run on the Island Rail Corridor.

Public interest has been expressed for the re-opening of Inter-City passenger rail and/or a Commuter Service. Tourist train company Rocky Mountaineer has expressed interest in offering a service on the island. The ICF has also expressed their interest in restoring passenger service and expanding freight movement on the island.

Figure 1: Island Rail Corridor Subdivision Map

Island Rail Corridor History

The Vancouver Island Railway was originally constructed by Sir Robert Dunsmuir (then premier of BC and owner of the then E&N Railway) in 1886 from Esquimalt to Nanaimo. Known then as the Esquimalt and Nanaimo Railway (E&N), the railway initially ran 115km (71.4miles) between Esquimalt and Nanaimo until the city of Victoria was incorporated in 1888 when the railway was extended to downtown Victoria. The original cost of constructing the railway was $626,000 per mile. Upon completion, passengers were able to board a train and travel from Victoria to Ladysmith for $1.25 taking just over 2 hours to complete the journey.

In 1905 Robert Dunsmuir's son sold the railway to the Canadian Pacific Railway (CPR). The railway was then extended north of Nanaimo to Parksville and Courtenay, and west to Port Alberni with 44 stations (8 on the Port Alberni Subdivision and 36 on the Victoria Subdivision).

In 1978 VIA took over the operation of passenger trains on the Victoria subdivision (passenger operations on the Port Alberni subdivision ceased in 1953), with ownership of the corridor still belonging to CPR. In 1999, shortline operator RailAmerica purchased the route from Nanaimo to Port Alberni, and leased the balance of the line from CPR. Despite the purchase by RailAmerica freight traffic continued to decline.

The Island Corridor Foundation (ICF) took over ownership of the corridor (Victoria and Port Alberni Subdivisions, Wellcox Spur and Wellcox Yard) in 2006 when it came to agreements with both CPR and RailAmerica to assume all rail assets in exchange for CPR and RailAmerica receiving federal tax credits. Southern Railway of Vancouver of Island (SVI) was appointed as railway service provider for the system by the ICF in 2006. In 2011, VIA passenger service stopped running, due to safety concerns with the track and bridge conditions. The SVI continued to operate a freight rail service until 2012. SVI continue to maintain the Victoria Subdivision and Wellcox Spur to operate a freight rail service within a 10 miles (16km) radius around Wellcox Yard in Nanaimo. SVI continues to monitor and inspect the Victoria Subdivision and Wellcox assets.

Island Corridor Foundation (ICF) Governance

The Island Rail Corridor is owned by the ICF. The ICF is a non-profit society with a twelve-person Board of Directors. Five directors represent the Regional Districts, five directors represent First Nations, and two are members at large. Membership is limited to local governments (five Regional Districts) and fourteen First Nation governments whose territories are wholly or partly within the geographic area of the corridor.

3 INTRODUCTION

The British Columbia Ministry of Transportation and Infrastructure (MoTI) engaged WSP Canada Group Ltd. (WSP) and their sub-consultants Bunt & Associates Transportation Planning and Engineering (crossing condition assessments) and Advicas Group Consultants Inc. (rockfall quantity surveying) to conduct a condition assessment, provide restoration improvements and all in costing for reinstatement of rail operations on the Island Rail Corridor between Victoria and Courtenay and Parksville to Port Alberni. The assessment of the corridor includes, railway infrastructure, grade crossings, bridges and rockfall activity. WSP was also engaged to assess the viability and cost of an Inter-City railway service between Victoria and Courtenay and a Commuter Service between Victoria and Langford.

As part of the Island Rail Corridor Condition Assessment, WSP has conducted field investigations with the support of Southern Railway of Vancouver Island (SVI) and the Island Corridor Foundation (ICF) and has drawn on both party's experience and knowledge base to understand the operations of the Island Rail Corridor. This report analyzes the current condition of the Victoria and Port Alberni subdivisions and provides remediation improvements to bring the corridor back into service.

The aim of this report is to expand on previous studies undertaken on the condition of the railway corridor and summarise findings and outcomes from the field investigations. The Island Rail Corridor Condition Assessment report and Island Rail Corridor Commuter Rail Assessment report provide remediation improvements to reinstate the corridor in a phased approach.

3.1 CURRENT CORRIDOR OPERATION STATUS

SVI operate a freight rail service on the Island Rail Corridor within a 10 mile (16km) radius of Wellcox Yard at Nanaimo Port. Freight is transported to/from downtown Nanaimo via Seaspan Ferries Corporation (Seaspan) largely from Annacis Island's ARMT, owned and operated by Southern Railway of BC (SRY – a sister company of SVI). SRY has an interchange in New Westminster with Canadian National Rail (CN), Canadian Pacific Rail (CPR) and Burlington North Santa Fe (BNSF) (connects with UN Pacific) which allows for movement of freight anywhere within North America.

SVI have approximately 1200 railcars travelling to/from Vancouver Island per year. Most rail cars travel loaded to Vancouver Island where they are transloaded into truck at Wellcox Yard for distribution or delivered to clients for off loading. The empty railcars are returned to the mainland by rail-barge over the Nanaimo marine facility. Cargo shipped between Wellcox Yard and Annacis Island largely includes, animal feed, forest products, aggregates, fertilizer and propane. All goods shipped (except propane) are transloaded to/from truck in Wellcox Yard. Approximately 250-300 cars of propane are shipped to/from the Island each year. Approximately seven cars shipped each week, during winter months and up to eight to ten cars during the winter. Propane is the only cargo transported by rail beyond Nanaimo.

SVI still provides a minimum level of maintenance through the entire Victoria Subdivision between Courtney and Victoria.

3.2 PREVIOUS STUDIES

This section focuses on reviewing previous studies completed around the condition of the Island Rail Corridor. The studies were reviewed to understand the previous condition of the Island Rail Corridor and identify focus areas and gaps in the outcomes.

The following studies were reviewed:

- Evaluation of the E&N Railway Corridor (2009-2010)
  - Foundation Report
  - Baseline Report Reference Report
  - Commuter Rail
  - Freight Analysis
  - Passenger Analysis
  - Tourist Train Analysis
  - Development Strategies for the Island Corridor Foundation
- Bridge Inspection and Assessment - E&N Railway (2012)
- Victoria Rail Rapid Transit Project (2011)
- Track and Geotechnical Condition Esquimalt & Nanaimo Railway Assessment Report (2003)

The following cost estimates were reviewed:

- ICF Budget Estimating Report
- Evaluation of the E&N Railway Corridor

	Evaluation of the E&N Railway Corridor
Report Authors	Hatch Mott MacDonald / IBI Group
Agency	BC Ministry of Transportation and Infrastructure
Date of Publication	2009-2010
General Content	The study focused on the viability of the Island Rail Corridor (E&N Corridor) on Vancouver Island. The report reviewed previous studies and worked with relevant stakeholders to determine business opportunities on the Island Rail Corridor. The report assessed the following viability of opportunities: • Freight Analysis • Intercity passenger Analysis • Tourist Excursion Train Analysis • Commuter Rail Analysis As part of the viability study, the condition of the corridor was also assessed to provide costing and the assessment of each business opportunity. The following was assessed as part of the condition assessment: • Track • Structures

	• Fencing • Communications • Signaling • Grade crossings • Barge ramp • Stations and facilities
Outcome of Study	The study recommended, given that there are a variety of business opportunities that could emerge in this corridor, that a corridor strategy be developed in partnership with the Island Corridor Foundation as a next step in this study. The objective of the corridor strategy would be to determine what conditions and economic circumstances need to be in place to preserve the corridor for future use and encourage and enhance the potential opportunities that are available.

	Bridge Inspection and Assessment - E&N Railway
Report Authors	Associated Engineering
Agency	BC Ministry of Transportation and Infrastructure
Date of Publication	2012
General Content	The purpose of the study was to assess the condition of 48 bridges on the Victoria Subdivision on the Island Rail Corridor (E&N Railway). No bridges were assessed on the Port Alberni subdivision. The bridges were assessed in order to determine the load carrying capacity of the bridges and to determine an estimated cost to restore or replace the bridges in support of 2021, 2031 & 2041 operations.
Outcome of Study	The study identified the condition of the 48 bridges on the Victoria Subdivision as well as the remediation and restoration cost to support the 2021, 2031 and 2041 operations.

	Victoria Rail Rapid Transit Project
Report Authors	BC Transit & CRD
Agency	BC Transit's Victoria Regional Rapid Transit
Date of Publication	2011
General Content	The study is concept study which outlines the need for a rapid transit corridor between the West Shore (region immediately west of Victoria) and Downtown Victoria. The study includes discussions on progress to date, alignment options, recommended rail technologies (including a cost benefit analysis) and associated costs.
Outcome of Study	The study identified an approved alignment and cost for an LRT system from West Shore to Downtown. The study also listed the benefits associated with the option and future steps.

Track and Geotechnical Condition Esquimalt & Nanaimo Railway Assessment Report	
Report Authors	Earth Tech
Agency	Vancouver Island Rail Company
Date of Publication	2003
General Content	The assessment study looked at the condition of the track structure and geotechnical condition of the Victoria subdivision but did not assess the Port Alberni subdivision. The study looked at the following components: • Rock stability • Slope Stability • Erosion • Culverts • Track ties • Ballast • Vegetation • Rails • Crossing
Outcome of Study	The study identified a number of concerns and difficulties within the Island Rail Corridor. The concerns included, rock stability, defective ties and vegetation within the ballast. The ties and vegetation concerns were noted along the subdivision, while the rock stability was noted between Langford and the Malahat pass.

3.3 FIRST NATIONS & STAKEHOLDERS

The Island Rail Corridor is owned by the ICF and is operated and maintained under contract by SVI. The corridor runs through 14 First Nations Territories and 14 municipalities who comprise of 5 regional districts. Consultation and Engagement was not conducted as part of this Condition Assessment, but further advancement of works on the Island Rail Corridor would require consultation. First Nations and Stakeholders identified at this stage include but are not limited to the lists below. For locations of the First Nations identified below please refer to Figure 2: First Nations & Community Map.

First Nations:

- Esquimalt Nation
- Songhees Nation
- Malahat Nation
- Cowichan Tribes
- Lake Cowichan First Nation
- Halalt First Nation
- Stz'uminus First Nation
- Penelakut Tribe
- Snunymuxw First Nation
- Snaw-Naw-As First Nation
- Qualicum First Nation
- Hupačasath First Nation
- Tseshaht First Nation
- K'ómoks First Nation

Stakeholders:

- Island Corridor Foundation
- Southern Railway of Vancouver Island
- Federal Government
- Provincial Government
- 5 Regional Districts
  - Capital Regional District
  - Cowichan Valley Regional District
  - Regional District of Nanaimo
  - Comox Valley Regional District
  - Alberni-Clayoquot Regional District
- 14 Municipalities
- General Public
- Local Industry
- Technical Safety BC

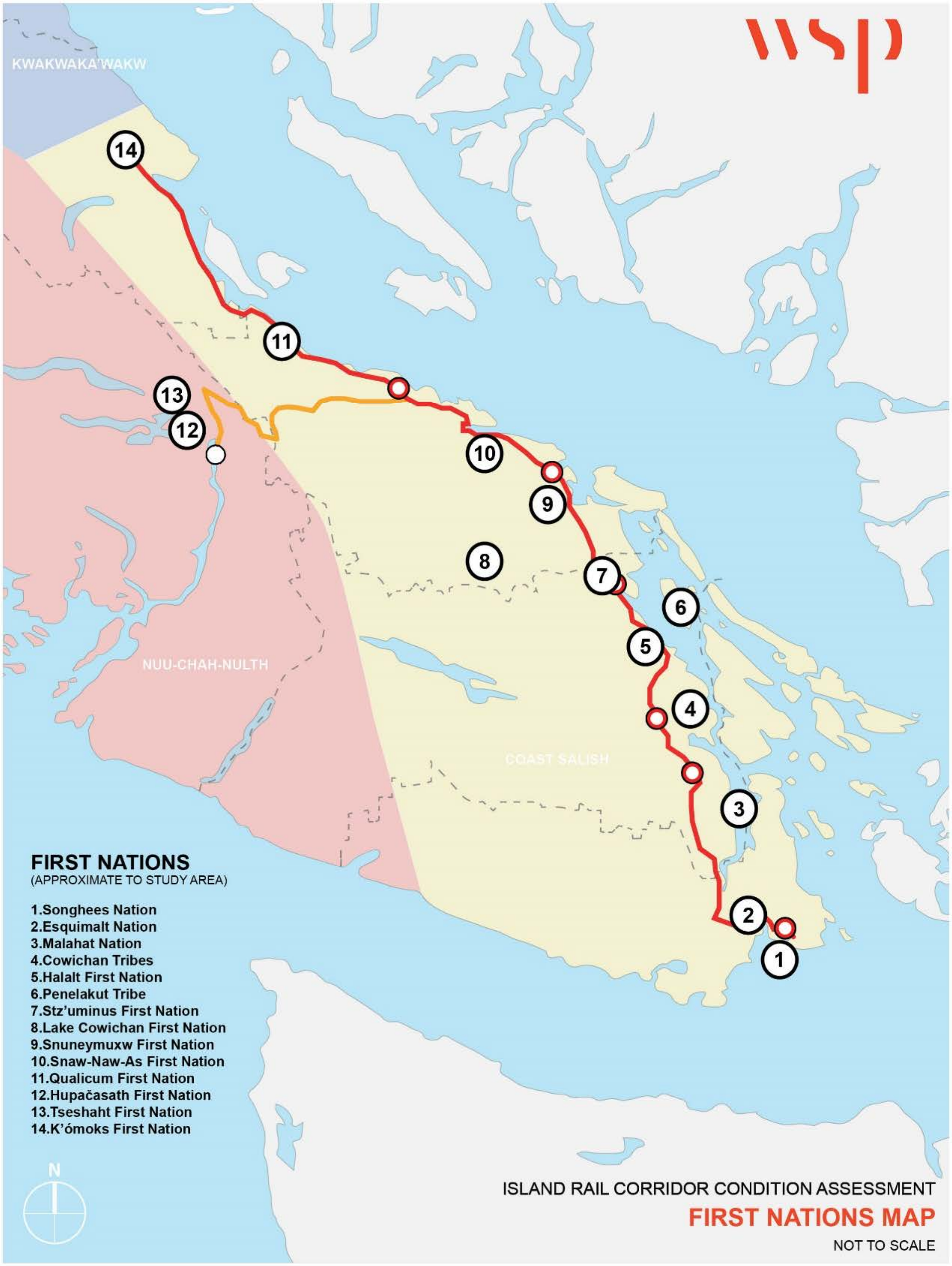


Figure 2: First Nations & Community Map

4 APPROACH AND METHODOLOGY

4.1 ASSESSMENT SCOPE AND CRITERIA

MoTI prescribed the following physical plant and the right of way to be assessed as part of this undertaking:

- Road bed
- Main Line Track Geometry Details
- Main Line Track Substructures (switches, ties and other track material)
- Bridges, Trestles, Tunnels, Culverts and Similar Structures
- Yard Tracks
- Industrial Sidings and Spurs (either owned or operated on)
- Communications Equipment
- Fencing and Similar Structures
- Barge Ramps
- Grade Crossings
- Grade Crossing Protection
- Pedestrian Crossings
- Wire Crossings
- Pipe Crossings
- Yard and Mainline Clearances

4.2 METHODOLOGY

After confirming the project parameters with the MoTI, WSP undertook the Island Rail Corridor Condition Assessment with the following methodology:

1. Compile and Review Existing and Provided Material
2. Workshops and Meetings
3. Conduct Gap Analysis
4. Perform Site Investigation
5. Analyze Investigation Results
6. Develop Improvements

Step 1: Compile and Review Existing Information

An assessment of previous studies, provided by MoTI and the ICF, was undertaken to understand areas, conditions and outcomes of previous investigations. Refer to Section 3.2 Previous Studies, for details on previous studies assessed.

Step 2: Workshops & Meetings

A workshop was undertaken on 15th July 2019, with MoTI, SVI and the ICF to confirm assessment items, identify missing studies and initial coordination for field investigations. A consultation meeting was also held with Technical Safety BC on the 18th of August 2019, which confirmed the Island Rail Corridor was a provincially regulated railway and Transport Canada's federal Grade Crossing Regulations and Standards would be used for grade crossing condition assessments.

Step 3: Conduct Gap Analysis

A gap analysis was undertaken to determine missing or incomplete areas from previous studies that was required further investigation.

Step 4: Perform Site Investigation

Site investigations were completed between June and August 2019. The project team leads led the site investigation in assessing the initial condition of the corridor. The teams included, bridges and structures, track, crossings and rockfall.

Step 5: Analyze Investigation Results (By Segments)

Upon completion of the site investigations, the corridor condition was analysed in further detail. To aid in analysis, the corridor was broken down into six (6) segments, as shown in the below Figure 3: Segment Map. The segments are defined as:

- Segment 1: Victoria to Langford – mile 0.00 to 10.0
- Segment 2: Langford to Duncan – mile 10.0 to 39.7
- Segment 3: Duncan to Nanaimo – mile 39.7 to 72.5
- Segment 4: Nanaimo to Parksville – mile 72.5 to 95.2
- Segment 5: Parksville to Courtenay – mile 95.2 to 139.7
- Segment 6: Port Alberni subdivision – mile 0.00 to 39.4

During the Analyze Investigation stage, the viability of an Inter-City railway service between Victoria and Courtenay and Commuter Service between Victoria and Langford were assessed. For further details on Inter-City railway service between Victoria and Courtenay and Commuter Service between Victoria and Langford refer to the Island Rail Corridor Commuter Rail Assessment report.

Step 6: Develop Improvements

Once the Analyze Investigation stage was complete, potential improvement options and associated cost estimates were developed for the rehabilitation of the Island Rail Corridor.

Figure 3: Segment Map

5 CORRIDOR CONDITION

During the Site Investigation and Analysis phases of this project, both the Victoria and Port Alberni subdivisions (including Wellcox spur) were inspected by hi-rail and walking between June and August 2019. Some sections of the Port Alberni subdivision were not accessible by hi-rail or by foot due to vegetation growth and downed trees along the subdivision.

Representatives from SVI, accompanied WSP for the inspections of the track and drainage, bridges and rockfall inspections, both of whom shared their knowledge of the corridor with WSP. In addition to WSP's visual site assessments, this section of the report draws from their experience with the maintenance and operations of the corridor.

The below sections of the report show the observations noted from the site investigations and discussion with SVI and the review of the 2009, Hatch Mott MacDonald, Evaluation of the E&N Railway Corridor: Baseline Report (HMM report). The HMM report was an accepted report layout by MoTI; for purposes of presenting updated conditions from the 2009 report, a similar format is presented in the following sections.

During the site investigation a Good, Fair, Poor rating was applied at each inspection to grade the overall condition of the road bed. An example and definition of the ratings can be found in Section 5.1: Road bed.

