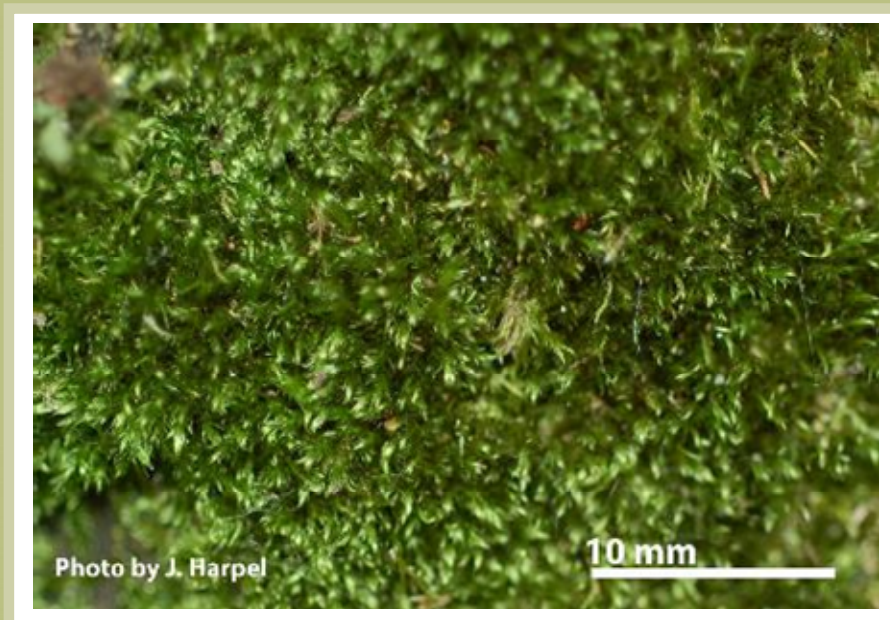


# Recovery Strategy for the Roell's Brotherella Moss (*Brotherella roellii*) in Canada

## Roell's Brotherella Moss



2022



Government  
of Canada

Gouvernement  
du Canada

Canada

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**Official version**

The official version of recovery documents is the one published in PDF. All hyperlinks were valid as of date of publication.

**Non-official version**

The non-official version of recovery documents is published in HTML format and all hyperlinks were valid as of date of publication.

For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the [Species at Risk \(SAR\) Public Registry](#)<sup>1</sup>.

**Cover illustration:** © Judith A. Harpel

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<sup>1</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html](http://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html)

# RECOVERY STRATEGY FOR THE ROELL'S BROTHERELLA MOSS (*Brotherella roellii*) IN CANADA

2022

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of British Columbia has given permission to the Government of Canada to adopt the *Recovery Plan for the Roell's Brotherella (Brotherella roellii) in British Columbia* (Part 2) under Section 44 of the *Species at Risk Act* (SARA). Environment and Climate Change Canada has included a federal addition (Part 1) which completes the SARA requirements for this recovery strategy.

The federal recovery strategy for the Roell's Brotherella Moss<sup>2</sup> in Canada consists of two parts:

Part 1 – Federal Addition to the *Recovery Plan for the Roell's Brotherella (Brotherella roellii) in British Columbia*, prepared by Environment and Climate Change Canada.

Part 2 – *Recovery Plan for the Roell's Brotherella (Brotherella roellii) in British Columbia*, prepared by the British Columbia Ministry of Environment.

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<sup>2</sup> This species is listed under SARA as Roell's Brotherella Moss (*Brotherella roellii*) and is referred to as Roell's Brotherella (*Brotherella roellii*) provincially. Both refer to the same species.

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Part 2 – *Recovery Plan for Roell’s Brotherella (Brotherella roellii) in British Columbia*, prepared by the British Columbia Ministry of Environment

**Part 1 – Federal Addition to the *Recovery Plan for Roell's Brotherella (Brotherella roellii) in British Columbia*, prepared by Environment and Climate Change Canada**

## Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)<sup>3</sup> agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change is the competent minister under SARA for the Roell's Brotherella Moss and has prepared the federal component of this recovery strategy (Part 1), as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the province of British Columbia as per section 39(1) of SARA. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (sub-sections 41(1) or (2)). The Province of British Columbia provided the attached recovery plan for the Roell's Brotherella Moss (Part 2) as science advice to the jurisdictions responsible for managing the species in British Columbia. It was prepared in cooperation with Environment and Climate Change Canada.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment and Climate Change Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Roell's Brotherella Moss and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment and Climate Change, other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

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<sup>3</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2](http://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2)

In the case of critical habitat identified for terrestrial species including migratory birds, SARA requires that critical habitat identified in a federally protected area<sup>4</sup> be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

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<sup>4</sup> These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

## Additions and Modifications to the Adopted Document

The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the *Recovery Plan for Roell's Brotherella* (*Brotherella roellii*) in *British Columbia* (Part 2 of this document, referred to henceforth as “the provincial recovery plan”) and/or to provide updated or additional information. This species is listed under SARA as Roell's Brotherella Moss (*Brotherella roellii*) and is referred to as Roell's Brotherella (*Brotherella roellii*) provincially. Both names refer to the same species.

Under SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Therefore, statements in the provincial recovery plan referring to protection of survival/recovery habitat may not directly correspond to federal requirements. Recovery measures dealing with the protection of habitat are adopted; however, whether these measures will result in protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.

### 1. Species Status Information

This section replaces information on the SARA legal designation for Roell's Brotherella Moss in Canada in “Section 2: Species Status Information” of the provincial recovery plan.

The legal designation for Roell's Brotherella Moss on SARA Schedule 1 is Endangered (2018).

**Table 1.** Conservation status of Roell's Brotherella Moss (B.C. Conservation Data Centre 2020; NatureServe 2019).

Global (G) Rank*	National (N) Rank*	Sub-national (S) Rank*	COSEWIC Status	B.C. List
G3	Canada (N1N2) U.S.A. (NNR)	Canada: British Columbia (S1S2) U.S.A: WA (SH)	Endangered (2010)	Red List

\* Rank 1– critically imperiled; 2– imperiled; 3- vulnerable to extirpation or extinction; 4- apparently secure; 5– secure; H– possibly extirpated; NR – status not ranked.

### 2. Species Population and Distribution

This section replaces the information summary for known populations of Roell's Brotherella Moss in Canada (Table 1 in Section 3.2 of the provincial recovery plan).

The information summary below (Table 2) describes the updated distribution of Roell's Brotherella Moss populations in Canada, all occurring in southwest British Columbia. Element occurrence (EO) numbers indicated align with those provided in the provincial



recovery plan, with the exception of new populations discovered in Port Moody, Abbotsford, Aldergrove and in the Echo Lake area (EO35, EO38, EO39, EO40, and EO46, respectively), and additional historical populations not reported in the provincial recovery plan (EO 36, EO43, EO44, respectively). Of the 46 recorded Roell's Brotherella Moss populations, four are considered extirpated, as suitable habitat is no longer present, and three are unconfirmed (see footnote in Table 2).

**Table 2.** Summary of Roell's Brotherella Moss populations in Canada. Information for each B.C. Conservation Data Centre EO number includes notes on status (X= presumed extirpated, N = new, + = not described in the adopted provincial recovery plan), population location, date of last observation (obs), and location uncertainty associated with the BC Conservation Data Centre EO data, and/or estimated location error from global positioning system (GPS) units.

<b>EO # (status)</b>	<b>Population location</b>	<b>Date last obs</b>	<b>Location uncertainty (m)</b>
EO1	Sumas Mtn. Regional Park, Abbotsford	2010	15
EO2	Downes Bowl Park, Abbotsford	2009	25
EO3	Century Park, Abbotsford	2007	25
EO4	Ravine Park, 1.2 km southwest of Abbotsford	2007	25
EO5 (X)	Agassiz	1889	150
EO6	Anvil Island, north slope (Howe Sound)	1969	150
EO7	Skway IR5, Arnold	1982	150
EO8	Brackendale	2006	150
EO9	Bridal Veil Falls Provincial Park	2004	150
EO10	Chilliwack	2009	25
EO11	Sardis	1970	150
EO12	Mt. Ludwig; 8 km east of Popkum	1968	150
EO13	Cheam View, Hope	1971	150
EO14	Kanaka Creek, east of Haney	1976	150
EO15	Howes Creek, near Aldergrove	1969	150
EO16	Ruby Creek (Skwawolt Creek)	2009	25
EO17	Seabird Island	1985	150
EO18	Squamish Rotary Park, Dentville	2012	25
EO19	Suicide (Norrish Creek), Dewdney area	1975	150
EO20	Sumas Mtn. escarpment	1981	150
EO21	Sumas Mtn., near Matsqui	1967	150
EO22	Sumas Mtn., Straiton area	1966	150
EO23	Pacific Spirit Regional Park, UBC Endowment Lands near golf course	1999	150
EO24 (X)	Pacific Spirit Regional Park near Southlands School	2009	150

EO # (status)	Population location	Date last obs	Location uncertainty (m)
EO25	Pacific Spirit Regional Park, Marine Dr. south of Fraser Monument	1969	150
EO26 (X)	Hastings, 1.1 km southeast of Coal Harbour	1889	150
EO27	Burnaby, Squint Lake Park next to Burnaby Mtn. golf course	2009	25
EO28	West Creek Wetlands Regional Park, Wood Duck Lake, Langley	2007	150
EO29	Little Mtn. Park, Chilliwack	2010	15
EO30	Port Moody	2012	50
EO31	Hope, Kawkawa Lake	2012	25
EO32	Burnaby, Burnaby Mtn., south side, Mel's Trail	2010	15
EO33	Dominion Sawmill, historical Langley	2010	15
EO34	Pemberton Hills, Langley	2010	15
EO35 (+,N)	Port Moody, Mossum Creek	2017	15
EO36 (+)	Cheakamus	1970	1000
EO38 (+,N)	Sumas Mtn., Wades Creek	2018	15
EO39 (+,N)	Aldergrove, Department of National Defence (DND Aldegrove)	2018	10
EO40 (+,N)	Abbotsford, DND Mastqui	2016	10
EO43 (+)	New Westminster	1889	1000
EO44 (+)	Fraser River, Yale District	1889	200
45 (X)*	Squamish Hwy., just north of Squamish	2009	Unknown
46 (+,N)*	Echo Lake	2014	10

Three BC CDC EOs for Roell's Brotherella Moss are considered unconfirmed reports and are not included in this table: EO37 (Bigby Inlet, 1964), EO41 (Mount Buxton, 1965), and EO42 (Dawson Inlet, 1964).

\* These occurrences do not have a CDC EO assigned to them at this time.

### 3. Critical Habitat

This section replaces “Section 7.1: Description of Survival/Recovery Habitat” section in the provincial recovery plan.

Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. The provincial recovery plan (Part 2, Section 3.3) provides a written summary of habitat requirements for Roell's Brotherella Moss. This science advice was used to inform the following critical habitat sections in this federal recovery strategy addition.

Critical habitat for the Roell's Brotherella Moss is identified at known or presumed extant locations, where the occurrence has been observed within the last 25 years (since 1995), and the location uncertainty distance is less than or equal to 150 m. Based on these criteria, critical habitat for Roell's Brotherella Moss is partially identified at this time. A schedule of studies (Section 3.2) outlines the activities required to identify additional critical habitat necessary to support the population and distribution objectives<sup>5</sup> for the species. The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan(s).

Critical habitat for Roell's Brotherella Moss is identified to the extent possible; as responsible jurisdictions and/or other interested parties conduct research to address the schedule of studies or knowledge gaps<sup>6</sup>, the critical habitat methodology and identification may be modified to reflect new knowledge.

### **3.1 Identification of the Species' Critical Habitat**

#### **3.1.1 Geospatial location of areas containing critical habitat**

Critical habitat for Roell's Brotherella Moss is identified for 23 confirmed populations in southwest British Columbia (Figures 1-15); these are linked with the population numbers provided in Table 1:

- **EO1:** Abbotsford; Sumas Mtn. Regional Park (Figure 13)
- **EO2:** Abbotsford; Downes Bowl Park (Figure 1)
- **EO3:** Abbotsford; Century Park (Figure 1)
- **EO4:** Abbotsford; Ravine Park (Figure 1)
- **EO8:** Brackendale (Figure 3)
- **EO9:** Bridal Veil Falls Provincial Park (Figure 4)
- **EO10:** Chilliwack (Figure 6)
- **EO16:** Ruby Creek (Figure 12)
- **EO18:** Dentville; Squamish Rotary Park (Figure 14)
- **EO23:** UBC Endowment Lands; Pacific Spirit Regional Park (Figure 9)
- **EO27:** Burnaby; Squint Lake Park (Figure 5)
- **EO28:** Langley; West Creek Wetlands Regional Park (Figure 15)

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<sup>5</sup> The population and distribution objective for Roell's Brotherella Moss (as set out in the provincial recovery plan - Part 2, Section 5) is to maintain the species' distribution throughout its range in British Columbia, and if feasible and appropriate increase the number of individuals at extant populations or re-introduce the species at historical locations.

<sup>6</sup> Knowledge gaps for Roell's Brotherella Moss are identified in the Recovery Planning Table in the adopted provincial recovery plan (see Part 2; Section 6.2).

- **EO29:** Chilliwack; Little Mtn. Park (Figure 6)
- **EO30:** Port Moody (Figure 11)
- **EO31:** Hope; Kawkawa Lake (Figure 8)
- **EO32:** Burnaby; Burnaby Mtn. (Figure 5)
- **EO33:** Langley; Dominion Sawmill (Figure 15)
- **EO34:** Langley; Pemberton Hills (Figure 10)
- **EO35:** Port Moody; Mossum Creek. (Figure 11)
- **EO38:** Sumas Mtn.; Wades Creek (Figure 13)
- **EO39:** Aldergrove; Department of National Defence (DND) Aldergrove (Figure 2)
- **EO40:** Abbotsford; DND Matsqui (Figure 13)
- **46:** Echo Lake (Figure 7)

The geospatial area containing critical habitat for Roell's Brotherella Moss is based on the following additive components: (1) best available information about occurrences<sup>7</sup> or area occupied by individual plants or patches of plants, including the associated location uncertainty related to the BC Conservation Data Centre (BC CDC) element occurrence record, or the potential location error from Global Positioning System (GPS) units (ranging from 10 to 150 m uncertainty distance); and (2) an additional 50-m distance (i.e., critical function zone<sup>8</sup>) to encompass immediately adjacent areas that are integral to the production and maintenance of suitable microhabitat conditions required by Roell's Brotherella Moss.

