Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Western Chorus Frog (*Pseudacris triseriata*), Great Lakes/ St. Lawrence – Canadian Shield population, in Canada

Western Chorus Frog

2015

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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

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[1] http://www.registrelep-sararegistry.gc.ca

PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] 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 of the publication of the final document on the Species at Risk Public Registry.

The Minister of the Environment and the Minister responsible for Parks Canada Agency are the competent ministers under SARA for the Western Chorus Frog (*Pseudacris triseriata*), Great Lakes / St. Lawrence – Canadian Shield population, and have prepared this strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Government of Quebec (ministère du Développement durable, de l'Environnement et de la Lutte contre les Changements Climatiques; ministère des Forêts, de la Faune et des Parcs; ministère de l'Énergie et des Ressources naturelles) and the Government of Ontario (Ministry of Natural Resources and Forestry) under subsection 39(1) of SARA.

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 Canada, Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Western Chorus Frog (*Pseudacris triseriata*), Great Lakes / St. Lawrence – Canadian Shield population, and for 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 Canada, Parks Canada Agency and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to the 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 the recovery strategy identifies critical habitat, there may be regulatory implications as SARA sets out a process to evaluate existing protection mechanisms under other Acts of Parliament and provincial and territorial legislation, and if necessary, to put in place additional protection under SARA. For critical habitat located on federal lands outside of federal protected areas the Minister of the Environment must either report on existing legal protection or make an order to provide protection. The Minister of the Environment will assess whether critical habitat is effectively protected on non-federal lands. The discretion to protect critical habitat that is not effectively protected rests with the Governor in Council.

[2] http://registrelep-sararegistry.gc.ca/default.asp?lang=en&n=6B319869-1#2

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EXECUTIVE SUMMARY

The Western Chorus Frog is a small amphibian that usually breeds in temporary wetlands located near open habitats or discontinuous forests. The species is considered globally secure. However, the Great Lakes / St. Lawrence – Canadian Shield (GLSLCS) population, found at the northern limit of the range, was assessed as Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2008 and has been listed according to the same status under Schedule 1 of the *Species at Risk Act* (SARA) since 2010.

The abundance of the Western Chorus Frog (GLSLCS) populations is unknown, although it is thought to fluctuate considerably from year to year depending on hydrological conditions, among other factors. In eastern Ontario, data from 1995 to 2006 show a decrease of more than 40% in the occupancy of breeding wetlands. In Quebec, the two regions in which the species' occurs (Montérégie and Outaouais), respectively lost 14% and 28% of known breeding wetlands between 2004 and 2009.

The main threats to the species are habitat loss and degradation through urban development, intensification of agriculture, climate change, pesticides and fertilizers, the expansion and maintenance of linear infrastructures, as well as habitat succession.

There are unknowns regarding the feasibility of recovery of the Western Chorus Frog (GLSLCS). Nevertheless, in keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA as would be done when recovery is determined to be feasible.

The population and distribution objectives for the Western Chorus Frog (GLSLCS) in Canada are:

- Over the short-term (2015-2025): maintain the areas of occupied suitable habitat as well as the breeding population level within each local population and, where a metapopulation is present, maintain the connectivity among the local populations constituting the metapopulation.
- Over the long-term (2015-2035): ensure the viability of each local population and of metapopulations, where present, by increasing the areas of occupied suitable habitat, the breeding population level within each local population, as well as the connectivity among the local populations constituting a metapopulation. Also, where technically and biologically feasible, restore historical or extirpated local populations or create new habitats.

Broad recovery strategies and approaches to achieve these objectives are presented in the Strategic Direction for Recovery section.

Critical habitat for the Western Chorus Frog (GLSLCS) is partially identified in this recovery strategy. It corresponds to the areas of suitable habitat within polygons combining breeding wetlands that have been used on at least 2 occasions in the past 20 years (including at least once in the past 10 years), adjacent terrestrial habitats, and

the dispersal habitats that connect them that meet the criteria set out in section 7.1.2. A total of 267 critical habitat units are identified, 218 of which are located in Ontario and 49 in Quebec. A schedule of studies has been developed to complete the identification of critical habitat necessary to meet the population and distribution objectives.

One or more action plans will be posted on the Species at Risk Public Registry before the end of 2020.

RECOVERY FEASIBILITY SUMMARY

Based on the following four criteria that Environment Canada uses to establish recovery feasibility, there are unknowns regarding the feasibility of recovery of the Western Chorus Frog (GLSLCS). Therefore, in keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA as would be done when recovery is determined to be feasible. This recovery strategy addresses the unknowns surrounding the feasibility of recovery.

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. Monitoring activities conducted in Quebec and Ontario show that, despite significant declines in the number of breeding wetlands or their occupancy, individuals remain in a number of locations throughout the range.

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

   Yes. However, the availability of suitable habitat is rapidly declining in urban landscapes and surrounding areas. Residual habitats need to be conserved, and the restoration of degraded wetlands or the creation of new ones is essential to recover the species.

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

   Unknown. Given the omnipresent and important pressures to develop residual habitats in urban landscapes, opportunities for recovery are rapidly being compromised. In agricultural landscapes, these opportunities still exist but are increasingly difficult to implement as agricultural practices are becoming more intensive. Isolated populations are at greater risk from urban development and agricultural intensification.

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

   Unknown. While the establishment of protected areas and stewardship agreements on all types of land tenures are effective measures to stabilize local populations in larger habitat parcels, other approaches (e.g., restoration, increasing connectivity) are necessary in smaller, more isolated populations. The effectiveness of such approaches is currently being tested.

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1. COSEWIC[6] SPECIES ASSESSMENT INFORMATION

Date of Assessment: April 2008

Common Name (population): Western Chorus Frog (Great Lakes / St. Lawrence – Canadian Shield population)

Scientific Name: *Pseudacris triseriata*

COSEWIC Status: Threatened

Reason for Designation: Ongoing losses of habitat and breeding sites for this small frog due to suburban expansion and alteration in farming practices have resulted in losses of populations and isolation of remaining habitat patches. Populations in Quebec are documented to have declined at a rate of 37% over 10 years and are expected to continue to decline. Despite there being some areas where chorus frogs remains evident, surveys of populations in Ontario indicate a significant decline in abundance of 30% over the past decade.

Canadian Occurrence: Ontario, Quebec

COSEWIC Status History: The species was considered a single unit and designated Not at Risk in May 2001. Split into two populations in April 2008. The Great Lakes / St. Lawrence – Canadian Shield population was designated Threatened in April 2008.

2. SPECIES STATUS INFORMATION

The Western Chorus Frog (Great Lakes / St. Lawrence – Canadian Shield (GLSLCS) population) is entirely (100%) found in Canada (COSEWIC 2008). This population was listed as Threatened in Schedule 1 to the *Species at Risk Act* (SARA) (S.C. 2002, c. 29) in 2010. In Quebec, this population has been listed as Vulnerable under the *Act Respecting Threatened or Vulnerable Species* (R.S.Q., c. E-12.01) since 2001, and its status is currently under review. In Ontario, the species is not currently listed under the *Endangered Species Act, 2007* (S.O. 2007, c. 6).

Globally, NatureServe (2012) considers the Western Chorus Frog to be Secure (G5). The GLSLCS population has not been assessed at the global or national levels. However, a subnational status of Apparently Secure (S4) was assigned in Ontario, while in Quebec it is considered Imperiled (S2).

[6] Committee on the Status of Endangered Wildlife in Canada.

3. SPECIES INFORMATION

In Canada, COSEWIC (2008, 2010) defines two designatable units for the Western Chorus Frog: the Great Lakes / St. Lawrence – Canadian Shield population (GLSLCS), discussed in this recovery strategy, and the Carolinian population, which has been designated as Not at Risk (Figure 1).

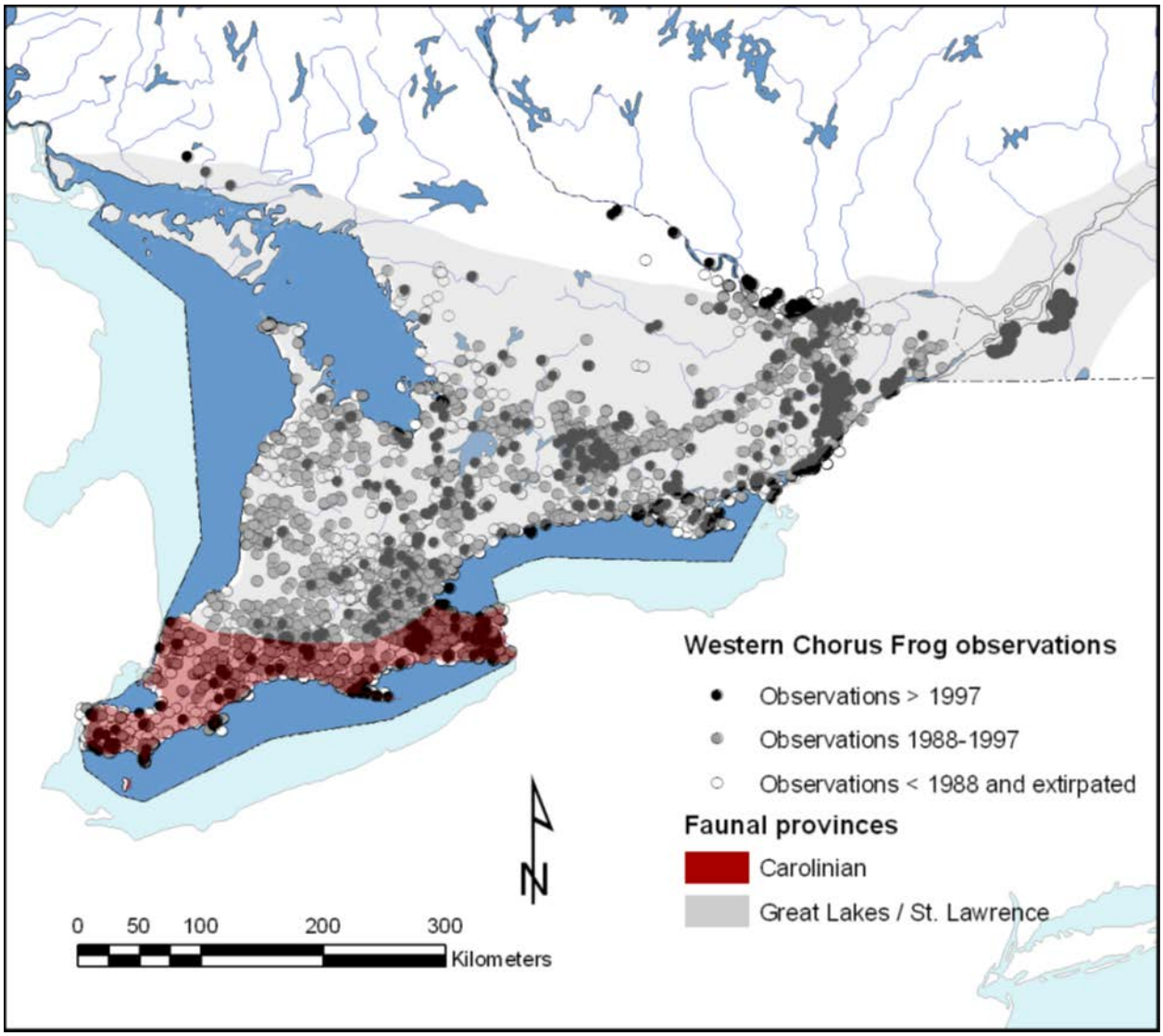

Figure 1. Canadian observations of the Western Chorus Frog in the Carolinian and the Great Lakes / St. Lawrence faunal provinces (adapted from COSEWIC 2008). Observations above the grey shaded area fall in the Canadian Shield faunal province.

Genetic analyses support the hypothesis that individuals of the GLSLCS population could be Boreal Chorus Frogs (*Pseudacris maculata*) rather than Western Chorus Frogs (Figure 2; Moriarty-Lemmon *et al.* 2007; Rogic *et al.* 2015). However, the Boreal Chorus

Frog has not been assessed by COSEWIC[7]. In light of the continued taxonomic uncertainty, EC relies on the pre-existing assessment of COSEWIC given its expertise in this matter. The scope of the present Western Chorus Frog (GLSLCS) is defined using the boundary between the Carolinian and Great Lakes/St. Lawrence – Canadian Shield faunal provinces established by COSEWIC (2008, 2010). The term Western Chorus Frog (GLSLCS) used hereafter refers to the individuals in southern Ontario and Quebec falling in the Great Lakes/St. Lawrence and Canadian Shield faunal provinces rather than to their genetic identity, in compliance with the species current listing under SARA. As this population is likely to remain as a distinct unit regardless of its taxonomic classification, the completion of this recovery strategy is appropriate. This Chorus Frog population is in a precarious state in southern Ontario and Quebec (see section 3.2).

