SOUTHERN RAILWAY OF VANCOUVER ISLAND LIMITED

Pest Management Plan #629-0003-11/16
2011-2016

FINAL DRAFT

SVI Rail Link

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May, 2011

Prepared for:

SOUTHERN RAILWAY OF VANCOUVER ISLAND LIMITED
PO Box 581,
7 Port Way,
Nanaimo, BC. V9R 5L3.
Phone: (250) 754-9222

Prepared By:

STREAMLINE ENVIRONMENTAL CONSULTING LTD.
Unit B, 6451 Portsmouth Road,
Nanaimo, BC V9V 1A3

SVI Rail Link

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Cover photo: A No-treatment Zone for a watercourse crossing applied to a section of the railway ballast treated with herbicide during the course of the previous PMP (SVI, Feb 2011).

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A. INTRODUCTION

Development of an effective vegetation management program is essential for safe railway operations. Uncontrolled vegetation can block visibility at crossings, hinder safety inspections, interfere with the operation of signals and switches, and increase the risk of fire. It also creates hazardous conditions for railway crews, the public and wildlife.

When the management of vegetation by a British Columbia railway utility integrates herbicide as one of its tools, Section 24(2)(a)(i) of the *Integrated Pest Management Regulations* is evoked requiring a Pesticide Management Plan be developed and made available to the public. An annual *Confirmation of a Pesticide Use Notice* from the provincial government is also required. This document details the Pest Management Plan (PMP) for the Southern Railway of Vancouver Island Limited (SVI) railway operation on Vancouver Island, BC. The "pest" being managed in this case is solely limited to intolerable vegetation.

An integrated pest management (IPM) approach has been employed to ensure effective vegetation management and the protection of environmental values and human health, in keeping with SVI's management philosophy. For a railway, IPM encompasses a limited number of realistic control options. Mechanical and manual methods of controlling weeds are the primary approaches that will be employed and pose some potential hazards and impacts. However, public and regulatory concerns over vegetation management are invariably focused on any use of chemical control. Therefore, while the integrated pest management approach of this PMP describes all management methods, much of the plan is focused on the use of herbicides to ensure their place in the IPM approach is understood.

SVI's purpose in preparing this PMP is to define the corporate policy, procedures, environmental controls and consultation processes in place to achieve the control of vegetation on the tracks, along the right-of-way (ROW), in yards and around maintenance shops and other facilities. This public document offers the opportunity for individuals and neighboring land managers to understand the proposed vegetation management program and to contribute to the safe operation of the private rail utility.

A.1 Southern Railway of Vancouver Island Limited

With transfer of the ownership of the Esquimalt and Nanaimo (E&N) Railway from Rail America and Canadian Pacific Railway to the Island Corridor Foundation (ICF) in 2006, Southern Railway of Vancouver Island Limited (SVI) assumed operation of the railway under an operating agreement with the ICF. The ICF is a non-profit foundation, authorized federally under letters of patent, consisting of 13 First Nations, 14 local governments, and 5 regional districts, all based on Vancouver Island. SVI provides rail freight services to customers involved in agricultural products, forest products, propane, concrete, animal feed and fuel products, and operates daily intercity passenger service from Victoria to Courtenay through a Train Service Agreement with VIA Rail Canada.

SVI is an independent subsidiary of Southern Railway of British Columbia Limited (SRY), a regional rail operator in BC's Lower Mainland and Fraser Valley areas. SRY is an affiliate of the Washington Group of Companies and is based in New Westminster, BC. SVI employs 26 people and has a wage expense of $1.5 million a year, included in the approximate $4.6 million total annual operating expense budget in contribution to the Vancouver Island economy.

SVI operates the following active railway trackage:

- The Victoria Subdivision (225 km / 140 miles) – between Victoria and Courtenay; and,
- The Wellcox Spur (5 km / 3.2 miles) – in Nanaimo.

In addition, SVI has an interest in future operating rights on the Port Alberni Subdivision, 60 km / 37 miles of track running between Parksville and Port Alberni. The Port Alberni Subdivision is currently inactive between Mile 0 at Parksville and Mile 31 in Port Alberni, and hence is not included in this PMP.

The history of the railway is documented online at the Railways of Canada website[1]. The historic E&N Railway was constructed by the Canadian Government to satisfy a commitment of confederation. In 1886 construction of the railway was completed and operation of 72 miles of rail between Esquimalt and Nanaimo began. The Port Alberni Subdivision was built in 1914. Two years later the Victoria Subdivision was extended to Courtenay, located at mile 139.9. Since its construction, the E&N Railway has been continuously operated as a rail transportation corridor, with the exception of the Port Alberni Subdivision which ceased freight operation in 2002. A small portion of this subdivision (~6 miles between Mile 31 and 37) is currently operated by the Alberni Pacific Railway group as a small steam train excursion between Port Alberni and the historic McLean's Mill.

A.2 Environmental Setting

Much of the Victoria Subdivision lies within the coastal plain along the eastern shoreline of Vancouver Island. The line passes through urban centers as well as rural farm and forest land. The lay of the railway along the coast bisects the lower reaches of the many watersheds that drain north and east into the Strait of Georgia. Surficial conditions vary from solid rock to alluvial deposits, to glacial tills and clay hardpans. Moisture content varies within the different soil types; however the ROW is generally well drained. The gradient of the railway is typically gentle and its elevation is close to sea level. Only the traverse along the fjord of Saanich Inlet along the Malahat has steeper gradients. The biogeoclimatic zone is predominantly moist maritime coastal Douglas fir (CDFmm). Along with Douglas fir dominated conifer forests, red alder, broadleaf maple and arbutus trees are also commonly found. Some sections of the railway also pass through rare Garry oak ecosystems.

[1] http://www.trainweb.org/canadianrailways/articles/EsquimaltAndNanaimoRailway.htm

The plant and animal communities along the railway are moderately well documented on a broad level. Many of the water bodies crossed by the railway are fish bearing or are directly connected to fish bearing waters. No specific aquatic inventory work has been conducted by the railway but areas where it is known that ecosystem features are unique and offer high environmental values are noted within the Resource Users Database discussed in Section C.3.

Six community water supply watersheds are traversed by the line, five of which are designated community water supply watersheds under the *Water Act* (Table A-1), and numerous domestic water intakes are located adjacent to the railway ROW.

Table A-1. Community water supply watersheds through which the railway passes. Designated community watersheds under the *Water Act* are highlighted in italics.

Watershed Name	Stream Name	Community Location
Englishman Community Watershed	Englishman River	Parksville
French Community Watershed	French Creek	Parksville, Qualicum Beach
Lantzville District Watershed	Aquifer	Lantzville
Little Qualicum Community Watershed	Little Qualicum River	Qualicum Beach
Nile Community Watershed	Nile Creek	Qualicum Bay
Shawnigan Community Watershed	Shawnigan Creek	Shawnigan, Cobble Hill

A.3 Plan History

This Pest Management Plan replaces the previous PMP (Confirmation No. 629-0002-05/10) developed for the E&N Railway Company (1998) Ltd. by Streamline Environmental Consulting Ltd. (SECL) in 2006 which expired in October 2010 (SECL 2006a). During the development of that plan, expertise and input was sought from a wide array of sources including weed control specialists, plant ecologists, government agents, environmental specialists, vegetation maintenance contractors, First Nations, and the general public. In addition to preparing the PMP, SECL prepared an *Inventory Data Report* (SECL 2006b) to accompany the Resource Users Database which identifies the location of environmental, economic and social features along the railway that require special consideration under the PMP, including watercourses, wells, and water intakes, amongst others. The role of the Resource Users Database in the implementation of the PMP is described in detail in Section C.3.

Upon assuming ownership of the railway in 2006, the ICF commissioned a review of alternative vegetation control techniques (SECL 2006c). The study identified no existing commercially viable alternative to chemical weed control. The ICF is continuing to investigate an innovative vegetation management model based on an ecological approach to vegetation management (Polster & Landry 1993; Polster 2007). This approach seeks to use the natural ecological attributes of vegetation to achieve the required management objectives. Successional distancing is identified as a particularly useful approach for right-of-way vegetation management. (see Section C.1).

Vegetation control has been a continuing challenge along the railway due to the original marginal construction methods utilized on the rail line, particularly the use of poor quality ballast material, and decades of deferred maintenance by previous owners/operators. Prior to the development of the previous PMP, chemical treatment of vegetation had not been used along the railway since 1989. Vegetation control had been limited to mechanical methods and in 2005 it was estimated that 75% of the ballast area was vegetated with a mix of grasses, leafy annuals and perennials, and even woody vegetation such as Scotch broom and red alder (SECL 2006a).

During the term of the 2005-2010 PMP, chemical treatment of vegetation using glyphosate (*Vantage*™ with *Sylgard*® *309 Silicone Surfactant*) was limited to the Victoria Subdivision and Wellcox Spur, and was restricted to the ballast section of the railway right-of-way (ROW). Spraying was conducted annually in the spring from 2007 to 2010 (Table A-2). No chemicals were used in 2006, partly due to delays in the finalization of the PMP, but also because SVI did not commence operation of the railway until July 2006, after the main part of the growing season. Following an initial two-year period that focused equally on chemical and mechanical methods of vegetation control, herbicide use as a proportion of the total area treated declined significantly over the course of the previous PMP (Table A-2), reflecting significant improvements in vegetation conditions in the ballast area. This is in large part due to the re-introduction of chemical methods to the integrated vegetation management program.

Table A-2. Summary of annual mechanical and chemical vegetation treatment activities along the ROW during the term of the 2005-2010 E&N Railway PMP.

Year	2006	2007	2008	2009	2010	5-year Average
Area treated by mechanical methods (ha)	164.82	82.41	82.41	224.47	224.47	155.72
Area treated by chemical methods (ha)	0.00	80.25	87.82	78.74	57.46	60.85
Total area treated (ha)	164.82	162.66	170.23	303.21	281.93	216.57
Quantity of herbicide used (kg)	0.00	480.00	520.00	460.00	330.00	358.00
Herbicide use kg/ha	0.00	2.95	3.05	1.52	1.17	1.74

Source: SVI annual Pesticide Use Reports to the BC Ministry of Environment 2006-2010.

Herbicide use may now be at maintenance levels. Without significant investment in infrastructure renewal, particularly ballast replacement (see Section C.6.1.4), and/or rapid advancements in the development of safe, effective and affordable alternatives to chemical control methods, further major reductions in herbicide use may be unlikely over the course of this PMP.

Reviews of potential alternative vegetation treatment methods were conducted by SVI during the term of the previous PMP, including steam weeding, flame entrainment,

organic and bioherbicides, amongst others, and SVI has continued to stay abreast of vegetation control initiatives conducted elsewhere in the railway sector.

Trials of two potential alternative vegetation treatment methods were conducted during the term of the previous PMP, including:

- Eco-care organic (non-synthetic) herbicide*;* and,
- *Chondrostereum purpureum* bioherbicide.

A single-application trial of Eco-Care Technologies' soap-based (fatty acid) organic herbicides was conducted in late summer 2008 along a portion of the railway track in Langford (SVI, unpubl. data). The efficacy of two formulations of the organic herbicide (ECF1 and ECF2) against grasses, other common weeds, and Scotch broom was assessed at regular intervals over a three month period, relative to untreated and glyphosate-treated plots. Both organic formulations proved equally effective to glyphosate against broom up to three months after treatment, however, only ECF2 produced comparable results to glyphosate against all weeds and grass over the same period. Currently only ECF1 is registered for use in Canada.

Similarly, a single-application trial of the bioherbicide, *Chondrostereum purpureum* (now sold under the name Chontrol Peat Paste) was conducted along a small portion of the railway track just north of Langford (MycoLogic Inc., pers. comm.). The target species was Scotch broom occurring in the ballast area of the track. *Chondrostereum purpureum* is a naturally occurring fungus that has been developed as a biological herbicide to prevent re-sprouting and re-growth of deciduous tree species following manual cutting or mowing. It was known to be effective against red alder, but few trials of its effectiveness against broom had been undertaken. In this trial, the bioherbicide proved to be ineffective, however this may have been due to the fact that the track-based mower could not cut the plants very low to the ground, allowing the broom to re-sprout from the lower portion of stem. This bioherbicide has now been registered for use in Canada, and SVI plans to re-trial its effectiveness, but this time focusing on alder control in the outer ROW.

In response to public interest for active involvement in the application of alternative methods to chemical control, SVI instituted an "Adopt-a-Mile" program during the term of the previous PMP. Under this program community groups can register an interest in a section of railway where, under SVI's supervision and according to strict safety protocols, the community group's members undertake hand-pulling of vegetation from the ballast area. This program is still under development, with the Cowichan Station community group the first to conduct vegetation control activities in 2010.

Potential alternatives to chemical control methods are discussed in more detail in Section C.6. In general, however, there have been no major advances in the development of safe, effective, and affordable alternative vegetation control methods since the development of the previous PMP.