### 3.1.2. Biophysical attributes of critical habitat

A description of the habitat needs of Roell's Brotherella Moss is presented in "Section 3.3.1: Habitat and Biological Needs" in the provincial recovery plan. The geospatial areas containing critical habitat represent the minimum areas required to sustain both the specific growing surface(s) and the microclimate conditions that the species needs, i.e., the critical function zones<sup>8</sup>. As such, within these geospatial polygons, critical habitat includes all natural features, including vegetation and substrates. Within these polygons, only areas that do not support microclimate or growing surfaces are excluded from identification as critical habitat. Examples of these excluded areas include: existing buildings, roadways, parking lots, railways, gravel pits,

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<sup>7</sup> Precise location of occurrence associated with EO38 was provided by S. Joya (pers. comms. 2019); and precise locations of occurrences associated with EO39 and EO40 were provided by Department of National Defense (C. van Cadsand, pers. comms. 2019).

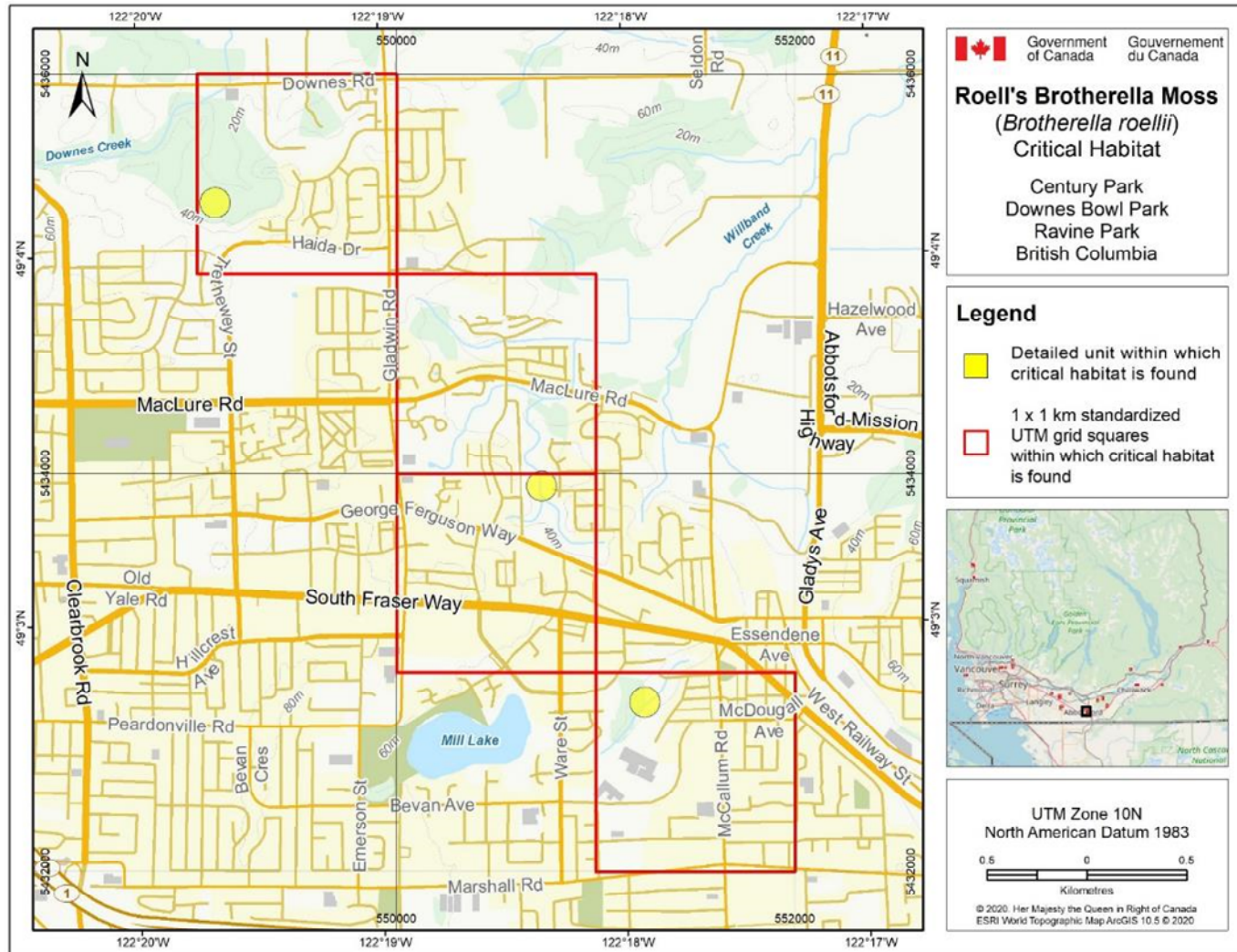
<sup>8</sup> Critical function zone distance has been defined as the threshold habitat fragment size required for maintaining constituent microhabitat properties for a species (e.g., critical light, moisture and humidity levels necessary for survival). Existing research provides a logical basis for applying a minimum critical function zone distance of 50 m for rare plant species occurrences (see: [Rationale for decision tree hierarchy](#)).

cultivated lawns, golf course fairways, as well as all non-forested or treeless areas, such as hydro right of ways.

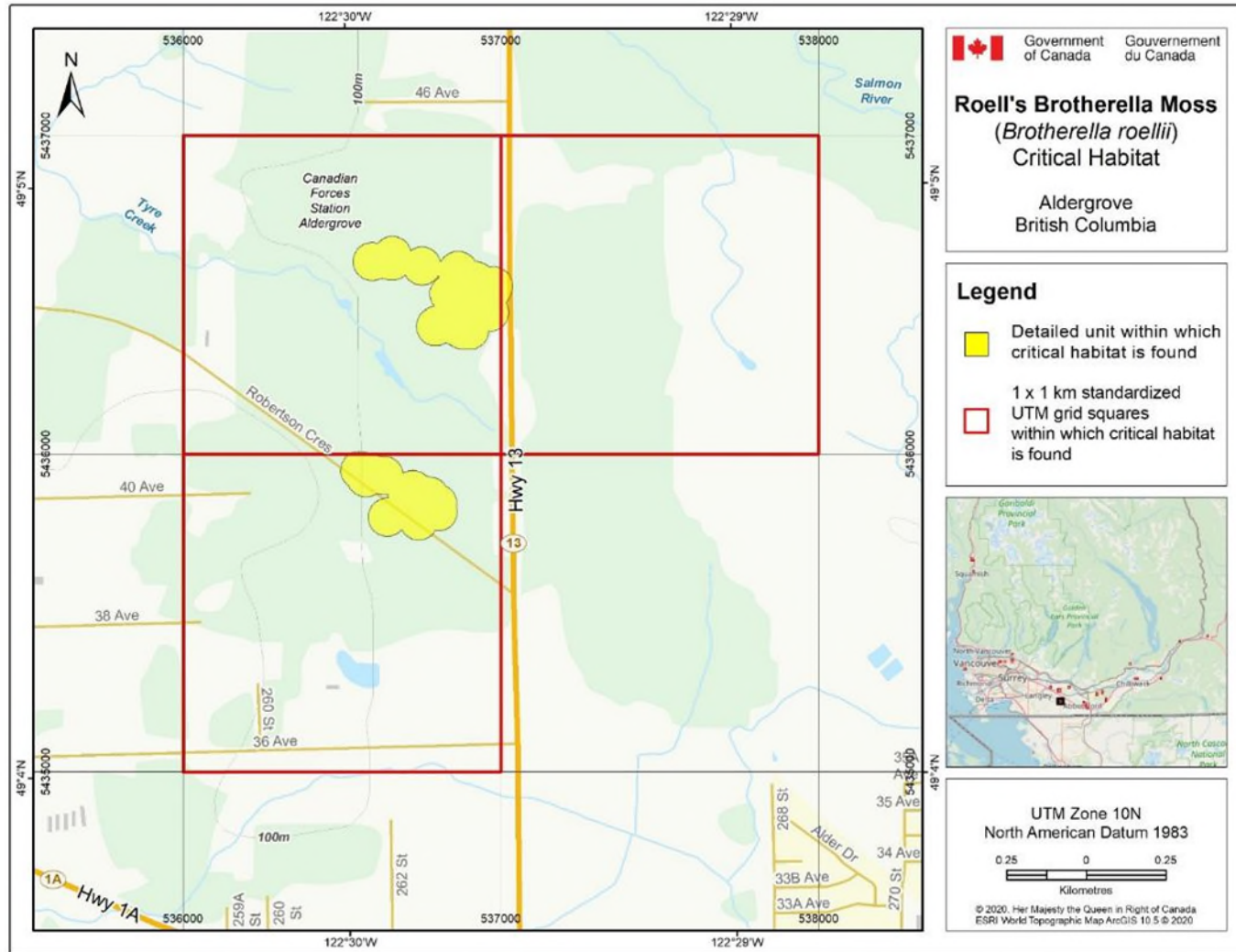
The areas containing critical habitat for Roell's Brotherella Moss (totalling 90.55 ha<sup>9</sup>) are presented in Figures 1-15. The 1 km x 1 km universal transverse mercator (UTM) grid overlay shown on these figures is a standardized national grid system that highlights the general geographical area containing critical habitat for land use planning and/or environmental assessment purposes.

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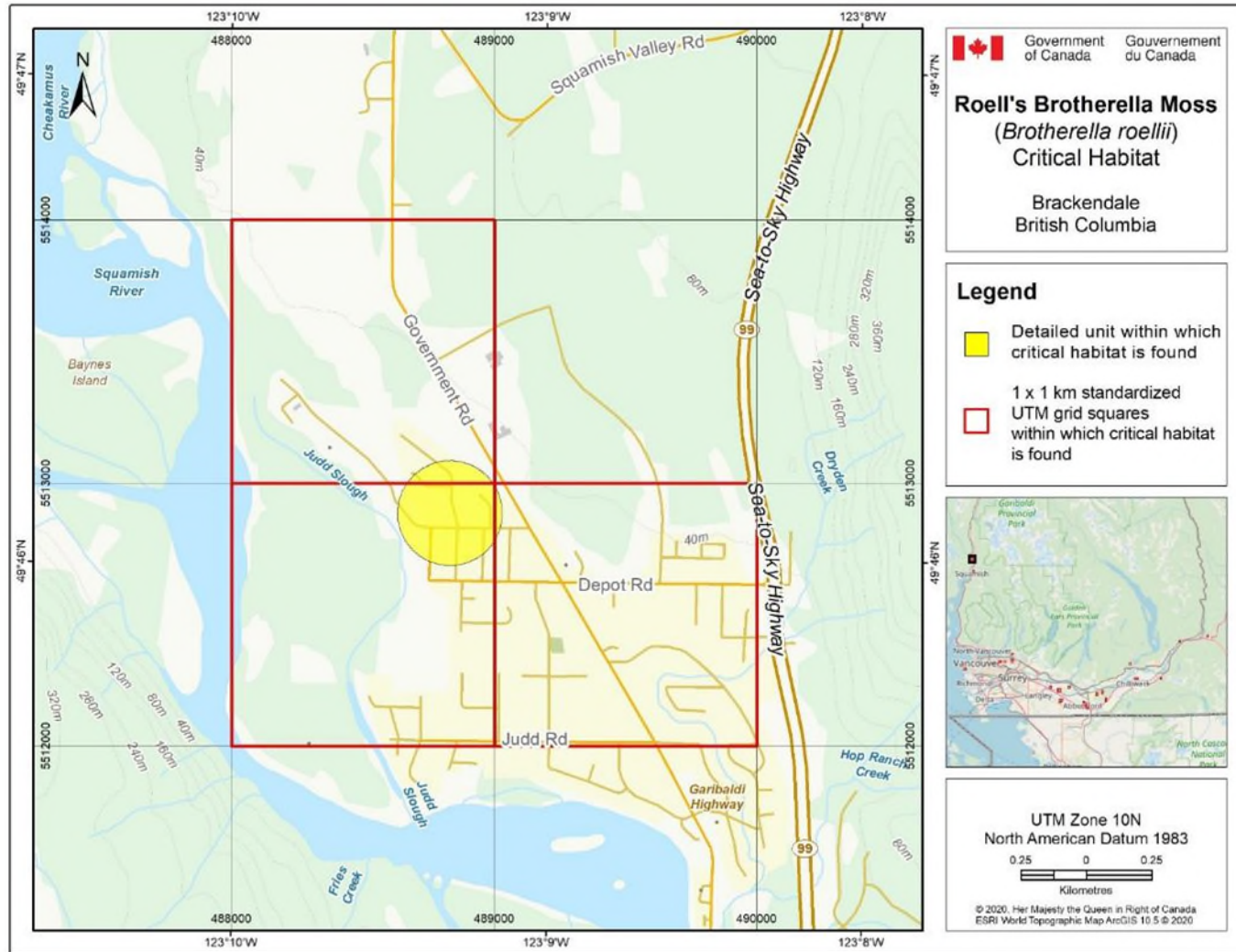
<sup>9</sup> Critical habitat does not occur within any Federal Protected Areas.



**Figure 1.** Critical habitat for Roell's Brotherella Moss near Abbotsford, B.C. is represented by the shaded yellow polygons, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

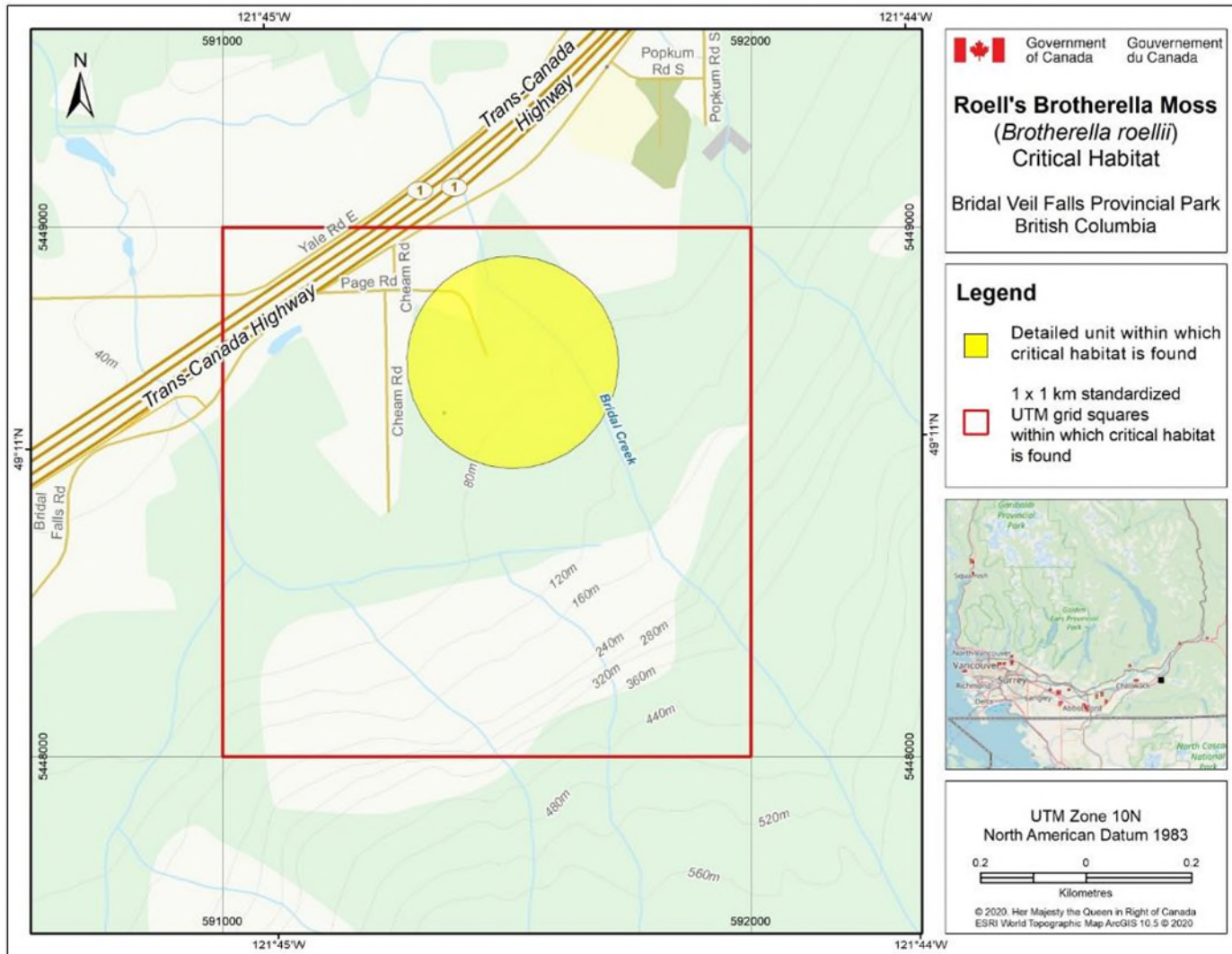


**Figure 2.** Critical habitat for Roell's Brotherella Moss in Aldergrove, B.C. is represented by the shaded yellow polygons, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

