Fisheries and Oceans Canada | Pêches et Océans Canada
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Central and Arctic Region

Canadian Science Advisory Secretariat
Science Response 2020/044

INFORMATION FOR IDENTIFICATION OF CANDIDATE CRITICAL HABITAT OF BULL TROUT, *SALVELINUS CONFLUENTUS* (SASKATCHEWAN-NELSON RIVERS POPULATIONS)

Context

Bull Trout, *Salvelinus confluentus*, is a char endemic to western North America. They occur in cold, clean, complex, and connected watercourses and are sensitive to habitat alterations due to their specific habitat requirements (COSEWIC 2012). They are divided into five Designatable Units (DU) determined by their National Freshwater Biogeographic Zone classification, range disjunction, and genetic lineage. The distribution range of Bull Trout has decreased over the last century, resulting in fragmented and isolated populations. Declines in population abundance have been observed across the range, particularly in the USA and the eastern range in Alberta (DFO 2017). Major threats to Bull Trout are habitat alteration, habitat fragmentation or loss, non-native species, and overfishing. Additionally, climate change, cumulative effects of habitat loss/degradation, road development, and resource extraction also represent threats to Bull Trout (DFO 2017).

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has assessed Bull Trout (Saskatchewan-Nelson rivers populations), DU 4 as *Threatened* (COSEWIC 2012). In August 2019, the Government of Canada listed Bull Trout (Saskatchewan-Nelson rivers populations) as *Threatened* under the *Species at Risk Act* (SARA). Subsequently, a Recovery Strategy must be developed that identifies the species' Critical Habitat, or "*the habitat that is necessary for the survival or recovery of a listed species and that is identified as the species Critical Habitat in the Recovery Strategy for the species*". Under the SARA, S.41.1(c), a species' Critical Habitat must be identified to the greatest extent possible, based on the best available information.

DFO Species at Risk program has requested Science Advice to support the identification of candidate Critical Habitat for Bull Trout. This Science Response Report results from the Science Response Process of February 27, 2020 on Information for Identification of Candidate Critical Habitat of Bull Trout, *Salvelinus confluentus* (Saskatchewan-Nelson rivers populations).

Background

The Saskatchewan-Nelson rivers populations comprise DU 4 of Bull Trout in Canada, an extent of occurrence greater than 20,000 km² in the eastern drainages of Alberta (COSEWIC 2012). Four river basins comprise this area: Oldman, Bow, Red Deer, and North Saskatchewan. Within these basins, main stem rivers, their tributaries, and lakes are used as habitat. Bull Trout typically occur in complex systems with substrates that include boulder, cobble, pebble, and gravel, and use cover provided by vegetation, undercut banks, large woody debris, root-wads, velocity breaks, and substrate. Bull Trout historically occupied lower elevation reaches in the area, however, their distribution is now restricted to headwater reaches in much of the area

(DFO 2017). Population modelling suggests that populations are particularly sensitive to disturbances that affect the survival of immature individuals (Caskenette et al. 2016).

Three life histories (resident, fluvial, adfluvial) of Bull Trout occur in DU 4 that differ in habitat use, behavior, diet, and growth (Sawatzky 2016). Water temperature is likely the most important natural limitation for Bull Trout, with adults occurring in water 17 °C or less (DFO 2017), but most populations are typically found in streams with mean August temperatures ≤ 12 °C and egg incubation temperatures (October–May) between 1.2–5.4 °C (DFO 2017, Isaak et al. 2017). Seasonal and perennial groundwater inflows are important for Bull Trout, particularly during spawning, warm summer conditions, and to maintain overwintering habitat. Connectivity between habitats is essential for Bull Trout to complete their life cycle and have access to overwintering locations (DFO 2017). Spawning typically occurs between late August through September and migratory individuals may travel large distances to access spawning sites in high gradient headwater or tributary streams (DFO 2017). Redds created by females for spawning and the development of eggs and alevins meet the SARA definition of residence (DFO 2017). The diet of Bull Trout consists of a variety of vertebrates and invertebrates and individuals may change their diet depending on prey availability and Bull Trout life history (DFO 2017).

Many of the major threats to Bull Trout in DU 4 are related to their habitat. Natural limitations mainly result from their specific habitat requirements for cold, clean, complex, and connected water. Anthropogenic threats include habitat fragmentation, habitat loss, habitat alteration, interaction with non-native species, and mortality from capture, including fishing and scientific sampling (Sawatzky 2016).

Analysis and Response

When an aquatic species is listed on Schedule 1 of the *Species at Risk Act* as *Threatened*, *Endangered* or *Extirpated*, the federal government must identify and protect habitat required for the survival and recovery of the species, which is linked to the population and distribution objectives established in the Species Recovery Strategy. The best available information is used to identify this habitat.

Critical Habitat is defined under SARA as "*the habitat that is necessary for the survival or recovery of a listed wildlife species*". Further, habitat of aquatic species is defined as "spawning grounds and nursery, rearing, food supply, migration, and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes or areas on which aquatic species formerly occurred and have the potential to be reintroduced". Information to support identification of habitat necessary for the survival or recovery of Bull Trout should include the geographic location (e.g., coordinates); functions, features, and attributes; and a summary of habitat identification relative to population and distribution objectives (DFO 2015).