Following five years of concerted vegetation control efforts by SVI, vegetation conditions

along the railway are much improved (Figure A-1). However, an assessment of conditions along the rail corridor in 2009 by Hatch Mott MacDonald (HMM 2009) for the BC Ministry of Transportation and Infrastructure found that vegetation conditions were still not adequate and were in contravention of the *BC Safety Authority Railway Regulations and Rules Respecting Track Safety (Part 30) for Common Carrier Railways*. In particular, the assessment found that the density of vegetation prevents track inspectors from viewing the condition of joints and fastenings, and foliage on the rails has interfered with crossing signal operations (HMM 2009). As a consequence, the BC Safety Authority, the provincial railway safety regulatory body, issued a letter of non-compliance, requiring SVI to develop a corrective action plan to address all items of non-compliance (ICF 2010). This PMP forms part of that plan, with respect to ongoing vegetation control.

Figure A-1. Bryn switch at Nanoose: top - before (spring, 2001); and, bottom - after (spring, 2011) the implementation of the 2005-2010 PMP.

A.4 Vegetation Management Objectives

The objective this PMP is to achieve an efficient, reliable, cost-effective maintenance standard which will protect the public, employees and the environment from the hazards that intolerable vegetation can pose to the operation of the railway. Implicit in this objective are the maintenance of a vegetation-free ballast section, and a stable community of compatible plant species on the adjacent ROW. This standard will result in more effective vegetation management with a net reduction in the quantity of chemical products used over the term of the PMP. Reduction or elimination of chemical usage is a long-term objective of SVI and the ICF.

The following sections summarize the major reasons for vegetation control within the railway ROW. All of these reasons relate to the safety requirements of the SVI Rail Link operation. Portions of text within these sections are drawn from the *BC Rail Draft Pest Management Plan* (BC Rail Ltd. 1999).

A.4.1 Maintenance of Structural Integrity of the Roadbed

Maintenance of proper drainage in the ballast section is one of the most critical requirements for a stable track structure. Uncontrolled vegetation contributes to the retention of fine soil particles and organic matter within the rail ballast, preventing proper drainage of water. These factors in turn promote additional vegetative growth. The presence of silt and clay, organic material and water reduces the ability of the ballast to support train loads, leading to mud pumping and soft spots. The result is problems with track support, alignment and profile, all of which are common causes of train derailments and the resulting risk to railway employees, the public and the environment.

Figure A-2. Logging Rd crossing at Mile 24: left, - thickly vegetated rail ballast before (spring, 1999); and, right - after (spring, 2011) the implementation of the 2005-2010 PMP.

Vegetation growing in ditches may obstruct the free flow of water and thereby promote flooding of the railway sub-grade, ballast and surrounding properties. Further, the presence of excess moisture contributes to premature deterioration of ties and track

hardware. A failure in the critical rail/tie bond caused by wood decay may result in differential settlement of the track and/or roll-over or spreading of the rail, leading to the risk of derailment.

A.4.2 Safety Inspections & Safe Operation of Automated Equipment

It is critically important that railway personnel are able to inspect standing and moving trains from trackside in order to observe defects in wheels, bearings, couplings and brake hoses. Maintenance crews must also be able to visually inspect switches, rail, ties and fasteners as a condition of bi-weekly inspections of an operating railway. In addition, the operation of the line is increasingly performed by automated equipment and sophisticated instrumentation. Proper operation of the following devices commonly utilized as part of a typical railway operation relies on a track ballast section that is largely clear of vegetative growth:

- Automated safety inspection systems;
- Power switches;
- Crossing signals;
- Hot box detectors;
- Flat wheel detectors;
- Lateral load detectors;
- Laser-guided track alignment;
- Track geometry test equipment; and,
- Ultrasonic rail testing instruments.

The functioning of this equipment is impaired by the presence of vegetation, restricting necessary lines-of-sight. Vegetative growth in the track structure also interferes with resistance and conductivity required for proper railway signal function.

A.4.3 Minimize Hazards to the Public

Fire is the greatest potential public hazard resulting from vegetated rail beds. Many sources of ignition are inherent in the operation of a railway including sparks from brakes, diesel engines, wheels, overheated bearings and operation of rail-grinding and welding equipment. These ignition sources, combined with the presence of dead grass and woody vegetation under hot, dry conditions, present the potential for fire, which puts the public at risk, along with possible damage to buildings, property and the environment. While the vegetation shown in photos A1 through A5 appears lush in spring, by mid-summer it is typically dry and readily combustible.

Excessive vegetation growth in the vicinity of road crossings and along curves in the track result in reduced sight line visibility and presents a greater risk of collisions to motorists, cyclists, pedestrians and wildlife. Tall-growing brush species can obscure the visibility of signs and signals and interfere with the electrical operation of switches and signals, all of which are critical to the safe operation of a railway and the protection of the public.

Figure A-3. Mile 26.6: left, uncontrolled vegetation reducing line of sight, obscuring visibility of signs and signals and attracting wildlife onto the line before (spring, 1999); and, right - after (spring, 2011) the implementation of the 2005-2010 PMP.

It is important to note, however, that the railway ROW is private land owned fee-simple by the ICF, so public trespass onto the ROW other than at designated crossings is illegal. For reasons of public safety and corporate liability, a railway ROW must be respected as private land. Climbing of rock cuts, berry picking, collection of herbs and mushrooms, hunting, hiking, fishing, diving off bridges and traverse by all-terrain vehicles are neither legitimate nor safe uses of the railway ROW.

A.4.4 Minimize Hazards to Railway Employees

Vegetation may be hazardous to employees performing their trackside duties. Train crews are frequently required to climb on and off slow moving trains and walk beside tracks when switching cars, assembling trains, or checking for problems en-route. Maintenance employees must work on and around track, switches and throughout the ROW. Vegetation contributes to wet, slippery conditions, causing employees to slip.

Excessive growth may also contribute to or obscure dangerous tripping hazards such as holes, uneven ground, tools or track hardware lying on the ground. Brush growing too close to the track may strike employees riding along the side of railway equipment or passengers in the coaches. Fallen trees may block the track and cause derailments or equipment damage.

A.4.5 Prevent Equipment Damage

The presence of weeds exceeding the height of the rail may cause wet, slippery conditions, which decreases traction and increases braking effort. This can result in costly damage to track and locomotive components. Skidding causes out-of-round wheels which is one of the primary causes of brittle fracture of the rail and joints, especially in cold weather. Because of the extra distance required to stop, a slippery track also increases the potential for collisions involving railway equipment moving in

opposing directions, or between railway equipment and vehicular traffic at public or private road crossings.

Figure A-4. Wellcox Spur: left, uncontrolled vegetation is a slipping and tripping hazard to employees performing trackside duties before (spring, 1999); and, right - after (spring, 2011) the implementation of the 2005-2010 PMP.

A.4.6 Enhance Work Program Efficiencies

The presence of excessive vegetation interferes with the ability of employees to carry out maintenance duty, track relaying, tie change-outs and other reconstruction projects. Tall growing vegetation not only interferes with work efficiency, but it often results in the permanent loss of track tools, lengths of rail, track hardware and other equipment which in turn represent tripping hazards to employees.

Figure A-5. Mile 26.6: left, uncontrolled vegetation interferes with safety inspections and maintenance efficiency before (spring, 1999); and, right - after (spring, 2011) the implementation of the 2005-2010 PMP.

A.4.7 Minimize Hazards to Wildlife and Domestic Animals

As sources of food and habitat, vegetation will often attract deer, bear and other wildlife species to the railway. Dense vegetation impedes the ability for animals to escape the railway when a train is approaching and can cause injuries to the animals when they lose their footing. Animals (including domestic pets) often stay on the tracks to avoid the dense vegetation beside the tracks and try to outrun oncoming trains, resulting in injury or death. Hence, the attraction of animals to the ROW for feeding and to escape predators is contrary to efforts to minimize train-animal collisions.

A.5 Regulatory Framework

In recognition of the critical relationship between vegetation control and safety, regulatory bodies in British Columbia have included statutory obligations for railways to control vegetation. The BC *Railway Safety Act* Track Safety Rules Part 30 states:

Vegetation on railroad property which is on or immediately adjacent to the road bed must be controlled so that it does not:

a. *Become a fire hazard to track carrying structures;*
b. *Obstruct visibility of railroad signs and signals;*
c. *Interfere with railroad employees performing normal trackside duties;*
d. *Prevent proper functioning of signal and communication lines; or,*
e. *Prevent railroad employees from visually inspecting moving equipment from their normal duty stations.*

In addition to the *Railway Safety Act*, another 10 provincial and federal acts and their associated regulations and/or rules define constraints to vegetation management. These are listed below and their application with respect to vegetation control is outlined in Appendix I:

- *Railway Safety Act*;
- *Integrated Pest Management Act*;
- *Weed Control Act;*
- *Wildfire Act*;
- Federal *Fisheries Act*;
- Federal *Species At Risk Act* (SARA);
- Federal *Migratory Birds Convention Act*;
- *Wildlife Act;*
- *Environmental Management Act;*
- *Drinking Water Protection Act;* and,
- *Water Act.*

A.6 Public Consultation Process

A draft of this PMP was subjected to a minimum 6½ week (45 day) public consultation process, during which comments were solicited from the public, and responses to any concerns were provided by SVI. To begin the public consultation process advertisements informing the public of the development of the PMP were placed in community newspapers serving the communities along the railway. The advertisements were run twice in each newspaper over a two week period, beginning on March 15th, 2011. Letters of Notice were sent to the 12 municipalities and four regional districts that overlap with the PMP area on March 11th. Additional public consultation activities undertaken included: a presentation by the General Manager of SVI and a Senior Biologist from SECL to the ICF Board on February 24th, including representatives of the municipalities, regional districts, the Stzuminus (Chemainus) First Nation, and the Snaw Naw As (Nanoose) First Nation; and, an interview given by the General Manager of SVI to CBC's *On the Island* radio program broadcast on March 28th.

Letters of Notice were sent to the 13 First Nation groups potentially affected by the PMP on March 2nd. In addition, to facilitate the PMP consultation process with First Nations, the ICF made its First Nations Liaison Officer available to SVI, who conducted numerous follow-up consultations with each of the First Nations supported by SVI.

Copies of the draft PMP were made available for viewing at the SVI office in Nanaimo, for download from SVI's website http://www.sryraillink.com/vancouver_isl_service.htm and were provided electronically on request. Opportunities to comment on the draft PMP were made available via mail, phone, via a web-form on SVI's website, and via a dedicated email address svipmp@sryraillink.com .

The public consultation process led to the identification of the following additional resource features adjacent to the railway ROW:

- Two properties with organic gardens;
- Two domestic water supply intakes; and,
- Traditional medicinal plant gathering areas.

These features have been added to the Resource Users Database and the appropriate no treatment zones (NTZs) will be applied.

In addition, as a consequence of the public consultation process SVI agreed to:

- Treat the District of Lantzville's water supply watershed as if it was a Designated Community Watershed under the *Water Act*; with respect to the application of NTZs; and,
- Provide support to the Arrowsmith Watersheds Coalition Society in the control of giant hogweed within the railway ROW below the French Creek bridge crossing.

The details of the public and First Nations consultations undertaken by SVI in the course of preparing this PMP have been documented in two separate reports which have been submitted to the BC Ministry of Environment along with this PMP.

A.7 Structure of this Pest Management Plan

The remainder of this PMP follows the content requirements in Section 58 of the *Integrated Pest Management Regulations* and described in the draft guidance document for the preparation of a Pest Management Plan recently released by the BC Ministry of Environment (MoE 2010).

B. IDENTIFYING INFORMATION

B.1 Plan Area

The PMP plan area encompasses the railway right-of-way owned by the Island Corridor Foundation (ICF) and operated by Southern Railway of Vancouver Island Limited (SVI), including the 225 km-long Victoria Subdivision, the 5 km-long Wellcox Spur, and associated yards, shops and other facilities (Figure B-1).

The typical ROW averages approximately 30 m (100 ft) in width. The vegetation to be managed within the ROW has been separated into four distinct vegetation treatment zones (Figure B-2):

1. *Zone A* is limited to the tie area of the ballast section. This zone has a total width of 8 ft (2.4 m) (4 ft on either side of the centerline).
2. *Zone B* is the ballast section beyond the tie area to the ballast shoulder having a typical width extending 4 ft (1.2 m) on either side of Zone A.
3. *Zone C* is the ROW from the edge of the ballast shoulder to the maximum reach of the brush cutter, approximately 32 ft (9.8 m) from centre of track or 22 ft. (6.7 m) beyond the edge of Zone A.
4. *Zone D* is the remainder of the ROW from the outer edge of Zone C to the outer edge of the ROW property, a distance averaging approximately 18 ft (5.5 m) depending on the total width of the ROW.

B.2 Scope and Term of the Plan

This plan is applicable to the lands operated by SVI on Vancouver Island.