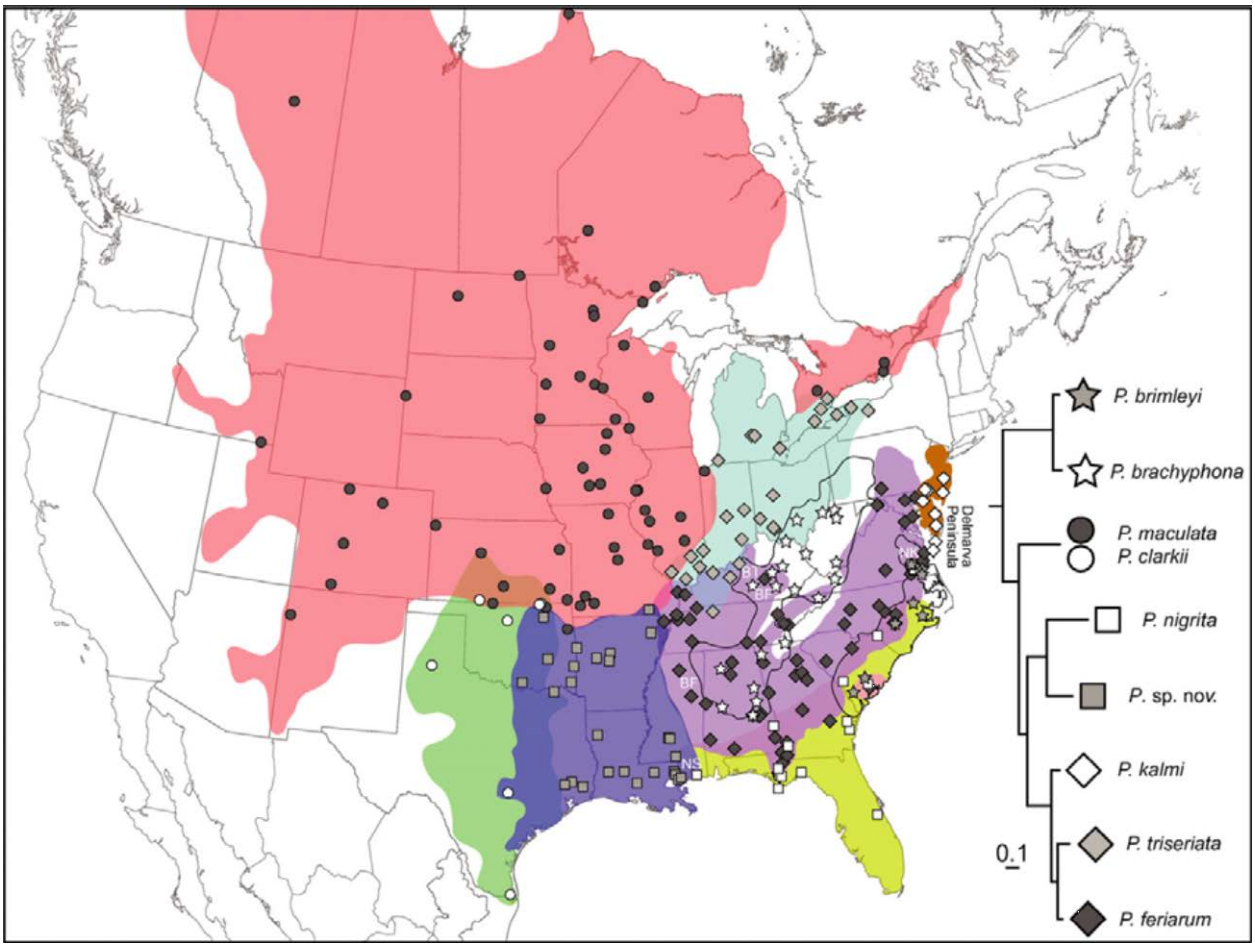

Figure 2. Subdivisions of the *Pseudacris* genus in North America based on mitochondrial DNA sequence markers. Note the presence of two distinct mitochondrial "races" (pink and light blue colours; black circles and grey diamonds) in southern Ontario with a postulated boundary between them corresponding to the division between the Great Lakes/St. Lawrence– Canadian Shield and Carolinian faunal provinces. Also note the complete disjunction in the distribution range between frogs carrying the "*maculata*" type mitochondrial genome (pink colour and black circles) from southern Ontario and Quebec vs. western Canada and northern Ontario. Source: Moriarty-Lemmon *et al.* (2007).

[7] The authoritative voice under SARA and for Environment Canada on taxonomic matters is COSEWIC.

3.1 Species Description

The COSEWIC (2008) status report describes the Western Chorus Frog (GLSLCS) as a small amphibian, ranging in colour from brown to olive grey, that weighs about 1 g and measures about 2.5 cm long as an adult. It has three dark lines along its back, one wider line on each flank, and a broad line that runs across the eyes. The species' call is a long *cre-ee-ee-ee-eek*, similar to the sound of running a fingernail across the teeth of a metal comb. To the inexperienced ear, this call can be confused with the territorial trill (different from the call) of the Spring Peeper (*Pseudacris crucifer*), a much more widespread and abundant species (Schueler and Karstad 2012a). The call of the Spring Peeper, a short *peeeep*, is very distinctive from that of the Western Chorus Frog. Both species breed in early spring and can produce impressive choruses within which the number of individuals cannot be determined.

The life expectancy of adult Western Chorus Frogs is usually one year (a single reproductive event), although some have been known to live up to two or three years (Whiting 2004). After mating and egg-laying occur, the eggs hatch in 3 to 27 days, depending on water temperature. Thereafter, tadpoles take between 40 and 90 days to complete their metamorphosis into adults (Whitaker 1971; Whiting 2004).

3.2 Population and Distribution

The distribution of the Western Chorus Frog extends from the east-central United States to southwestern Quebec (Figure 2). In Canada, the Western Chorus Frog is found in the lowlands of south-central and eastern Ontario as well as south-western Quebec.

In Quebec, the Western Chorus Frog (GLSLCS) was historically present in the southern part of the province, from the Ottawa Valley to the foothills of the Appalachians and west of the Richelieu River (Bonin and Galois 1996; Picard and Desroches 2004; Figure 3). Currently, the species is estimated to occupy only 10% of its former range (Bonin and Galois 1996). In the Montérégie region (south-western Quebec), the species is thought to have been reduced to just over 800 highly fragmented sites within a narrow 20 km wide band between the municipalities of Beauharnois to the south and Contrecoeur to the north (Bonin and Galois 1996; COSEWIC 2008; Rioux 2008). The Western Chorus Frog recovery team in Quebec (WCFRTQ) determined that 14% of known breeding habitats were destroyed in this region over the 2004-2009 period (WCFRTQ 2010). The presence of the species is also confirmed in more than 220 sites[8] in the Outaouais region (western Quebec) along a 10 km wide and 100 km long band that stretches east to west along the Ottawa River between Gatineau and Île-du-Grand-Calumet (St-Hilaire and Belleau 2005; COSEWIC 2008). Between 2004 and 2009, 28% of known breeding habitats were destroyed in this region (WCFRTQ 2010). In 2009, the species occupied 102 km^2 of habitat (60 km^2 in the Montérégie region and 42 km^2 in the Outaouais region) (WCFRTQ 2010), an area in constant decline since.

[8] As a site may represent a single wetland or multiple wetlands, it is not possible to compare the number of sites in the Outaouais and Montérégie regions.

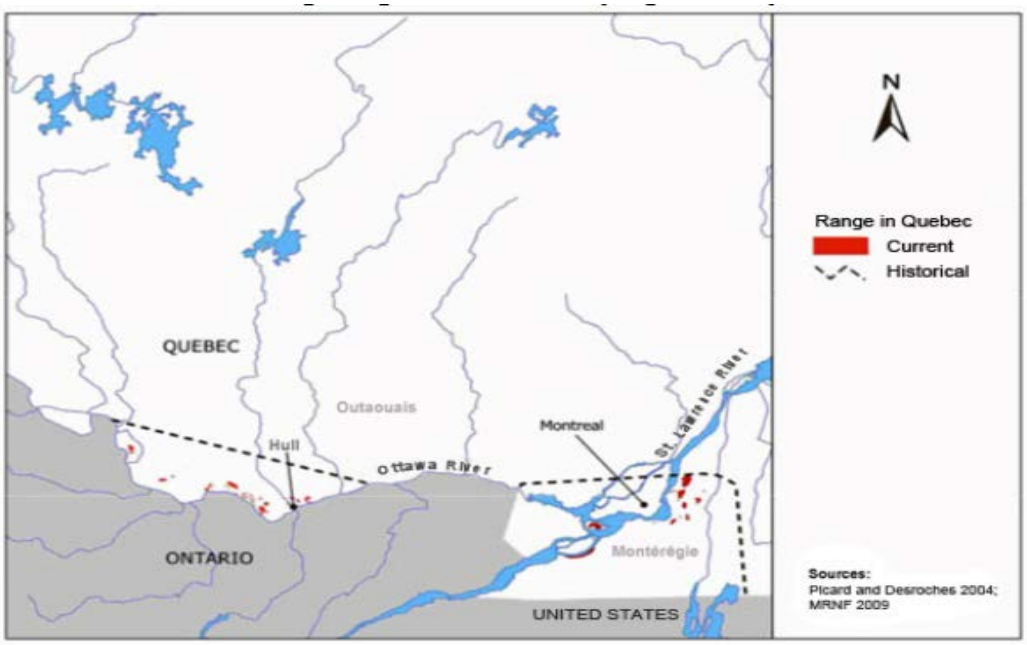

Figure 3. Historical and current ranges of the Western Chorus Frog (GLSLCS) in the Outaouais and Montérégie regions of Quebec (from Gagné 2010).

In Ontario, the Western Chorus Frog (GLSLCS) is much more widespread, extending from the United States border to Georgian Bay, south of Algonquin Park in the Frontenac Axis, and up the Ottawa Valley to Eganville (Oldham and Weller 2002). Few systematic surveys specific to the species and its habitat have been conducted in this province (Cook 1992; Schueler 2006; Schueler and Karstad 2012b); therefore, a complete estimate of the number of occupied sites is not available. An analysis of the Marsh Monitoring Program[9] data for the period of 1995–1996 to 2005–2006 however shows that the number of occupied sites in the Great Lakes and St. Lawrence River faunal province decreased by 42.6% in Ontario (Crewe *et al.* 2009 – supplement to the 2008 COSEWIC[10] status report). A few studies in eastern Ontario also report a decrease in the number of sites where the species has historically been present (a decline of 30% near Ottawa: Seburn and Gunson 2011; a decline of 95% near Cornwall: Seburn *et al.* 2008). These two studies were conducted in the urban/agricultural interface and illustrate the trend of loss of habitat due to housing developments in this type of context. They do not, however, take into account the fact that some adjacent breeding sites have since been colonized.

Western Chorus Frog surveys are based on auditory detections, which, for this species, cannot be used to determine population abundance trends since the number of individuals cannot be estimated in larger choruses (COSEWIC 2008). The abundance of Western Chorus Frog populations is therefore unknown. In addition to limitations related to the survey methodology, the identification of trends is complicated by the

[9] The Marsh Monitoring Program is a wildlife monitoring program for coastal and inland marshes based on the efforts of volunteers who collect data on marsh birds, habitat, frogs and toads. It should be noted that the permanent wetlands (e.g. marshes) monitored by this program are not the most representative of habitats used by the Western Chorus Frog and that reported trends should be interpreted accordingly.
[10] The data available at the time of preparation of the status report suggested a 30% decline (see Section 1).

temporary and therefore dynamic nature of occupied wetlands, large fluctuations in some populations due to climatic conditions and the possibility of cyclic variations in populations (Skelly *et al.* 2003; Crewe *et al.* 2009).

3.3 **Needs of the Western Chorus Frog (GLSLCS)**

The Western Chorus Frog (GLSLCS) occupies a variety of lowland habitats with an open or discontinuous canopy (e.g., clearings, damp meadows, fallow lands, shrublands), where slight depressions in topography allows the formation of wetlands (e.g., marshes, swamps, ponds) that generally dry out in summer (Ouellet and Leheurteux 2007). The vegetation in those habitats is mainly herbaceous (e.g., sedges [*Carex* spp.], cattails [*Typha* spp.], Reed Canary Grass [*Phalaris arundinacea*]), but also includes shrubs (e.g., Red Osier Dogwood [*Cornus stolonifera*], willows [*Salix* spp.], Speckled Alder [*Alnus incana ssp. rugosa*]) and partially submerged trees (e.g., Black Ash [*Fraxinus nigra*], Red Maple [*Acer rubrum*]).

Within the habitats occupied by the species, the home range[11] of an individual must provide for the specific needs of the various life cycle stages (breeding, foraging and movements, hibernation). Dispersal outside of individual home ranges is also an important element to maintain local populations and metapopulations[12] of the Western Chorus Frog.

Breeding

During the breeding period, individuals primarily occupy temporary wetlands (Bonin and Gallois 1996; Picard and Desroches 2004). This could be the result of a reduced predation pressure. Indeed, Skelly (1995, 1996) showed that the number, size and diversity of predators increased with the degree of permanence of a wetland. The reduced influence or absence of predators is also a characteristic of wetlands that are physically isolated from the hydrologic network.

In agricultural landscapes of the Outaouais region, St-Hilaire (2005) and Gagné (2011) found that breeding wetlands ranged from 0.01 to 6.12 ha (average 0.27 ha), 68% were not connected to a stream, and only 9% were within 50 m of a wetland large enough to be mapped by current geospatial tools. These statistics have not been compiled in Ontario or for the Montérégie region in Quebec but breeding wetlands are generally below 1 ha in the latter (Picard and Desroches 2004).