This Science Response provides a review of available information that supports the identification of habitat necessary for the survival and recovery of Bull Trout within the Saskatchewan-Nelson rivers populations. Critical Habitat identification includes a biophysical and a geographic description. Consequently, two objectives were identified to support this review and addressed in further detail within this document:

Objective 1: Review information available on the habitat necessary for survival and recovery of Bull Trout Saskatchewan-Nelson rivers populations (DU 4) and identify the functions, features, and attributes of this habitat.

Objective 2: Present candidate Critical Habitat locations using the Bounding Box approach.

The intent of the Science Response is to inform identification of candidate Critical Habitat. Data to map watercourses, waterbodies, Hydrological Unit Code (HUC) watersheds (on a HUC 8 watershed scale for the Province of Alberta and HUC 12 watershed scale in National Parks, respectively), and species distribution (presence/absence) were gathered from the Alberta Fish and Wildlife Management Information System (FWMIS) and Parks Canada. Files for wooded areas, national and provincial boundaries were downloaded from the Government of Canada Open Government Portal. A detailed review of the functions, features, and attributes of habitat used by each life stage of Bull Trout was completed for the Recovery Potential Assessment of Bull Trout (DFO 2017) and is summarized in Table 1.

Given the information available, the Bounding Box Approach (BBA) was used to delineate candidate Critical Habitat, which defines an area within which Critical Habitat is found (DFO 2015). The BBA is useful when habitat features and their attributes can be described but their exact location varies yearly or knowledge of their specific location is not available. In order for a particular site to be considered Critical Habitat, it must be within the bounding box and represent the described functions, features, and attributes within the bounding box.

The Hydrologic Unit Code (HUC) developed by the United States Geological Survey and modified by the Alberta Environment and Parks was used to display the bounding box for candidate Critical Habitat on a HUC 8 (provincial waters; Figure 1) and on a HUC 12 watershed scale in National Parks (AESRD 2014; Figure A1.43). The HUC 8 scale was used for provincial assessment of Bull Trout as it addressed the interconnection of resident and fluvial life history types and was a workable scale at the provincial level (MacPherson et al. 2014) whereas Parks Canada Agency adopted a HUC 12 scale.

The following three-step approach was used to inform the identification of candidate Critical Habitat on provincially-managed lands (HUC 8) and National Parks (HUC 12) for the Saskatchewan-Nelson rivers Bull Trout populations.

Step 1

The Bounding Box Approach was used on HUC 8 or 12 scale, respectively, to identify the current population range of Bull Trout for consideration as candidate Critical Habitat. Areas were either included or excluded based on the following criteria:

- HUCs within the distributional range of Bull Trout defined by Alberta's current Fish Sustainability Index were included for consideration of candidate Critical Habitat. However, HUCs where Bull Trout are deemed 'functionally extirpated' in the Fish Sustainability Index were excluded for consideration of candidate Critical Habitat as well as HUCs that were not part of their historical distribution (i.e., above waterfalls) even if it was within the Bull Trout range. Functionally extirpated is defined as recent sampling showing either no fish or too few fish to constitute a viable population (MacPherson et al. 2014).
- **Rationale for the approach**: Candidate Critical Habitat considers only the current distributional range of Bull Trout and does not include restoration potential of watersheds where the species is extirpated at the respective HUC watershed scale. Future updates of candidate Critical Habitat could expand to areas where restoration has been successful.