The proposed term of this PMP is for a five year period from June 1, 2011 to May 31, 2016. This plan may be revised to reflect developments in available vegetation treatment technologies, and in response to the effectiveness of the treatments employed to control vegetation.

Figure B-1. SVI Pest Management Plan Area. Map reproduced from IBI Group (2010).

B.3 Responsible Person

The responsible person for the SVI Pest Management Plan is the:

General Manager
SOUTHERN RAILWAY OF VANCOUVER ISLAND LIMITED

B.4 Contact Information

The principal contact for information relating to the SVI Pest Management Plan is:

Al Kutaj
Roadmaster
SOUTHERN RAILWAY OF VANCOUVER ISLAND LIMITED
PO Box 581
7 Port Way
Nanaimo, BC V9R 5L3
Phone: (250) 754-9222

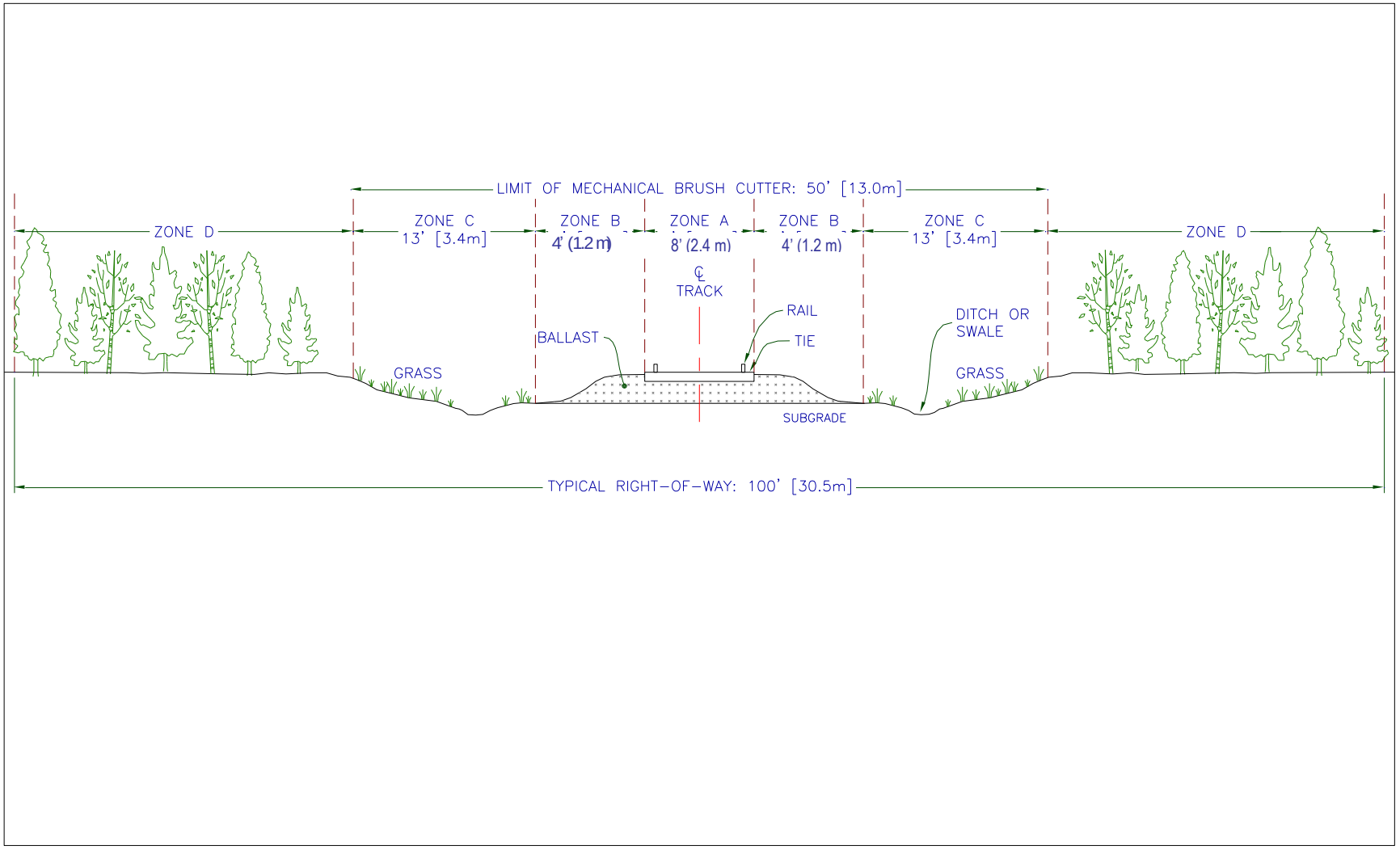

Figure B-2. Vegetation Treatment Zones within the railway ROW.

C. INTEGRATED VEGETATION MANAGEMENT PROGRAM

C.1 Prevention

In the management of vegetation it is important to consider the principles of vegetation ecology. A large bank of weed seeds is usually available beneath the soil surface. Left undisturbed the buried seeds remain viable yet dormant whereas surface seeds are subject to rot and consumption by insects and rodents. Disturbances to the ground commonly offer light, temperature and nutrient changes that promote seed germination (Taylorson & Hendricks 1972; Milberg 1997). Pioneering species such as annual weeds and broad leafed shrubs (Scotch broom) are often the initial colonizers of disturbed sites. The weed free conditions required of the railway ballast provides conditions for pioneering seeds to germinate and plants to colonize. Left undisturbed the species composition would change through progressive succession, ultimately reaching a stable climax stage. When disturbances to succession occur there is a disclimax where species succession reverts and more primary species (weeds) become reestablished. Vegetation control often triggers a disclimax, resulting in additional weed growth and a continuous cycle of maintenance needs.

The management approach of this PMP will attempt to avoid activities that lead to a disclimax, particularly along the ROW, and instead promote rapid species transition to later successional stages according to the principles of successional distancing (Polster 2007). When soil disturbances are made, reseeding and planting with grasses and conifers will be done to avoid opportunities for less intolerable vegetation to germinate and become established. On sites of established vegetation, management will focus on the promotion of later successional species such as grasses, eliminating niche opportunities for pioneering species such as annuals and broad leafed shrubs and trees. Grasses tend to be competitively-exclusive reducing opportunities for seed producing weeds to establish next to the ballast. The low growing stature of grass offers fewer conflicts with rail operations, provides stable ground structure and requires less maintenance. Conifers are also known to be a later successional species offering slower growth, tolerance to pruning and minimal seed production. The promotion of conifer cover will be considered on sites where sight-line requirements are minimal. In environmentally sensitive sites such as adjacent to fish bearing waters, fast growing deciduous trees can be replaced with slower growing conifers that can be periodically topped while still retaining riparian function. The methods of species transition are detailed below and could include reseeding, planting, mechanical cutting or manual application of selective herbicide.

Species transition is not an option within the rail ballast where vegetation-free conditions are required. As such, vegetation control of the ballast is an unavoidable disclimax activity that will promote seed germination. Seed germination will be less abundant if clean well-drained ballast substrate is maintained. Vegetation management of the outer ROW will help to reduce seed dispersal. Germination within the ballast section will also be reduced if vegetation management and rail maintenance avoids ballast disturbance where possible. When railway maintenance results in ballast disturbance, clean ballast

replacement and proactive vegetation maintenance such as spot herbicide applications. Flame, steam weeding or natural herbicides (biocides) are potential alternate methods of addressing the initial germination period when plants are more vulnerable to less aggressive treatments. SVI will continue to review, and assist to develop, these and other potentially viable alternate methods of control.

C.2 Pest Identification

Given the objective of this PMP is to control all vegetation that may impede the safe operation of the railway; a species-specific pest identification program is considered unnecessary, except for noxious and invasive plants.

Vegetation along the railway ROW is typical of disturbed sites along the east coast of Vancouver Island. Along the rail ballast where mowing has been repeated close to the rail bed, Scotch broom, red alder and grasses dominate and are intermixed with leafy annuals and perennials. On the ROW to the edge of the ballast, vegetation is brush cut and less disturbed allowing more woody species to survive. Red alder, Scotch broom, salal, big leaf maple, salmon berry and thimble berry are common with conifers intermittent. Table C-1 presents a list of the most common species identified within the ballast area.

Table C-1. Common plant species found within the rail ballast and on the ROW. Species identified as a priority for control by the Coastal Invasive Plant Committee are highlighted in italics (Wikeem & Wikeem 2010).

Plant species common name		
Bentgrass	Hairgrass	Sorrel
Big leaf maple	*Himalayan blackberry*	Spike trisetum
Bluegrass	Horsetail	*St. John's-wort*
Bracken fern	Lichen	Sweet vernal grass
Bromegrass	*Orchardgrass*	Thimbleberry
Buttercup	Plantain	Ticklegrass
Cat's ear	Quackgrass	Trailing blackberry
Dandelion	Red alder	Velvet grass
Douglas fir	Salmonberry	Wall lettuce
Fescue	*Scotch broom*	White mustard
Field bindweed	Scouring rush	Wild vetch
Gorse	Silky bluegrass	

Noxious and invasive broad-leafed species will be partially controlled coincidentally with other vegetation, but their aggressive characteristics may occasionally warrant special attention. Himalayan blackberry, Scotch broom, and gorse constitute the most prevalent weeds in this category in the plan area.

The noxious weed purple loosestrife *(Lythrum salicaria*) is known to occur in the Courtenay area. The plant is a wetland perennial that grows 1 to 3 metres in height; has

a stiff, four-sided stem with opposite or sometimes whorled stalk-less leaves and purple flowers in a dense terminal spike. Purple loosestrife is sometimes confused with fireweed which is less likely to be found in wetland areas.

Giant hogweed (*Heracleum mantegazzianum*), also known as giant cow parsnip and found between Parksville and Qualicum (particularly around French Creek), is also of particular concern. This plant is currently considered a nuisance weed in BC, and an effort is underway to have this plant added to the noxious weed list. It is a large (up to 5 m tall), hairy perennial herb in the parsley family with hollow green stems and purple spots. Dark green, coarsely toothed leaves are divided into three large segments, and lower leaves can exceed 2.5 metres in length. Small white flowers are produced in large flat-top umbrella-like terminal clusters up to 0.8 meters across. The small hairs on stems and leaves contain a poisonous sap that can cause severe skin irritation, blistering and dermatitis.

Where populations of any of these invaders are identified along the ROW they will be subject to a targeted control strategy developed using species-specific TIPS or Targeted Invasive Plant Solutions sheets for guidance (IPCBC 2007), along with advice from the provincial government, regional districts and local stewardship groups.

C.3 Pre-treatment Monitoring

SVI Rail Link personnel have detailed knowledge of the line they maintain. At a minimum, track safety inspections are conducted twice weekly, including inspection of vegetation conditions. More detailed surveys of the railway are also conducted to determine the condition of the track, assess potential hazards at crossings and determine other concerns relating to vegetation management. Project and safety meetings take place almost daily, whereat safety hazards associated with vegetation are brought forward by employees. In addition, concerns received from the public are noted and acted upon where required.

An annual control program encompassing both mechanical and chemical methods is generally conceived in the fall based on an assessment of the control activities that have taken place that year and in previous years, and finalized prior to commencement the following year. More formal monitoring of vegetation for the purpose of program planning is normally performed in the spring during peak growing conditions. This includes a hi-rail trip along the entire length of the railway to assess vegetation conditions, particularly in Zones A and B, during which general treatment areas are identified based on the tolerance thresholds described in Section C.4 below. More detailed assessments of each proposed treatment area are conducted immediately prior to application, at which time the treatment area boundaries are finalized and No-treatment Zones are marked. Qualitative observations of vegetation conditions along the ROW are considered adequate for the purpose of program planning. Specific control plans are fine-tuned depending on seasonal weather and soil conditions, contractor availability, and budgetary constraints.

A Resource Users Database was developed concurrently with the previous PMP to identify environmental, economic and social sensitivities along the railway (SECL 2006b). Most of the environmentally sensitive areas are known along the east coast of Vancouver Island between Victoria and Courtenay. Searches were made of provincial government databases for wells and water licenses. Information on other sensitivities was available from various government agencies, community stewardship groups, and corporate inventory work. Field assessments were conducted to ground truth the information in the database and to determine the location of any additional features of concern (SECL 2006b). Where knowledge gaps exist as to the sensitivity of an environmental attribute, its status was by default assigned as sensitive until more detailed information is obtained. For example, all water bodies were classified as fish-bearing, pending a formal assessment by a qualified environmental professional. SVI reviews and updates the database annually in advance of each annual herbicide application program, and whenever additional users and management concerns are identified, or existing users/concerns change.

Resource features identified in the database include:

- Watercourses (perennial streams, shorelines, wetlands, ephemeral streams, wells);
- Registered or identified drinking water wells and intakes within 30 m of the ROW;
- Certified organic farms adjacent to the ROW;
- First Nations land adjacent to the ROW;
- Provincial Park lands adjacent to the ROW;
- Designated Community Watersheds / community water supplies; and,
- Regional District boundaries.

