PROPOSED

Species at Risk Act
Recovery Strategy Series
Adopted under Section 44 of SARA

Recovery Strategy for the Western Painted Turtle (*Chrysemys picta bellii*) Pacific Coast population in Canada

Western Painted Turtle Pacific Coast population

2018

Government of Canada
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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[1].

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[1] http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1

RECOVERY STRATEGY FOR THE WESTERN PAINTED TURTLE (*Chrysemys picta bellii*) PACIFIC COAST POPULATION IN CANADA

2018

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 Painted Turtle - Pacific Coast Population (*Chrysemys picta *pop. 1) 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 Western Painted Turtle Pacific Coast population in Canada consists of two parts:

Part 1 – Federal Addition to the *Recovery Plan for the Painted Turtle - Pacific Coast Population (*Chrysemys picta *pop. 1) in British Columbia*, prepared by Environment and Climate Change Canada.

Part 2 – *Recovery Plan for the Painted Turtle - Pacific Coast Population (*Chrysemys picta *pop. 1) in British Columbia*, prepared by the Western Painted Turtle Recovery Team for the British Columbia Ministry of Environment.

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Part 2 – *Recovery Plan for the Painted Turtle - Pacific Coast Population (*Chrysemys picta *pop. 1) in British Columbia*, prepared by the Western Painted Turtle Recovery Team for the British Columbia Ministry of Environment.

Part 1 – Federal Addition to the *Recovery Plan for the Painted Turtle - Pacific Coast Population (*Chrysemys picta *pop. 1) 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)[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 after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Western Painted Turtle Pacific Coast population 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 (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, the Parks Canada Agency, and Fisheries and Oceans 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, the Parks Canada Agency, Fisheries and Oceans Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Western Painted Turtle Pacific Coast population 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 Canada, the Parks Canada Agency, Fisheries and Oceans Canada, and 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.

[2] http://registrelep-sararegistry.gc.ca/default.asp?lang=En&n=6B319869-1%20

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area[3] 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.

Acknowledgments

Development of this recovery strategy was coordinated by Matt Huntley, Kella Sadler, and Eric Gross (Environment and Climate Change Canada, Canadian Wildlife Service – Pacific Region (ECCC CWS-PAC)). Marie-Andrée Carrière and Véronique Brondex (ECCC CWS-National Capital Region), Kym Welstead, Connie Miller Retzer, and Trudy Chatwin (British Columbia Ministry of Forests, Lands and Natural Resources Operations), Excedera St. Louis and Leah Westereng (British Columbia Ministry of Environment) provided helpful editorial advice and comment. Clayton Crawford (ECCC CWS-PAC) provided additional assistance with mapping and figure preparation.

[3] 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 the Painted Turtle - Pacific Coast Population (*Chrysemys picta *pop. 1) in British Columbia* (Part 2 of this document, referred to henceforth as "the provincial recovery plan") and/or to provide updated or additional information.

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

The Canadian range of Western Painted Turtle (*Chrysemys picta bellii*) occurs in three disjunct populations as described in section 3.2.1 of the provincial recovery plan. The Pacific Coast population is restricted to the southwestern Pacific Coast (Lower Fraser Valley, Sunshine Coast, and Texada, Vancouver, and Saltspring islands) of British Columbia (B.C.). The Intermountain-Rocky Mountain population is restricted to the southern interior of B.C. and the Prairie/Western Boreal-Canadian Shield population occurs across Alberta, Saskatchewan, Manitoba, and Ontario (COSEWIC 2006). All references to "Western Painted Turtle" in this document imply the "Western Painted Turtle Pacific Coast population", wherever population name is not specifically stated.

1.1 Species Population and Distribution

This section replaces the information summary for known populations[4] of Western Painted Turtle in Canada (Table 4 in Appendix 1 of the provincial recovery plan).

The information summary below (Table 1) describes the updated distribution of populations in Canada, all occurring in southwestern British Columbia. Since publication of the provincial recovery plan, additional occurrences have been reported (Engelstoft 2016; Welstead pers. comm. 2016) comprising five new population units: Nathan Creek (#42) in the Fraser Valley area, Alberni Summit – Summit Lake (#41), Comox Valley – Maple Lake (#40), Chemainus – Chemainus Lake (#38), and Cobble Hill – Koksilah River (#39) on Vancouver Island. Morrell Lake has been reported as a new site in Nanaimo (#33)(Engelstoft 2016). Summit Lake is a new elevational record for the population (382 m; Engelstoft 2016).

[4] Population designations were based on the grouping of sites where it is reasonable for the species to move among sites using a separation distance of 3 km as per Natureserve (2016).

There are currently 41 recorded Western Painted Turtle population units. Environment and Climate Change Canada considers 40 of these populations to be extant. Although population unit #6 (Cultus Lake) is described as extant in the provincial recovery plan, the specific date and location details are unknown, and it is characterized as "historical" by BC CDC (2016). No Western Painted Turtles have been confirmed at this location and it is unknown if the habitat at this site is suitable for restoration and/or reintroduction efforts. Population unit #23 (Pender Island-Greenburn Lake) is not included in the population summary (Table 1) because the observed turtles to date from this location have only been identified as individuals from the Eastern Painted Turtle subspecies (*Chrysemys picta picta;* Engelstoft pers. comm. 2016, Ovaska pers. comm. 2016).

Table 1. Summary of the population units of Western Painted Turtle in Canada as of 2017. Population unit numbers (Pop. Unit #), population unit names, and sites align with those included in the provincial recovery plan where relevant; additional new populations/sites are denoted by an asterisk (*). Last observation (Last Obs.) and status are shown for each site.

Pop. Unit #	Population Unit	Site	Last Obs.	Status[a]
Lower Fraser Valley				
1	Alaksen Wildlife Refuge	Alaksen Wildlife Refuge	2013	extant
2	Aldergrove Lake	Aldergrove Lake	2015	extant
3	Burnaby / Deer Lakes	Burnaby Lake	2016	extant
		Deer Lake	2016	extant
4	Campbell Valley / Livingstone Lake	Campbell Valley Regional Park-McLean Pond	2015	extant
		Livingstone Lake/Murchie Road	2016	extant
5	Coquitlam	Lost Lake, Mundy Park	2016	extant
		Como Lake	2010	extant
		Colony Farm	2016	extant
		Lafarge Lake	2013	extant
		Como Creek	2010	extant
6	Cultus Lake	Cultus Lake	unknown	unknown
7	Great Blue Heron Nature Reserve	Great Blue Heron Nature Reserve	2015	extant
8	Iona[b]	Iona Beach	2012	extant
9	Jerry Sulina	Jerry Sulina	2007	extant
10	Kanaka Creek	Haney Bypass and Kanaka Creek area	2015	extant
11	Lakemount Marsh	Lakemount Marsh	2007	extant
12	Lost Lagoon / Stanley Park	Lost Lagoon	2015	extant
13	Marshall Creek	Marshall Creek	2011	extant
14	Mill Lake	Mill Lake	2015	extant
15	Minnekhada / Pitt-Addington	Deboville Slough/McLean Creek	2015	extant
		Minnekhada Regional	2011	extant

Pop. Unit #	Population Unit	Site	Last Obs.	Status[a]
		Park		
		Pitt-Addington Marsh	2015	extant
16	Nicomen Slough	Nicomen Slough	2016	extant
17	Queen Elizabeth Park	Queen Elizabeth Park	2013	extant
18	Sardis Pond	Sardis Pond	2012	extant
19	Silvermere Lake	Silvermere Lake	2011	extant
20	Vicarro Ranch	Vicarro Ranch Estates, McKee Creek Watershed	2015	extant
21	Westcreek Wetland	Westcreek Wetland	2015	extant
42*	Nathan Creek	Nathan Creek	2016	extant
Capital Regional District, Vancouver Island				
22	Langford / Saanich	Florence Lake	2015	extant
		Langford Lake	2014	extant
		Glen Lake	2011	extant
		Swan Lake	2012	extant
		Maltby Lake	2006	extant
		Beaver/Elk Lakes / Beaver Ponds	2016	extant
		Eagles Lake	2013	extant
		Adam Kerr Park	2010	extant
		McKenzie Lake	2008	extant
		Metchosin Road Ponds	2009	extant
		Olympic View Golf Course	2015	extant
24	Rocky Point	Rocky Point Road	2012	extant
		Matheson Lake	2011	extant
25	Sooke	Kemp Lake	2010	extant
Alberni Valley, Nanaimo, and Gulf Islands[c]				
26	South Saltspring Island	Fulford Valley	2011	extant
		Cusheon Lake	2010	extant
		Stowel Lake	2011	extant
		Isabella Point	2008	extant
		Mountain Road	2011	extant
27	North Saltspring Island	Bullock Lake	2010	extant
		St. Mary's Lake	2010	extant
33	Nanaimo	Buttertubs Marsh	2016	extant
		Diver Lake	2015	extant
		*Morrell Lake	2015	extant
35	South Alberni	Somers Lake[d]	2015	extant
		Devil's Den Lake	2015	extant
		McKenzie Slough, Stamp River	2011	extant

Pop. Unit #	Population Unit	Site	Last Obs.	Status[a]
		Airport Wetlands	2015	extant
		Little Turtle Lake	2015	extant
		Patterson Lake	2009	extant
36	North Alberni	McLaughlin Lake	2014	extant
		Turnbull Lake	2014	extant
38*	Chemainus	Chemainus Lake	2015	extant
39*	Cobble Hill	Koksilah River	2015	extant
40*	Comox Valley	Maple Lake	2015	extant
41*	Alberni Summit	Summit Lake	2015	extant
Sunshine Coast and Texada Island				
28	Garden Bay / Ruby Lake	Daniel Point Wetland	2011	extant
		Hotel Lake	2011	extant
		Garden Bay Lake	2011	extant
		Mixal Lake and wetland	2011	extant
		Katherine Lake	2011	extant
		Sakinaw Lake	2011	extant
		Iris Griffith Centre wetland	2011	extant
		Ruby Lake	2011	extant
		Little Goose Lake	2011	extant
		Brown Lake	2011	extant
		Ruby Lake Lagoon	2011	extant
		Klein Lake	2011	extant
		North Lake	2011	extant
29	Cranberry Lake	Cranberry Lake	2012	extant
30	Dogleg Pond	Dogleg Pond	2011	extant
31	Madeira Park	Francis Point Pond 1	2009	extant
		Francis Point Pond 2	2010	extant
		Lily (Paq) Lake	2011	extant
32	Trout Lake/Halfmoon Bay	Trout Lake	2011	extant
34	Nelson Island	West Lake	2016	extant
		Cockburn Bay Pond	2016	extant
37	Texada Island	Emily (Turtle) Lake	2016	extant
		Priest Lake	2016	extant
		Case Lake	2016	extant
		Cap Sheaf Lake	2011	extant

[a] Western Painted Turtle populations are marked as “extant” where a record has been verified within the last 40 years.

[b] Recently (in July 2016) a Western Painted Turtle observation was recorded at Lynas Morey Channel at Richmond, B.C., which may be connected to the Iona population unit (K. Welstead pers. comm. 2017); however the record is vague and the area is highly suburbanized.

[c] Population #23 (Pender Island-Greenburn Lake) is not included in this summary because Western Painted Turtles have not been confirmed as this location. Observed turtles to date were identified as individuals from the Eastern Painted Turtle subspecies (*Chrysemys picta picta*).

[d] Somers Lake recently has been verified (Engelstoft 2016) and is no longer considered historical (see Appendix 1 in the provincial recovery plan).

The overall abundance of the Western Painted Turtle Pacific Coast population in Canada is unknown, but it is thought to be ~3000 adults (COSEWIC in press). The Canadian range of the Pacific Coast population is estimated to make up less than 1% of the North American range of the species[5] (COSEWIC 2006; NatureServe 2016).

2. Population and Distribution Objectives

The provincial recovery plan contains a statement on population and distribution objectives, and supporting rationale, i.e., "Section 5.1 Recovery (Population and Distribution) Goal" and "Section 5.2 "Rationale for the Recovery (Population and Distribution Goal". Environment and Climate Change Canada adopts the intent of the provincial recovery goal and supporting rationale with modifications as follows:

Population and distribution Objectives:

To maintain, or to increase (where biologically and technically feasible), the number of individuals within extant population units and the distribution of extant population units within the species' range in coastal B.C.

Rationale:

The Western Painted Turtle Pacific Coast population has a small distribution on the south coast of B.C. where it is isolated from other populations occurring in interior B.C. (Intermountain-Rocky Mountain population) and farther east (Prairie/Western Boreal – Canadian Shield population). Its areas of occurrence in southwestern B.C. are subject to rapid rates of increase in roads and human developments that result in ongoing habitat loss and degradation. Long-term population and distribution/habitat targets for survival and recovery are not included because of a lack of baseline data on historical distribution and abundance as well as data gaps regarding current population size and trends. Addressing these knowledge gaps will help identify the distribution and abundance targets needed to ensure self-sustaining population units. In absence of this information, it is assumed that all known population units are necessary for the persistence of the Western Painted Turtle – Pacific Coast population in B.C.

It is likely that the Western Painted Turtle Pacific Coast population will continue to be at risk in Canada. Improving the species' condition may be possible in the future, provided

[5] Based on index of area of occupancy range estimates of 528 km^2 for the Pacific Coast population provided in COSEWIC (2006) and total range extent of >2,500,000 km^2 for Painted Turtles in North America (Natureserve 2016).

that threats to the habitat and population can be substantially reduced such that the quality and quantity of habitat remains stable or increases, and survivorship and recruitment is stable or increased within its range. The immediate recovery objectives are, therefore, to maintain or to increase (where biologically and technically feasible) the number of individuals within extant population units, and the distribution of extant population units within the species' range. These objectives will be accomplished by threat mitigation, habitat restoration, and population management techniques such as (i) population augmentation where populations are small or declining; (ii) reintroduction at historical sites; (iii) relocation of individuals from habitat that is no longer suitable to occupied locations with better quality habitat; and/or (iv) creation of new sites via restoration and introduction of genetically native turtles. In some cases, it may not be feasible to restore habitat in specific areas within population units. In these circumstances, recovery will occur within the species range at more suitable locations through introduction/relocation to sites that are identified as most suitable for this purpose.

3. Critical Habitat

This section replaces "Section 7: Species Survival and Recovery Habitat" 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 for Western Painted Turtle includes a description of the biophysical attributes of survival / recovery habitat (see Table 1 in Part 2). This science advice was used to inform the following critical habitat sections in this federal recovery strategy.

Critical habitat for the Western Painted Turtle is identified in this document to the extent possible. As responsible jurisdictions and/or other interested parties conduct research to address knowledge gaps, the existing critical habitat methodology and identification may be modified and/or refined to reflect new knowledge.

Critical habitat is partially identified in this recovery strategy. Critical habitat has not been identified for one population unit (#6 - Cultus Lake) owing to inadequate location details, unknown status as extant, and whether or not the habitat at this site is suitable for restoration and/or reintroduction efforts. Critical habitat has not been identified for terrestrial areas beyond 150 m of the aquatic habitat owing to uncertainty regarding which additional portions of this habitat are required for the species' survival and recovery. The schedule of studies (Section 3.2) outlines the activities required to complete the identification of additional critical habitat necessary in supporting the population and distribution objectives for the species.

3.1 Identification of the Species' Critical Habitat

Geospatial location of areas containing critical habitat

Critical habitat for the Western Painted Turtle is identified for 40 extant population units in four geographic areas of southwestern British Columbia:

- Lower Fraser Valley (Figures 1-5)
- Capital Regional District, Vancouver Island (Figure 6)
- Alberni Valley, Nanaimo, and Gulf Islands (Figures 7-11)
- Sunshine Coast and Texada Island (Figures 12-13)

Within the geographic areas where it occurs, Western Painted Turtle requires both aquatic habitat (for breeding, foraging, basking, overwintering, and movement) and surrounding terrestrial habitat (for nesting, basking, and movement) to complete life history functions. Together, these aquatic and terrestrial habitats form the critical habitat that is essential for the persistence of the local breeding population. Critical habitat is identified to encompass these life history functions and regular seasonal movements between aquatic and terrestrial habitat.

Most Western Painted Turtles in B.C. are typically found within 150 m from water (B.C. Ministry of Forests, Lands and Natural Resource Operations 2014). The maximum nesting distance from water observed in three years of study at Nicomen Slough was 179 m (Welstead pers. comm. 2017). Additionally, Steen et al. (2012) found that a terrestrial distance of 154 m from an aquatic feature captures 95 % of nesting observations (n=4100; based on nest sites and gravid females) for Painted Turtle (*Chrysemys picta*)(including data from the Western Painted Turtle subspecies). The terrestrial area within 150 m of suitable aquatic habitat also provides critical movement corridors through which hatchling Western Painted Turtles access wetlands when dispersing from their nests.

Although most nesting and terrestrial movements occur within 150 m of aquatic habitat, key attributes of habitat in contextual surrounding areas can influence the ecological integrity of the aquatic habitat. Characteristics of terrestrial habitat up to at least 339 m from the water's edge can be integral to the survival and population maintenance of most freshwater turtle species, including Painted Turtles (Semlitsch and Bodie 2003). However, current known Western Painted Turtle population units exist in a mosaic of different natural and anthropogenic habitat types and there is uncertainty regarding which additional portions of habitat beyond 150 m are required for the species' survival and recovery (see also Section 3.2).

It is also recognized that longer-range dispersal movements of Western Painted Turtle occur. The maximum reported dispersal distance of Western Painted Turtles to neighbouring waterbodies is 3 km (Bowne et al. 2006; House et al. 2010; see also section 7.2.1 in the provincial recovery plan).

The areas containing critical habitat for Western Painted Turtle are identified based on sequential application of the following methods:

(1) Compilation of verified occurrence records[6] where at least one individual has been observed in any single year[7] in the last 40 years[8].

(2) Identification of all suitable aquatic habitat features (e.g., lakes, ponds, marshes, river channels, roadside or drainage ditches, sluggish streams, and sloughs) within a radial distance of 3 km of each record (i.e., aligning with maximum observed dispersal distance).[9]

(3) Preliminary delineation of geospatial areas containing critical habitat by applying a 150 m terrestrial distance around all known nest locations identified in Step (1) and suitable aquatic habitat features identified in Step (2).

(4) Geospatial exclusion of any areas delineated in Steps (2),(3) that are isolated by clearly impassible barriers (large fast-flowing rivers and salt water bodies).

Biophysical features and attributes of critical habitat

Within the geospatial area described above, critical habitat is identified wherever any of these biophysical features and attributes occur:

- Slow-moving or stagnant freshwater waterbodies, i.e.: lakes, ponds, marshes, river channels, roadside or drainage ditches, sluggish streams, sloughs, where features include any of the following attributes:
    - emergent vegetation, floating vegetation, vegetative mats
    - bottom substrates: organic material such as decaying vegetation and detritus; partially organic silt or sand; mud;
    - submerged or emergent logs or large woody debris; rocks
    - warm shallow water margins
- Open terrestrial habitat types, i.e.: areas with exposed soil and little to no vegetation, e.g., beaches, shoreline, sandy/loamy riparian edges or banks, natural islands, rocky bluffs, canopy gaps in forested habitats, where features include any of the following attributes:
    - flat or gently sloping ground (no pooling water)

[6] Records considered for the identification of critical habitat include data from all valid sources (e.g., professional surveys, incidental sightings, telemetry studies, and nest site observations). These records must have spatial precision (≤ 100 m) or provide enough detail to be associated to a specific location to be considered adequate to identify.
[7] In B.C., many of the remaining local populations include only a small number of individuals. As such, a single observation may be indicative of a local population and has been used to determine habitat occupancy.
[8] A forty-year period has been chosen for the habitat occupancy criterion. It is appropriate given the extended lifespan of the species (estimated to be 30-40 years (COSEWIC in press)), and it allows for the inclusion of local populations that likely persist but for which Western Painted Turtle individuals may not have been detected in recent years.
[9] Identification of suitable aquatic features based on BC Freshwater Atlas data (GeoBC 2017).

    - substrates: sand, gravel, or silt; low organic content
- Additional types of natural terrestrial habitat features, e.g.: forest, shrublands, grasslands, fields.

The areas identified as containing critical habitat for the Western Painted Turtle Pacific Coast population are presented in Figures 1-13. Critical habitat for the Western Painted Turtle occurs within the shaded yellow polygons shown on each map where the biophysical features and attributes described in this section occur. The biophysical features and attributes required for Western Painted Turtle life history functions (i.e., nesting, breeding, foraging, basking, overwintering, movement) overlap biophysically, geospatially, seasonally, and across life history stages (i.e., eggs, hatchings, neonates, juveniles, adults). Therefore, within these polygons, clearly unsuitable areas that do not support the species (i.e., do not contain any of the biophysical features and attributes required by the species at any time) are not identified as critical habitat.

Examples of clearly unsuitable habitat include: (i) existing permanent infrastructure (buildings, extensive spans of artificial surfaces, running surface of major paved roads having high traffic volumes); (ii) salt water bodies, and (iii) portions of terrestrial habitat that are completely isolated by impassable barriers, e.g., non-traversable topography, large fast-flowing rivers, continuous concrete road barriers (where no culvert or underpass exists).

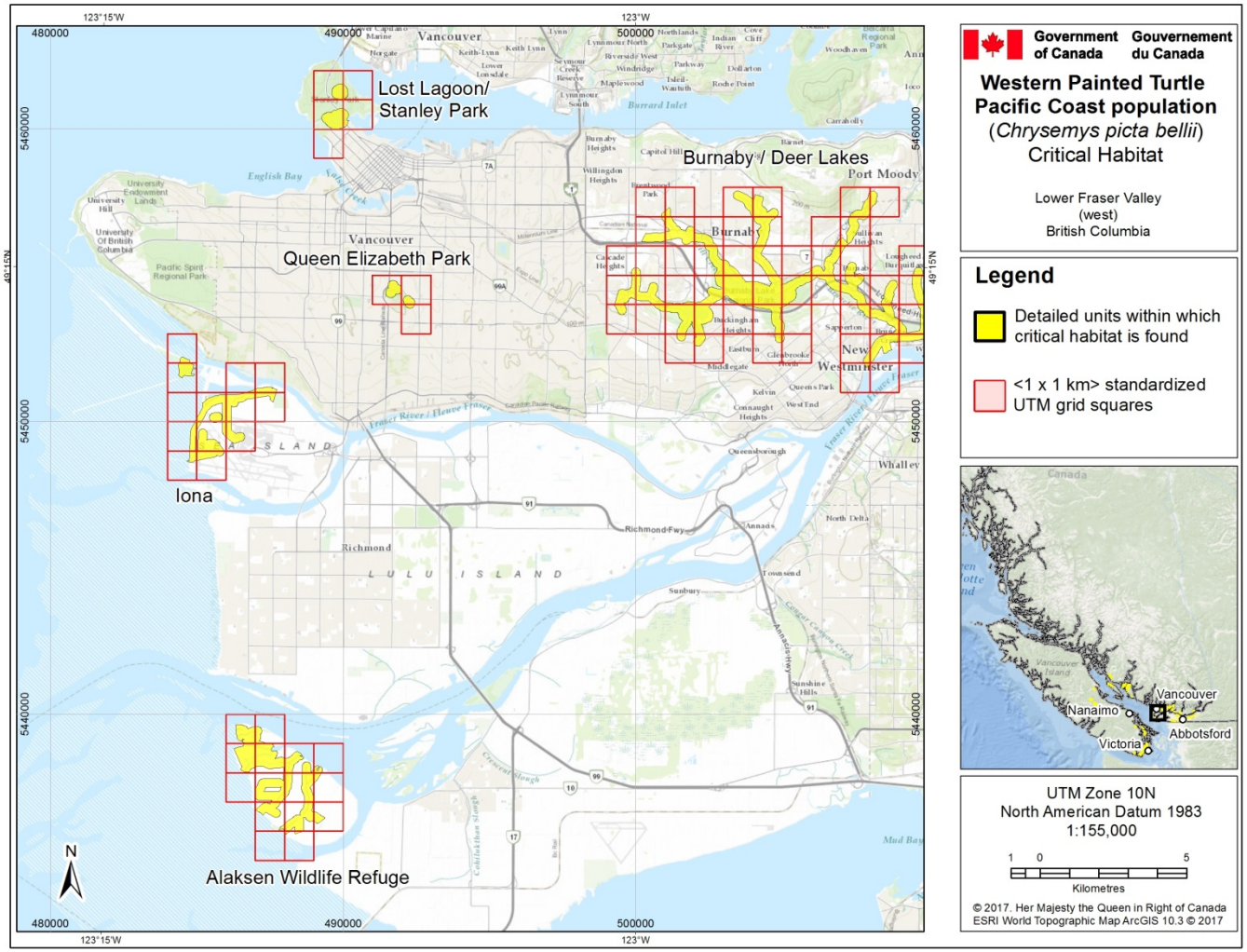

Figure 1. Critical habitat for Western Painted Turtle, populations #1, #3, #8, #12, and #17 in the Lower Fraser Valley (west) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