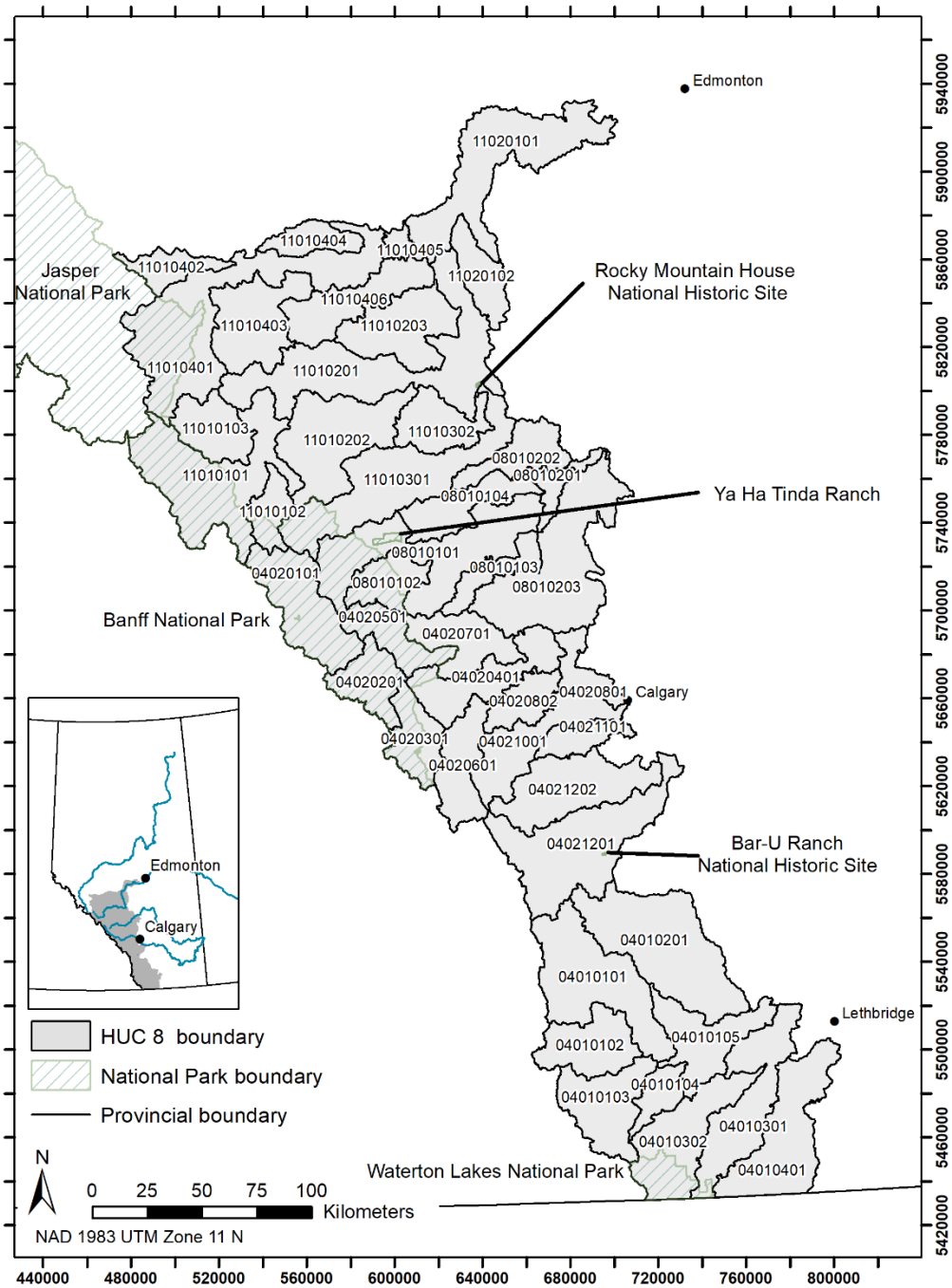

Figure 1. Extent of the 45 HUC 8 watersheds encompassing the range of the Bull Trout Saskatchewan-Nelson rivers populations, Designatable Unit 4 (DU 4). Watersheds are labelled with their HUC 8 code.

Step 2

For HUCs with self-sustaining Bull Trout populations and using known and observed occurrences of Bull Trout, candidate Critical Habitat was identified in all rivers, tributaries, and lakes upstream and downstream of locations where Bull Trout have been detected within

thermally-suitable habitat zones. Thermally suitable zones are defined as areas with mean modelled summer surface water temperatures ≤15 °C.

Bull Trout occurrences are related to the temporal and spatial distribution of both sampling locations and movement of individuals. This could create the following issues when identifying candidate Critical Habitat:

- Candidate Critical Habitat could be restricted to the distribution of sampling locations.
- Candidate Critical Habitat for certain Bull Trout functions (e.g., summer rearing) may be misrepresented by presence data related to other functions (e.g., migration).

To address the above issues, the following approach was taken to identify candidate Critical Habitat:

- The summer thermally-suitable zone (feature) associated with Bull Trout rearing and reproduction (functions) was identified. The attribute associated with these functions and features was the mean modelled summer surface water temperatures ≤15 °C.
- Subsequently, all rivers, tributaries, and lakes upstream and downstream of locations where Bull Trout have been detected within thermally-suitable zones were delineated as candidate Critical Habitat including:
    - All Strahler stream orders.
    - Waters currently unoccupied by Bull Trout, including waters above barriers.
    - The riparian area 30 m from the high water mark on both stream banks and shorelines of lakes and reservoirs.
- The attribute of ≤15 °C mean summer surface water temperature was based on a statistical analysis of observed Bull Trout presence/absence within provincial waters of the Oldman, Bow, Red Deer, and North Saskatchewan rivers basins. Presence/absence data was coupled to currently available models that predict mean July to September water temperatures (mean summer surface water temperature) for these basins. Temperatures >15 °C were associated with a ≤20% probability of Bull Trout presence in these basins, which was deemed unsuitable thermal habitat (Alberta Environment and Parks, unpublished data, Cochrane, Alberta). However, it should be stressed that the 15 °C criteria is directly related to the current temperature models and should be applied with caution to other areas or if using different temperature models. Furthermore, as temperature models are updated and refined, the specific temperature criteria could change.

These waters provide habitat that supports rearing and production for all Bull Trout life history stages. Upstream waters that are above barriers and fishless provide suitable quantity and quality of water to downstream occupied waters. Any activity in these upstream waters that disrupts the delivery in quantity or quality of water could affect downstream Bull Trout populations and their habitat (Poff and Zimmerman 2010). All tributary streams, permanent or seasonal, are physically, chemically, and biologically connected to downstream rivers via channels and alluvial deposits (Caldwell et al. 2015, Larsen et al. 2019). Water transports sediment, wood, organic matter, nutrients, and chemical contaminants to downstream areas (Fausch et al. 2002, Thorp et al. 2006, Caldwell et al. 2015). Headwater streams convey water into local groundwater storage compartments such as ponds, shallow aquifers, alluvial aquifers, and into regional aquifers; these local storage compartments are also important sources of water for maintaining base flow (Schaller and Fan 2009, Allen et al. 2010).