5.1 ROAD BED

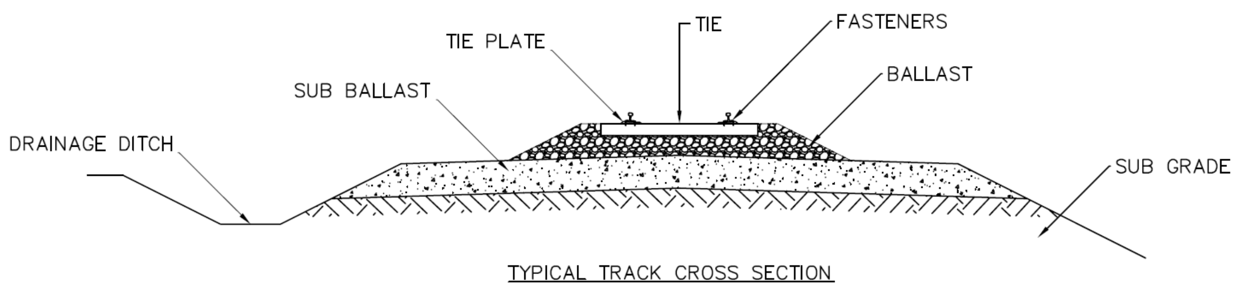


Figure 4: Typical Railway Track Cross Section

Figure 4: Typical Railway Track Cross Section shows a typical cross section of a single line railway, similar to what is found on the Island Rail Corridor. The track sits on top of the 'Road Bed', or the ballast, sub ballast and sub grade. If the ballast or road bed is fouled by vegetation or mud, possibly through irregular maintenance, impacts to the quality of the track and its performance can occur. Maintenance of the track drainage and vegetation clearing is integral to the safety of the railway.

5.1.1 *DRAINAGE & CULVERTS*

The drainage was observed during a week-long site investigation in which it rained most days. This provided an opportunity to observe the drainage performance. During this investigation, there was no significant water ponding noted. As stated in the 2009, HMM report, the drainage was deemed to be in a Fair condition. The 2019 site inspections showed little change to this assessment. Vegetation within the ballast section which prevents free flowing drainage was noted as being the most common observation.

Culverts were observed to be functioning; allowing the passage of water from either side of the track and preventing ponding. Overall, the system was observed to have a fair draining condition and function for its intended purpose. Vegetation and sediment typically accumulate in culverts which can sometimes fully block them. No fully blocked culverts were observed but they could still exist. Rail corridors can still have positive drainage with plugged culverts due to redundancy in their drainage design and porous road bed structure. Although the culverts are in fair condition, vegetation was noted to be partially blocking culvert inlets and outlets. It does not appear that an extensive culvert cleaning program has been performed along the rail corridor. The HMM report notes that there is a speed restriction of the culvert at mile 114.95. No repairs were observed at this location. This section of track is not currently in service.

Figure 5: Typical Drainage Ditch Observed at Langford. shows a typical example of the drainage along the Island Rail Corridor. Vegetation within ballast and drainage ditch but still deemed to be in fair condition allowing the water to flow away from the track maintaining it's integrity.

Figure 5: Typical Drainage Ditch Observed at Langford.

5.1.2 WASHOUTS

During the site investigation two repaired washouts were observed. The first was a washout of the track at approximately mile 37 of the Victoria Subdivision. SVI had repaired the washout by placing armouring material at the base of the road bed and re-establishing the track. Washout repairs typically require the dumping of armouring material into the waterway to re-establish and protect the track bed. On operating railways this is done as quick as possible (and mandated by federal regulators in some cases) to re-open the track for the movement of goods and passengers and to generate revenue. Without being present during the placement of the armouring material WSP cannot confirm the slope's integrity. However, from visual inspection it appeared to be suitable for rail loading and to mitigate washouts. Given the proximity, angle of approach and history of the waterway, this site should be monitored to confirm the repair is performing. SVI indicated they have not observed issues at this site since the repair was made. Refer to Figure 6: Washout at mile 37 – Victoria Subdivision.

Figure 6: Washout at mile 37 – Victoria Subdivision

The second repaired washout was observed at approximately mile 84.4 of the Victoria Subdivision which was created by the washout of Rumming road located directly above the rail corridor. The slope from the rail up to the road was repaired. A new 900mm culvert was installed under the rail track to convey drainage from the above road safely under and away from the track. Refer to Figure 7: Washout at mile 84.4 - Victoria Subdivision.

Figure 7: Washout at mile 84.4 - Victoria Subdivision

5.1.3 SLOPE FAILURE

A slope failure was observed at approximately mile 22 of the Victoria Subdivision just south of Shawnigan Lake. SVI indicated that the downside slope failure was not caused naturally but by a third-party excavation of the toe of the slope approximately 100 feet below the rail line. Due to this slope failure the track was impassable at this location. WSP did not confirm the cause of the slope failure as repair of the slope failure is in the process of being addressed with the parties involved. Refer to Figure 8: Slope Failure at mile 22.

Figure 8: Slope Failure at mile 22

5.1.4 VEGETATION

The Track Safety Rules state that vegetation on railway property which is on or immediately adjacent to the road bed must be controlled so it does not:

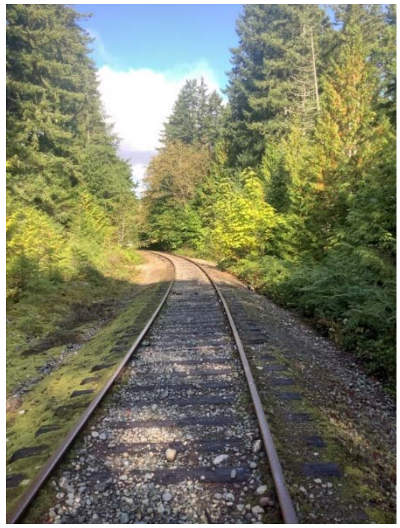
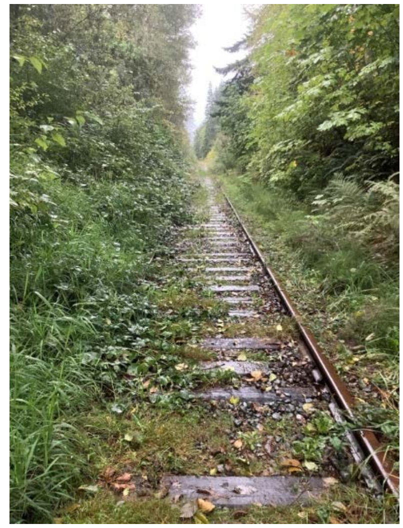
- Become a fire hazard to track carrying structures;
- Obstruct visibility of railway signs and signals;
- Interfere with railway employees preforming duties;
- Prevent proper functioning of signals and communications; or
- Prevent railway employees from visually inspecting moving trains.

Therefore, regular maintenance and removal of vegetation is key to maintaining a safe railway.

The HMM report stated since 2006, SVI has a Pest Management Plan (PMP) in place and is using chemical herbicides (Vantage) and brush cutting to maintain the corridor. The report mentioned that the herbicide does not kill the roots of the vegetation, so its effectiveness is determined by the timing and frequency of the program.

During WSP's site investigations during the summer of 2019, SVI confirmed they have a brush cutting program, and clarified that they use glyphosate, an active chemical in Vantage to control vegetation. SVI added that it does kill the roots of much of the vegetation, however is not very effective at controlling cedar and fir that grows along the corridor.

Table 2: Vegetation Condition Example Photos

Vegetation Condition Example Photos		
		
Typical "Good" Vegetation Condition	Typical "Fair" Vegetation Condition	Typical "Poor" Vegetation Condition

The current condition, of vegetation observed from the site investigation, is similar to the conditions noted in the 2009 HMM report. There is still vegetation within the ballast and trees obstructing the sightlines along both subdivisions. Victoria subdivision is in better condition than the Port Alberni subdivision, as the PMP is not in place on the Port Alberni subdivision. Above, Table 2: Vegetation Condition Example Photos shows a typical example of Good, Fair and Poor vegetation conditions along the corridor. The overall condition of the vegetation along the railway corridor ranges between Fair and Poor.

Below, Table 3: Vegetation Condition by Segment shows the average condition of the vegetation broken down by segment. For further detail on the condition of the vegetation and inspection reports, see Appendix A: Track Condition Assessment Report.

Table 3: Vegetation Condition by Segment

Segment	Vegetation Condition
Segment 1: Victoria to Langford	Fair
Segment 2: Langford to Duncan	Fair - Poor
Segment 3: Duncan to Nanaimo	Fair
Segment 4: Nanaimo to Parksville	Fair
Segment 5: Parksville to Courtenay	Fair - Poor
Segment 6: Parksville to Port Alberni	Poor
Wellcox Yard	Good

5.2 TRACK GEOMETRY

The track geometry encompasses track alignment of the railway, comprising of tangents (straight sections), spirals, super elevation, curves, track surface (track smoothness), level and cross-level, track grade and vertical curves. To maintain the track geometry, regular monitoring conducted by a track testing vehicle is used. The track testing vehicles measure the horizontal and vertical alignment, super elevation (track angle through curves), track surface, track gauge (distance between rails) and notes any potential issues.

The 2009, HMM report states that SVI employ Holland TrackStars run track testing vehicles to measure the track geometry and tie conditions annually. While conducting site investigations in August 2019, it was observed that SVI continue to employ Holland TrackStars to measure the track geometry and track surface. SVI indicated that they test track within the 10 mile radius of Nanaimo more frequently than once per year since it is currently in service. The remainder of the Victoria subdivision is tested annually using the Holland TrackStar. SVI does not run the track geometry vehicle on the Port Alberni Subdivision. Please refer to Figure 9: Holland TrackStar Vehicle observed in Nanaimo.

Figure 9: Holland TrackStar Vehicle observed in Nanaimo

During the site inspections, it was noted that the general track surface was observed to be in a fair condition across the Island Rail Corridor. No appreciable twisting or warping of the track was detected. The track geometry was observed to be in fair condition. While class of track is restricted in some sections, for instance through the Malahat summit, or through the Capital Regional District (CRD), the condition of the Victoria subdivision is found to be in acceptable Fair condition. Track geometry has more restrictive design guidelines than road geometry; it takes longer for a train to ‘turn’ than an automobile. Where tighter geometry is required to navigate around natural features, speeds will typically have to be reduced and the track will be super-elevated in curves to compensate for such conditions. For further detail on the condition of the track geometry and inspection reports, see Appendix A: Track Condition Assessment Report.

5.3 TRACK STRUCTURE

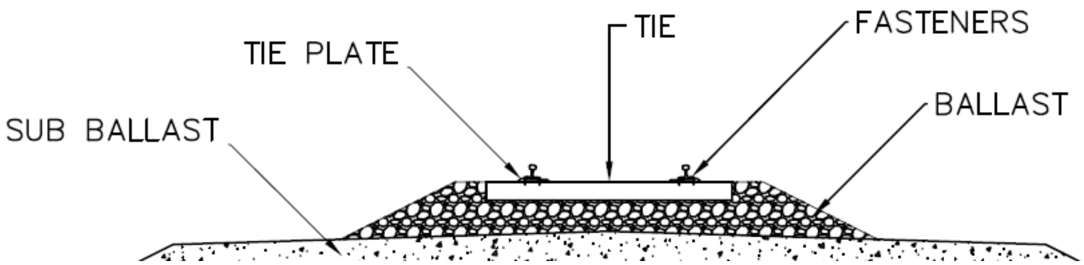


Figure 10: Typical Track Structure

The track structure consists of the rails, fasteners, railroad ties and ballast, plus the underlying subgrade. It enables trains to move by providing a dependable surface for their wheels to roll upon. As shown in Figure 10, is a section of a typical single-track railway similar to what can be found on the Island Rail Corridor. Track is a combination of elements consisting of two rails fastened to timber ties by a rail spike/tie plate fastening system, all supported in a course granular encasement placed, on a free draining graded granular surface overlaying a structural soil. The rail, tie and fastening system is similar to that shown below in Figure 11: Rail Spike Fastening System. The Fastening system is made up of a rail spike, tie plates and anchors.

Figure 11: Rail Spike Fastening System

5.3.1 *TIES*

The purpose of rail ties is to maintain the gauge between the rails and to distribute the loads from the trains down through the ballast and into the underlaying structural soils. For the most part, the Island Rail Corridor use timber ties sourced in British Columbia.

Over time timber ties deteriorate and may loose gauge. This leads to the need to replace the track ties or to lower track speeds in order to maintain a safe railway operation. Transport Canada Safety Regulations (2012) state:

- Trackage specifications employing a track tie spacing of 22 inches can expect to have 21 track ties per 39-foot length of track
- For Class 2 Track, each 39 foot segment of rail requires 8 non-defective ties (approximately 40% of segment), with one non-defective tie located within 24 inches of a rail joint.

- For Class 3 Track, each 39 foot segment of rail requires 10 non-defective ties (approximately 50% of segment), with one non-defective tie located within 18 inches of a rail joint.

A defective tie is defined as:

- broken through;
- split or otherwise impaired to the extent the crossties will allow the ballast or even vegetation to work through, or will not hold spikes or rail fasteners;
- so deteriorated that the tie plate or base of rail can move laterally more than 1/2 inch relative to the crossties; or
- cut by the tie plate through more than 40 percent of a tie's thickness.

Table 4: Tie Condition Photos

Tie Condition Example Photos		
		
Typical "Good" Tie Condition	**Typical "Fair" Tie Condition**	**Typical "Poor" Tie Condition**

As stated in the 2009, HMM report, groups of decayed ties and decayed ties under rail joints were deemed to be non-compliant with rail safety regulations and that an estimated 260,000 ties will reach their service life within the next 15-20 years (now 5-10 years away).

During the 2019 inspection, an estimated 180,000 ties (45% of all ties) across both subdivisions are currently considered defective. The overall conditions of the ties were deemed to be in Poor condition. However, it was noted in the Nanaimo rail service area that ties have been replaced and the track is operational.

Below, Table 5: Tie Percent by Segment, shows the average percent defective ties per segment. For further detail on the condition of the ties and associated inspection reports, see Appendix A: Track Condition Assessment Report

Table 5: Tie Percent by Segment

Segment	Average percent of defective ties
Segment 1: Victoria to Langford	50%
Segment 2: Langford to Duncan	47%
Segment 3: Duncan to Nanaimo	51%
Segment4: Nanaimo to Parksville	53%
Segment 4: Parksville to Courtenay	58%
Segment 5: Parksville to Port Alberni	34%
Wellcox Yard	25%

5.3.2 TIE PLATES

As shown above in Figure 11: Rail Spike Fastening System, tie plates are part of the rail spike fastening system and separate the rail from the ties. Tie plates serve as a bearing plate between the base of the rail and surface of the track tie. They serve as a mechanism to spread the train loads through the rail onto the tie. Tie plates are generally held in place using rail spikes. The plates are typically either single shoulder plates or double shoulder, as shown in Figure 12: Types of Tie Plates. Shoulders help hold the rail in place and increase the life of the rail spikes by reducing the shear load against the spike and reduces the rotational torque applied to the spike from the rail, thus increasing the life of the track tie. Larger dimensioned plates, while more costly, can improve load distribution to the tie and tie longevity.

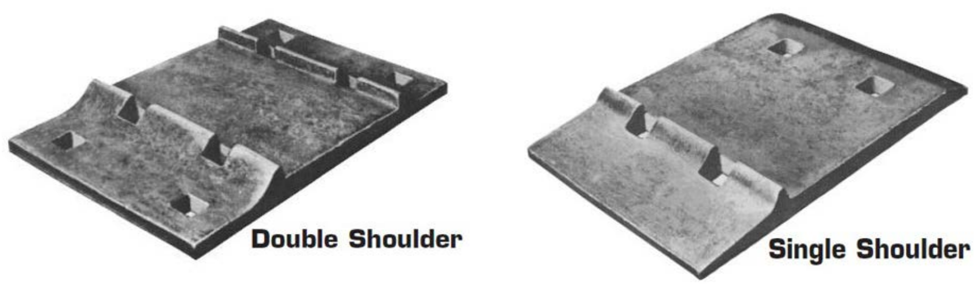


Figure 12: Types of Tie Plates

The 2009, HMM report states, that approximately 60% of the Island Rail Corridor has single shoulder plates. During the site 2019 inspection it was observed that the majority of the tie plates were single shoulder and it is agreed that double shoulder plates would be preferred to provide increased performance and tie longevity. This assessment defined that a single shoulder plate was considered to be in Poor condition and double shoulder plates were considered to be in Fair condition.

5.3.3 RAIL

Rail is the main structural part of the track structure that interfaces with the train wheels. Rails comes in different sizes that vary in weight, height, width and section which allows for different train loads. The majority of rail on the Island Rail Corridor is 85lb rail, with some sections containing 100lb and some newly upgraded 115lb rail mainly the at upgraded rail grade crossings. From a load carrying capacity, 85lb rail is not preferred for heavy axel loading (286,000 lbs railcar loading). Refer to Figure 13: Typical Rail Section.

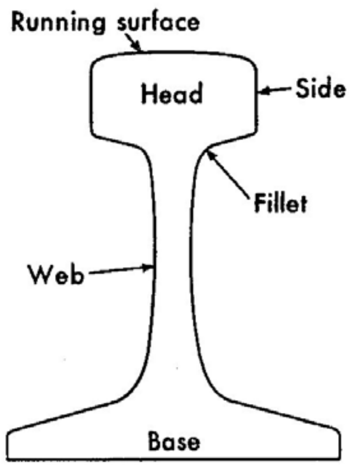


Figure 13: Typical Rail Section

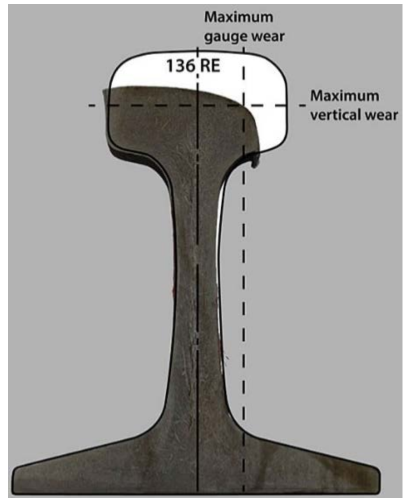


Figure 14: Head Loss (136lb rail)

The 2009, HMM report, describes that the existing rail along the corridor is in fair (adequate) condition. 2019 site investigations also found that the rail is also in fair condition. The 2019 investigation also found that the rails have an average of 7.7mm of rail head loss, with a maximum measured value of 10mm. Head Loss is where the combination of the train load and wheel dynamics have worn down running edge of the rail.

Refer to Figure 14: Head Loss (136lb rail). Shows an example of 10mm head loss which is deemed condemnable on CN and CP mainline Class 1 track. However, the level of operation is important to consider when assessing the appropriateness of the rail's condition; and therefore, the rail is found to be in fair condition.

Table 6: Rail Condition by Segment, shows the average condition and amount of head loss observed, separated into segments. For further detail on the condition of the ties and associated inspection reports, see Appendix A: Track Condition Assessment Report

Table 6: Rail Condition by Segment

Segment	Average Rail Condition	Average Head Loss (mm)
Segment 1: Victoria to Langford	Fair	7.6
Segment 2: Langford to Duncan	Fair	8.3
Segment 3: Duncan to Nanaimo	Fair	9.0
Segment4: Nanaimo to Parksville	Fair	5.5
Segment 4: Parksville to Courtenay	Fair	8.0
Segment 5: Parksville to Port Alberni	Fair	7.4
Wellcox Yard	Fair	10.0

5.3.4 RAIL JOINTS

Rail joints connect rail sections together to create a continuous running surface for the wheels of the trains to operate on. The condition of rail joints has an impact on the railway operating speed, train performance and in the case of a commuter service, the passenger comfort experience. The joint bar assembly provides for a minor amount of longitudinal movement of the rails to accommodate for rail expansion and contraction resulting form changes in temperature. Where there are gaps between the rail ends, or a difference in rail heights at joints, both passengers and trains are affected. Defects like these also have an impact on train journey times as the trains speeds are slowed through theses sections. Left unaddressed, these defects can accelerate damage to the rail and track structure.