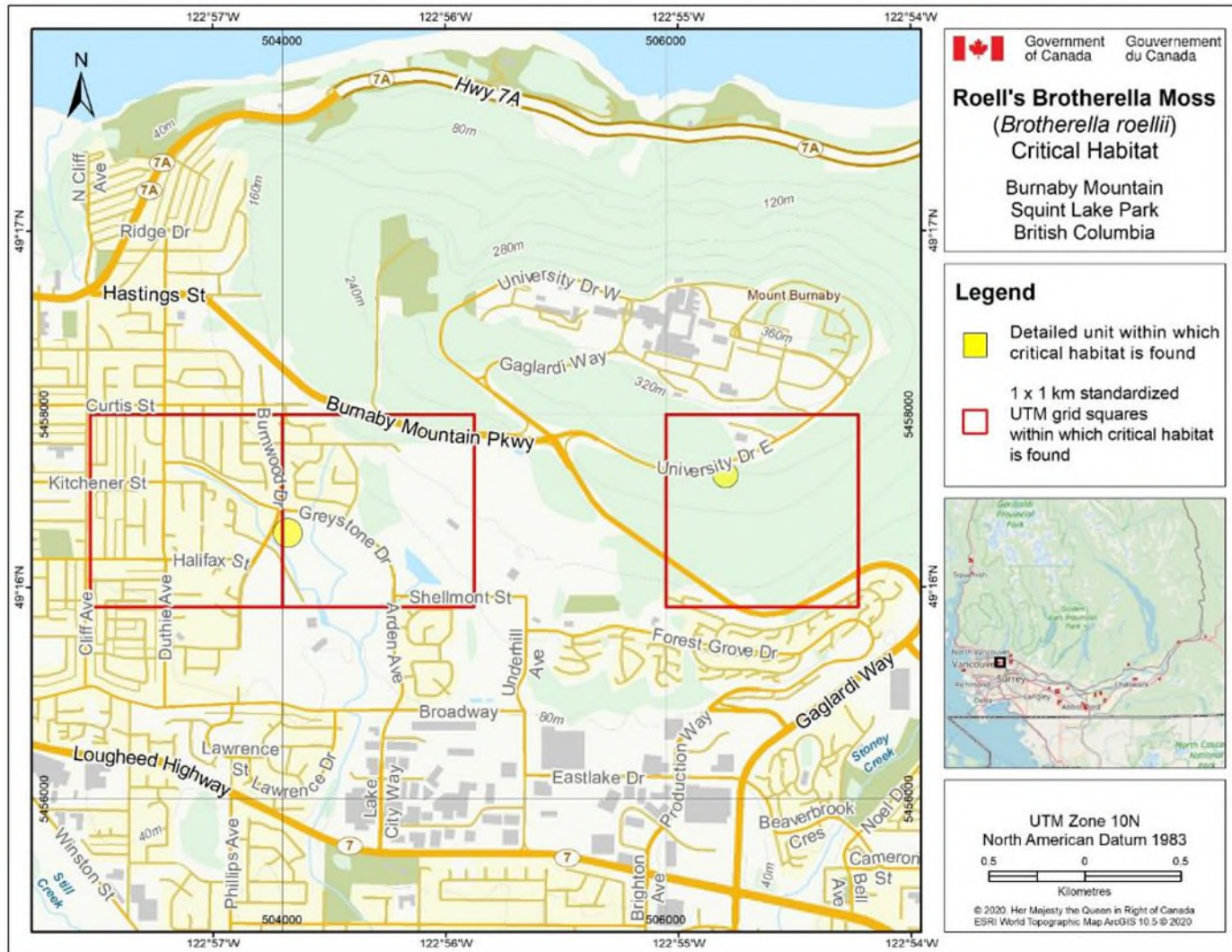


**Figure 3.** Critical habitat for Roell's Brotherella Moss near Brackendale, B.C. is represented by the shaded yellow polygon, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygon do not contain critical habitat.

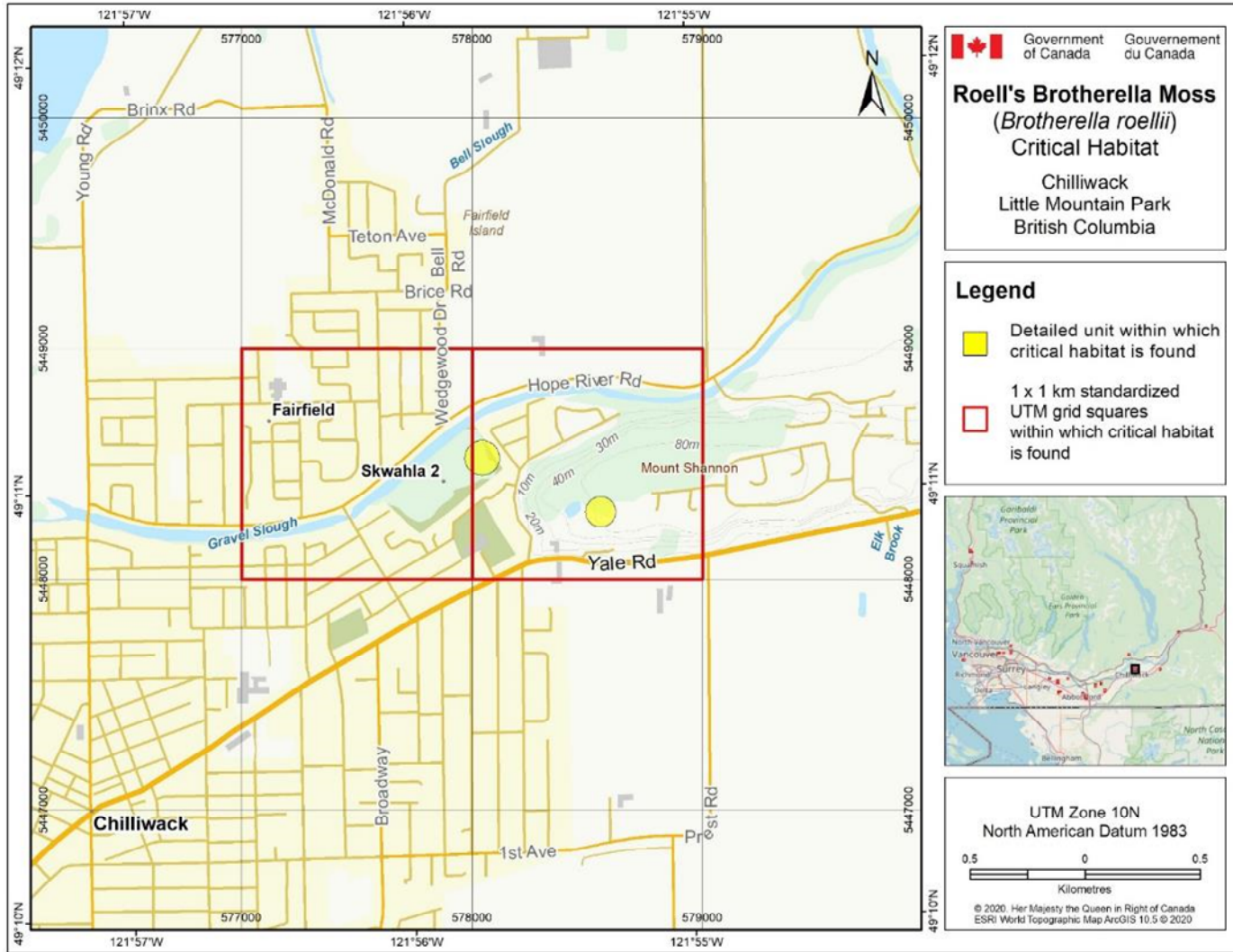




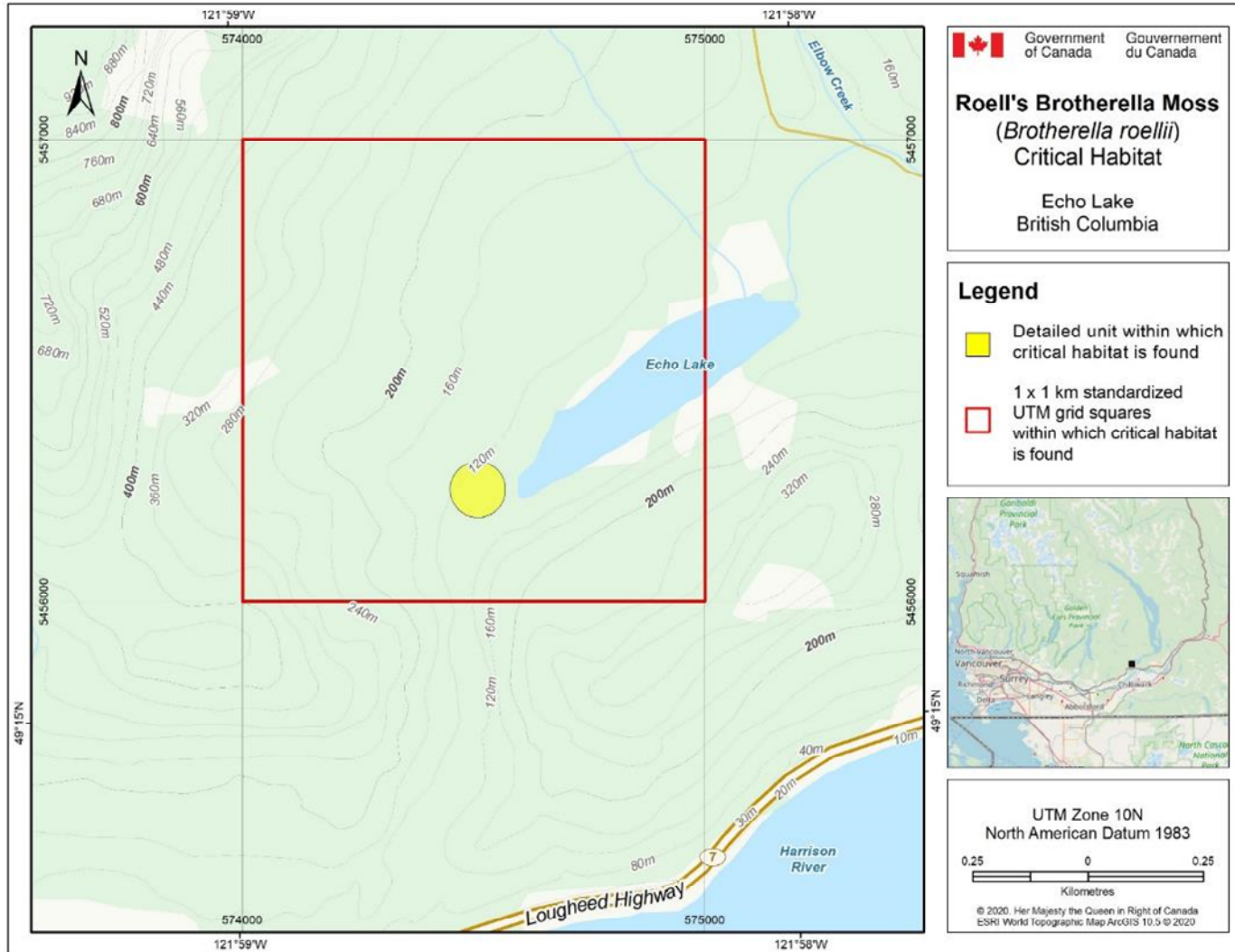
**Figure 4.** Critical habitat for Roell's Brotherella Moss at Bridal Veil Falls, B.C. is represented by the shaded yellow polygon, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygon do not contain critical habitat.