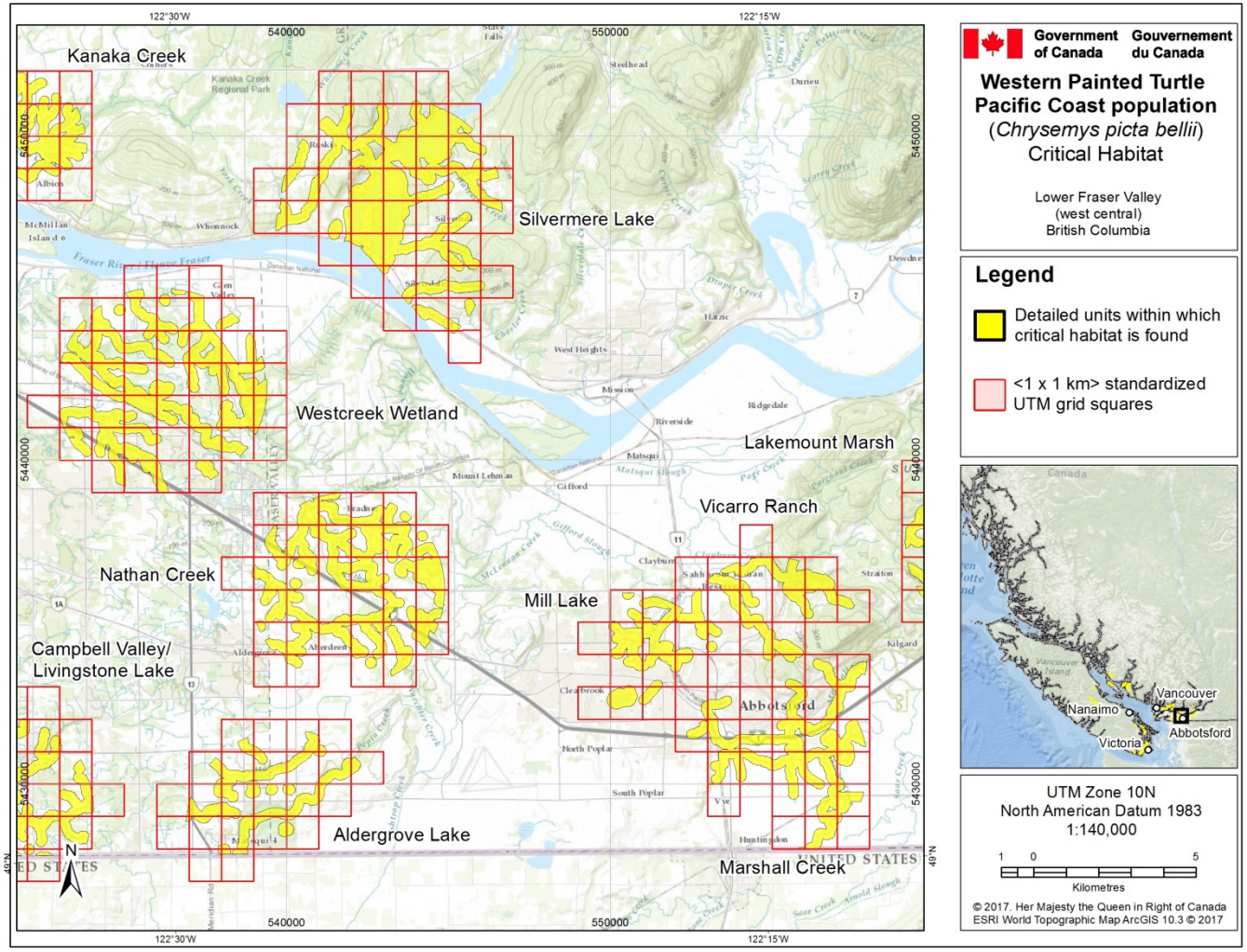

Figure 2. Critical habitat for Western Painted Turtle, populations #2, #4, #10, #11, #13, #14, #19, #20, #21, and #38 in the Lower Fraser Valley (west central) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

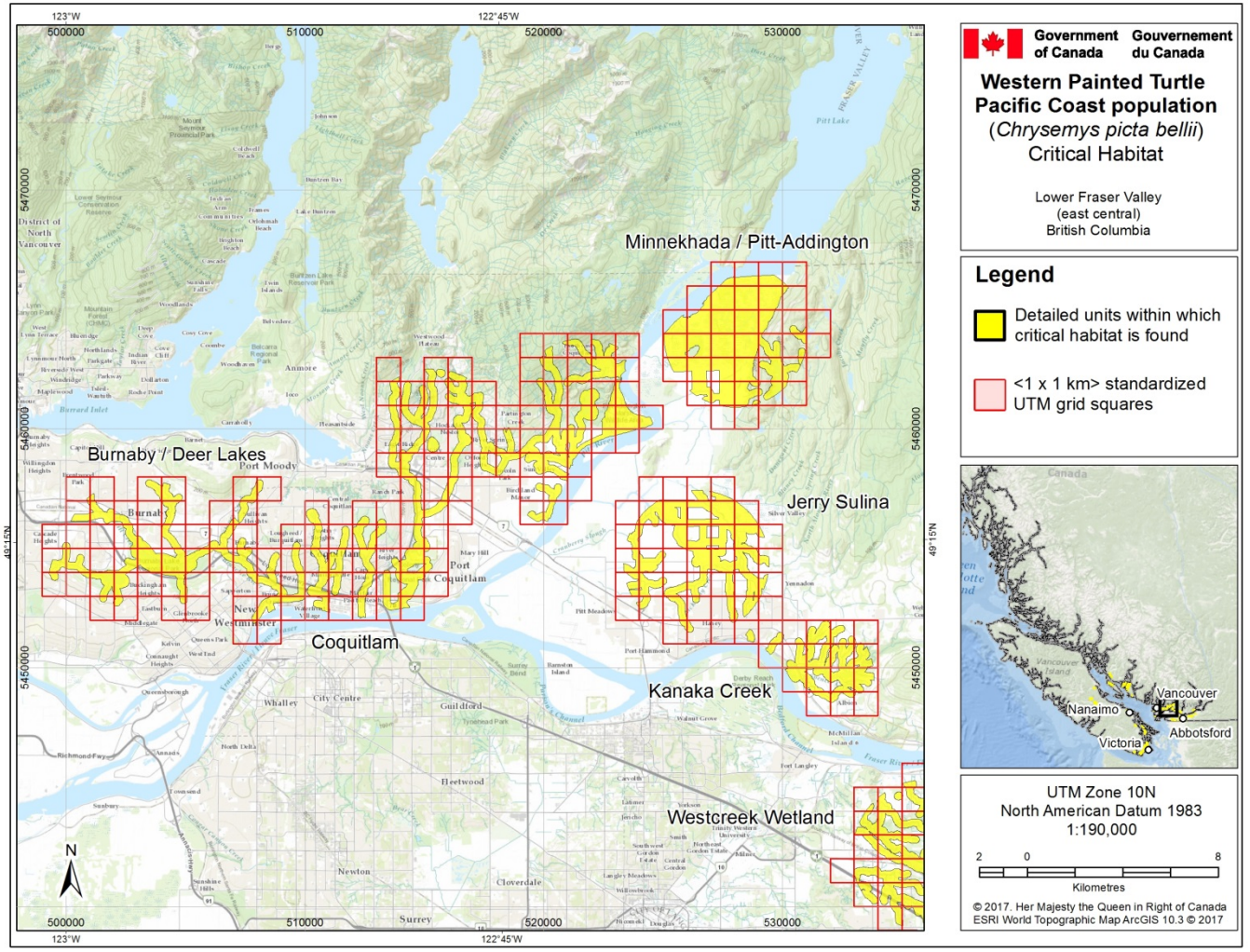

Figure 3. Critical habitat for Western Painted Turtle, populations #3, #5, #9, #10, #15, and #21 in the Lower Fraser Valley (east central) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

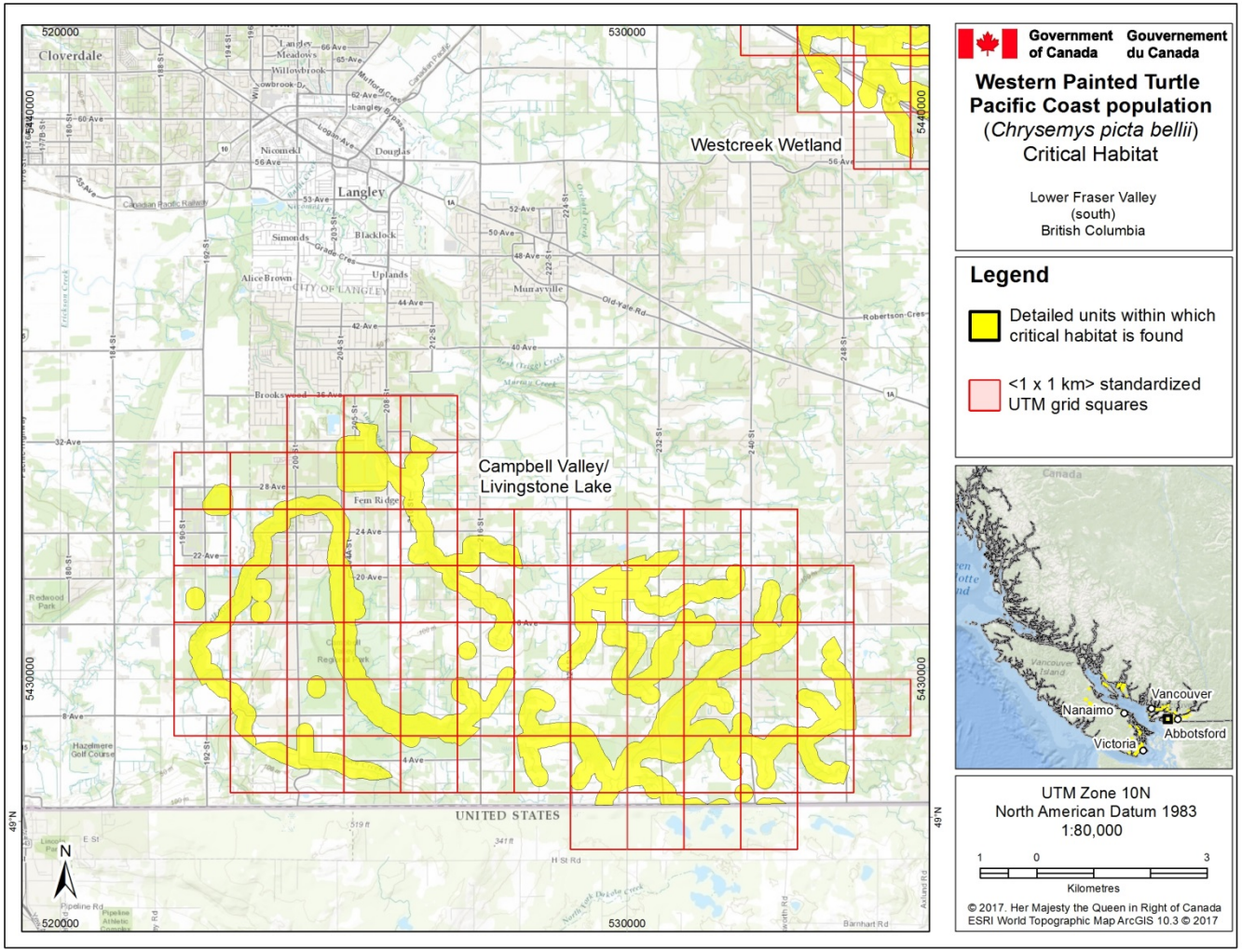

Figure 4. Critical habitat for Western Painted Turtle population #4 and population #21 in the Lower Fraser Valley (south) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 5.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

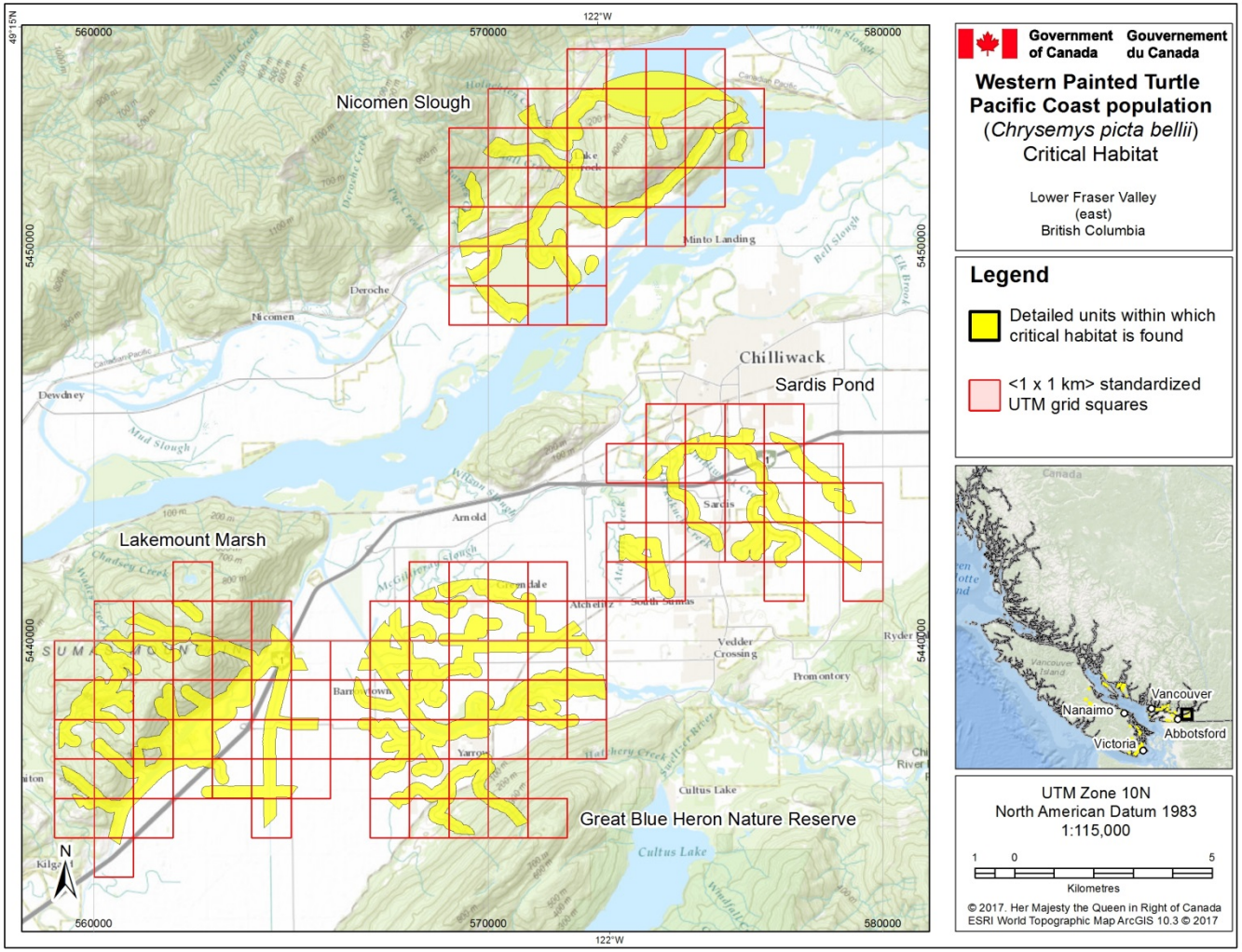

Figure 5. Critical habitat for Western Painted Turtle populations #7, #11, #16, and #18 in the Lower Fraser Valley (east) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

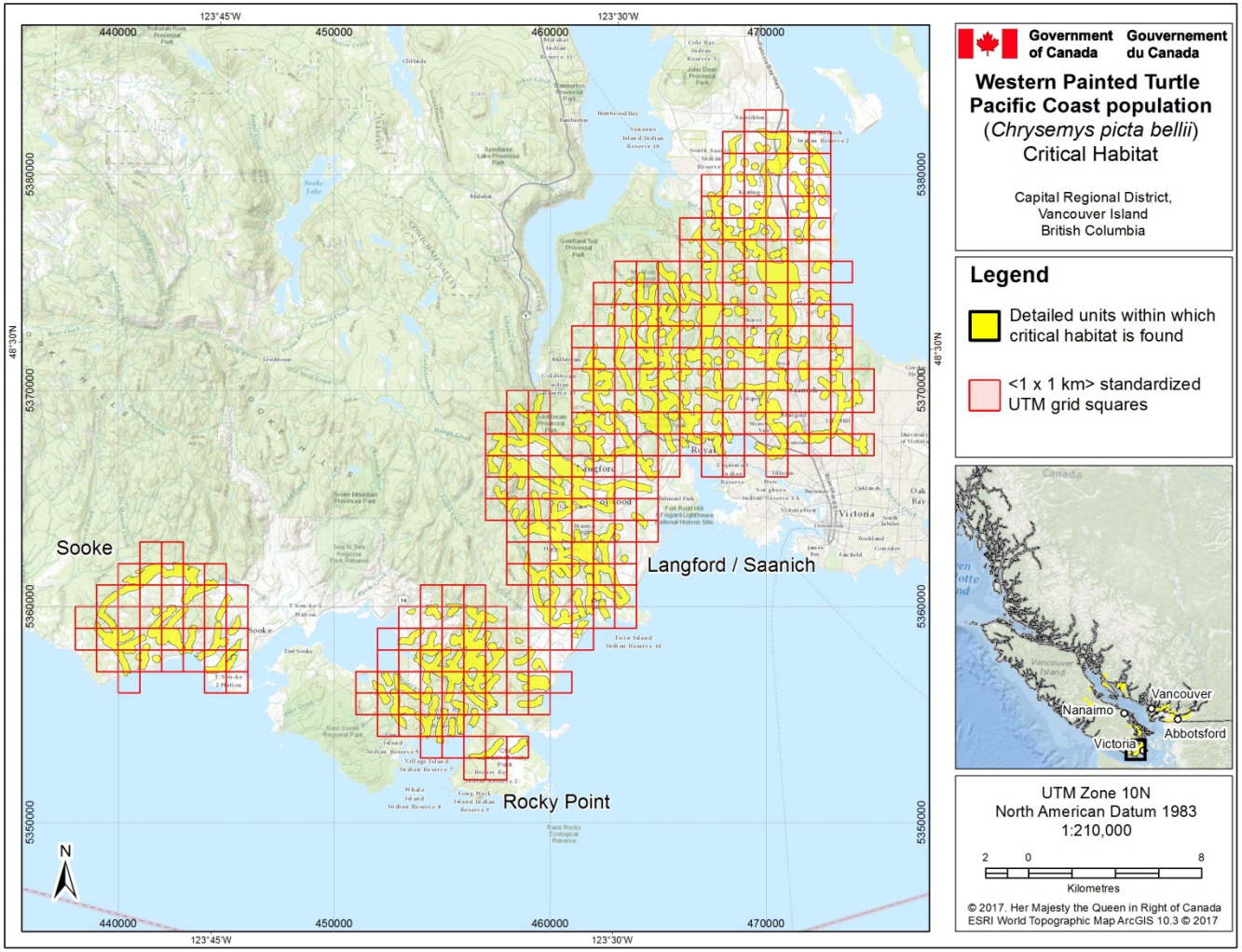

Figure 6. Critical habitat for Western Painted Turtle populations #22, #24, and #25 in the Capital Regional District, Vancouver Island area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

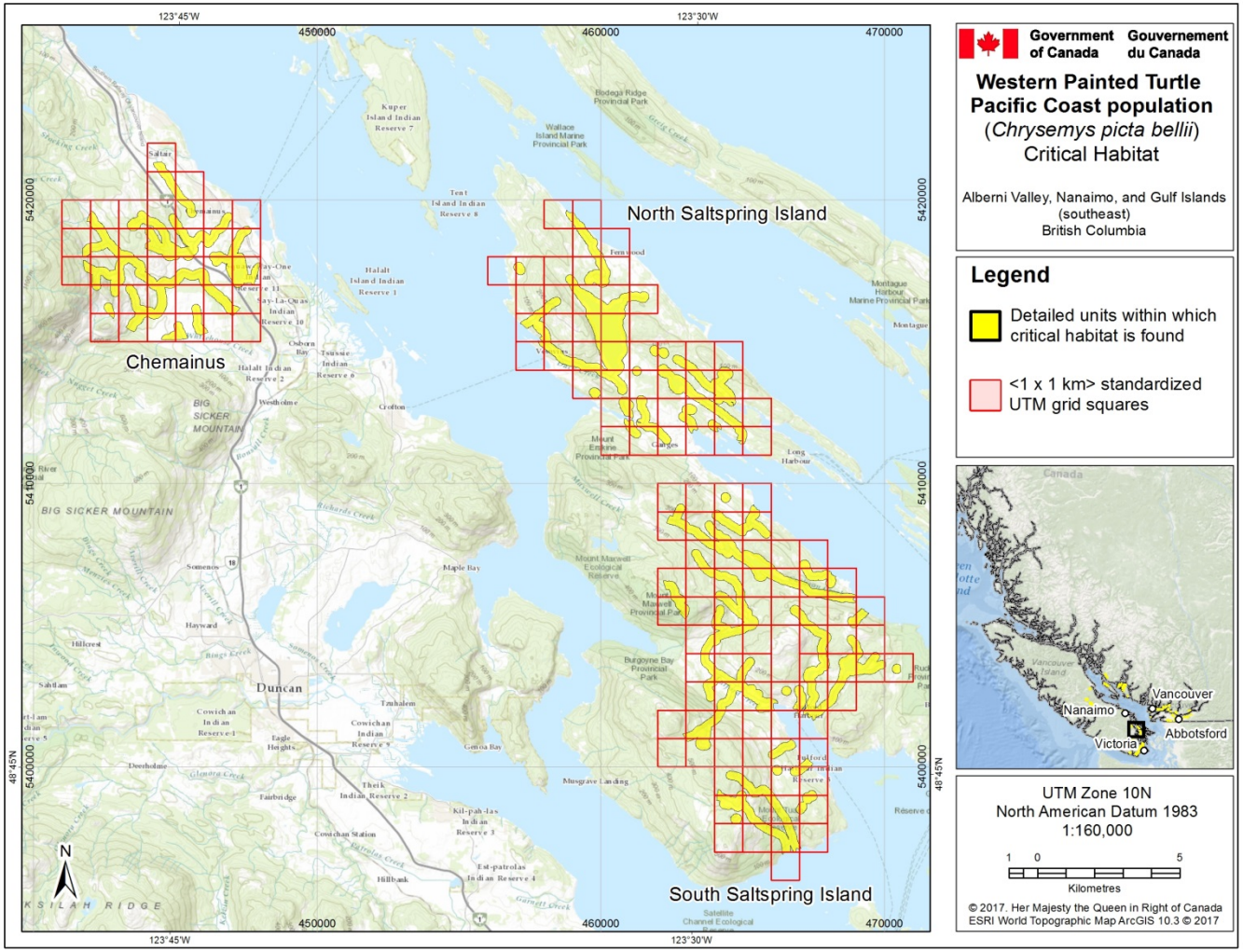

Figure 7. Critical habitat for Western Painted Turtle populations #26, #27, and #41 in the Alberni Valley, Nanaimo, and Gulf Islands (southeast) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

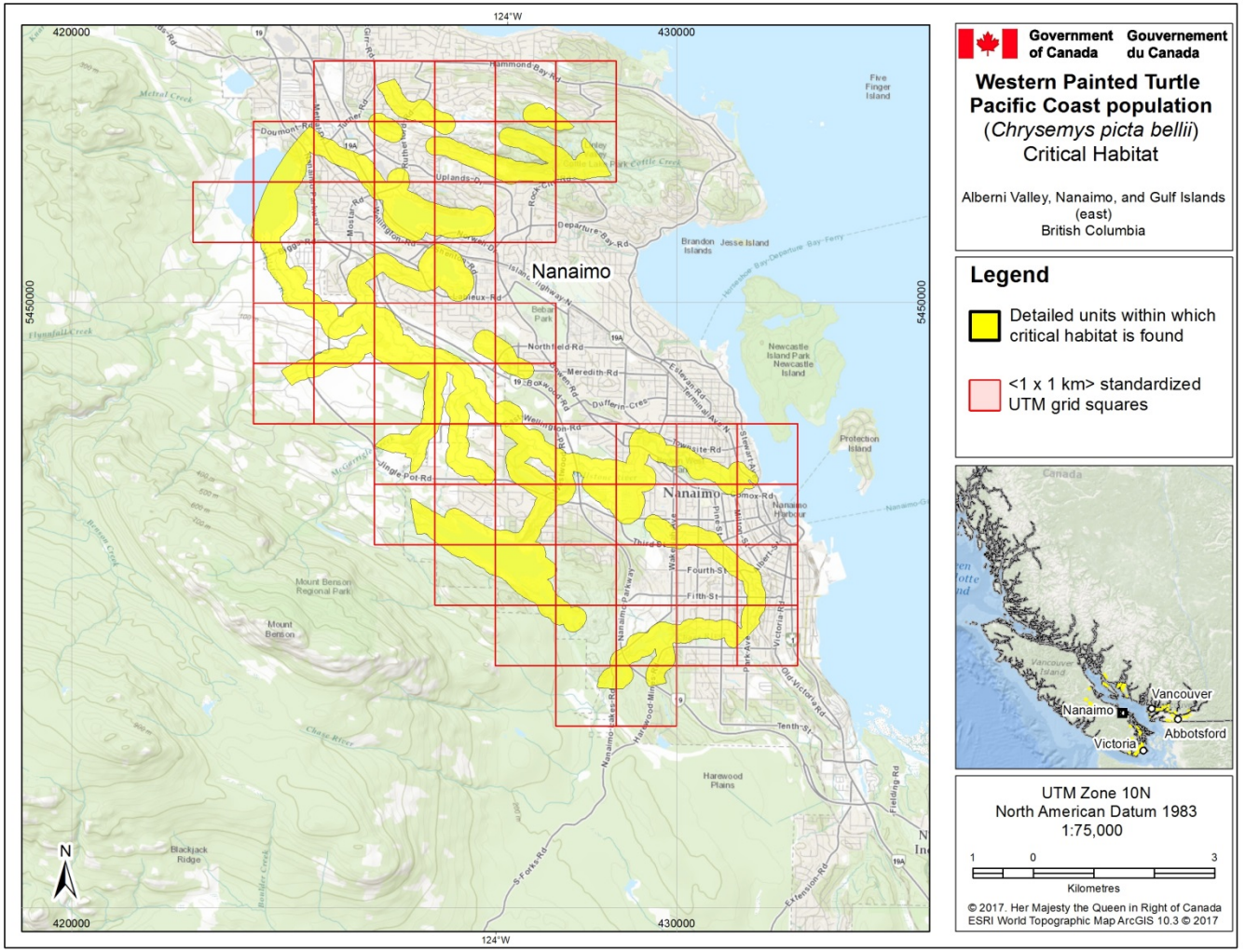

Figure 8. Critical habitat for Western Painted Turtle population #33 in the Alberni Valley, Nanaimo, and Gulf Islands (east) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