[11] The home range corresponds to the area where an animal lives and that is sufficient to meet its primary needs.

[12] Based on Levin's (1969) study, a metapopulation consists of several distinct populations (referred to as local populations in the present recovery strategy) and associated areas of suitable habitat (both occupied and unoccupied). Each population exists in relative independence of the other populations and may eventually go extinct as a consequence of random events (e.g., low population size, climatic factors such as droughts) - the smaller the population, the more prone it is to extinction. Although local populations may cycle through extant and extinct states, the metapopulation as a whole is often stable because immigrants from one local population (which may, for example, be expanding) are likely to re-colonize habitat which has been left open by the extinction of another local population. They may also emigrate to a depleted local population and prevent its extinction (a process called the rescue effect).

The temporary nature of breeding habitats increases the susceptibility to premature drying due to climate variations such as high temperatures, low precipitation or other causes such as altered drainage. This partly explains why large inter-annual fluctuations in abundance may occur in some populations. The persistence of local populations therefore depends on the availability of a sufficient number of wetlands having a hydroperiod (presence of water) sufficiently long to allow tadpoles to metamorphose into their adult form, even in drought years.

Foraging and movements within a local population

Foraging as well as other activities conducted in terrestrial habitats have been shown to generally occur within a 250 to 300 m radius of breeding wetlands (Desroches *et al.* 2002; Semlitsch and Bodie 2003; Ouellet and Leheurteux 2007). Indeed, Western Chorus Frogs (GLSLCS) have limited movement capabilities both in aquatic and terrestrial habitats, with a daily average of 3.5 m and a maximum of 42 m (Kramer 1973). In combination with their small size, these characteristics make individuals susceptible to dehydration when they cross drier environments (e.g., roads, agricultural fields; Picard and Desroches 2004; Whiting 2004; Mazerolle and Desrochers 2005). The type of habitat that surrounds and connects breeding wetlands therefore influences the distances traveled by an individual. Although home ranges can incorporate significant agricultural cover (up to 86% in Seburn *et al.* 2011) or urban land uses if biophysical attributes are suitable and available in sufficient amount to meet the species' needs, Gagné (2011) showed that occupied sites include less intensive annual crops (3% of the total area for occupied sites versus 8% of the total area for non-occupied sites) and more open, uncultivated land (31% of the total area for occupied sites versus 13% of the total area for non-occupied sites) within a 300 m radius around breeding sites.

Hibernation

Western Chorus Frogs hibernate in the terrestrial portion of their home range, in soft soil substrates, under rocks, dead trees or dead leaves or in existing burrows (Froom 1982). Although individuals are freeze-tolerant at subzero temperatures during hibernation (Storey 1990, Storey and Storey 1986, 1987), these biophysical attributes may help to reduce further their vulnerability to weather events.

Whiting's (2004) study in the Montérégie region indicates that almost all individuals hibernate less than 100 m from breeding wetlands, one possible reason being that proximity to such sites affords a reproductive advantage during the spring thaw.

Dispersal between local populations

Given that adults are thought to breed only once in their lifetime and that the mortality rate is high at all life-cycle stages (81% to 99% for adults: Smith 1987; Whiting 2004), the survival of each local population is dependent on annual recruitment of individuals through breeding (i.e. produced within the local population) and/or through immigration from adjacent local populations (long-distance dispersal).

In Western Chorus Frog populations, the genetic diversity found at the landscape scale suggests that dispersal can reach 750 m on occasion (Spencer 1964), although distances as far as 2.1 km have been suggested during years with higher average summer precipitation (Schueler and Karstad 2013). A limited number of immigration events are, however, sufficient to result in local populations remaining functionally connected, thereby acting as a metapopulation.

As is the case for movements within local populations, long-distance dispersal depends on connectivity and ease of movement across the habitats. Furthermore, maintaining dispersal corridors between local populations could allow individuals to adapt to pressures exerted by environmental conditions (e.g., recurring droughts, pollution, anoxic environment) by progressively moving to areas within or outside of their home range that may have more suitable biophysical attributes. As such, dispersal corridors are essential for a species that has limited movement capabilities and is confined to highly fragmented agricultural and urban landscapes.

4. THREATS

4.1 Threat Assessment

Table 1. Threat Assessment

Threat	Level of Concern[a]	Extent	Occurrence	Frequency	Severity[b]	Causal Certainty[c]
Habitat loss and degradation						
Urban development	High	Widespread	Current	Continuous	High	High
Intensification of agriculture	High	Widespread	Current	Continuous	High	High
Expansion and maintenance of linear infrastructures	Medium	Localized	Current	Continuous	Unknown	Unknown
Habitat succession	Medium	Localized	Current	Continuous	Unknown	Medium
Pollution						
Pesticides and fertilizers	Medium	Widespread	Current	Seasonal/ Continuous	Moderate	Medium
Climate and natural disasters						
Climate change	Medium/High	Widespread	Current	Continuous	Unknown	Unknown

[a] *Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table.*

[b] *Severity: reflects the population-level effect (high: very large population-level effect, moderate, low, unknown).*

[c] *Causal certainty: reflects the degree of evidence that is known for the threat (high: available evidence strongly links the threat to stresses on population viability; medium: there is a correlation between the threat and population viability e.g. expert opinion; low: the threat is assumed or plausible).*

4.2 **Description of Threats**

The threats described below are presented in order of decreasing level of concern.

Urban Development

A number of Western Chorus Frog (GLSLCS) populations occupy habitats that are highly sought after for residential, commercial and industrial development. The loss and degradation of suitable habitat resulting from these activities are presumably responsible for the bulk of the observed decline for this species (COSEWIC 2008; WCFRTQ 2010).

In the Boisé de la Commune in La Prairie (south shore of Montréal), one of the last remaining and most significant metapopulations for the species in Canada owing to its size, number of breeding wetlands, and large choruses, 44 of the 99 known breeding wetlands were destroyed by urban development over a very short period spanning from 2004 to 2009 (WCFRTQ 2010). Since then, the majority of the remaining wetlands have been either destroyed, degraded or are threatened. The same trend is observed on Île Perrot (west of Montréal), where infilling for residential development resulted in the destruction of 27 of the 80 breeding wetlands between 2004 and 2009, and where at least 14 other wetlands were threatened (WCFRTQ 2010). Many sites in western Quebec (Outaouais) and eastern Ontario show similar patterns of habitat destruction, particularly at the urban/agricultural interface (Sanders 1970; Seburn *et al.* 2008, 2011; WCFRTQ 2010; Schueler and Karstad 2012b).

The negative effects of urbanisation near suitable Western Chorus Frog habitats (hereafter referred to as edge effects) also include changes to hydrology caused by soil impermeability and drainage, increased sedimentation and pollution (including the deposit of waste), increased interactions with introduced animal and plant species or with native animals that benefit from contact with humans (e.g., raccoons), and effects on the local micro-climate (Hamer and McDonnell 2008). Collectively, these effects exert continuous pressures on habitats and individuals.

Urban development also leads to habitat fragmentation, which further isolates the local populations. The resulting decrease in immigration increases the likelihood of a local population becoming extinct (Hanski *et al.* 1995), namely by the absence of a rescue effect. In the longer term, there may also be a decrease in genetic diversity, in the survival rate of individuals (Hitchings and Beebee 1997) and in the capacity of the metapopulation to persist in time.

Intensification of Agriculture

Intensive agriculture has led to filling, draining (including through topographic levelling) and forest clearing in the St. Lawrence Lowlands, resulting in extensive habitat loss and degradation as well as reduced connectivity (COSEWIC 2008). The situation is particularly acute in the Montérégie region, where natural habitats only covered 33% of the landscape in 2001 (Latendresse *et al.* 2008) and where most Western Chorus Frog populations found in agricultural landscapes are surrounded by annual crops.

In the Outaouais region, half of the Western Chorus Frog populations are in agricultural landscapes (WCFRTQ 2010) and mostly on lands where soils are better suited for less-intensive agriculture (e.g., 86% of the fields are used to grow perennial crops; livestock; Jobin *et al.* 2004; also see Gagné 2011). Furthermore, the crop rotation cycle is generally longer (6 to 16 years) than the provincial average of 5 years (see Gagné 2011). Overall, this has resulted in fewer changes to natural drainage patterns and facilitated the maintenance of Western Chorus Frog local populations (Bonin and Galois 1996). High market prices for annual crops are however adding pressure to convert these fields to more intensive agriculture (Daniel Toussaint, personal communication).

There is less information that establishes a direct link between agricultural intensification and Western Chorus Frog (GLSLCS) populations in Ontario. In their Ottawa study, despite a 35% reduction in the occupancy of sites surveyed repeatedly since the 1970s, Seburn *et al.* (2011) observed no significant changes in land-use variables within a 1-km radius. On the other hand, east of Ottawa and north of Renfrew, Schueler and Karstad (2012b) found that the species had disappeared from large areas where the only apparent change in land use was agricultural intensification.

Climate Change

Climate change can impact Western Chorus Frog habitat by affecting the duration of flooding (hydroperiod) of the temporary ponds in which the species breeds. Indeed, reduced accumulations of snow, faster spring snowmelt, and prolonged periods of drought would cause ponds to dry up more quickly and reduce the breeding success of the Western Chorus Frog (Bonin and Galois 1996; Barnett *et al.* 2005). More generally, changes in weather patterns (precipitation, drought) can alter the population dynamics of a number of amphibian species, including the Western Chorus Frog (Walls *et al.* 2013). In a laboratory study, Amburgey *et al.* (2012) recently found that that the Boreal Chorus Frog has limited potential to adapt to reduced hydroperiods.

Among other effects, climate change could also influence vegetation structure and composition, including plant succession patterns (Blaustein *et al.* 2010) which may in turn affect Western Chorus Frogs. The magnitude of this threat, however, remains unknown.

Pesticides and Fertilizers

The toxic and mutagenic effects (e.g., deformities, feminization of males) of pesticides have been observed on many amphibian species, including Western Chorus Frogs, both in natural habitats (see Mazzacano and Black 2013) and in laboratory studies (Bishop 1992; Berril *et al.* 1997). Non-selective pesticides such as the neonicotinoids have also been shown to reduce insect prey populations (Colburn *et al*. 1993, Wickramasinghe *et al*. 2004; Mineau and Palmer 2013; Hallmann *et al.* 2014). Neonicotinoids are generally used on agricultural lands, but have been detected in adjoining wetlands (Main *et al.* 2014) and waterways in Canada (Environment Canada 2011; Xing *et al.* 2013). Mineau and Palmer (2013) suggested that the effects of neonicotinoids may not be limited to the farm scale, but likely expand to the watershed or regional scale. Although this conclusion was reached using bird data, it also likely applies to amphibians and implies that all life cycle stages in aquatic and terrestrial habitats could be affected.

The use of the insecticide BTi to control West Nile Virus is also increasing, owing to considerations related to public health and the comfort of urban residents. These pesticides have the potential to affect Western Chorus Frog local populations in or near urban areas.

Fertilizers also constitute a threat. In certain areas of intensive agriculture with few riparian buffer strips, the concentration of nitrates reaches levels recognized as problematic for the hatching and growth of amphibians, including the Western Chorus Frog (Hecnar 1995).

Expansion and Maintenance of Linear Infrastructures

The expansion of the network of linear infrastructures (e.g., roads, trails, right-of-ways) is a threat to the species throughout its range. In addition to resulting in direct mortality of individuals and the spread of invasive plant species, linear infrastructures can act as barriers to dispersal and thus contribute to habitat fragmentation (COSEWIC 2008). In Quebec, many breeding wetlands that became isolated because of anthropogenic structures were abandoned after a few years, despite the continued presence of suitable habitat (Picard and Desroches 2004). Maintenance of roadside ditches, utility and pipeline right-of-ways may also adversely affect individuals and render the habitat unsuitable (e.g., creating slopes that are too steep, drainage, stabilizing materials; WCFRTQ 2000). However, when conducted in the appropriate period and favouring the maintenance of suitable habitat conditions, the maintenance of infrastructures can contribute to the maintenance of local populations.

With respect to trails, frogs sometimes use puddles in ruts created by off-road vehicles. These ruts act as ecological traps because there is an increased risk that individuals will be crushed (Galois and Ouellet 2005). In some cases, these puddles could also dry up prematurely, thereby preventing the metamorphosis of tadpoles into adults. The magnitude of this threat remains unknown.

Habitat Succession

Although the Western Chorus Frog (GLSLCS) sometimes breeds in mature forests near hard edges, it prefers open habitats (Bonin and Galois 1996). When agriculture is abandoned on marginal land, succession towards more mature forests begins. This may affect the hydroperiod, particularly when shrubs or persistent residues left by dense cattails and Reed Canary Grass increase the time necessary to thaw the wetland and to raise their temperature (Skelly and Meir 1997; Whiting 2004). Such changes in some of the breeding sites appear to have caused the extirpation of some local populations of the Western Chorus Frog (GLSLCS) in Quebec and Ontario (Bonin and Galois 1996; Seburn and Gunson 2011; Schueler and Karstad 2014). The importance of this threat is unknown and may be site-specific.