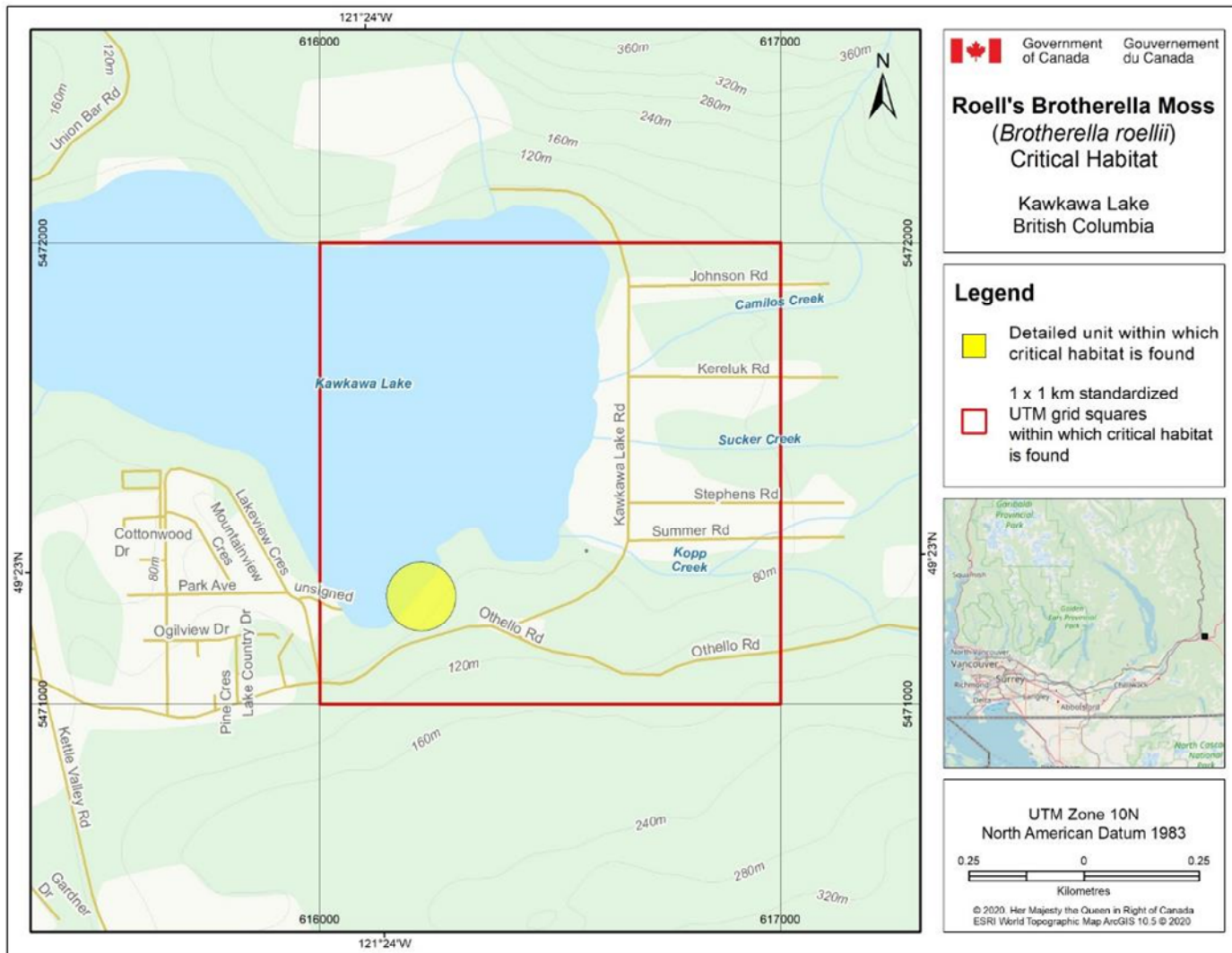
**Figure 5.** Critical habitat for Roell's Brotherella Moss in Burnaby, B.C. is represented by the shaded yellow polygons, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.



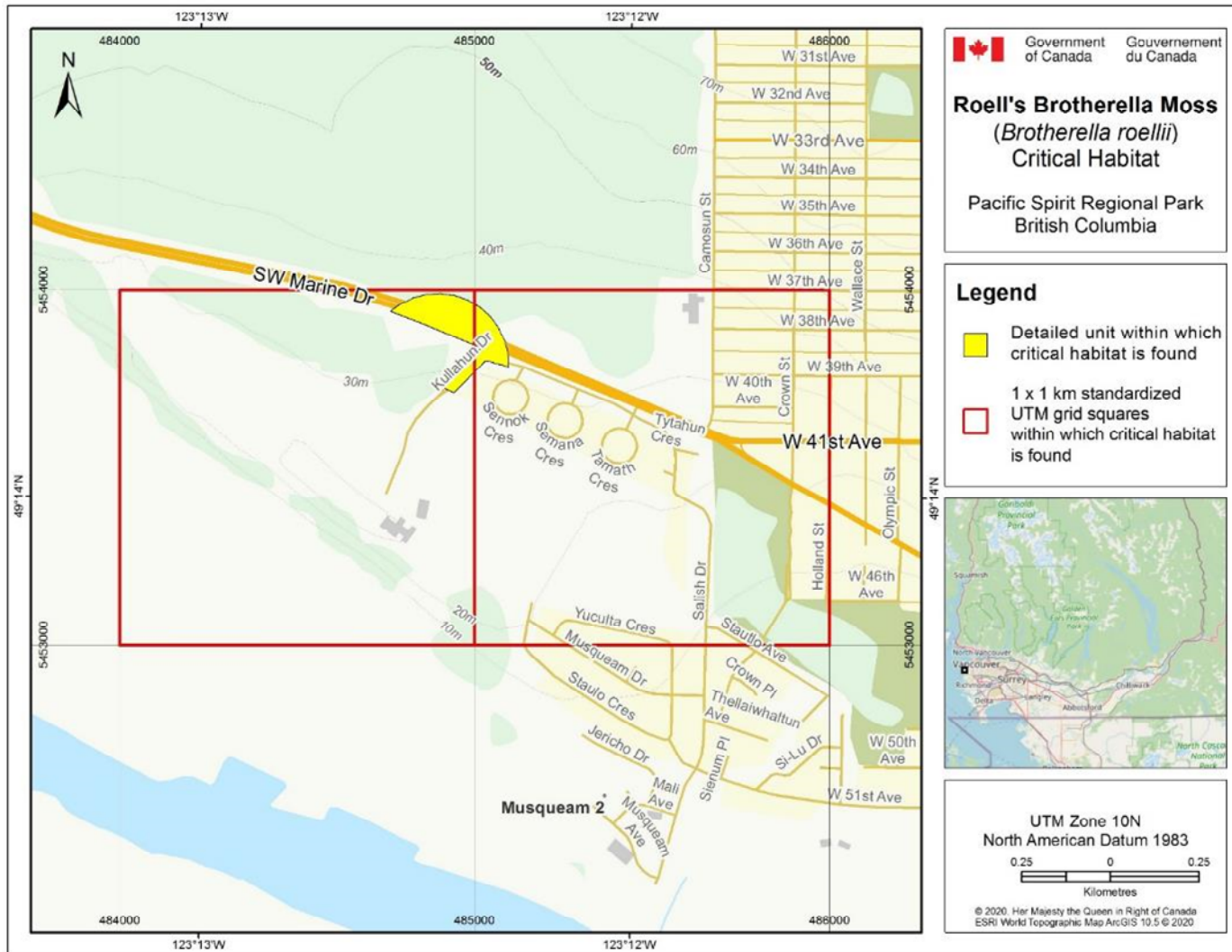
**Figure 6.** Critical habitat for Roell's Brotherella Moss in Chilliwack, B.C. is represented by the shaded yellow polygons, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.



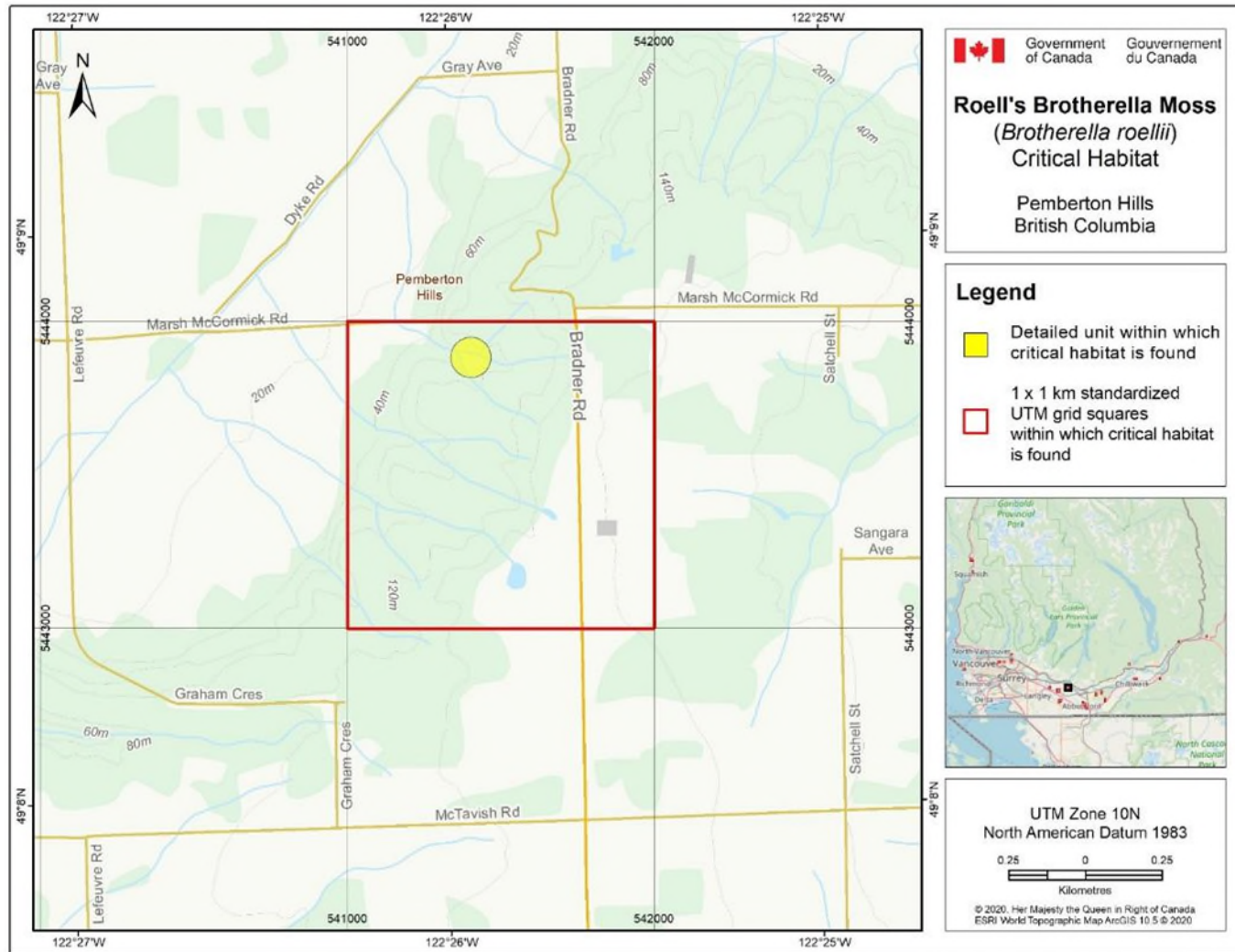
**Figure 7.** Critical habitat for Roell's Brotherella Moss near Echo Lake, B.C. is represented by the shaded yellow polygon, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygon do not contain critical habitat.



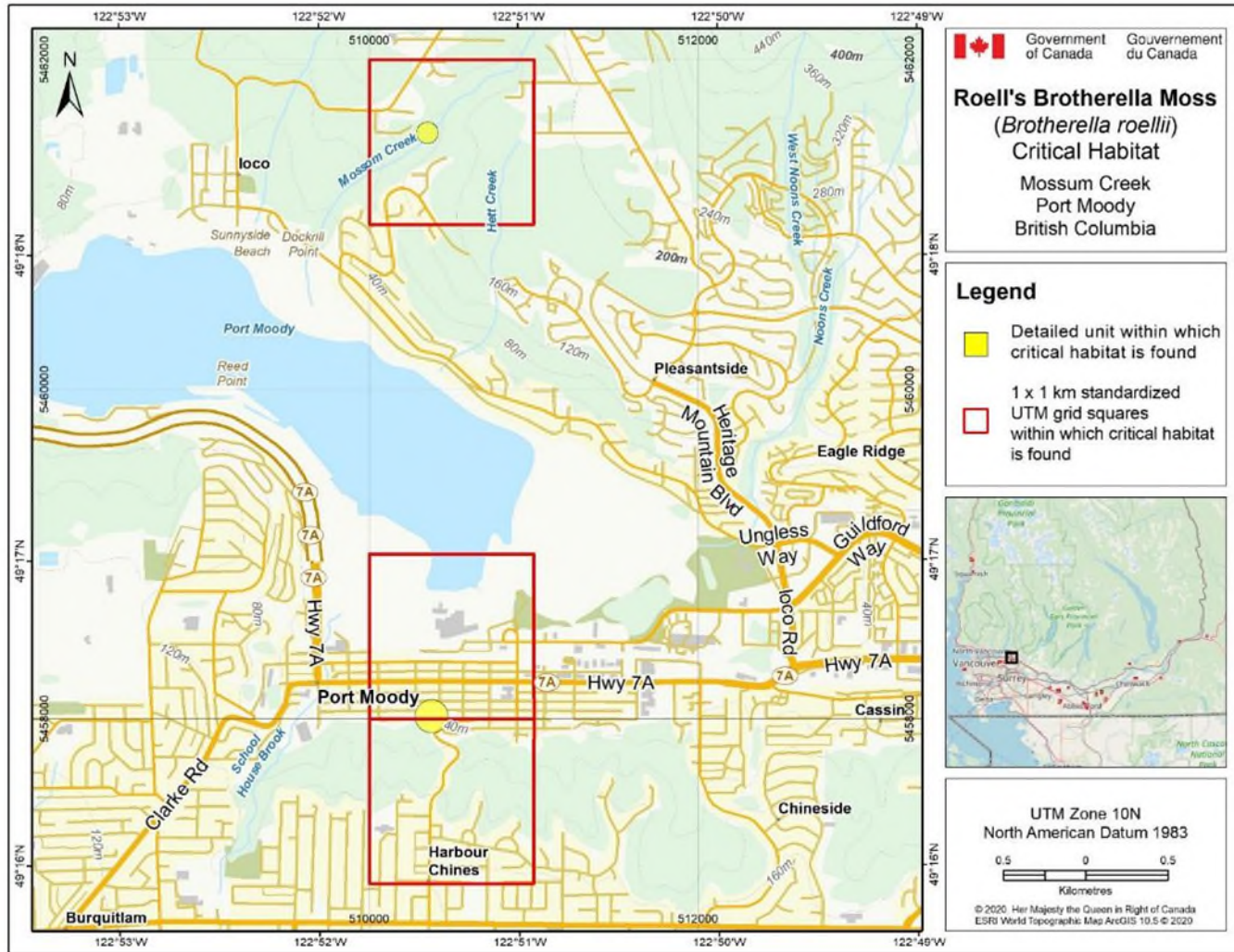
**Figure 8.** Critical habitat for Roell's Brotharella Moss at Kawkawa Lake, near Hope, B.C. is represented by the shaded yellow polygon, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygon do not contain critical habitat.



**Figure 9.** Critical habitat for Roell's Brotherella Moss near Pacific Spirit Regional Park, in Vancouver, B.C. is represented by the shaded yellow polygon, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygon do not contain critical habitat.