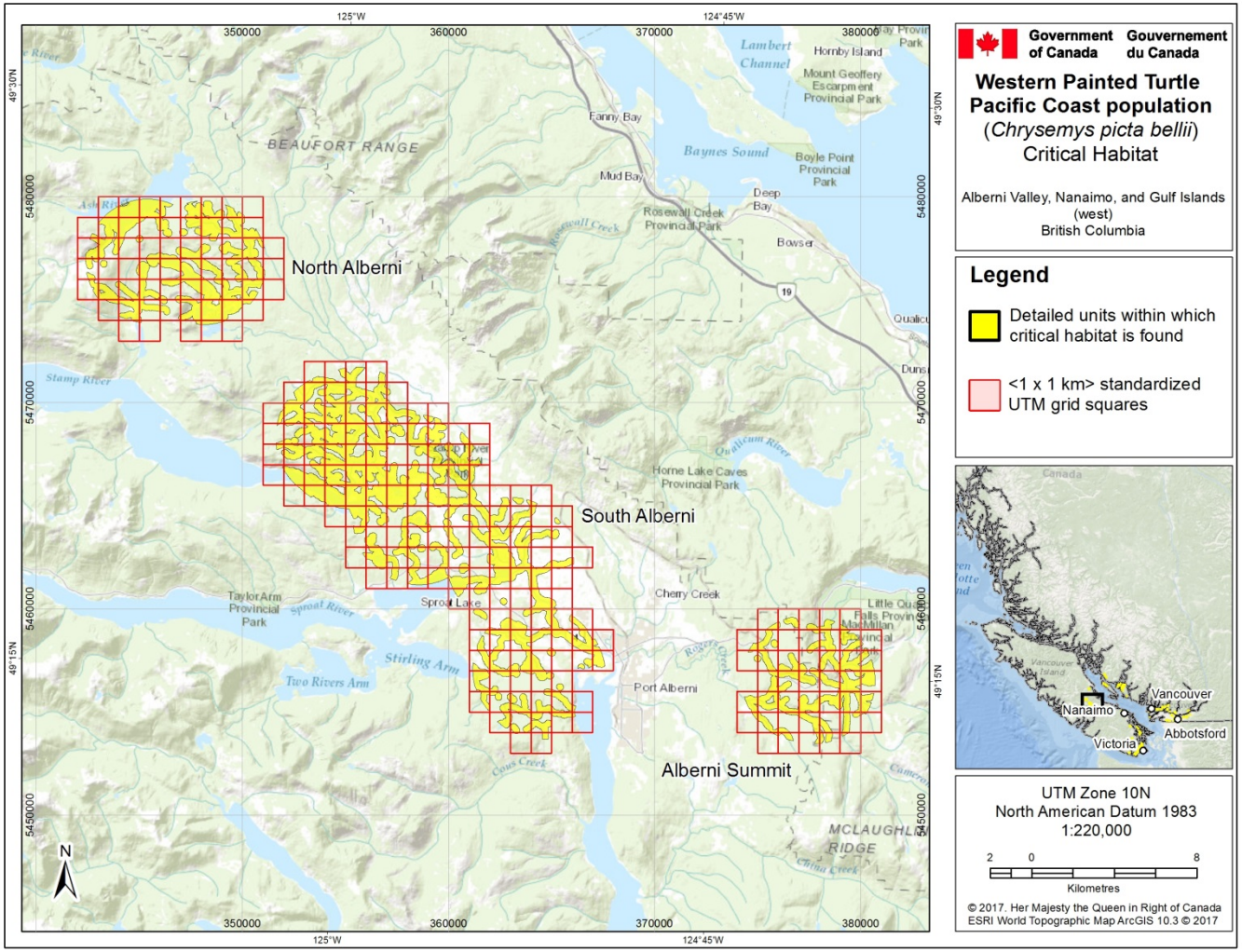

Figure 9. Critical habitat for Western Painted Turtle populations #35, #36, and #39 in the Alberni Valley, Nanaimo, and Gulf Islands (west) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

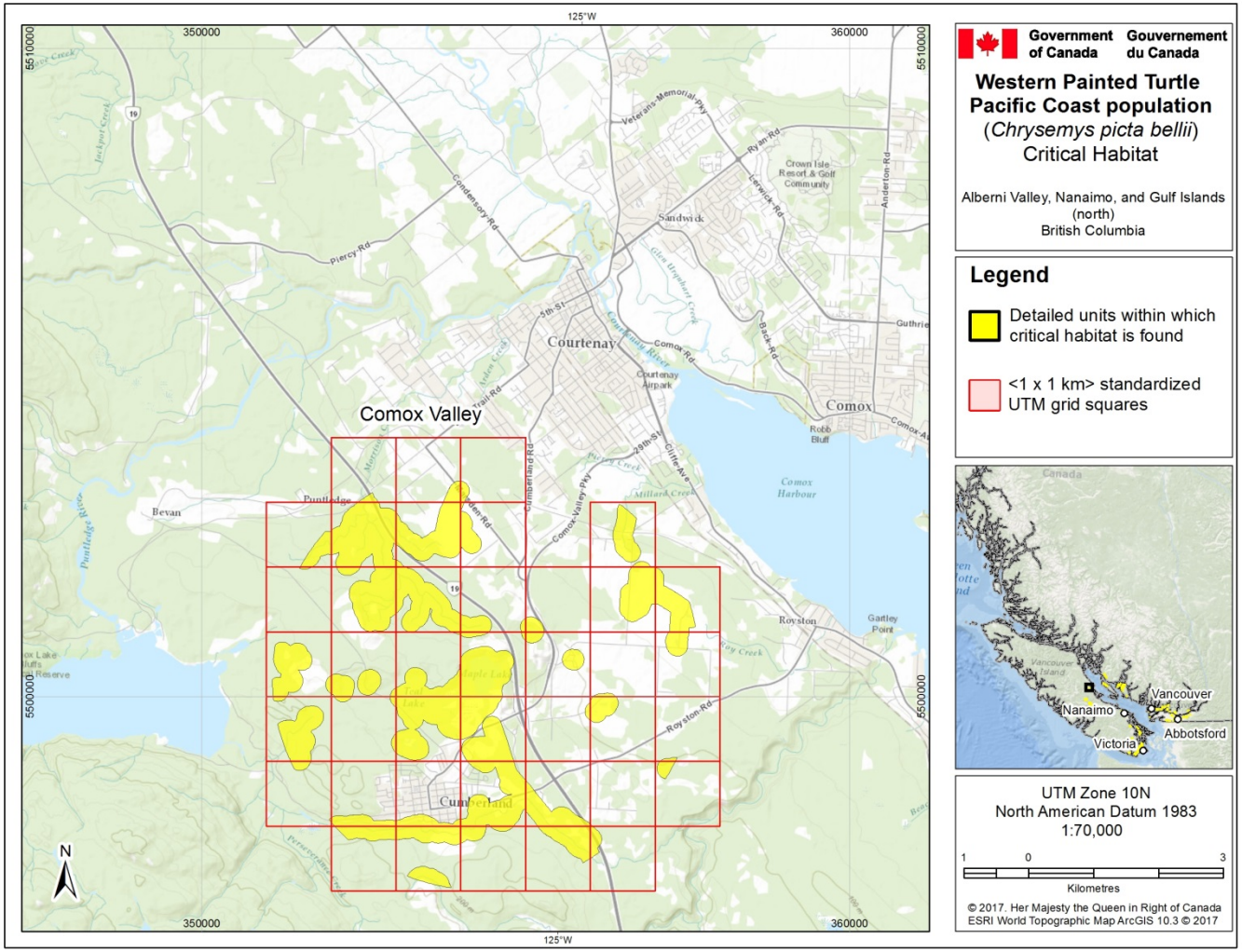

Figure 10. Critical habitat for Western Painted Turtle population #40 in the Alberni Valley, Nanaimo, and Gulf Islands (north) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

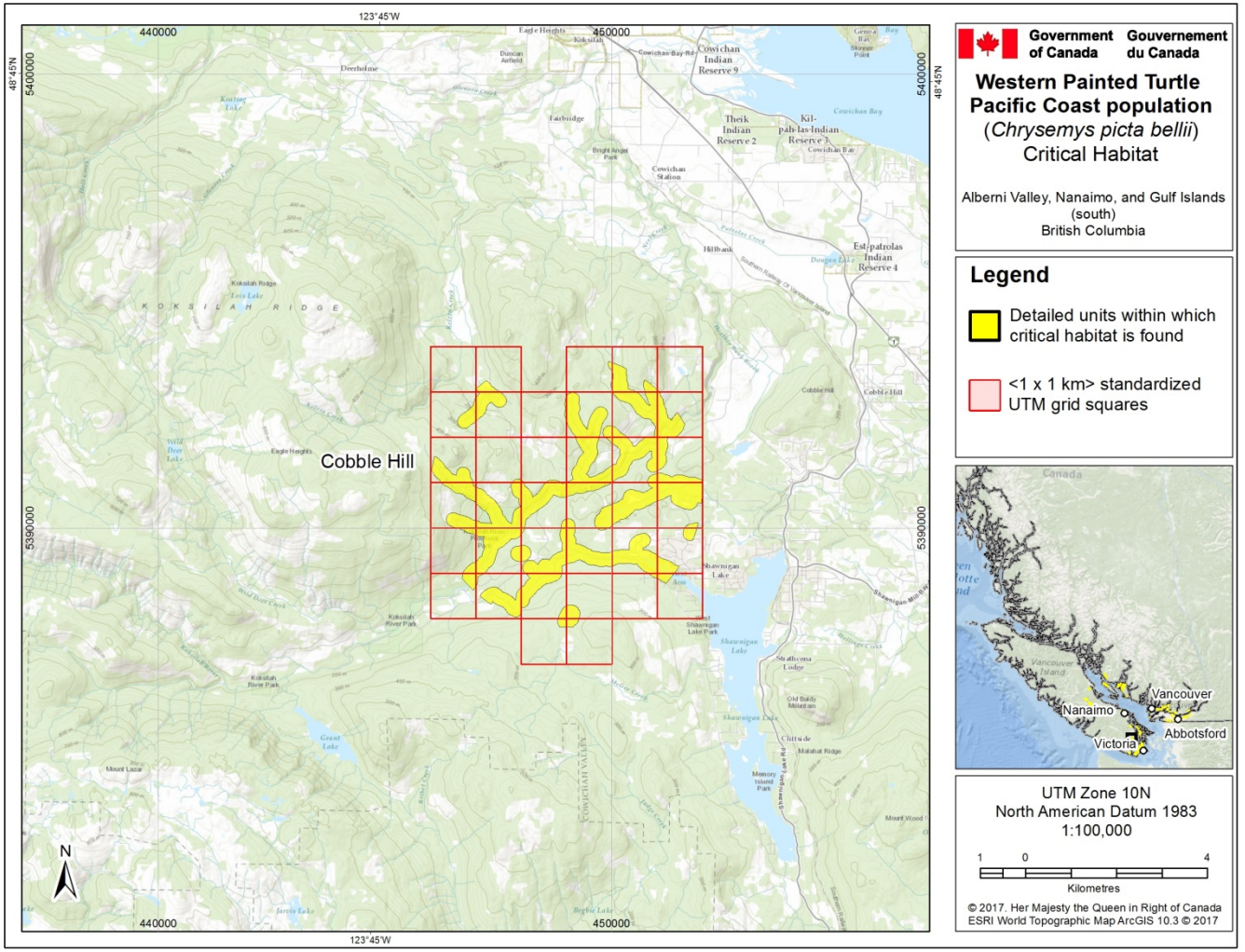

Figure 11. Critical habitat for Western Painted Turtle population #39 in the Alberni Valley, Nanaimo, and Gulf Islands (south) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

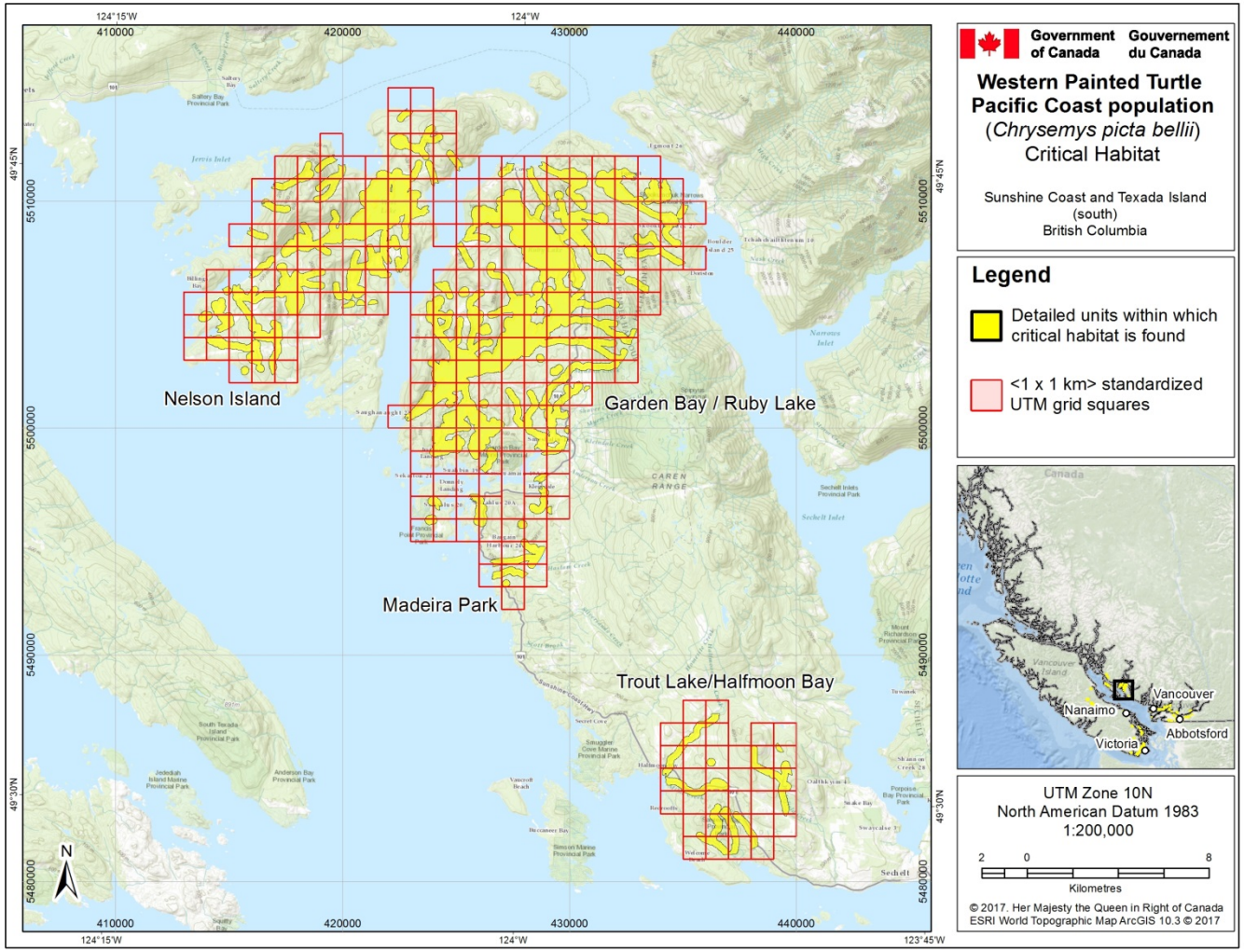

Figure 12. Critical habitat for Western Painted Turtle populations #28, #31, #32, and #34 in the Sunshine Coast and Texada Island (south) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

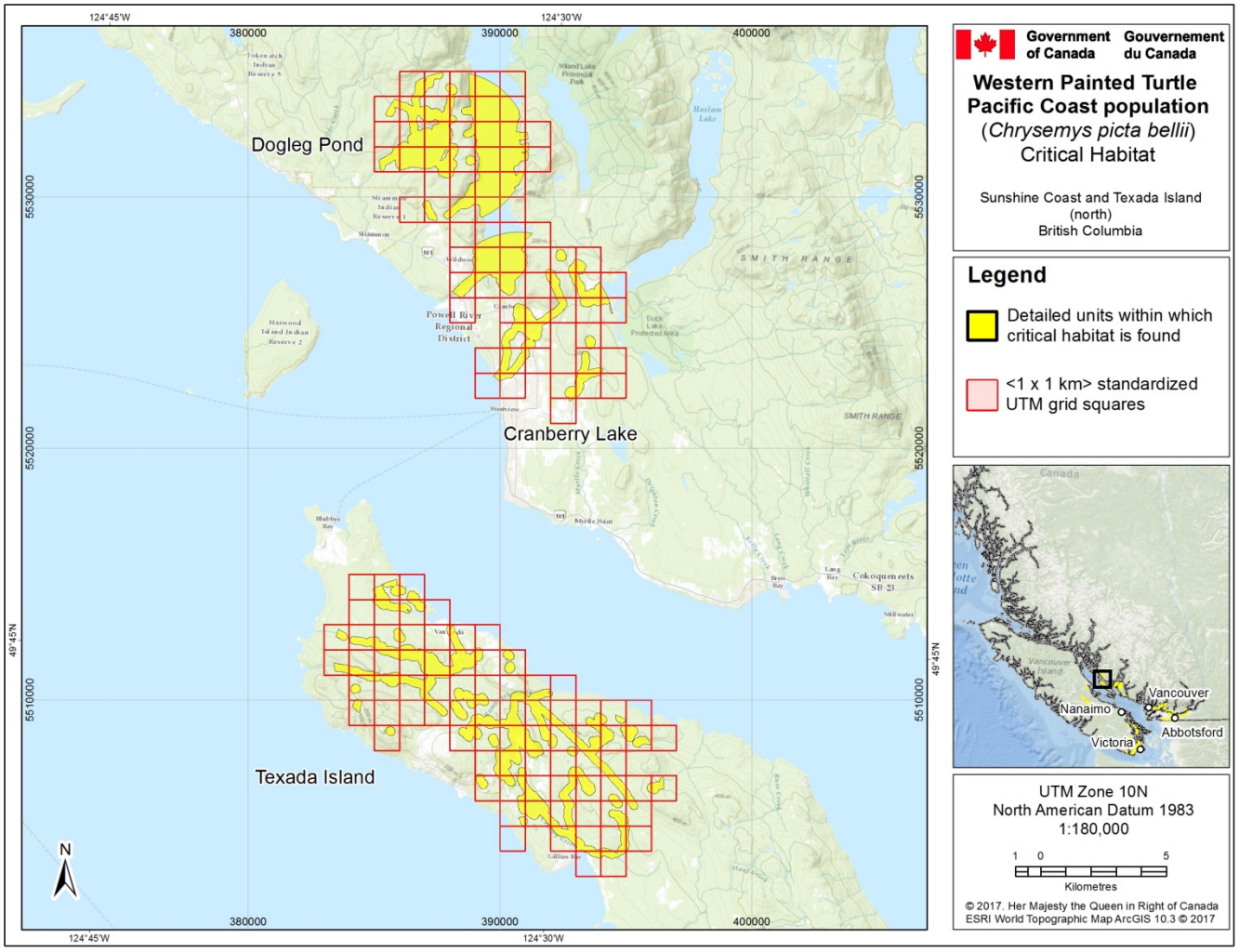

Figure 13. Critical habitat for Western Painted Turtle populations #29, #30, and #37 in the Sunshine Coast and Texada Island (north) area, B.C., is represented by the shaded yellow polygons (units) except where clearly unsuitable habitats (as described in Section 2.1) occur. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat in Canada. Areas outside of the shaded yellow polygons do not contain critical habitat.

3.2 Schedule of Studies to Identify Critical Habitat

The following schedule of studies (Table 2) outlines the activities required to complete the identification of critical habitat for Western Painted Turtle. This section addresses parts of critical habitat that are known to be missing from the identification based on information that is available at this time. Actions required to address future *refinement* of critical habitat (such as fine-tuning boundaries, and/or providing greater detail about use of biophysical attributes) are not included here. Priority recovery actions to address these kinds of knowledge gaps are outlined in the recovery planning table in the adopted provincial recovery plan.

Table 2. Schedule of studies to identify critical habitat for Western Painted Turtle.

Description of Activity	Rationale	Timeline
Conduct population surveys and habitat assessments at Cultus Lake (#6) to determine whether individuals are extant at this location, and if not, whether suitable habitat remains or can be restored to support reintroduced populations.	This activity is necessary to confirm the location and extent of populations and determine the extent of suitable habitat and possible locations to restore historical occurrences.	2018 - 2023
Identify additional critical habitat within an additional distance of 190 m surrounding the identified geospatial area containing critical habitat.	Although most nesting and terrestrial movements occur within 150 m of aquatic habitat, characteristics of terrestrial habitat up to approximately 340 m from the water's edge can be integral to the survival and population maintenance of most freshwater turtle species, including Western Painted Turtles. Where deemed appropriate and necessary for the species' survival and recovery, additional critical habitat should be identified within this additional area.	2018 - 2023

3.3 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 single or multiple activities occurring once or from the cumulative effects of one or more activities over time. The provincial recovery plan provides a description of limitations and threats[10] to Western Painted Turtle. Activities (described in Table 3) include those likely to cause the destruction of critical habitat for the species; however, destructive activities are not limited to those listed.

[10] Threat classification (CMP 2010) is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system (www.conservationmeasures.org).

Table 3. Activities likely to result in destruction of critical habitat for Western Painted Turtle.

Description of activity	Rationale	Additional information; related IUCN threat
Land conversion for residential, commercial, agricultural, recreational, or industrial development.	This activity can result in the direct loss of critical habitat outright, or could degrade habitat (terrestrial and/or aquatic features) to a point where it no longer meets the needs of the species. It may also fragment or isolate suitable habitat, precluding movements.	IUCN-CMP Threat 1.1, 1.2, 1.3, 2.1, 2.3, 3.2, 4.1, 5.3, 6.1, 7.2, 7.3 Habitat loss due to residential and commercial development is an increasing threat for the species as human population densities increase in the region. Concurrently, the development of transportation infrastructure is also an increasing threat. Natural systems are commonly modified for human benefit in human-dominated landscapes, and many types of land conversion activities are known to impact freshwater turtle populations.
Recreational use of landscape that results in significant adverse effects[a], e.g. camping, digging in the sand, human or pet disturbance through usage of trails or boating, use of all-terrain vehicles.	This activity can result in the direct loss of critical habitat outright, or could degrade habitat (terrestrial and/or aquatic features) to a point where it no longer meets the needs of the species. It may also fragment or isolate suitable habitat, precluding movements.	IUCN-CMP Threat 6.1 These activities are most likely to result in destruction of critical habitat when they occur during the nesting season and at nesting sites. Because turtles typically choose south-facing, open locations for nest laying, there are overlaps with recreation use at many sites.
Activities that cause alteration in local hydrological characteristics e.g., draining and filling in wetlands, water diversion due to irrigation and ditching, dredging, water management, damming, removal of log-jams, clearing of culverts, artificial channelization, reduction of sandbars, shoreline alteration.	Results in habitat loss or degradation of aquatic and/or shoreline terrestrial habitat required by Western Painted Turtle for all life history functions. Hydrology changes can also fragment or isolate patches of suitable habitat, destroying areas required for dispersal.	IUCN-CMP Threat 1.1, 1.2, 1.3, 2.1, 2.3, 3.2, 4.1, 5.3, 6.1, 6.3, 7.2, 7.3 Alterations in hydrological characteristics can be caused by land conversion for residential, commercial, agricultural, recreational, or industrial development, management of water/dams, or other natural system modifications. Although activities are most likely to result in destruction when they occur within the bounds of critical habitat, destruction may also be caused by activities outside these boundaries.

Description of activity	Rationale	Additional information; related IUCN threat
Development and/or maintenance or modification of existing structures, road building, expansion, upgrading, or installation of other types of barriers to turtle movement without installation of mitigations such as safe movement passages and fencing.	Destroys or degrades critical habitat by fragmenting or isolating suitable habitat, precluding movements or obstructing access to nesting areas.	IUCN-CMP Threat 4.1 Road densities are high throughout much of the Western Painted Turtle range. Therefore, road maintenance and construction activities are likely to result in destruction of critical habitat. This threat is particularly severe on the Lower Sunshine Coast and on Saltspring Island where roads parallel occupied wetlands.
Activities that cause introduction of non-native plant species e.g., deliberately planting non-native species, moving fill that contains propagules of non-native species.	Non-native plants (e.g., Yellow Flag Iris (*Iris pseudacorus*), Eurasian Water Milfoil (*Myriophyllum spicatum)*, Reed Canarygrass (*Phalaris arundinacea*), and Himalayan Blackberry (*Rubus armeniacus*)) outcompete native plants used by Western Painted Turtles for foraging and can destroy areas necessary for basking or nesting due to encroachment.	IUCN-CMP Threat 8.1 Invasive and/or exotic species pose a threat to the survival of Western Painted Turtle across the species' range.
Mechanical removal of invasive species or encroaching native vegetation.	Mechanical removal of vegetation can destroy habitat structure and/or attributes used for refuge or basking. Note: Depending on the location, and timing/frequency of application, in some circumstances (e.g., restoration of habitat for the species), targeted removal may result in a neutral or potential net benefit to Western Painted Turtle. Appropriate application (i.e., in line with best management practices and with consideration of the species' life history) is essential to avoid destruction.	IUCN-CMP Threat 6.3, 7.3, 8.1 Mechanical clearing of lilies using lily cutters, weed tow boats, harvesters, or shedders is a concern in Burnaby Lake and Mill Lake. Invasive vegetation removal (terrestrial and aquatic) can be a concern where such vegetation is providing predator protection (e.g., blackberries) or screening from human disturbances.
Introduction of American Bullfrogs (*Lithobates catesbieanus*), Red-eared Sliders (*Trachemys scripta elegans*), other subspecies of Painted Turtle, or other turtle species into water bodies within the species' range.	Predatory and/or competitive influence of American Bullfrogs, Red-eared Sliders, and other introduced turtles can cause aquatic habitats to be unsuitable for Western Painted Turtles.	IUCN-CMP Threat 8.1 Invasive and/or exotic species pose a threat to the survival of Western Painted Turtle across the species' range. Hybridization with other subspecies can change the genetic makeup of Western Painted Turtle.