C.4 Tolerance Thresholds

The lowest tolerance threshold applies to Zone A (ballast tie area) which must be nearly free of vegetation in order to provide an acceptable level of safety; progressively higher thresholds apply to Zones B, C and D (Table C-2). Zone B also needs to be kept virtually weed free to maintain safe track structure and to reduce tripping and fire hazards; however, there is reduced need for the conduct of visual inspections in this zone. Sight-line visibility requirements of the British Columbia Railway Safety Act, Adopted Provisions, and other applicable federal and provincial regulations determine the vegetation control thresholds in Zones C and D. The control in Zone C must be higher than Zone D as the management objectives in Zone C include reducing fire and tripping hazards, as well as allowing for better escape from the track for people, domestic animals, and wildlife. Often, little control is needed in Zone D except for the sight-line control at corners and at rail crossings.

The ballast section of yard and shop tracks, like the main track, must be nearly free of weeds because of safety concerns for yard train crews who are actively moving about. Table C-2 summarizes the various thresholds which would trigger a decision for vegetation treatment.

Table C-2. Treatment thresholds for Zone A and Zone B ballast, siding, storage track, and yards.

Ballast Area	Threshold (% unwanted vegetation cover)
Main track Zone A	3%
Main track Zone B	5%
Siding	10%
Storage track	20%
Yards	5%

The low threshold values applied to Zones A and B reflect a virtual zero-tolerance approach to vegetation in the ballast area of the track. Thresholds for Zones C and D within the ROW are determined by sight-line formulas as described in Transport Canada Draft Regulation RTD-10 *Road / Railway Grade Crossings – Technical Standards and Inspection, Testing and Maintenance Requirements*.

C.5 Decision Process

The decision to undertake vegetation control will depend on the degree to which the tolerance thresholds presented above have been exceeded. A threshold may be exceeded locally over such a small area that it would not warrant bringing in control or treatment equipment in light of other priorities and budget constraints.

The vegetation thresholds listed in Table C-2 are often exceeded, given the practical limitations of treatment. Practical constraints include treatment timing windows, budgets allocated for treatment costs, and the availability of equipment and manpower. For mechanical brush control, SVI has one rail mounted track shoulder mower, has access through its parent company (SRY) to one track mounted Gradall with a brush cutter head, and hand-operated weed cutters. Conversely, vegetation control projects which might be considered lower priority and left for later treatment may be accelerated if supervisors are prompted by the receipt of safety concerns brought forth by track maintenance personnel, regulatory authorities, or the public.

Variables such as plant age, species and configuration, treatment history, proximity to sensitive resource users, ROW zone being affected, and access influence the selection of treatment approach. During the planning process the annual needs for herbicide treatment and appropriate timing will be identified. With that, the annual plan for herbicide use can be formalized.

C.6 Treatment Options

C.6.1 Mechanical and Manual Methods

Mechanical control is the primary approach to vegetation control in this PMP. The

effectiveness and limits of mechanical and manual methods are well understood as they were the sole approach used on the railway between 1989 and 2006, when herbicide use recommenced. The advantages and disadvantages of specific mechanical approaches are reviewed below. An important factor for consideration is the overall cost of petroleum consumption and the resulting carbon emissions in operating the equipment needed throughout the growing season.

C.6.1.1 Hand Pulling

Hand pulling is used to remove established unwanted vegetation that can be easily uprooted, such as young tree seedlings, clumps of grass and small patches of noxious and invasive weeds where the roots can be fully removed. This vegetation management option is effective if the amount of unwanted vegetation to be pulled is small and the site is a manageable size. Hand pulling may be the only option available in some environmentally sensitive areas. Other areas where hand pulling or cutting may be employed are in the vicinity of signs, switches, shops, bridges and buildings, or in areas where herbicides cannot be used.

Advantages of this method are that it produces very quick results and can be performed at virtually anytime of the year. A significant disadvantage of this approach is the disturbance it makes to the rail ballast that often promotes seed germination and re-infestation. Hand pulling is physically demanding, slow and consequently often cost prohibitive.

Pulling has been recognized as an effective method of controlling new germinations of Scotch broom. This treatment has particular application adjacent to environmentally sensitive sites and sites of isolated infestation within the outer zones of the ROW. Canadian Forest Service research determined initial hand treatment of Scotch broom to be about $1,000/ha during the first treatment with follow up treatment costs of about $300/ha. (Prasad 2003). Costs are likely to be significantly higher in railway conditions, where the plant stature is low and root systems are tightly entangled in the rail ties and compacted ballast.

There are instances where SVI can accept public (volunteer) help by providing hand weed removal from the track area. SVI has termed this its “Adopt-a-Mile” Program. Such control however must involve hand pulling of weeds, not cutting. Cutting of live weeds in the track area promotes thicker growth and a worsening of the condition causing an increase in humus base and reduction in drainage of the track structure area. Volunteers also must arrange with the railway for track protection to assure that any and all persons working on or about the track are protected from train traffic by being under the direction of a qualified railway flag person. SVI’s railway safety policy for work on or around the tracks must be strictly followed. The “Adopt-a-Mile” Program is still in the early stages of development, with the Cowichan Station community group the first to conduct weed control activities in 2010.

C.6.1.2 Manual Vegetation Trimming

Manual trimming of unwanted vegetation is used in areas such as in environmentally sensitive sites, along fence lines, around switches (Figure C-1), signs and equipment, and in areas around shops, buildings, bridges and station grounds. Trimming is also an important treatment in the outer zones of the ROW where line of sight must be maintained but vegetation growth is desirable for ground stability. Manual vegetation trimming allows individual plants to be targeted while releasing desirable plants to become established and therefore plays an important role when species transition is the objective. Trimming achieves immediate results and can be done at any period throughout the year. The disadvantage of this method is that repeat treatments are required to maintain the lower growth. Cutting of brush often leads to suckering and an increasing level of maintenance. The high costs of manual trimming can be prohibitive.

Brush saws, chain saws and hand loppers are common tools for this work. Chain saws are often used on the outer ROW to maintain sight lines and to remove 'danger trees' which could compromise safety and operations.

Figure C-1. Alberni / Victoria switching site where manual vegetation control has been used, July 2005.

Timing of trimming can affect treatment success. To minimize re-growth and suckering of most species trimming should be done when carbohydrate food reserves in the root system are at their lowest. This would be the period in late spring when food reserves have been used for maximum vegetative growth and flowering is just taking place. Trimming to avoid seed set is important to eliminate opportunities for re-infestation. If done just prior to drought periods, well-timed trimming can also result in reduced survival of re-sprouting vegetation.

C.6.1.3 Mechanical Mowing and Brush Cutting

SVI uses mowers and brush cutters extensively in vegetation management. Mowers and brush cutters are often mounted on hi-rail vehicles which travel on the tracks (Figures C-2 and C-3). Hi-rail mounted mowers can effectively cut most vegetation to a height of 15 cm from the ground and extend a maximum of 7 metres from the rail.

Figure C-2. SVI's rail-mounted track shoulder mower (SVI, Feb 2011).

Figure C-3. SVI has access to a track-mounted Gradall with a brush cutter or mowing head through its parent company SRY (SVI, Feb 2011).

During the long period without herbicide use E&N Railway (1998) Ltd. developed a specialized mower deck that mows between the rails (Figure C-4). However, long-term mowing of the ballast section of the rail bed proved to be detrimental. Mown refuse remained on the rail bed concentrating organics, degrading the ballast drainage and enhancing growing conditions. The mown plants remained alive and quickly re-sprouted. The stubble became very dense and robust. The tender shoots which re-sprouted in response to cutting were prime forage for deer. All of these results intensified maintenance and safety concerns. It has subsequently been found that this

machinery is more effective if integrated with chemical treatments. Cutting of woody vegetation followed immediately by herbicide application has been found to be particularly effective at eradication of persistent perennials, in particular Scotch broom (Prasad 2003).

Figure C-4. Specialized mower deck adapted to control ballast vegetation. E&N Railway, 1999.

The brush cutter is a primary mechanism for vegetation maintenance within the outer zones of the ROW. This method is generally found to be effective for much of the sight-line control needed; however, repeat cuttings creates an increasingly dense thicket of stems which, over time, renders the brush intractable. Further, because the cutting must be undertaken above ground level, it leaves sharp spikes at ankle or knee height which can cause injuries to employees, passengers or wildlife from abrasion, puncture or tripping. Further, it does not discriminate between desirable and undesirable plant species. Some integration of other control techniques is needed to increase effectiveness and reduce safety concerns.

In station grounds and around shops and buildings, mowing may not be used due to the unevenness of the terrain. Lawns or vacant areas covered with grass or other low growing vegetation will be mowed prior to the unwanted vegetation developing seed heads. Where the mowed areas are in close proximity to track ballast, the mowing may reduce the seed source available for dispersal to the ballast areas.

C.6.1.4 Ballast Maintenance

Railway ballast section maintenance is necessary to maintain the integrity of the railway. Newly placed ballast is typically well drained, free of organics and fine particles and locks together to form a solid rail support. These conditions do not provide a suitable medium in which weeds can grow. Over time, fine particles move into the ballast from the continual fracturing and powdering of the ballast rock caused by movement of trains, from deposition of dust by wind action and by migration from the underlying soils through "mud pumping". However, weeds that multiply by runners can

also invade the ballast by penetration of the shoulder. Vegetation that does become established eventually dies and decomposes, adding organic material that further promotes the growth of vegetation.

The railway has not only had many years to accumulate fines and organics but was built using poor quality ballast, with a relatively high percentage of fines in the material. As a result, the ballast retains moisture and provides a suitable medium for plant growth. This condition leaves little opportunity to reestablish the unsuitable growing conditions desired. Some ballast regulation is carried out which can help to reduce weed levels over the short term. This necessary maintenance activity is incorporated in the annual vegetation control planning.

As part of its response to the letter of non-compliance issued by the BC Safety Authority, the Island Corridor Foundation has recently applied to the provincial and federal governments for infrastructure funding, including $2 million for re-ballasting, re-surfacing, and grading of the track profile, including the supply and placement of 60,000 tonnes of new crushed rock ballast (ICF 2010). This extensive track maintenance program would result in a significantly reduced need for vegetation control in Zones A and B, and hence significantly reduced use of herbicide over the term of this PMP.

"Surfacing" is a mechanized track maintenance activity which has the objective of restoring the vertical and horizontal geometry of the track and increasing the density of ballast around the ties through tamping. Surfacing and tamping of the track disturbs the ballast and temporarily disrupts plant growth. Because ballast regulation does not change the characteristic of the ballast medium its effect at vegetation control is temporary. For this reason, surfacing is not considered an effective means of controlling vegetation.

Ballast cleaning is a track structure activity carried out to increase the strength of the ballast and improve drainage. Ballast cleaning also assists in the removal of vegetation and fine material in which weeds can germinate. The poor quality of ballast on the rail line currently limits this activity to lifting and tamping the track. Lifting and tamping track usually result in a small amount of clean ballast being placed directly under and along the ties. This has the effect of breaking up root systems and improving the lateral drainage of water. Nevertheless, the accumulated deleterious materials in the ballast are still present to retain water and to form a medium which is conducive to vegetation growth. This track maintenance activity does little to address long term vegetation control; however it can be timed to assist in prolonging acceptable ballast conditions until chemical treatment takes place.

C.6.1.5 Stripping and Re-vegetation

Plant competition can be an effective and inexpensive biological vegetation control method. Heavy equipment is commonly used to strip vegetation and re-establish sightlines at road crossings. The immediate establishment of preferred vegetation cover will assist in preventing the encroachment of unwanted vegetation. Where invasion of

unwanted vegetation does occur the infestation is rarely as extensive as it would be where mineral soil is left exposed. This offers the option of spot-mechanical or herbicide treatment. Spot treatments can remove unwanted vegetation while releasing the desirable vegetation to become better established. Grass/legume mixtures are generally used along the railway ROW. Some legumes, such as clover have a low growth form, are excellent ground covers and remain green throughout the growing season thereby minimizing fire hazard.

C.6.2 Chemical Methods

The use of herbicides by railways as part of an integrated pest management plan to control vegetation is a standard practice. Herbicides offer a useful tool that can be integrated with other vegetation management techniques. The absence of herbicide use on the former E&N Railway for 16 years has contributed to the present state of the railway. Given currently available technologies, without some herbicide use the weed-free status required of the railway ballast cannot be achieved through anything less than replacement of the ballast. It is unlikely that without some herbicide use, alternative vegetation control methods such as steam or flame treatment, natural herbicides or biocides would be effective at achieving the required vegetation control and maintaining safe operating conditions.