5. POPULATION AND DISTRIBUTION OBJECTIVES

The population and distribution objectives for the Western Chorus Frog (GLSLCS) in Canada are:

- Over the short-term (2015-2025): maintain the areas of occupied suitable habitat as well as the breeding population level within each local population and, where a metapopulation is present, maintain the connectivity among the local populations constituting the metapopulation.
- Over the long-term (2015-2035): ensure the viability of each local population and of metapopulations, where present, by increasing the areas of occupied suitable habitat, the breeding population level within each local population, as well as the connectivity among the local populations constituting a metapopulation. Also, where technically and biologically feasible, restore historical or extirpated local populations or create new habitats.

These objectives address the species' long-term decline, which was the reason for its designation as Threatened (COSEWIC 2008). The 10-year time frame for the short term objectives corresponds to the period between successive COSEWIC assessments of a species' status and is considered reasonable given the challenge of simply maintaining the areas of occupied suitable habitat that the current number of Western Chorus Frog local populations represents. As for the long term objectives, ensuring that all local populations and metapopulations are viable is necessary given the substantial losses already sustained, the continued pressures affecting the species and its habitats and its sensitivity to climatic events.

The objectives of the federal recovery strategy are in line with those of the provincial *Recovery plan and Action plan for the Western Chorus Frog in Quebec* (WCFRTQ 2000; update in prep.), which are to maintain the remaining suitable habitat, restore degraded habitat and create new habitat or structures (e.g., amphibian crossings) to promote the viability of local populations by increasing their abundance and connectivity. There is no equivalent document for the province of Ontario since the species is not listed under the Ontario *Endangered Species Act, 2007*.

These objectives may be reviewed during the development of the report required five years after this strategy is posted to assess the implementation of the strategy and the progress towards meeting its objectives (SARA s. 46).

6. BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Currently Underway

- Multiple projects targeting the Western Chorus Frog on federal, provincial and private lands with funding from the Habitat Stewardship Program for Species at Risk, the Interdepartmental Recovery Fund and the Aboriginal Fund for Species at Risk.
- Small-scale restoration and creation of wetlands for Western Chorus Frogs, including reintroduction of individuals (e.g., Cook 1992 in Ontario; Lyne Bouthillier 2001 in Quebec).

<u>Quebec</u>

- Targeted surveys (1993–2014 in the Outaouais region; 1992–2014 in the Montérégie region) and a survey of all known breeding wetlands in 2004–2005 and 2014 (Picard and Desroches 2004); volunteer surveys through the Marsh Monitoring Program (since 2004).
- Creation of the Western Chorus Frog recovery team (1998).
- Publication of a provincial recovery plan in 2000 and the 1999–2009 recovery assessment report (WCFRTQ 2000, 2010).
- Publication and implementation of 11 regional conservation plans (Bouthillier and Léveillé 2002; Centre d'information sur l'environnement de Longueuil and WCFRTQ 2006; Angers *et al.* 2007, 2008a, b, c, d, e, f, g; Bernard 2010; Gagné 2010; Tanguay *et al.* 2012).
- Publication and implementation of a standardized population monitoring protocol (Daigle *et al.* 2011)
- Publication of a protocol for the creation of temporary wetlands (Montpetit *et al.* 2010).
- Completion of a number of studies on habitat requirements and genetic characterization of populations (Ouellet and Leheurteux 1997; Whiting 2004; Rogic *et al*., 2015).
- *Ex situ* breeding program at the Montréal Biodôme and the Ecomuseum from 2008 to 2014.
- Outreach activities for landowners, farmers, municipalities, residents and students and the signing of stewardship agreements since the early 2000s.
- Signing of a biodiversity conservation agreement between the provincial government and Hydro-Québec (2001).
- Preservation of significant habitats (e.g., Boisé du Tremblay, which is home to about 25% of Western Chorus Frogs in the Montérégie region; Bois de Brossard, ~ 530 ha; Bois de Boucherville, ~ 188 ha; Breckenridge).

Ontario

- First International Conference on Northeastern populations of Pseudacris triseriata, Kemptville, Ontario, March 2001.
- Population monitoring through the Marsh Monitoring Program (since 1994)
- Collection of information on amphibians through Frogwatch Ontario (amphibian monitoring project).
- Targeted surveys in southern Ontario in 1992, 2006 and 2012 (Cook 1992; Schueler 2006; Schueler and Karstad 2012b).
- The Ontario Herpetofaunal Summary Atlas made it possible to collect information on various amphibian and reptile sightings throughout Ontario (also see Oldham and Weller 2000).
- The new Ontario Reptile and Amphibian Atlas has improved knowledge of the distribution and status of various species through the collection of information on known sightings throughout the province, the implementation of field surveys and the amalgamation of existing databases.

6.2 Strategic Direction for Recovery

Table 2: Recovery Planning for the Western Chorus Frog (GLSLCS)

Threat or Limiting Factor	Broad Recovery Strategy	Priority[d]	General Description of Research and Management Approaches
Urban development; Intensification of agriculture; Pesticides and fertilizers; Expansion and maintenance of linear infrastructures; Plant succession	Stewardship and management of the species and its suitable habitat	High	– Implement legal or stewardship measures in suitable habitat and in adjacent areas to reduce the impact of threats – Support the development and implementation of Beneficial Management Practices (BMP) at the local and landscape levels to increase population size, the areas of occupied habitat and connectivity – Restore or create habitats to promote the recolonization (natural or via the reintroduction of individuals) of portions of the historical range and increase connectivity between local populations
		Medium	– Integrate BMPs for Chorus Frogs with BMPs for other wildlife
Knowledge gaps	Surveys and monitoring	High	– Implement a standardized monitoring protocol for Ontario and Quebec – Conduct periodic surveys (e.g., every 10 years) to clarify the area occupied by the GLSLCS population, determine population trends, and monitor threats
		Medium	– Share up to date information relating to populations and their habitats
		Low	– Conduct a periodic survey of the historical range, including in alvars, prairies, and other open areas where the species might have lived before agricultural expansion

Threat or Limiting Factor	Broad Recovery Strategy	Priority[d]	General Description of Research and Management Approaches
Knowledge gaps; Pesticides and fertilizers; Climate change; Plant succession	Research	Medium	– Clarify the range boundary, degree of hybridization and population dynamics of *P. maculata* and *P. triseriata* in southern Ontario – Specify the attributes of habitat and how individuals react to variations in these attributes in space and time (i.e. the species' ecology) – Determine population viability criteria – Develop, validate or improve metapopulation models (e.g., to inform environmental impact assessments) – Monitor and model the impact of climate change on the hydroperiod of breeding wetlands – Examine the effects of pesticides, particularly neonicotinoids, at all life cycle stages (aquatic and terrestrial)
All threats	Communication and Partnerships	High	– Establish partnerships with governmental departments and agencies, conservation organizations, aboriginal communities, private landowners and the public to implement a training/ outreach/ restoration/ reintroduction program – Examine the possibility of creating of a North American working group
All threats	Law and Policy	High	– Promote the compliance with existing environmental laws, regulations and policies to prevent breaches and offenses for all types of activities on all types of land tenures

[d] *"Priority" reflects the degree to which the approach contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.*

7. CRITICAL HABITAT

7.1 Identification of the Western Chorus Frog (GLSLCS)'s Critical Habitat

SARA defines critical habitat as "the habitat that is necessary for the survival or recovery of a listed wildlife species." For the Western Chorus Frog (GLSLCS), critical habitat is partially identified in this recovery strategy to the extent possible using the best available information. The schedule of studies (Section 7.2) outlines the activities required to complete the identification of critical habitat to meet the population and distribution objectives. As new information becomes available, more precise boundaries may be established and additional critical habitat may be identified.

The identification of critical habitat for the Western Chorus Frog (GLSLCS) is based on two criteria: habitat occupancy and habitat suitability.

7.1.1 Habitat Occupancy

This criterion refers to the geographic locations where there is a reasonable degree of certainty of recurrent use by the species (an indicator of breeding habitat and adjacent terrestrial habitat suitability) and of their contribution to the dispersal of individuals between adjacent local populations (an indicator of sustained metapopulation processes).

Habitat occupancy is established by selecting the data obtained from point counts conducted during the breeding period and other records:

- dating from the year 1992 or later;
  AND
- covering at least two separate years within a 20-year period, with at least 1 of the records dating from the last decade.

The period starting in 1992 corresponds to the first systematic surveys of breeding wetlands in Quebec (1992–1993), but also to the threshold beyond which a record is considered historical in conservation data centres (i.e. 20 years for the Ontario Natural Heritage Information Centre (NHIC) and the Centre de données sur le patrimoine naturel du Québec (CDPNQ)). Owing to the dynamic nature of Western Chorus Frog (GLSLCS) habitat, incorporating a more recent record as part of the habitat occupancy criteria also increases the confidence that the suitable habitat is still available.

The data used to identify critical habitat in the present recovery strategy are inclusively from 1992 to 2011 in Ontario and from 1992 to 2012 in Quebec.

7.1.2. Habitat Suitability

This criterion refers to the biophysical attributes of habitats where individuals can meet the needs associated with the various stages of their life cycle (e.g. mating, egg-laying, tadpole metamorphosis, foraging, hibernation, dispersal) in Canada (see Table 3). For aquatic stages, all areas of suitable breeding wetlands up to 300 m from a record are considered critical habitat. For terrestrial stages, all areas of suitable habitat are incorporated up to 300 m from the boundaries of critical habitat for aquatic stages to allow for the completion of the species' annual life cycle (Desroches *et al.* 2002; Semlitsch and Bodie 2003; Ouellet and Leheurteux 2007).

To maintain connectivity between local populations and sustain the processes essential for the persistence of metapopulations, the present recovery strategy also includes dispersal habitats as part of the critical habitat. They correspond to the areas of suitable habitat up to 300 m from any dispersal habitat type (table 3) connecting two breeding wetlands that meet the habitat occupancy criteria and that are separated by a maximum distance of 900 m. This is three times the average maximum distance travelled by the species within its annual life cycle and is suggested by NatureServe (2002) as a precautionary value for linking habitats together on the basis of individuals' movements. It is also in the same range as the 750 m distance for long-distance dispersal reported by Spencer (1964) and within the maximum dispersal distance of 2.1 km suggested by Schueler and Karstad (2013). Until more information is known about local habitat use by the species, dispersal habitat identified as critical habitat is bounded by minimum convex polygons encompassing local populations that form a metapopulation. These polygons are based on the known dispersal distances provided above and are referred to as critical habitat units.

Table 3. Description of the Biophysical Attributes of Suitable Habitat for the Life Cycle Stages of the Western Chorus Frog (GLSLCS).

Habitat Type and Life-cycle Stages	Biophysical Attributes
Wetlands (e.g., ponds, basins/potholes, marshes, swamps, and including drainage ditches) **Life cycle stages** Breeding; Dispersal between local populations	• Temporary wetlands[e] or shallow portions of permanent wetlands **AND** • Vegetation structure and composition: generally herbaceous (e.g., cattails, sedges, Reed Canary Grass) with occasional shrubs (e.g., Speckled Alder, Red Osier Dogwood, willows) or partially submerged trees (e.g. Black Ash, Red Maple) forming an open or discontinuous canopy, although some local populations breed at the edge of closed-canopy habitats (e.g., Silver Maple swamps) **AND** • Absence or limited presence of fish or other aquatic predators
Terrestrial (e.g., lowlands such as pastures, clearings, meadows, fallow lands, shrublands) **Life cycle stages** Hibernation; Foraging and movements within a local population; Dispersal between local populations	• Vegetation structure and composition correspond to those of breeding wetlands • (Hibernation only) Availability of soft substrate with dead leaves, woody debris or burrows

[e] This type of habitat, largely used by the Western Chorus Frog (GLSLCS), is not mapped in an accurate or consistent way in current land-use classification frameworks because of limitations due to minimum mappable units (e.g., occupied wetlands are often very small), discernibility of elements (e.g., difficulty of detecting suitable features under tree canopies or shrubs), or frequency of updating the data (e.g., hydroperiod variability from year to year results in occupied habitat not always being static in space).

7.1.3. Application of the Critical Habitat Criteria

Critical habitat for the Western Chorus Frog (GLSLCS) is partially identified in this recovery strategy because data were inadequate (e.g. poor spatial accuracy, only one year of information) to proceed with critical habitat identification at some known local populations and because unsurveyed local populations could exist in the Canadian Shield faunal province. Critical habitat corresponds to the areas of suitable habitat within polygons combining breeding wetlands that have been used on at least 2 occasions within a 20-year period (including at least once in the past 10 years), adjacent terrestrial habitats, and the dispersal habitats that connect them that meet the criteria set out in section 7.1.2. A total of 267 critical habitat units covering approximately 33,693 ha are identified, including 218 units in Ontario (17,418 ha) and 49 units in Quebec (16,275 ha).