[a] Significant adverse effects are those that negatively impact the species' survival and recovery. Success of the species' survival and recovery will be assessed by the population and distribution objective set out in Section 2, and the associated performance measures set out in Section 4.

4. Measuring Progress

This section replaces “Section 8: Measuring Progress” in the provincial recovery plan.

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives for Western Painted Turtle Pacific Coast population:

- The distribution of extant population units has been maintained or increased (i.e., the distribution of extant population units has not contracted); and,
- The number of individuals within extant population units has been maintained or increased (i.e., the number of individuals within extant population units has not decreased)

5. Statement on Action Plans

One or more action plan(s) for Western Painted Turtle will be posted on the Species at Risk Public Registry by 2023.

6. 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*[11]. 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[12] (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.

The provincial recovery plan describes the effects of recovery actions on other species (Section 9: Effects on other Species) and Environment and Climate Change Canada adopts this section. In addition a number of federally-listed species at risk may overlap the range and habitat of Western Painted Turtle Pacific Coast population including (but

[11] www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[12] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

not limited to): Pacific Water Shrew (*Sorex bendirii*; Endangered), Western Screech-owl *kennicottii* subspecies (*Megascops kennicottii kennicottii*; Special Concern), Great Blue Heron *fannini* subspecies (*Ardea herodias fannini;* Special Concern), Red-legged Frog (*Rana aurora*; Special Concern), and Western Toad (*Anaxyrus boreas*; Special Concern). Recovery planning activities for Western Painted Turtle Pacific Coast population will be implemented with consideration for all co-occurring species, with focus on species at risk, to avoid or minimize negative impacts to these species or their habitats.

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Part 2 – *Recovery Plan for the Painted Turtle - Pacific Coast Population (*Chrysemys picta *pop. 1) in British Columbia*, prepared by the Western Painted Turtle Recovery Team for the British Columbia Ministry of Environment

Recovery Plan for the Painted Turtle – Pacific Coast Population (*Chrysemys picta pop. 1*) in British Columbia

Prepared by the Western Painted Turtle Recovery Team

May 2016

Updated – April 2017

About the British Columbia Recovery Strategy Series

This series presents the recovery documents 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 documents to ensure coordinated conservation actions and to 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 provincial recovery document?

Recovery documents summarize the best available scientific and traditional information 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. This information may be summarized in a recovery strategy followed by one or more action plans. The purpose of an action plan is to offer more detailed information to guide implementation of the recovery of a species or ecosystem. When sufficient information to guide implementation can be included from the onset, all of the information is presented together in a recovery plan.

Information in provincial recovery documents may be adopted by Environment Canada for inclusion in federal recovery documents that the federal agencies prepare to meet their commitments to recover species at risk under the *Species at Risk Act*.

What's next?

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.

Success in the recovery of a species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this document. All British Columbians are encouraged to participate in these efforts.

For more information

To learn more about species at risk recovery in British Columbia, please visit the B.C. Ministry of Environment Recovery Planning webpage at:
<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>

Recovery Plan for the Painted Turtle – Pacific Coast Population (*Chrysemys picta* pop. 1) in British Columbia

Prepared by the Western Painted Turtle Recovery Team

May 2016

Updated – April 2017

Recommended citation

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Cover illustration/photograph

Adult Painted Turtle – Pacific Coast Population Nesting at Nicomen Slough. Photo by Kym Welstead.

Additional copies

Additional copies of this recovery plan can be downloaded from the B.C. Ministry of Environment Recovery Planning webpage at:

< http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/species-ecosystems-at-risk/recovery-planning/recovery-planning-documents >

Publication information

This is an updated version of the May 2016 first edition of this document.
See **Updates** for specific changes to the document.

Updates

Updated April 2017. Changes to the original posting (May 2016) include: updating the COSEWIC Assessment Summary to 2016; removing Appendix 2 and a reference to it, as well as correcting a site name and changing some wording under Threats 2.1 & 2.3.

Disclaimer

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

This document identifies the recovery strategies and actions that are deemed necessary, based on the best available scientific and traditional information, to recover Painted Turtle 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 findings.

The responsible jurisdictions and all members of the recovery team 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 on the recovery team. 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 Painted Turtle Painted Turtle – Pacific Coast Population.

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Michael Russello /	Observer	Associate Professor, Department of Biology,

Evelyn Jensen (alternate)		University of British Columbia, Okanagan Campus
Leanne Harris	Observer	Wildlife Genetics Lab
Marc Hayes	Observer	Senior Research Scientist, Science Division, Habitat Program, Washington Department of Fish and Wildlife
Alison Evely/ Janice Jarvis	Observer	Metro Vancouver Regional District Parks

EXECUTIVE SUMMARY

The Painted Turtle – Pacific Coast Population (*Chrysemys picta pop. 1*) is an endemic, colourful freshwater turtle with unique patterns on its plastron (belly). Within coastal British Columbia, it is currently restricted to 37 population units.

The Western Painted Turtle - Pacific Coast population (*Chrysemys picta bellii* [Pacific Coast Population] referred to in this document as Painted Turtle – Pacific Coast Population) was designated in 2006 as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is on Schedule 1 of the *Species at Risk Act* (SARA). In British Columbia, the Painted Turtle – Pacific Coast Population is ranked S2 (imperiled) by the Conservation Data Centre and is on the provincial Red list. The B.C. Conservation Framework ranks this population as a priority 2 under goal 3 (maintain the diversity of native species and ecosystems). It is protected from capture and killing, under the British Columbia *Wildlife Act*. Major ongoing threats include: extensive loss of aquatic and riparian habitat related to residential, agricultural, and industrial developments; road expansion and vehicular mortality; collection for consumptive use and pet trade; and non-native and invasive species.

Survival and recovery habitat for the Painted Turtle – Pacific Coast Population includes a ***Core Area of Activity*** that comprises all occupied aquatic habitat and 80 m of terrestrial habitat on either side of the waterbody or watercourse, and an additional ***Adjacent Terrestrial Area*** that incorporates 260 m of habitat beyond the 80-m terrestrial buffer. Both areas cover biophysical attributes and habitat within 3 km of an occurrence. Management of these survival and recovery habitat areas should avoid and mitigate impacts to the biophysical attributes that support essential functions and features of the Painted Turtle – Pacific Coast Population in British Columbia.

The long-term goal (45 years[1]) for the Painted Turtle – Pacific Coast Population is to ensure healthy, self-sustaining population units over three generations.

To work towards achieving the long-term recovery (population and distribution) goal, the following medium term objective (10 years) has been identified:

The recovery (population and distribution) goal (within 10 years) is to maintain or increase the number of individuals and distribution of Painted Turtle – Pacific Coast Population units, and ensure the quality and quantity of habitat remains stable or increases, while improving survivorship and recruitment within its range[2] in British Columbia.

[1] Based on three generations and a 15 year generation time as per COSEWIC 2006

[2] The Painted Turtle - Pacific Coast Population's range includes its current distribution, known historical distribution, and possible extension beyond current range to account for climate change or other threats.

The recovery plan has the following six objectives.

1. ***Protect***[3] and ***restore habitat***, features, and connectivity[4] at all recoverable[5] and new population units.[6]
2. Implement ***population management***[7] and ***threat mitigation*** to stabilize or increase recruitment and survivorship rates of all life stages, as needed, while maintaining the genetic distinctiveness of Pacific Coast populations.
3. ***Manage*** invasive/non-native ***species*** to improve survival of native turtles, mitigate interbreeding with non-native turtles (retain genetic integrity), mitigate disease transfer, and reduce resource competition.
4. ***Inventory*** new areas and clarify distribution of the species to prevent the inadvertent loss of not-yet discovered populations.
5. ***Monitor*** population trends and habitat status to evaluate the effectiveness of recovery actions.
6. ***Research*** life history, historical distribution population dynamics, and habitat use of the species, and clarify threats facing these populations, so that appropriate conservation measures can be taken to adaptively improve conservation and recovery efforts.

RECOVERY FEASIBILITY SUMMARY

The recovery of the Painted Turtle – Pacific Coast Population in British Columbia is considered technically and biologically feasible based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility.

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. Surveys completed at several nesting sites throughout the range of the species indicate that reproductive individuals are available. Although some sites have so few adults that breeding no longer takes place, population augmentation and head-starting are currently being implemented, or can be implemented, to restore the population abundance and recruitment rates at these sites.

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

[3] 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.
[4] Prevent habitat fragmentation at all occupied sites and restore habitat connectivity to facilitate seasonal movements and dispersal of turtles.
[5] Not all occupied sites can be restored to suitable habitat, owing to existing threats that cannot be mitigated (e.g., site is a stormwater detention pond). In these cases, an alternative site to recover will be found so that population unit numbers can be maintained.
[6] To maintain number and extent of distribution, additional locations will be added through population introduction/reintroduction to make up for sites that are not recoverable.
[7] Population management techniques include population augmentation, captive breeding, translocations, and/or head-starting.

YES. Sufficient suitable habitat is currently available to support the species, and the recent creation of wetland on the South Coast has increased the availability of suitable habitat. Research shows that the species is a generalist and fairly compatible with urban ecosystems, as long as appropriate threat mitigation measures are employed (Ovaska et al. 2004).

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

YES. Primary threats to the species and its habitat can be mitigated and/or avoided through recovery actions. Such recovery actions can reduce many existing threats, and have already been implemented for some sites, including minimizing the spread of invasive species, reducing road mortality, creating and/or enhancing safe nesting areas, and increasing recruitment and survivorship rates through head-starting at-risk nests.

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

YES. Captive breeding, head-starting, and release techniques exist and will be used to augment non-breeding populations at priority sites. Distribution objectives will be achieved through maintaining and restoring survival habitat as needed, as well as selecting replacement sites close by if existing ones cannot be restored.

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1 COSEWIC* SPECIES ASSESSMENT INFORMATION

Assessment Summary: November 2016
Common name: Western Painted Turtle - Pacific Coast Population
Scientific name: *Chrysemys picta bellii*
Status: Threatened
Reason for designation: The distribution of this population overlaps with an area of dense human population in southwestern British Columbia, including the Lower Fraser Valley, where wetland loss has been extensive. Across its range, this population continues to face multiple threats from habitat loss and alteration, road mortality, and introduced species, such as Bullfrog and introduced turtles. Survey efforts within the past 10 years have revealed many new localities, bringing the total number of occupied waterbodies to over 80, grouped within 39 clusters. However, the Canadian population and local subpopulations are small and many, especially in the Lower Fraser Valley, are declining or considered not viable. The long-term persistence of the Canadian population remains precarious.
Occurrence: British Columbia
Status history: Designated Endangered in April 2006. Status re-examined and designated Threatened in November 2016.

* Committee on the Status of Endangered Wildlife in Canada.
****** Common and scientific names reported in this recovery strategy/plan follow the naming conventions of the British Columbia.

2 SPECIES STATUS INFORMATION

Painted Turtle – Pacific Coast Population (*Chrysemys picta pop. 1)*[a]		
Legal Designation:		
FRPA:[b] No OGAA:[b] No	B.C. *Wildlife Act*:[c] Schedule A	SARA:[d] Schedule 1 - Endangered (2006)
Conservation Status[e]		
B.C. List: Red	B.C. Rank: S2 (2012)	National Rank: N2(2011) Global Rank: G5T2 (2007)
B.C. Conservation Framework (CF)[f]		
Goal 1: Contribute to global efforts for species and ecosystem conservation.		Priority:[g] 4 (2009)
Goal 2: Prevent species and ecosystems from becoming at risk.		Priority: 6 (2009)
Goal 3: Maintain the diversity of native species and ecosystems.		Priority: 2 (2009)
CF Action Groups:	Compile Status Report; Planning; List under *Wildlife Act*; Send to COSEWIC; Habitat Protection; Habitat Restoration; Private Land Stewardship; Species and Population Management	

[a] Data source: B.C. Conservation Data Centre (2014) unless otherwise noted.
[b] No = not listed in one of the categories of wildlife that requires 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 impacts of oil and gas activities on Crown land under the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008).
[c] Schedule A = designated as wildlife under the B.C. *Wildlife Act*, which offers it protection from direct persecution and mortality (Province of British Columbia 1982).
[d] Schedule 1 = found on the List of Wildlife Species at Risk under the *Species at Risk Act* (SARA).
[e] Red: Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in British Columbia. 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.
[f] Data source: B.C. Ministry of Environment (2010).
[g] Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority).

3 SPECIES INFORMATION

3.1 Species Description

True to its name, the Painted Turtle is a colourful species (Figure 1). The plastron (belly or bottom shell) is red or orange, with a combination of dark and light markings that form abstract designs similar to fingerprints or topographic patterning branching out along the scute margins (Macartney and Gregory 1985). The distinctive individual plastron pattern is present from hatching to maturity and allows for individual identification of Painted Turtles. The red or orange colouration is also visible along the marginal scutes (sides) and the lower edges of the carapace and plastron sides. The head is dark olive green, with irregular bright yellow markings extending from snout to neck along the sides and throat. Subadults and adults have a low-domed oval shell. The carapace (back or top shell) is smooth and unkeeled, and ranges in colouration from dark green to black-brown (Gregory and Campbell 1987). Hatchlings often have light, irregular lines visible on the carapace, and can form intricate net-like patterns especially in subadults (Conant and Collins 1998).

Figure 1. Underside of female 2-79 Painted Turtle – Pacific Coast Population, showing red-orange base colouration on plastron with abstract radiating dark lines. Note red on undersides of carapace. Photo by K. Welstead.

Male and female turtles are similar in appearance. Visual gender determination can only be made once the secondary sexual characteristics start to show (suggesting sexual maturity) around 3–4 years old for males (plastron length ≤ 84 mm) and around 8 years or older for females (plastron length > 156 mm) (Hayes *et al.* 2002). Females (150-250 mm in plastron length and with an

upper weight of 1940 grams) generally attain a greater length and weight than males (90 and 187 mm in length and weighing less than 1000 g (Cook 1984; Mitchell 1988; Iverson and Smith 1993; Blood and Macartney 1998; Currie and Mitchell, pers. comm., 2014). Mature males have much longer claws on the forefeet than do females (Stebbins 1966; Gregory and Campbell 1987).

The Painted Turtle co-occurs with the non-native introduced Red-eared Slider (*Trachemys scripta elegans*) in many areas of its range and may be confused with this species. Both species are similar in size and carapace colouration. However, Red-eared Sliders have more matte or rough shells, yellow marginal scutes; a yellow plastron covered in dark, blotchy markings; and a red ear mark located just behind the eye (although this ear mark is not always visible in older specimens) (Bunnell 2005).

3.2 Populations and Distribution

3.2.1 Distribution

The Painted Turtle, (*Chrysemys picta bellii*) has the largest distribution of four genetically and phenotypically distinct subspecies of Painted Turtles that collectively have a wide distribution in North America (Figure 2; Crother, ed. 2008). In Canada, the Painted Turtle *C.p. bellii* subspecies has been subdivided into three Designatable Units (DU) that are geographically separated (COSEWIC 2006). The DUs are the Prairie/Western Boreal – Canadian Shield Population, which spans several provinces (AB, SK, MB, ON); the Intermountain – Rocky Mountain Population, which is confined to the low-lying Rocky Mountain Trench and other lowlands of the southern Interior of British Columbia (*C. p.* pop. *2*); and the Pacific Coast Population (*C. p.* pop. *1*), which has a limited distribution occurring only in southwestern B.C.

In British Columbia, Jensen (2013a) used mitochondrial DNA from samples to define six genetically distinct clusters: three within the Intermountain – Rocky Mountain Population (Williams Lake, Kootneys and Thompson Okanagan) and three within the Pacific Coast Population (South Coast comprising Victoria and the Lower Mainland, Sunshine Coast (Sechelt area), and Upper Island Coast (Powel River and Port Alberni; Figure 3).

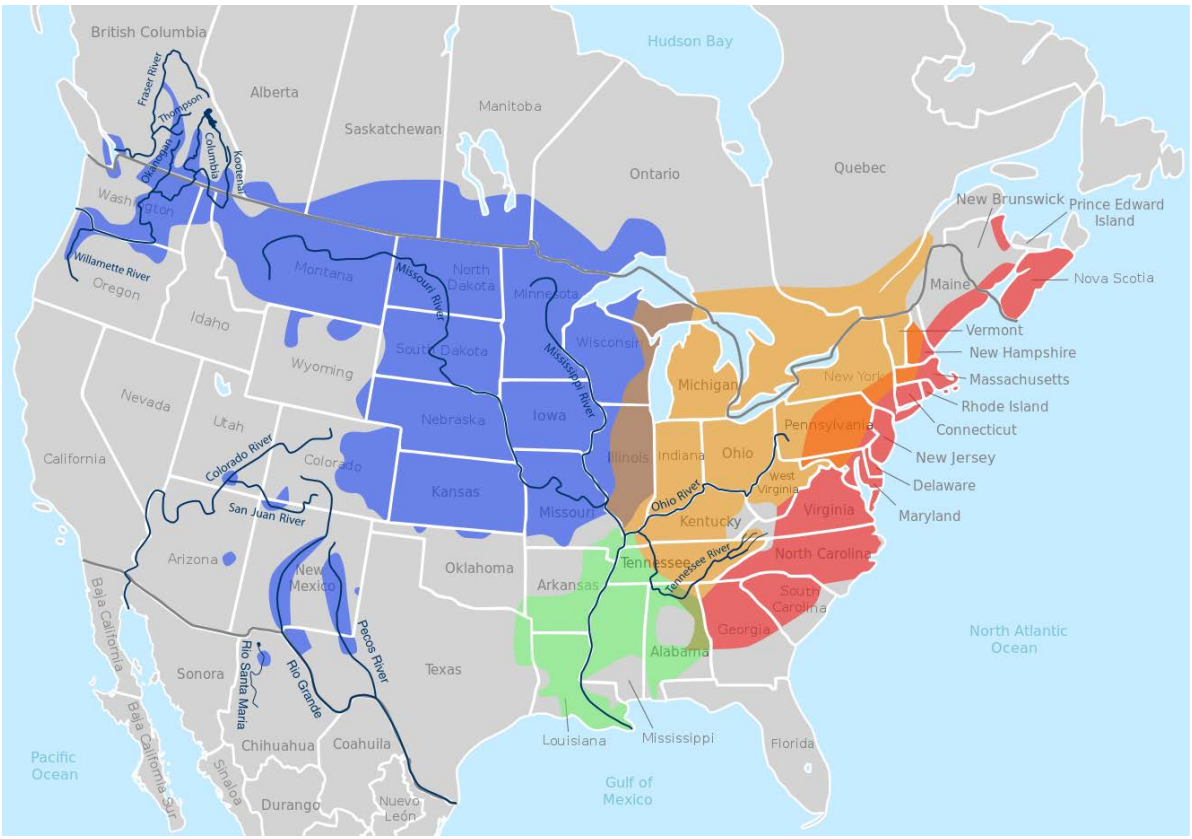

Figure 2. Distribution of Painted Turtles in North America. Source: Wikimedia Commons.
The Eastern Painted Turtle (*C. p. picta*) is in red, the Midland Painted Turtle (*C. p. marginata*) is centrally located in yellow, the Southern Painted Turtle (*C. p. dorsalis*), the smallest subspecies, is represented in green and the Western Painted Turtle (*C. p. bellii*) is in blue. Intergrade areas (shaded between the 4 subspecies) are where the subspecies have natural overlap in range and interbreed.

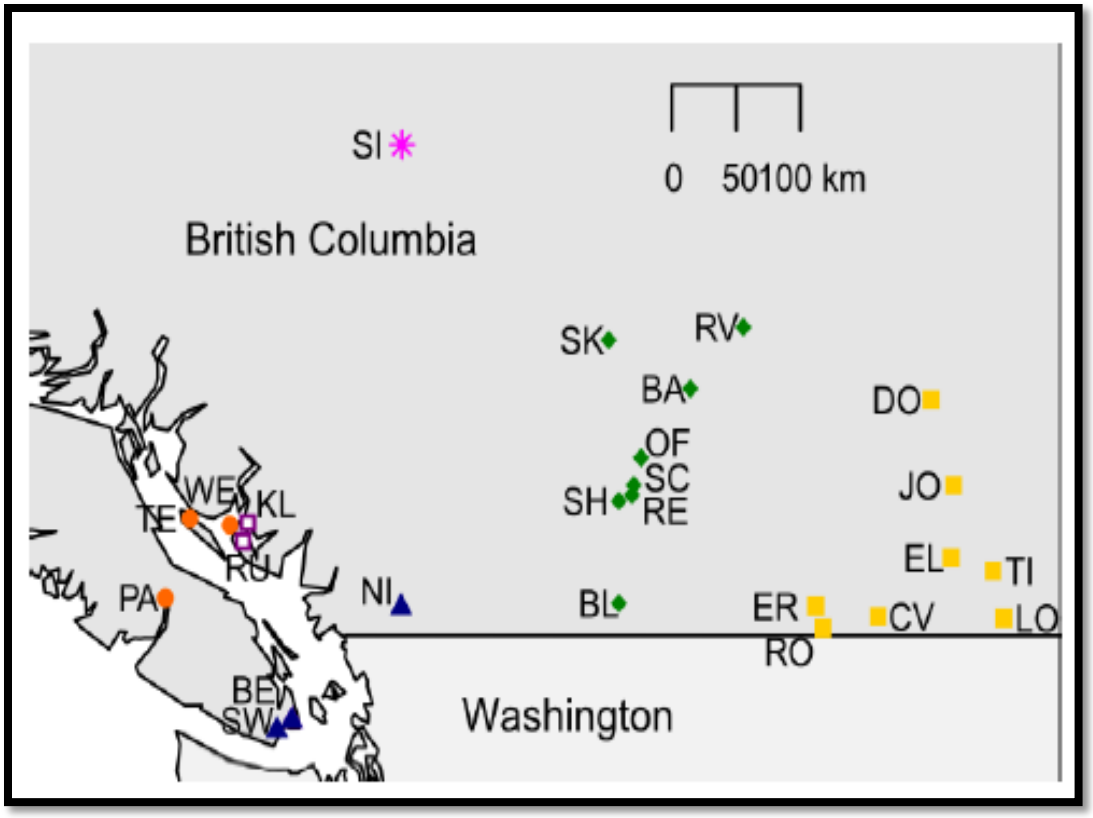

Figure 3. Map showing the 6 genetic clusters of Painted Turtle that are predicted to exist in British Columbia (from Jensen *et al*.2014).

The three genetic clusters within the Pacific Coast Population: South Coast (comprising Victoria and the Lower Mainland) blue triangles, Sunshine Coast (Sechelt area) pink open circles, and Upper Island/Coast (Powel River and Port Alberni) orange closed circles. Three Intermountain – Rocky Mountain Population clusters: Williams Lake shown as a pink asterisk, Kootneys yellow squares and Thompson Okanagan as green diamonds.

There are currently 37 known discrete population units for Painted Turtle – Pacific Coast Population (Figure 4; Appendix 1). This includes 36 population units where the Painted Turtle – Pacific Coast Population is known to be present[8] as well as one population unit with suitable habitat for recovery[9].These population units were based on the grouping of sites where it is reasonable for the species to move among sites (NatureServe 2014). To qualify as a distinct population unit NatureServe (2014) suggests a separation distance of 3 km for upland habitat, a separation distance of 10 km across more or less continuously joined suitable aquatic or wetland habitat and a separation distance of 5 km for intermediate situations. Separation barriers between population units may include large fast-flowing watercourse, salt water, large highways, non-traversable topography (cliffs), and urban areas. As most of the habitat in southwestern B.C. is

[8] May also include historical observations[8] (greater than 40 years old).
[9] The Painted Turtle – Pacific Coast Population has not been confirmed at this site; however, other Painted Turtles are present and the habitat is suitable for recovery.

heavily fragmented, we used a separation distance of 3 km to delineate population units. This is also supported by local telemetry data (see 3.3.6 Connecting Habitat for Dispersal section).

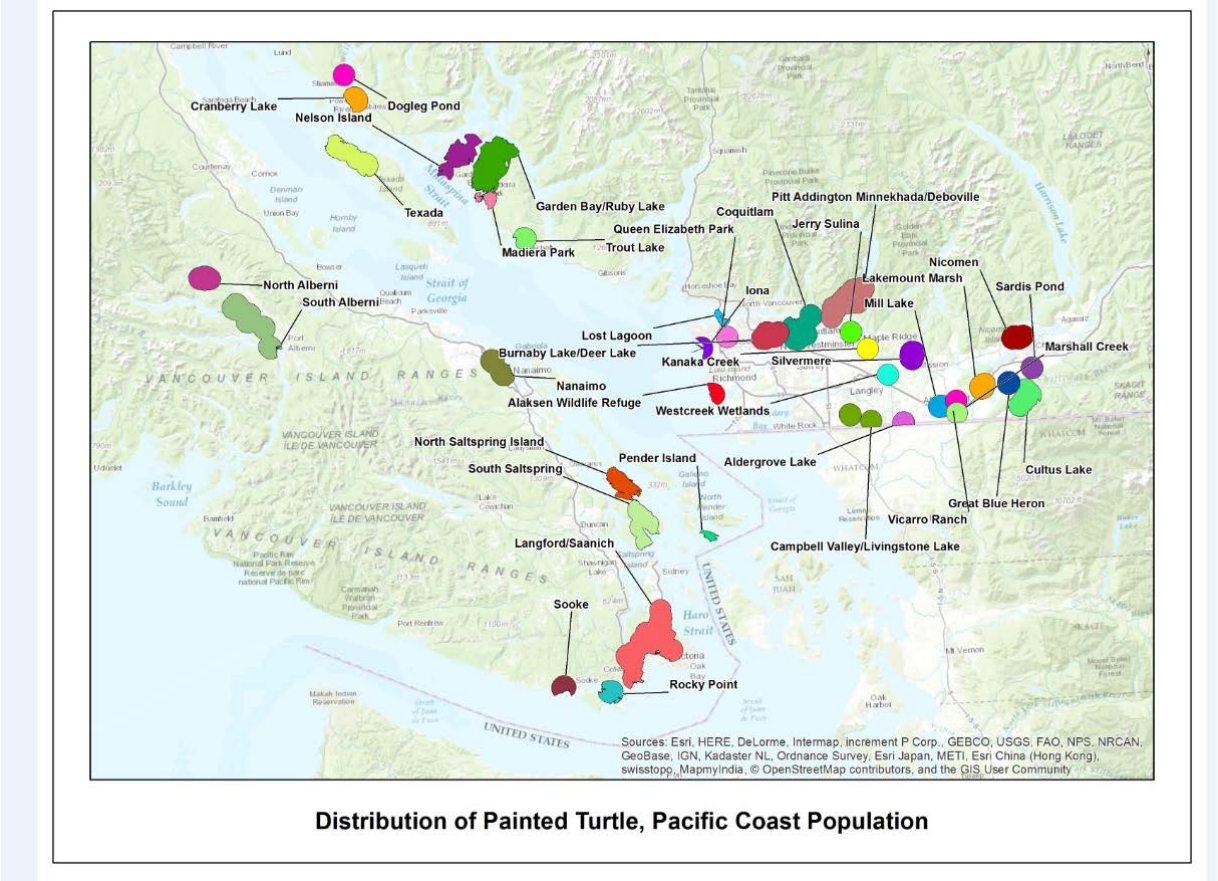

Figure 4. Distribution of Painted Turtle, Pacific Coast Population in British Columbia showing 37 population units[10] (as of Spring 2016).