Herbicides may also be useful in the control of vegetation outside of the ballast section. Tall growing brush must be controlled so as to not impair the sight lines to signals, signs or crossings. The vegetation must also not impede human and wildlife passage from and alongside the track. Though most of this maintenance can be achieved using non-chemical approaches some manual application is practical for targeting individual plants. This is particularly the case where management objectives attempt to shift species composition towards later successional species that are easier to manage.

The herbicides registered for industrial use in Canada fall into three broad categories: residual, temporary-residual and non-residual. Residual herbicides enter the soil and remain phytotoxic (toxic to plants) for one to five years. Temporary-residual herbicides also enter the soil, but remain active for up to 1 year. Although the long-term maintenance feature of residual herbicides is appealing for railway ballast control there is the concern of chemical movement through the soil and into areas outside of the treatment zone. This excludes their use as an environmentally and socially acceptable option on Vancouver Island. In addition, ballast treatment with residual herbicides may lead to disclimax conditions within the ROW leading to additional weed and seed production, and aggravating vegetation maintenance requirements (Polster 1994). No residual herbicides are proposed for use by SVI in this PMP.

Non-residual herbicides are generally foliar or contact-applied with excess molecules quickly absorbed by soil particles rendering them inactive and less mobile. Two non-residual herbicide compounds, glyphosate and triclopyr are planned for integrated use with other methods to bring vegetation under control within the railway ROW. The primary focus of herbicide use will be on the ballast area where shrouded boom

application will be used, while the outer ROW will be manually spot-treated as deemed necessary.

The herbicides selected for use during the term of this PMP are chemical herbicides with the active compounds of glyphosate and triclopyr (Table C-3). All herbicide treatments will be maintained within the dosage range regulated for use by the federal government in Canada.

Table C-3. Chemical herbicides proposed for vegetation control in this PMP.

Active Ingredient	Herbicide Brand	Manufacturer	PCP No.	Target Vegetation
Glyphosate	Vantage Plus® (or equivalent)	Dow Agrosciences	26172	Non-selective (all vegetation)
Triclopyr	Garlon 4® (or equivalent)	Dow Agrosciences	21053	Selective (broad-leafed vegetation and Scotch broom)

When a systemic herbicide is applied to a weed it must penetrate the leaf surface and move through the plant's vascular system to be effective. Several barriers exist within plants that hinder absorption, including the cuticle, cell wall and cellular membrane. Herbicide surfactants can:

1. Reduce the surface tension of the carrier solution;
2. Improve retention and coverage of spray droplets on the leaf surface;
3. Increase herbicide absorption rates; and,
4. Reduce the need for the over-application of herbicides.

Silicone-based surfactants such as *Sylgard® 309* are recommended to improve the efficacy of herbicides, effectively reducing the amount of herbicide used to meet vegetation control objectives. The surfactant reduces the tendency of the herbicide droplets to run off the leaf and onto the ground. This surfactant will be employed in this PMP.

Although safe for human use, caution is noted about the toxicity of some common surfactants to amphibians (Relyea 2005; Govindarajulu 2008). However, silicone-based surfactants have been shown to be less acutely toxic than others (e.g. POEA-based surfactants commonly used with glyphosate) (Monheit *et al.* 2004). Recently developed organic (i.e., non-synthetic) surfactant formulations may offer reduced environmental risk compared to other, commercially available surfactants. For example, CB-707 was developed by EcoChem Corporation in Alberta and can be purchased online at www.ecochem.com/t_cb707.html. However, no test data on its efficacy or environmental effects could be found, and it does not appear to be registered for use in Canada. Should products such as this be approved for use in Canada, SVI may employ them on a trial basis during the term of this PMP.

C.6.3 Mixed Methods

Mechanical cutting, chemical treatments, ballast maintenance and natural alternatives are complementary techniques available to achieve vegetative cover which is compatible with railway, public and environmental safety.

Some techniques involve both physically cutting vegetation and the use of selective herbicide or bioherbicide treatment. This practice is common in targeted treatments of broadleaf trees and shrubs. 'Hack and squirt', 'basal bark injection' and 'cut and wick' methods all rely on spot treatment to ensure that re-sprouting does not occur. A recently developed technology called Sprout-Less™ adapts a circular brush saw blade to deliver small concentrations to the cut zone during cutting (http://www.sprout-less.com/main_e.html). These methods will be used in the treatment of unwanted vegetation outside of the ballast area.

C.6.4 Alternative Methods

Southern Railway of Vancouver Island Ltd. and the Island Corridor Foundation have explored a variety of other vegetation control options. Maintenance managers remain abreast of developments within the industry that may offer a technique that addresses program efficiencies and environmental concerns. A discussion of potential control options is provided below. Cost-effective alternative technologies will be incorporated into the PMP according to the level of vegetation control success they are demonstrated to have in trials conducted by SVI or other railway operators. To the extent possible, these alternative methods will supplement or replace herbicide treatments, reducing the quantities of chemicals required to effectively treat the railway.

C.6.4.1 Conventional Burning

Burning has been used as a method of vegetation control in the past and may still on occasion be practiced. Periodic burning is useful for promoting the development of grass communities rather than tree communities on ROWs. However, as a vegetation control method, burning has serious limitations. It is not effective in killing brush and tree species; roots often survive and the vegetation re-sprouts. Furthermore, the ash left behind supplies nutrients for future vegetation.

Conventional burning of weeds in the ballast is not practical. The primary disadvantage of burning is that fire is difficult to control. Burning offers only short-term effectiveness and presents rather serious environmental danger including damage to railway and private property, air quality concerns and occupational hazards. The limitations and dangers of burning are sufficiently serious that it is considered an unsuitable method of control and is not considered further within this PMP.

C.6.4.2 Steam Weeding

In the early 1990's Canadian Pacific Railway Ltd. developed and tested a track mounted

prototype which applied super-heated steam to weeds growing within the ballast section. The steam train consisted of up to 10 railway cars including components of a 1950's steam locomotive (as the steam generator and super-heater) supported by a control car a generator car, four water cars, one or more diesel tank cars and a locomotive. Fuel consumption was approximately 3,000 liters per day to treat 10 miles of track. In addition to the prohibitive consumption of fuel and the high production of CO_2, steam was shown to be incapable of killing the roots of some perennials, requiring repeated treatments. After an expenditure of several million dollars, Canadian Pacific abandoned the research in 1997, and resumed herbicide use for ballast treatment.

Treatment trials on the former E&N Railway showed steam to be particularly effective at eradicating Scotch broom, while repeat treatments were partially successful at the control of grasses and other hardy perennials. Its value as a tool to control vegetation growth by promoting more successionally advanced species within the ROW is suggested by Polster (2007). It is thought that modern boiler technology might prove to be more viable than that used in the CP and E&N trials. Unfortunately, appropriate equipment does not yet exist and significant investments of time, resources and funding are needed for development (Woldnik 2008), a cost which is prohibitive to the long term economic viability of the railway.

Figure C-5. Steam machine (second car) and support equipment on Goldstream Bridge, June 1992.

C.6.4.3 Flame Entrainment Weeding

Flame entrainment weeding is a vegetation control technology in the development stage that may offer potential for treatment within the ballast area. While the technical details remain proprietary at this time, the approach is one of using a 'superheated' gas flame to burn plants. It is hoped that the heat delivered by the system will be significantly higher than that of steam treatment. If this is achieved, the technology should be more

effective than steam, and should use less fossil fuel energy by eliminating the steam heating step.

The developer of this treatment technology has provided assurance that accidental fires will not occur as a result of flame entrainment. More study and trial is necessary to determine whether this method will sufficiently damage roots to prevent or suppress re-sprouting of vegetation, while assuring protection of the environment from fire hazard, reduced air quality, and excessive greenhouse gas emissions.

C.6.4.4 Advanced Application Technologies

A WeedSeeker™ selective spray system is a newly developed technology described online at www.ntechindustries.com/weedseeker-home.html . The technology uses infrared optics to sense the presence of vegetation on the track and high speed solenoids to deliver a dosage of herbicide to the vegetation via a track-mounted spray boom. Significant reductions in herbicide volumes are claimed by the manufacturer of WeedSeeker™, an important consideration in reducing environmental risk, public concerns and project costs. It is thought that the technology is well suited to treating a low density of weeds.

A variation of this method is being tested by Canadian Pacific Railway (CPR 2010). Some reports on this new technology indicate that misfire on substrate anomalies such as loose cobbles is common and that the spray can at times miss portions of the target. It is likely that this technology will continue to be refined.

CPR has also begun full-scale field trials of a new generation automated weed identification and herbicide application system called Chlorovision® (CPR 2010). This system accurately identifies vegetation within a 10 meter wide treatment zone with pinpoint accuracy and automatically controls the rail-based application equipment to precisely treat only the targeted vegetation. This system includes an integrated GPS that creates a report on a daily basis, including images and GPS coordinates.

CPR is also investigating the potential use of WetBlade® and OnePass® technologies that combine traditional mechanized cutting of unwanted vegetation with sequential wick application herbicide treatment.

SVI will continue to monitor the development of these advanced application technologies and may consider deploying them in the future once an acceptable lower density of vegetation on the ROW has been achieved.

C.6.4.5 Natural Herbicides

In response to environmental concerns and public opposition to synthetic chemical herbicides there is a growing body of research underway to develop natural tools for vegetation management. Products now becoming available are commonly formulated from blends of natural compounds with active ingredients such as citric acid, garlic, fatty

acids (soap), pine oil extract and clove oil extract. Some home-made formulations are commonly known such as a mixture of vinegar, salt and dish soap. These 'natural' herbicides generally 'burn-down' top growth foliage offering temporary control before re-growth from the roots which remain unaffected. Some of the formulations do not need registration due to their natural contents. Commercial products such as AllDown Green Chemistry Herbicide® (BioLynceus Biological Solutions, Colorado), Matran™ 2, (EcoSMART Technologies, Tennessee) Interceptor™ (Sentinel Direct, New Zealand), BurnOut II (St. Gabriel Organics, Virginia), and others are available in the United States but not in Canada. Two organic formulations available in Canada include: Safer's Topgun, and Natura's Weed-A-Tak. Both are sold for domestic use but are not available in industrial quantities.

Due to concerns that Canada's pesticide registration process may be inappropriate for natural herbicides and/or overly burdensome for small companies generally involved in the development of natural alternative herbicides, the Pest Management Regulatory Agency is currently soliciting public comment on the development of a more flexible registration framework for low-risk, non-conventional pesticides, including natural herbicides. A simpler registration process may prove to be a stimulus for accelerated development and/or wider availability of natural herbicides in Canada.

Natural herbicide technology is still in the developmental stage and, therefore, offers limited industrial use. A trial by SVI of two soap-based (fatty acid) organic herbicides (ECF1 and ECF2) developed by EcoCare Technologies found that both organic formulations proved equally effective to glyphosate against broom up to three months after treatment, however, only ECF2 produced comparable results to glyphosate against all weeds and grass over the same period. Only ECF1 is currently registered for use in Canada.

C.6.4.6 Bioherbicides

Bioherbicides, or biocides, use natural plant pathogens to suppress or reduce the population of weeds. During the past decade the indigenous silver leaf fungus *Chondrostereum purpureum*, which occurs naturally in red alder has been developed as a viable mycoherbicide*. C. purpureum* occurs globally in temperate zones. It can invade only through fresh wounds in the plant xylem and is a weak pathogen causing mild sap streak in infected trees, killing only those trees which are severely compromised. Its application can only be used effectively if the target vegetation is cut back significantly and immediately treated. Trials have shown it to be 100 % effective in suppressing re-growth of cut stumps of alder and aspen. Cut-and-treat trials of two year old Scotch broom showed *C. purpureum* to be as effective as the conventional herbicide Release™ at preventing the re-sprouting of 2 year old Scotch broom plants. Another feature of this mycoherbicide is that its chlamydospores can persist in the soil for a long time and they may suppress the germination of seedlings from the prolific seed bank commonly found in Scotch broom infestation sites (Prasad 2000).

Chondrostereum purpureum was registered for use in British Columbia in 2007 and is

sold under the name of Chontrol Peat Paste (MycoLogic Inc.). SVI plans to conduct a second trial of this bioherbicide during the term of this PMP, focusing on its effectiveness at alder control in the outer ROW.

C.7 Treatment Timing

The seasonal timing of treatments can have a significant influence on the results of the vegetation management. Seasonal variations occur in plant stature and resistance to treatment, the rate of re-growth, the nutritional value for ungulate browse as well as the environmental risks of treatment. Table C-4 summarizes the primary treatment methods and their appropriate timing.

Table C-4. Suitable treatment timing based effective results and reduced environmental impacts.