In Appendix A, tables A-1 and A-2 and figures A-1 to A-7 present the 10 km x 10 km standardized UTM grid (red outlines) and the critical habitat units (yellow polygons) for the Western Chorus Frog (GLSLCS) in Canada. The 10 km x 10 km standardized UTM grid indicates the general geographic area containing critical habitat and can be used for various purposes, including land-use planning and environmental assessment. To respect provincial data-sharing agreements, detailed polygon information (in yellow in the figures for Quebec's critical habitat) is not provided in Ontario figures. However, this information is available and may be requested on a need-to-know basis by contacting Environment Canada – Canadian Wildlife Service at: RecoveryPlanning_PI@ec.gc.ca

Although individuals may only occupy a small portion of suitable habitat within a critical habitat unit at any given time, the entire suitable habitat complex within the unit is identified as critical habitat. This consideration is particularly important given that the locations of local populations have been observed to shift over a relatively short period of time and that the data used to map critical habitat provide only a snapshot of the situation in time (Nathalie Tessier, 2013, personal communication). It also takes into account the fact that physical barriers (e.g., housing developments, highways) adjacent to breeding wetlands result in home ranges of varying sizes and shapes. Lastly, it provides the necessary space to restore or create habitats within or between neighbouring local populations, thereby eventually increasing the area of occupied habitat and connectivity.

Any anthropogenic structures (e.g., houses, paved surfaces) and any areas (e.g. drained agricultural fields, sewage treatment/settling ponds) that do not have the characteristics of suitable habitat for the Western Chorus Frog (GLSLCS) are not identified as critical habitat. Any significant disruption in the continuity of the habitat that results in a dispersal barrier (e.g., multi-lane highway, large watercourse) would be considered a boundary edge for critical habitat in that site (i.e. two separate critical habitat units would result if the habitat occupancy criteria are still met).

7.2 Schedule of Studies to Identify Critical Habitat

Table 4: Schedule of studies.

Description of the Activity	Rationale	Schedule
Conduct surveys in and/or obtain data for areas known to support a local population but where additional information is required (e.g., locations containing poor spatial accuracy of information, or only one year of information; locations which only partly meet the critical habitat identification criteria)	Addition of critical habitat units with the goal of representing each local population (i.e. reach the short-term population and distribution objectives)	2015–2025
Conduct surveys in the Canadian Shield faunal province to clarify the distribution of Chorus Frogs and to identify the northern boundary for including observations in critical habitat identification for the Western Chorus Frog (GLSLCS)	Addition of critical habitat units with the goal of representing each local population (i.e. reach the short-term population and distribution objectives)	2015-2025
Monitor and evaluate use of created or restored habitats by Western Chorus Frogs	Addition of critical habitat units to reach the long-term population and distribution objectives	2015–2035

7.3 Activities Likely to Result in the 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. Activities described in Table 5 are examples of those likely to cause destruction of critical habitat for the species; however, destructive activities are not necessarily limited to those listed. It should be noted that some activities that would result in the destruction of critical habitat if conducted during the breeding season can also contribute to the maintenance of suitable habitat conditions in the long term (e.g., by keeping the breeding habitats open).

Table 5. Examples of Activities Likely to Result in the Destruction of Critical Habitat for the Western Chorus Frog (GLSLCS).

Description of Activity	Description of Effect	Details of Effect
Construction and maintenance of linear infrastructures (e.g., roads, trails, pipelines, energy corridors)	Loss or degradation of suitable habitat for all life stages (e.g., removal of vegetation cover all the way to the ground, conversion to paved surfaces); changes to the habitat resulting in barriers to dispersal (e.g., steep slopes, multi-lane roads, concrete lane dividers, inhospitable dispersal surfaces); dumping of snow containing minerals (e.g. salts) that affect water quality; changes to the habitat from edge effects and increased recreational use of habitat	Applicable at all times if the effect is permanent (e.g., paving). If conducted outside the period when individuals are using the targeted biophysical attributes and in a manner that does not prevent future use, the maintenance of linear infrastructures (e.g. cutting shrubs under power lines) may not be considered habitat destruction
Construction of housing units and other urban infrastructures (e.g., commercial and industrial buildings, playgrounds)	Loss or degradation of suitable habitat for all life-cycle stages (e.g., filling of wetlands; removal of vegetation used for foraging); changes to the habitat resulting in barriers to dispersal; changes to the habitat from edge effects and increased recreational use of habitat	Applicable at all times
Reshaping (levelling and/or filling), drainage or channelization of wetlands (temporary and permanent)	Loss or degradation of suitable breeding habitat (e.g., draining of adjacent areas leading to drop in the water table level, increased water depth, steep slopes); connecting a predator-free wetland to a fish habitat (e.g., via drainage ditches) resulting in the introduction of predators	Applicable at all times
Intensification of agricultural practices	Loss or degradation of suitable habitat for all life-cycle stages (e.g., conversion from perennial to annual crops; reduced foraging opportunities through the removal of vegetation); changes to the habitat resulting in barriers to dispersal; reduced water quality and prey availability (aquatic and terrestrial) owing to increased runoff of pesticides and fertilizers into adjacent habitats	Applicable at all times

8. MEASURING PROGRESS

The performance indicators presented below provide a way to define and measure progress in achieving the population and distribution objectives.

- Over the short-term (2015-2025): the areas of occupied suitable habitat, the breeding population level within each local population and, where a metapopulation is present, the connectivity among the local populations constituting the metapopulation is maintained.
- Over the long-term (2015-2035): the viability of each local population and, where present, of metapopulations is ensured by increasing the areas of occupied suitable habitat, the breeding population level within each local population, as well as the connectivity among the local populations constituting a metapopulation. Where technically and biologically feasible, historical or extirpated local populations have been restored and new habitats have been created.

The year of reference for measures of progress related to Western Chorus Frog habitat components (areas, connectivity) is 2012, the last year of data used to for the identification of critical habitat in the present version of the recovery strategy. The year of reference for breeding population level and local population viability corresponds to the most recent year in which a local population was surveyed at the moment of critical habitat identification in the present version of the recovery strategy (2012 or before).

9. STATEMENT ON ACTION PLANS

One or more action plans for the Western Chorus Frog (GLSLCS) will be posted on the Species at Risk Public Registry by the end of 2020.

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Appendix A. Critical Habitat for the Western Chorus Frog (GLSLCS)

Table A-1. 10 km x 10 km standardized UTM grid squares containing critical habitat for the Western Chorus Frog (GLSLCS) in Quebec. Critical habitat occurs where the criteria described in Section 7.1 are met.

10 km ×10 km UTM Grid Square ID[f]	UTM Grid Square Coordinates[g]		Number of Critical Habitat Unit Centroids within the UTM Gride Square[h]	Total Critical Habitat Unit Area (ha) within the UTM GridSquare[i]	Land Tenure[j]
	Easting	Northing			
18WR60	560000	5000000	0	41	Other Federal Land/ Non-federalLand
18WR70	570000	5000000	1	1,727	Other Federal Land / Non-federal Land
18WR71	570000	5010000	0	1	Other Federal Land / Non-federal Land
18WR72	570000	5020000	0	7	Non-federal Land
18WR80	580000	5000000	0	201	Other Federal Land / Non-federal Land
18WR81	580000	5010000	2	758	Other Federal Land / Non-federal Land
18WR82	580000	5020000	3	1,610	Non-federal Land
18XR12	610000	5020000	1	627	Non-federal Land
18XR14	610000	5040000	1	38	Non-federal Land
18XR22	620000	5020000	0	865	Non-federal Land
18XR23	620000	5030000	2	1,135	Non-federal Land
18XR24	620000	5040000	3	1,569	Non-federal Land
18XR25	620000	5050000	1	1,381	Non-federal Land
18XR33	630000	5030000	1	140	Non-federal Land
18XR34	630000	5040000	1	344	Other Federal Land / Non-federal Land
18XR37	630000	5070000	1	101	Other Federal Land / Non-federal Land
18VR04	400000	5040000	2	475	Other Federal Land / Non-federal Land
18VR13	410000	5030000	0	13	Non-federal Land
18VR14	410000	5040000	4	1,205	Other Federal Land / Non-federal Land

10 km ×10 km UTM Grid Square ID[f]	UTM Grid Square Coordinates[g]		Number of Critical Habitat Unit Centroids within the UTM Gride Square[h]	Total Critical Habitat Unit Area (ha) within the UTM GridSquare[i]	Land Tenure[j]
	Easting	Northing			
18VR22	420000	5020000	0	13	Non-federal Land
18VR23	420000	5030000	8	915	Other Federal Land / Non-federal Land
18VR24	420000	5040000	1	166	Other Federal Land / Non-federal Land
18VR32	430000	5020000	1	34	Non-federal Land
18VR33	430000	5030000	2	693	Other Federal Land / Non-federal Land
18VR43	440000	5030000	5	465	Other Federal Land / Non-federal Land
18VR53	450000	5030000	3	557	Non-federal Land
18UR66	360000	5060000	0	84	Non-federal Land
18UR76	370000	5060000	2	411	Non-federal Land
18UR84	380000	5040000	2	496	Non-federal Land
18UR94	390000	5040000	0	6	Non-federal Land
18UR95	390000	5050000	2	197	Other Federal Land / Non-federal Land
		Total	**49**	**16,275**	

[f] Square ID is based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098), where the first two digits represent the UTM Zone, the following two letters indicate the 100 km x 100 km standardized UTM grid, and the final two digits represent the 10 km x 10 km standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology used for the Breeding Bird Atlases of Canada (see http://www.bsc-eoc.org/ for more information on breeding bird atlases).

[g] The listed coordinates represent the southwest corner of the 10 km x 10 km standardized UTM grid containing all or a portion of the critical habitat unit. The coordinates may not fall within critical habitat and are provided as a general location only.

[h] A value of "0" means the grid square contains a portion of (a) critical habitat unit(s) but not the parcel centroid.

[i] The area presented corresponds to the sum of critical habitat units falling within the UTM square (rounded up to the nearest 1 ha). It is an approximation obtained by incorporating 300 m of wetland and terrestrial habitats (suitable or not) around each observation meeting the habitat occupancy criteria (Section 7.1.1.). The actual area of critical habitat may be much less, depending on where the criteria for critical habitat are met (see Section 7.1). Field verification may be required to determine the precise area of critical habitat.

[j] Land tenure is provided as an approximation of the types of land ownership that exist within the critical habitat units and should be used for guidance purposes only. Accurate land tenure will require cross-referencing critical habitat boundaries with surveyed land parcel information.

Figures of the
Western Chorus Frog (GLSLCS) Critical Habitat in Quebec

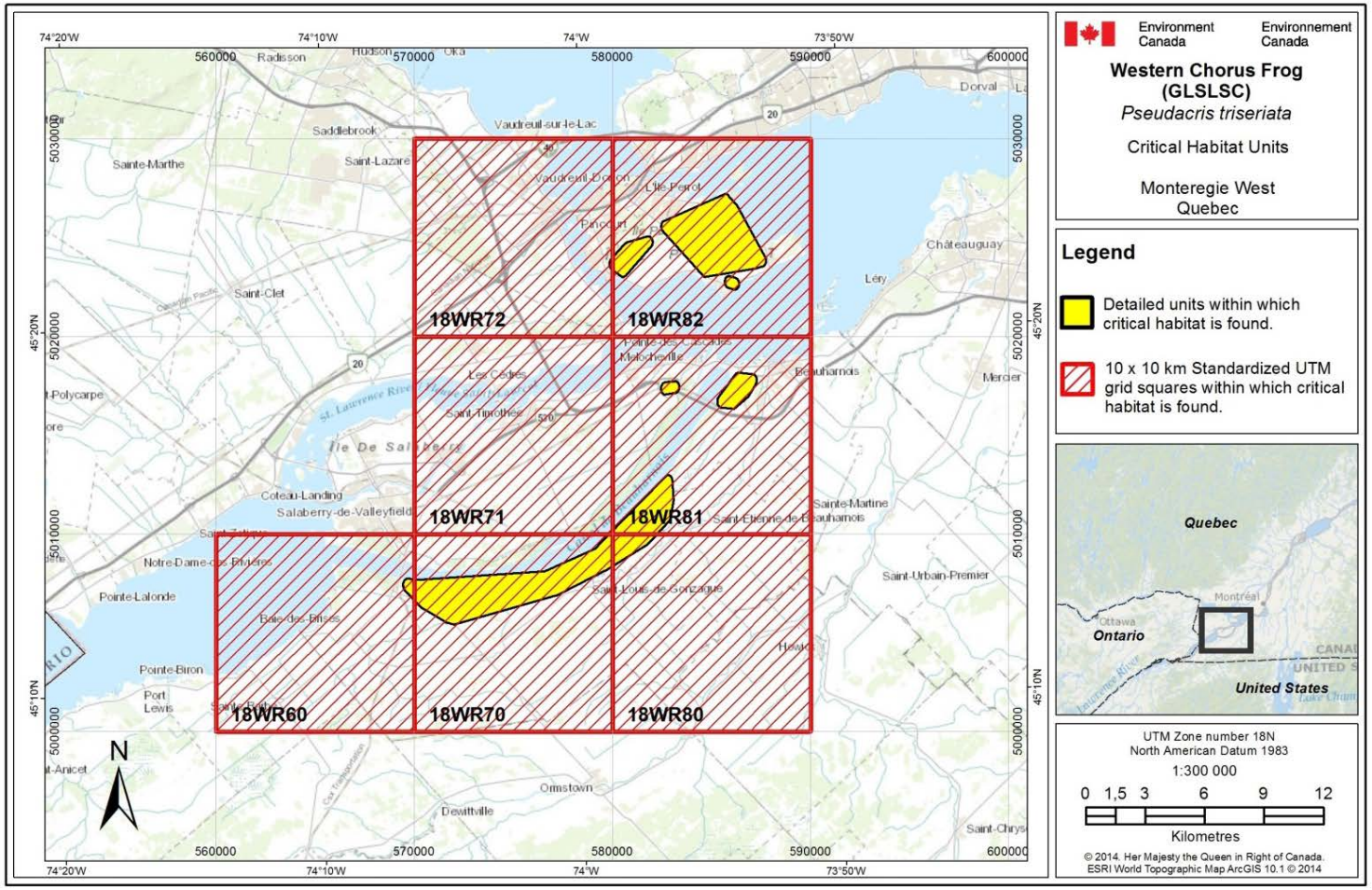

Figure A-1. Critical habitat for the Western Chorus Frog (GLSLCS) in the Montérégie West region of Quebec occurs within the 10 km x 10 km UTM grids (red outline) and critical habitat units (yellow polygons), where the criteria set out in Section 7.1 are met. The standardized national grid system indicates the general geographic area containing critical habitat.