Fossil records suggest that Painted Turtles have been widespread across over North America for 2–5 million years (Starkey *et al.* 2003). Bleakney (1958) shows a historical distribution of Painted Turtles that is similar to current records including those within southwestern B.C. Post-glacial dispersal was likely from a refugium in New Mexico and the species moved through Idaho into British Columbia.

Historical observations of Painted Turtles have shown up in field accounts from naturalists in southwestern B.C. since 1866 (Lord [1866] as cited in Cook *et al.* 2005; Thacker 1924; Percy 1974; Ham *et al.* 1986; Thompson 1997). Thacker (1924) described turtles in the Victoria area and in Port Alberni. Ham *et al.* (1986) described two turtle fragments, including a plastron fragment found at a 3500- to 4500-year-old archeological at the south end of the Alex Fraser Bridge (also see Welstead 2003). Percy (1974) also discovered a piece of turtle bone worked into a pendant, which was uncovered at a 1500- to 2500-year-old site on Crescent Beach. Thompson

[10] The Pender Island population unit contains potential recovery habitat for Painted Turtles but no turtles from the Pacific Coast Population have been found.

(1997) describes foreign mine workers eating turtle soup on Texada Island in 1898. In the absence of detailed historical distribution data, it is assumed that suitable habitat within the species extent is its historical range.

The historical evidence combined with the genetic results leaves no doubt that Painted Turtle – Pacific Coast Populations are indigenous to southwestern B.C. (McTaggart Cowan 1938; Carl 1952; COSEWIC 2006).

3.2.2 Population Trend

Population trend data are lacking since most occurrences are only recently known and historical distribution data are scant. Given life history traits of all turtles such as delayed maturity and low recruitment rates, there is an inherent delay in observation of population declines. Thus, declines in local populations are easily overlooked because seemingly abundant populations have few breeding adults and little or no recruitment. This could be due to limited suitable nesting habitat and/or increased egg and hatchling mortality (Klemens, ed. 2000; Browne and Hecnar 2007). The Painted Turtle – Pacific Coast Population is at particular risk because the majority of local populations appear to have few adults remaining in isolated sites concentrated in areas of high human density. For instance, of the 21 population units in the Lower Fraser Valley, only 6 are known to have any recruitment, while many of the sites consist of less than 5 individuals with no known recruitment (Mitchell *et al.* 2013b; Welstead, pers. comm., 2016), indicating population declines. In contrast, several sites on Vancouver Island have successful reproduction and appear to have at least some recruitment of young (Engelstoft and Ovaska, surveys in 2008–2012).

In healthy turtle populations, adult survivorship is usually very high, especially for females (Iverson and Smith 1993). However, survivorship of adults in human-dominated landscapes is usually much lower, and females are especially susceptible to high mortality due to increased movements through high-risk areas (roads, trails, lawns, etc.) during nesting (Klemens, ed. 2000). Compton (1999) estimated that the removal of three adult wood turtles (*Glyptemys insculpta*) annually would lead to the extinction of a hypothetical population of 100 individuals in only 50 years. This is likely similar to Painted Turtle populations. Population viability analysis was conducted at a site in Oregon that had an estimated population of 400 Painted Turtle individuals (Padilla 2007; Gervais et al. 2009). The population had a modest decline over 5 years ($u = -0.071$). With that modest decline, the median time to extinction ranged from 6 to 63 years. This could be applicable to several of our “larger” breeding sites such as Nicomen Slough, Elk/Beaver Lake, and some sites on the Sunshine Coast, all of which have population estimates around 350–400 individuals.

3.3 Habitat and Biological Needs

Painted Turtles occupy both aquatic and terrestrial habitats year round. In British Columbia, the Painted Turtle inhabits a variety of aquatic habitat types with open water and abundant aquatic vegetation, including lakes, shallow bays of larger lakes, open and forest ponds, marshes, river channels, riverine habitat, wetlands, bogs, roadside ditches, sluggish streams, and sloughs (Van Damme 2005; Engelstoft and Ovaska 2008; Kilburn 2010; Evelyn, unpubl. data, 2009). The Painted Turtle – Pacific Coast Population is known only from lower elevation waterbodies less

than 200 m (Kilburn 2010; Evelyn, unpubl. data, 2009). Suitable aquatic habitat is essential for basking (thermoregulation), foraging, overwintering, and breeding. Terrestrial habitat is essential for nesting including overwintering of nestlings, and dispersal of adults and sub-adults.

3.3.1 Foraging Habitat

For foraging, Painted Turtles prefer warm, shallow, slow-moving or stagnant water with ample emergent and floating vegetation, which provides basking sites, foraging opportunities, and cover (Sexton 1959; Blood and Macartney 1998; Ultsch 2006). They are opportunistic feeders and omnivorous throughout their lives, with adults tending towards herbivory while juveniles are generally more carnivorous (Bouchard and Bjorndal 2005). The presence of Painted Turtles is positively correlated with bottom substrates composed of organic material such as decaying vegetation and detritus (Marchand and Litvaitis 2004a). This type of substrate likely provides for more invertebrates and vegetation growth, which improves foraging opportunities. Painted Turtle growth rates are generally lower in waterbodies with inorganic or sandy bottom substrates, likely due to lower growth rates of aquatic vegetation and poorer foraging opportunities (Mitchell 1988; Marchand and Litvaitis 2004a). Painted Turtles cease foraging at water temperatures below 15°C (Ultsch 2006) thus water temperature above 15°C is needed for foraging.

3.3.2 Breeding Habitat

There are no specific habitat requirements for breeding as courtship and mating occur in the aquatic environment when turtles are active (Ernst *et al.* 1994), but a peak in copulation occurs in the late summer and early fall (Gist *et al.* 1990). Although turtles will use the entire extent of the waterbody for daily and seasonal movements, mating is thought to occur in the warmer margins.

3.3.3 Overwintering Habitat

Suitable habitat is essential for the survival of Painted Turtles over the 4–6 months of the year when they are vulnerable and sluggish during brumation (overwintering state of dormancy). Freshwater turtles have been known to experience mass mortality if only suboptimal overwintering sites are available (Taylor and Nol 1989; Ultsch 2006). Painted Turtles begin the transition to overwintering habitat when air temperatures consistently drop below water temperatures, generally around 10°C (Hayes, pers. comm., 2009).

Optimal overwintering conditions appear specific to site and climate but generally have the following characteristics: water depth between 0.5 and 3 m within 10 m of shore; submerged and large woody debris; and partially organic silty or sandy substrate (Evelyn and Stiles 2013; Mitchell *et al.* 2013a; Mitchell *et al*. 2014). When the data were pooled, all the identified overwintering sites had higher dissolved oxygen compared to random sites (Evelyn and Stiles 2013; Mitchell *et al.* 2014, also seen in Rollinson *et al*. 2008). Research shows Painted Turtles significantly prefer overwintering sites with submerged logs and abundant large woody debris (Evelyn and Stiles 2013; Mitchell *et al.* 2013a). One exception occurred on the Sunshine Coast where turtles overwintered in a reed bed with dense emergent and aquatic vegetation (Evelyn and Stiles 2013).

Turtles were mostly stationary from November to February in the Lower Mainland and Fraser Valley, with brumation estimated to start between late October and the end of November at mean water temperatures of 8.7°C (Mitchell *et al.* 2013a). Telemetry results from Burnaby Lake (*n* = 6) suggest that some Painted Turtles remain relatively active throughout temperate winter months, moving up to 250 m horizontally and between various depths (1–2 m). Turtles moved to their overwintering sites, which at Burnaby Lake consisted of the connecting watercourses (i.e., Still Creek, Deer Lake Brook, or Brunette River), at the end of August to the beginning of September (Gowans 2010) and remained there all winter. Turtles emerge from their overwintering sites when water temperatures become warmer than sediment temperatures, usually at about 6°C (Taylor and Nol 1989). Ovaska and Engelstoft (2011) found turtles in Swan Lake, Vancouver Island, overwintered in very shallow water at the same southeast corner of the lake in both winters they were tracked (2010/2011). Hayes (pers. comm., 2009) suggested that water depth is important to reduce the risk from terrestrial predators.

Communal overwintering areas have been observed at several sites, with multiple turtles using one area for overwintering. On the Sunshine Coast, 94% of the tagged turtles overwintered close together, suggesting deliberate selection of specific limited environmental requirements and/or a social behaviour (Evelyn and Stiles 2013).

3.3.4 Basking Habitat and Biology

Basking sites are critical for thermoregulation. Basking can be categorized into “aquatic” basking or “atmospheric” basking (Peterman and Ryan 2009). Aquatic basking is most common when the ambient aquatic and atmospheric temperature is high, such as late in the summer or late in the day. Aquatic basking involves floating on the surface sometime supported by aquatic vegetation. Atmospheric basking involves hauling out of the water and usually occurs when water temperature is lower than air temperature. Suitable basking sites may include emergent logs, floating vegetative mats, shoreline areas, rocks, and human-made objects. Floating basking sites located in deeper waters are usually preferred over shoreline basking sites due to the ease of underwater escape from predation. Despite this, turtles have been shown to use sloping banks when solar exposure is maximized in the morning or evening (Cadi and Joly 2003). Turtles usually show basking site fidelity and bask communally (Lefevre and Brooks 1995). Basking can occur at any time of the day but is more frequent in the morning and usually peaks around noon, especially in hotter weather in the summer (Lefevre and Brooks 1995). Therefore, basking sites are usually facing in a southerly direction to maximize exposure in cooler climates.

3.3.5 Nesting Habitat and Biology

Suitable nesting sites are characterized as having exposed soil with little vegetation on south-facing aspects, being on flat or gently sloping ground, and being located in areas of open canopy (Marchand and Litvaitis 2004b). Known natural nesting areas for the Pacific Coast Population include sandy/loamy riparian edges, banks, natural islands, sparsely vegetated old-field habitat, natural rocky bluffs, and the forest floor in areas of open canopy gaps. However, most of the known nesting sites for the Pacific Coastal population are on human-altered sites including gravel shoulders of roads, gravel pits, boat launches, recreational beaches, lawns and gardens, on and beside gravel trails (ATV/dirt bike) and driveways, dykes, and sandy campsites. Many of

these sites are communal nesting areas (Engelstoft and Ovaska 2008; Ovaska and Engelstoft 2009, 2010; Kilburn 2010; Evelyn, unpubl. data, 2009) (Figure 5).

Figure 5. Nesting female on a boat launch in Nicomen Slough. Eggs were taken into the head-starting program at the Great Vancouver Zoo. Photo: K. Welstead

Human-disturbed open areas often attract nesting female turtles (Marchand and Litvaitis 2004b). However, these types of habitats also attract subsidized predators[11], and nest predation in some turtle populations worldwide regularly reaches 100% (Klemens, ed. 2000). This level of nest predation has been recorded at some communal nesting areas on the south coast of B.C. (Ovaska and Engelstoft 2009; Kilburn 2010). Clark and Grueing (2002 report as cited in COSEWIC 2006) found that skunks depredated 80–100% of the eggs during a 3-year period at Elizabeth Lake in the B.C. Interior. Unprotected nests at Burnaby Lake are completely depredated often within the first 3 weeks of laying (Kilburn, pers. comm., 2009). However, at some sites predation rates are surprisingly low such as at Elk-Beaver Lake Park (Engelstoft and Ovaska 2008). Predation rates are inversely related to distance of the nesting site from water, where predator (e.g., Raccoon) activity is often concentrated, with the highest rates within 50 m of the water (Marchand and Litvaitis 2004b). Likely predators for our population include Skunks (*Mephitis mephitis*)**,** Raccoons (*Procyon lotor)*, Northwestern Crows (*Corvus caurinus*), dogs and other small predators[12].

A scarcity of nesting sites is often associated with clumped nests or a communal “nesting beach” or clumped nest sites may increase predation rates relative to more scattered nests that are harder

[11]Human subsidies in urban areas such as access to garbage and feeding have resulted in an increase in populations of some predators such as racoons and skunks that thrive in urban areas.

[12]Small mammal tunnels have been observed at nests at Burnaby Lake where hatchlings or eggs have gone missing or hatchlings have been found dead with signs of predation by small mammals (i.e., chewing marks, missing appendages) but the actual culprits are unknown

to detect (Marchand and Litvaitis 2004b). Human-made and managed nest-sites can balance these negative impacts through stewardship, monitoring, and implementing nest protection, which can result in nesting success (Welstead, pers. comm., 2014).

Figure 6. Neonates emerging from the nest in spring and occasionally in the fall. Photo: A. Mitchell.

Painted Turtle – Pacific Coast Population females nest from mid-May through mid-July (Engelstoft and Ovaska 2008; Ovaska and Engelstoft 2009, 2010; Kilburn 2010; Evelyn, unpubl. data, 2009). Females may also lay multiple clutches in one season. In 2013, females at Burnaby Lake were observed nesting in early (June) in the season and then again later in the season (July) in 4 out of 9 nests (Welstead, pers. comm., 2013). One female nested twice at Burnaby Lake amounting to 29 eggs laid in one season. An average of 10.4 eggs are laid per clutch in Cranbrook (Clarke and Gruenig 2003) but single clutches as high as 23 eggs have been observed in the Sunshine Coast and Vancouver Island (Welstead and Chatwin, pers. comm., 2012).

The Painted Turtle has temperature-dependent sex determination (TSD) (Janzen 1994). Eggs incubated at higher temperatures (constant temperatures ≥ 29°C) produce female hatchlings, whereas lower incubation temperatures (≤ 26°C) produce male hatchlings and at a pivotal temperature of 28°C, an approximately equal number of males and females are produced (Schwarzkopf and Brooks 1987). Eggs hatch in the fall and hatchlings generally overwinter in the nest and emerge (as neonates see Figure 6) the following spring (Mitchell 1988). In B.C., neonates generally emerge from the nest in April to mid-May; however, spring emergence occurs as early as March 18 on Vancouver Island (see Ovaska and Engelstoft reports 2008–2012) and as late as June 7 in the Lower Mainland (Kilburn 2010). Fall emergence occurs rarely and it is suspected that this is more likely when the summer has been hot and the fall remains warm. Early excavation of nests at Burnaby Lake in September 2013 showed hatchlings had moved close to the surface and most appeared ready to emerge (N = 135 hatchlings; Welstead, pers. comm., 2013). Given that neonates usually emerge in the spring, which is when nesting begins, nesting areas are often occupied 11–12 months of the year.

Soil composition affects soil temperature and moisture and thus influences successful egg development and hatchling overwinter survival. Across the range of the Painted Turtle, increased

survival to hatching is associated with decreased vegetation surrounding the nest (Weisrock and Janzen 1999). Roots of plants may grow through eggs and hatchlings and can cause complete mortality in some clutches (Maltby 2000; Welstead, pers. comm., 2016). Lower organic content in the nesting substrate increases survival because organic substrates contain ice-nucleating agents that may cause hatchlings to freeze and consequently die (Costanzo *et al.* 2000a; Hughes and Brooks 2006). Successful recruitment is positively correlated with increased amounts of clay in the substrate because clay binds moisture and prevents egg and hatchling desiccation; this simultaneously allows overwintering hatchlings to resist freezing and instead supercool (i.e., remain unfrozen at temperatures below the equilibrium freezing point of their body fluids) (Costanzo *et al*. 2000b; Packard and Packard 2001). Packard and Packard (1997) found higher mortality risks for hatchlings in sand only compared to clay or loamy sand at –7°C. Mortality rates as high as 45% (Nagle *et al.* 2000) can occur where soil temperature drops below –7 but mortality rates decrease significantly during mild winters or when the nesting site is insulated by snow and soil temperatures remain above –2°C.

On the south coast of B.C., where winter temperatures are mild and freezing of overwintering hatchlings is less of a concern, low organic content in nesting substrate may play less of a role in successful recruitment. Painted Turtles are known to choose a variety of soil types in which to nest, including clay, moist loam, clay loam, loam, sandy loam, loamy sand, and sand (Hughes and Brooks 2006). Loam soils (40% sand, 40% silt, and 20% clay) are likely to promote highest hatching success because these types of soils are easy to work, maintain high soil temperatures and moisture, and at the same time remain well drained (Costanzo *et al*. 2000b). Heavily compacted soils or soils with lots of coarse fragments may cause shell deformities as observed in some individuals at Nicomen Slough (Welstead, pers. comm., 2016).

Seasonal or human controlled water levels changes can also cause mortality if the nest chamber becomes inundated with water. Holte (1998) found increased mortality of Pond Turtles when inundation times increased and suggested it is an important factor to manage. Painted Turtles in B.C. select nesting sites where there is a lower risk of flooding, nesting high on the dykes and up-road embankments (Welstead, pers. comm., 2016).

Movements to nest sites

The distance that females have been observed moving to find suitable nesting sites is variable and may be dependent on the availability of suitable nesting habitat. While most Painted Turtles nest within 5 m of the occupied waterbody, in southwestern Quebec, nesting female Painted Turtles have been known to travel as much as 621 m from the water's edge to lay their eggs, although more routinely travelling an average of 100 m to find suitable sites (Christens and Bider 1986). In BC, researchers have found movement up to 150 m from the water (Gregory and Campbell 1987; St. John 2002). In the Vancouver area, most turtles are observed nesting 5–80 m from water, such as nest sites mapped at Nicomen Slough from 2010-14 (Welstead, pers. comm., 2014). Seasonal movements of turtles were studied at Nicomen Slough (Gielens *et al.* 2013). Overland movements were observed by the 5 tagged turtles which made occasional movements through fields and forest of 45–239 m from known water presumably for nesting or moving to a new watercourse (Engelstoft and Ovaska, pers. comm., 2013) observed a radio-tagged female turtle traveling 440 m from the lake along the creek to its nesting site across the highway. One turtle attempted to nest at 220 m from Burnaby Lake (Mitchell, pers. comm., 2013). In 2014, a

different turtle attempted to nest 190 m from water in a horse paddock (Welstead, pers. comm., 2014).

3.3.6 Connecting Habitat for Dispersal

Connectivity between waterbodies is essential to maintain metapopulation dynamics, maintenance of gene flow, and overall persistence of patchy populations (Harrison 1991). Painted Turtles will generally move between habitats to increase mate choice (males), to select habitat with better food or other resources, and (for seasonal movement) to reach overwintering or nesting areas.

Freshwater turtles are effective dispersers, regularly moving long distances. MacCulloch and Secoy (1983) have observed the length of river used by individuals averaged about 6 km in adult males (max. length 26 km), 3 km in adult females (max. length 8 km), and about 0.5 km in juveniles (max. length 1.5 km). The 26 km movement of adult males is farther than that reported in most studies, which cite movements of approximately 3–3.3 km, or less (Bowne *et al.* 2006). In Kansas, House *et al.* (2010) found distance traveled was 266–3275 m for males, 230–1284 m for females, and 266–2734 m for juveniles. Gregory and Campbell (1987) also suggested that Painted Turtles would travel distances of up to 3 km between sites. This is supported by Ballin's research (pers. comm., 2012) in the Shuswap region, which demonstrated the movement of a single individual between Niskonlith Lake to Nan's Pond (2080 m distance), presumably to overwintering habitat. Daily movement of a radio-tagged turtle recorded in the Lower Mainland showed average movement of 97.8 m within 2 hours, with a maximum of 582 m traveled in a 2-hour period. From July to March, one individual moved a straight-line distance of 2 km, traversing four sloughs and ending up in a small wetland (Kilburn and Mitchell 2011).

Because of this long-distance movement, wetlands do not contain demographically independent populations; instead, source–sink dynamics (Pulliam 1988) may best explain freshwater turtle populations. For instance, turtles must move between patches of varying quality and therefore often choose larger, less-isolated wetlands (Attum *et al*. 2008), depending on their life-cycle needs and in response to changing environmental conditions (Roe and Georges 2007; Bowne *et al.* 2006). Because of the naturally patchy distribution of wetland habitat, some authors suggest that local freshwater turtle populations exist as metapopulations (Burke *et al.* 1995; Joyal *et al*. 2001) and that the wetland complex should be the unit of conservation. Movement can be impeded by geographic features, roads, and other barriers, and by human interference (collection/moving). This suggests a conservative population separation distance of 3 km is justified. Thus, the recovery team defines its population units as sites within 3 km that are not geographically constrained or isolated owing to habitat modification.

3.4 Summary of Biophysical Attributes

Table 1. Summary of essential functions, features, and attributes of Painted Turtle – Pacific Coast Population habitat in British Columbia.

Life stage	Function[a]	Feature(s)[b]	Attributes[c]
Neonates, juveniles, adults	**Basking** generally Mar. to Oct. provides thermoregulation, control of ectoparasites, metabolic and digestion requirements, predator avoidance, egg development before laying, shell and skin maintenance for synthesising calcium/Vitamin D	Aquatic or shoreline habitat	• Exposure to sunlight (southern exposures are preferable) • Aquatic basking o aquatic vegetation (may be used for support) o deeper waters (often 1-2 meters) preferred due to ease of escape from predation) • Atmospheric basking o aquatic areas or shoreline areas o Supports to rest on such as large wood or logs, emergent objects, floating mats/islands of vegetation, rocks, and human-made objects (e.g. swimming platforms, docks, overturned boats etc.)
Neonates, juveniles, adults	**Daily Movements and Dispersal** generally Mar. to Oct. movement through the winter has also been detected during warmer days.	Aquatic habitat	• Slow-moving watercourse/ waterbodies (e.g., marshes, sloughs, ditches, ponds) including deep areas of the waterbody – for daily movement between habitat features • No barriers to movement
Neonates, juveniles, adults	**Foraging**	Shallow, slow-moving or stagnant water	• Shallow water (less than approximately 2 meters) • Slow-moving or stagnant water (areas with no strong currents) • Warm water, often above 15°C • Generally waters with detritus, silt, or organic/substrates that support invertebrates and vegetation • Adequate quantity of prey (crayfish, aquatic invertebrates, tadpoles) and aquatic plants (emergence and non-emergent)
Neonates, juveniles, adults	**Breeding** Courtship and mating is thought to occur both in the fall and spring.	Shallow margins of waterbodies or watercourses.	• Shallow water (less than approximately 3 meters) • Warm water (greater than 10 degrees Celsius) • Silty or sandy substrate (not rock/gravel)
Eggs, hatchlings, neonates (emergence), adult (for nest selection)	**Nesting** occurs mid-May through mid-July but nests are occupied Mid-May to mid-April of the next year (11 months).	Open terrestrial habitat	• Open areas with exposed soil and little to no vegetation (roadways, fields, paths, beaches, erosion areas, etc.), • Loose to dense soil, sand, gravel or silt, low organic content e.g. sand,

Life stage	Function[a]	Feature(s)[b]	Attributes[c]
			clay and silt) • Generally flat or sloped areas with good drainage (no pooling water), • Warm, south-facing aspects with light exposure
		Riparian habitat	Localized bank stability (to ensure water quality and quantity)
Adults and juveniles	**Dispersal** allows gene flow between sites, seasonal movements, movements to brumation sites, increase frequency of mate encounters, ability to leave poor or impacted habitat. (generally Mar. to Oct.)	Terrestrial habitat	• Preferably natural suitable cover such as forest, riparian vegetation, • No barriers to movement (dispersal) • Traversable habitat including open fields, forest, old-field habitat, shrubs, etc.
Adults, juveniles, neonates (that emerged in the fall)	**Overwintering / Brumation** (Oct. to Mar.)	Aquatic habitat	• Water depth often within 0.5–3 m • Often within 10 m of the shore • Dense emergent vegetation, tussocks or vegetation mats, within shallow water or muddy areas • Higher than average dissolved oxygen content • Submerged and large woody debris • Partially organic silty or sandy substrates • Temperatures that do not drop below freezing

[a] **Function** is a life-cycle process of the species.
[b] **Features** are the essential structural components of the habitat required by the species.
[c] **Attribute** are the building blocks or *measurable* characteristics of a feature.

3.5 Ecological Role

The Painted Turtle is the only remaining native freshwater turtle species in B.C. and is thus a significant element in the overall biodiversity of the province (COSEWIC 2006). Painted Turtles are omnivorous and consume a wide range of invertebrate and small vertebrate prey, herbaceous material, carrion, and other decaying organic matter (Bouchard and Bjorndal 2005). Turtles serve an important role in nutrient retention and cycling in a freshwater ecosystem essential for primary producers. They also help in aquatic vegetation control, and keeping water clean by scavenging and cycling of dead animals (Gregory and Campbell 1987). Although the impacts of turtles on fish stocks is negligible, turtles may prey on weak and sick individuals, thus keeping fish stocks healthy and strong (Lagler 1943). Turtles disperse seeds of aquatic plants (Lagler 1943) as seeds that have passed through turtles remain viable. Turtles also serve to control invertebrate populations including midges and mosquitoes (Knight and Gibbons 1968).