Step 3

To identify candidate Critical Habitat for Bull Trout migration, overwintering, and rearing (functions) not captured within the summer thermally suitable zone, river or lake segments that connect Bull Trout locations outside the thermally suitable zone to the nearest Bull Trout location within a thermally suitable zone are included. These habitats include:

- All watercourses and waterbodies along the hydrologic network.
- The riparian area 30 m from the high water mark on both stream banks and shorelines of lakes and reservoirs.
- Only the connecting river segment and not tributaries to this river segment.
- Exclude connections that span known barriers (i.e., waterfalls or dams).
- Exclude reported Bull Trout locations from irrigation or hydropower canals.

These waters are intended to provide habitat for Bull Trout migration and overwintering and have also been shown to provide rearing habitat for larger Bull Trout during summer when water temperatures exceed 15 °C (Muhlfeld and Marotz 2005, Popowich and Paul 2006, Homel and Budy 2008). These migration/overwintering/rearing segments tend to occur in areas where tributaries are unlikely to provide a significant contribution to Bull Trout habitat.

The above three-step approach was applied to identify candidate Critical Habitat within the Saskatchewan-Nelson rivers basins. However, the candidate Critical Habitat was then reviewed by local fisheries biologists to ensure:

- Bull Trout occurrences did not include erroneous or outdated data.
- Areas identified as candidate Critical Habitat did not have other physical, chemical or biological factors that would exclude them from being listed as candidate Critical Habitat. These exceptions were rare but included fragmented river or reservoir segments (e.g., Bow River or Spray Lakes Reservoir) that do not support Bull Trout populations and do not supply water to downstream populations.
- Areas not identified as candidate Critical Habitat did not contain a function, feature or attribute of Bull Trout habitat that warrant their inclusion as candidate Critical Habitat. This occurred in only one case for provincial waters. A small portion of candidate Critical Habitat was identified in a functionally extirpated HUC 8 (Brazeau Canal 11010405) as it provided a migration pathway between the Nordegg and North Saskatchewan rivers.

After examining the HUCs using the developed framework, candidate Critical Habitat was identified within 40 of the 45 HUC 8 (provincial waters) and 81 of the HUC 12 (National Parks) watersheds that encompass the distribution range of Bull Trout in DU 4 (Table 2; see Appendix). No candidate Critical Habitat was found within Bow River and Bighill Creek (04020801), Fish Creek (04021101), Willow Creek (04010201), North Saskatchewan above Wabamum (11020101), and Wolf Creek (11020102). However, these or additional watersheds (or portions thereof) may be considered as Critical Habitat in future periods, based on restoration/range recovery planning and information.

Critical Habitat for aquatic species may include riparian areas on both stream banks for the entire length of the stream segments and shorelines of lakes and reservoirs (DFO 2019). Riparian areas and instream structures contribute to stream complexity, creation of refugia, stabilization of stream banks, maintenance of colder stream temperatures by reducing insolation, and provide a dietary source of terrestrial invertebrates (Fausch et al. 2002; Baxter et

al. 2005). The width of the riparian area that is required to protect the features and attributes of Critical Habitat must be sufficiently large to maintain clean and cold water, sediment and silt free substrates, and provide terrestrial food inputs and woody debris into the aquatic environment. As a reasonable and precautionary approach, a width of 30 m from the high water mark on both stream banks and shorelines of lakes and reservoirs is recommended (Figure 2). Riparian zones contribute large woody debris to streams, which are used by fish as cover, help maintain channel morphology, provide localized bank stability and shade, input organic and inorganic matter, and help prevent erosion and reduce sedimentation (Allan et al. 2003, Baxter et al. 2005, Richardson et al. 2010).