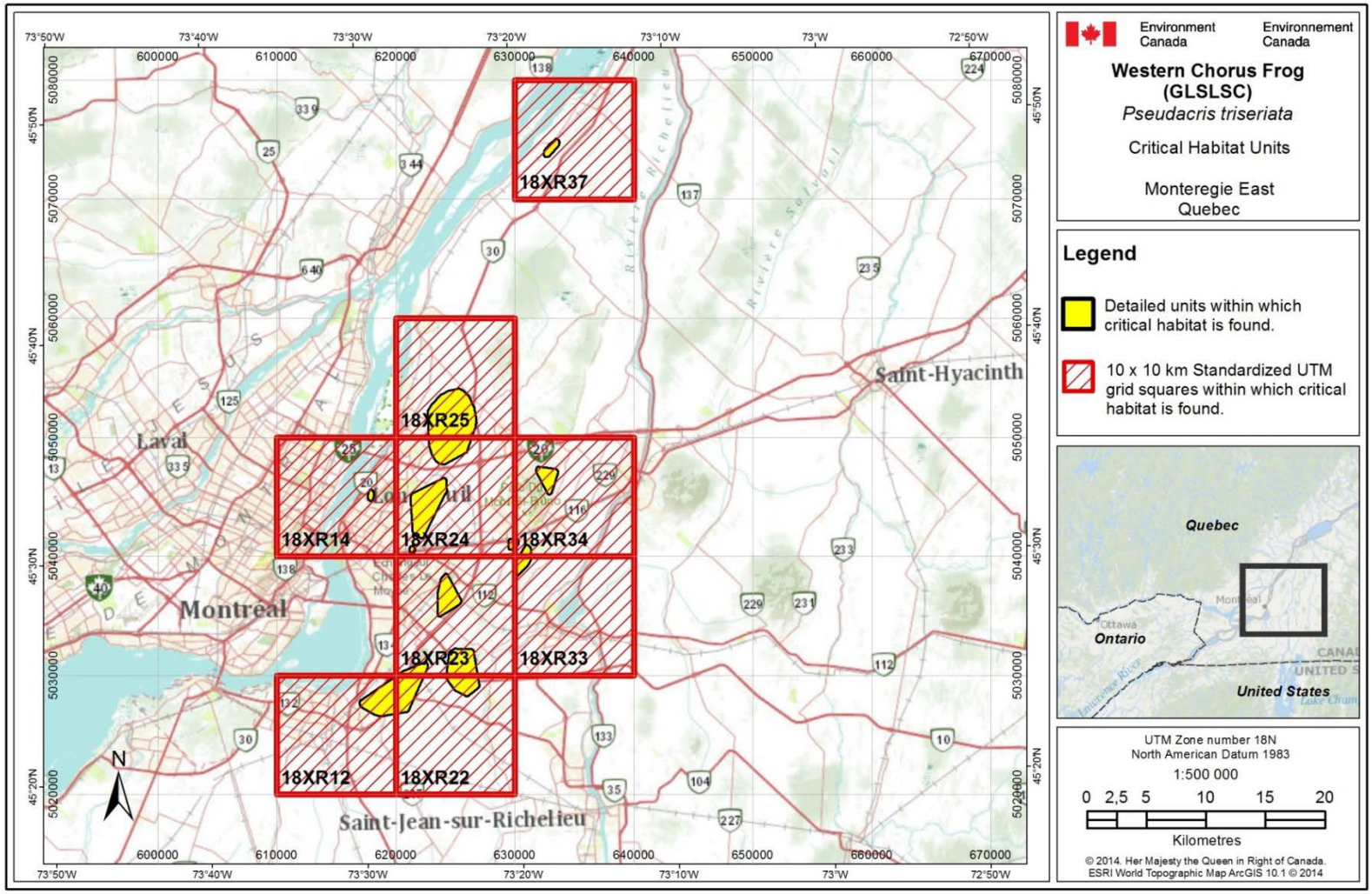

Figure A-2. Critical habitat for the Western Chorus Frog (GLSLCS) in the Montérégie East region of Quebec occurs within the 10 km x 10 km UTM grids (red outline) and critical habitat units (yellow polygons), where the criteria set out in Section 7.1 are met. The standardized national grid system indicates the general geographic area containing critical habitat.

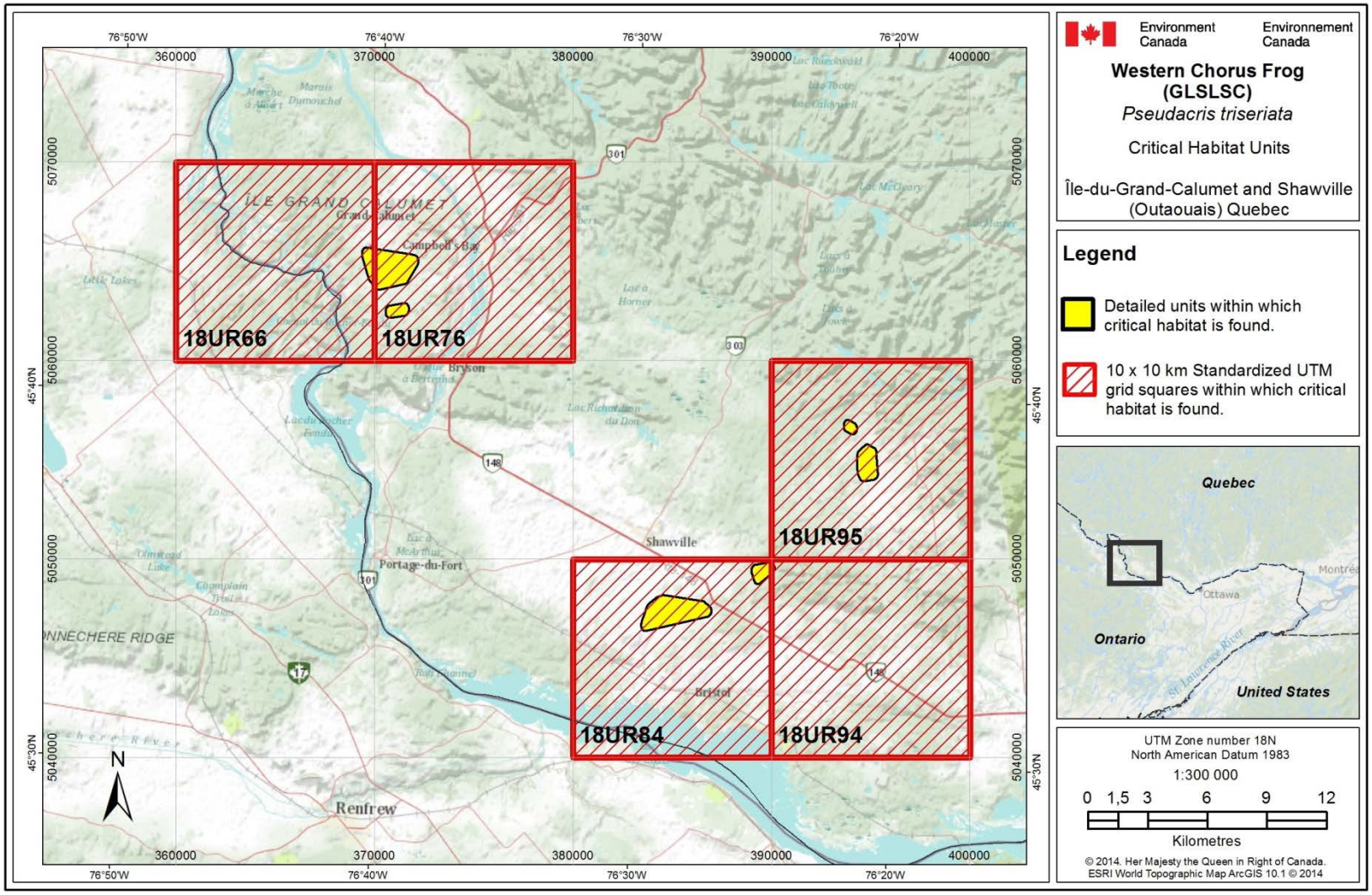

Figure A-3. Critical habitat for the Western Chorus Frog (GLSLCS) in the Île-du-Grand-Calumet and Shawville regions of Quebec occurs within the 10 km x 10 km UTM grids (red outline) and critical habitat units (yellow polygons), where the criteria set out in Section 7.1 are met. The standardized national grid system indicates the general geographic area containing critical habitat.

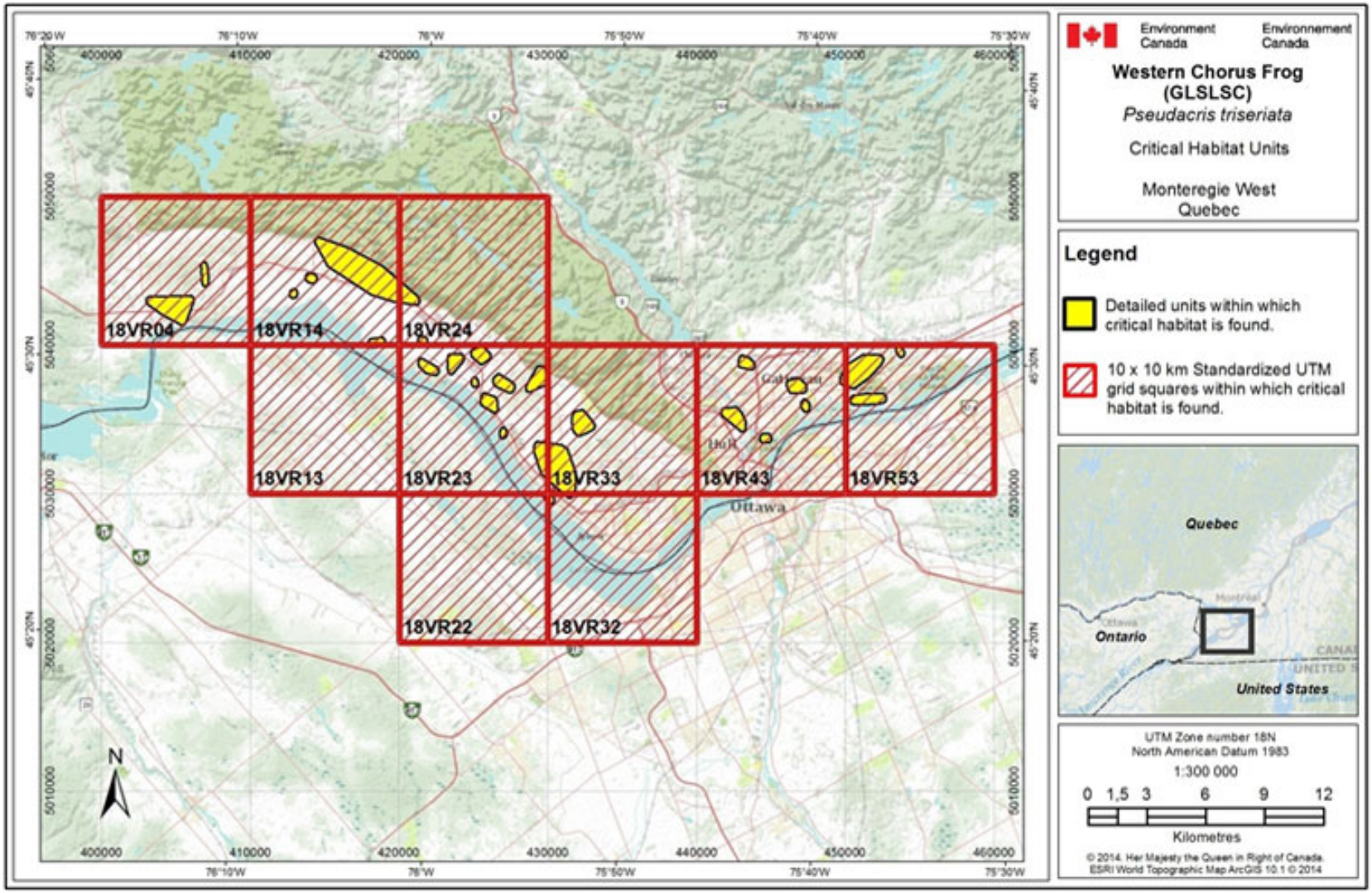

Figure A-4. Critical habitat for the Western Chorus Frog (GLSLCS) in the Gatineau (Outaouais) region of Quebec occurs within the 10 km x 10 km UTM grids (red outline) and critical habitat units (yellow polygons), where the criteria set out in Section 7.1 are met. The standardized national grid system indicates the general geographic area containing critical habitat.