The eggs, hatchlings, and juvenile turtles serve as prey for Great Blue Heron (*Ardea herodias fannini*) (COSEWIC 2006). Furthermore, populations at northern range limits such as the Painted Turtle – Pacific Coast Population are critical sources of genetic variation for potential, future

adaptation to changing environmental and climate conditions. This is especially true of northern populations in the face of global climate change (Lesica and Allendorf 1995).

3.6 Limiting Factors

Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to recovery/conservation efforts (e.g., inbreeding depression, small population size, and genetic isolation).

Low Reproductive Rate
Painted Turtles are long-lived (≤ 50 years) with delayed sexual maturity and low annual recruitment/low survivorship of hatchlings (Iverson and Smith 1993; Blood and Macartney 1998). These characteristics stem from naturally high and unpredictable levels of embryo, hatchling, and juvenile mortality (Stearns 1976). Population maintenance is thus dependent on high sub-adult and adult survival rates (Klemens, ed. 2000) and has limited ability to recover if there is high adult mortality.

Limited Habitat Suitability and Connectivity
As a species at the northern limit of its range, Painted Turtle populations in British Columbia are constrained by limited suitable habitat and geographic barriers, making them highly susceptible to human-induced threats (i.e., roads and other human-caused mortality factors) (Blood and Macartney 1998). Although Painted Turtles are aquatic habitat generalists, they require a combination of aquatic and terrestrial habitats that are connected. In many areas of B.C.'s south coast, habitat connectivity has been lost. The creation of dense road networks poses a severe mortality risk to individuals that attempt to disperse overland between sites needed to support meta-population dynamics. Additionally, female turtles are attracted to human disturbed areas such as roads for nesting (Klemens, ed. 2000). There are only a few sites in the population where natural nesting areas of open canopy near waterbodies remain. Most open areas adjacent to waterbodies have been modified for human use in the form of beaches, dykes, trails, roads, boat launches, and lawns. Many of these modified open areas where turtles are currently nesting serve as ecological sinks for the local population, especially at communal nesting sites where disturbance by humans, pets, and subsidized predators results in limited or no population recruitment (Ovaska and Engelstoft 2009, 2010; Kilburn 2010).

Genetic Distinctiveness
Recent studies have demonstrated the genetic distinctiveness of three clusters in the Pacific Coast Population (Jensen 2013a, b: Jensen *et al.* 2014). Preservation of this distinctiveness limits rescue options for these particular populations. Genetic drift or inbreeding is a concern for small individual populations (Jensen 2013a, Frankham et al. 2002) as there is little gene flow among individual sites within genetic clusters even between sites well within the dispersal range of the species (Jensen 2013a, Jensen *et al.* 2014). Many sites support only a few individuals and there is ongoing threat of the loss of genetic diversity as these individuals are lost.

4 THREATS

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause 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 our threat assessment, only present and future threats are considered.[13] Threats do not include limiting factors, which are presented in Section 3.6, Limiting Factors.[14]

For the most part, threats are related to human activities, but they can also be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., introduction of invasive species). Effects of natural phenomena (e.g., fire, flooding) may be especially important when the species is concentrated in one location or has few occurrences, which may be a result of human activity (Master *et al.* 2012). As such, natural phenomena are included in the definition of a threat, though they should be considered cautiously. These stochastic events should only be considered a threat if a species or habitat is damaged from other threats and has lost its ability to recover. In such cases, the effect on the population would be disproportionately large compared to the effect experienced historically (Salafsky *et al.* 2008).

[13] 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- and/or short-term trend factors (Master *et al.* 2012).

[14] 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 (e.g., inbreeding depression, small population size, and genetic isolation).

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. For a detailed description of the threat classification system, see the Open Standards website (Open Standards 2014). 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.* (2012) and table footnotes for details. Threats for the Painted Turtle – Pacific Coast Population were assessed for the entire province (Table 2).

Table 2. Threat classification table for Painted Turtle – Pacific Coast Population (*Chrysemys picta pop. 1*) (as of January 2016).

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Medium	Restricted	Serious	High
1.1	Housing & urban areas	Medium	Restricted	Serious	High
1.2	Commercial & industrial areas	Low	Small	Extreme	High
1.3	Tourism & recreation areas	Low	Small	Moderate	High
2	Agriculture & aquaculture	Low	Small	Moderate	High
2.1	Annual & perennial non-timber crops	Low	Small	Moderate	High
2.3	Livestock farming & ranching	Low	Small	Moderate	High
3	Energy production & mining	Low	Small	Moderate-slight	High
3.2	Mining & quarrying	Low	Small	Moderate-slight	High
4	Transportation & service corridors	Medium	Pervasive	Moderate	High
4.1	Roads & railroads	Medium	Pervasive	Moderate	High
5	Biological resource use	Low	Large	Slight	High
5.1	Hunting & collecting terrestrial animals	Low	Large	Slight	High
5.3	Logging & wood harvesting	Low	Restricted	Slight	High
5.4	Fishing & harvesting aquatic resources	Unknown	Large	Unknown	High
6	Human intrusions & disturbance	Low	Pervasive	Slight	High
6.1	Recreational activities	Low	Pervasive	Slight	High
6.3	Work & other activities	Low	Small	Moderate-Slight	High
7	Natural system modifications	Medium-low	Large	Moderate-slight	High
7.2	Dams & water management/use	Medium-low	Large	Moderate-slight	High
7.3	Other ecosystem modifications	Low	Small	Slight	High
8	Invasive & other problematic species & genes	High-Medium	Pervasive	Serious-Moderate	High
8.1	Invasive non-native/alien species	High	Pervasive	Serious-Moderate	High
8.2	Problematic native species	Unknown	Pervasive	Unknown	High

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
9	Pollution	Unknown	Pervasive	Unknown	High
9.1	Household sewage & urban waste water	Unknown	Pervasive	Unknown	High
9.2	Industrial & military effluents	Unknown	Small	Unknown	High
9.3	Agricultural & forestry effluents	Unknown	Restricted	Unknown	High
11	Climate change & severe weather	Unknown	Pervasive	Unknown	Moderate
11.2	Droughts	Unknown	Pervasive	Unknown	Moderate
11.3	Temperature extremes	Unknown	Large	Unknown	Moderate
11.4	Storms & flooding	Unknown	Large	Unknown	Moderate

[a] **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 stress 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%).

[b] **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%)

[c] **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 3-generation timeframe. For this species a generation time of 15 years (COSEWIC 2006) was used resulting in severity being scored over a 45 -year timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%)

[d] **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 Very High-High.[15] This overall threat considers the cumulative impacts of multiple threats. The major threats include the loss of aquatic and riparian habitat through residential, agricultural, and industrial development; road expansion and vehicular mortality; collecting for consumptive use and pet trade; and non-native and invasive species (Table 2). Details are discussed below under the Threat Level 1 headings.

Threat 1. Residential & commercial development

1.1 Housing & urban areas; 1.2 Commercial & industrial areas

Habitat loss due to residential and commercial development is an increasing threat for the Painted Turtle – Pacific Coast Population as human population densities increase in the region. This threat is most severe in the Lower Mainland/Fraser River Valley, southeast Vancouver Island, and on some Gulf Islands. In these areas, few suitable waterbodies remain due to historical conversion of aquatic habitat through draining and filling of wetlands and shallow lakes. Habitat loss is a continuing process. For example, on Kettle Lake in Langford (Vancouver Island) an industrial development project is threatening the local population (Engelstoft, pers. comm., 2015). To exemplify the problem, wetland loss in the Fraser River Delta has been estimated to be as high as 87% (Boyle *et al.* 1997). Most remaining occupied waterbodies are located in urban parks and are isolated by extensive urban development, including houses and residences, commercial and industrial areas, and roads. The concentration of urban development surrounding remaining waterbodies also results in limited recruitment of large woody debris into aquatic habitat, impacting turtles by reducing basking opportunities (Annschild, pers. comm., 2010). In addition to the direct impacts of urbanization through habitat loss, residential and commercial development leads to additional threats that impact the Painted Turtle – Pacific Coast Population, including: transportation and service corridors (Threat 4), biological resource use (Threat 5), human intrusions and disturbance (Threat 6), natural system modifications (Threat 7), invasive and other problematic species and genes (Threat 8), and pollution (Threat 9).

1.3 Tourism & recreation areas

As well, the installation of docks and other recreational features such as swimming docks may impact habitat availability and usage of shoreline habitat. This is an increasing concern particularly for the Sunshine Coast population where cottage users have been observed building docks across entire bays on Lake Sakinaw but is also a growing concern on other “cottage” lakes such as Ruby Lake and Garden Bay (Welstead, pers. comm., 2016).

Threats may still exist in areas designated as parks and protected areas due to recreational development. Most municipalities have bylaws that minimize the loss of aquatic ecosystems,

[15] 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, which included 3 High, 1 High-Medium, 2 Medium, and 3 Low (Table 2).The overall threat impact considers the cumulative impacts of multiple threats.

especially under park management; however, degradation of these aquatic ecosystems through poor stream and riparian management practices is common (Bodie 2001)

Threat 2. Agriculture & aquaculture

2.1 Annual & perennial non-timber crops

New agricultural methods in the Fraser Valley tend to be more intensive than traditional agriculture. For instance, large-scale greenhouses that cover a majority of a property can create a barrier to turtle dispersal and render the land unusable as habitat. Additionally, many farmers now use frequent ploughing (increasing risk of mortality or injury) and occasionally employ plastic soil coverings (e.g., between the rows of blueberry plants) to control weeds. When the soil is covered with impermeable materials, the field becomes less natural (compared to exposed soil) and likely reduces dispersal. These increases in land use may have impacts at several sites (e.g., Alaksen, Marshall Creek, Nicomen Slough). Cranberry cultivation sometimes uses adjacent water to flood the field in the fall during harvest time, which can cause drawdowns in occupied watercourses (Pitt Addington). Water diversion due to irrigation and ditching, as well as watercourse infilling removing habitat still occurs in the South Coast region.

2.3 Livestock farming & ranching

With increasing livestock production, farm buildings are built larger and more densely cover the land. This increase in infrastructure intensifies land use pressure around occupied turtle sites impacting their dispersal across the landscape.

Threat 3. Energy production &mining

3.1 Mining & quarrying

Quarrying is a concern at several sites as turtles will use the substrate for nesting if it is close to occupied habitat and subsequent gravel removal may lead to direct mortality of eggs and hatchlings/neonates. A quarry and associated road near Nicomen Slough used for dyking materials is occasionally used as a nesting area and could be subject to direct impacts (Mitchell, pers. comm., 2014; Welstead, pers. comm., 2016). In the Alberni Valley, inactive gravel pits near lakes occupied by the Painted Turtle – Pacific Coast Population are used as communal nesting sites. These gravel pits could potentially be re-activated in the future. The gravel company is aware of the nesting activities by the Painted Turtles - Pacific Coast Population and is currently taking steps to protect the sites (Engelstoft, pers. comm., 2015).

Threat 4. Transportation & service corridors

4.1 Roads & railroads

As human population density increases, traffic, road density also magnify, and therefore the development of transportation infrastructure is an increasing threat. Transportation and service corridors restrict movement between habitats and/or cause direct mortality when turtles travel between waterbodies (Bowne *et al*. 2006). This threat is particularly severe on the Lower Sunshine Coast and on Salt Spring Island where roads parallel occupied wetlands (Annschild,

pers. comm., 2015; Evelyn, pers. comm., 2015). Garden Bay was occupied by over 100 turtles and now has less 10 individuals. This reduction is likely due to the increase in traffic in the area (Evelyn, pers. comm., 2015). During a single nesting season, 17 turtles (most likely nesting females) were killed in a 50 m section of road on Ruby Lake Lagoon (Evelyn, pers. comm., 2015). Providing an alternate nesting beach for turtles at Ruby Lake has dropped the mortality rate to 1–2 turtles per year (Kilburn *et al*. 2011). The dyke road is the main nesting area at Nicomen Slough and nests have also been found in a road turn-around area (Mitchell, pers. comm., 2013; Welstead, pers. comm., 2013). Mechanical maintenance of vegetation and herbicide use are also concerns for nesting and emerging turtles and incubating eggs. The dyke road where the Nicomen Slough population nests is subject to grading and vegetation removal using heavy equipment that may inadvertently result in injury or mortality. Female turtles generally move overland while searching for nesting sites and road mortality of female turtles has a pronounced negative demographic effect (Steen and Gibbs 2004). Females are often attracted to road embankments along wetlands because of the loose soil and gravel composition of the terrain, the open aspect, and the lack of vegetation (Kolbe and Janzen 2002). However, nests laid along roadsides are likely to have limited recruitment due to nest burial, resulting in crushing of eggs or the death of overwintering neonates during routine road maintenance, as well as road mortality of hatchlings leaving the nests in the spring (Klemens, ed. 2000).

Road infrastructure also causes indirect impacts through the isolation of local population patches (Hitchings and Beebee 1997; Knutson *et al.* 1999). If turtles are unable to move safely between habitat patches due to anthropogenic landscape fragmentation and its associated threats, local patchy turtle populations become genetically isolated over time. When patch extinctions occur, colonization of new patches becomes unlikely (Hanski and Simberloff 1997). The patch extinction process is likely to be hastened by processes like disease introductions if patches contain populations of limited genetic variability (Joyal *et al*. 2001). The gene flow between local populations of the Painted Turtle – Pacific Coast Population is limited in many areas (Jensen 2013a; Jensen *et al.* 2014). The reason for this is unclear but at some sites it is likely due to limited habitat connectivity or barriers to dispersal.

Railroads pose an increasing threat with the increase in transport of crude oil, propane, and coal in the Fraser Valley. Ports are expanding in the Fraser Valley with quadrupled rail traffic to ports projected over the next 10 years (Cattaneo 2014). In addition, “in Canada in 2009, there were only 500 carloads of crude oil shipped by rail; in 2013, there were 160,000 carloads” (TSB 2014).” This poses a risk of direct mortality from nesting on tracks as well as train derailments and spills such as that occurred in 2014 at Burnaby Lake (Welstead, pers. comm., 2016). The threat could be substantial where rail runs adjacent to populations (e.g., Nicomen Slough, Burnaby, Sunshine Coast – Ruby Lake).

Threat 5. Biological resource use

5.1 Hunting & collecting terrestrial animals

The extent to which Painted Turtle eggs, hatchlings, juveniles, and adults are collected for food or as pets is unknown. However, from anecdotal reports (from private landowners, park visitors, local naturalists, and internet searches) it appears as though collection and subsequent movement of turtles to different locations is a threat to the species at some sites across its range (e.g.,

Burnaby Lake, Katherine Lake, Cranberry Lake). Collection of adult females would be most likely since females move during nesting and are out in the open. Removal of adult females from a given population is likely to have serious effects on population size and viability over the long term (see Section 3.6, Limiting Factors). Poaching of adults has been observed at Deer Lake (Welstead, pers. comm., 2013) and is suspected at Nicomen Slough (Gielens, pers. comm., 2015). Although it is unlikely that there will be another large food trade market for turtles, some cultures in B.C. continue to consider turtles a harvestable food item. Hatchlings were known to have been removed at one site in the Sunshine Coast (Evelyn, pers. comm., 2009).

5.3 Logging & wood harvesting

Forestry impacts are restricted to a few sites on the Sunshine Coast and in the Alberni Valley of Vancouver Island (Ovaska and Engelstoft 2009; Evelyn, unpubl. data, 2009). Watercourse regulations generally only require a riparian buffer of 30 m during harvest, which is not sufficient for protecting upland habitat needed for nesting (Semlitsch and Bodie 2003). In addition, forestry practices usually require logging road creation, resulting in road-related impacts to turtle populations at occupied sites (see Threat 4). Upstream of Nicomen Slough a landowner is clearing his property for timber (Welstead, pers. comm., 2016). This unregulated resource extraction can lead to erosion, loss of buffer, sedimentation, and geo-hazards.

5.4 Fishing and harvesting aquatic resources

Fishing and fish stocking are other threats to Painted Turtle populations at many sites (North, Klein, Deer, Burnaby, Trout, Aldergrove, Alouette, Errock, Mill, Divers Lake, Cathers Lake and Como lakes). Impacts come from direct mortality of hatchings from fish, especially when brood stock (full-grown fish) are directly released (e.g., Mill Lake) as well as other indirect impacts (see Recreational use section Threat section 6.1).

Threat 6. Human intrusions & disturbance

6.1 Recreational activities

The effects of human disturbance on turtle populations are most pronounced during the nesting season and at nesting sites (Klemens, ed. 2000). Disturbance of nesting female turtles can result in nests being laid in poor habitat resulting in reduced survival or fitness of eggs and hatchlings (Maltby 2000). Because turtles choose south-facing, open locations for nest laying, they are often competing for this space with recreationists. At several lakes on the Sunshine Coast, turtles lay their eggs on busy public beaches; these eggs are often crushed or dug up (Evelyn, pers. comm., 2009). Human pets, especially dogs, also pose a threat at nesting sites. At Burnaby Lake and at North Lake on the Sunshine Coast dogs repeatedly dig up turtle nests at nesting beaches (Kilburn, pers. obs. 2011).

In a 20-year study, two wood turtle (*Glyptemys insculpta*) populations declined precipitously following the opening of an otherwise remote area to human recreation, due to road mortality of reproductive females; increased predation by human commensal species like dogs, raccoons, and skunks; and removal of individual turtles by humans for pets (Garber and Burger 1995). Development for tourism resulted in habitat loss and increased impacts from human intrusions at turtle occupied sites on the Sunshine Coast and Salt Spring Island (Evelyn, pers. comm., 2010). Recreational use of off-road vehicles impacts some turtle nesting sites. For example, at Nicomen

Slough turtles nest along an ATV trail leading down to the water (Welstead, pers. comm., 2013). Hiking/cycling along paths at occupied sites may also have an impact since gravel paths are often used by nesting turtles (Marchand and Litvaitis 2004b). These activities often result in reduced recruitment through direct mortality due to compression of the nest chamber when soils are compacted. In addition, the disturbance during nesting has been frequently noted at Burnaby Lake and Buttertubs Marsh where turtles abandoned nesting attempts because of the presence of pedestrians and dogs. Recreational boating is also a likely threat to the Painted Turtle – Pacific Coast Population at some occupied sites due to disturbance of basking turtles (Gordon and MacCulloch 1980).

Indirect impacts from recreational fishing include damage to riparian vegetation from trampling and disturbance during nesting and basking. For instance, an angler was observed setting up a picnic chair and umbrella right on top of an occupied nesting site at a signed and fenced nesting beach at Burnaby Lake (MacTavish, pers. comm., 2013; Mitchell, pers. comm., 2013). Population impacts from motorized and non-motorized recreational fishing are known in a number of species of freshwater turtles, including Painted Turtles, Map Turtles (*Graptemys geographica*), and Red-eared Sliders (*Trachemys scripta elegans*). Impacts include changes in basking behaviour (due to noise and wake) and direct mortality when turtles ingest hooks and/or are injured or killed by watercraft propellers (Gordon and MacCulloch 1980; Smith *et al.* 2006). Injury or mortality from fish hook captures or injuries is a threat at several sites. For instance, in 2014, three turtles were captured and brought into vets with fish hooks embedded in their mouths; two will be partly blind because of these injuries (Welstead, pers. comm., 2016). The last native turtle to be seen at Como Lake died because of a fish hook injury (Kilburn, pers. comm., 2010).

Increased on-lake human access for recreational use could limit basking opportunities for the turtles, increase disturbance at nesting sites, and lead to an increase in collection of these animals for pets (see Threat 5.1). A number of bylaws and approaches that are available to various municipalities in the range of the Painted Turtle – Pacific Coast Population can be used to protect rare and sensitive species and ecosystems (Environmental Law Clinic *et al*. 2007).

6.3 Work and other activities

Dredging, and mechanical clearing of lilies using lily cutters, weed tow boats, harvesters, or shedders is a concern in Burnaby Lake and Mill Lake. This mechanical removal not only reduces the habitat structure but may also cause direct mortality to juvenile turtles basking on the vegetation surface.

Threat 7. Natural system modifications

7.2 Dams & water management/use

Natural systems are commonly modified for human benefit in human-dominated landscapes, and many modifications are known to impact freshwater turtle populations. Water management and damming can both create habitat but also put it at risk. At some sites (e.g., Burnaby Lake) turtles have become trapped downstream in unsuitable habitat as a result of a dam. Regulating flow and water levels can impact freshwater turtles by causing nest inundation. This in turn results in destroying embryos and/or hatchlings in nests and or killing overwintering turtles through

disturbance during the winter months (Bodie 2001). It is not known to what extent dams and water level regulation negatively impact turtles at managed waterbodies on the south coast of B.C. However, given that turtles require slow-moving warm water, changes in flow could result in the loss of overwintering sites and foraging/mating habitat.

In addition to dams and water management/use, Bodie (2001) identified eight ecosystem modification practices that negatively affect freshwater turtles globally. All of these practices apply to at least some subpopulations of the Painted Turtle – Pacific Coast Population. The following activities can damage habitat or cause sudden water flow and depth changes, which may impact overwintering turtles, and nesting and basking sites: removal of logjams, clearing of culverts, artificial channelization, changes in water velocities that often cause direct mortality through the dredging process, reduction of sand bars and beaches for nesting, stabilization of natural erosion areas, and management for monotypic conditions as is done in some locations for fish species resulting in low diversity of stream geomorphology like water velocity and depth.

7.3 Other Ecosystem Modifications

Invasive vegetation removal (terrestrial and aquatic) can be a concern where such vegetation is providing predator protection (e.g., blackberries) or screening from human disturbances. Ditch clearing to remove reed canarygrass may inadvertently cause mortality for turtles that use the ditches to traverse habitats.

Dredging is known to be very detrimental to turtle populations (Aresco and Gunzburger 2004), and dredging in the winter could cause significant mortality if hibernating turtles are not adequately protected. Dredging has been a concern at several sites (Lakemount Marsh, Burnaby Lake, Minnekada). Dredging has often been done to increase recreational activities such as hunting, fishing, and rowing, but can also be used to prevent succession and natural infill.

Threat 8. Invasive & other problematic species & genes

8.1 Invasive non-native/alien species

Invasive and/or exotic species pose a threat to the survival of the Painted Turtle – Pacific Coast Population across its range. In particular, adult Bullfrogs (*Rana catesbeiana*) are known to prey on hatchling turtles; in urban ponds where hatching success is probably already low, these predators could affect recruitment (COSEWIC 2006; Sloan 2012). Recent information on Vancouver Island has confirmed consumption of the Painted Turtle – Pacific Coast Population hatchlings by Bullfrogs, with 12 hatchlings discovered in stomach contents (Jancowski and Orchard 2013).

Red-eared Sliders (*Trachemys scripta elegans*) are released pet turtles that have become established in numerous sites throughout the range of the Painted Turtle – Pacific Coast Population (Semproni and Ogilvie 2007; Mitchell *et al.* 2013b). They commonly occur in ponds of urban parks, or other waterbodies of easy human access (Bunnell 2005). These turtles have probably been co-occurring with Painted Turtles in B.C. since the 1970s (Semproni and Ogilvie 2007). The effect of sliders on Painted Turtle – Pacific Coast Population in sites of co-occurrence is unknown, but competition for resources (nesting areas, food, and basking sites) and negative effects from transmitted diseases are possible. In Europe, Red-eared Sliders outcompete native

turtles for basking sites (Cadi and Joly 2003), grow faster, and reproduce better (Cadi and Joly 2004).They also affect space use and habitat selection through release of semiochemicals avoided by native turtles (Polo-Cavia *et al*. 2008). In California, Red-eared Slider introductions facilitated the spread of a deadly respiratory infection in a threatened Pond Turtle (*Emys marmorata)* population (Spinks *et al*. 2003). Several adult Painted Turtles in the south coast used in the captive breeding program were treated for respiratory tract infections (Welstead, pers. comm., 2016). Sliders have been shown to successfully reproduce in the wild in B.C.'s northern climate. Viable eggs and hatched neonates were observed in 2013 and 2014; in 2015 it has been demonstrated that the hatchlings are capable of successfully surviving the winter and emerging in good health (A. Mitchell and Welstead, pers. comm., 2016). Other introduced turtle species co-occur with the Painted Turtle, but at lower frequency: Yellow-bellied slider (*Trachemys scripta scripta*), Midland Painted Turtle (*Chrysemys picta marginata*), Southern Painted Turtle (*Chrysemys picta dorsalis*), Diamondback Terrapin (*Malaclemys terrapin*), Snapping Turtle (*Chelydra serpentina*), and Reeves Turtle (*Mauremys reevesii*) (Welstead, pers. comm., 2016).

There is genetic evidence that hybridization between Painted Turtles– Pacific Coast Population and released non-native Painted Turtles (Midland, Southern, and Eastern including intergraded Painted Turtles) has occurred at Burnaby Lake and may be a threat at other sites including Pender Island[16]and Alaksen (Welstead, pers. comm., 2016). Non-native turtles should be removed as the adverse impacts on the genetics of the turtles can extend beyond the impacted lakes as humans are known to transport turtles between lakes and regions. In 2013, the percentage of hybridized turtles in Burnaby Lake was 66% but, after removal of non-native species, the ratio in 2014 of hybridization in the hatchlings was down to 33% (Welstead, pers. comm., 2014). Invasive aquatic and riparian vegetation may also threaten Painted Turtle populations. Invasive aquatic plants, such as yellow flag iris (*Iris pseudacorus*), and Eurasian water milfoil (*Myriophyllum spicatum*) may choke out native plants used by turtles for foraging, may impede movements through aquatic habitats and restrict basking opportunities (Marchand and Litvaitis 2004a). Invasive vegetation in riparian habitats (e.g., reed canarygrass (*Phalaris arundinacea*), Yellow Flag Iris (*Iris pseudacorus*) Himalayan Blackberry (*Rubus armeniacus*) will limit nesting opportunities by filling in sandy riparian areas that would otherwise be open and free of vegetation. Generally turtles avoid vegetated areas when nesting (Marchand and Litvaitis 2004b), but if few suitable nesting areas exist, or if nesting sites are in areas of high human or predator disturbance, turtles may choose to lay nests in or beside vegetation as defensive cover from human disturbance (Maltby 2000). Nests laid in vegetation clumps rarely survive as roots penetrate eggs and overwintering hatchlings (Maltby 2000; observed at Nicomen and Burnaby lakes, Welstead, pers. comm., 2016).