Treatment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mowing					xxxx	xxxx			xxx	x		
Brush cutting					xxxx	xxxx	xxxx	xxxx	xxxx	xx		
Bioherbicides			xxxx	xxxx	xxxx				xxxx	xxxx		
Herbicide (Boom-spray)					xxx	xx	x		xxx	x		
Herbicide (Blackberries)									x	xx		
Herbicide (Hand application)				xxxx	xxxx	xxxx	xxxx	xxxx	xxxx			
Ballast maintenance					xxxx	xxxx	xxxx	xxxx	xxxx	xxxx		
Clearing and replanting				xx	xxxx	xx			xxxx	x		

Mowing cannot be expected to kill weed species that have subsurface reproductive structures, but it will remove plant top growth and seed production. Timely mowing of the weeds and woody vegetation will reduce re-growth and must be based on the physiology of the plants involved. Typically, the most effective cutting will occur when the root carbohydrate reserves are at a minimum. This usually occurs at the onset of full leaf expansion, when the plants have expended significant energy reserves in the growth of leaves and shoots, but before there has been much time for energy from photosynthesis to be stored. Annual species should be mown just prior to flowering and before seed set. Studies of Scotch broom control found that mature plants cut at the time of flowering resulted in minimal re-spouting due to the lack of reserves for re-growth (Prasad 2003).

The quality of regenerating plant growth for herbivore browse depends on when plants

are cut (Rea 2003). Plants brushed in the middle of the growing season produce re-growth that is high in nutritional value for at least two winters following brushing when compared with plants brushed at other times of the year. Because mid-summer is generally the time of the year that roadsides are brushed, there may be a link between roadside vegetation management practices and the winter peaks in ungulate-related vehicular collisions. Therefore it is recommended that brushing be done early in the growing season to reduce the risk of wildlife collisions.

The timing of herbicide application is dependant on both the plant species and the herbicide type. The non-residual foliar herbicides that will be employed in this PMP will be effective in both Spring at bud to early flowering stage, and in the Fall as plants prepare for winter dormancy, storing reserves in their root systems. In the spring following rapid vegetative growth, the reproductive structures of perennial plants have the lowest amount of energy reserves and begin to move reserves from their above-ground growth to their roots. The movement of food reserves can assist the movement of foliar herbicides to underground root structures. A second, even more marked translocation of nutrients from the vegetation to the roots takes place in the fall as plants prepare for winter dormancy. At this period the efficacy of foliar herbicides can be reduced as the vegetation is often more hardened and difficult for herbicides to penetrate. Additional surfactant, a greater herbicide concentration or moister application conditions are sometimes needed to achieve an effective fall treatment.

It is noted that the herbicide treatment of Himalayan blackberries is most effective with spot foliar treatments in late Fall; post berry-drop and prior to leaf-fall. Application of a systemic, non-residual herbicide in late September or early October has been found to be effective as it translocates to the roots of the plant through the fall and winter months and kills the plant before new growth emerges the following year. In addition, to minimize the risk of herbicide ingestion, blackberry eradication needs to be timed for a period when flowering or berry production will not attract wildlife and the public to recently sprayed plants.

C.8 Vegetation Management Prescriptions

This section describes the vegetation management prescriptions for the ballast, the ROW and the yards.

The vegetation control treatment option is guided by the Resource Users Database. This is an actively maintained database that catalogues key environmental, economic and social resource features, collectively termed 'resource users', by track mileage. Track mileage is established accurately by the longitudinal rail system survey and is the operational standard for site location along the railway. Precise track locations are metered by the maintenance fleet using an onboard RAC-100 track meter accurate to 1 foot per mile. The meter can be recalibrated at most major track crossings to ensure accuracy. A key function of the Resource Users Database is to identify the precise locations of features along the railway where no-treatment zones (NTZs) apply.

C.8.1 Zone A (Inner ballast, Tie section)

Ballast is the layer of crushed rock, which supports and restrains the track and ties. Ballast is designed to provide free drainage of water, provide structural support for vertical loads and keep the ties and rail from moving transversely and longitudinally as a result of dynamic train forces and compressive or expansive forces occurring during rail temperature changes.

Ballast is the single most critical area of railway operations requiring vegetation control. Vegetation of any kind in the ballast section can lead to problems which are incompatible with a stable track structure. Vegetation within Zone A has the potential to short the electronic signal that activates traffic controls at public road crossings. Track turnouts and switching gear are located within Zone A.

Foot traffic associated with train operations, track maintenance and track inspection occurs within this zone. The ballast section is also most prone to fire as a result of the close proximity to sources of combustion which may ignite ties and dry weeds growing on the track.

Despite attempts to develop alternatives, herbicides have proven to be the most effective method for controlling vegetation growth within the ballast section. In areas where Zone A is not adjacent to watercourses, vegetation in the ballast will be controlled by the use of a non-selective, non-residual herbicide suitable for the climate, soil and target plant species.

Specific environmentally sensitive areas where herbicides are not to be applied have been termed pesticide-free zones (PFZs). A no-treatment zone (NTZ) may be applied around the pesticide-free zone to protect the PFZ from contamination. The criteria used for assigning a PFZ and determining the width of its associated NTZ in each treatment zone is outlined in Section D.2.

Where bridges or trestles exist, no herbicide treatments will be made where ballast and growing medium is absent. Mowing and manual hand weeding will become the alternative treatments where chemical treatment is excluded.

In most areas the width of the ROW provides a sufficient buffer to adjacent properties from herbicide treatment occurring in Zone A. At some sites, the presence of watercourses flowing perpendicular to the ROW, the close proximity of track-side ditches discharging to watercourses, or the parallel alignment of adjacent streams will determine the selection of the vegetation control treatment.

C.8.2 Zone B (Outer ballast and signal and switch stands)

In Zone B vegetation control remains imperative for track stability, fire control and worker safety. Zones A and B will generally be treated together. However, in some areas Zone B will have additional restrictions due to the proximity of environmentally

sensitive areas, for example at stream crossings and wetted ditch sites where the NTZ may limit herbicide application to Zone A.

Although signal and switch stands are often located beyond the rail ballast and are within Zone C they have been included within Zone B for treatment requirements as vegetation control in these areas is imperative for worker safety and fire hazard control. Both mechanical mowing and herbicide treatments will be used to maintain vegetation control at these sites.

C.8.3 Zone C (Sub-grade, ballast edges)

Much of the vegetation to be managed is located in Zone C. Drainage ditches or swales are usually located on one or both sides of the track within this zone. Zone C also contains signs, signals and portions of switches (but see above). Selective control of vegetation is necessary in this zone in order to reduce vegetation height and volume. The elimination of brush and trees in favor of grasses and other ground cover is often an ideal objective. The chief concerns for vegetation control within this zone are:

- Maintaining sight line visibility at all vehicle and pedestrian crossings;
- Maintaining sight line visibility along curves;
- Providing clear visibility to signs and signals;
- Reducing physical hazards to railway crews and track maintenance personnel who must work in these areas;
- Minimizing fire hazards; and,
- Reducing escape barriers to wildlife.

Mechanical methods will be the dominant vegetation control within Zone C. The width of this zone is in fact determined by the maximum reach of the high-rail mounted brush cutter. Although over the short term, many of the vegetation control objectives in Zone C can be achieved by regular mechanical cutting, frequent re-cutting encourages a growth pattern which leads to a need for more frequent cutting due to the proliferation of shoots from many species such as willow (*Salix spp.*), maple (*Acer spp.*), alder (*Alnus spp.*) and cottonwood (*Populus spp.*). In addition, the process of cutting results in jagged shoots at a height ideal for tripping and wounding persons or animals walking through the stubble. This condition continues to get worse with each cutting. Cutting also does not discriminate between desirable and undesirable plant species, and the effectiveness of cutting is limited at some sites by irregular terrain.

In order to reduce populations of herbaceous plants and multi-stemmed woody growth, selective herbicides will at times be used to compliment mechanical cutting treatments. Careful timing of both mechanical cutting and herbicide application will culture a shift towards the desired plant community. Once this optimum condition is reached, the frequency of herbicide application can be reduced.

The methods of both mechanical and chemical treatments can be manual, targeting individual plants and species, or mechanized, treating the entire zone. Large trees within Zone C which pose a danger of falling or impeding sight lines at crossings and

signals will typically be cut down or trimmed.

Within NTZ's adjacent to watercourses manual or brush cutting of select vegetation in Zones C and D will take place to maintain sight lines, which will minimize disturbance to riparian vegetation so that it will retain its function, providing bank stability, shade, habitat, and intercepting runoff. Vegetation height tolerances will be as high as possible to preserve riparian vegetation. In many instances riparian function may be best preserved while maintaining railway needs by the culture of compatible species. Conifer trees such as Western redcedar (*Thuja plicata*), Sitka spruce (*Picea sitchensis*) and Douglas fir (*Pseudotsuga menziesii*) along with short stature bushes such as salmonberry (*Rubus spectabilis*) and thimbleberry (*R. parviflorus*) tolerate repeated topping while retaining healthy roots and lower branches. Deciduous trees such as red alder, broad leaf maple and willow are not desirable due to their rapid vertical growth. The planting and culture of preferred species is a long term objective. This will involve the suppression or eradication of competing vegetation. Where individual control of problem plants is needed, selective manual application techniques such as wick and basal bark treatments may be employed using the herbicide use criteria outlined below.

C.8.4 Zone D (ROW and sight-lines)

Zone D consists of the portion of the ROW beyond the reach of the brush cutter, extending to the edge of the property. Usually, there is little infrastructure located in Zone D although overhead services such as power and telephone lines and underground services such as communications cables and sewer may be found in this zone.

For the typical 100 ft (30.5 m) ROW, Zone D is approximately 18 ft (5.5 m) wide. Ideally, this zone should be combined with Zone C for treatment as previously discussed. However, this degree of vegetation removal is considered too costly, except at road crossings (where safety and legal issues require it), as well as on the inside of tight curves where visibility is limited. In these critical locations removal of tall brush and trees to the full width of the ROW will be achieved by mechanical cutting, girdling, manual cutting, blading with earth machinery, and where appropriate by the use of herbicides which selectively eliminate brush without affecting grasses. Herbicide selection within Zone D is the same as for Zone C. Herbicide application in Zones C & D will be manual and will not be done by a boom sprayer.

C.8.5 Railway Yards and Station Grounds

Elimination of vegetation is required on railway yard tracks for the same reasons as described earlier for mainline track and sidings. Bare ground is desirable around buildings and storage areas, as well as other service areas, for safety, cleanliness and fire prevention. In other areas of yards, bare ground is not necessary and it is adequate to simply control vegetation for aesthetics and to minimize fire hazards.

Control in areas requiring eradication of all vegetation may be provided first by

mechanical methods (track-mounted mowers and brush cutters, brush saws, weed trimmers and manual digging) in overgrown areas, followed by timely spot application of nonselective herbicides. Herbicides are chosen on the basis of overall suitability for soil and climate conditions, minimal human toxicity and limited potential for off-site movement. These products are usually low volatility/low odor products that will not be offensive to the work force or public. Where possible, treatment of yards near buildings and other working areas will be conducted during annual shutdowns or after-hours to reduce potential concerns.

Where bare ground is not required the presence of vegetation provides aesthetic benefits, erosion control, ground stabilization and some biodiversity value. Grassed areas around buildings may be controlled by mowing. Manual cutting of brush using brush saws or weed trimmers is the method of choice where practical. Where problem species exist such as Scotch broom, a combination of brush cutting, mowing or pulling, and application of a selective herbicide will be used so that the woody plant communities are shifted towards grass communities. Vegetation removal and reseeding bare ground with grasses and legumes will promote this succession. Diligent vegetation control should ultimately reduce the need for herbicides as the desirable species gradually crowd out and displace woody varieties.

C.8.6 Crossings

Mandated requirements for sightlines at highway, access and pedestrian crossings are identified by provincial and federal regulations. To meet the regulations cut slopes are graded back and vegetation is controlled primarily by mechanical methods. Crossing sightlines are particularly well suited to species transition, replacing tall growing brush and trees with lower growing bush and grasses. Longer-term control at crossings may require the use of herbicides to suppress brush and woody stubble that can become established after repeated mowing. An herbicide applied by selective manual treatment or boom sprayer will be used to address such circumstances.

C.9 Post-treatment Evaluation

SVI conducts post-treatment monitoring assessments to determine if the objectives of the integrated vegetation management program have been met and to identify possible improvements to the program. Visual inspections of treated areas are conducted after the effects of treatments are well-established, generally in late Summer.

SVI's post-treatment evaluations encompass assessments of:

- Compliance with the commitments of this PMP, particularly the maintenance of pesticide-free zones;
- The adequacy of applied rates of herbicide;
- Evidence of off-target herbicide movement;
- The amount and rate of survival or re-growth of unwanted vegetation; and,
- The general effectiveness of the treatment.

The results of post-treatment evaluations feed back into the development process for the following year's vegetation control program, under an adaptive management approach that enables continual improvement of vegetation control planning and treatment practices.