Figure 15: Joint Bar Types

As mentioned in the 2009, HMM report, there are three types of joint bars used on the Island Rail Corridor. Splice bars, toeless joint bars (standard joint bars) and angled joint bars known as "toe bars" (as shown above in Figure 15). Angled joint bars are older technology and cause wear issues under the head of the rail as well as accelerate tie and tie plate wear. The 2009 Report noted there were many joints that were "frozen" due to bolts of the joint bars being rusted together, leaving the track susceptible to buckling.

Figure 16: Standard Joint Bar

Figure 17: Angle Joint Bar

The 2019 site inspections noted similar issues with "frozen" rail joints. The inspections identified standard (refer to Figure 16: Standard Joint Bar) and angled (refer to Figure 17: Angle Joint Bar) joint bars. For the purposes of this assessment, it was deemed that angled joint bars are considered to be in Poor condition while standard joint bars are in Fair condition.

5.3.5 BALLAST

Ballast is the aggregate on which the tie sits and is made up of selected uniform sized angular aggregate possessing one or more fracture faces, and capable of free draining. Ballast is used to distribute the static and dynamic train loads throughout the track grade. The ballast also is used to drain the track and allow water to flow through and into the drainage ditches typically located on either side of the track. The shoulder of the ballast (ballast on the outside of the tie) is designed to restrain the lateral forces of the track and prevent the track from moving.

Figure 18: Typical Ballast Along the Corridor

The 2009, HMM report, noted that the ballast on the Island Rail Corridor has been fouled with fine granular (typically sediment and organics). Recent inspections noted similar issues along the corridor. The inspection identified certain areas to be in Poor condition. Figure 18: Typical Ballast Along the Corridor, shows a typical example of ballast fouled with mud and vegetation. Fouled ballast, poorly distributes loads from the track, reduces drainage, increases maintenance requirements and other track issues.

Below, Table 7: Ballast Condition by Segment shows the average condition of ballast and shoulders broken down into segment. For further detail on the condition of the ballast, ballast cribs (space between each tie), shoulder and site inspection reports, see Appendix A: Track Condition Assessment Report.

Table 7: Ballast Condition by Segment

Segment	Average Ballast Condition	Average Shoulder Condition
Segment 1: Victoria to Langford	Poor	Fair - Poor
Segment 2: Langford to Duncan	Fair - Poor	Poor
Segment 3: Duncan to Nanaimo	Fair - Poor	Poor
Segment4: Nanaimo to Parksville	Fair - Poor	Fair - Poor
Segment 4: Parksville to Courtenay	Poor	Poor
Segment 5: Parksville to Port Alberni	Poor	Fair - Poor
Wellcox Yard	Poor	Fair

5.4 TURNOUTS

Turnouts are a specific track fixture that allows the train to move from one track to another. Turnouts are used at railway junctions to switch between track, allow for passing of trains and connect two different lines or branches together (two different subdivisions or spurs). Figure 19: Typical Turnout within Corridor, shows a typical turnout on the Island Rail Corridor.

Figure 19: Typical Turnout within Corridor

The 2009, HMM report states that there is a mixture of 85lb and 115lb rail turnouts on the Island Rail Corridor. It also states the turnouts are in a good to fair condition noting that most turnouts are in need of varying levels tie replacement. In the recent 2019 site inspections, similar observations were noted. The condition of the ties within the turnout were considered to be fair to poor. There rail was also noted to have been worn, with 11mm of head loss as seen on some components of the turnout.

The Victoria subdivision (including Wellcox yard) and the Port Alberni subdivision have 78 and 20 turnouts respectively. Overall the turnouts are considered to be in fair condition across the corridor, requiring some tie replacements and re-gauging. For further detail on the condition of the turnouts and inspection reports, see Appendix A Track Condition Assessment Report.

5.5 STRUCTURES

5.5.1 BRIDGES

Bridges located along the Island Rail Corridor are an assortment of structures which have a wide variation in type, age and condition. Previous detailed inspection of the bridges along the Victoria Subdivision and Wellcox Spur were completed in 2011. Of the 48 bridges located on the Victoria Subdivision, 31 bridges were inspected in 2019 to confirm the overall condition and to determine if any major deterioration had occurred since the 2011 inspections. No previous inspection data was available for the 19 bridges located on the Port Alberni Subdivision. Overall 13 out of the 19 bridges on the Port Alberni Subdivision were inspected in 2019 to ascertain an overall representative condition assessment of the structures.

The 2019 Victoria Subdivision bridge inspections found the condition of the structures to be in general conformance with the 2011 inspections, demonstrating an overall condition of the bridges varying from good to poor. Based on the inspections, most bridges will require minimal levels of rehabilitation to re-establish rail traffic. Several of the steel bridges were repurposed by CPR, being relocated from other locations in the country when CPR undertook upgrading programs. Much of this activity took place in the first decades of the 1900's. Many of the timber bridges were constructed through the 1940's and 1950's with maintenance and upgrades during the 1980's. Bridges located on the Port Alberni Subdivision are primarily timber trestles, which will require major rehabilitation or replacement within the next 50 years. The other structures on the subdivision are in Good to Fair condition.

The table below summarizes the general condition of the bridges based on each segment. Overall condition ratings are based on the expected level of effort and cost to maintain and or replace the steel structures on each segment for the next 50 years:

- Good: Only minor rehabilitation and maintenance is expected.
- Fair: Low to moderate risk of replacement or major rehabilitation for several structures.
- Poor: Major rehabilitation or replacement is expected for either several small or one or more large structures.

Table 8: Bridge Segment Summary Table

Segment	Overall Condition[1]	General Comments	Initial Cost	Cost (50 yr maintenance/ rehabilitation/ replacement)
Victoria to Langford	Good	• Mostly newer structures, built after 1997	$211,500	$569,500
Langford to Duncan	Poor	• 2 timber structures will should be considered for replacement within the next 50 years • Niagara Canyon and Cowichan River bridge have a high risk of replacement within the next 50 years	$10,952,500	$28,543,500
Duncan to Nanaimo	Fair	• 3 timber structures will require replacement within the next 50 years	$12,311,500	$5,714,000
Nanaimo to Parksville	Fair	• 2 timber structures will require replacement within the next 50 yeas	$5,474,000	$4,386,500
Parksville to Courtenay	Fair-Poor	• 2 timber structures will require replacement or major rehabilitation within the next 50 years • Tsable River bridge deck truss has a moderate risk of requiring replacement	$9,471,000	$34,333,500
Port Alberni	Fair	• 13 timber structures will require replacement within the next 50 years	$34,704,500	$19,178,000

[1] Overall condition does not encompass timber bridges as it is expected that all timber bridges will require major rehabilitation or replacement within the next 50 years, therefore not affecting the level of effort required over that time period

Previous load ratings of the bridges located on the Victoria Subdivision were completed in 2012. Based on the 2019 inspection results the 2012 load ratings are still representative of the current bridge conditions. The load ratings identified all bridges are capable of supporting passenger vehicles (RDC-1). However, historical speed restrictions of 10, 15, and 20 MPH do exist on several bridges. All 48 bridges were load rated for heavier 286 kip (286,000lb) freight cars. This identified several bridges that require rehabilitation or further analysis prior to supporting heavier loading conditions.

Several inspected bridges which pass over top of roadways had lower vertical clearance to the roadway than permitted by the MoTI standard of 5m, as required for new bridges. The Shawnigan Lake Road Bridge (mile 26.80) and Koksilah Road Bridge (mile 35.60) have excessively low vertical clearances of 3.40m and 2.90m respectively. The minimal clearances effect the availability for use as routes for certain types of vehicles and trailers. The restricted clearance increases the chance of vehicle impact on the bridge superstructures. The Shawnigan Lake Road Bridge superstructure was replaced in approximately 2005 presumably due to a vehicle impact.

Listed below are several of the bridges located on the Victoria Subdivision which are in poor condition and/or have a high risk of replacement within the next 50 years.

Niagara Canyon Bridge

Niagara Canyon Bridge, located at mile 14.0, is a 160.2m long double cantilevered deck truss supported on masonry block abutments and piers. The bridge was originally fabricated in 1883 located on CPR in Quebec and was moved to its current site in 1912. Strengthening of the cantilever deck truss occurred in 1928 as well as 1940.

Considering the age of the structure and results of the inspection which identified several minor deficiencies the risk of replacement over the next 50 years was estimated at 70%. The estimated cost to replace the structure is $22,000,000.

Figure 20: Niagara Canyon Bridge - mile 14.0

Cowichan River Bridge

Cowichan River Bridge, located at mile 39.30, is an open deck single span double through truss supported on masonry block abutments. Truss elements are wrought and cast iron with floor beams and stringers made of steel plate beams. The truss was fabricated in 1876 and the abutments were constructed in 1892.

Initial rehabilitation costs to support recommencement of passenger vehicle rail traffic has been estimated at $748,000. The cost is largely due to several deficiencies identified during the inspections. However, even with the required bridge rehabilitation the bridge still has a high risk of replacement within the next 50 years. Therefore, bridge replacement prior to the recommencement of rail traffic may be the most cost effective. Bridge replacement is estimated to cost $4,950,000.

Figure 21: Cowichan River Bridge – mile 39.30

French Creek Bridge

French Creek Bridge, located at mile 98.60, consists of a combination of timber frame trestle approach spans, and steel plate girder main spans that are supported on steel lattice towers. The steel girder spans were constructed in 1913 and the timber frame trestle spans were constructed in 1977. Some maintenance replacement of timbers on the trestle spans has occurred since 1977.

The timber trestle spans were assessed to be in good condition however it is not expected that the timber elements will last another 50 years. Due to the combined length of the timber spans (275m) the cost to replace or rehabilitate the spans is appreciable. The cost to replace the timber spans with a concrete and steel structures is estimated to cost $17,000,000 while rehabilitating the timber spans over the next 50 years is estimated to cost $14,000,000.

Figure 22: French Creek - mile 98.60

5.5.2 CLEARANCES

The clearance requirements for trains as measured to other objects such as buildings, bridges, fixtures and other trains is identified in regulatory requirements for the safe operation of trains. Clearances from vehicles to structures and overhead obstructions is captured by the Ministry of Transportation and Infrastructure design requirements. Where there are restricted clearance issues between vehicles to bridges, therein lies a risk to the safety of the railway and the public. Bridges impacted by vehicles cause damage to the bridges, pose a risk to the public using the roadway, can potentially pose a risk to train movements and render the bridge unserviceable for railway operations. Attention to substandard clearance issues with railway structures is a safety risk to the railway and to the public.

The 2009, HMM report, reported that there were low clearances on bridges across highways. Damage caused by low clearance issues were noted during the bridge inspections. Figure 23: Shawnigan Lake Road Bridge Impact. shows Shawnigan Lake Road Bridge, on the Victoria Subdivision, having been impacted by vehicle collisions. Road signs were observed on roadways with at-risk bridge locations.

For further details of the bridge clearances and the bridge inspection reports, see Appendix C: Bridge Condition Assessment Report.

Figure 23: Shawnigan Lake Road Bridge Impact.

The clearance issues between adjacent tracks has a low risk of potential issue as the Island Rail Corridor is predominantly a single line railway with intermittent sidings along the corridor. The Holland TrackStar track vehicle has the ability to measure clearances and does so as part of the annual inspection. This was observed during their annual survey of the track in August 2019.

5.5.3 ROCKFALL

Rockfall needs to be managed for both railways and roadways running through mountainous areas. Rocks falling onto the track cause risk to the safety of the train and occupants. Due to the terrain the railway passes through, visibility of rocks on the tracks is a concern. Rockfall mitigation measures (rockfall meshes and rockfall detectors) are typically in place along high risk areas of rockfall activities.

The 2009, HMM report identified potential rock fall sites at Mile 15.6, 15.7, 16.2 and 16.3 Victoria Subdivision noted "active rock faces with freshly fallen material in the ditches and significant cracking between the blocks".

The 2019 site inspection conducted a similar assessment along the Victoria Subdivision, identifying areas between Langford and Shawnigan Lake as having potential rockfall risks. Areas of risk were noted between Mile 13.1 and 21.3. The Port Alberni Subdivision was also inspected and noted potential risks east of Cameron Lake to Summit Lake.

Figure 24: Rockfall Located on Port Alberni Subdivision

Figure 24: Rockfall Located on Port Alberni Subdivision above, shows an example of existing rockfalls located on the Port Alberni Subdivision. For further details about rockfall risks and mitigation options, see Appendix D: Rockfall Assessment Memo.

5.6 FENCING

Fencing along the rail corridor is intended to deter people, vehicles and livestock from access to the track. Railway fencing as defined by Regulatory Authorities is typically four-by-four wire mesh fencing fabric on wooden fence posts. It is at the discretion of the land owner or Civic Authority to provide an upgrade to chain link, wooden or livestock proof fencing.

As stated in the 2009, HMM report, the fencing is on fair to good condition. However, also stated is there are reports of a number of trespasser issues as noted during the 2006 and 2009 site inspections. Fencing and other measures were noted to be possible mitigations for trespasser issues.

Similar issues were noted during the 2019 inspections. Fencing is commonly employed to mitigate trespass and associated liability. The existing fencing where installed was noted to be in Fair to Good condition within the residential or urban areas such as Victoria and Nanaimo.

5.7 CROSSINGS

5.7.1 GRADE & PEDESTRIAN CROSSINGS

A level grade or pedestrian crossings exist where a road or foot path cross a railway line. Below in Figure 25: Typical Grade Crossing, is a diagram of a typical break down of a level crossing, as per Transport Grade Crossing Canada Standards.

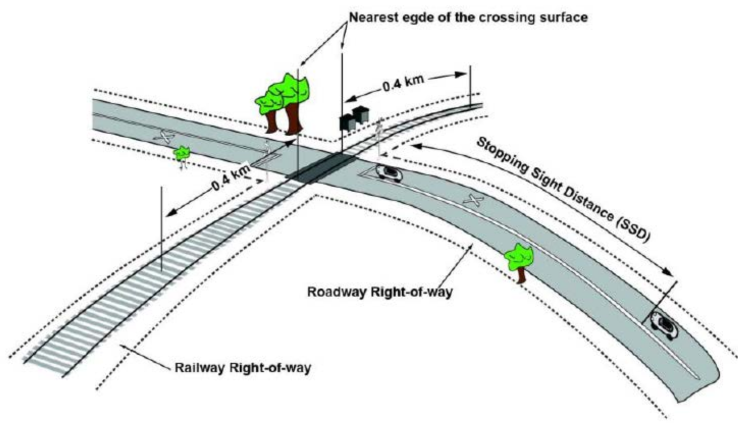
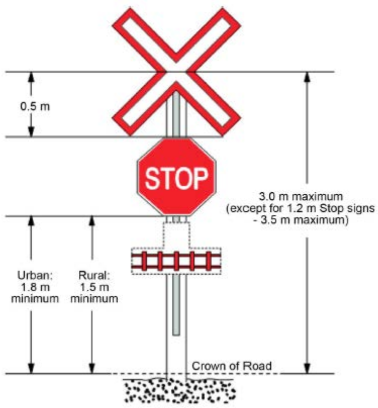
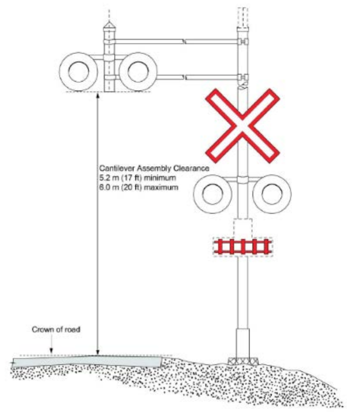
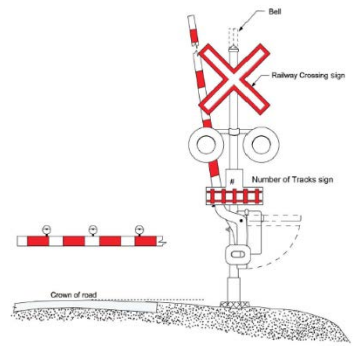


Figure 25: Typical Grade Crossing

The Island Rail Corridor has 236 at-grade crossings (including pedestrian crossings) across both the Victoria and Port Alberni Subdivisions. Grade crossing protection systems are divided into passive crossings (non signalized), and active level crossings (signalized crossings). Active crossings are further broken down into two types, the maximum level of crossing protection is offered by Flashing Lights, Bell and Gates (FLB&G) and the slightly lesser level of protection is offered by Flashing Lights and Bell (FL&B). Gates are warranted where train and vehicle traffic levels exceed target levels. Gates are typically installed with FL&B (becoming FLB&G) where sight lines of a train movement from the at-grade are obscured or restricted sufficiently or warranted by the Transport Canada Grade Crossing Regulations and Standards (2015), or where safety protocols warrant the additional protection. Example diagrams of the various levels of crossing protection from Transport Canadas Grade Crossing Standard (2015) can be seen in Table 9Table 9: Grade Crossing Types.

The type of grade crossing protection system is determined by, among other things, the number of trains/vehicles using the crossing, crossing/road surface, the road approach, the proximity to adjacent roadways and the sightlines (fields of vision) between the train and vehicles and vehicles and obstructions.

Table 9: Grade Crossing Types

Crossing Types and Protection		
		
Passive Crossing – cross bucks only- Addition of Stop Signs may be applicable as warranted	**Active Crossing – FLB** **Flash Lights and Bell.**	**Active Crossing – FLBG** **Flash lights, Bell and Gates**

The 2009, HMM report stated that some of the crossing equipment on the Victoria Subdivision may have reached their service life. Where replacement parts are no longer supported by the manufacturer, upgrades should be considered. For the 2019 crossing condition assessments, a rating system of poor, marginal, adequate, good and excellent was used. For better definition of this rating system please refer to Appendix B: Crossing Condition Assessment Report. These assessments determined that the crossings were overall in adequate condition. For the purposes of this summary report and consistent rating terminology, the overall condition of the crossings are considered to be in Fair condition.

Assessing the individual components of the grade crossing determined that sightlines range from Poor to Fair, with an average of Fair. Sightline improvements, like vegetation clearance, will improve the condition. The automatic crossing protection warning systems were also determined to be out of date and in need of upgrade or replacement in some cases.

The below Table 10: Crossing Condition by Segment show the number of crossings per segment and the average condition of the crossing. The crossings were assessed against Transport Canada’s Grade Crossing Regulations and Standards (2015). For further details of the crossing conditions, refer to Appendix B: Crossing Condition Assessment Report.