8.2 Problematic native species

Nest predation is a major source of turtle egg mortality, and in human-dominated landscapes, increased populations of subsidized predators can cause increased nest predation, approaching 100% in some local populations (Marchand and Litvaitis 2004a). Subsidized predators, like raccoons, skunks, foxes, coyotes, ravens, and crows, are generalist predators that are attracted to human-dominated landscapes due to increased food sources (i.e., garbage). Populations of generalist predators (especially raccoons) in these landscapes are often at unnaturally high

[16] Pacific Coast Population turtles not confirmed at this site.

densities (Klemens, ed. 2000). High turtle nest predation is common in human-dominated landscapes not only because of the increased predator populations, but also because limited nesting habitat results in clumped distribution of nests on edge habitats that predators can easily locate (Marchand and Litvaitis 2004a). In addition as described in Threat 5.4, fish stocking can cause direct mortality through ingestion of neonates.

Threat 9. Pollution

9.1 Household sewage & urban waste

Most occupied waterbodies surrounded by residential areas are likely to be impacted by household sewage, urban waste water, pollution and siltation of aquatic habitats. Pollution from sewage and urban waste water can increase the siltation in an area and lead to reduced food availability; however, the severity of this threat is unknown.

9.2 Industrial & military effluents

At the Painted Turtle– Pacific Coast Population site at Great Blue Heron Nature Reserve in Chilliwack, leakage from a creosote-treated log retaining wall (installed during past military operations at the site) is resulting in contamination by carcinogenic polycyclic aromatic hydrocarbons (PAHs) in the water. Turtles are known to experience chromosomal damage from exposure to PAHs, which can lead to tumour development and lethal deformities like scoliosis, carapace distortion, missing toes, and malformed jaws (Matson *et al.* 2005; Bell *et al.* 2006). PAH-induced genetic damage and resulting deformities have been documented worldwide for a number of turtle species occupying contaminated sites, including Snapping Turtles, Painted Turtles, European Pond Turtles, and Caspian Turtles (Matson *et al.* 2005; Bell *et al.* 2006). Extreme instances of PAH pollution (i.e., oil spills) are known to cause high rates of mortality in turtles (De Lathouder *et al*. 2009).

9.3 Agricultural & forestry effluents

Pollution from pesticides and herbicides is a concern in the Lower Fraser Valley (Wan *et al.* 2005; Woudneh *et al.* 2009). Water contamination from agricultural and forestry effluents can affect the reproductive output of freshwater turtles, resulting in developmental abnormalities, and endocrine disruption (Crews *et al*. 1995; Shelby-Walker *et al*. 2009). Sites that are near agricultural fields such as Alaksen National Wildlife Area are more vulnerable to water contamination from pesticides and herbicides (Kilburn and Mitchell 2011). Spraying of glyphosate herbicide occurred over an important nesting location in Nicomen Slough in 2013 and again in 2014 while the hatchlings turtles were underground. Toxicity of glyphosate such as Glypro® on Red-eared Slider (*Trachemys scripta elegans*) embryos and early hatchlings showed low hatch weight, problems self-righting, and genetic damage (Sparling *et al.* 2006). While the risk of glyphosate is lower for hatchlings as they are buffered by the soil while underground, herbicides may impact developing eggs and turtles. Glyphosate may linger in the soil and water especially when there is a failure to follow label directions. Glyphosate is strongly adsorbed in soil particles; its average soil half-life is approximately two months (Tu *et al*. 2001). The use of less toxic surfactant such as LI700® and hand application with specific timing reduces direct contact with turtles and thus the risk to turtles if used instead (USFWS 2010).

Threat 11. Climate change & severe weather
The impacts of climate change and severe weather on turtle populations are currently unknown but are expected to increase in the future, correlated with predictions of other climate change impacts.

11.3 Temperature extremes
Given that the Painted Turtle– Pacific Coast Population has temperature-dependent sex determination (TSD), entire local populations are susceptible to temperature extremes and fluctuations in humidity, especially during July when hatchling sex is determined (Janzen 1994). As such, modest increases in mean July temperature (about 2°C) could skew the sex ratio of a given local population, and Janzen (1994) suggested that an average increase of 4°C could eliminate male offspring. Heat waves during incubation can result in morphological abnormalities in Painted Turtles (Telemeco *et al*. 2013). Extreme heat for more than 60 hours can result in abnormal shells. The selection of shaded areas did not mitigate this and the author suggests these abnormalities can impact fitness and survival of affected cohorts. Climate change impacts are complex since changes in rainfall, not just changes in temperature, may also alter sex ratios (Leblanc and Wibbels 2009). Moreover, turtles may be able to buffer the effects of climate change on hatchling sex ratios through the evolution of behavioural changes in maternal choice of nesting timing and location (St. Juliana *et al*. 2004). The severity of this threat is unknown.

11.2 Droughts, and 11.4 Storms and flooding
Changes in weather patterns resulting in increased droughts, storms, and flooding might also impact turtles by causing loss of habitat and changing movement patterns. Drought conditions could result in increased movements of turtles overland, thereby increasing mortality due to predation and road kills (COSEWIC 2006). Droughts may also cause drawdowns during overwintering, resulting in exposure to freezing and increased predation risk to the Painted Turtle– Pacific Coast Population. Alternatively, increased flooding conditions could cause drowning of eggs and hatchlings (Bodie 2001). However, in the advent of habitat shifting and alteration, the Painted Turtle – Pacific Coast Population may be able to resist some impacts of climate change through progressive movement northward, providing changes are not too rapid (Lesica and Allendorf 1995).

5 RECOVERY GOAL AND OBJECTIVES

5.1 Recovery (Population and Distribution) Goal

The long-term goal (45 years[17]) for the Painted Turtle – Pacific Coast Population is to ensure healthy, self-sustaining population units over three generations.

To work towards achieving the long-term recovery (population and distribution) goal, the following medium term goal (10 years) has been identified:

[17] Based on three generations and a 15 year generation time as per COSEWIC 2006.

The recovery (population and distribution) goal (within 10 years) is to maintain or increase the number of individuals and distribution of Painted Turtle – Pacific Coast Population units, and ensure the quality and quantity of habitat remains stable or increases, while improving survivorship and recruitment within its range[18] in British Columbia.

5.2 Rationale for the Recovery (Population and Distribution) Goal

The historical extent of the species is inferred from the current distribution of the species and from historical occurrence data. Quantitative targets are thus based on the occupied and historical records[19]. The goal is to maintain or increase the number of individuals and distribution of Painted Turtle – Pacific Coast Population units as well as its habitat. However, in some cases, it is not feasible to recover habitat in specific areas within population units. In these circumstances, recovery will occur within the species range at more suitable locations through introduction/relocation to those more suitable sites. For instance, Lafarge Pond currently is not a viable site for Painted Turtles because it is a storm water detention pond channeling and settling road run-off with pollutants, therefore an alternative site will be selected within the same area if it can't be restored thus retaining the net number of "sites" as defined by occupied watercourse/bodies. COSEWIC (2006) suggests that the wetland conversion and rapid urbanization that has accelerated since the early 1900s has caused extensive extirpation of local populations and resulted in the isolation of the remaining local populations. Therefore, intervention such as population management is needed to maintain remaining populations across much of its range.

In order to maintain or increase the number of population units there are four scenarios that are applied (see Appendix 1):

1. Extant sites currently occupied – maintain or augment population where population is small or declining.
2. Historical sites where genetically native turtles have not been confirmed in over 40 years – reintroduction
3. Occupied sites where habitat is now unsuitable for population viability – relocation maybe required
4. Recovery habitat - sites with suitable habitat are candidate locations for introduction of genetically native turtles

Minimum viable population targets are currently unknown but from the literature there is some consensus that the minimum number of individuals required for long-term genetic persistence of most species is probably several thousand (Traill *et al*. 2007) within their range. Additional research will inform the minimum viable population targets for this species in the future.

[18] The Painted Turtle - Pacific Coast Population's range includes its current distribution, known historical distribution, and possible extension beyond current range to account for climate change or other threats.
[19] Historical records refer to observations that are 40 years or older.

The recovery goal is set in an adaptive management framework with a 10-year applied program to define current distribution, restore site and population viability, monitor trends, and mitigate threats. This program will be followed by a longer-term recovery implementation program to secure population persistence within 45 years.

5.3 Recovery Objectives

The suggested timeframe to meet the medium term recovery goal is 10 years. Methods for measuring progress towards meeting the recovery objectives, in the interim, are listed in Section 8. The recovery objectives should be re-evaluated every 5 years and updated as new information becomes available.

The recovery plan has the following six objectives.

1. ***Protect***[20] and ***restore habitat***, features, and connectivity[21] at all recoverable[22] and new population units.[23]
2. Implement ***population management***[24]and ***threat mitigation*** to stabilize or increase recruitment and survivorship rates of all life stages, as needed, while maintaining the genetic distinctiveness of Pacific Coast populations.
3. ***Manage*** invasive/non-native ***species*** to improve survival of native turtles, mitigate interbreeding with non-native turtles (retain genetic integrity), mitigate disease transfer, and reduce resource competition.
4. ***Inventory*** new areas and clarify distribution of the species to prevent the inadvertent loss of not-yet discovered populations.
5. ***Monitor*** population trends and habitat status to evaluate the effectiveness of recovery actions.
6. ***Research*** life history, historical distribution population dynamics, and habitat use of the species, and clarify threats facing these populations, so that appropriate conservation measures can be taken to adaptively improve conservation and recovery efforts.

[20] 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.
[21] Prevent habitat fragmentation at all occupied sites and restore habitat connectivity to facilitate seasonal movements and dispersal of turtles.
[22] Not all occupied sites can be restored to suitable habitat, owing to existing threats that cannot be mitigated (e.g., site is a stormwater detention pond). In these cases, an alternative site to recover will be found so that population unit numbers can be maintained.
[23] To maintain number and extent of distribution, additional locations will be added through population introduction/reintroduction to make up for sites that are not recoverable.
[24] Population management techniques include population augmentation, captive breeding, translocations, and/or head-starting.

6 APPROACHES TO MEET RECOVERY 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 2006). Update due 2015.

Send to COSEWIC (complete)

- Western Painted Turtle (*Chrysemys picta bellii*) assessed as Endangered (COSEWIC 2006). Re-assessment done 2015.

List under Wildlife Act

- The Painted Turtle is on the B.C. *Wildlife Act* so individuals are afforded legal protection on both provincial and municipal public land; they cannot be lawfully handled, trafficked, moved, or otherwise disturbed without a permit.

Planning (complete)

- B.C. Recovery Plan completed (this document, 2015).

Habitat Protection and Private Land Stewardship (in progress)

- Of the known occupied sites of the Painted Turtle – Pacific Coast Population, the majority of the core area is within a park or protected area managed by the regional, municipal, federal, or provincial governments. The remaining sites are on private land not already protected (~36% e.g., Livingstone Lake, areas around Ruby Lake etc.).
- "Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia (2014): A companion document to Develop with Care 2012" has best management practices to manage Painted Turtle habitat
- The Painted Turtle – Pacific Coast Population is on Schedule 1 of the *Species at Risk Act* and thus individuals and their residences (nesting and overwintering habitat) are fully protected from harm on federal land under SARA. In the range of the Painted Turtle (Pacific Coast Pop), this protection applies only to portions of the populations at Alaksen National Wildlife Area, Nicomen Slough, Silvermere, and the Great Blue Heron Nature Reserve in the Lower Mainland/Fraser River Valley. In the future, it could also include Greenburn Lake on South Pender Island if a Pacific Coast Population is confirmed or if this becomes an introduction site.
- As the Painted Turtle is on the B.C. *Wildlife Act,* individuals are afforded legal protection on public land, both provincial and municipal; they cannot be lawfully handled, trafficked, moved, or otherwise disturbed without a permit. Wetlands on Crown land not

already protected as parks have varying degrees of protection from loss and degradation, depending on their size, location, and landscape configurations. Riparian Areas Regulation, B.C. *Fish Protection Act,* and the *Water Sustainablity Act* apply to private land and the private use of Crown land.

- Working with local cattle farmers to mitigate impacts from cattle farm operations is ongoing at Nicomen through fencing riparian habitat.
- Radio-telemetry has been used to investigate overwintering, habitat use, and movement patterns of the adult and juvenile Painted Turtle – Pacific Coast Population (2013 - ongoing) in the Sunshine Coast and in the Fraser Valley.
- Nesting surveys are being conducted and continuous temperature measurement at known nesting sites at Burnaby Lake and Nicomen Slough to clarify habitat requirements and document timing and nesting success as conditions fluctuate from year to year (2013 - ongoing).

Habitat Restoration and Private Land Stewardship (in progress)

- Over 12 nesting sites in Sunshine Coast, Lower Mainland and Nanaimo have been created at several sites to entice turtles away from roadsides to mitigate Threat 4 (Transportation and service corridors).
- Signs have been erected to alert vehicle traffic to slow down next to over 10 Painted Turtle – Pacific Coast Population nesting sites (e.g. Lily Lake, Trout Lake, Garden Bay, Nicomen Slough, Divers Lake Nanaimo, and Buttertubs Marsh).
- Outreach and education initiatives are underway to educate the public about not collecting turtles for pets.
- Human intrusion is currently being addressed at several nesting sites through nesting site enhancement and fencing to reduce disturbance as.
- Basking logs have been installed at many sites where basking habitat was limited.
- The Painted Turtle – Pacific Coast Population is included in the public outreach and education programs (landowner contact projects) of Habitat Acquisition Trust (Vancouver Island and some Gulf Islands), the Salt Spring Island Conservancy (Salt Spring Island), Coastal Western Painted Turtle Project (Fraser Valley and Upper Sunshine Coast), and the Ruby Lake Lagoon Nature Reserve Society (Sunshine Coast).

Species and Population Management (in progress)

- Provincial enforcement is under way to mitigate the influx of selling illegal non-native turtles in pet stores (Welstead, pers. comm., 2016).

<u>Captive rearing/breeding and population augmentation/translocations</u>:

- The head-starting program was first initiated and trialed in the Sunshine Coast 2012 with great success. The program focused on augmenting populations in the Fraser Valley with the first releases in 2014 at 4 sites along with telemetry studies to track movement and survivorship. As of 2016, we have re-introduced or augmented 11 population units (see Appendix 1).

- Outreach and education initiatives are underway to reduce potential impacts of invasive species through educating about not releasing pet Red-eared Sliders or other turtles into the wild.
- Predator exclosures are used at high-risk nests and have successfully prevented predation by problematic predators at Nicomen Slough and Burnaby Lake (since 2010 – ongoing).
- Non-native painted (e.g., Midland Painted Turtles) and other species (e.g. Red-eared Sliders) are removed from lakes where recovery for painted turtles is a priority (since 2013 – ongoing).
- Temperature/humidity data loggers have been installed at known nesting sites on Vancouver Island, on the Sunshine Coast, on Texada Island, and in the Lower Mainland. Trends in temperature/soil moisture (water potential) over time will be monitored at nesting sites to comment on changes in climate and weather over time and eventually compare against population demographics and recruitment priority (since 2013 – ongoing).

Current species distribution:

- Since 2007, surveys to clarify distribution have been initiated at a number of sites across the range of the Painted Turtle – Pacific Coast Population and occurrence records have been updated. We have expanded from only 4 sites known in 2006 to over 80 in 2014.

Population demographics:

- A mark-recapture program is ongoing at several sites to determine population demographics and more accurately assess threats to the Painted Turtle – Pacific Coast Population (since 2013 – ongoing; Welstead, pers. comm., 2016).
- Monitoring for numbers and locations of turtle road mortality is ongoing on the Sunshine Coast and Victoria (Evelyn, pers. comm., 2014).
- Monitoring of known nests and known nesting sites is occurring to quantify nest predation and hatchling recruitment (Welstead, pers. comm., 2016).

Population genetics:

- A protocol for sampling blood from turtles for population genetic work is completed.
- Genetic assessment is ongoing looking at the composition and uniqueness of population unit on the South Coast (Welstead, pers. comm., 2016; ongoing).

6.2 Recovery Action Table

Table 3. Recovery actions for Painted Turtle – Pacific Coast Population in British Columbia.

Objective #	Actions to meet objectives	Threat[a] or concern addressed	Priority[b]
Habitat protection			
1	Protect and maintain the distribution and quality of all survival/recovery habitats. Secure the number and distribution of population units including occupied and potential recovery sites. Direct development away from areas within the core or Adjacent Terrestrial Area polygons. Where sites are not recoverable seek replacement recovery habitat to maintain or increase the population unit numbers (minimum 37).	1, 2, 3, 4, 5, 6, 7, 9	Essential
1, 2, 4	Mitigate direct and indirect threats to survival and recovery habitat and threats that impact survivorship.	1, 2, 3, 4, 5, 6, 7, 9	Essential
1	Facilitate a shared stewardship approach by providing survival and recovery habitat spatial definition/mapping to relevant agencies and land users to inform management land use planning and decisions to avoid and reduce impacts from urban, industrial, or agricultural development.	1, 2, 3, 4, 5, 6, 7, 9	Essential
1	Ensure development projects under the *Canadian Environmental Assessment Act*, Riparian Area Regulation, or other relevant legislation/policies avoid and/or mitigate impacts to Painted Turtle within both the Core and Adjacent Terrestrial Area. Develop detailed Best Management Practices guidelines to provide the best available science for works in and around survival or recovery habitat.	1, 2, 3, 4, 5, 6, 7, 9	Necessary
1	Ensure water quality and quantity are maintained or improved at all sites. Ensure that changes in hydrological condition are minimized or improved to protect or recover foraging, overwinter and basking habitat.	7, 9	
1	In recreational areas, minimize damage to survival habitat caused by erosion and destruction of riparian vegetation; restrict intensive recreational activities and motorized boats use along occupied streams.	6	Necessary
4	Conduct surveys at all remaining suitable sites on south coast of B.C. and update distribution maps.	Knowledge gap	Necessary
2, 5	Biannual monitoring at all occupied sites using basking surveys, and additional mark-recapture to monitor population demography at site with active population management. Annual nest monitoring at priority sites. Population trends evaluate the habitat status	Knowledge gap	Essential
1, 5	Monitor survival and recovery habitat features and respond to signs of degradation as appropriate.	All threats	Essential
5, 6	Describe, monitor (for threats and changes), and report on the biophysical, chemical, and microclimate characteristics of seasonal habitats at currently occupied, historical, and newly established sites.	1, 2, 3, 4, 5, 6, 7 Knowledge gap	Necessary

Objective #	Actions to meet objectives	Threat[a] or concern addressed	Priority[b]
Habitat restoration			
1	Rehabilitate/manage habitat to ensure that it remains suitable for Painted Turtle. Minimize or eliminate the threats that limit habitat suitability or connectivity.	1, 2, 3, 4, 5, 6, 7, 9	Essential
1	Improve, expand, and/or restore the area, extent and quality of seasonally occupied habitats (e.g., nesting sites, brumation sites, basking sites, foraging areas, and dispersal/connecting habitat) at occupied and recovery sites.	1, 2, 3, 4, 5, 6, 7, 9	Essential
1	Where possible, protect connecting habitat between occupied locations with the goal of restoring natural migration dynamics. Coordinate with regional districts, municipalities, and forest licensees to promote connectedness among riparian habitat through landscape-level planning.	1, 2, 3, 4, 5, 6, 7, 9	Beneficial
1, 2, 5	Monitor, and restore (where needed) water quality. Increase compliance to regulations to improve water quality. Monitor water quality and quantity (levels) in partnership with agencies to ensure a natural hydrologic state.	1, 2, 3, 4, 5, 6, 7, 9	Necessary
1, 5	Develop guidelines for habitat rehabilitation and make them available to park managers, stakeholders, funding bodies, and agencies (e.g., DFO, Habitat Conservation Trust Fund) for implementation to avoid inadvertent impacts during enhancement works for other species.	6, 7	Essential
1	Enhance/create safe, suitable nesting areas away from roads and other areas of high turtle or nest/hatchling mortality through vegetation removal and fencing and/or nest cages to limit human, domestic pet, and subsidized predator disturbance to nesting females and nests.	4, 3, 6, 8	Necessary
1	Restore or enhance basking sites and overwintering sites (e.g., install and anchor basking logs/large woody debris in sites where limited suitable basking sites exist in a manner that does not conflict with drainage needs).	1, 2	Essential
1, 5, 6	Monitor and evaluate newly created and enhanced habitats to ensure they are effective (e.g., new nesting sites not producing unbalanced sex ratios).	All, Knowledge gaps	Beneficial
Population management			
2, 3	Enforce the *Wildlife Act* with regards to importing, trafficking, poaching, and possessing turtles. This includes targeting stores that illegally sell non-native turtles.	5, 6	Essential
2, 3	Stop stocking of non-native fish into lakes with recovering populations and where impacts from competition, hooking, disturbance, and habitat loss cannot be effectively mitigated.	8	Necessary
	Protect all life stages and population augmentation		
2	Mitigate direct and indirect threats to adults, hatchlings, neonates, and eggs.	Limiting factors; all threats	Essential
2	Improve recruitment at sites where nests are habitually impacted and at risk through head-starting nests and juveniles. Obtain turtles eggs from high-risk areas, incubate eggs, and head-start hatchlings.	Limiting factors. all threats	Essential
2	Conduct captive breeding to augment sites with few native individuals or where sex ratio is skewed and there is no to limited recruitment or to improve genetic composition. Augment	Limiting factors. all threats	Essential

Objective #	Actions to meet objectives	Threat[a] or concern addressed	Priority[b]
	declining populations to increase productivity and restore known/historic populations and restore or improve genetic representation.		
2, 3	Conduct genetic analyses to estimate the effective population size, rates of dispersal, and mixing among populations, and levels of relatedness.	Limiting factors. all threats	Necessary
2	Reintroduced turtles to sites where they were historically but are locally extirpated. Augment head-started turtles at sites with small and/or declining populations. Introduce head-started turtles to recovery sites if existing sites are not restorable or are a high risk (e.g., make-up sites that are not restorable).	Small populations; Limiting factors	Beneficial
Mitigate direct mortality			
2	Identify and prioritize sites where road mortality and unsafe/unsuitable nesting areas are of highest concern. Work with the Ministry of Transportation in high priority areas to erect turtle crossing signage and/or identify additional means of slowing down road traffic. Fence roadsides to limit turtle movements across roads to reach original unsafe nesting areas. Provide alternate nesting areas to redirect nesting turtles from high risk areas.	4, 6	Essential
1, 2	Mitigate impacts from quarrying and road maintenance activities.	3, 4	Essential
1, 2	Work with the dyking commission on the timing and methods for vegetation clearing activities that do not use pesticides/herbicides.	9, 7	Essential
1, 2	Reduce disturbance at nesting sites from pedestrian traffic by redirecting trails, alternate nesting beaches, and/or barriers.	6	Essential
1, 2	Reduce injury and mortality from fisheries or other recreational activities (motorized boats) by delineating no-go zones.	5, 6	Essential
2	Install nest protection measures to improve survivorship and recruitment by reducing predation and physical impacts to at risk nests.	8	Essential
1, 2	Redirect ATV trails and boat launches or provide alternate nesting areas.	6	Essential
2, 3	Investigate the impacts of pet releases, fish stocking, and bullfrogs on Painted Turtles.	8	Beneficial
3, 6	Control Red-eared Slider and other non-native turtle species (in particular other non-native Southern, Eastern and Midland Painted Turtles) in areas of conservation concern. Conduct population surveys and remove invasive species and hybrid individuals from populations in ensure genetic recovery and maintain uniqueness of Coastal sub-populations (e.g. Burnaby Lake and potential recovery site on Pender Island). Investigate disease transfer and resource competition from invasive species.	8	Essential
3	Monitor bullfrog populations and initiate control measures, reduce population numbers, where feasible. Reduce habitat suitability for bullfrogs. Outreach messaging to not move bullfrogs and other non-native species.	8	Necessary
3, 5	Assess and monitor parasite and disease threats.	8 – Knowledge gap	Necessary
5	Establish population monitoring at all occupied locations to estimate baseline population	Knowledge gap	Necessary

Objective #	Actions to meet objectives	Threat[a] or concern addressed	Priority[b]
	parameters using capture-mark-recapture, radio-telemetry, and other suitable techniques. Monitoring nesting success, predation rates, and population heath and demographics will help to assess the long-term viability of a population.		
1, 6	Monitor the impacts of climate change on Painted Turtles through nest site thermal and humidity monitoring and population demographic. Correlating juvenile recruitment and population demographics with climate patterns over time is essential for determining impacts of climate change on sex determination in turtles, and comparing movement patterns with severe weather events (floods and droughts).	11 Knowledge gaps	Necessary
6, 3	Continue to conduct genetic studies to determine extent of genetic mixing, turtle introductions, and isolation of populations. This is necessary for managing and maintaining native genetic clusters and guiding conservation efforts aimed at restoring genetic diversity. It is necessary to facilitate future reintroductions to historical and restored/created sites.	8	Necessary
4,6	Inventory Research- Improve methods to detect presence of Painted Turtles in wetland systems in order to be able to manage this species (e.g. Environmental DNA, Cameras etc.) , expand areas of inventory such as Quadra Island, Sea-to-sky, Bowen Island etc.		Essential
Land stewardship			
1	Develop, promote, and implement best management practices for Painted Turtles and include management recommendations that will help ensure effective protection and reduce impacts to survival habitat and restore habitat features.	1, 3, 4, 5, 6, 7, 8	Essential
1, 2, 3	Work with all levels of government, land managers (including municipal and regional governments), and private landowners to inform and encourage best practices and ensure compliance in relation to water quality, hydrology, and land use practices.	1, 2, 3, 4, 6, 7, 9	Necessary
1	Develop and implement site management plans with land managers/users/owners for occupied locations addressing site-specific threats and developing site-specific mitigation measures.	1,2,3,4,5,6,7,8 and 9 Knowledge gaps	Necessary
1	Work one-to-one with willing landowners/managers to mitigate threats (e.g., fencing of riparian areas to prevent disturbance by people, pets, and livestock; pollution reduction). Where there are willing landowners, implement formal conservation covenants or stewardship agreements.	1, 2, 7, 8, 9	Necessary
4, 5	Encourage conservation groups and local residents to get involved with turtle surveying (occurrence surveys and nesting surveys) on private land. Continue to development the volunteer nest monitoring program.	Knowledge gaps	Beneficial
Information management and outreach			
1, 5	Maintain a current database and a map delineating survival and recovery habitat that is easily available to all levels of government and other land managers to prevent inadvertent impacts to Painted Turtle habitat.	1, 2, 3, 4, 5, 6, 7, 9	Essential
1	Build public and stakeholder support for recovery activities by increasing understanding and promoting responsible behaviour toward wetland conservation, and amphibians, among all levels of governments, natural history groups, volunteers, general public, and private	1, 2, 3, 4, 5, 6, 7, 9	Necessary

Objective #	Actions to meet objectives	Threat[a] or concern addressed	Priority[b]
	landowners.		
2	Install interpretive signage at high priority public sites, especially near nesting areas, to reduce threats from human activities and encourage reporting of turtle observations.		Beneficial
Planning			
All	Collaborate on habitat assessment, recovery planning, and implementation with conservation biologists and recovery teams in Washington and Oregon.	Knowledge gaps	Necessary

[a] Threat numbers according to the IUCN-CMP classification (see Table 3 for details).
[b] Essential (urgent and important, needs to start immediately) and Necessary (important but not urgent, action can start in 2–5 years).