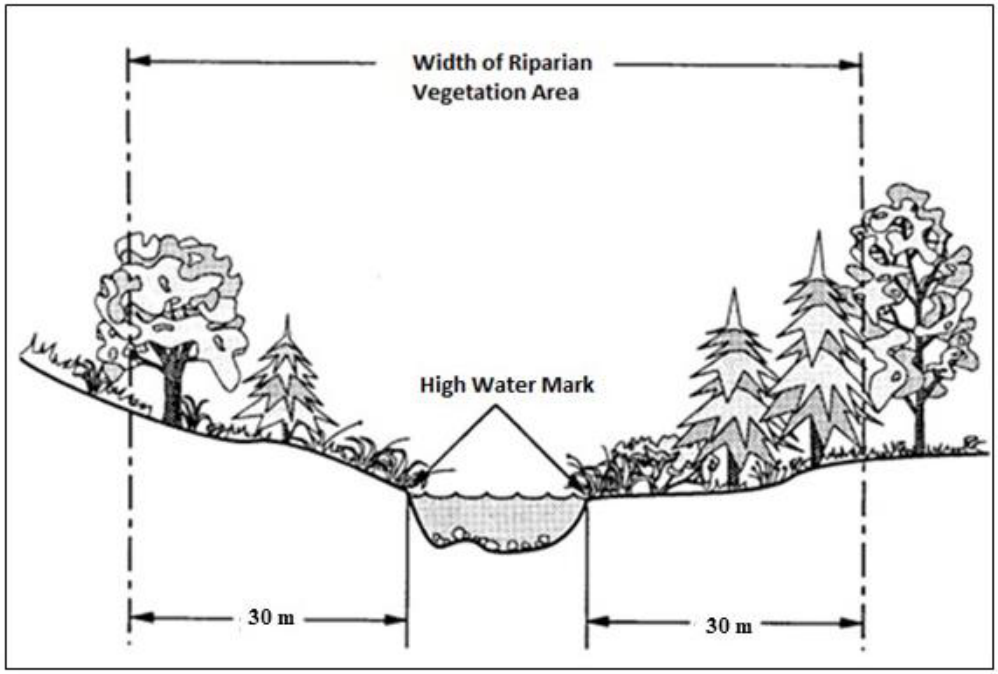

Figure 2. Proposed width of the riparian area that falls in the candidate Critical Habitat of Bull Trout. Riparian vegetation areas are continuous and extend horizontally from the high water mark to a width of 30 m (from DFO 2019).

Table 1. Summary of the functions, features, and attributes for each life stage of Bull Trout. Modified from DFO (2017). See Sawatzky (2016) for the full list of citations.

Life Stage	Function	Feature(s)	Attributes (Observed)	For Identification of Critical Habitat (Inferred)
Spawning / Incubation	• Reproduction	• Interstices of bottom substrate in small tributary streams; redds are often constructed in areas with perennial groundwater upwellings	• High gradient streams • Spawning depth range: 0.07-0.93 m • Incubation depth range: 0.1-0.2 m • Substrate: gravel/cobble dominated substrate • Substrate size: 2-200 mm • Cover: overhanging vegetation, undercut banks, large woody debris, rootwads, but overhead cover is not a prerequisite for spawning; redds are often constructed along river margins. • Run-type reaches; low gradient and flood plain sections • Velocity: 2-99 cm/s • Turbidity: 0.1-1.0 NTU • Oxygen: Intergravel 8-12 mg/L, mean 9 mg/L; Instream 10-11.5 mg/L, mean 10 mg/L • Water Temperature: Spawning 5-9 °C; Incubation 1.2-5.4 °C; perennial groundwater upwellings are important in maintaining temperature • Fluvial and adfluvial Bull Trout migrate to spawning habitat, thus unobstructed access is required	• Unimpeded access to spawning areas • Gravel/cobble dominated substrate associated with perennial groundwater upwellings • Areas with minimal disturbances and low levels of fine sediment
Young-of-Year	• Nursery • Cover • Feeding • Overwintering	• Shallow shoreline pools and riffles of side channels; deeper pools; interstices of bottom substrate; often overwinter in areas associated with perennial groundwater upwellings	• Depth range: 0.07-0.93 m • Substrate: cobble and boulder, silt • Cover: overhanging vegetation, undercut banks, large woody debris, gravel substrate, boulders, small wood, cobble, velocity breaks • Velocity: low velocity backwaters and side channels • Nose velocity: 0.05-0.1 m/s; upper limit: 0.33 m/s • Bottom velocity: 0.05-0.15 m/s; upper limit: 0.23 m/s • Water Temperature: 2-20 °C; ultimate upper incipient lethal temperature (UUILT) 20.9 °C (60 days), 23.5 °C (7 days) • Pool and run habitats are preferred • Connectivity between spawning sites and rearing locations	• Low velocity backwaters and side channels; pool and run habitats • Adequate cover (intact riparian zone) • Seasonal and perennial groundwater upwellings • Connectivity between spawning sites and rearing locations

Life Stage	Function	Feature(s)	Attributes (Observed)	For Identification of Critical Habitat (Inferred)
Juvenile and Adult	• Feeding • Cover • Overwintering	• Higher gradient habitats, often in shallow pools and riffles; interstices of bottom substrates; often overwinter in isolated pools maintained by perennial groundwater upwellings • Pools, riffles, runs, lakes (adfluvial)	• Gradient: 1.0-15.6% • Depth: deeper water during the day and shallower water (littoral zone, runs, channel margins, backwaters) at night; pools associated with groundwater input for overwintering • Substrate: cobble, boulder, silt (juveniles), rubble, sand (night use) • Cover: overhanging vegetation, undercut banks, large woody debris, substrate, boulders, rootwads (juveniles), velocity breaks (juveniles), may also use deep-water habitat; diel shifts to habitats without cover at night are common • Oxygen: acute limit = > 2 mg/L; likely the same for juveniles and adults • Water Temperature: below 12 °C; UUILT slightly lower than for young-of-year; maximum daily-maximum temperature 12 °C, maximum weekly-maximum temperature 11 °C; average maximum summer temperature 17 °C • Fluvial Bull Trout migrate to overwintering areas and therefore require well-connected habitat • Velocity (Juvenile) – Nose velocity: 0.05-0.25 m/s, upper limit: 0.48 m/s; Bottom velocity: 0.20-0.28 m/s, upper limit: 0.31 m/s, Mean column velocity: 0.05-0.20 m/s, upper limit: 0.8 m/s	• Unimpeded access to overwintering areas • Adequate cover (intact riparian zone) • Pools and riffles • Seasonal and perennial groundwater upwellings

Table 2. Summary of candidate Critical Habitat designation for each HUC 8 watershed.