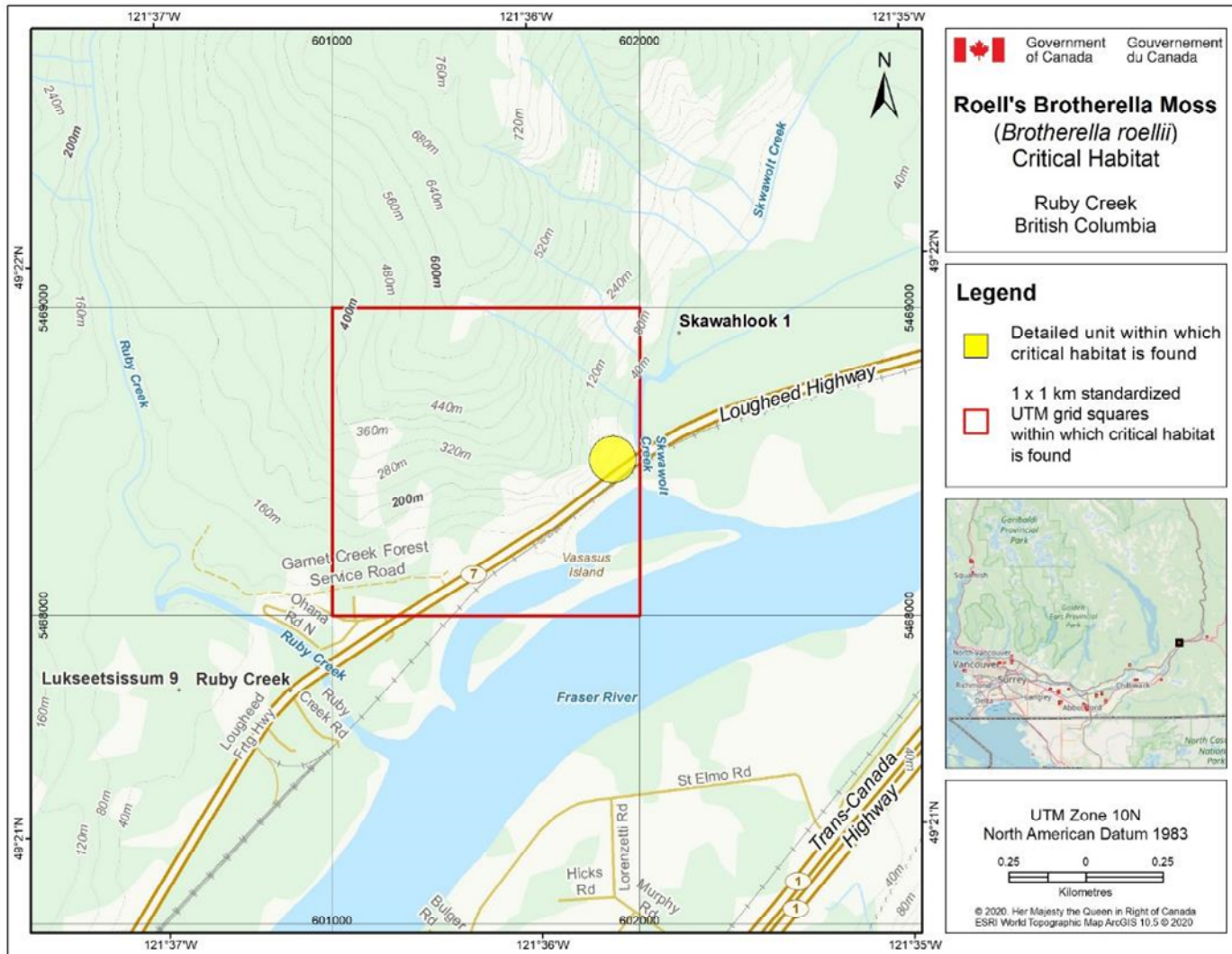


**Figure 10.** Critical habitat for Roell's Brotherella Moss in the Pemberton Hills area, B.C. is represented by the shaded yellow polygon, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygon do not contain critical habitat.

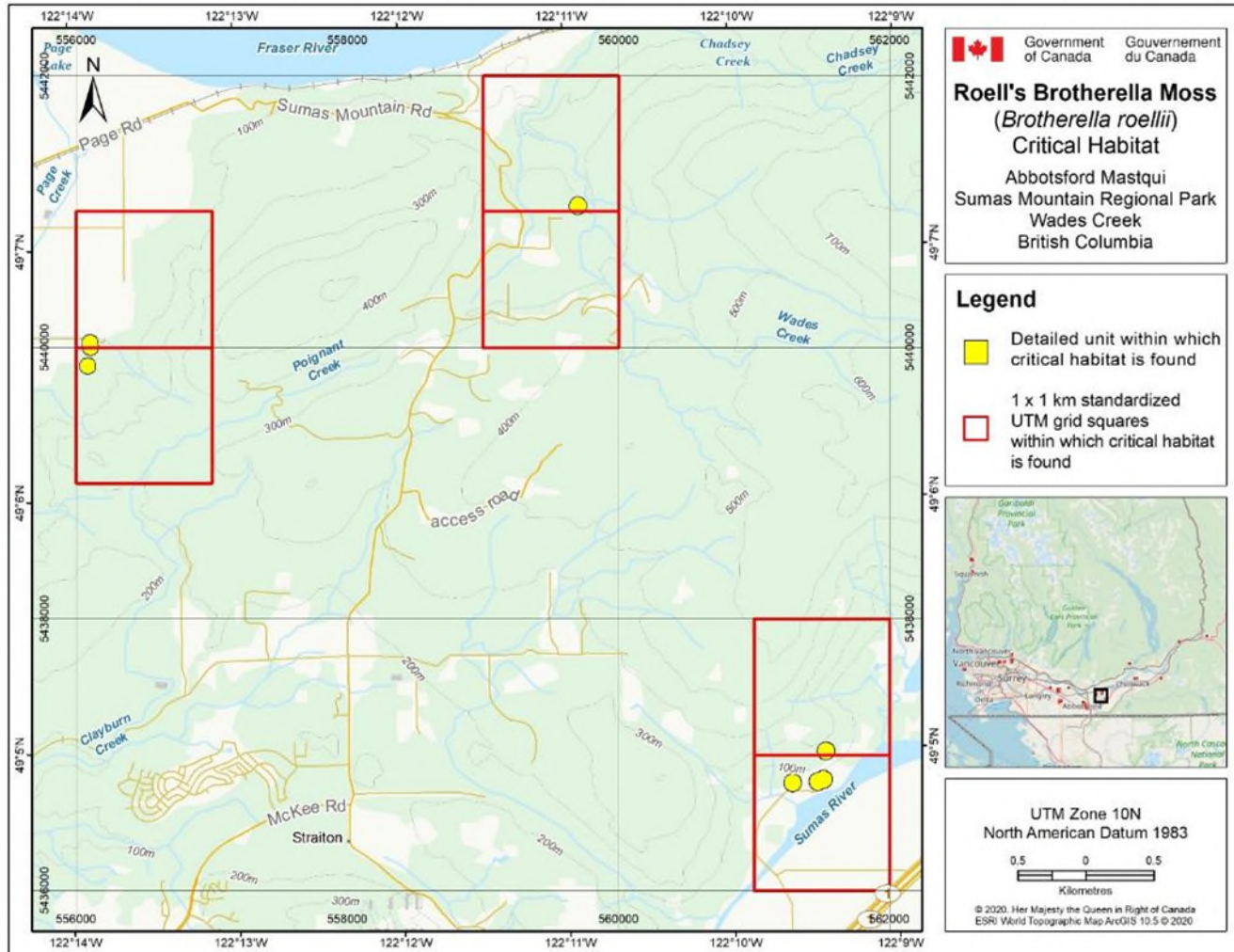


**Figure 11.** Critical habitat for Roell's Brotherella Moss in the Port Moody area, B.C. is represented by the shaded yellow polygons, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

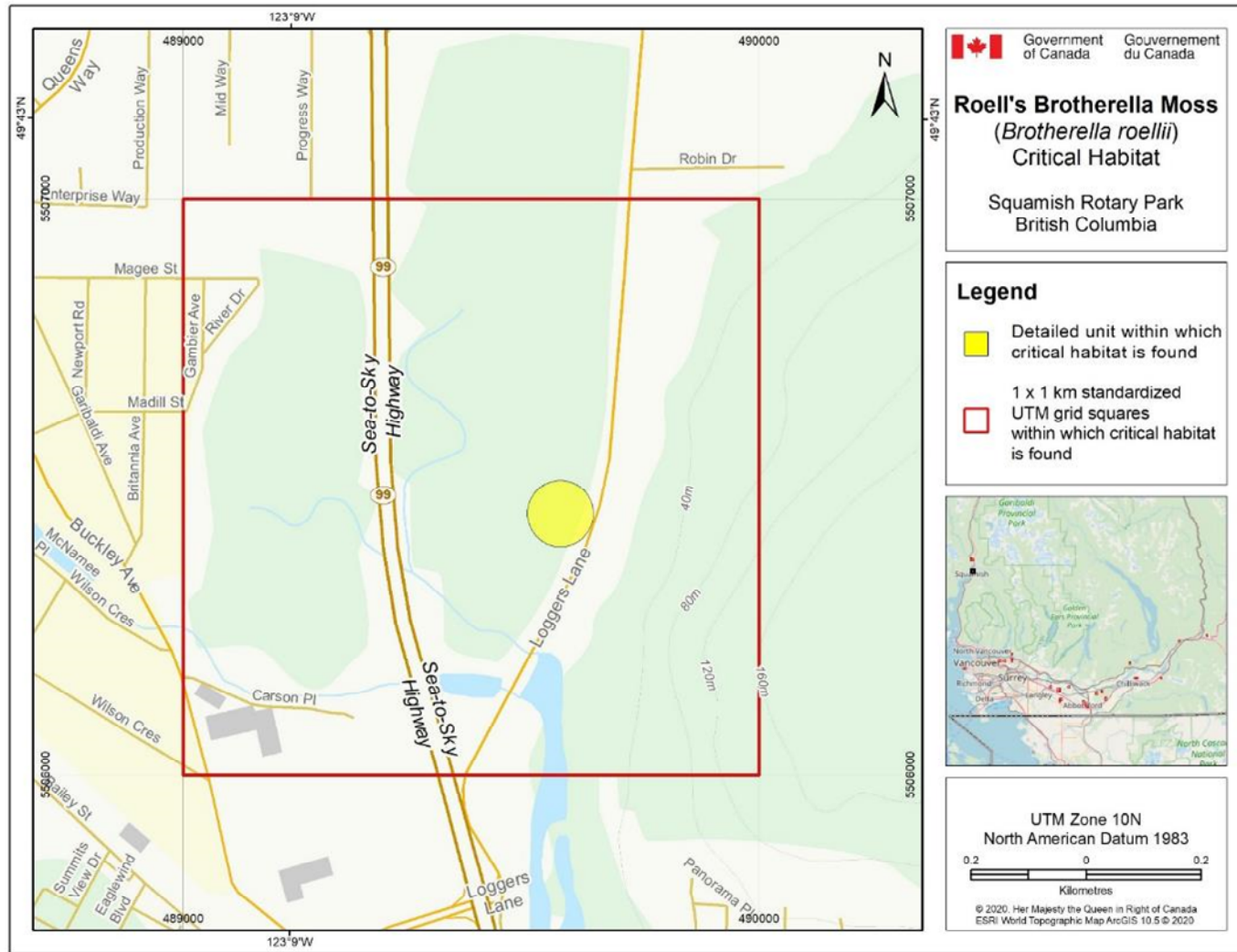




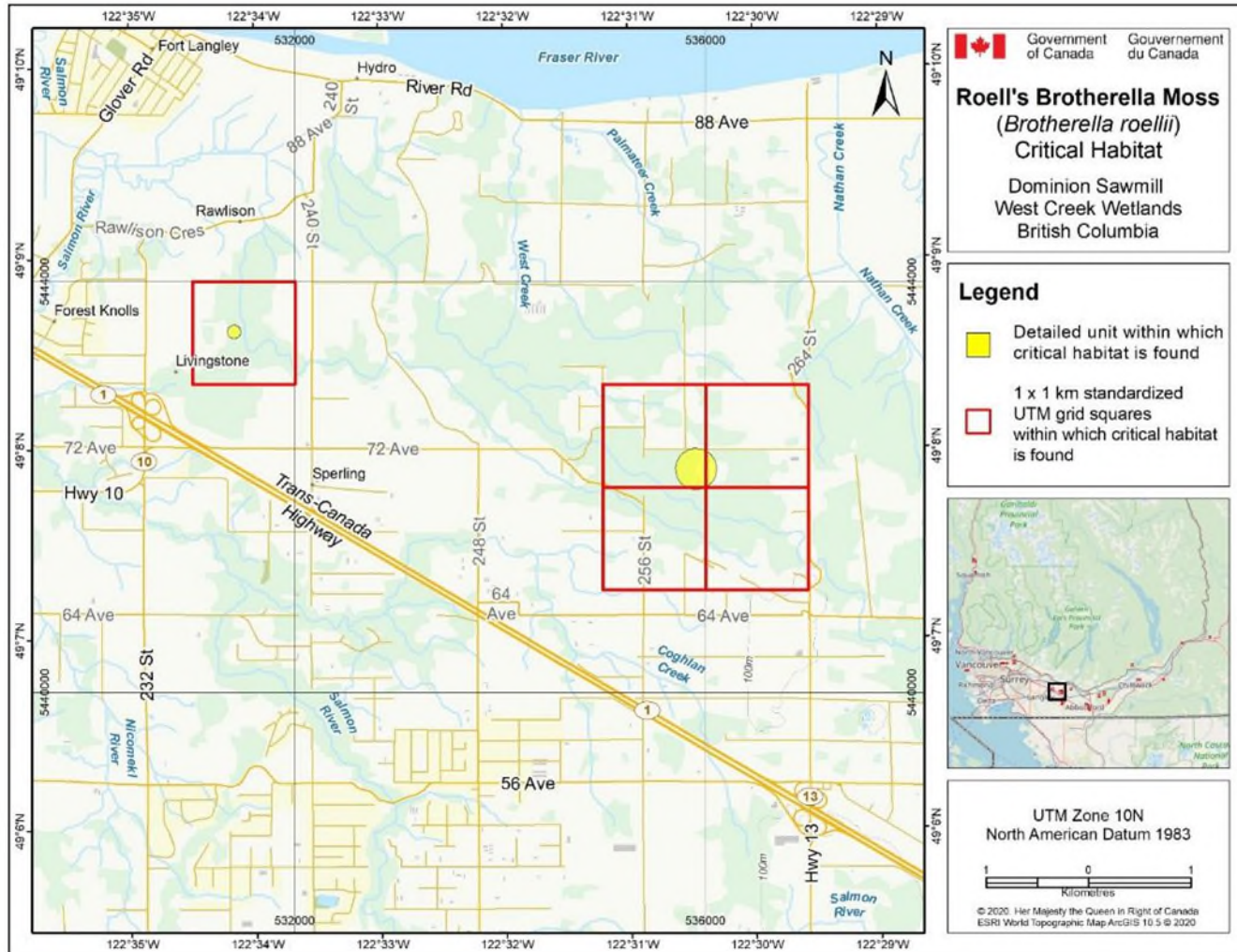
**Figure 12.** Critical habitat for Roell's Brotherella Moss in the Ruby Creek area, B.C. is represented by the shaded yellow polygon, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygon do not contain critical habitat.



**Figure 13.** Critical habitat for Roell's Brotherella Moss in the Sumas Mountain area, B.C. is represented by the shaded yellow polygons, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.