Table A-2. 10 km x 10 km standardized UTM grid squares containing critical habitat for the Western Chorus Frog (GLSLCS) in Ontario. Critical habitat occurs where the criteria described in Section 7.1 are met.

10 km x 10 km UTM Grid Square ID[k]	UTM Grid Square Coordinates[l]		Number of Critical Habitat Unit Centroids within the UTM Grid Square[m]	Total Critical Habitat Unit Area (ha) within the UTM Grid Square[n]	Land Tenure[o]
	Easting	Northing			
17LM82	380000	5120000	1	29	Non-federal Land
17MH37	430000	4770000	1	30	Non-federal Land
17MH39	430000	4790000	1	35	Non-federal Land
17MH65	460000	4750000	1	39	Non-federal Land
17MH76	470000	4760000	1	30	Non-federal Land
17MH85	480000	4750000	1	30	Non-federal Land
17MJ63	460000	4830000	1	30	Non-federal Land
17NH46	540000	4760000	2	64	Non-federal Land
17NH56	550000	4760000	1	26	Non-federal Land
17NH57	550000	4770000	1	49	Non-federal Land
17NH58	550000	4780000	1	30	Non-federal Land
17NH59	550000	4790000	2	60	Non-federal Land
17NH89	580000	4790000	1	208	Non-federal Land
17NH99	590000	4790000	1	56	Non-federal Land
17NJ41	540000	4810000	1	30	Non-federal Land
17NJ51	550000	4810000	1	30	Non-federal Land
17NJ52	550000	4820000	1	30	Non-federal Land
17NJ62	560000	4820000	2	60	Non-federal Land
17NJ71	570000	4810000	1	43	Non-federal Land
17NJ81	580000	4810000	2	60	Non-federal Land
17NJ90	590000	4800000	0	9	Non-federal Land
17NJ91	590000	4810000	2	325	Non-federal Land
17NK12	510000	4920000	1	29	Non-federal Land
17PJ01	600000	4810000	0	15	Non-federal Land
17PJ04	600000	4840000	1	344	Non-federal Land
17PJ05	600000	4850000	1	1023	Non-federal Land
17PJ06	600000	4860000	1	66	Non-federal Land

10 km x 10 km UTM Grid Square ID[k]	UTM Grid Square Coordinates[l]		Number of Critical Habitat Unit Centroids within the UTM Grid Square[m]	Total Critical Habitat Unit Area (ha) within the UTM Grid Square[n]	Land Tenure[o]
	Easting	Northing			
17PJ07	600000	4870000	1	45	Non-federal Land
17PJ11	610000	4810000	1	46	Non-federal Land
17PJ13	610000	4830000	0	22	Non-federal Land
17PJ14	610000	4840000	1	57	Non-federal Land
17PJ15	610000	4850000	2	85	Non-federal Land
17PJ28	620000	4880000	1	44	Non-federal Land
17PJ47	640000	4870000	2	180	Non-federal Land
17PJ59	650000	4890000	1	37	Non-federal Land
17PJ68	660000	4880000	1	29	Non-federal Land
17PJ69	660000	4890000	0	7	Non-federal Land
17PK36	630000	4960000	1	29	Non-federal Land
17PK41	640000	4910000	1	29	Non-federal Land
17PK49	640000	4990000	1	29	Non-federal Land
17PK50	650000	4900000	0	22	Non-federal Land
17PK52	650000	4920000	1	29	Non-federal Land
17PK60	660000	4900000	4	181	Non-federal Land
17PK88	680000	4980000	1	29	Non-federal Land
17QJ17	710000	4870000	1	29	Non-federal Land
17QJ19	710000	4890000	1	29	Non-federal Land
17QJ39	730000	4890000	1	29	Other Federal Land
17QK02	700000	4920000	4	518	Other Federal Land / Non-federal Land
17QK03	700000	4930000	5	1365	Other Federal Land / Non-federal Land
17QK04	700000	4940000	2	423	Non-federal Land
17QK06	700000	4960000	2	148	Non-federal Land
17QK11	710000	4910000	4	693	Other Federal Land / Non-federal Land
17QK13	710000	4930000	3	304	Other Federal Land / Non-federal Land
17QK15	710000	4950000	1	66	Non-federal Land
17QK20	720000	4900000	1	135	Non-federal Land
17QK21	720000	4910000	4	535	Non-federal Land

10 km x 10 km UTM Grid Square ID[k]	UTM Grid Square Coordinates[l]		Number of Critical Habitat Unit Centroids within the UTM Grid Square[m]	Total Critical Habitat Unit Area (ha) within the UTM Grid Square[n]	Land Tenure[o]
	Easting	Northing			
17QK22	720000	4920000	5	562	Non-federal Land
17QK23	720000	4930000	4	427	Other Federal Land / Non-federal Land
17QK24	720000	4940000	1	121	Non-federal Land
17QK30	730000	4900000	2	85	Non-federal Land
17QK31	730000	4910000	6	809	Non-federal Land
17QK32	730000	4920000	0	64	Non-federal Land
17QK33	730000	4930000	3	162	Non-federal Land
17QK34	730000	4940000	1	211	Non-federal Land
17QK35	730000	4950000	1	180	Non-federal Land
18TP87	280000	4870000	2	179	Non-federal Land
18TP96	290000	4860000	0	14	Non-federal Land
18TP97	290000	4870000	1	29	Federal Protected Area (Wellers Bay National Wildlife Area) / Other Federal Land / Non-federal Land
18TP98	290000	4880000	1	30	Other Federal Land / Non-federal Land
18TQ61	260705	4910000	1	71	Non-federal Land
18TQ63	261440	4930000	2	195	Non-federal Land
18TQ72	270000	4920000	3	208	Non-federal Land
18TQ74	270000	4940000	2	171	Other Federal Land / Non-federal Land
18TQ75	270000	4950000	1	359	Other Federal Land / Non-federal Land
18TQ80	280000	4900000	1	29	Other Federal Land / Non-federal Land
18TQ91	290000	4910000	1	29	Non-federal Land
18UP06	300000	4860000	1	16	Non-federal Land
18UP08	300000	4880000	2	68	Non-federal Land
18UP16	310000	4860000	1	29	Non-federal Land
18UP18	310000	4880000	4	190	Non-federal Land
18UP19	310000	4890000	2	112	Non-federal Land
18UP28	320000	4880000	1	29	Non-federal Land
18UP36	330000	4860000	2	64	Non-federal Land

10 km x 10 km UTM Grid Square ID[k]	UTM Grid Square Coordinates[l]		Number of Critical Habitat Unit Centroids within the UTM Grid Square[m]	Total Critical Habitat Unit Area (ha) within the UTM Grid Square[n]	Land Tenure[o]
	Easting	Northing			
18UP37	330000	4870000	1	25	Non-federal Land
18UP39	330000	4890000	1	29	Non-federal Land
18UP46	340000	4860000	1	29	Non-federal Land
18UP49	340000	4890000	1	29	Non-federal Land
18UP59	350000	4890000	1	29	Non-federal Land
18UP69	360000	4890000	1	29	Non-federal Land
18UP79	370000	4890000	1	82	Other Federal Land / Non-federal Land
18UQ00	300000	4900000	1	29	Non-federal Land
18UQ02	300000	4920000	1	29	Non-federal Land
18UQ03	300000	4930000	1	29	Non-federal Land
18UQ10	310000	4900000	1	29	Non-federal Land
18UQ30	330000	4900000	1	25	Non-federal Land
18UQ31	330000	4910000	0	4	Non-federal Land
18UQ36	330000	4960000	1	29	Non-federal Land
18UQ55	350000	4950000	1	29	Non-federal Land
18UQ60	360000	4900000	0	1	Non-federal Land
18UQ61	360000	4910000	1	28	Non-federal Land
18UQ70	370000	4900000	4	175	Non-federal Land
18UQ86	380000	4960000	1	29	Non-federal Land
18UQ87	380000	4970000	2	214	Non-federal Land
18UQ91	390000	4910000	1	25	Non-federal Land
18UQ92	390000	4920000	0	5	Non-federal Land
18UR90	390000	5000000	1	75	Non-federal Land
18UR93	390000	5030000	1	29	Non-federal Land
18VQ00	400000	4900000	1	36	Federal Protected Area (Thousand Islands National Park) / Non-federal Land
18VQ01	400000	4910000	0	4	Non-federal Land
18VQ10	410000	4900000	0	4	Non-federal Land
18VQ11	410000	4910000	1	188	Non-federal Land

10 km x 10 km UTM Grid Square ID[k]	UTM Grid Square Coordinates[l]		Number of Critical Habitat Unit Centroids within the UTM Grid Square[m]	Total Critical Habitat Unit Area (ha) within the UTM Grid Square[n]	Land Tenure[o]
	Easting	Northing			
18VQ17	410000	4970000	1	31	Other Federal Land / Non-federal Land
18VQ21	420000	4910000	3	272	Federal Protected Area (Thousand Islands National Park) / Non-federal Land
18VQ23	420000	4930000	1	29	Non-federal Land
18VQ28	420000	4980000	1	48	Non-federal Land
18VQ29	420000	4990000	0	65	Non-federal Land
18VQ31	430000	4910000	1	29	Federal Protected Area (Thousand Islands National Park) / Non-federal Land
18VQ32	430000	4920000	4	382	Federal Protected Area (Thousand Islands National Park) / Non-federal Land
18VQ34	430000	4940000	4	299	Non-federal Land
18VQ35	430000	4950000	6	328	Non-federal Land
18VQ36	430000	4960000	2	58	Non-federal Land
18VQ37	430000	4970000	3	257	Non-federal Land
18VQ38	430000	4980000	3	298	Non-federal Land
18VQ39	430000	4990000	0	1	Non-federal Land
18VQ43	440000	4930000	1	32	Non-federal Land
18VQ44	440000	4940000	2	105	Non-federal Land
18VQ46	440000	4960000	6	364	Non-federal Land
18VQ47	440000	4970000	5	272	Non-federal Land
18VQ48	440000	4980000	1	45	Non-federal Land
18VQ57	450000	4970000	1	169	Non-federal Land
18VQ65	460000	4950000	1	29	Non-federal Land
18VQ67	460000	4970000	1	29	Non-federal Land
18VQ97	490000	4970000	1	30	Non-federal Land
18VQ98	490000	4980000	0	7	Non-federal Land
18VR01	400000	5010000	1	103	Non-federal Land
18VR03	400000	5030000	2	90	Non-federal Land
18VR10	410000	5000000	3	133	Non-federal Land

10 km x 10 km UTM Grid Square ID[k]	UTM Grid Square Coordinates[l]		Number of Critical Habitat Unit Centroids within the UTM Grid Square[m]	Total Critical Habitat Unit Area (ha) within the UTM Grid Square[n]	Land Tenure[o]
	Easting	Northing			
18VR11	410000	5010000	1	77	Non-federal Land
18VR31	430000	5010000	1	69	Other Federal Land / Non-federal Land
18WQ09	500000	4990000	1	73	Non-federal Land
18WR15	510000	5050000	1	29	Non-federal Land
		Total	**218**	**17,418 ha**	

[k] Square ID is based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098), where the first two digits represent the UTM Zone, the following two letters indicate the 100 km x 100 km standardized UTM grid, and the final two digits represent the 10 km x 10 km standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology used for the Breeding Bird Atlases of Canada (see http://www.bsc-eoc.org/ for more information on breeding bird atlases).

[l] The listed coordinates represent the southwest corner of the 10 km x 10 km standardized UTM grid containing all or a portion of the critical habitat unit. The coordinates may not fall within critical habitat and are provided as a general location only.

[m] A value of "0" means the grid square contains a portion of (a) critical habitat unit(s) but not the parcel centroid.

[n] The area presented corresponds to the sum of critical habitat units falling within the UTM square (rounded up to the nearest 1 ha). It is an approximation obtained by incorporating 300 m of wetland and terrestrial habitats (suitable or not) around each observation meeting the habitat occupancy criteria (Section 7.1.1). The actual area of critical habitat may be much less depending on where the criteria for critical habitat are met (see Section 7.1). Field verification may be required to determine the precise area of critical habitat.

[o] Land tenure is provided as an approximation of the types of land ownership that exist within the critical habitat units and should be used for guidance purposes only. Accurate land tenure will require cross-referencing critical habitat boundaries with surveyed land parcel information.