6.3 Narrative to Support Recovery Planning Table

Species and Population Management
Recent studies have demonstrated the genetic distinctiveness of three clusters in the Painted Turtle – Pacific Coast Population (Jensen 2013a; Jensen *et al.* 2014). Preservation of this distinctiveness limits rescue options for populations and means each cluster needs careful management and protection. Maintaining the distinctiveness of each genetic cluster precludes restoring populations in threatened areas with individuals from outside their own metapopulation (i.e., genetic cluster). Any direct population enhancements must take this into account. At the same time, genetic diversity within these metapopulations is imperative for the long-term persistence for the species (Jensen 2013a,b). This lack of current genetic connectivity between sites is further evidence that newly created (i.e., anthropogenic) impermeable barriers are fragmenting habitat and metapopulations. Many sites support only a few individuals and there is ongoing threat of the loss of genetic diversity as these individuals are lost.

All Painted Turtle populations should be considered native unless proven otherwise by genetic or other conclusive data. Even when the site has non-local Painted Turtles, if a site supports Painted Turtles from other regions (e.g., Vicarro Ranch has Thompson Okanagan Turtles, Pender Island has Midland Painted Turtles) but is within the native range, then it should be recovered to contain turtles of that local genetically distinct cluster. This will facilitate the recovery of the genetically distinct populations and prevent genetic contamination from interbreeding.

Habitat Protection, Restoration, and Land Stewardship
Appropriate municipal, regional, provincial, and federal government departments, land managers and planners, private landowners, and park visitors should be made aware of the species' locations, need for protection, and protection measures that are proposed or in place. Outreach and education to land managers, through the creation and distribution of best management practices for Painted Turtles, could improve aquatic and upland terrestrial habitat management in municipal and regional parks. Additionally, the general public needs to be made aware of the Painted Turtle's endangered status and its protection under the *Wildlife Act;* anecdotal evidence suggests that visitors to parks regularly move or collect turtles. Signage, fencing, and/or enforcement are needed at occupied public sites to protect turtles or turtle nests in areas where turtles occur. Finally, invasive species pose a threat to Painted Turtle populations. Although some of these species are included under the *Wildlife Act*'s Controlled Alien Species Regulations, the Red-eared Slider, a species of concern, is on Schedule A of the *Wildlife Act*, which affords it legal protection as a native species. This listing may require future re-evaluation. At the very least, there is a need to develop and promote unified outreach education about the importance of not introducing pet sliders to the wild.

7 SPECIES SURVIVAL AND RECOVERY HABITAT

Survival/recovery habitat is defined as the habitat necessary for the survival or recovery of the species.

Survival habitat is the area that the species naturally occurs or depends on directly or indirectly to carry out its life-cycle processes. Survival habitat has been mapped to the extent possible with all known occurrence records. However, additional occupied sites maybe discovered through inventory and should be considered survival habitat.

Recovery habitat is suitable habitat within the species range that may be selected for re-introduction at sites where historical observations are known or for introductions at new sites where the Painted Turtle – Pacific Coast Population is not confirmed,

The survival and recovery habitat described in this recovery plan is not complete as additional habitat will be needed to achieve the long-term recovery goal.

7.1 Biophysical Attributes of Survival and Recovery Habitat

The description of survival and recovery habitat includes the biophysical features and attributes that support the species at all life stages and that permit it to perform essential functions, including breeding, nesting, foraging, basking, overwintering, and dispersing. Section 3.3 ("Habitat and Biological Needs") provides a description of known biophysical features and attributes of the species' habitat required to support these life-cycle processes/functions (see Table 1 for a summary).

7.2 Geospatial Description of Survival and Recovery Habitat

The quantity of survival/recovery habitat required for a species is guided by the amount of habitat needed to meet the recovery goal. To meet the recovery goal "to maintain or increase the number of individuals and distribution of Painted Turtle – Pacific Coast Population units," all 37 described population units are required to achieve the 10-year recovery goal. This includes survival habitat for 36 population units where there are extant occurrences of Painted Turtle. It also includes potential recovery habitat for one population unit that has suitable habitat and where introducing the Painted Turtle – Pacific Coast Population is recommended as it currently contains Midland Painted turtles that can impact local populations (Pender Island; see section 8.1 Invasive non-native/alien species).

Two distinct areas have been described for survival/recovery habitat: the Core Area of Activity used for all life stages, which includes both aquatic and terrestrial habitat; and the Adjacent Territorial Area used primarily for dispersal.

Core Area of Activity

Core Aquatic Habitat:

- Select the entire surrounding waterbody or complete watercourse reach where the Painted Turtle – Pacific Coast Population is known to occur or [re]introduction locations.

- In addition to the above surrounding aquatic habitat, select all suitable adjacent aquatic habitat for any life stage within 3 km where it is considered feasible for the Painted Turtle to transverse.
- Aquatic habitat includes wetlands, ponds, ephemeral pools, seeps, streams, areas of seasonal flooding, and ditches, whether perennial, ephemeral, or intermittent, and where the habitat is less than 1000 m in elevation. Salt water is excluded. Large, fast-flowing watercourses maybe excluded where habitat is not suitable on the other side. Habitats on the edges of larger rivers where turtles can travel to access mouths of adjacent aquatic habitat (creeks, sloughs) are included to connect habitat.

Core Terrestrial habitat:

- An 80-m area of terrestrial habitat around the core aquatic habitat, i.e., around the waterbody and on either side of watercourses measured from the high-water mark[25] (or the top of bank for ditches);

  or

- where watercourses are fast flowing with high-gradient channels equal to or above 6% for the majority of its length, then a 45-m area of terrestrial habitat around the watercourse is needed to maintain water quantity and quality of survival/ recovery habitat

Adjacent Territorial Area

- An additional area of 260 m adjacent to and beyond the Core Area of Activity

A more detailed description and rationale follows for both of these areas.

7.2.1 Core Area of Activity

The Core Area of Activity includes the habitat required for all life stages (egg, juveniles, and adults) and the associated biophysical habitat features/attributes that support the life functions of the species (e.g., breeding, nesting, foraging, basking, overwintering, and dispersing). These habitat features/attributes (see Table 1) must be maintained so they are not "rendered ineffective" by damaging or destroying activities (refer to "Threats" [Section 4]). Maintaining these features/attributes by avoiding impacts from known threats is essential to the survival of the populations.

Core Area of Activity includes the entire waterbody that is occupied or the complete watercourse reach (if it is a slough, creek, etc.). For instance, a large lake such as Ruby Lake the turtles can move throughout the lake. Thus, the entire lake is included in this area. Suitable aquatic habitat for any life stage within 3 km of an occurrence in the watershed is also included to provide habitat used for daily movement and connecting habitat for dispersal, if it is considered feasible

[25] "'*High water mark*' means the visible high water mark of a stream where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark on the soil of the bed of the stream a character distinct from that of its banks, in vegetation, as well as in the nature of the soil itself, and includes the active floodplain." *Fish Protection Act*, Riparian Areas Regulation, B.C. Reg. 376/2004, Section 1(1). <http://www.bclaws.ca/civix/document/id/complete/statreg/376_2004> [Accessed February 2016]

for the Painted Turtle to transverse. Including these areas will increase the probability of incorporating habitat important to the species during all its life stages (e.g., turtles frequently move to creeks and streams during brumation). It will also provide habitat diversity making the sites more resilient through various environmental conditions (e.g., extremely wet or dry years, or long-term changes potentially associated with climate change). This connecting habitat is also essential to facilitate meta-population dynamics and gene flow.

The 3 km distance was based on local telemetry data and the published literature. Painted Turtles in coastal areas of the province have been observed moving between waterbodies and using watercourses within a 3.3 km radius in agricultural settings (see Section 3.2.6, "Connecting Habitat for Dispersal"). Thus, the recovery team recommends that the core area of activity be defined by a radius of 3 km, because of the potential for movement between aquatic habitats. This is also the distance used to delineate population units. Nevertheless, this distance may be reduced if geographic barriers (steep cliffs, high elevation) exist that turtles are unlikely to traverse. Including entire wetlands, waterbodies, and associated watercourses in the Core Area of Activity will also help to maintain suitable hydrologic characteristics associated with Painted Turtle habitat.

The riparian component of the Core Area of Activity is essential to capture the seasonal movement and nesting sites of Painted Turtles. After reviewing extensive seasonal use data from telemetry studies at Nicomen Slough and the telemetry data from the Sunshine Coast, the recovery team concluded that a distance of 75–80 m covers approximately 95% of the species' core movement area (see Gielens *et al.* 2013). Thus, adopting a precautionary approach, the recovery team recommends an 80 m area around waterbodies and on either side of watercourses as survival habitat.

This riparian component of the Core Area of Activity also acts as an essential buffer for the aquatic habitat from surrounding land uses. The semi-aquatic nature of Painted Turtles makes them vulnerable to chemicals entering wetland habitat. In a meta-analysis of peer-reviewed studies of the effectiveness of riparian buffers in removing nitrogen, Mayer *et al.* (2007) suggested that buffers wider than 50 m were more effective at removal of excess nitrogen from runoff than buffers 0–25 m wide. Thus, the 80 m of riparian habitat included in the Core Area of Activity will also increase the probability of maintaining the aquatic habitat required for the survival of the Painted Turtle.

For watercourses with high-gradient channels equal to or above 6% for the majority of their length, the riparian component can be reduced to 45 m. This is because high gradient, cold, fast flowing streams are likely used less frequently than low-gradient, slow-moving watercourses, and thus require a smaller area to facilitate turtle movements. In these areas, the primary function is to buffer edge effects, which will both protect the integrity of these habitats and preserve water quality and quantity. Brosofske *et al.* (1997) concluded that, at a minimum, a 45 m buffer on each side of a stream is necessary to maintain a natural riparian microclimate and to retain a stable hydrological environment in Washington State.

7.2.2 Adjacent Terrestrial Area

A 260 m Adjacent Terrestrial Area beyond the Core Area of Activity is included to provide dispersal habitat for males or juveniles, and thus maintain habitat attributes required for terrestrial dispersal (see Table 1, row 4). In many urban areas, this adjacent habitat is already significantly impacted and unlikely to be restored; however, some opportunities may exist to restore connectivity between aquatic habitats in other areas. Activities within adjacent terrestrial areas will require management on a site-by-site basis to ensure habitat features that allow for dispersal are not rendered ineffective. Before considering any work in the area, a regional biologist or qualified environmental professional should be consulted to ensure activities will not isolate populations or influence habitat quality within the Core Area of Activity.

In addition to providing dispersal habitat, these adjacent terrestrial areas may contain nesting habitat or undetected habitat features. Although an 80 m riparian habitat within the Core Area of Activity will capture the majority of nesting locations, females will often travel farther to nest. On several occasions, females have been observed to move about 200 m to nest. Mature female turtles will often move between aquatic and terrestrial habitats to find nesting sites, traveling up to 150 m from the water's edge (Ovaska *et al.* 2004). As nesting habitat is essential, the attributes of these features must be maintained if nesting habitat, or other features required for survival, are found (see Table 1).

Painted Turtles require both aquatic and terrestrial features at different life stages. The Core Activity Area of 80 m area of terrestrial habitat around the aquatic habitat is insufficient to ensure long-term survivorship, dispersal, and meta-population dynamics. Burke and Gibbons (1995) recommended a total buffer of 275 m around wetlands to maintain habitat integrity. Semlitsch and Bodie (2003) found that maintaining terrestrial habitat of at least 339 m from the water's edge is critical for the survival and population maintenance of most freshwater turtle species, including Painted Turtles. The recovery team has adopted the advice (80 m + 260 m = 340 m total terrestrial habitat around watercourses) based on local observations and telemetry data that showed turtles traversing upland habitat (see Section 3.2.6, "Connecting Habitat for Dispersal").

8 MEASURING PROGRESS

Evaluating the effects of recovery activities for this species will be difficult since the longevity of the species means that population-level changes are not seen for many years, and monitoring programs often cannot transcend turtle generation times. The following are some strategic measures of performance that can be used to evaluate the effectiveness of recovery approaches pertaining to each objective:

Measurables for Objective 1

- Number of population units and watercourse/bodies and area of survival/recovery habitat are stable or increasing.
- Amount of survival habitat protected through non-legal/legal agreements.

- Habitat features restored, maintained, or enhanced to improve survivorship and recruitment (e.g., # and area of suitable and safe nesting habitat enhanced/created; # of females using new nesting sites; # of occupied/successful nests).
- A current database and maps of occurrences are available for land managers and regulators.
- Best management practices developed and implemented.
- Amount of upland terrestrial dispersal habitat maintained/restored between existing and restored aquatic ecosystems.
- A commitment to restore/maintain connectedness through landscape-level planning by regional districts, municipalities, or forest licensees; number of aquatic habitat fragments connected.
- Map of occupied sites created showing land use and landscape features acting as potential barriers to turtle movement, areas of degraded habitat, and potential sites for rehabilitation based on above features; number of candidate areas identified where habitat rehabilitation could improve connectivity.
- Contacts established and consultations initiated with different municipalities, contractors, and stewardship groups to incorporate available information on suitable habitat into restoration design of rehabilitated habitats.
- Numbers of private landowners, stewardship groups, and land trusts and conservancy organizations engaged and acting to protect habitat through covenants or stewardship agreements.

Measurables for Objective 2

- Numbers of reproductive adults increasing.
- Numbers of turtle nests and eggs obtained from high-risk areas and relocated or brought in for head-starting.
- Numbers of injured or displaced turtles obtained for captive-breeding purposes; captive-breeding program initiated.
- Reduced road mortality: numbers of turtles found dead or injured declining.
- Predation rates declined and increased recruitment.
- Number and area of threatened nesting sites mitigated through vegetation removal, fencing, and/or nest cages; number of occupied nests protected.
- Viable existing populations identified through population assessments at occupied sites; population demographics data collected at number of occupied sites; data analyzed to identify sites where population enhancement is required; number of turtles reintroduced in number of sites.
- Evaluation and monitoring plan initiated to assess survivorship and reproductive success of reintroduced (marked) turtles; number of head-started juveniles recaptured over time; number of head-started turtles of reproductive capacity in population (will take > 8 years to monitor); number of nesting attempts and nests; recruitment into population quantified.

Measurables for Objective 3

- Fewer non-native species observed during surveys.
- Improved or maintained genetic purity of populations.

- Monitor and mitigate diseases as they emerge.

Measurables for Objective 4

- Presence/not-detected surveys conducted at remaining areas where turtles are expected including Quadra Island, east coast of Vancouver Island, east of Chilliwack to Yale, Fraser Valley, north of Powell River; number of new occurrences; updated occurrence map created.
- Number of stewards engaged in occurrence and nesting surveys; number of new occurrences/nests discovered.
- Number of local stewards engaged in threat mitigation and surveying/monitoring in parks and on private land.

Measurables for Objective 5

- Monitor population demographics at all sites once every two years.
- Population genetics monitored and improving showing a reduction in non-native genetic clusters and maintenance of unique clusters.
- Area/number of individuals of invasive/exotic species removed from number of occupied sites (aquatic and upland).
- Survival habitat monitored and impacts avoided or mitigated in both the core and Adjacent Terrestrial Areas.

Measurables for Objective 6

- Undertake priority research to address knowledge gaps population, habitat, and threat knowledge gaps that limit recovery implementation. Measured by the number of publications and presentation made per year and a reduction of the number of knowledge gaps.
- Continue to refine our knowledge of the genetic structure and impacts or benefits of migrants measured by the number of samples taken and analyzed annually.
- Monitor temperatures at nesting beaches annually and review climate change risk.

9 EFFECTS ON OTHER SPECIES

Recovery actions for Painted Turtle – Pacific Coast Population are unlikely to have any negative effects on non-target species or communities. Recovery planning activities for Painted Turtle – Pacific Coast Population will be implemented with consideration for all co-occurring species at risk, such that there are no negative impacts to these species or their habitats. The proposed actions emphasize habitat protection, restoration, and connection with natural communities and processes, and restoring the proper functioning of wetland and riparian ecosystems. All of these activities will benefit other native species, including several species at risk. In particular, recovery of the species to natural population levels may positively affect the ecological community by providing an increased food source (hatchlings) to other species at risk, and possibly decrease negative effects of introduced bullfrogs through increased predation by turtles

(Engelstoft, pers. comm., 2009). Additionally, if the removal of invasive/exotic species from occupied turtle sites is initiated (e.g., invasive plants in foraging and nesting areas, Bullfrogs, and Red-eared Sliders), this would result in an additional positive effect for these ecological communities (see Section 3.5, Ecological Role).

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Appendix 1. Location of population units for Painted Turtle – Pacific Coast Population in B.C.

Data sourced from the B.C. Conservation Data Centre (2015). See Figure 4 for the distribution of population units. Population size estimates are based on the survey data, maximum number of turtles observed, mark/recapture data, and/or known augmentation or introductions of Painted Turtles. Status of the population units is based on what is present as of spring 2016.

Extant means that there is at least one Painted Turtle occupying the site. **Breeding** confirms that nesting has been detected at the location. **Historical** refers to areas with observation records that are more than 40 years old.

Augmented means that head-started juveniles have been released or adults translocate to an area where there are low population numbers (of local genetics) and/or poor recruitment. **Re-introduction** is the translocation of adults or release of head-started individuals at a historical site whereas **introduction** occurs at recovery sites where a historical record is not confirmed. The number in brackets is the number released in 2014 or 2015.

Recovery habitat is suitable habitat within the species range that may be selected for re-introduction at sites where historical observations are known or for introductions at new sites where the Painted Turtle – Pacific Coast Population is not confirmed.

Table 4. Location of population units for Painted Turtle – Pacific Coast Population in B.C. as of spring 2016.

Pop unit #	Population units	Site	Status	B.C. CDC EO #[a]	Population size estimate
Fraser Valley Area					
1	Alaksen Wildlife Refuge	Alaksen Wildlife Refuge	Extant	#33	3
2	Aldergrove Lake	Aldergrove Lake	Extant / Augmented (22)	#37	22-25
3	Burnaby / Deer Lakes	Burnaby Lake	Extant / Breeding / Augmented (118)	#14	200-225
		Deer Lake	Extant / Augmented (25)	#32	25-30
4	Campbell Valley / Livingstone Lake	Campbell Valley Regional Park-McLean Pond	Extant / Augmented (46)	#38	46-50
		Livingston Lake/ Murchie Road	Extant / Breeding		5-20
5	Coquitlam	Lost Lake, Mundy Park	Extant / Augmented (5)	#18	5-10
		Colony Farm	Extant	#31	1-5
		Como Lake	Extant	#34	1
		Lafarge Lake	Extant	#35	1
		Como Creek (east)	Historical - Recovery Habitat	#40	0
		Como Creek (Culvert)	Extant		1
6	Cultus Lake	Cultus Lake	Extant	#42	1

Pop unit #	Population units	Site	Status	B.C. CDC EO #[a]	Population size estimate
7	Great Blue Heron Nature Reserve	Great Blue Heron Nature Reserve	Extant	#15	1-5
8	Iona	Iona Beach	Extant	#16	5-10
9	Jerry Sulina	Jerry Sulina	Extant	#17	1
10	Kanaka Creek	Haney Bypass and Kanaka Creek area	Extant	TBD[b]	1-5
11	Lakemount Marsh	Lakemount Marsh	Extant	#41	1
12	Lost Lagoon	Lost Lagoon Stanley Park	Extant	TBD	1
13	Marshall Creek	Marshall Creek	Extant	#39	1
14	Mill Lake	Mill Lake	Extant / Breeding	#19	5-10
15	Minnekhada / Pitt-Addington	Deboville Slough/Mclean Creek	Extant	#36	10-20
		Minnekhada Regional Park	Extant / Augmented (26)		26-30
		Pitt-Addington Marsh	Extant[26] / Re-introduction (25)	TBD	25
16	Nicomen Slough	Nicomen Slough	Extant / Breeding	#53	300-350
17	Queen Elizabeth Park	Queen Elizabeth Park	Extant	TBD	1
18	Sardis Pond	Sardis Pond	Extant	#43	5-10
19	Silvermere Lake	Silvermere Lake	Extant / Breeding	#20	5-10
20	Vicarro Ranch	Vicarro Ranch Estates, McKee Creek Watershed	Extant / Breeding	#55	25-50
21	Westcreek Wetland	Westcreek Wetland	Extant[26]/ Re-introduction (32)	TBD	32
Vancouver Island and Sunshine Coast					
22	Langford/ Sannich	Florence Lake	Extant	#6	2
		Langford Lake	Extant	#8	20-50
		Glen Lake	Extant		2-5
		Swan Lake	Extant / Breeding	#10	20-50
		Maltby Lake	Extant	#29	2-5
		Eagles Lake	Extant		50-150
		McKenzie Lake	Extant		2-5
		Adam Kerr Park	Extant	#4	1
		Beaver/Elk Lake/Beaver Ponds	Extant		2-5
		Metchosin Rd. Ponds	Extant	#49	10
		Olympic View Golf Course	Extant	TBD	25-50
23	Pender Island	Greenburn Lake	Suitable Recovery Habitat	NA	0
24	Rocky Point	Rock Pt Rd.	Extant	#9	1-5

[26] Was historical now extant.

Pop unit #	Population units	Site	Status	B.C. CDC EO #[a]	Population size estimate
		Matheson Lake	Extant		1-5
25	Sooke	Kemp Lake	Extant	#48	1
26	South Saltspring Island	Fulford Valley	Extant	#23	1 -5
		Stowel Lake	Extant		1 -5
		Cusheon Lake	Extant	#22	1 -5
		Isabella Point	Extant	#50	1 -5
		Mountain Road	Extant		1 -5
27	North Saltspring Island	Bullock Lake	Extant	#24	1 -5
		St. Mary's Lake	Extant		1 -5
28	Garden Bay / Ruby Lake	Daniel Point Wetland	Extant	#2	1
		Hotel Lake	Extant / Breeding		15-20
		Garden Bay Lake	Extant / Breeding		5-10
		Mixal Lake and wetland	Extant / Breeding		10-50
		Katherine Lake	Extant / Breeding		50-100
		Sakinaw Lake	Extant / Breeding		100-200
		Iris Griffith Centre wetland	Extant		1-5
		Ruby Lake	Extant		150-300
		Little Goose Lake	Extant		5
		Brown Lake	Extant		2
		Ruby Lake Lagoon	Extant / Breeding		50-150
		Klein Lake	Extant / Breeding		20-50
		North Lake	Extant / Breeding		20-50
29	Cranberry Lake	Cranberry Lake	Extant	#45	5
30	Dogleg Pond	Dogleg Pond	Extant	#46	1
31	Madeira Park	Francis Point Pond 2	Extant	#28	1-10
		Lily (Paq) Lake	Extant / Breeding	#3	100-150
		Francis Point Pond 1	Extant	updated #28	1-10
32	Trout Lake	Trout Lake	Extant / Breeding	#1	10-50
33	Nanaimo	Buttertubs Marsh	Extant	#11	1-5
		Diver Lake	Extant	#54	5-10
34	Nelson Island	West Lake	Extant	#51	200-350
		Cockburn Bay Pond	Extant		1
35	South Alberni	Somers Lake	Extant	#27	10-20
		Patterson Lake	Extant		1
		McKenzie Slough, Stamp River	Extant	#13	4
		Airport wetlands	Extant		50-150
		Little Turtle Lake	Extant		2
		Devil's Den Lake	Extant	#12	10-20
36	North Alberni	McLaughlin Lake	Extant	TBD	1-5
		Turnbull Lake	Extant	#47	5-10

Pop unit #	Population units	Site	Status	B.C. CDC EO #[a]	Population size estimate
37	Texada Island	Emily (Turtle) Lake	Extant / Breeding / Augmented (3)	#25	15-50
		Priest Lake	Extant / Augmented (3)		3-10
		Case Lake	Extant / Breeding / Augmented (4)	#26	5-10
		Cap Sheaf Lake	Extant / Breeding		10-50

[a] B.C. CDC EO# refers to BC Conservation Data Center's Element Occurance (EO) number.
[b] TBD = To be determined. Occurrence not yet mapped by the CDC.