**Figure 14.** Critical habitat for Roell's Brotherella Moss in the Squamish Rotary Park area, B.C. is represented by the shaded yellow polygon, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygon do not contain critical habitat.



**Figure 15.** Critical habitat for Roell's Brotherella Moss in the West Creek Wetlands area of Langley, B.C. is represented by the shaded yellow polygons, except where excluded areas (as described in section 3.1.2) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

### 3.2 Schedule of Studies to Identify Critical Habitat

This section replaces “Section 7.2: Studies Needed to Describe Survival/Recovery Habitat” in the provincial recovery plan.

The following schedule of studies (Table 3) outlines the activities required to complete the identification of critical habitat for the Roell's Brotherella Moss.

**Table 3.** Schedule of studies to identify critical habitat for Roell's Brotherella Moss.

Description of activity	Rationale	Timeline
Complete detailed surveys at locations where the species has not been recorded for >25 years, and where habitat is still potentially suitable (EO #s 6,7,11,12,13,14,15, 17,19,20,21,22,25,37) and/or where precise location information is not available (EO #s 41,42,43,44)	There are a number of EOs for which recent, targeted surveys are lacking, and/or where there is a high degree of location uncertainty associated with observations. The described activities are required to (1) confirm status of Roell's Brotherella Moss at these sites and complete the identification of critical habitat for extant populations, and (2) to enable investigation into whether and where critical habitat should be identified to support re-introduction of the species at historical locations.	2022-2032
Work with applicable organizations to complete identification of critical habitat in the Pacific Spirit Park area.	Critical habitat has not been identified for a portion of lands in the Pacific Spirit Park area. This activity is required such that sufficient critical habitat is identified to meet the population and distribution objective.	2022-2032

### 3.3 Examples of Activities Likely to Result in Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case-by-case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. The provincial recovery plan provides a description of potential threats to Roell's Brotherella Moss (Part 2, Section 4). Activities described in Table 4 include those likely to cause destruction of critical habitat for the species; destructive activities are not limited to those listed.

**Table 4.** Examples of activities likely to result in destruction of critical habitat for Roell's Brotherella Moss.

Description of activity	Rationale	Additional Information including related IUCN-CMP threat <sup>a</sup>
Activities that result in removal or destruction of natural habitat features within the area containing critical habitat, e.g., logging and wood harvesting; land conversion for residential, urban, and industrial development (mining), construction of roads, or for recreation such as trail construction, expansion and/or maintenance.	The removal or destruction of natural habitat features (e.g., vegetation, substrates) causes destruction of critical habitat by degrading the suitability of microhabitat conditions (shade, humidity, moisture, local hydrology) and/or the availability of growing surfaces required by the species (trees, logs, stumps).	<p>Related IUCN Threats #1.1, 1.3, 6.1.</p> <p>These activities are most likely to result in the destruction of critical habitat when they occur within the boundaries of critical habitat. Activities that result in significant changes to local hydrology may result in destruction of critical habitat when they occur in areas outside the bounds but adjacent to critical habitat.</p> <p>Destruction of critical habitat by this activity can be caused at any time of the year.</p>
Activities that result in the introduction or significant increase of airborne pollutants into critical habitat areas, e.g., via land conversion for urban or agricultural development	Roell's Brotherella Moss requires habitat that is free of urban and agricultural derived pollutants (e.g., industrial outputs, agricultural fertilizers or pesticide sprays) for successful growth and reproduction. Mosses obtain water and nutrients for growth via direct absorption of solutes in airborne rainwater, cloud, and mist and are thereby highly sensitive to pollutants.	<p>IUCN-CMP Threats #1.1, 9.5</p> <p>Activities may cause destruction when they occur in or outside/adjacent to the bounds of critical habitat. Effects are likely cumulative. Threshold unknown.</p> <p>Destruction of critical habitat can be caused at any time of the year by this activity.</p>

<sup>a</sup> Threat classification is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system ([www.conservationmeasures.org](http://www.conservationmeasures.org)).

## 4. Measuring Progress

This section replaces “Section 8: Measuring Progress” in the provincial recovery plan<sup>10</sup>.

Priority actions for Roell's Brotherella Moss are included in Table 4 of the provincial recovery plan (Part 2, Section 6.2). The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives:

- The distribution of Roell's Brotherella Moss in Canada has been maintained (i.e., extent of occurrence has not decreased); and
- The abundance of Roell's Brotherella Moss in Canada has been maintained (i.e., the number and sizes of known extant populations have not decreased)

## 5. Statement on Action Plans

One or more action plans for the Roell's Brotherella Moss will be posted on the Species at Risk Public Registry within 10 years of the posting of the final recovery strategy.

## 6. Effects on the Environment and Other Species

This section replaces “Section 9: Effects on Other Species” in the provincial recovery plan.

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the [Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals](#)<sup>11</sup>. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the [Federal Sustainable Development Strategy](#)'s<sup>12</sup> (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

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<sup>10</sup> In addition to these performance indicators, the performance measures set out in the provincial recovery plan (Section 8) will provide pertinent information to assess interim progress towards achieving the ultimate population and distribution objectives for this species.

<sup>11</sup> [www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html](http://www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html)

<sup>12</sup> [www.fsds-sfdd.ca/en#/en/goals/](http://www.fsds-sfdd.ca/en#/en/goals/)

Recovery planning activities for Roell's Brotherella Moss will be implemented with consideration for all co-occurring species, with focus on species at risk, such that inadvertent negative impacts to these individuals and their habitats are minimized or avoided. Some recovery actions for Roell's Brotherella Moss (e.g., inventory and mapping, threat mitigation, habitat conservation, education, and research) may promote the conservation of other species at risk that overlap in distribution and rely on similar habitat attributes.

Other SARA Schedule 1 wildlife species that may benefit from protective measures taken for Roell's Brotherella Moss include (but not limited to): Mountain Beaver (*Aplodontia rufa*; Special Concern), Peacock Vinyl Lichen (*Leptogium polycarpum*; Special Concern), Oregon Forestsnail (*Allogona townsendiana*; Endangered) and Pacific Watershrew (*Sorex bendirii*; Endangered).

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**Part 2 – *Recovery Plan for Roell's Brotherella (Brotherella roellii) in British Columbia*, prepared by the British Columbia Ministry of Environment**

# Recovery Plan for Roell's Brotherella (*Brotherella roellii*) in British Columbia



Prepared by the BC Ministry of Environment



Ministry of  
Environment

July 2013

## **About the British Columbia Recovery Strategy Series**

This series presents the recovery strategies or recovery plans that are prepared as advice to the Province of British Columbia on the general approach required to recover species at risk. The Province prepares recovery strategies to ensure coordinated conservation actions and meet its commitments to recover species at risk under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada–British Columbia Agreement on Species at Risk*.

### **What is recovery?**

Species at risk recovery is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

### **What is a recovery strategy?**

A recovery strategy summarizes the best available science-based and traditional knowledge of a species or ecosystem to identify goals, objectives, and strategic approaches that provide a coordinated direction for recovery. These documents outline what is and what is not known about a species or ecosystem, identify threats to the species or ecosystem, and explain what should be done to mitigate those threats, as well as provide information on habitat needed for survival and recovery of the species (if available). The Province of British Columbia accepts the information in these documents as advice to inform implementation of recovery measures, including decisions regarding measures to protect habitat for the species. When sufficient information to guide implementation for the species can be included, the document is referred to as a recovery plan, and a separate action plan is not required.

### **For more information**

To learn more about species at risk recovery in British Columbia, please visit the Ministry of Environment Recovery Planning webpage at:

<<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>>

**Recovery Plan for Roell's brotherella (*Brotherella roellii*)  
in British Columbia**

**Prepared by the B.C. Ministry of Environment**

**July 2013**

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## Disclaimer

This recovery plan has been prepared by the B.C. Ministry of Environment as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The British Columbia Ministry of Environment has received this advice as part of fulfilling its commitments under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada–British Columbia Agreement on Species at Risk*.

This document identifies the recovery strategies that are deemed necessary, based on the best available scientific and traditional information, to recover Roell's brotherella populations in British Columbia. Recovery actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. These goals, objectives, and recovery approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies or the personal views of all individuals.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this plan. The B.C. Ministry of Environment encourages all British Columbians to participate in the recovery of Roell's brotherella.

## **ACKNOWLEDGEMENTS**

This document was completed by Brenda Costanzo (Ministry of Environment) with sections drafted by Dr. Terry McIntosh (consultant). Dr. Karen Golinski (consultant), Steve Joya and Dr. Judith Harpel (University of B.C.) and Kym Welstead (Ministry of Forests, Lands and Natural Resource Operations) provided reviews. The Ministry of Forests, Lands and Natural Resource Operations funded part of the drafting of this document through Land Based Investment funds.

## EXECUTIVE SUMMARY

Roell's brotherella (*Brotherella roellii*) is a small moss that grows in turf-like mats. Its stems are 0.5 to 1.0 mm wide and somewhat flattened; they occasionally forming thinner deciduous shoots. Its ovate-lanceolate, concave leaves are toothed along their upper margins. The costa or mid-rib of the leaf is short and double or absent. Large, inflated alar cells found along the sides of the leaf base are most distinctive. Sporophytes are commonly produced.

Roell's brotherella was designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) due to pressures from recreational use; road construction; and urban, agricultural, resource, and industrial development. It is listed as Endangered in Canada on Schedule 1 of the *Species at Risk Act* (SARA). In British Columbia, Roell's brotherella is ranked S1S2 (critically imperiled to imperiled) by the Conservation Data Centre and is on the provincial Red list. The B.C. Conservation Framework ranks Roell's brotherella as a priority #2 under Goal #1 (contribute to global efforts for species and ecosystem conservation) and Goal #2 (prevent species and ecosystems from becoming at risk). Recovery is considered to be biologically and technically feasible.

The population and distribution goal is to maintain the species' distribution throughout its range in British Columbia, and if feasible and appropriate increase the number of individuals at extant populations or re-introduce the species at historical locations.

The following are the recovery objectives:

1. Ensure long-term protection<sup>1</sup> for the known populations and habitat of Roell's brotherella.
2. Assess and mitigate the threats to Roell's brotherella populations (e.g., housing and tourism development, recreational activities, and mining).
3. Confirm the distribution of all populations (existing and new locations) of Roell's brotherella in British Columbia.
4. Identify specific habitat requirements for the species.
5. Determine population size and trends (including reproductive success; sporophyte development and spore viability) of all known populations.
6. Determine if it is feasible and appropriate to augment<sup>2</sup> populations.

## RECOVERY FEASIBILITY SUMMARY

The recovery of Roell's brotherella in B.C. is considered technically and biologically feasible based on the criteria outlined by the Government of Canada (2009):

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<sup>1</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas

<sup>2</sup> Augmentation is defined as adding new individuals to an existing population in order to increase the number of individuals and/or the genetic diversity of the population. This may be done by propagating genetic stock from the receptor site *ex situ* or by adding genetic material from other locations if the existing population is suffering from demographic collapse due to inbreeding.



1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

Yes, extant populations are reproducing via spores and it is thought that this level of reproduction is sufficient to sustain or improve the abundance of these populations.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

Yes, it is extant in several locations and there are areas of unoccupied habitat that appear sufficient to support the species.

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.

Yes, some of the primary threats (housing and urban areas; mining and quarrying; recreational activities, airborne pollutants) to the species or its habitat can be avoided or mitigated. The development of best management practices and training for land owners is one recovery action that could potential reduce the first three threats. However, air pollution will be more difficult to mitigate.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

Yes, protection of host trees and downed woody debris can be achieved through the development of best management practices and followed-up by training of land owners and maintenance crews. The potential to augment populations can be investigated.

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# 1 COSEWIC\* SPECIES ASSESSMENT INFORMATION

<p><b>Date of Assessment:</b> November 2010  <b>Common Name:**</b> Roell's Brotherella Moss  <b>Scientific Name:**</b> <i>Brotherella roellii</i>  <b>COSEWIC Status:</b> Endangered  <b>Reason for Designation:</b> The moss is endemic to western North America, where all known extant populations occur in the densely populated southwestern mainland area of British Columbia. Extensive collecting within and beyond this region has shown this species to occur only on hardwoods and rotten logs in remnant second-growth stands within urban areas. Twenty-nine individuals are known from 9 of the 26 extant locations that have recently been verified. The species is subject to pressures from recreational use, road construction, and urban, agricultural, resource, and industrial development, all of which threaten the quantity of its preferred habitat and host trees and logs, as well as the quality of these habitats in terms of moisture levels and air quality.  <b>Canadian Occurrence:</b> British Columbia  <b>COSEWIC Status History:</b> Designated Endangered in November 2010.</p>
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\* Committee on the Status of Endangered Wildlife in Canada.

\*\* Common and scientific names reported in this recovery plan follow the naming conventions of the British Columbia Conservation Data Centre, which may be different from names reported by COSEWIC.

# 2 SPECIES STATUS INFORMATION

<b>Roell's brotherella<sup>a</sup></b>	
Legal Designation:	
<a href="#">FRPA:</a> <sup>b</sup> No	B.C. <i>Wildlife Act:</i> <sup>c</sup> No
<a href="#">OGAA:</a> <sup>b</sup> No	<a href="#">SARA:</a> Pending <sup>d</sup>
<b>Conservation Status<sup>e</sup></b>	
B.C. List: Red	B.C. Rank: S1S2 (2011)
<a href="#">National Rank:</a> N3 (2010)	Global Rank: G3 (2004)
Other <a href="#">Subnational Ranks:</a> <sup>f</sup> WA: SH	
<b>B.C. Conservation Framework (CF)<sup>g</sup></b>	
Goal 1: Contribute to global efforts for species and ecosystem conservation.	Priority: <sup>h</sup> #2 (May 2009)
Goal 2: Prevent species and ecosystems from becoming at risk.	Priority: #2 (May 2009)
Goal 3: Maintain the diversity of native species and ecosystems.	Priority: #3 (May 2009)
<a href="#">CF Action Groups:</a> <sup>g</sup>	Compile Status Report; Monitor Trends; Planning; Send to COSEWIC; Habitat Protection; Habitat Restoration; Private Land Stewardship;

<sup>a</sup> Data source: B.C. Conservation Data Centre (2013) unless otherwise noted.

<sup>b</sup> No = Not listed in one of the categories of wildlife which require special management attention to address the impacts of forest and range activities on Crown land under the *Forest and Range Practices Act* (FRPA; Province of British Columbia 2002) and/or the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008).

<sup>c</sup> No = Not designated as wildlife under the B.C. *Wildlife Act*, and as such is not offered protection from direct persecution and mortality (Province of British Columbia 1982).

<sup>d</sup> COSEWIC has completed its assessment and this species is awaiting decision by the Governor in Council as to whether it will be added to the List of Wildlife Species at Risk (Schedule 1) under the *Species at Risk Act* (SARA).