Watershed Name	HUC 8 Code	Candidate Critical Habitat Designated	National Park Boundaries
Upper Oldman River	04010101	yes	-
Crowsnest River	04010102	yes	-
Castle River	04010103	yes	-
Pincher Creek	04010104	yes	-
Oldman below Oldman River reservoir	04010105	yes	-
Willow Creek	04010201	no	-
Belly River	04010301	yes	Waterton Lakes
Waterton River	04010302	yes	Waterton Lakes
St. Mary River	04010401	yes	-
Upper Bow River	04020101	yes	Banff
Brewster Creek	04020201	yes	Banff
Spray Lakes River	04020301	yes	Banff
Bow River and Ghost Reservoir	04020401	yes	Banff
Cascade River	04020501	yes	Banff
Kananaskis River	04020601	yes	-
Ghost River	04020701	yes	-
Bow River and Bighill Creek	04020801	no	-
Jumpingpound Creek	04020802	yes	-
Elbow River	04021001	yes	-
Fish Creek	04021101	no	-
Highwood River	04021201	yes	Bar-U Ranch National Historic Site
Sheep River	04021202	yes	-
Upper Red Deer River	08010101	yes	Banff & Ya Ha Tinda Ranch
Panther River	08010102	yes	Banff
Fallentimber Creek	08010103	yes	-
James River	08010104	yes	-
Red Deer River and Gleniffer Lake	08010201	yes	-
Raven River	08010202	yes	-
Little Red Deer River	08010203	yes	-
North Saskatchewan above Abraham	11010101	yes	Banff
Siffleur River	11010102	yes	Banff
Cline River	11010103	yes	-
North Saskatchewan below Abraham	11010201	yes	Rocky Mountain House National Historic Site
Ram River	11010202	yes	-
Baptiste River	11010203	yes	-
Clearwater River	11010301	yes	Banff
Prairie Creek	11010302	yes	-
Brazeau River	11010401	yes	Jasper
Cardinal River	11010402	yes	-
Blackstone River	11010403	yes	-
Elk River	11010404	yes	-
Brazeau Canal	11010405	yes	-
Nordegg River	11010406	yes	-
North Saskatchewan above Wabamum	11020101	no	-
Wolf Creek	11020102	no	-

Other Considerations

The best available scientific data was used to delineate candidate Critical Habitat. In instances where data were sparse or insufficient, participants reached consensus on a logical decision framework to identify candidate Critical Habitat using scientific principles. However, it is important to recognize that Critical Habitat designated in the Critical Habitat Order may differ from candidate Critical Habitat identified in this Science Response. The former may include socio-economic considerations in the designation process whereas the Science Response only considered best available ecological scientific evidence.

Conclusions

Bull Trout is a sensitive freshwater char that requires cold, clean, complex, and connected habitats for survival. The distribution and abundance of the Saskatchewan-Nelson rivers populations (DU 4) has declined across the historical range due to natural and human causes. This DU has been assessed by COSEWIC and listed by DFO under SARA as Threatened. Given the best data available, a Bounding Box Approach outlining the functions, features, and attributes of Critical Habitat was used to identify candidate Critical Habitat at the HUC 8 (provincial waters) and HUC 12 (National Parks) watershed scale. In addition, recommendations for the protection of riparian zones were provided and functions, features, and attributes of Critical Habitat have been outlined. Using the Bounding Box Approach, candidate Critical Habitat for Bull Trout (DU4) was only partially identified due to data limitations. Therefore, this DU requires further work to identify potential recovery areas for Bull Trout. An example of undesignated potential Critical Habitat includes areas in watersheds where Bull Trout are functionally extirpated. Areas not designated as candidate Critical Habitat may be designated as potential reintroduction zones if they possess the functions, features, and attributes of Critical Habitat. An ongoing goal will be to provide Science Advice for identification of additional Critical Habitat and recovery areas to support the Species at Risk program.

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Appendix 1. Bull Trout Candidate Critical Habitat