Table 10: Crossing Condition by Segment

Segment	No of Grade Crossings per Segment	Average condition of Grossing
Segment 1: Victoria to Langford	20	Fair
Segment 2: Langford to Duncan	28	Fair
Segment 3: Duncan to Nanaimo	61	Fair
Segment4: Nanaimo to Parksville	35	Fair
Segment 4: Parksville to Courtenay	56	Fair - Poor
Segment 5: Parksville to Port Alberni	33	Fair - Poor
Wellcox Yard	3	Fair

5.7.2 WIRE & PIPE CROSSINGS

Overhead or underground wires, pipes, poles and fibreoptic cable crossings exist along the Island Rail Corridor. Utility crossings require railway approval to cross the corridor and must comply with provincial and in some cases federal guidelines. In each instance a separate agreement is required to be produced for each utility covering responsibilities and obligations between the railway and the utility owner. Where utilities cross above the track, the utility owner is obligated to ensure that utility remains sufficiently above the limits of the clearance envelope (provided by the Transportation Regulator). When disrepair, acts of environment, or neglect by the utility owner occurs, the railway becomes concerned with encroachment into the railway envelope (airspace occupied by the train as it moves). When utilities cross under the track, the railway is warry about the contact with wrongfully installed utilities during maintenance activities involving signaling, drainage, and rail loading impact on said utility. No clearance issues were noted in the 2009, HMM report. Similarly, during the 2019 site investigations, no clearance issues were observed with overhead wires furthermore buried utilities presented no observable issue.

5.8 COMMUNICATION

The 2009, HMM report indicates that "Communication is by radio and cell phone. There are two repeater towers used for radio. The south repeater covers Victoria to Nanaimo and the north repeater covers Nanaimo to Parksville. Personnel can communicate through either repeater to the Rail Traffic Controller (RTC) but cannot call to each other when on different repeaters. The equipment is relatively modern; 8 years old and is properly maintained."

Through discussions with SVI during the workshop and the site investigations, SVI confirmed the communication system is in good working condition and suitable for the required function. They also clarified that the north repeater, located on Mount Cokely, covers from Nanaimo to Courtenay plus the Port Alberni subdivision, and that the south repeater tower is located on Salt Spring Island. These towers were not observed during the site investigations due to accessibility.

5.9 BUILDINGS & FACILITIES

During the workshop with SVI, ICF and MoTI on the 15th of July 2019, it was indicated that of the existing railway stations some are leased out, some to be handed over to municipalities and others were in poor condition or not appropriate for future station use. This discussion determined that in all cases the existing stations would not be used for a future rail service and that assessing their condition was not required.

Existing offices are co-shared by ICF and SVI, and the workshop facilities support SVI's daily operations. The Wellcox Yard barge ramp that supports transport of railcars between Vancouver Island and the lower mainland via rail-barge is owned and maintained by Seaspan. As part of the same workshop it was determined that the offices, workshops and barge ramp would not have their condition's assessed.

5.10 ROLLING STOCK (RAIL CARS)

During the July 15th workshop, it was also noted that the ICF do not own rolling stock that run on the Island Rail Corridor. All rollingstock is supplied and maintained by SVI or others. In addition, rollingstock does not always stay on the island as it is exchanged with different rollingstock related to new railcar shipments through Wellcox Yard barge ramp. Accordingly, it was determined that assessing the condition of rolling stock running on the Island Rail Corridor would not be required as part of this assessment.

6 IMPROVEMENTS

6.1 PHASED IMPROVEMENT APPROACH

A phased improvement approach was developed based on meetings held with ICF, SVI, MoTI, Technical Safety BC, site visits, findings, previous reports reviewed, and different potential use cases being considered for the Island Rail Corridor. With these inputs, WSP has outlined a rehabilitation program that entails three improvement phases: Initial, Intermediate, and Ultimate; each will be elaborated on in Phased Improvements below.

Phasing the improvements allocates the appropriate amount of funding for the appropriate levels of demand. For example: When rail volumes increase beyond the Initial phase, capital would be required to implement the Intermediate phase. Similarly, as rail traffic volumes increase beyond the Intermediate phase, capital would be required to implement the Ultimate phase. If rail traffic volumes did not increase, then additional capital funding would not be required (excluding maintenance and operations). Furthermore, dividing the corridor into six different segments allows flexibility for phased improvements to be implemented where and when there is demand.

The phased rationale is based on carrying out improvement works to meet Technical Safety BC and Transport Canada's maximum allowable operating speeds as identified in Figure 26: Classes of Track: Operating speed limits in mph (Rules Respecting Track Safety, 2012, Part II, Section A). These improvement works discussed will include structure upgrades (to allow trains to move faster over the structure) and upgrading at-grade rail crossings to allow for rail traffic to move through intersections unimpeded. Several sections of the corridor cannot attain the intended track class speed due to geometric limitations such as summitting the Malahat Pass and navigating through the winding track geometry in the CRD. Table 11: Geometric Constraint Location between Victoria and Duncan - Ultimate Phase, identifies locations where the operating speed is limited due to track geometry between Victoria and Duncan. However, the overall average anticipated track speeds will support the studied scenarios. Therefore, changes to track geometry are not considered at this time.

Maximum allowable operating speeds

Over track that meets all of the requirements prescribed in this part for-	The maximum allowable operating speed for freight trains is -	The maximum allowable operating speed for passenger trains is -
Class 1 track	10	15
Class 2 track	25	30
Class 3 track	40	60
Class 4 track	60	80
Class 5 track	80	95*

* For LRC Trains, 100

Figure 26: Classes of Track: Operating speed limits in mph (Rules Respecting Track Safety, 2012, Part II, Section A)

Table 11: Geometric Constraint Location between Victoria and Duncan - Ultimate Phase

Geometric Constraint Location between Victoria and Duncan – Ultimate Phase		
Mile Range	**Approximate Operating Speed (MPH)**	**Constraint**
0.0 – 1.6	10 to 15	Very tight horizontal curvature
1.6 – 4.1	25 to 30	Tight horizontal curvature
4.1 – 4.2	10	Very tight horizontal curvature
11.8 – 11.9	10	Very tight horizontal curvature & steep vertical grade
11.9 – 28.3	25 to 30	Tight horizontal curvature
28.3 – 28.4	10	Langford to Duncan

6.2 PHASED IMPROVEMENTS

The approach to track restoration has been divided into three phases. In each phase, a rail traffic volume Use Case is assigned and provides a corresponding track class and load characteristics. Additional detail on the specific track infrastructure upgrades can be referenced in Appendix H: Phased Improvements – Track Restoration. Increase of Use Case is dependant on the steady increase in operation/demand of both freight and passenger services and are not dependent on time. The approach below is designed to be in sequential order, i.e. if the Ultimate Phase is selected, the Initial and Intermediate Phase upgrades would have to be completed prior to proceeding with the Ultimate Phase upgrades.

6.2.1 INITIAL PHASE

Initial Phase Improvement: includes costs to upgrade infrastructure to re-establish a minimum rail freight and passenger service along the rail corridor.

Initial Phase: Class 2 Track Standard Restoration	
Use Case:	• 2-4 passenger trains per day • 2-4 freight trains (10-20 car trains) per day
Track Characteristics:	Class 2 Track Standard (25 mph Freight, 30 mph passenger). *
Load Case:	Not suitable for sustained 286k lb car loading
Remediation Includes	• Track upgrades — Vegetation removal — Defective tie replacement — Shoulder plate and anchor replacements — Additional ballast • Turnout upgrades • Bridge replacement and rehabilitation • Grade crossing upgrades • Rockfall remediation.

*Speeds refer to maximum safe allowable operating speed as per Figure 26: Classes of Track: Operating speed limits in mph (Rules Respecting Track Safety, 2012, Part II, Section A).

6.2.2 INTERMEDIATE PHASE

Intermediate Phase Improvement: includes costs to upgrade infrastructure beyond the Initial Phase. This phase will support higher freight loading (286k lb rail car loading) which will accommodate increased freight and passenger volumes and increased speeds.

Intermediate Phase: Class 3 Track Standard Restoration and 286lb Upgrade	
Use Case:	• 4 passenger trains/d up to 8 trains/d • 4 freight trains (10-20 car trains)/d up to 4 million tonnes per annum (MTPA) or 133 cars/d total. • Once passenger/freight train volumes increase above Initial Phase 1 Use Case or, • Higher operating speeds are desired, further upgrade will be necessary. • Assumes improvements for Initial Phase have already been completed.
Track Characteristics:	Class 3 Track Standard (40 mph Freight, 60 mph passenger). *
Load Case:	Suitable for sustained 286k lb car loading
Remediation Includes	• New track – supporting higher loading — Vegetation maintenance — Rail upgrade — Tie replacement — New rail joints — Additional ballast • New turnouts – supporting higher loading

*Speeds refer to maximum safe allowable operating speed as per Figure 26: Classes of Track: Operating speed limits in mph (Rules Respecting Track Safety, 2012, Part II, Section A).

6.2.3 ULTIMATE PHASE

Ultimate Phase Improvement: includes costs to upgrade infrastructure beyond the Intermediate Phase. This phase will support higher freight and passenger volumes than the Intermediate Phase. This phase is recommended for the implementation of a Commuter Rail Service evaluated in Section 7 Inter-city and South Island Commuter Operations.

Ultimate Phase: Ballast Program	
Use Case:	• To be implemented during higher passenger volumes at or above 8 trains/d and • Higher freight volumes. If current volumes increase above 4MTPA or 133 cars/d. (Current freight volumes assumed to be 110,000t/yr or 4 cars/d). • Assumes improvements for Intermediate Phase have already been completed.
Track Characteristics:	Class 3 Track Standard (40 mph Freight, 60 mph passenger). *
Load Case:	Suitable for sustained 286k lb car loading
Remediation Includes	• New ballast to support higher freight and passenger numbers — Additional ballast and rail lift

6.3 COMMON CORRIDOR FEATURES

COMMUNICATION

The existing communication system is relatively new and in good working condition. The technology is appropriate for SVI's current operations. No upgrade improvements are recommended at this point in time.

FENCING

It is recommended that as part of the Initial Phase Improvements that new fencing be installed to enclose exposed or higher risk areas along the right of way. Based on site inspections, new fencing would be required along 50% of the Victoria to Langford segment of the Victoria subdivision; 5% of the remaining corridor length along the Victoria and Port Alberni subdivisions would require new fencing. No fencing is proposed in any further phases.

SIGNALLING

If a segment is upgraded to the Ultimate Phase and more specifically if a Commuter Service is implemented with requisite rail traffic volumes, a simple signalling system to control movement of trains such as fixed block, relay based or computerized system is recommended. It is a cost effective and appropriate system for this headway. The principle of fixed block signalling system is to divide track into sections called blocks, the occupancy of each block is monitored by axle counter. The switches can be controlled remotely, and the switch position changed based on the requested route. The switch machine changes the switch remotely and reads the status and position. If set correctly, the proceed aspect is presented to the driver via signal. By setting the route, interlocking protects the safe movement of the train from start to the end of the route and protects for over running. When the train reaches its destination, the previous section of track is released and allows another train to enter the track block. For segments where the Ultimate Phase has not been implemented, maintaining the current Occupancy Control System (OCCS) signalling is appropriate.

ELECTRIFICATION

The Island Rail Corridor as currently constructed and considering different operating scenarios, is not considered a good candidate for electrification. Please refer to Appendix I: Electrification Memo, for further discussion on electrification. As conditions change, electrification should be re-evaluated to determine appropriateness.

BRIDGES

It is recommended that as part of the Initial Phase Improvement works, all bridges are to be rehabilitated to support the 286,000 lb car loading. Costing to support the rehabilitation is based on visual inspections and the review of previous reports conducted in 2011. Costs have been reviewed from previous reports and considered when determining 2019 associated rehabilitation costs. Overall the cost of bridge replacements and rehabilitation have increased between inspections, due to deterioration of the structures. For a detailed breakdown of the costs associated with individual bridge rehabilitation, refer to Appendix C: Bridge Condition Assessment Report.

7 INTER-CITY AND SOUTH ISLAND COMMUTER OPERATIONS

This section of the report assesses the feasibility (and informs the cost established in Section 9: Cost Estimates) of re-establishing an Inter-City rail service and implementing a new Commuter Rail Service in the South Island area. This section explores several scenarios under which both of these services could operate. However, it has not explored every scenario or possible combination of operating elements. Should either the Inter-City or Commuter Rail Services be advanced, both should undergo further scenario and ridership analysis to determine the appropriate level of service at that time.

7.1 OPERATING SCENARIOS

WSP evaluated several operating scenarios as part of this preliminary assessment. A complete discussion of that evaluation process is available in Appendix F: Commuter Rail Assessment. As a result of that evaluation process, there are three operating scenarios advanced for the purposes of this report. These scenarios provide a high-level concept of what Inter-City and Commuter Rail services could look like. However, further analysis of the demands, data collection methods and scenario analysis would be required to move forward with either of these services.

The three operating scenarios are:

1. **Initial Phase**: Inter-City service between Victoria and Courtenay requires the least amount of track infrastructure upgrades and runs at the previously posted 2011 track speeds (average 30 mph).
2. **Intermediate Phase**: Inter-City service between Victoria and Courtenay requires additional upgrades to the track infrastructure beyond the Initial Phase and runs at average track speeds of 50 mph.
3. **Ultimate Phase**: The third scenario combines the Inter-City between Victoria and Courtenay and a Commuter Rail Service between Victoria and Langford. It will require additional upgrades between Victoria and Langford to the track infrastructure beyond the Intermediate Scenario.

   The Ultimate Phase Scenario includes a ballast program which does not increase track speeds above the 50 mph (achieved in the Intermediate Phase) but will accommodate the higher rail volume loading described by the introduction of the Commuter Rail Service in South Vancouver Island.

For more detailed information on the Phased Improvement approach, and the coinciding Track Class Speeds, please refer to Section 6.1 Phased Improvement approach. As identified in Section 6.1, several sections of the corridor cannot attain the intended track class speed due to geometric limitations such as summitting the Malahat Pass and navigating through the winding track geometry in the Capital Regional District (CRD).

However, the overall average anticipated track speeds will support the Three Operating Scenarios. Therefore, changes to track geometry are not considered at this time.

A breakdown of the different service types and assumptions is shown in Table 12: Three Operating Scenarios for the IRC. below.

Table 12: Three Operating Scenarios for the IRC.

	Inter-City Only Initial Service	Inter-City Only Intermediate Service	Inter-City with Local Commuter Service
Track Speed Avg. mph	30	50	50 33 (Langford-Victoria)
Trains / day	1	1	4
Stations	8	8	13
Single-direction run duration	5 hours 11 mins	3 hours 8 mins	3 hours 8 mins 28 mins (Langford-Victoria)
Off-peak storage requirements	1 train daily at Victoria, overnight at Courtenay	1 train daily at Victoria, overnight at Courtenay	4 trains daily at Victoria, 1 overnight at Courtenay, 3 overnight at Westhills

The current analysis includes assessment of Monday-Friday service only.

For all scenarios, feasible operating profiles and time tables were developed that conform to the Initial Scenario and aspirational track conditions outlined elsewhere in this report. In all instances, travel times between stations have been calculated based on average speeds, known chainage distances, an assumed 15 seconds – 30 seconds dwell time at each station, and some contingency for normal delays and track switching.

Operating times are based on reasonable peak commuter running and origin/destination times; not based on any comparison with existing commuter transit services.

Given the length of track and estimated volume of rail traffic, the proposed Commuter Line is not a good candidate for electrification. Further discussion on electrification considerations can be seen in Appendix F: Commuter Rail Assessment. The Commuter Service scenario therefore assumes a stock capable of both Inter-City service from Courtenay to Langford and local service to stations from Langford to Victoria. No vehicle transfer for passengers is required at Langford.

7.1.1 ROLLING STOCK (RAIL CARS)

This assessment of rolling stock options assumes the following (see Section 9: Cost Estimates for estimates):

- All the track related deficiencies will be addressed to accommodate the safe operation of the selected type of rolling stock up to the maximum track design speed.
- The existing infrastructures such as bridges and rail crossings will be accommodating a rolling stock with a similar or smaller dynamic envelope (space occupied by rail car while in motion) as Via Budd Rail Diesel cars.
- Existing tunnels may need to be modified to accommodate a larger rollingstock envelope, such for bilevel coaches.
- Acceleration and deceleration efforts would be affected by a series of factors including technology selection, number of cars in one trainset, brake system type, and axle load which are not being considered at this stage of the report.

- Selection of any fleet will require a provision of spare vehicles to ensure that service levels can be maintained throughout the project life, regardless of possible vehicle failures or planned maintenance intervals. The number of spares will depend on the reliability of the type of vehicle selected, the size of the fleet, and the concept of Operations and Maintenance for the system.

Table 13: Rolling stock types and applications

Vehicle Type and Standard Application				
Criteria	**100% LFLRV (Elec)**	**Diesel Multiple Unit (DMU) Commuter Class**	**Diesel Locomotive, Bilevel Coach**	**Budd Rail Diesel Car (legacy fleet)**
Seated+ standing Capacity	200 (2 car)	135+150 (3 car)	162 per car, 12 car set	70 to 90
Commute Distance (km)	5 to 40	5 to 150	20 to 200	20 to 400
Max Op. Speed (km/hr)	50 to 80	140	160	137
Reference Vehicle	Bombardier Flexity	Alstom LINT	Bombardier Bi-Level	Budd Company
Reference Project	Waterloo LRT	Ottawa Trillium Line	West Coast Express	Vancouver Island Rail Corridor

Canadian reference projects that employ the use of these rolling stock options are listed below:

- The Waterloo Light Rail Transit (LRT) is an integrated urban LRT which provides 5-minute headways and a rapid service using electrified 100% low floor Light Rail Vehicles (LRVs).
- The Ottawa Trillium Line features a modern DMU (diesel multiple unit) and provides a high level of service and reliability. It runs a diesel LRT service on an existing mainline freight corridor which features numerous sections of single track, 15-minute headways, and stations spaced at intervals of typically one to two kilometers apart.
- Bilevel cars have been providing commuter service in Canada's largest cities for several decades using conventional diesel locomotive technology. These systems are characterized as having very high capacity ridership, stations further apart, with a higher operating speed and longer trip durations. GO Transit in Greater Toronto and Hamilton Area in Ontario and West Coast Express in the Lower Mainland both employ the use of bilevel rolling stock.

For further discussions on these options please refer to Appendix F: Commuter Rail Assessment.

Table 14: Rolling Stock References

Rolling Stock References Options	
	
Waterloo LRT (https://www.bombardier.com)	**Ottawa Trillium Line** (https://obj.ca)

	
West Coast Express (https://www.bombardier.com)	**VIA RDC – Vancouver Island Rail Corridor** (https://www.CBC.com)

7.1.2 DOUBLE-TRACKING

Although double tracking is not considered necessary to reopen the line and has not been included in cost estimates, some discussion on opportunities and constraints to double track have been explored. The corridor is constrained with regards to right of way and capacity to widen or double track the rail service for additional capacity and redundancy (see current track diagram below). However, some opportunities do exist for double tracking and shared rail platforms between Victoria to Langford and Shawnigan Lake to Courtenay. The Malahat area poses significant challenges to double tracking given the elevation change and geometry. Significant blasting and tunnelling would be required to accommodate.

Double-tracking portions of the line permits greater flexibility for maintenance and fewer track-switching delays to Inter-City and Commuter Services. A peak-direction service with only four trains will not likely require double-tracking upgrades. However, should additional trains (or 2-way service) be added over and above what is shown in the Ultimate service scenario, more double-track capacity will need to be added to minimize train conflicts and delays. These levels of service are not considered in this study and costs for double tracking have not been included in this assessment.