<sup>e</sup> S = subnational; N = national; G = global; T = refers to the subspecies level; B = breeding; X = presumed extirpated; H = possibly extirpated; 1 = critically imperiled; 2 = imperiled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; NA = not applicable; NR = unranked; U = unrankable. U.S. data from NatureServe (2012).

<sup>f</sup> Data source: NatureServe (2012).

<sup>g</sup> Data source: B.C. Ministry of Environment (2010).

<sup>h</sup> Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority).

### 3 SPECIES INFORMATION

#### 3.1 Species Description

Roell's brotherella is a small, glossy green or yellow-green moss that grows in turf-like mats. The leafy stems are 0.5–3 mm long by 0.5–1.0 mm wide, somewhat flattened and occasionally form thinner deciduous shoots. Other characteristics include 0.8–1.2 mm long, ovate-lanceolate, concave stem leaves which are toothed along their upper margins and are sometimes weakly recurved near the base. The mid-rib or costa is short and double or absent. The upper and medial leaf cells are long and linear whereas its basal cells are shorter and have thicker walls. The large, inflated alar cells found along the sides of the leaf base are one of the most distinctive characters of Roell's brotherella. The walls of the cells across the leaf base are often pale yellow or orange. Male and female sex organs occur on the same plant (autoecious) and sporophytes are common. The sporophyte is composed of a 0.6–1.0 cm tall seta and a 1.0–1.5 mm long cylindrical capsule, which is erect or slightly curved and sub-erect. Additional descriptive details and photographs can be found in COSEWIC (2010) and Schofield (2009; in prep.).

#### 3.2 Populations and Distribution

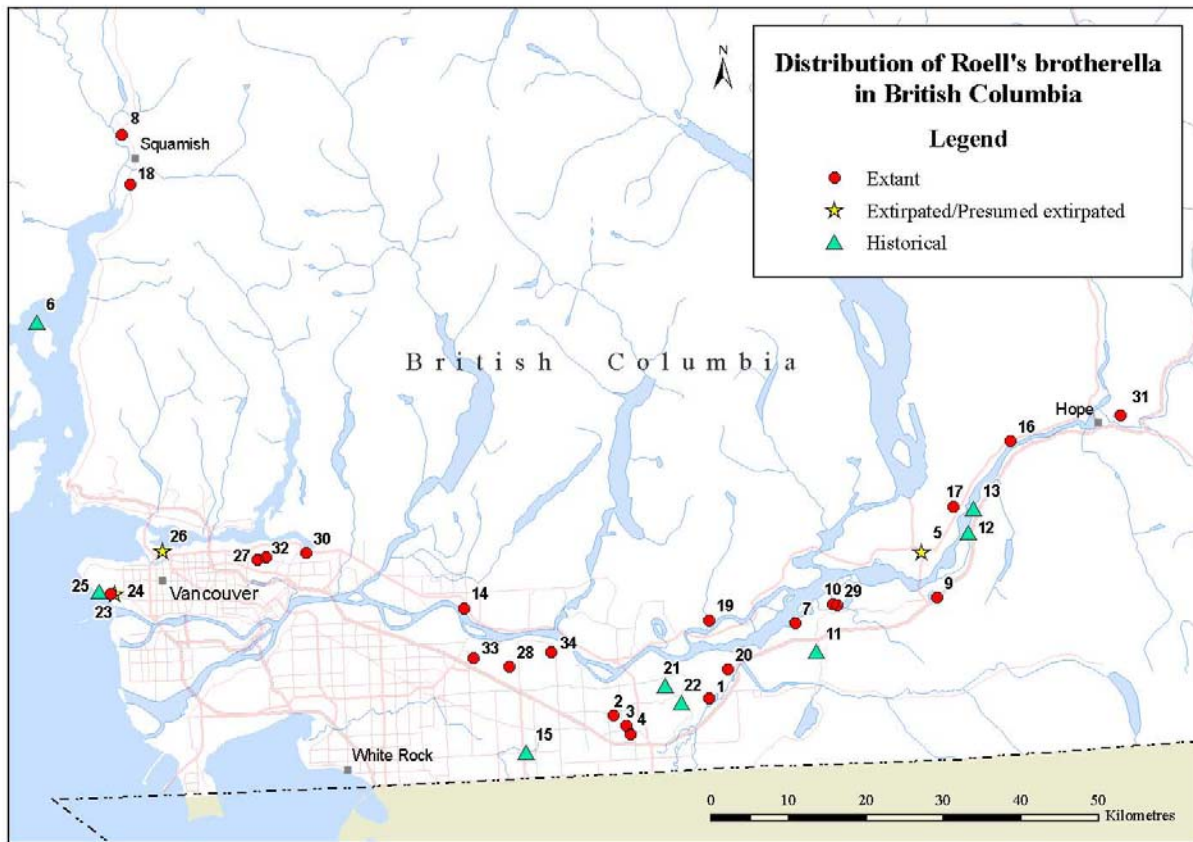
Globally, Roell's brotherella is endemic to western North America, where it is restricted to southwestern British Columbia and western Washington State. In British Columbia, it has been reported from the Lower Mainland, from Vancouver along the Fraser Valley to east of Chilliwack, and in and around Squamish at the end of Howe Sound (Figure 1). There are six historical locations in Washington State which have had no specimens collected for more than 70 years (Schofield 2009), however, in 2011 a new location was found in Mt. Rainier National Park (J. Harpel, pers. comm. 2013). The historical populations had a scattered distribution in the Puget Sound area and in the lower elevations of the Cascade Mountains in Washington. Reports of this species from Alaska, New Brunswick, and Vancouver Island (British Columbia) were based on misidentifications (COSEWIC 2010).

The 35 reported occurrences for Roell's brotherella in British Columbia are listed in Table 1. There are two extirpated element occurrences (EO)<sup>3</sup> at Squamish Highway, north of Squamish (there is no corresponding EO), and at Pacific Spirit Regional Park near Southlands School (EO24), as noted in 2009 by Harpel (COSEWIC 2010). As well, two occurrences are presumed to be extirpated: at Agassiz (EO5), last seen in 1889, and at Coal Harbour in Vancouver (EO26), not seen since 1889. An additional eight occurrences have not been relocated since the late 1960s (they were searched for in 2008-09 field season for the COSEWIC status report), and are denoted as historical in Figure 1 and Table 1. For the remaining 23 locations, most are in or near the Abbotsford and Chilliwack areas, and these occurrences are 60–70 km from the nearest historical location in Washington State.

Over 95% of the global population of this species is found in B.C.

---

<sup>3</sup> Element Occurrence (EO): An area of land where a species is, or was present (B.C. Ministry of Environment).



**Figure 1.** Distribution of Roell's brotherella in British Columbia (COSEWIC 2010).

**Table 1.** Status and description of Roell's brotherella populations in B.C. Populations marked with an \* are considered extant.

Population <sup>a</sup>	Date last observed and number of patches (if documented)	Land tenure
*EO1. Sumas Mt. Regional Park, Abbotsford	2010: 4 patches	Regional park
*EO2. Downes Bowl Park, 1.8 km SW of Abbotsford	2009: ~ 9 patches	Municipal park
*EO3. Century Park, Abbotsford	2007: 3 patches	Municipal park
*EO4. Ravine Park, 1.2 km southwest of Abbotsford	2007: 3 patches	Municipal park
EO5. Agassiz	Presumed extirpated. <sup>b</sup> 1889	Unknown
EO6. Anvil Island, north shore (Howe Sound)	Historical. 1969	Unknown
*EO7. Skway IR5, Arnold	1982	First Nations
*EO8. Brackendale	2006: > 1 patch; Could be same location as historical: 1916	Private
*EO9. Bridal Veil Falls Provincial Park	2004	Provincial park
*EO10. Chilliwack	2009: 2 patches	First Nations

<b>Population<sup>a</sup></b>	<b>Date last observed and number of patches (if documented)</b>	<b>Land tenure</b>
EO11. Sardis	Historical. 1970	Private?
EO12. Mt. Ludwig; 8 km east of Popkum	Historical. 1968	Unknown
EO13. Cheam View, Hope	Historical. 1971	Unknown
*EO14. Kanaka Creek, east of Haney	1976	Unknown
EO15. Howes Creek, near Aldergrove	Historical. 1969	Private?
*EO16. Ruby Creek (Skwawolt Creek)	2009: 2 patches	First Nations?
*EO17. Seabird Island	1985	First Nations
*EO18. Squamish Rotary Park, Dentville	2012: >2 patches	Municipal park
*EO19. Suicide (Norrish Creek), Dewdney area	1975	Private?
*EO20. Sumas Mt. escarpment	1981	Unknown
EO21. Sumas Mt., near Matsqui	Historical. 1967	Unknown
EO22. Sumas Mt., Straiton area	Historical. 1966	Unknown
*EO23. Pacific Spirit Regional Park, UBC Endowment Lands near golf course	1999	Regional park
EO24. Pacific Spirit Regional Park near Southlands School	Extirpated 2009. 1966	Regional park
EO25. Pacific Spirit Regional Park, Marine Dr. south of Fraser Monument	Historical. 1969	Regional park
EO26. Hastings, 1.1 km southeast of Coal Harbour	Presumed extirpated. 1889	Unknown
*EO27. Burnaby, Squint Lake Park next to Burnaby Mt. golf course	2009: 2 patches	Municipal park
*EO28. West Creek Wetlands Regional Park, Wood Duck Lake, Langley	2007	Regional park
*EO29. Little Mt. Park, Chilliwack	2010: 3 patches	Municipal park
*EO 30. Port Moody	2012: 1 patch; likely more around in forest	Municipal
*EO31. Hope; Kawkawa Lake	2012: 1 small patch	Private
*EO 32. Burnaby, Burnaby Mtn., south side, Mel's Trail	2010: 1 patch	Municipal
*EO 33. Dominion Sawmill, historical Langley	2010	Private
*EO 34. Pemberton Hills, Langley	2010	Unknown
Squamish Hwy., just north of Squamish (no EO)	Extirpated 2009. 1970	Unknown

<sup>a</sup> Population numbers refer to BC Conservation Data Centre "CDC Element Occurrence data" numbers. Populations marked with an (\*) are considered extant.

<sup>b</sup> Presumed Extirpated – Species or ecosystem is believed to be extirpated from the jurisdiction (i.e., nation, or state/province). Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered (NatureServe 2012).

### 3.3 Needs of Roell's Brotherella

#### 3.3.1 Habitat and Biological Needs

In British Columbia, all of the populations of Roell's brotherella occur at low elevations, between 4 and 100 m, within the Coastal Western Hemlock (CWH) biogeoclimatic zone. Roell's brotherella is found in the cool and humid environments of mixed deciduous and coniferous second-growth forests on stream terraces, swampy floodplains, and, occasionally, in creek ravines. In Washington State, one new occurrence from 2011 is located on a floodplain within an old-growth forest (J. Harpel, pers. comm. 2013). Most of the habitats in British Columbia are remnants of second-growth forests found within city parks and in undeveloped areas or in floodplain regions along waterways. Specific habitats include the trunks of trees, notably red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), western flowering dogwood (*Cornus nuttallii*), and birch (*Betula* sp.). Roell's brotherella has also been observed on rotting logs and stumps (COSEWIC 2010).

#### 3.3.2 Limiting Factors

As this species of moss has not been studied in detail, a number of factors may limit the survival and recovery of Roell's brotherella in British Columbia. As such, those listed below will need further investigation:

- Probable weak competitive ability, especially with respect to other mosses.
- Small area of physical occupancy leaves it susceptible to chance events including those that operate at a small scale (e.g., loss of host tree or removal of woody debris).
- Small population sizes may increase its vulnerability to extirpation due to competition and demographic stochasticity.
- Restricted to specialized habitats, at the bases of trees and on rotting wood, which are temporary habitats.
- Roell's brotherella is found in closed canopy environments, and as well, has a highly fragmented distribution. These factors may restrict long-distance dispersal of spores, and the potential for local rescue effects or establishment in unoccupied habitat areas.
- It is not known if spores are viable.
- It is not known whether the spores (if viable) are able to disperse to the specialized microhabitat sites that will allow the establishment of mature individuals.

## 4 THREATS

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (Salafsky *et al.* 2008). For purposes of threat assessment, only present and future

threats are considered.<sup>4</sup> Threats presented here do not include biological features of the species or population such as inbreeding depression, small population size, and genetic isolation; or likelihood of regeneration or recolonization for ecosystems, which are considered limiting factors (Table 2).<sup>5</sup>

For the most part, threats are related to human activities, but they can be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., invasive species introduction). Effects of natural phenomena (e.g., fire, flooding) may be especially important when the species or ecosystem is concentrated in one location or has few occurrences, which may be a result of human activity (Master *et al.* 2009). As such, natural phenomena are included in the definition of a threat, though they should be applied cautiously. These stochastic events should only be considered a threat if a species or habitat is damaged from other threats and has lost its resilience, and is thus vulnerable to the disturbance (Salafsky *et al.* 2008) so that these types of events would have a disproportionately large effect on the population/ecosystem compared to the effect they would have had historically.

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<sup>4</sup> Past threats may be recorded but are not used in the calculation of Threat Impact. Effects of past threats (if not continuing) are taken into consideration when determining long-term and/or short-term trend factors (Master *et al.* 2009).

<sup>5</sup> It is important to distinguish between limiting factors and threats. Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to recovery/conservation efforts.



## 4.1 Threat Assessment

The threat classification below is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system and is consistent with methods used by the B.C. Conservation Data Centre and the B.C. Conservation Framework. For a detailed description of the threat classification system, see the [CMP website](#) (CMP 2010). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat “impact” is calculated from scope and severity. For information on how the values are assigned, see [Master \*et al.\*](#) (2009) and table footnotes for details. Threats to Roell's brotherella were assessed for the province (Table 2).

**Table 2.** Threat classification for Roell's brotherella.

Threat #	Threat description	Impact <sup>a</sup>	Scope <sup>b</sup>	Severity <sup>c</sup>	Timing <sup>d</sup>
1	Residential & commercial development	Medium	Restricted (11–30%)	Serious (31–70%)	High (Continuing)
1.1	Housing & urban areas	Low	Small (1–10%)	Extreme (71–100%)	High (Continuing)
1.3	Tourism & recreation areas	Low	Restricted (11–30%)	Moderate (11–30%)	High (Continuing)
6	Human intrusions & disturbance	Low	Large (31–70%)	Slight (1–10%)	High (Continuing)
6.1	Recreational activities	Low	Large (31–70%)	Slight (1–10%)	High (Continuing)
9	Pollution	Unknown	Large (31–70%)	Unknown	High (Continuing)
9.5	<u>Airborne pollutants</u>	Unknown	Large (31–70%)	Unknown	High (Continuing)

<sup>a</sup> **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment (e.g., timing is insignificant/negligible (past threat) or low (possible threat in long term)); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

<sup>b</sup> **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

<sup>c</sup> **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

<sup>d</sup> **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [ $< 10$  years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

## 4.2 Description of Threats

The overall province-wide Threat Impact for this species is Medium.<sup>6</sup> This overall threat considers the cumulative impacts of multiple threats. The most important significant threats are residential development, recreational activities, and mining (Table 2). Additional threats include agriculture, transportation and service corridors, biological resource use, and pollution. Details are discussed below under the Threat Level 1 headings.