D. OPERATIONAL INFORMATION

SVI maintenance crews carry out much of the mechanical vegetation control such as brush cutting, mowing, replanting and ballast maintenance. The application of pesticides will be carried out by qualified, certified contractors. Only responsible contractors having a proven track record in the lawful and competent application of herbicides will be employed by SVI. Contractors will be bound by the requirements of this PMP, as well as the label restrictions for the chemicals used and the codes of practice of their applicators' license.

Where herbicide application is isolated from environmentally sensitive areas such as within yards and accessible sidings, certified contractors whose quality of work has been verified by SVI may be permitted to work independently. All mainline herbicide application will be monitored by a suitably qualified environmental monitor, independent of the herbicide contractor.

D.1 Herbicide Handling Procedures

The transportation, storage, handling, application and disposal of herbicides are governed by federal and provincial legislation. All contractors working with herbicides will follow safe handling practices including workplace requirements for Workplace Hazardous Materials Information System (WHMIS) labeling and worker education, and in compliance with Division 7 of the Regulation. Legal obligations of herbicide applicators and their workers are detailed in:

1. *Workers Compensation Act* and Occupational Health and Safety Regulation.
2. WHMIS Material Safety Data Sheets.
3. BC Ministry of Environment (Adams 2005) *Handbook for Pesticide Applicators and Dispensers*.
4. WorkSafe BC (2009) *Standard Practices for Pesticide Applicators*.
5. *Integrated Pest Management Act* and Regulations.
6. *Transport of Dangerous Goods Act* and Regulations.
7. *Environmental Management Act* and *Hazardous Waste Regulation*.

D.1.1 Safe Transportation of Herbicides

The transportation of herbicides will comply with all Federal and Provincial laws governing their transport. The following procedures will be followed while herbicides are

being transported:

- Limited amounts of herbicides will be carried in any one vehicle. The quantity will be no more than what is necessary for each project.
- Herbicides will be carried in a secure, lockable compartment.
- Herbicides will be transported in their original, labeled containers.
- Herbicides will be transported separately from food and drinking water, safety gear and personnel.
- Spill containment and clean-up equipment will be transported separately from herbicides, but in close proximity to them, on each vehicle during transport and application.
- All documents and placards will be carried in, or placed on, transport vehicles if required under the federal *Transportation of Dangerous Goods Act*.
- All herbicide containers will be inspected for defects prior to transporting, and will be secured against spillage or unauthorized removal.

D.1.2 Storage of Herbicides

Herbicides will be stored in facilities that are:

- Equipped with non-permeable floors and adequate secondary containment;
- Vented to the outside;
- Not used for storage of food intended for consumption;
- Locked when unattended;
- Accessible only to personnel authorized by the individual in charge of storing the herbicide; and,
- Signed "WARNING: CHEMICAL STORAGE - AUTHORIZED PERSONS ONLY" in block letters and visible to a person approaching each door providing access to the facility.

D.1.3 Mixing and Loading Herbicides

Mixing and loading are to be conducted at sites that maximize the vertical distance to unconfined aquifers. At a minimum, a 100 m horizontal distance will be maintained between mixing and loading activities and all environmentally sensitive zones. Convenient and safe sites for this activity will be identified in the Resource Users Database. No mixing and loading will take place away from prescribed sites unless approved by the environmental monitor.

All mixing and use of herbicides will be carried out by certified herbicide applicators in the appropriate category of certification, or by individuals directly supervised by a certified herbicide applicator in the appropriate category of certification. The following

practices will be implemented during herbicide mixing and loading:

1. Mixing of herbicides will always be conducted in a safe manner.
2. Safety spill kits, spill response plans and first aid supplies will be present on site.
3. Eye wash station(s) and protection clothing, as recommended on the respective product labels, will be available on-site.
4. Product labels and MSDS's will be available on-site to ensure that quantities of herbicides being mixed and used are consistent with label rates.

D.1.4 Disposal of Herbicides

Disposal of empty containers will be in accordance with the manufacturer's instructions as noted on the product label or Provincial instructions and recommendations that are detailed in the BC Ministry of Environment (2005) *Handbook for Pesticide Applicators and Dispensers*.

D.1.5 Spill Response

SVI has a contingency plan covering spills associated with the transportation of dangerous goods. A spill response plan will be available at each work site and given to each herbicide contractor. All personnel and contractors working on a project involving herbicides must be familiar with its contents. The following procedure will be followed if a spill occurs:

1. All personnel will be protected from herbicide contamination by wearing appropriate protective clothing and safety gear.
2. The source of the spill will be addressed and containment will be affected using spill containment equipment and appropriate techniques, possibly including the creation of a berm.
3. The project supervisor will notify employees and the SVI Roadmaster or delegate, and will ensure operations cease until the spill is contained.
4. The SVI Roadmaster or approved representative will be notified by the project supervisor of the details related to the spill as soon as is practical.
5. Where the herbicide involved in the spill results or may result in its release into the environment, the person responsible for the product will immediately report it to the Provincial Emergency Program by telephoning 1-800-663-3456 or, where that is impractical, to the local police or nearest detachment of the RCMP.
6. Cleanup will begin immediately.
7. Absorbent material will be spread over the spill, if applicable, to absorb any liquid and will be collected into garbage bags or containers, with the contents clearly marked.
8. Contaminated soil or other material will be removed from the spill site and placed in garbage bags or containers.

9. Disposal of contaminated material will be consistent with applicable regulations.

D.2 Environmental Protection Strategies and Procedures

Vegetation management around watercourses can have significant environmental aspects and regulatory requirements, particularly where herbicides are being used. Watercourses, domestic water wells, water supply intakes, and certified organic cropland all require specific herbicide use restrictions which must be adhered to (Table D-1). In addition to these restrictions, general precautions shall be taken to ensure that the herbicides are used in a manner that will not result in damage to non-target plant species or in the contamination of soil used for agricultural crop production, gardening or landscaping purposes.

D.2.1 Protection of Community Watersheds, Domestic and Agricultural Waters

Designated Community Water Supply Watersheds (Community Watersheds) will be protected by the following strategies and procedures:

- A minimum 10 m pesticide-free zone, except for biological herbicides, will be maintained around all streams, lakes, and other water bodies, whether fish-bearing or not within a community watershed. This applies to all streams whether flowing or not. An additional buffer of 2 m will be applied by SVI (making a no-treatment zone of 12 m) for boom spray operations to prevent contamination of the PFZ.
- A 105 m no-treatment zone (NTZ) will be applied upslope of a community water supply intake.
- A 35 m no-treatment zone (NTZ) will be applied downslope of a community water supply intake.
- Herbicides will not be stored within a community watershed for more than 24 hrs prior to their use, and will be removed from the community watershed within seven days of use, unless stored in a secure permanent location.

Domestic and agricultural wells and all other water supply intakes will be protected by a minimum 35 m no-treatment zone around the well/intake location.

Any domestic water wells or intakes located within the ROW anywhere along the railway are illegal, as their presence conflicts with the rights of the railway. Some licensed water intakes and registered wells are located adjacent to the ROW. Existing water resource users are identified in the Resource Users Database. Where future field assessments or public consultations identify additional domestic water resource users within 30 m of the ROW they will be added to the database.

Table D-1. No-treatment zones to be applied to environmentally sensitive areas.

Environmental Sensitivity	Herbicide	Application method	Zone A	Zone B*	Zone C	Zone D
Upslope of a community water supply intake in a Designated Community Water Supply Watershed.	All	All	105 m (100 m PFZ)	105 m (100 m PFZ)	105 m (100 m PFZ)	105 m (100 m PFZ)
Downslope of a community water supply intake in a Designated Community Water Supply Watershed.	All	All	35 m (30 m PFZ)	35 m (30 m PFZ)	35 m (30 m PFZ)	35 m (30 m PFZ)
Domestic & agricultural wells and all other water supply intakes.	All	All	35 m (30 m PFZ)	35 m (30 m PFZ)	35 m (30 m PFZ)	35 m (30 m PFZ)
Certified organic cropland.	All	All	12 m (10 m PFZ)	12 m (10 m PFZ)	12 m (10 m PFZ)	12 m (10 m PFZ)
All streams, lakes, and other waterbodies in a Designated Community Water Supply Watershed whether streams are flowing or dry.	All	All	12 m (10 m PFZ)	12 m (10 m PFZ)	12 m (10 m PFZ)	12 m (10 m PFZ)
All fish-bearing water bodies and all non-fish-bearing water bodies that are not dry.	Glyphosate	Boom	4 m (2 m PFZ)	4 m (2 m PFZ)	—	—
	Glyphosate	Selective	2 m	2 m	2 m	2 m
	Triclopyr	Selective	10 m	10 m	10 m	10 m
Non-fish-bearing water bodies that do not have direct connection to fish-bearing waters and are not a source of a community water supply and are dry.	Glyphosate	Boom	0 m	0 m	—	—
	Glyphosate	Selective	0 m	0 m	0 m	0 m
	Triclopyr	Selective	10 m	10 m	10 m	10 m

* Plus signal switches and yards.

Direct connection to fish bearing waters means surface water connectivity.

Selective application means manual non-spray application, including: basal bark, hack-and-squirt, wick, injection/frill, cut stump.

PFZ = Pesticide-free Zone.

In some cases water supply lines passing through culverts that cross the ROW have been authorized by encroachment permits issued by the railway. Previous field surveys revealed other unauthorized water crossing the railway. It is the policy of SVI to require that unauthorized pipelines be removed. In any case, the presence of water supply pipelines does not preclude the use of herbicides as there is no likelihood of chemicals penetrating plastic or metal pipes.

No restrictions for the use of glyphosate for vegetation control of the ballast are required when the water body is known to meet the following criteria:

- The water body is non-fish-bearing;
- The water body does not have surface water connectivity with fish-bearing waters at any time;
- The water body is not a source of a community water supply; and,
- The water body is dry at the time of application.

The PFZ for the selective application of triclopyr will still be 10 m under these conditions.

All no-treatment zones and/or pesticide-free zones adjacent to wet or dry water bodies will be measured from the margin or high water mark as defined in the latest edition of the *B.C. Handbook for Pesticide Applicators and Dispensers*.

D.2.2 Protection of Fish, Wildlife and Riparian Areas

It is recognized that a high percentage of the water bodies[2] crossed along the railway are fish-bearing or have direct connectivity (surface flow) to fish-bearing waters. Unless fish absence is known or is confirmed by future inventory work, all water bodies will be treated as fish bearing unless a qualified environmental professional determines otherwise.

In areas not designated as community watersheds, a 4 m no-treatment zone will be applied to all fish-bearing water bodies and all water bodies directly connected to fish-bearing waters, whether flowing or not, during the application of glyphosate by boom spray to the ballast area (Zones A & B). This can be reduced to 2 m for the selective application of glyphosate in all zones. The PFZ for the selective application of triclopyr will be 10 m in all zones.

[2] Water bodies include:
a) Water in a watercourse such as a river, stream or creek;
b) Water in the basin of a lake, marsh or slough:
c) Marine or estuarine water; or
d) Water in a ditch;
but do not include human-made, self-contained water bodies (e.g. ponds and dugouts) (Adams 2005).

Wildlife use of the ROW is incompatible with the safe operation of the railway. One of the objectives of the vegetation control program is to reduce hazards to wildlife by removing attracting vegetation from the track, ballast area, and trackside ditches. As such, most wildlife use should be restricted to Zone D (the outermost part of the ROW) where only selective application of herbicides will be used to maintain sight-lines.

Where possible, mechanical or mixed methods of vegetation treatment for the removal of tall shrubs, trees, or snags within this zone will be timed to avoid the bird breeding season of April 1 to July 31. When these activities cannot be scheduled outside this time period, a pre-clearing survey for migratory and resident bird nests and/or raptor nests will be conducted by a qualified environmental professional, such as a Registered Professional Biologist.

Given the disturbed nature of vegetation and wildlife habitats along the railway, there is a low probability of occurrence of Species At Risk. Possible exceptions include the red-legged frog and rare plants associated with Garry Oak ecosystems. However, given the NTZs that will be applied to water bodies, and that most herbicide use will be restricted to the ballast area, no impacts on any SARA species are expected as a consequence of vegetation control activities along the railway.

The application of no-treatment zones and the limited extent of clearing of compatible plant species in the ROW will ensure the protection of riparian areas and associated wildlife habitats. In addition, no refueling of vegetation control machinery or mixing and loading of herbicides will be conducted within 100 m of any flowing or standing water.

D.2.3 Prevention of Contamination of Food for Human Consumption

Where certified organic farmland borders the rail ROW appropriate buffers will be maintained to ensure that organic certification is preserved. There are numerous certifying agencies in British Columbia, all of which fall under the Certified Organic Association of BC. The Certified Organic Management Standards - Version 7, Book 2 (January 2005) states that a buffer zone is required by the farmer between certified cropland and other land uses: "*Buffer zones should usually be 8 m in width and wherever feasible contain a hedge row or trap crop that is 1.5 times the height of the adjacent crop*". A 12 m NTZ will be maintained from organic farmland. In most cases herbicide use by the railway will be limited to Zones A and B (ballast area) offering a buffer of over 10 m within the ROW itself. This buffer in conjunction with the required farm buffer offers over 20 m of buffer to the certified crop. SVI encourages on-site discussion should certified organic farmers express concerns. Mowing is likely to be the primary alternative method of control used in PFZ's.