Figure 27: Current Track Diagram – Double Tracking below, illustrates potential locations for double tracking.

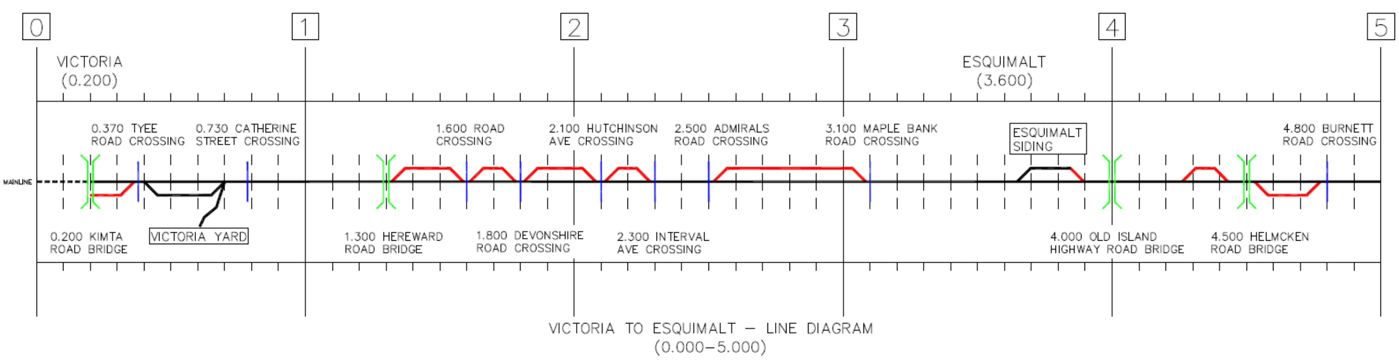


Figure 27: Current Track Diagram – Double Tracking

7.1.3 INITIAL SCENARIO – INTER-CITY SERVICE AT 2011 TRACK SPEEDS

In this scenario, one inter-city train makes a single return trip per day between Victoria and Courtenay; also travelling to six other stations:

- Station 1 – Victoria (same for Inter-City and Commuter service scenarios)
- Station 2 – Shawnigan Lake Station
- Station 3 – Duncan
- Station 4 – Ladysmith
- Station 5 – Nanaimo
- Station 6 – Parksville
- Station 7 – Qualicum Beach
- Station 8 – Courtenay

The Inter-City train runs inbound to Victoria in the AM peak period and outbound to Courtenay in the PM peak period at track speeds commensurate to what were achieved prior to the line's decommissioning in 2011.

The daily Inter-City inbound train is scheduled to arrive in Victoria at 08:32 and depart it at 17:00. The required departure time from Courtenay (03:00) is not ideal but not uncommon for other inter-city services in Canada. The schedule was established to provide some commuter functionality for riders from Duncan and Nanaimo. See Appendix F: Commuter Rail Assessment, for alternative time table options and ridership profiles.

Trains would travel at the average speeds listed below for a journey time of just over **five hours**:

- 23 mph between Victoria Station (Station 1) and Shawnigan Lake Station (Station 2)
- 30 mph between Shawnigan Lake Station (Station 2) and Courtenay Station (Station 8)

The operating schedule assumes a 15-minute hold in Duncan for schedule adjustment, operator break, and/or contingency.

Presently all bridges and level crossing infrastructure between Victoria and Shawnigan Lake is single track. This is not proposed to change with the Initial operating scenario. Increased travel speeds will still need to share single track bridges and level crossings for later (Intermediate and Commuter) scenarios.

7.1.4 INTERMEDIATE SCENARIO – INTER-CITY SERVICE AT ULTIMATE TRACK SPEEDS

In this scenario, one Inter-City train makes a single return trip per day between Victoria and Courtenay; also travelling to the same six other stations listed above. The train runs inbound to Victoria in the AM peak period and outbound to Courtenay in the PM peak period at Ultimate track speeds.

The daily Inter-City inbound train is scheduled to arrive in Victoria at 08:28 and depart it at 17:00. Trains would travel at the average speeds listed below for a journey time of just over **three hours**:

- 33 mph between Victoria Station (Station 1) and Shawnigan Lake Station (Station 2)
- 55 mph between Shawnigan Lake Station (Station 2) and Courtenay Station (Station 8)

The operating schedule also assumes a 15-minute hold in Duncan for schedule adjustment, operator break, and/or contingency. Track and bridges would remain single-track as outlined in the Initial service.

7.1.5 COMMUTER SERVICE SCENARIO – ADDITION OF COMMUTER SERVICE BETWEEN LANGFORD AND VICTORIA

The Commuter Service scenario assumes a 4-train, peak-direction service based on Ultimate operating speeds. In addition to the one daily train to and from Courtenay, local commuter service is provided between Langford and Victoria at five additional stations (station location analysis discussed in greater detail in Section 0:

Locations), bringing the total number of Inter-City and Commuting Service stations to 13:

- Station 1 – Victoria (same for Inter-City and Commuter service scenarios)
- Station 2 – Admirals Station
- Station 3 – Six Mile Station
- Station 4 – Atkins Station
- Station 5 – Langford Station
- Station 6 – Westhills Station
- Station 7 – Shawnigan Lake → Station 13 – Courtenay (7 stations total)

The operating schedule also assumes a 15-minute hold in Duncan for schedule adjustment, operator break, and/or contingency. The travel times between Duncan and Victoria as well as Nanaimo and Victoria are unchanged from the Intermediate Scenario.

At Ultimate operating speeds, the train from Westhills Station in Langford takes **twenty-eight minutes**. The fourth AM inbound train will arrive at Westhills Station from Courtenay at 08:00 and continue to Victoria for a scheduled 08:28 terminus.

The first PM train will depart Victoria 17:00 and continue through to Courtenay. The following three trains will terminate at Westhills.

7.2 FORECAST RIDERSHIP

A forecast analysis conducted as part of this report shows that rail trips increase with corresponding increases in track speed. The Intermediate and Commuter Service scenarios demonstrate a greater number of peak period rail passengers than the Initial service scenarios.

Additional information on the analysis' methodology – in addition to other operating scenarios evaluated – are included in Appendix F: Commuter Rail Assessment.

7.2.1 RESULTS TABLES

The following result tables reflect peak period (AM & PM) ridership estimates. Station boarding totals inter-station travel boardings (i.e. riders boarding with destinations different from Victoria). They show the ridership forecast profiles of the most efficient of six scenarios reviewed, based on average riders per train. The scenario corresponds to Case 2B from the appendix report noted above – 3 Commuter-only trains per peak per day + 1 combined Inter-City + Commuter train per peak per day.

7.2.1.1 PEAK-DIRECTION TRAIN SERVICE

As shown in The elasticity analysis employed to forecast these figures used regional Origin-Destination information from two sources. The figures therefore include trips shifted from both transit and private vehicle commuter travel modes at ratios roughly equal to those existing, regional commuting mode shares:

- Between Victoria and Langford, the Capital Regional District (CRD)'s Household Travel Survey data (2017)
- Between the CRD region and Courtenay, a 3rd party smartphone application

They also do not reflect trips between individual stations within the CRD Commuter service catchment area and those north of Westhills. For Inter-City to Commuter-service area trips, the CRD area was considered a single catchment area whose trips were assigned to Victoria Station. Therefore, no destination trips are identified in the AM between individual Commuter service-area stations and stations north of the CRD. For the purposes of tracking OD trips between areas within and north of the CRD, the CRD was treated as a single catchment area with all CRD passengers assigned to Victoria Station.

Table 15 shows forecast ridership increasing in the AM peak period with the higher service speeds between the Initial and Intermediate track conditions. The table shows boardings for the single combined Inter-City + Commuter-service train and three Commuter-only train services whose schedules are noted above. Overall boardings increase approximately 300% over the Intermediate Service scenario with the introduction of Commuter Service between Victoria and Langford. The largest, single station boardings are at the Admirals and Six Mile stations.

The elasticity analysis employed to forecast these figures used regional Origin-Destination information from two sources. The figures therefore include trips shifted from both transit and private vehicle commuter travel modes at ratios roughly equal to those existing, regional commuting mode shares:

- Between Victoria and Langford, the Capital Regional District (CRD)'s Household Travel Survey data (2017)
- Between the CRD region and Courtenay, a 3rd party smartphone application

They also do not reflect trips between individual stations within the CRD Commuter service catchment area and those north of Westhills. For Inter-City to Commuter-service area trips, the CRD area was considered a single catchment area whose trips were assigned to Victoria Station. Therefore, no destination trips are identified in the AM between individual Commuter service-area stations and stations north of the CRD. For the purposes of tracking OD trips between areas within and north of the CRD, the CRD was treated as a single catchment area with all CRD passengers assigned to Victoria Station.

Table 15: AM Peak Period Trip Boarding for peak-direction service options

<table>
<tr><th rowspan="2">Stations</th><th colspan="3">Boardings per station with 4-train service (Case 2B)</th></tr>
<tr><th>Initial Service</th><th>Intermediate Service</th><th>Commuter Service</th></tr>
<tr><td>Victoria</td><td rowspan="6">n/a</td><td rowspan="6">n/a</td><td>0</td></tr>
<tr><td>Admirals</td><td>120</td></tr>
<tr><td>Six Mile</td><td>114</td></tr>
<tr><td>Atkins</td><td>48</td></tr>
<tr><td>Langford</td><td>110</td></tr>
<tr><td>Westhills</td><td>83</td></tr>
<tr><td>Sub-total</td><td rowspan="2">n/a</td><td rowspan="2">n/a</td><td>475</td></tr>
<tr><td>Avg. per train</td><td>119</td></tr>
<tr><td>Shawnigan Lake</td><td>72</td><td>70</td><td>70</td></tr>
<tr><td>Duncan</td><td>105</td><td>131</td><td>131</td></tr>
<tr><td>Ladysmith</td><td>31</td><td>35</td><td>35</td></tr>
<tr><td>Nanaimo</td><td>62</td><td>71</td><td>71</td></tr>
<tr><td>Parksville</td><td>66</td><td>75</td><td>75</td></tr>
<tr><td>Qualicum Beach</td><td>151</td><td>179</td><td>179</td></tr>
<tr><td>Courtenay</td><td>10</td><td>13</td><td>13</td></tr>
<tr><td>Total</td><td>497 – 1 train</td><td>574 – 1 train</td><td>1,049 – 3 Commuter + 1 dual Commuter / Inter-City train</td></tr>
<tr><td>Avg. per train</td><td>497 – 1 train</td><td>574 – 1 train</td><td>262</td></tr>
</table>

The majority of these trips are shifted from private vehicles, not existing transit. For ridership forecasts between Westhills and Victoria stations, the percentage of Commuter Service customers likely shifting from existing bus service is only equal to the percentage of transit commuter mode share near the stations for buses running at or near the same time as the proposed Commuter train service. The rest comes from car commuters.

For ridership between Westhills and Victoria stations, at the Commuter service scenario proposed here, there would only be four peak-direction trains per day. If train journey times are faster for passengers who currently take bus routes that run near these six train stations, they will likely switch to the Commuter service. If those travel times do not overlap, or if the Commuter service does not offer a faster trip relative to an existing car or bus journey, customers will retain their current travel modes.

For ridership between Courtenay and Victoria (or the CRD region), these potential transit mode shift figures were checked against existing ridership on two express commuter bus routes from the Cowichan Valley – the 66 from Duncan to Victoria and the 99 from Shawnigan Lake to Victoria. The 66 operates four peak-direction runs per day at approximately 80 minutes per trip. The 99 operates two per weekday and takes approximately 90 minutes.

Although ridership data supplied by BC Transit shows average maximum passenger counts of 26 passengers for each AM run of Route 66 from Duncan and 25 passengers on Route 99 from Shawnigan Lake, the methodology of this report's elasticity analysis and train ridership forecasts would not capture any of these figures, as all proposed train service from these locations is an hour after commuter bus service ends. Running additional train service scenarios that overlap with commuter bus schedules would likely show some mode shift transfer above its current proportion of overall travel mode share, but this would still be proportional to the time savings offered by the rail service.

PM service shows the same pattern, but with a greater number of boardings for all scenarios and results are shown in Appendix F: Commuter Rail Assessment and below in Table 16: PM Peak Period Trip Boarding for peak-direction service options The PM peak is typically longer than the AM, resulting in a prolonged period of mode share elasticity for transit use relative to car use. This typically results in higher PM transit boardings, as is shown below.

Table 16: PM Peak Period Trip Boarding for peak-direction service options

Stations	Boardings per station with 4-train service (Case 2B)		
	Initial Service	Intermediate Service	Commuter Service
Victoria	n/a	n/a	387
Admirals			170
Six Mile			53
Atkins			0
Langford			46
Westhills			0
Sub-total	n/a	n/a	656
Avg. per train			164
Shawnigan Lake	182	208	208
Duncan	47	55	55
Ladysmith	76	86	86
Nanaimo	181	213	213
Parksville	242	284	284
Qualicum Beach	2	3	3
Courtenay	0	0	0
Total	730 – 1 train	849 – 1 train	1,505 – 3 Commuter + 1 dual Commuter / Inter-City train
Avg. per train	730 – 1 train	849 – 1 train	376

8 COMMUTER RAIL STATIONS & MAINTENANCE FACILITY

8.1 FOOTPRINT AND AMENITIES

The following assumptions were made to develop the footprint for stations servicing the proposed commuter rail. Costs are noted in Section 9: Cost Estimates.

- Capacity for three 25m passenger cars + one additional locomotive and/or rail car = 100m length
- Single platform for single-direction peak service + contingency = 5m width (500m^2 area total)
- Basic concrete platform approximately 100m X 5m
- Single covered shelter approximately 5m X 2.5m
- Single ticket machine
- Dual platform (median or dual-sided) for dual-track sections and stations (where applicable)

The general opportunities and constraints for each station location are provided in the section below; focusing on the requirements to achieve reasonable, multi-modal access and the basic station template described above.

The Trillium Line in Ottawa (Bayview Station pictured below) demonstrates how trains can service a single-side platform from either direction. The platform is equipped with basic shelters and amenities for passengers.

Figure 28: Comparator Station – Bayview, Trillium Line, Ottawa (www.cbc.ca)

8.2 LOCATIONS

The revised commuter rail service includes 13 upgraded stations whose locations are described in the Table 17: List and Mileages of Inter-City and Commuter Rail Stations. Stations 1 – 6 (Victoria to Westhills, for the Commuter Service scenario) were explicitly identified in the 2011 IBI report as potential future stations. This assessment has revisited those same locations and presents updated descriptions of current conditions and challenges in providing a basic, template station platform and minimal amenities (described further below).

The provision of a basic park and ride amenity is discussed in the descriptions of stations 3 (Six Mile), 5 (Langford), and 6 (Westhills). Supplemental transit connectivity is also discussed in the description of Station 1 (Victoria).

This assessment places the southern terminus of both the Inter-City and Commuter rail services at Victoria Station – located at the western approach of the Johnson Street Bridge (west shore of the Upper Harbour). Consideration for a commuter rail link directly into downtown Victoria was not considered as there is no current connection in place.

Without a fixed link, commuters will alight just west of downtown. Some enhanced multi-modal connectivity features are discussed below to mitigate potential transfer times for commuters. However, this additional time has been worked into the total travel time factors built into the demand model discussed in the previous section.

Table 17: List and Mileages of Inter-City and Commuter Rail Stations

Station Number	Station Name	Inter-City or Commuter	Mileage	General Location Description
1	Victoria	Inter-City / Commuter	0.00	West end of the Johnson Street Bridge
2	Admirals	Commuter	2.63	Lockley Road/Admirals Road intersection, Esquimalt
3	Six Mile	Commuter	5.50	Island Highway/Atkins Avenue intersection, Langford
4	Atkins	Commuter	6.77	Opposite 380 Atkins Road, Langford
5	Langford	Commuter	7.90	Opposite 827 Station Avenue, Langford (Transit Exchange)
6	Westhills	Commuter	10.06	West Shore Parkway/Landing Lane intersection, Langford
7	Shawnigan Lake	Inter-City	27.80	Shawnigan Lake Community Centre, Shawnigan Lake
8	Duncan	Inter-City	39.70	120 Canada Avenue, Duncan
9	Ladysmith	Inter-City	58.40	Transfer Beach Boulevard, Ladysmith
10	Nanaimo	Inter-City	72.50	321 Selby Street, Nanaimo
11	Parksville	Inter-City	95.20	Nicnebec Way and Alberni Highway
12	Qualicum Beach	Inter-City	101.80	198 Sunningdale Road West, Qualicum Beach
13	Courtenay	Inter-City	139.70	899 Cumberland Road, Courtenay

The locations of stations 7 – 13 (Shawnigan Lake to Courtenay) were identified as the nearest to the locations of the former stations that could accommodate a basic, template station platform, minimal amenities, and some provision of park and ride.

These locations north of Westhills were reviewed at high-level in the 2011 IBI report and have been examined to a similar level of detail in this report.

Additional information on station conditions and future station viability is found in Appendix F: Commuter Rail Assessment.

8.2.1 COMMUTER STATIONS

As shown in Figure 29: South Island Commuter Map the proposed Commuter service would make local stops between Langford and Victoria. Each of the proposed stations is outlined below and discussed in more detail in Appendix F: Commuter Rail Assessment. This section precedes discussion of Inter-City service within this report because these station sites are closest to Victoria and were reviewed in IBI's 2011 Commuter Rail report.

Upon reflecting on the findings and analysis of this report, it has been determined that Atkins Station in Langford does not present a viable option for a station location. This option was originally explored to build on previous studies which evaluated this location and to validate it. Due to ridership, catchment, safety, and limited benefits per costs associated with its construction it has been identified as a non-viable station location. It is discussed in this report only to demonstrate the assessment of these factors.

Figure 29: South Island Commuter Map

8.2.1.1 *STATION 1 – VICTORIA (INTER-CITY & COMMUTER SERVICE) – MILEAGE 0.00*

EXISTING CONDITIONS

Victoria Station is the southern terminus of both the Inter-City and Commuter service lines. The rail terminus location, shown in the figure below, ends to the south of and roughly parallel to Esquimalt Avenue at its intersection with Harbour Road – approximately 120m west of the Johnson Street Bridge span.