Figures of the
Western Chorus Frog (GLSLCS) Critical Habitat in Ontario

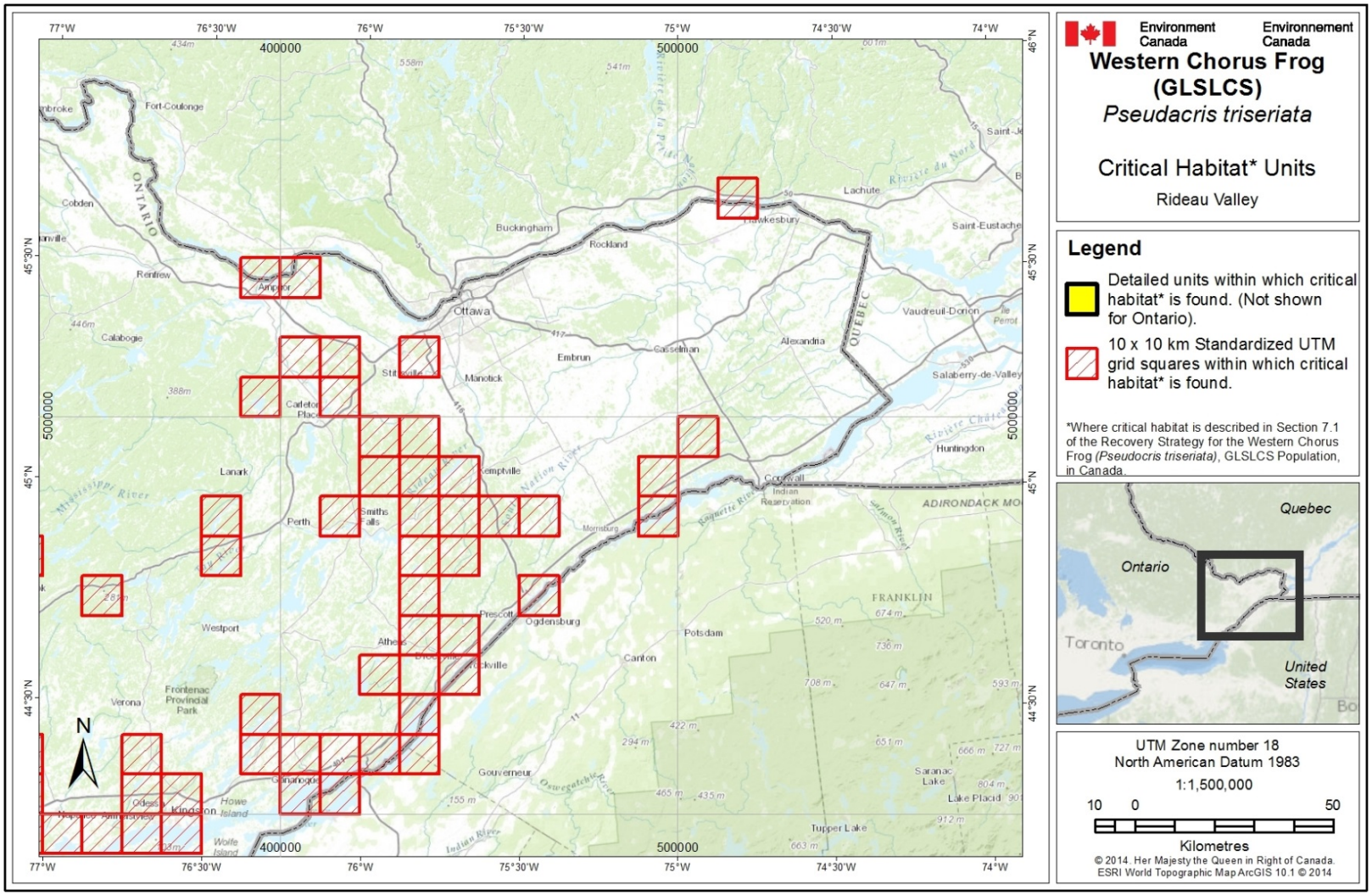

Figure A-5. Critical habitat for the Western Chorus Frog (GLSLCS) in the Rideau Valley, Ontario occurs within the 10 km x 10 km UTM grids indicated (red outline), where the criteria set out in Section 7.1 are met. This standardized national grid system indicates the general geographic area containing critical habitat; detailed critical habitat mapping is not shown.

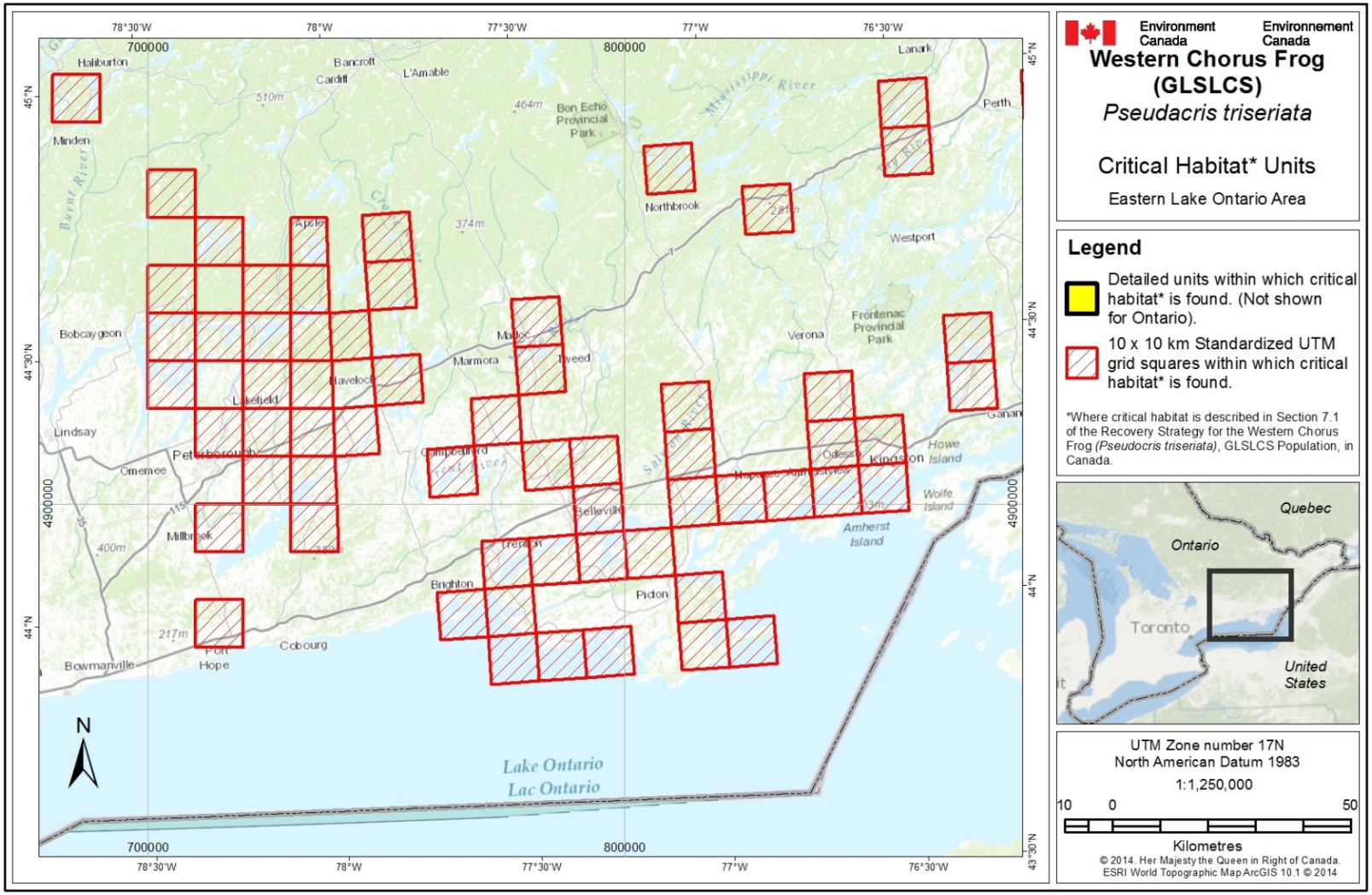

Figure A-6. Critical habitat for the Western Chorus Frog (GLSLCS) in the Eastern Lake Ontario Area, Ontario occurs within the 10 km x 10 km UTM grids indicated (red outline), where the criteria set out in Section 7.1 are met. This standardized national grid system indicates the general geographic area containing critical habitat; detailed critical habitat mapping is not shown.

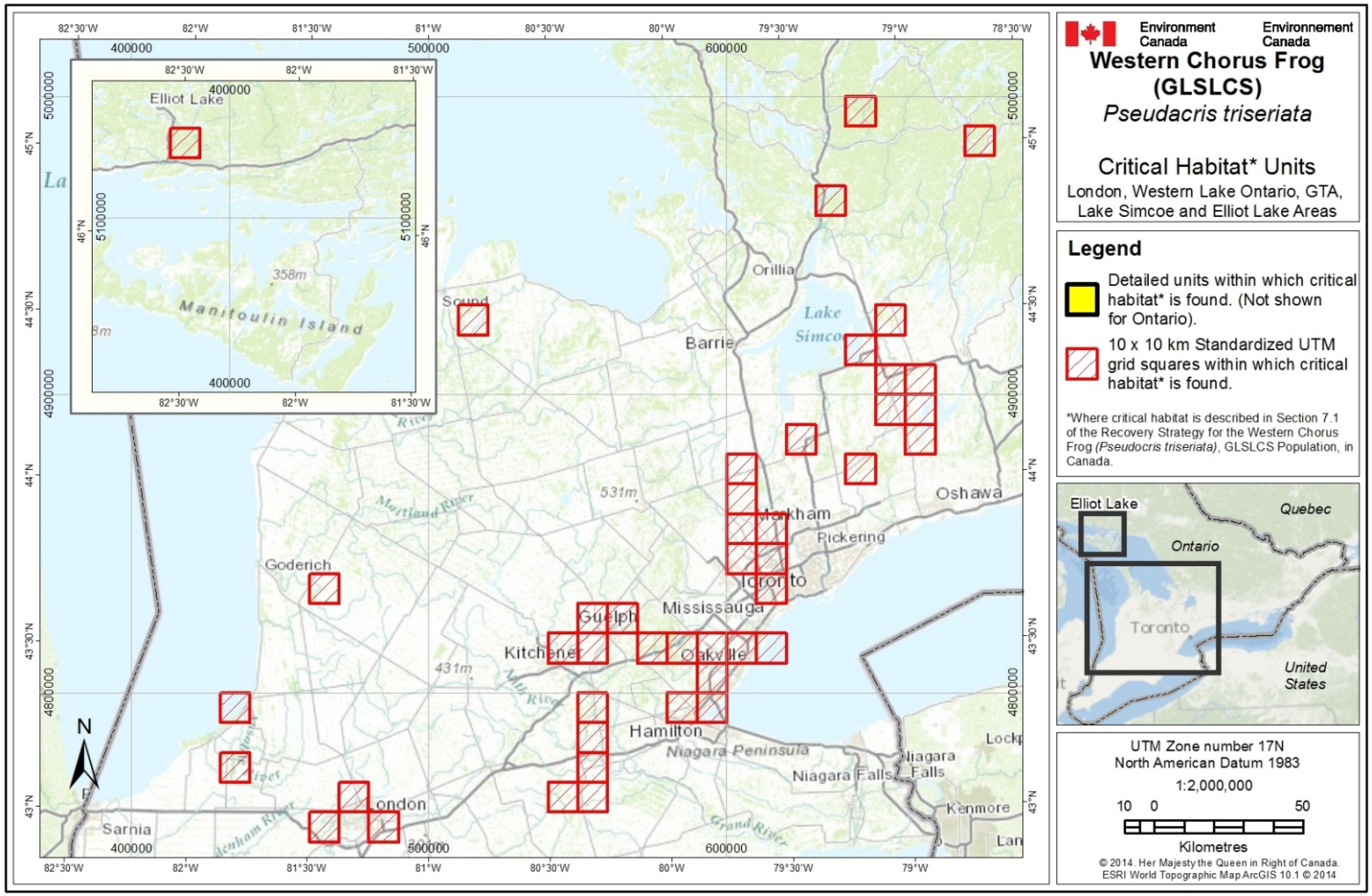

Figure A-7. Critical habitat for the Western Chorus Frog (GLSLCS) in the London, Western Lake Ontario, Greater Toronto Area (GTA), Lake Simcoe and Elliot Lake areas, Ontario occurs within the 10 km x 10 km UTM grids indicated (red outline), where the criteria set out in Section 7.1 are met. This standardized national grid system indicates the general geographic area containing critical habitat; detailed critical habitat mapping is not shown.

APPENDIX B: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

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*[13]. 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 determine whether the outcomes of a recovery planning document could affect any component of the environment or any of the goals or targets in the Federal Sustainable Development Strategy's[14] (FSDS).

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.

A number of amphibian and reptile species are likely to benefit from conservation efforts for the Western Chorus Frog, including the Grey Treefrog (*Hyla versicolor*), Northern Spring Peeper (*Pseudacris crucifer*), Green Frog (*Lithobates clamitans melanota*), Leopard Frog (*Lithobates pipiens*) and American Toad (*Anaxyrus americanus*). In permanent marshes, the Least Bittern (*Ixobrychus exilis*), King Rail (*Rallus elegans*), Blanding's Turtle (*Emydoidea blandingii*) and Snapping Turtle (*Chelydra serpentina*) may also share similar habitats. No adverse effects on other species or the environment are anticipated.

[13] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[14] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1