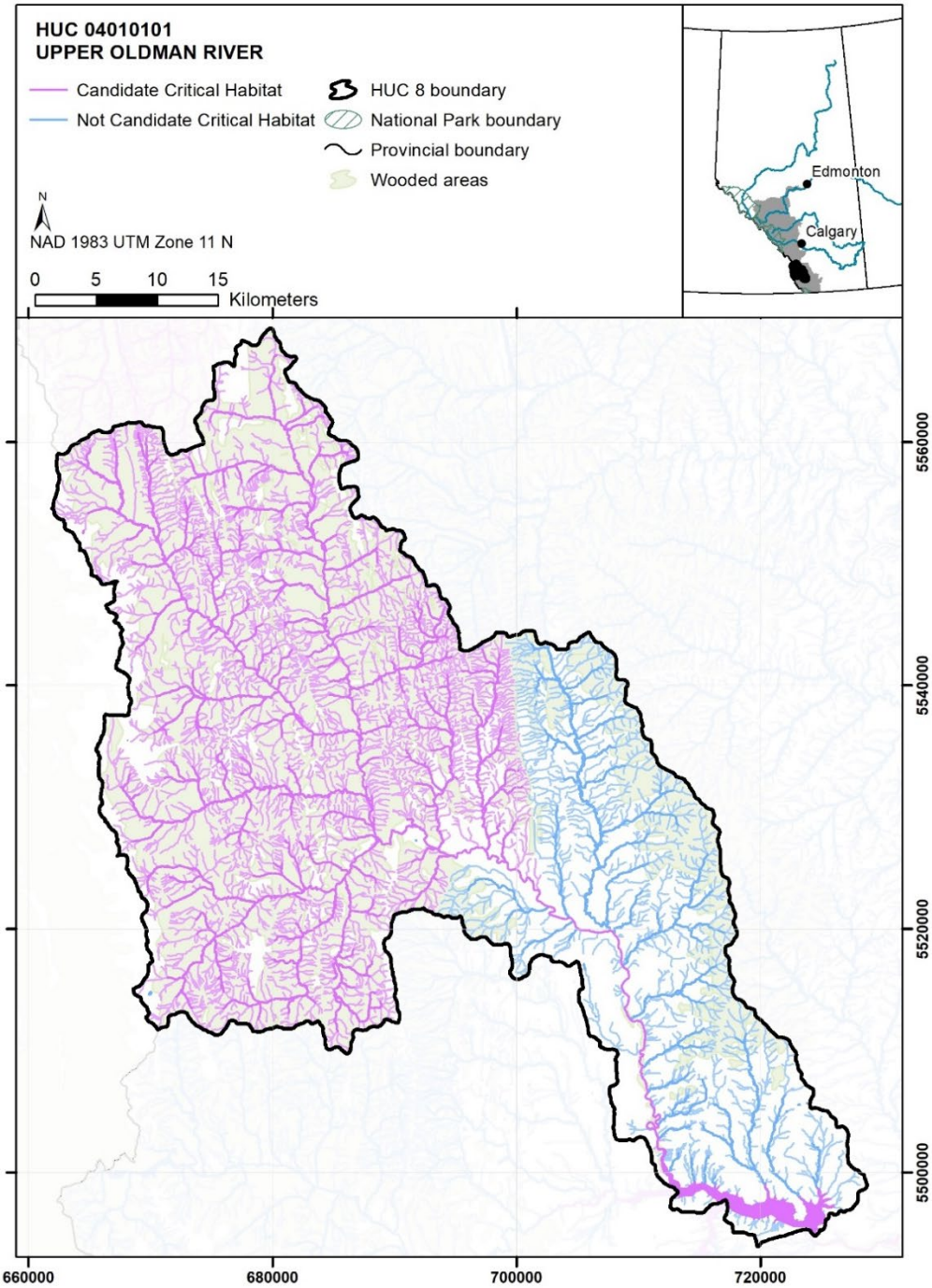

Figure A1.1. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04010101) Upper Oldman River. All first and second order streams are reduced to improve visibility.