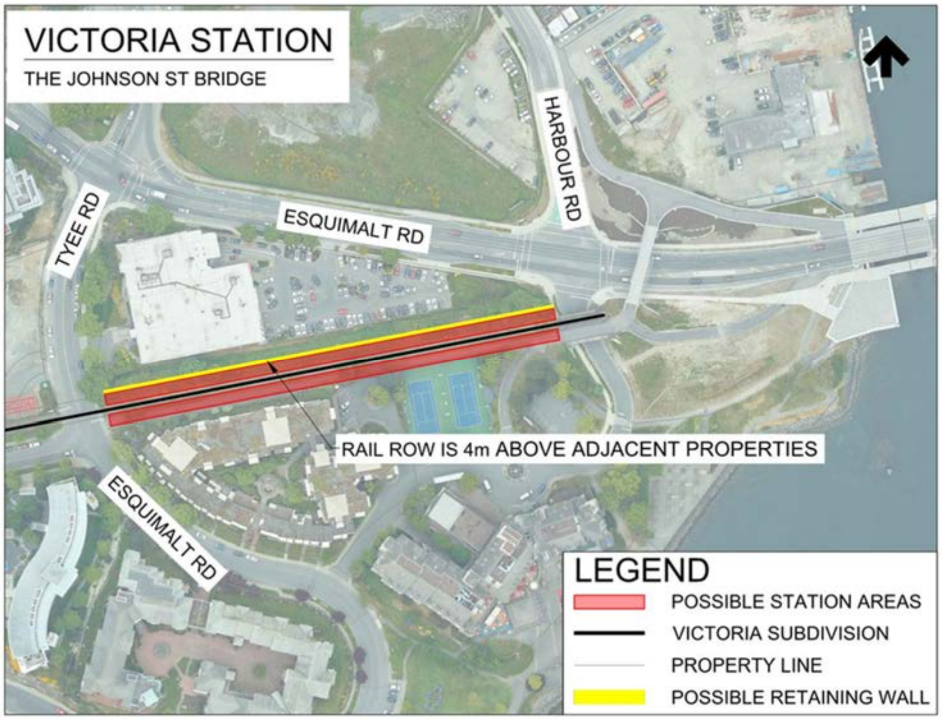


Figure 30: Victoria Station layout, context, options

The rail line is elevated approximately 4m above Esquimalt Road, Harbour Drive, and adjoining properties to the north. The linear rail property itself is bounded by a residential development immediately to the south, Harbour Drive to the east, a car dealership on the north, and Tyee Road to the west – a length of 220m. A 4m-wide multi-use path runs adjacent and parallel to the line on its south side, which connects to the pedestrian and cycling networks across the Johnson Street Bridge for access into downtown and to a smaller bridge over Esquimalt Road.

CHANGES SINCE 2011

The priority of the road and rail alignments to the bridge have been reversed since the 2011 IBI report. The previous alignment of Esquimalt Road followed the original rail alignment to the bridge. The connection to Esquimalt Road was indirect and ran around and under the original bridge alignment. As part of the Johnson Street Bridge reconstruction in 2017, the priority of alignment was reversed. Esquimalt Road is now the more direct connection to the bridge and the rail line’s previous bridge alignment has been severed. The former station house on the east side of the bridge (not in aerial but referenced in the 2011 report) was also removed to accommodate a new westbound alignment for Pandora Avenue vehicle traffic.

The new alignment provides more options for both pedestrians and cyclists. The former rail bridge on the north side of the vehicle bridge has been replaced with a multi-path bridge for cyclists and pedestrians. However, on-road cycle lanes also exist on both sides of the bridge for both eastbound and westbound cyclists. Pedestrians also can cross on either side of the bridge, foregoing the need for additional crossings on both approaches to access a single side of the bridge.

For Inter-City and Commuter rail service, the primary outcome of this change has been a severing of simpler connectivity into downtown. Without significant investment in new bridge realignment or tunnel infrastructure, the fixed location of the rail line will restrict the service's southern terminus to this location at the west end of the bridge.

TEMPORARY TRAIN STORAGE

All rail operating scenarios (Initial, Intermediate, and Commuter) require storage capacity for off-peak trains at or near Victoria Station. This ranges from one train for the Initial? and Intermediate service scenarios to four trains for the Commuter service scenario. This is temporary, daily off-peak storage only but requires between 150m and 800m total linear metres of train storage space (assuming 100m per train + 25m for gaps and contingency).

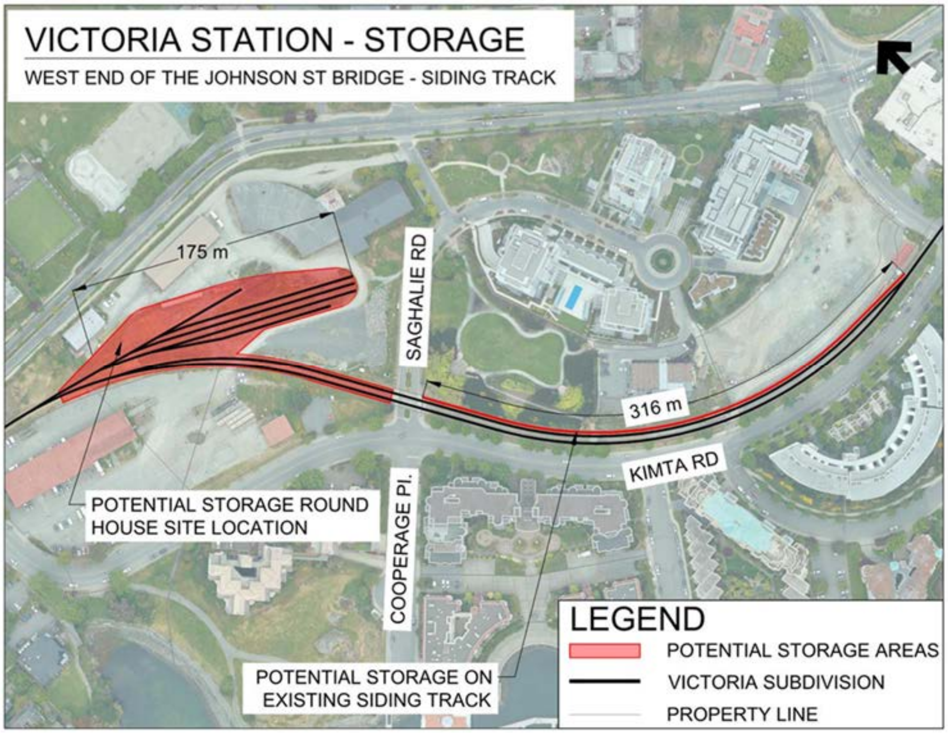


Figure 31: temporary train storage options at Victoria Station

Temporary storage space for up to four trains of this assumed length is potentially available in the vicinity of Victoria Station, but this is contingent upon local development, track management capacity, and any additional car-servicing needs during off-peak storage times.

This includes the potential use of the IRC Roundhouse location, which is still zoned for transportation use. However, this is challenged by its position within the Bayview place development proposal; a multi-use development that proposes to use the current Roundhouse site as its centre market. While a large-scale, urban development would undoubtedly benefit from its proximity to a commuter rail line, the potential for utilization of this area as an active, train operations or storage facility will need to be carefully negotiated and managed with the property owners and Bayview place development team.

8.2.1.2 *STATION 2 – ADMIRALS ROAD – MILEAGE 2.63*

EXISTING CONDITIONS

Admirals Station is located adjacent to the intersection of Admirals Road and Colville Road in Esquimalt. The station itself would be located on the north side of the westbound Admirals Road approach and to the south of the Galloping Goose trail, which runs parallel to and just north of the IRC alignment.

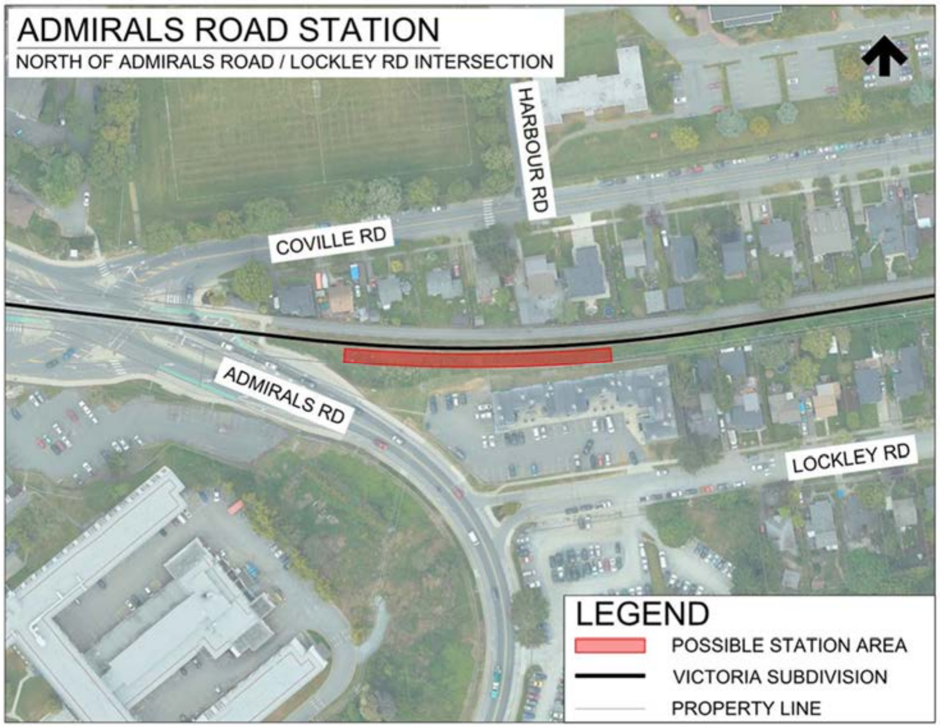


Figure 32: Esquimalt Station layout and context

The station site is opposite the Esquimalt Navy Base, and many nearby land uses reflect housing, commercial, and recreational needs of naval and military personnel. Indicative of this, the 2011 IBI report placed a potential, future station at 1250 Lockley Road, a lot which has since been developed and is now occupied by a Seaspan facility.

CHANGES SINCE 2011

Aside from the introduction of the Seaspan facility and some cycling infrastructure improvements through the intersection, there have been relatively few, significant changes to the station area since 2011.

8.2.1.3 *STATION 3 – SIX MILE – MILEAGE 5.50*

EXISTING CONDITIONS

Six Mile Station would be located near the intersection of Atkins Road and Brydon Road in Langford; approximately halfway between Island Parkway (150m to the south) and the Trans Canada Highway (150m to the north). As shown in Figure 33: Six Mile Station layout, context, and options, this is a relatively remote area with few adjoining land uses in the immediate vicinity. Thee are some residences to the south and west of the station area and a mix of commercial and retail to the south on Island Highway near Six Mile Road.

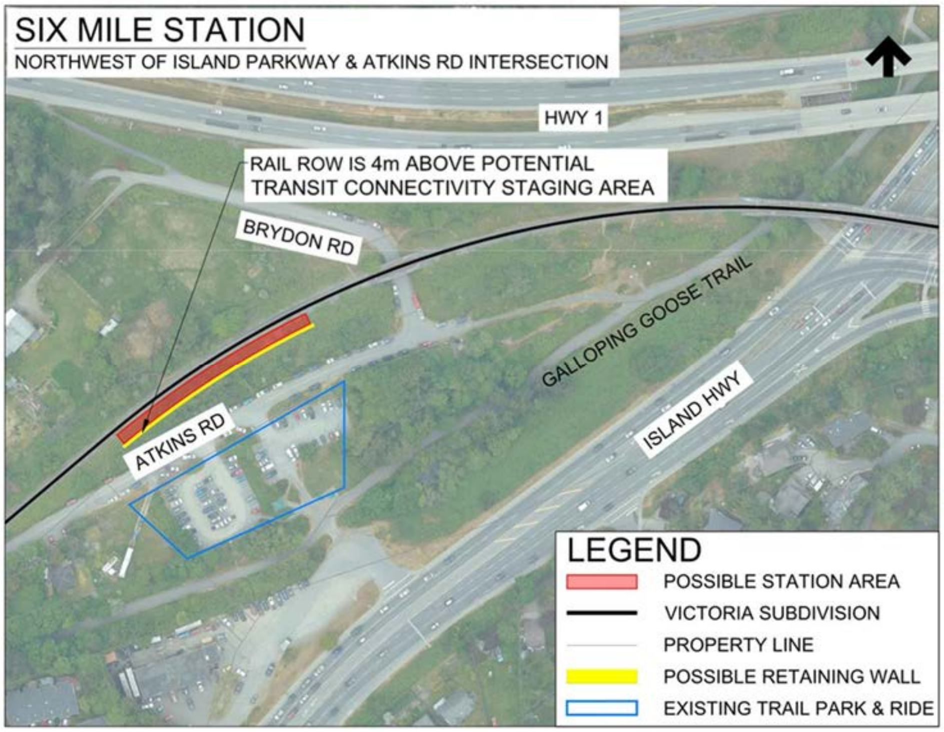


Figure 33: Six Mile Station layout, context, and options

The station is situated close to the highway on/off ramps and off a major arterial; including pedestrian access to express commuter bus service directly to downtown. However, the local pedestrian infrastructure is limited to 1.5m wide sidewalks directly on the 5-7 lane arterial. It is a 360m walk along Island Highway to cross to the north at Burnside Road and 390m to cross it to the south at Six Mile Road. It is two kilometres north of Colwood Transit Exchange.

Vehicle access to the station is currently blocked from Island Highway by bollards separating a small access road to a commercial business from the Galloping Goose Trail and a park and ride for trail riders. Motorists access the park and ride from Atkins Road via Six Mile Road, 500m to the west.

CHANGES SINCE 2011

There have been relatively few, significant changes to the immediate station area since the 2011 IBI report.

8.2.1.4 *STATION 4 – ATKINS STATION – MILEAGE 6.77*

EXISTING CONDITIONS

The Atkins Station site is in a low-density, residential area approximately 2 kilometres southwest of the Six Mile Station site. The proposed station area is just west of the single track's crossing of Atkins Avenue, opposite the residences at 364-380 Atkins Avenue.

Access to and around the station area is predominantly by car. There are no sidewalks in the immediate vicinity of the station and although there is a connecting link to the Galloping Goose Trail 280m to the east, there is otherwise no cycle infrastructure on Atkins Avenue; a relatively narrow, 2-lane road with a 30 km/hr posted speed.

There is currently no direct pedestrian or vehicle access to Goldstream Avenue, a major arterial and potential catchment area 300m to the south. The station site is served by BC Transit's 53 bus route, providing local service between the Langford and Colwood transit exchanges. The only road illumination is from vehicle headlamps and lighting from the homes on the north side of the road.

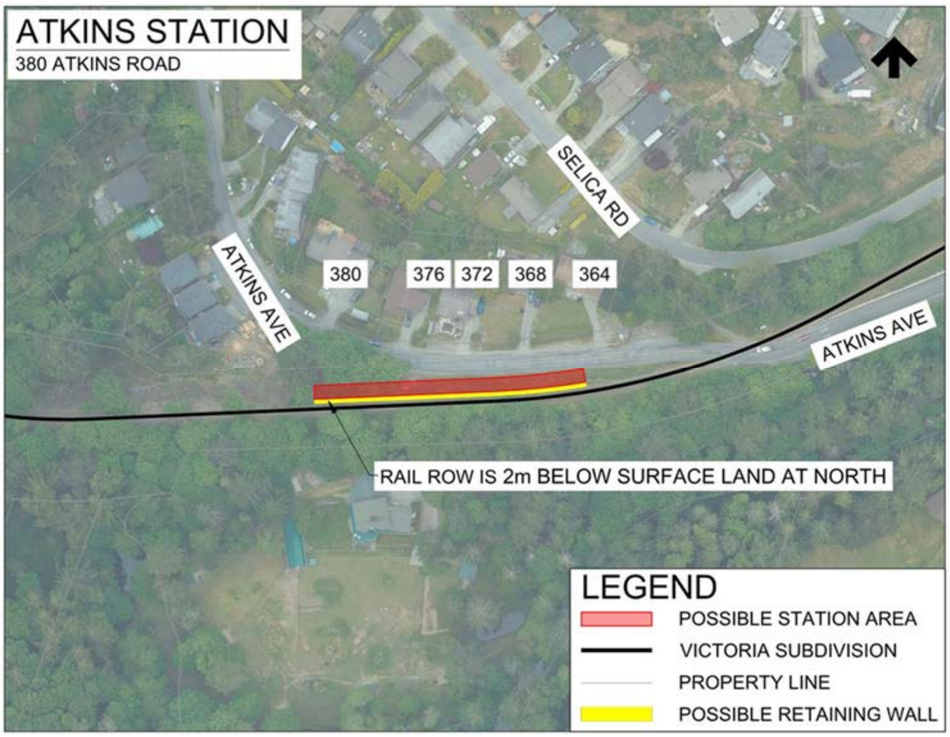


Figure 34: Atkins Station layout and context

As with stations 1 and 3, the rail line at Atkins Station runs atop a steep wooded ridge sloping down to the south. The crossing and station area traverses a utility corridor, further limiting any dual-track or expanded station platform capacity. Visibility from the site of a potential platform is limited to less than 50m to the west due to a 90-degree bend in the road and less than 80m to the east due to vegetation and changes to the road's horizontal and vertical profile.

Upon reflecting on the findings and analysis, it has been determined that Atkins Station does not present a viable option for a station location. This is due to ridership, catchment, safety, and limited benefits per costs associated with its construction.

CHANGES SINCE 2011

Local land uses and road network characteristics do not demonstrate many changes since the 2011 report.

8.2.1.5 *STATION 5 – LANGFORD STATION – MILE 7.90*

EXISTING CONDITIONS

The Langford Station site is located adjacent to the existing BC Transit Langford Transit Exchange on Station Avenue between Jacklin Road and Peatt Road in central Langford. The line runs north of the existing transit exchange's eight sawtooth bay curbs (see Figure 35: Langford Station layout and context). The transit exchange serves 14 bus routes, including the 50, which runs express from Langford to downtown Victoria via Island Parkway and Highway 1.

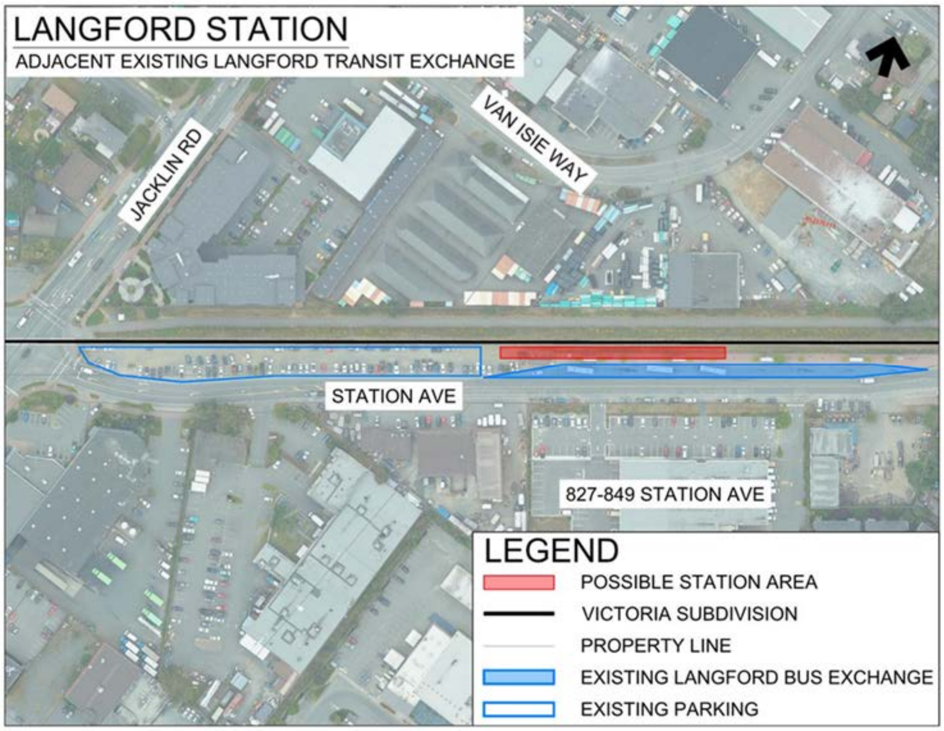


Figure 35: Langford Station layout and context

The location is surrounded by commercial and light industrial uses, with residences 200m beyond. The Langford Official Community Plan (2008, updated 2019) identifies this location as the site of a "Major Transit Exchange" and stop on a commuter rail alignment.