### 4.2.1 Existing threats

#### IUCN-CMP Threat 1. Residential & commercial development

##### 1.1 Housing and urban areas

Most of the extant occurrences of Roell's brotherella are located either in or near densely populated areas with increasing populations and expanding development footprints. The population within the Fraser Valley Regional District could rise from 277,593 (2013) to 462,660 (2031) (Urban Futures, 2005). However, many of the known populations are located in areas that may afford it some measure of protection from development owing to their occurrence in municipal and/or regional parks. Two occurrences could be threatened by development in Abbotsford (EO1) and Chilliwack (EO10) but it is unlikely that any locations will be developed within the next 10 years. However, there is an adjacent housing development next to Bridal Veil Falls Provincial Park, but it is unknown whether this development will affect the current location of the species within the park, or if there is suitable habitat for the species within this development area.

##### 1.3 Tourism and recreation areas

Threats to populations within parks include trail construction or maintenance, replacement of native tree species with ornamental species, and expansion of human-use areas (e.g., playgrounds, entry roads, or parking lots) (COSEWIC 2010). Currently, there are ten populations found within parks (municipal, regional and provincial) and this threat appears to be possible in at least two locations (Squint Lake Park EO27; Sumas Mt. EO1)

#### IUCN-CMP Threat 6. Human intrusions and disturbance (6.1 Recreational activities)

Incidental disturbance or vandalism by hikers, mountain bikers, and other park users is a threat at the seven locations that occur in municipal and/or regional parks.

#### IUCN-CMP Threat 9. Pollution (9.5 Airborne pollutants)

Many bryophytes, including Roell's brotherella, obtain water and nutrients by intercepting and absorbing solutes in rainwater, cloud, and mist droplets, and airborne dust through their shoots

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<sup>6</sup> The overall threat impact was calculated following Master *et al.* (2009) using the number of Level 1 Threats assigned to this species where Timing = High or Moderate. This includes one Medium, two Low, and one Unknown (Table 2). The overall threat considers the cumulative impacts of multiple threats.

(COSEWIC 2010). Therefore, it is possible that air pollution could impact this species, in particular spore germination (Glime 2007). Many of the populations are located near urban areas, including in the Fraser Valley where urban and agricultural-derived summer pollution levels are often very high (Metro Vancouver, 2011). Increased urban development, as is planned near many of the locations, and the proposed magnesium-processing plant located near Ruby Creek could lead to increased levels of air pollution.

#### **4.2.2 Negligible threats or threats outside the assessed timeframe**

##### **IUCN-CMP Threat 2. Agriculture and aquaculture (2.1 Annual and perennial non-timber crops; 2.3 Livestock farming & ranching)**

For agriculture, both non-timber crops (e.g., fruit crops and ornamental nurseries) and livestock farming and ranching are considered to be past threats, which may have led to extirpation of previously known occurrences.

##### **IUCN-CMP Threat 3. Energy production and mining (3.2 Mining and quarrying)**

COSEWIC (2010) noted that the development of a mine and processing facility (the Cogburn Magnesium Project) west of Hope may affect the population near Ruby Creek (EO16). The pit construction, roads, altered local hydrology, and pollution from the mine are cited concerns. However, this project is currently inactive (Reed Business Information 2013).

##### **IUCN-CMP Threat 4. Transportation and service corridors (4.1 Roads and railroads)**

The scope for road construction is small and the severity extreme; however, "impact" has not been calculated as it is unlikely that this will be a threat within the next 10 years (i.e., outside the threat assessment timeframe). Many populations are adjacent to roads and could be affected by road expansion or maintenance in the future (e.g., casting of debris has possibly eliminated one population at Ruby Creek [EO16]) (COSEWIC 2010). There is also the possibility of new road construction, for example, to a mine site, during urban development, or for logging purposes.

##### **IUCN-CMP Threat 5. Biological resource use (5.3 Logging and wood harvesting)**

As Roell's brotherella grows in small patches logging could completely destroy a population due to removal of trees as well as any removal of downed woody debris. Changes in light levels and other microclimate changes caused by removal or thinning of the canopy could also affect populations (COSEWIC 2010). Logging could occur at Chilliwack (EO10), Sardis (EO11), and Kanaka Creek (EO14), but this is currently unknown. It is unlikely though, that the trees on which this species typically grows on, such as bigleaf maple, red alder, western flowering dogwood, and birch, will be targeted for tree removal (although one occurrence at Ruby Creek (EO16) may have been buried when a bigleaf maple tree was cut down). Within parks, hazard tree removal does occur due to both trail and park facility maintenance; however, provincial park managers are aware that this species does occur within Bridal Veil Falls Provincial Park. The impact of this threat is thought to be negligible.

## 5 RECOVERY GOAL AND OBJECTIVES

### 5.1 Population and Distribution Goal

The population and distribution goal is to maintain the species' distribution throughout its range in British Columbia, and if feasible and appropriate increase the number of individuals at extant populations or re-introduce the species at historical locations.

### 5.2 Rationale for the Population and Distribution Goal

This species is endemic to western North America and is known from 35 locations in British Columbia, and only one in Washington State. As there is minimal chance of any rescue effect from outside populations, using recovery techniques to maintain and augment the existing populations is a realistic goal and will prevent extirpation of this species. As well, any new populations<sup>7</sup> that may be identified in the future will need to be maintained. This species has narrow habitat specificity and extant populations only occur in densely populated areas in the southwestern mainland of British Columbia. Although this species was once widespread, it was not common (COSEWIC 2010). Therefore investigating the feasibility of augmenting extant populations (i.e., where they are shown to be in decline), and/or increasing the number of populations by re-introducing the species at historical locations are considered reasonable goals.

### 5.3 Recovery Objectives

Recovery will be considered significantly advanced if the following short-term (5–10 years) objectives have been met:

1. Ensure long-term protection<sup>8</sup> for the known populations and habitat of Roell's brotherella.
2. Assess and mitigate the threats to Roell's brotherella populations (e.g., housing and tourism development, recreational activities, and mining).
3. Confirm the distribution of all populations (existing and new locations) of Roell's brotherella in British Columbia by conducting thorough field surveys.
4. Identify specific habitat requirements for the species.
5. Determine population size and trends (e.g., reproductive success; sporophyte development; production of viable spores) of all known populations.
6. Determine if it is feasible and appropriate to augment<sup>9</sup> populations.

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<sup>7</sup> A population is defined as the total number of individuals of the taxon (IUCN 2010).

<sup>8</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas

<sup>9</sup> Augmentation is defined as adding new individuals to an existing population to increase the number of individuals and/or the genetic diversity of the population. This may be done by propagating genetic stock from the receptor site *ex situ* or by adding genetic material from other locations if the existing population is suffering from demographic collapse due to inbreeding (Maslovat, 2009).

## 6 APPROACHES TO MEET OBJECTIVES

### 6.1 Actions Already Completed or Underway

The following actions have been categorized by the action groups of the B.C. Conservation Framework (B.C. Ministry of Environment 2010). Status of the action group for this species is given in parentheses.

#### Compile Status Report (complete)

- COSEWIC report completed (COSEWIC 2010). Update due 2020.

#### Send to COSEWIC (complete)

- Roell's brotherella assessed as Endangered (COSEWIC 2010).

#### Planning (in progress)

- BC Recovery Plan completed (this document, 2013).

#### Habitat Protection and Private Land Stewardship

- Table 3 outlines the existing mechanisms that currently provide habitat protection for Roell's brotherella.

**Table 3.** Existing mechanisms that afford habitat protection for Roell's brotherella.

<b>Existing mechanisms that afford habitat protection</b>	<b>Threat<sup>a</sup> or concern addressed</b>	<b>Site</b>
Provincial <i>Parks Act</i>	Habitat loss: 1.1; 1.3; 3.2	Bridal Veil Falls Provincial Park
Municipal and Regional parks (e.g., local by-laws; park management plans)	Habitat loss: 1.1; 1.3; 3.2	Century Park; Downes Bowl Park; Little Mtn. Park; Pacific Spirit Regional Park; Ravine Park; Squamish Rotary Park; Squint Lake Park; Sumas Mtn. Regional Park; West Creek Wetlands Regional Park

<sup>a</sup> Threat numbers according to the IUCN-CMP classification (see Table 2 for details).

## 6.2 Recovery Planning Table

**Table 4.** Recovery planning table for Roell's brotherella.

<b>Recovery Objective</b>	<b>Actions to meet objectives<sup>a</sup></b>	<b>Threat<sup>b</sup> or concern addressed</b>	<b>Priority<sup>c</sup></b>
1	Determine appropriate measures to protect habitat	1.1, 1.3, 6.1	Essential
	Develop stewardship agreements, conservation covenants with private landowners on all properties	1.1, 1.3, 6.1	Essential
	Develop Best Management Practices including mapping of locations in parks and training (e.g. habitat identification and maintenance activities that may threaten the species).	1.1, 1.3, 6.1	Essential
	Advise landowners on Best Management Practices to mitigate threats	1.1, 1.3, 6.1	Essential
2	Assess impacts of threats at all locations	All	Essential
	Monitor locations to assess the effects of any management activities taken to mitigate threats	All	Beneficial
3	Identify and map occupied habitat for the species	Knowledge gaps	Necessary
	Identify and map suitable habitat for the species	Knowledge gaps	Necessary
	Prioritize areas for inventory	Knowledge gaps	Necessary
	Conduct inventories	Knowledge gaps	Necessary
4	Identify specific habitat requirements for the species (e.g. exposure, humidity, light intensity, soil moisture, temperature, wind speed) for both micro and macro habitats) and decay stage, size and diameter of host tree or woody debris	Knowledge gaps	Beneficial
5	Develop and implement monitoring protocols for Roell's brotherella distribution, abundance and condition of habitat at each location	Knowledge gaps	Beneficial
	Monitor status of populations to determine size and populations trends (including determining reproductive success and information on sporophyte development and viability)	Knowledge gaps	Beneficial
6	Research to determine whether it is appropriate and feasible to re-introduce to historic sites, and/or augment extant populations.	Knowledge gaps	Beneficial
	Determine the suitability of augmentation at one location to be used as a trial site.	Knowledge gaps	Beneficial
	Develop an augmentation plan if deemed feasible.	Limiting factors	Beneficial
	Augment the species if determined feasible.	Limiting factors	Beneficial

<sup>a</sup> All actions fall under the Habitat Protection and Private Land Stewardship action groups of the B.C. Conservation Framework.

<sup>b</sup> Threat numbers according to the IUCN-CMP classification (see Table 2 for details).

<sup>c</sup> Essential (urgent and important, needs to start immediately); Necessary (important but not urgent, action can start in 2–5 years); or Beneficial (action is beneficial and could start at any time that was feasible).

## 7 INFORMATION ON HABITAT NEEDED TO MEET POPULATION AND DISTRIBUTION GOAL

Threats to Roell's brotherella habitat have been identified. To help meet the population and distribution goal for this species, it is recommended that specific habitat attributes be identified. In addition, it is recommended that locations of survival/recovery habitat be geospatially identified to facilitate mitigating habitat threats and actions for meeting the population and distribution goal.

### 7.1 Description of Survival/Recovery Habitat

A general description of the habitat requirements of Roell's brotherella is provided in Section 3.3.1; however, specific habitat requirements for the species' survival and recovery still need to be determined (see Section 7.2).

At minimum, survival habitat should include:

- the suitable habitat within the area of occupancy<sup>10</sup> for this species based on International Union for the Conservation of Nature standards (IUCN Standards and Petitions Subcommittee 2010);
- habitat immediately adjacent to the suitable habitat sufficient to maintain micro- and macro-habitat conditions including maintaining occupied trees and woody debris as well as the adjacent habitat and surrounding influential water flow.

Recovery habitat is also required and can be defined as suitable habitat needed to augment populations if deemed feasible.

### 7.2 Studies Needed to Describe Survival/Recovery Habitat

A schedule of studies outlining the work necessary to identify survival/recovery habitat is provided in Table 5.

**Table 5.** Studies needed to describe survival/recovery habitat to meet the population and distribution goal for Roell's brotherella.

<b>Description of activity</b>	<b>Outcome/rationale</b>	<b>Timeline</b>
Conduct surveys: <ul style="list-style-type: none"> <li>• Map occupied habitat using established mapping techniques.</li> </ul>	Known locations are mapped	2014–15

<sup>10</sup> Area of Occupancy (AOO) is defined as the area within its extent of occurrence, which is occupied by a taxon, excluding cases of vagrancy. Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary, which can be drawn to encompass all the known, inferred, or project sites of present occurrence of a taxon, excluding cases of vagrancy. AOO is measured using a grid size of 2 km (a cell area of 4 km<sup>2</sup>) (IUCN Standards and Petitions Subcommittee 2010).

Description of activity	Outcome/rationale	Timeline
<p>Describe and record condition of occupied habitat as well as surrounding habitat required for survival/recovery.</p> <ul style="list-style-type: none"> <li>• Delineate the habitat features and site conditions supporting the species.</li> <li>• Compile site-specific information on community composition, site characteristics, ecological condition (competition, land use activities, other intrinsic limitations), and landscape context (adjacent land use, succession, habitat connectivity).</li> </ul>	<p>Information on the occupied habitat characteristics and features are available to inform land management activities.</p>	<p>2014–15</p>

## 8 MEASURING PROGRESS

The overall measure of success will be determined primarily through monitoring of populations and habitat trends through time. The following performance measures (listed below for each objective) provide a way to define and measure progress toward achieving the population and distribution goal and recovery objectives.

**Measure for Objective 1:** At least 10 locations (others added in the future) have stewardship agreements established for protection of the species by 2016.

**Measure for Objective 2:** Threats have been assessed and mitigation initiated by 2015.

**Measure for Objective 3:** Inventory has been conducted in 50% of suitable habitats by 2016.

**Measure for Objective 4:** Monitoring has been initiated by 2014 and conducted on a regular basis to determine the size and population trend of all known populations.

**Measure for Objective 5:** Specific habitat requirements (e.g. exposure, humidity, light intensity, soil moisture, temperature, wind speed for both micro and macro habitats) and decay stage, size and diameter of host tree or woody debris) is determined for the species by 2015.

**Measure for Objective 6:** The feasibility and appropriateness for a trial augmentation has been assessed by 2016. Potential habitat has been investigated by 2017, and if feasible, the plant augmented at a trial site by 2018.

## 9 EFFECTS ON OTHER SPECIES

This species occurs in second-growth forests within urban areas in Vancouver, the Fraser Valley and Howe Sound Region in Canada. Negative impacts to other species are not anticipated.



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