The harvesting of wild berry crops on the ROW is an illegal activity due to trespass and it is discouraged due to public safety hazards. Despite this, no chemical treatment of raspberries and blackberries (*Rubus spp.*) in Zones C and D will be conducted during the period from opening of flowers until the berries are predominantly dropped from the vine.

D.2.4 Pre-treatment Inspection Procedures for Identifying Treatment Area Boundaries

An onboard location system will use the track mileage information contained in the Resource Users Database to accurately identify treatment prescription limits. As an additional precaution, and to accurately identify current seasonal water courses, rail maintenance crews will mark the boundaries of all no-treatment zones along the railway immediately prior to all applications. A qualified environmental monitor will accompany the herbicide application crew to ensure that appropriate procedures are being followed. Environmental monitoring requirements are discussed in Section D.2.6.

D.2.5 Herbicide Use Notification

Where public access areas are to be chemically treated, such as at public road crossings, signs will be erected notifying the public of the planned herbicide use (Figure D-1). These signs will be positioned on stakes or poles at public crossings and in public areas where concerns about herbicide application have been expressed. The signs identify the date of treatment, the trade name of the chemical and a telephone number to call for additional information. Signs will be positioned immediately prior to treatment and be left up for at least seven days following treatment; a conservative practice since approved label re-entry times are typically less than 24 hours.

D.2.6 Environmental Monitoring

The application of herbicides under this PMP will be monitored by a qualified environmental monitor. The monitor will be positioned onboard the spray vehicle in such a position that they can monitor the rail mileage indication as well as the status of the spray unit control. The monitor will be a person experienced in the identification and classification of aquatic and terrestrial habitats and environmentally sensitive features. A detailed spray plan will be adhered to, based on the Resource Users Database and the restrictions for application of herbicide adjacent to environmentally sensitive areas (Table D-1). A record of adherence to the plan will be kept by the monitor as the treatment progresses. This record will be used to assist the compilation of annual pesticide use reports. The environmental monitor will have the authority to override the herbicide spray plan by altering treatment areas based on site conditions and attributes at the time of application. Alterations to the treatment prescription will be recorded along with the rationale in the database and will be included in the annual treatment records.

Figure D-1. An example of a herbicide use sign posted by SVI in areas of public access proposed for herbicide application under the previous PMP.

D.3 Herbicide Application Methods

D.3.1 Herbicide Application Methods and Equipment

D.3.1.1 Zones A and B (Tie Area, Ballast Section)

The most practical equipment for application of herbicide to railway ballast is the rail-mounted (hi-rail) truck equipped with a shrouded spray boom. The shrouded boom allows the herbicide mix to be applied over the 4.8 m width of the ballast area (i.e., Zones A and B combined) from a height of 0.3 m, using low pressure to produce large droplets which do not drift significantly even under adverse wind conditions. Shrouded boom spray applications will take place at speeds of 16 km per hour or less to ensure drift is minimized. Maximum spray electronic nozzle controls on the boom also allow the spray to be instantly isolated to just the Zone A rail tie area in situations where environmental sensitivities require minimal application. Where spot treatments may be needed, ballast may also be treated using a smaller boom mounted on an all-terrain vehicle or by hand using a backpack sprayer, low pressure hand gun or hand-held wick applicator. Triclopyr use in Zones A and B will be done by targeted hand application using stem injection (hack and squirt), basal bark application or Sprout-less™ cutter-head technology.

D.3.1.2 Zone C (outer ballast, edges)

Herbicide use in Zone C will be restricted to targeted hand application. Stem injection (hack and squirt), basal bark application or Sprout-less™ cutter-head technology are the methods considered for manual targeted use at this time. To avoid the potential for drift, the ground operated equipment used for foliar treatments shall not treat vegetation that is greater than 1.5 m in height above the ground on which the applicator is standing.

D.3.1.3 Zone D (outer ROW)

Vegetation control in Zone D is limited to individual plant treatments to maintain lines-of-sight and problem vegetation that can achieve > 2 m height. Methods of herbicide application are limited by the distance from the railway. Stem injection (hack and squirt), basal bark application or Sprout-less™ cutter-head technology will be used.

D.3.1.4 Yards

Tracks within yards, including classification tracks, shop tracks and storage tracks are normally treated by the high-rail shrouded spray boom. However, it is often more efficient to apply herbicide to these tracks by spot treatment using a hand gun or a side nozzle from a small tank on an all-terrain vehicle or pickup truck, which can move freely between adjacent tracks. The method is particularly effective when the vegetation requiring treatment is primarily located on the shoulder and is amenable to spot treatment. Non-track areas requiring spot treatment where personnel work around shops and buildings and parts storage are generally treated by back pack sprayer.

Triclopyr use in yards will be done by targeted hand application using stem injection (hack and squirt), basal bark application or Sprout-less™ cutter head technology.

D.3.2 Maintenance and Calibration of Herbicide Application Equipment

All herbicide application equipment used will be safe, clean, in good repair, and compatible and appropriate for the herbicide being used. This will necessitate inspecting, servicing and repairing all equipment as required.

All herbicide application equipment will be inspected daily prior to use, calibrated using a timed volume test prior to each project, and re-calibrated as required as the project progresses.

D.3.3 Procedures for Monitoring Weather Conditions

Spraying will not be planned to take place during periods when rain and/or excessive wind/drift conditions are forecast. Prior to, and periodically during herbicide application, measurements will be made to record weather conditions. Specifically, wind speed and direction, precipitation, temperature, and atmosphere conditions (clear, overcast, cloudy, partly cloudy) will be monitored and recorded.

Herbicide applications will be terminated if:

- The maximum application temperature stated on the herbicide label is exceeded;
- The ballast is frozen or saturated;
- The wind speed and/or direction cause the herbicide to drift and/or miss the intended target; or,
- It begins to rain, increasing the chances of excessive run off and leaching.

D.4 Reporting and Record Keeping

SVI will maintain at its Nanaimo office up-to-date records relating to herbicide use for at least three years after the use or application to which they relate.

D.4.1 Records of Use

Records of herbicide use for each treatment area and day of use will be maintained by SVI. These records will include the following information:

- Date and time of herbicide use;
- Purpose of the herbicide use;
- Trade name and registration number of each herbicide used;
- The prevailing meteorological conditions, including temperature, precipitation, and air speed and direction; and,
- Precautions to be taken to minimize exposure to the herbicide.

Additional records will be maintained for each treatment area, describing:

- The results of pest monitoring activities;
- The use of monitoring results to assess injury thresholds;
- How and where public notification was given;
- The effectiveness and impacts of the herbicide use; and;
- Calibration activities carried out on application equipment.

D.4.2 Public Consultation Records

The following records of public consultations carried out during the preparation of this PMP will be maintained by SVI:

- Details of when and in what newspaper the notice of the public consultation was published;
- A summary of verbal responses received from the public;
- A summary of responses provided by SVI to public responses received;
- Copies of notices published or given under notification requirements of the Regulation, and all written responses to the notices; and,
- Copies of herbicide use notices given to individuals as a consequence of an agreement made between SVI and an individual during the public consultation process.

D.4.3 Annual Use Report

Beginning in 2012, SVI will submit an annual report of herbicide use to the BC Ministry of Environment by January 31st each year, summarizing the previous calendar-year's herbicide use activities. The annual report will include:

- Name and address of the PMP holder and SVI's confirmation number;
- Description of the treatment areas and associated map;
- The trade name, registration number, active ingredient(s), and amount of each herbicide used (in kg);
- Methods used to apply the herbicides;
- Total-area treated with all herbicides used, and total area treated with each herbicide; and,
- Non-herbicide treatment methods used and estimated total area of their use.

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APPENDICES

Appendix I – Regulatory Framework

BC *Railway Safety Act*

The Safety Authority Railway Regulations and Rules Respecting Track Safety (Part 30) for Common Carrier Railways in British Columbia require that:

Vegetation on railroad property which is on or immediately adjacent to the road bed must be controlled so that it does not:

a. *Become a fire hazard to track carrying structures;*
b. *Obstruct visibility of railroad signs and signals;*
c. *Interfere with railroad employees performing normal trackside duties;*
d. *Prevent proper functioning of signal and communication lines; or,*
e. *Prevent railroad employees from visually inspecting moving equipment from their normal duty stations.*

Integrated Pest Management Act

The *Integrated Pest Management Act – Regulations*, *Section 24(2)(a)(i)* exempts railway utilities from requiring a pesticide license or permit for application of pesticides. Instead *Section 58* describes the requirements of a Pest Management Plan that is to be developed and made publicly available and requires an annual *Confirmation of a Pesticide Use Notice, Section 27* from the provincial government. The Act requires that pesticide use only occur within an integrated pest management approach, defined as a:

…. process for managing pest populations that includes the following elements:

a. *Planning and managing ecosystems to prevent organisms from becoming pests;*
b. *Identifying pest problems and potential pest problems;*
c. *Monitoring populations of pests and beneficial organisms, damage caused by pests, and environmental conditions;*
d. *Using injury thresholds in making treatment decisions;*
e. *Suppressing pest populations to acceptable levels using strategies based on considerations of:*
    i. *biological, physical, cultural, mechanical, behavioral and chemical controls in. appropriate combinations, and*
    ii. *environmental and human health protection; and,*
f. *Evaluating the effectiveness of pest management treatments.*

Weed Control Act.

The British Columbia *Weed Control Act* requires plants listed as noxious weeds to be controlled.

Wildfire Act

BC's Wildfire Regulation 38/2005 Sections a, b and c clearly identify railway obligations

to prevent wild fires including maintain the railway ROW so that it is substantially free from dead or dry grass, weeds and other combustible materials.

Federal *Fisheries Act*

Under the *Fisheries Act* it is an offence to cause harmful alteration, disruption or destruction of fish habitat as well as to introduce any material into water that may be harmful to fish or fish habitat. *Section 35* of the Act dictates that no person shall deposit or permit the deposit of a deleterious substance of any type in fish-bearing waters or where it may end up in fish-bearing waters. Indiscriminate chemical vegetation control could lead to violation of these conditions.

Federal *Species At Risk Act* (SARA)

The federal *Species At Risk Act* (SARA) aims to protect wildlife at risk of becoming extinct or lost from the wild. It prohibits the killing, harming, harassing, capturing, or taking of a species officially listed as threatened, endangered or extirpated, and the destruction of their residences or critical habitats. SARA covers birds, plants, fish, mammals, invertebrates, amphibians, and reptiles. SARA also seeks to manage species of special concern to prevent them from becoming endangered or threatened.

Federal *Migratory Birds Convention Act*

The Migratory Bird Regulations provide protection for migratory birds, including their eggs and nests. To avoid disturbing birds or nests, activities such as vegetation clearing or tree falling should not occur during the typical bird breeding season - April 1 to July 31 in southwest BC. When the activity cannot be scheduled outside this time period, a pre-clearing survey for migratory bird nests must be conducted by a qualified environmental professional.

Wildlife Act

British Columbia has no stand-alone endangered species act. The provincial *Wildlife Act* protects virtually all vertebrate animals from direct harm, except as allowed by regulation (e.g., hunting or trapping). Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species, and also enables the protection of habitat in a Wildlife Management Area. The Act enforces the protection of bird nest sites.

Specifically, it is an offence to possess, take, injure, molest or destroy:

a) A bird or its egg;
b) The nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl; or,
c) The nest of any other bird when the nest is occupied by a bird or its egg.

Clearing of vegetation should not occur during the critical bird-nesting periods - April 1 to July 31 in southwest BC. Where this is not possible, a pre-clearing survey for migratory and resident bird nests and/or raptor nests must be conducted by a qualified environmental professional (QEP). The Act protects the nest of herons, owls, vultures,

eagles, falcons and hawks in perpetuity. Pre-clearing surveys for raptor nests should be conducted by a QEP, regardless of the time of year.

Environmental Management Act

This provincial Act protects the quality of air, land and water by regulating the handling, storage, and disposal of hazardous waste, including waste associated with pesticide use, and the discharge or emission of effluent, waste or contaminants. The Act also contains a specific regulation for spill reporting.

Drinking Water Protection Act

The quality of drinking water is protected by the provincial *Drinking Water Protection Act – Part 4, Section 23, 1 a & b* where it is illegal to introduce anything to a drinking water source or a well recharge zone that is likely to result in a drinking water health hazard.

Water Act

The Act provides for the allocation and management of surface water by authorizing issuance of water licences and approvals, creation of reserves, development of water management plans, and establishment of water user communities. In a planning area, ground water development may be regulated by requiring drilling authorizations. The Act also sets out protective measures for wells and groundwater, and identifies offences and penalties.