CHANGES SINCE 2011

There have been relatively few, significant changes to the immediate station area since the 2011 IBI report.

8.2.1.6 *STATION 6 – WESTHILLS STATION – MILEAGE 10.06*

EXISTING CONDITIONS

The Westhills Station site is located in the Goldstream neighbourhood of Langford, just west of Langford Lake and three kilometres south of Highway 1. The 2011 reported tentatively placed a future station just north of the IRC track and to the west of the then-unbuilt portion of West Shore Parkway. This portion of West Shore Parkway is newly-constructed, as is most of the adjacent land development. The road is an arterial that connects Langford Centre and Westhills Stadium in the east to Highway 1 to the north.

Figure 36: Westhills Station layout, context, and options

The Goldstream neighbourhood is a developing area and consists of a mix of newly-built homes and businesses, cleared development sites, and wooded hills. It is Langford's – and the Capital District Region's – westernmost developing area.

Bus stops at the site currently serve the limited express 47 bus route, running twice inbound and twice outbound per weekday to downtown Victoria via Highway 1; and the local 58 route, running to Langford Transit Exchange once per hour every day.

The Langford Official Community Plan (2008, updated 2019) identifies this area off West Shore Parkway as the site of a "Major Transit Exchange" and stop on a commuter rail alignment. However, lots to the northeast, northwest, and southeast of the general site have either been developed or are currently under development. The southwest portion of the site is a heavily-forested rise that terminates at a BC Hydro right of way corridor just south of the track.

Similar to Station 4 (Atkins), the rail intersects the road between two bends, limiting visibility to the south and north from the points of the crossing and a future station. The curvature of the roadway limits visibility to approximately 80m to the south and 100m to the north.

CHANGES SINCE 2011

Since the 2011 IBI report, the adjacent lots north of the track have since been developed or are currently under development. The lots to the north of the track and west of West Shore Parkway are now home to 150 residences at Kettle Point and a new commercial-area development in the West Shore Business Park. The 3.5 ha site to the north of the track and east of West Shore Parkway is the site of Aqua Langford Lake, a planned residential community of 950 residences situated on Langford Lake.

TEMPORARY TRAIN STORAGE

The operating service scenarios noted in this report require between three and six trains to be stored overnight and on weekends/non-service days at or near Westhills Station. This requires a storage facility be constructed in close proximity of the station with facilities for temporary maintenance, heating, and personnel access road. Given the local constraints noted in this section, and the alignment and topography constraints north of Westhills noted elsewhere in this report, the only viable location for is on the south side of the rail west of West Shore Parkway. This could be accommodated in the linear corridor adjacent to the existing track, but again, would likely require relocation and/or burial of the overhead utility lines.

8.2.2 INTER-CITY STATIONS

As shown in Figure 37: Inter-City Map the proposed Inter-City service would travel up the southeast coast of Vancouver Island. Each of the proposed stations is outlined below and discussed in more detail in Appendix F: Commuter Rail Assessment.

Figure 37: Inter-City Map

8.2.2.1 *STATION 7 – SHAWNIGAN LAKE – MILEAGE 27.80*

The Shawnigan Lake Station would be located adjacent to the former station site at the northeast shore of the lake – behind the Shawnigan Lake Commuter Centre, west of the intersection of Shawnigan Lake Road and Mill Bay. The area is a mix of local retail land uses and nearby residences. There are no sidewalks or formal cycle facilities on Shawnigan Lake Road, but it is a two-lane, narrow road through the village centre with clear sight lines to pedestrians on a 2.0m – 3.0m hard shoulder.

The Community Centre area is served by BC Transit's Cowichan Valley Regional Service, with 7 trips per day between Shawnigan Lake and downtown Duncan; a 1 hour, 10-minute one-way trip. The Shawnigan Lake commuter ervice (Route 99) makes two trips to/from the Government Centre transit exchange in Victoria at 90 minutes per trip.

With a limited pedestrian and cycling catchment within 800m, the majority of station demand would be vehicle trips and park and ride. There is some space within the Community Centre and adjacent Shawnigan Lake Museum lots for additional parking, pending environmental and arboreal assessments.

8.2.2.2 *STATION 8 – DUNCAN – MILEAGE 39.70*

The station house is still located at 120 Canada Avenue, in downtown Duncan, where it was prior to the suspension of the Dayliner service in 2011. The original station house is now part of the Cowichan Valley Museum facility.

The station easily accessible to the city's multi-modal transportation network and three-hour, public parking; some of which would have to be removed if the line were to be double-tracked. The area is well-served by Cowichan Valley Regional Transit. The Canada at Station stop, located in front of the original station/museum, is a major downtown stop, served by the 2, 3, 4, 5, 6, 7, 8, 9, 36 and 44 routes.

Station catchment would be served by pedestrian, cycling, driving, and transit connections.

8.2.2.3 *STATION 9 – LADYSMITH – MILEAGE 58.40*

The former Via Rail station was located near the intersection of Trans-Canada Highway with Gatacre Street in Ladysmith. The station and track are to the northeast of the highway, but at a grade approximately 3m below the highway. The station sits on the rise of a slope overlooking the harbour and is obscured by overgrowth.

The only access to the site is currently by vehicle from an access road off of Transfer Beach Boulevard. There is no transit on Trans-Canada Highway and the only pedestrian access is via the crossing at Transfer Beach Boulevard en-route down to Transfer Beach Park.

8.2.2.4 *STATION 10 – NANAIMO – MILEAGE 72.50*

The original station building is located at 321 Selby Street in Nanaimo, approximately 500m west of central Nanaimo. The historic building is now occupied by a pub and is accessible from Selby Street via a marked pedestrian crossing over the tracks from Prideaux Street. The station is in a densely-populated neighbourhood with a mature, multi-modal network of sidewalks, cycle facilities, parking, and transit.

The 9m ROW provides sufficient width double-tracking and a centre platform; should passenger demand warrant. The urban transportation network provides easy access, but rail speeds would necessarily be slow through most of Nanaimo to reduce conflicts. There are ten level crossings in the two kilometres between Seventh Street and Comox Road in central Nanaimo. Rail speeds and road operation impacts would need to be reviewed prior to determining appropriate mitigation measures.

8.2.2.5 *STATION 11 – PARKSVILLE – MILEAGE 95.20*

The original Parksville Station is located near the intersection of Nicnebec Way and Alberni Highway, 1.6 kilometres southwest of central Parksville. The station building still sits on Nicnebec Way on the south side of the tracks, east of

Alberni Highway. The station is near two major highways and the entry point to the City of Parksville, but it is remotely located from transit, cycling, and pedestrian infrastructure. Access is primarily by car and without significant enhancements to multi-modal connections, the demand catchment would be limited to vehicles and park and ride customers.

However, should the catchment be contained primarily to park and ride, there is sufficient space adjacent to the station and ROW for double-track and platform alignments.

8.2.2.6 *STATION 12 – QUALICUM BEACH – MILEAGE 101.80*

The historic Qualicum Beach Station is located at 198 Sunningdale Rd W, Qualicum Beach, near the centre of the village. It can be accessed from all three adjacent roads: Harlech Road, Beach Road and Sunningdale Road and is a 15-minute walk from the beach. For a village the size of Qualicum Beach, the demand catchment is well-served by vehicle and pedestrian proximity. Parking is also available for expanded park and ride.

8.2.2.7 *STATION 13 – COURTENAY – MILEAGE 139.70*

Courtenay Station is located at 899 Cumberland Road, at the southwest end of central Courtenay and about 900m southwest of the Courtenay River. The area around the station is a mix of light industrial land uses.

There is some multi-modal access to the station area, via the #8 bus route, adjacent Rotary Connector trail, and a cycling and sidewalk network to adjacent businesses and neighbourhoods. The station building includes a parking lot on the south side, with access directly from Cumberland Avenue.

8.3 MAINTENANCE FACILITY

The preliminary assumption was that maintenance of new commuter rail rollingstock would be done at the Wellcox Yard Maintenance Facility located in Nanaimo. However, if a dedicated facility is desired, assumptions about the facility requirements and costs have been made and carried for the purposes of this report. To develop a high level estimate the following inputs were considered:

- Site preparation
- Utilities
- Trackwork
- Buildings
- Shop Equipment

9 COST ESTIMATES

Cost estimates have been developed with input from MoTI and in accordance with MoTI's best practices for cost estimation. WSP has developed the **Construction Cost** estimates based on Phased Improvement options discussed in Section 6.2: Phased Improvements. The rates used represent costs associated with MoTI best practices for cost estimation for improvements of this scale and complexity. Please refer to Table 19: MoTI Contingencies.

The cost estimate splits the rail corridor into six segments to show where costs are geographically located. In addition, the cost estimates have been broken down into three phases: Initial, Intermediate and Ultimate. For basis of each estimate, refer to Appendix G: Cost Estimate.

Furthermore, this condition assessment is an update to previous condition assessments. In order to appreciate the changes in conditions over time, the cost estimates for the 2009 HMM report and ICF/SVI Budget Estimate – 2018/2019 are shown below in Table 18: Previous Cost Estimates. WSP's 2019 Cost Estimates are subsequently included in Table 18 – Table 24 and are in 2020 dollars except where escalations are accounted for in Table 25: Cost Escalation.

For reference, the 2009 HMM report outlines an upgrade program that is consistent with WSP's Initial Phase Improvements. However, HMM's detailed estimate was not available for review so this comparison is based on their report and summary cost estimates only. The ICF/SVI Budget Estimate outlines an upgrade program that is consistent with WSP's Intermediate Phase Improvements. Therefore, compare these previous cost estimates to WSP's Initial and Intermediate **Construction Cost** estimates only. Therefore, exclude MoTI contingency and rates.

A detailed risk registry was not conducted as part of this assessment. However, some high-level risks have been identified in Table 26: High Level Risk Identification.

Table 18: Previous Cost Estimates

	Segment 1 (Victoria to Langford)	Segment 2 (Langford to Duncan)	Segment 3 (Duncan to Nanaimo)	Segment 4 (Nanaimo to Parksville)	Segment 5 (Parksville to Courtenay)	Sub Total (Victoria Subdivision)	Sub Total (Port Alberni Subdivision, Segment 6)	Island Rail Corridor Total
ICF/SVI Budget Estimate 2018 /2019 **(comparable to Initial Phase: Class 2 Track)**	$42,690,936			$52,339,991		**$95,030,927**	**$53,061,852**	**$148,092,779**
Hatch Mott MacDonald 2009 Reference Report **(comparable to Intermediate Phase: Class 3 Track & 286lb Upgrade)**	$88,240,000	$20,640,000	$61,720,000			**$170,600,000**	**$25,700,000**	**$196,300,000**

Table 19: MoTI Contingencies

Contingencies	Percentage
Project Management & Administration	10%
Engineering	12%
Construction supervision	10%
Contingency	50%
First Nations Consultation	15%
TOTAL =	97%

Table 20: Initial Phase Cost

Initial Phase: Class 2 Track									
Item #	Description of work	Segment 1 (Victoria to Langford)	Segment 2 (Langford to Duncan)	Segment 3 (Duncan to Nanaimo)	Segment 4 (Nanaimo to Parksville)	Segment 5 (Parksville to Courtenay)	Sub Total (Victoria Subdivision)	Sub Total (Port Alberni Subdivision, Segment 6)	Island Rail Corridor Total
1	**Construction**	$7,367,385	$24,237,778	$32,507,005	$16,553,861	$34,719,448	$115,385,478	$50,324,366	$165,709,843
2	**Construction Supervision (10%)**	$736,739	$2,423,778	$3,250,700	$1,655,386	$3,471,945	$11,538,548	$5,032,437	$16,570,984
	Construction Sub-Total	**$8,104,124**	**$26,661,556**	**$35,757,705**	**$18,209,247**	**$38,191,393**	**$126,924,025**	**$55,356,802**	**$182,280,828**
3	**Engineering (12%)**	$884,086	$2,908,533	$3,900,841	$1,986,463	$4,166,334	$13,846,257	$6,038,924	$19,885,181
4	**Project Management & Administration (10%)**	$736,739	$2,423,778	$3,250,700	$1,655,386	$3,471,945	$11,538,548	$5,032,437	$16,570,984
5	**First Nation Consultation & Accommodation**	$1,105,108	$3,635,667	$4,876,051	$2,483,079	$5,207,917	$17,307,822	$7,548,655	$24,856,477
6	**Contingency (50%)**	$3,683,693	$12,118,889	$16,253,502	$8,276,931	$17,359,724	$57,692,739	$25,162,183	$82,854,922
	Other Cost Sub-Total	**$6,409,625**	**$21,086,867**	**$28,281,094**	**$14,401,859**	**$30,205,920**	**$100,385,365**	**$43,782,198**	**$144,167,564**
	Total Project Costs	**$14,513,749**	**$47,748,423**	**$64,038,799**	**$32,611,106**	**$68,397,313**	**$227,309,391**	**$99,139,001**	**$326,448,391**

Table 21: Intermediate Phase Cost

Intermediate Phase: Class 3 Track & 286lb Upgrade									
Item #	Description of work	Segment 1 (Victoria to Langford)	Segment 2 (Langford to Duncan)	Segment 3 (Duncan to Nanaimo)	Segment 4 (Nanaimo to Parksville)	Segment 5 (Parksville to Courtenay)	Sub Total (Victoria Subdivision)	Sub Total (Port Alberni Subdivision, Segment 6)	Island Rail Corridor Total
1	**Construction**	$6,988,850	$16,897,101	$25,824,054	$14,094,345	$26,717,794	$90,522,143	$23,983,207	$114,505,351
2	**Construction Supervision (10%)**	$698,885	$1,689,710	$2,582,405	$1,409,434	$2,671,779	$9,052,214	$2,398,321	$11,450,535
	Construction Sub-Total	**$7,687,734**	**$18,586,811**	**$28,406,459**	**$15,503,779**	**$29,389,574**	**$99,574,358**	**$26,381,528**	**$125,955,886**
3	**Engineering (12%)**	$838,662	$2,027,652	$3,098,886	$1,691,321	$3,206,135	$10,862,657	$2,877,985	$13,740,642
4	**Project Management & Administration (10%)**	$698,885	$1,689,710	$2,582,405	$1,409,434	$2,671,779	$9,052,214	$2,398,321	$11,450,535
5	**First Nation Consultation & Accommodation**	$1,048,327	$2,534,565	$3,873,608	$2,114,152	$4,007,669	$13,578,322	$3,597,481	$17,175,803
6	**Contingency (50%)**	$3,494,425	$8,448,551	$12,912,027	$7,047,172	$13,358,897	$45,261,072	$11,991,604	$57,252,675
	Other Cost Sub-Total	**$6,080,299**	**$14,700,478**	**$22,466,927**	**$12,262,080**	**$23,244,481**	**$78,754,265**	**$20,865,390**	**$99,619,655**
	Total Project Costs	**$13,768,034**	**$33,287,290**	**$50,873,385**	**$27,765,860**	**$52,634,054**	**$178,328,623**	**$47,246,918**	**$225,575,541**

Table 22: Ultimate Phase Cost

Ultimate Phase: Ballast Program									
Item #	Description of work	Segment 1 (Victoria to Langford)	Segment 2 (Langford to Duncan)	Segment 3 (Duncan to Nanaimo)	Segment 4 (Nanaimo to Parksville)	Segment 5 (Parksville to Courtenay)	Sub Total (Victoria Subdivision)	Sub Total (Port Alberni Subdivision, Segment 6)	Island Rail Corridor Total
1	**Construction**	$3,648,816	$17,022,148	$18,146,356	$11,473,194	$22,163,796	$72,454,310	$17,268,721	$89,723,031
2	**Construction Supervision (10%)**	$364,882	$1,702,215	$1,814,636	$1,147,319	$2,216,380	$7,245,431	$1,726,872	$8,972,303
	Construction Sub-Total	**$4,013,698**	**$18,724,363**	**$19,960,992**	**$12,620,513**	**$24,380,176**	**$79,699,741**	**$18,995,594**	**$98,695,335**
3	**Engineering (12%)**	$437,858	$2,042,658	$2,177,563	$1,376,783	$2,659,656	$8,694,517	$2,072,247	$10,766,764
4	**Project Management & Administration (10%)**	$364,882	$1,702,215	$1,814,636	$1,147,319	$2,216,380	$7,245,431	$1,726,872	$8,972,303
5	**First Nation Consultation & Accommodation**	$547,322	$2,553,322	$2,721,953	$1,720,979	$3,324,569	$10,868,147	$2,590,308	$13,458,455
6	**Contingency (50%)**	$1,824,408	$8,511,074	$9,073,178	$5,736,597	$11,081,898	$36,227,155	$8,634,361	$44,861,516
	Other Cost Sub-Total	**$3,174,470**	**$14,809,269**	**$15,787,330**	**$9,981,679**	**$19,282,503**	**$63,035,250**	**$15,023,788**	**$78,059,037**
	Total Project Costs	**$7,188,168**	**$33,533,632**	**$35,748,321**	**$22,602,192**	**$43,662,678**	**$142,734,991**	**$34,019,381**	**$176,754,372**

Table 23: Commuter Rail Service Cost

Commuter Rail Service		
Item #	**Description of work**	**Segment 1 (Victoria to Langford)**
1	**Signalling Upgrades**	$26,000,000
2	**Rollingstock x 7**	$38,430,000
3	**New Stations x 6**	$27,192,850
4	**Property Acquisition**	$44,237,000
5	**New Commuter Storage Tracks**	$1,637,950
6	**Maintenance Facility**	$60,000,000
7	**Phased Improvements**	
7.1	**Victoria to Langford: Initial Phase**	$7,367,385
7.2	**Victoria to Langford: Intermediate Phase**	$6,988,850
7.3	**Victoria to Langford: Ultimate Phase**	$3,648,816
	Total Construction	**$230,979,628**
8	**Construction Supervision (10%)**	$23,097,963
	Construction Sub-Total	**$254,077,591**
9	**Engineering (12%)**	$27,717,555
10	**Ministry Overheads (10%)**	$23,097,963
11	**First Nation Consultation & Accommodation**	$34,646,944
12	**Contingency**	$255,489,814
	Other Cost Sub-Total	**$340,952,276**
	Total Project Costs	**$595,029,867**

Table 24: Costs for Combining Sequential Phases

Costs for Combining Sequential Phases (includes MoTI contingencies)								
	Segment 1 (Victoria to Langford)	Segment 2 (Langford to Duncan)	Segment 3 (Duncan to Nanaimo)	Segment 4 (Nanaimo to Parksville)	Segment 5 (Parksville to Courtenay)	Sub Total (Victoria Subdivision)	Sub Total (Port Alberni Subdivision, Segment 6)	Island Rail Corridor Total
Initial Phase	$14,513,749	$47,748,423	$64,038,799	$32,611,106	$68,397,313	**$227,309,391**	$99,139,001	**$326,448,391**
Intermediate = Initial + Intermediate	$28,281,783	$81,035,713	$114,912,185	$60,376,966	$121,031,367	**$405,638,013**	$146,385,919	**$552,023,932**
Ultimate = Initial + Intermediate + Ultimate	$35,469,950	$114,569,344	$150,660,506	$82,979,158	$164,694,045	**$548,373,004**	$180,405,300	**$728,778,304**
Commuter Rail Service	$595,029,867	N/A						**$595,029,867**

The MoTI has requested a scenario to illustrate how cost escalation would impact the price of future phased works up to 2031. To illustrate this scenario, it is assumed the Initial Phase Improvements are completed in 2021, Intermediate Phase Improvements in 2026, followed by Ultimate Phase Improvements with the Commuter Rail Service in 2031. Please refer to Table 25: Cost Escalation

Table 25: Cost Escalation

Costs for Combining Sequential Phases: With 3% Annual Escalation (includes MoTI contingencies)								
	Segment 1 (Victoria to Langford)	Segment 2 (Langford to Duncan)	Segment 3 (Duncan to Nanaimo)	Segment 4 (Nanaimo to Parksville)	Segment 5 (Parksville to Courtenay)	Sub Total (Victoria Subdivision)	Sub Total (Port Alberni Subdivision, Segment 6)	Island Rail Corridor Total
Initial Phase (2021)	$14,949,162	$49,180,876	$65,959,963	$33,589,439	$70,449,232	**$234,128,673**	**$102,113,171**	**$336,241,843**
Intermediate Phase (2026)	$16,439,752	$39,746,764	$60,745,483	$33,153,888	$62,847,814	**$212,933,701**	**$56,415,291**	**$269,348,993**
Ultimate Phase (2031)	$9,950,105	$46,418,389	$49,484,037	$31,286,720	$60,439,358	**$197,578,609**	**$47,090,780**	**$244,669,388**
Commuter Rail Service (2031)	$823,660,496	N/A						**$823,660,496**

A detailed risk registry was not conducted as part of this assessment. However, some high-level risks have been identified and listed below in Table 26: High Level Risk Identification

Table 26: High Level Risk Identification

Risk Category	Risk Item	Risk Description
Engineering	Unidentified bridge defects	The 2019 bridge inspections were limited to basic visual inspections of most bridge components and the previous detailed bridge inspections are 9 years old. Detailed bridge inspections occurring prior to the reestablishment of rail traffic may observe undocumented defects which would affect the load carrying capacity of a bridge and may require some level of rehabilitation.
Engineering	Accelerated rate of bridge deterioration	As the existing rail structures continue to age the rate of bridge deterioration may accelerate due to increased exposure to debris, coating failure and stress caused by the reestablishment of rail traffic. The accelerated rate of deterioration may increase the number of structures that require rehabilitation or replacement within the next 50 years.
Engineering	Seismic Retrofit Costs	The costs developed for the seismic retrofit implementation (construction) program were developed under the assumption that the structures would require seismic upgrades. Since no analysis was performed, the actual extent of rehabilitation necessary is unverifiable.
Engineering	Bridge Replacement Costs	Bridge replacement costs were based on assumed unit rates for similar structures and actual replacement costs may vary.
Geotechnical	Underground Mineworkings	Underground mineworking in Nanaimo and Cumberland Areas. Possible surface subsidence associated with collapse either due to time or possible seismic shaking.
Geotechnical	Liquefiable Soils	Areas where soils may be susceptible to liquefaction during a seismic shaking event. Could cause localised loss of support and/or lateral spread. See seismic memo.
Geotechnical	Upslope Rockfall Hazard	Relating to large slope above Cameron Lake - rockfall source zone may be present significant distance outside the railway corridor.
First Nations Consultation	First Nations Support	Partnering/Involvement of First Nation with project.
Planning	Change in Future Demand	Viability of business case (freight/commuter/tourist) to sustain railway operation long term.
Environment	Climate Change	Influence of weather pattern changes on engineering/construction costs of infrastructure.
Engineering	Pit Source	Development of source of locally supplied ballast, grade material.
Engineering	Disposal of retired track material	Finding accepting destinations for defunct creosote ties, rail steel, contaminated ballast.
Environment	Archeological Investigation	First Nation artifacts discovered during revitalization of rail line.
Engineering	Road Authority Funding	At some if not all of the 93 rail crossings where the Ministry is not the Road Authority, a municipality may not have access to the necessary funding needed to pay for the improvements required to improve the at-grade crossing.
Engineering	Standards Change	The conditions of the provincially regulated grade crossings were measured against the standards prescribed in the federal Grade Crossing Regulations (2014) and Grade Crossing Standards (2014) which Technical Safety BC is anticipated to adopt. If Technical Safety BC does not adopt these standards, then fewer improvements may be required for the railway crossings to be deemed compliant.
Engineering	Change in Future Traffic Conditions	Traffic volumes may increase beyond those anticipated in the assessment at any or all 124 passive crossings or any or all 96 active crossings equipped with Flashing Lights & Bells that would require a higher level of protection.
Engineering	Change in Future Rail Operations	Train volumes may increase beyond those anticipated in the assessment at any or all 124 passive crossings or any or all 96 active crossings equipped with Flashing Lights & Bells that would require a higher level of protection.
Engineering	Change in Track Elevation	If the elevation of the rail is raised/lowered by the Railway Company to such an extent that the Road Approaches would need to be reconstructed to meet the maximum

		permissible grades than the Railway Company may be responsible for funding that improvement (subject to the terms of the Grade Crossing Agreement).
Engineering	Encroachment of Developments	Future developments adjacent to the rail corridor may result in obstructions (buildings, landscaping, etc.) that block sight lines resulting in a higher level of protection at a crossing, e.g. flashing lights, bells and gates.
Planning	Future developments	Future developments may cause locations of proposed stations and ridership to be re-evaluated.
Planning	Commuter Rail & Inter-City Service change	Changes to the proposed level of service could impact all elements of the project and should be re-evaluated as necessary.
Planning	Station foot print and amenities change	A change in station requirement may impact the station function and foot print.
Planning	Public infrastructure adjacent to track	An introduction of public infrastructure such as bikeways and footpaths may limit the viability of future double tracking along the corridor.
Properties	Track storage property	Additional land may need to be acquired for new rail car maintenance facility and storage tracks due to increase in level of service.
Properties	Station property	Additional property may be required for stations if station requirements change
Engineering	Signalling - Yards and Maintenance Facility	There is a risk that a signalling system will be required in the non-mainline track, including yards and maintenance facility to provide safe train separation and protection for train movements within the yard. This may increase the cost of the signalling system.
Engineering	Signalling - Brownfield	There is a risk that the existing Brownfield track conditions may require the Signalling designs to change due to unanticipated track layout and intersection conditions.
Engineering	Signalling - Technology	There is a risk that the interoperability challenges with Freight rail may force a change to the Signalling system technology design selection (e.g. Fixed Block conventional signalling to Positive Train Control PTC).
Procurement	Vehicle - Late Delivery	Late delivery of the first vehicles for testing and commissioning will delay the opening of the network for revenue service.
Procurement	Vehicle - Testing Certification	Vehicle fails testing requiring redesign of sub-system or component, delaying the opening of the network for revenue service.
Procurement	Vehicle - Interoperability with freight trains	Interoperability of Light Rail vehicles with Freight impacts with system certification.
Procurement	Vehicle - Station Platform Gaps	Vehicle to station platform gap is not managed which causes non-compliance to prevailing standards for Accessibility and Safety.
Engineering	Electrification	As part of this current project, the Island Rail Corridor is not considered a good candidate for Electrification at this point. Should future requirements change, additional risks below should be considered.
Engineering	Electrification- EMI	There is a risk that Electromagnetic Interference (EMI) of Electrification of the existing track impacts on third party system. For instance, public communication network.
Engineering	Electrification- EMI	There is a risk that Electrification of the existing track impacts on existing communication system.
Engineering	Electrification- EMI	There is a risk that Electrification of the existing track impacts on existing signalling system.
Engineering	Electrification- Power Quality Index	There is a risk that Electrification impacts on power quality index of utility network due to unbalanced feeding of electrified line and generated harmonics from traction system.
Engineering	Electrification- Design changes	As no specific standards, codes and concept design are identified for the electrification, there is a risk of design changes due to these uncertainties.
Engineering	Electrification-Track modification	There is risk that existing track shall be modified to guarantee compatibility of existing track with electrification requirements. For instance, track to ground electrical resistance.
Engineering	Electrification- Power Requirement	There is a risk that required electrical power for this electrification may not be available to provide from a near utility feeding point, if any.

10 ASSUMPTIONS & DISCLAIMERES

The below project assumptions have been made:

- Due to unforeseen market conditions creating excessive demand, availability could be limited and/or impact pricing.
- Uniform existing conditions between zones inspected and those uninspected.
- Previous phase infrastructure will be maintained when next phase is implemented (no maintenance will result in additional cost to subsequent phases).
- All unit rates in 2020 dollars.
- 50% of Victoria – Langford requires new fencing. 5% of remainder of corridor requires new fencing (crossings and high traffic areas). Based on observations while in field and desktop study.
- To determine the type and volume of replacement ties, the following was assumed. 60% of track is tangent (straight) with No. 2 ties and 40% is on curve with No. 1 ties. Based off aerial imagery (in the absence of existing track schematics).
- Ballast sourced from Lower Mainland and shipped via truck and tandem trailers. Locally sourced (Vancouver Island) would save on shipping. In discussions with SVI they have indicated that there are suitable pits located on the Island.
- Relay components (85# rail, joint bars, plates, etc.) are available in sufficient quantities at time when work is completed.
- Uninspected bridges on Port Alberni Sub assumed to be in similar condition to inspected bridges based on known similar structure types, similar climate, locations and historical loadings and maintenance.
- All segments will remain OCS (Occupancy Control System – radio clearance for rail movements), no allowance for incorporation of CTC (Centralized Traffic Control – system of signals to convey instructions to train crews) have been made for track. For higher frequency commuter rail between Victoria – Langford, allowance for CTC is included in costs.
- All commuter and inter-city maintenance assumed to be completed at Wellcox yard, using existing facilities.
- Operational and maintenance costs have not been included in the cost estimate.
- Environmental Impact assessment of the Island Rail Corridor was not assessed as part of this project.

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APPENDIX

A

TRACK CONDITION ASSESSMENT REPORT

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B CROSSING CONDITION ASSESSMENT REPORT

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C

BRIDGE CONDITION ASSESSMENT REPORT

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D ROCKFALL ASSESSMENT MEMO

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SEISMIC CONSIDERATION MEMO

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COMMUTER RAIL ASSESSMENT

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H

PHASED IMPROVEMENTS – TRACK RESTORATION

Initial Phase: Class 2 Track Standard Restoration	
Use Case:	• 2-4 passenger trains per day • 2-4 freight trains (10-20 car trains) per day
Track Characteristics:	Class 2 Track Standard (25 mph Freight, 30 mph passenger). *
Load Case:	Not suitable for sustained 286 lb loading
Proposed Restoration Approach:	Track Restoration 1. Vegetation and weed control: - Clear canopy by brush cutting. - Spray to kill weeds, then remove. 2. Replace 55% to 70% of defective ties (approx. 800 to 1000 new ties) with No. 2 ties. 3. Replace single shoulder plates with second double shoulder plates on those ties that are replaced. 4. Add anchors. Box (4 anchors per tie) ever 4th tie on tangent, Box every 2nd tie on curve. 5. Replace old style angle joint bars with standard joint bars and with new bolts. 6. Resurface track and add limited additional ballast (approx. 325 cu yards/mile or 5-7 car loads per mile = 1.5" lift for resurfacing). Assuming each car = 55 cu yards 7. No rail replacement. This rail displays head loss (7-10mm) but can support light traffic. 8. Test track geometry and rail condition with TrackStar before commissioning. 9. Allow ballast to consolidate for 100,000 tonnes of rail traffic prior to operating at Class 2 Track Standard speeds. Turnout Restoration 1. Replace 30% turnout ties. 2. Re-gauge. 3. Replace rigid braces with adjustable rail braces. (8/switch) 4. Repair frog wing rail by welding and grinding. 5. Replace bad switch points, frogs and stands. 6. Re-surface turnout and half car of ballast.

*Speeds refer to maximum safe allowable operating speed as per Figure 26 in body of report.

Intermediate Phase: Class 3 Track Standard Restoration and 286lb Upgrade	
Use Case:	• 4 passenger trains/d up to 8 trains/d • 4 freight trains (10-20 car trains)/d up to 4 million tonnes per annum (MTPA) or 133 cars/d total. • Once passenger/freight train volumes increase above Initial Phase Use Case or, • Higher operating speeds are desired, further upgrade will be necessary. • Assumes improvements for Initial Phase have already been completed.
Track Characteristics:	Class 3 Track Standard (40 mph Freight, 60 mph passenger). *
Load Case:	Suitable for sustained 286 lb loading
Proposed Restoration Approach:	The following approach has been adopted for the Class 3 Track Standard Restorations and is assumed to occur within 5 years of the end of Initial Phase restoration. It is believed the approach will support the above criteria. Track Restoration 1. Vegetation has been maintained. 2. Replace all 80, 85, 100 lb rail with 115 lb rail. 3. Replace all remaining defective ties (assumed 20-30% of total tie count) with No. 1 ties. 4. Install new #115 tie plates. 5. Install new anchors. Boxed every 4th tie on tangent and every 2nd on curve. 6. Install new joint bars with new bolts. 7. Resurface track and add limited additional ballast (approx 325 cu yards/mile or 5-7 car loads per mile = 1.5" lift for surfacing). Assuming each car = 55 cu yards 8. Turnouts will need to be upgraded to 115 lb Turnouts for this phase. Turnout Restoration 1. Completely install 115 lb Turnouts. Can be good condition used materials. 2. All new switch ties. 3. New ballast.

*Speeds refer to maximum safe allowable operating speed as per Figure 26 in body of report.

Ultimate Phase: Ballast Program	
Use Case:	• To be implemented during higher passenger volumes at or above 8 trains/d and • Higher freight volumes. If current volumes increase above 4MTPA or 133 cars/d. (Current freight volumes assumed to be 110,000t/yr or 4 cars/d). • Assumes improvements for Intermediate Phase have already been completed.
Track Characteristics:	Class 3 Track Standard (40 mph Freight, 60 mph passenger). *
Load Case:	Suitable for sustained 286 lb loading
Proposed Restoration Approach:	The following approach has been adopted for the Ballast Program and is assumed to occur within 5 years of the end of Intermediate Phase restoration. It is believed the approach will support the above criteria. 1. Undercut track by 6". 2. Renew ballast up to 6" under the tie.

*Speeds refer to maximum safe allowable operating speed as per Figure 26 in body of report.

Summary of Quantities
Initial Phase: Class 2 Track Standard Restoration

Component		Unit	Segment 1 (Victoria to Langford)	Segment 2 (Langford to Duncan)	Segment 3 (Duncan to Nanaimo)	Segment 4 (Nanaimo to Parksville)	Segment 5 (Parksville to Courtenay)	Segment 6 (Parksville to Port Alberni)	Total
			Quantity						
Ties	Number 2 Softwood ties	No.	10583	16114	21658	13611	30208	15754	137541
	Number 1 Hardwood ties	No.	6881	10742	14439	9074	20138	10502	91519
Rail	85lb Relay Rail	Lf	5892	15829	21596	12508	23871	22429	125341
	115lb Rail	Lf	0	0	0	0	0	0	0
Joint Bars	85lb Standard Joint Bars	Pairs	6804	1688	2303	1334	2546	2392	25719
	115lb Standard Joint Bars	Pairs	0	0	0	0	0	0	0
Tie-Plates	85lb Single Shoulder Tie-Plates	No.	8732	13428	18049	11343	25173	13128	114530
	115lb Double Shoulder Tie-Plates	No.	0	0	0	0	0	0	0
Anchors	85lb Anchors	No.	35354	94975	129569	75048	143222	134574	752036
	115lb Anchors	No.	0	0	0	0	0	0	0
Ballast	Crushed Gravel – 40mm	Cu Yd	4102	10793	16000	8528	16276	15906	87435
Turnouts	Repair 85lb Turnout	No.	12	3	41	9	7	21	105
	115lb No. 9 Turnout	No.	0	0	0	0	0	0	0
	115lb No. 7 Turnout	No.	0	0	0	0	0	0	0

Summary of Quantities
Intermediate Phase: Class 3 Track Standard Restoration and 286lb Upgrade

Component		Unit	Segment 1 (Victoria to Langford)	Segment 2 (Langford to Duncan)	Segment 3 (Duncan to Nanaimo)	Segment 4 (Nanaimo to Parksville)	Segment 5 (Parksville to Courtenay)	Segment 6 (Parksville to Port Alberni)	Total
			Quantity						
Ties	Number 2 Softwood ties	No.	0	0	0	0	0	0	0
	Number 1 Hardwood ties	No.	5432	17904	24065	15124	33564	17504	140287
Rail	85lb Relay Rail	Lf	0	0	0	0	0	0	0
	115lb Rail	Lf	106593	284930	396728	225150	429676	407584	2268552
Joint Bars	85lb Standard Joint Bars	Pairs	0	0	0	0	0	0	0
	115lb Standard Joint Bars	Pairs	1367	3653	5087	2887	5509	5225	29086
Tie-Plates	85lb Single Shoulder Tie-Plates	No.	0	0	0	0	0	0	0
	115lb Double Shoulder Tie-Plates	No.	10864	35808	48130	30248	67128	35008	280574
Anchors	85lb Anchors	No.	0	0	0	0	0	0	0
	115lb Anchors	No.	35354	94975	129569	75048	143222	134574	752036
Ballast	Crushed Gravel – 40mm	Cu Yd	4018	10793	14724	8528	16276	15293	85462
Turnouts	Repair 85lb Turnout	No.	0	0	0	0	0	0	0
	115lb No. 9 Turnout	No.	5	3	7	9	7	5	48
	115lb No. 7 Turnout	No.	7	0	34	0	0	16	57

Summary of Quantities Ultimate Phase: Ballast Program									
Component		Unit	Segment 1 (Victoria to Langford)	Segment 2 (Langford to Duncan)	Segment 3 (Duncan to Nanaimo)	Segment 4 (Nanaimo to Parksville)	Segment 5 (Parksville to Courtenay)	Segment 6 (Parksville to Port Alberni)	Total
			Quantity						
Ties	Number 2 Softwood ties	No.	0	0	0	0	0	0	0
	Number 1 Hardwood ties	No.	0	0	0	0	0	0	0
Rail	85lb Relay Rail	Lf	0	0	0	0	0	0	0
	115lb Rail	Lf	0	0	0	0	0	0	0
Joint Bars	85lb Standard Joint Bars	Pairs	0	0	0	0	0	0	0
	115lb Standard Joint Bars	Pairs	0	0	0	0	0	0	0
Tie-Plates	85lb Single Shoulder Tie-Plates	No.	0	0	0	0	0	0	0
	115lb Double Shoulder Tie-Plates	No.	0	0	0	0	0	0	0
Anchors	85lb Anchors	No.	0	0	0	0	0	0	0
	115lb Anchors	No.	0	0	0	0	0	0	0
Ballast	Crushed Gravel – 40mm	Cu Yd	21320	59960	66620	47380	90420	77660	363360
Turnouts	Repair 85lb Turnout	No.	0	0	0	0	0	0	0
	115lb No. 9 Turnout	No.	0	0	0	0	0	0	0
	115lb No. 7 Turnout	No.	0	0	0	0	0	0	0

APPENDIX

I

ELECTRIFICATION MEMO