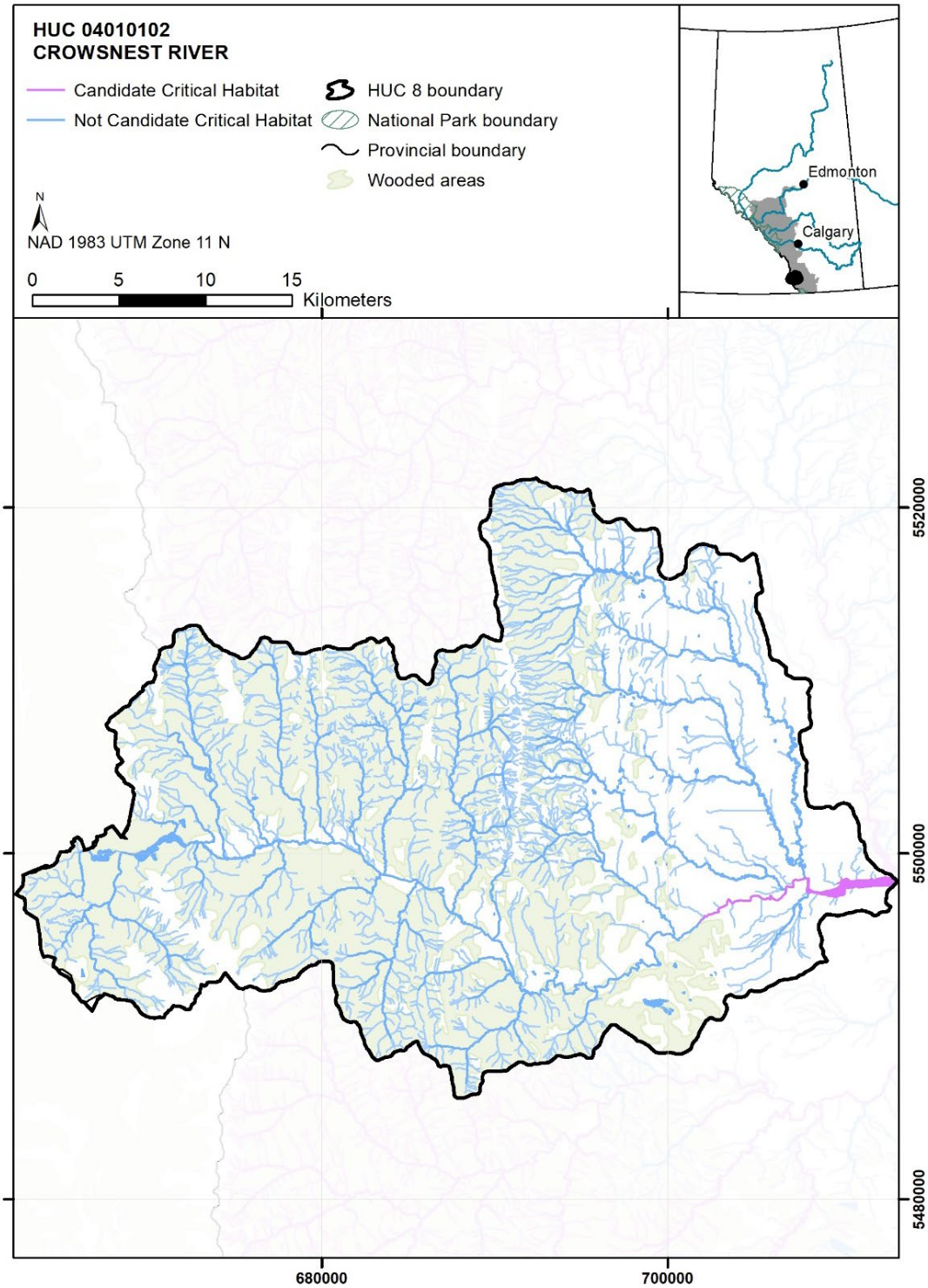

Figure A1.2. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04010102) Crowsnest River. All first and second order streams are reduced to improve visibility.

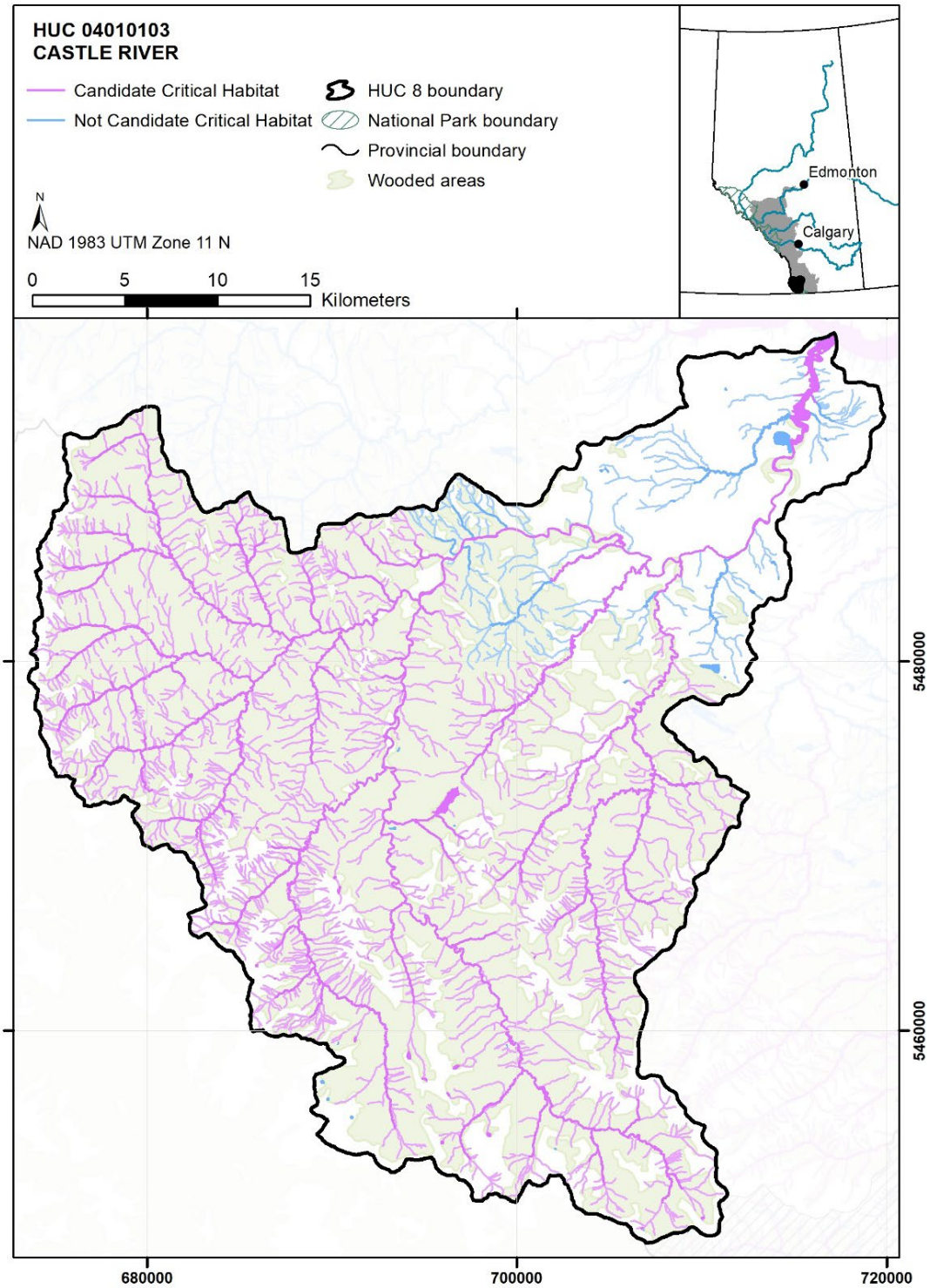

Figure A1.3. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04010103) Castle River. All first and second order streams are reduced to improve visibility.

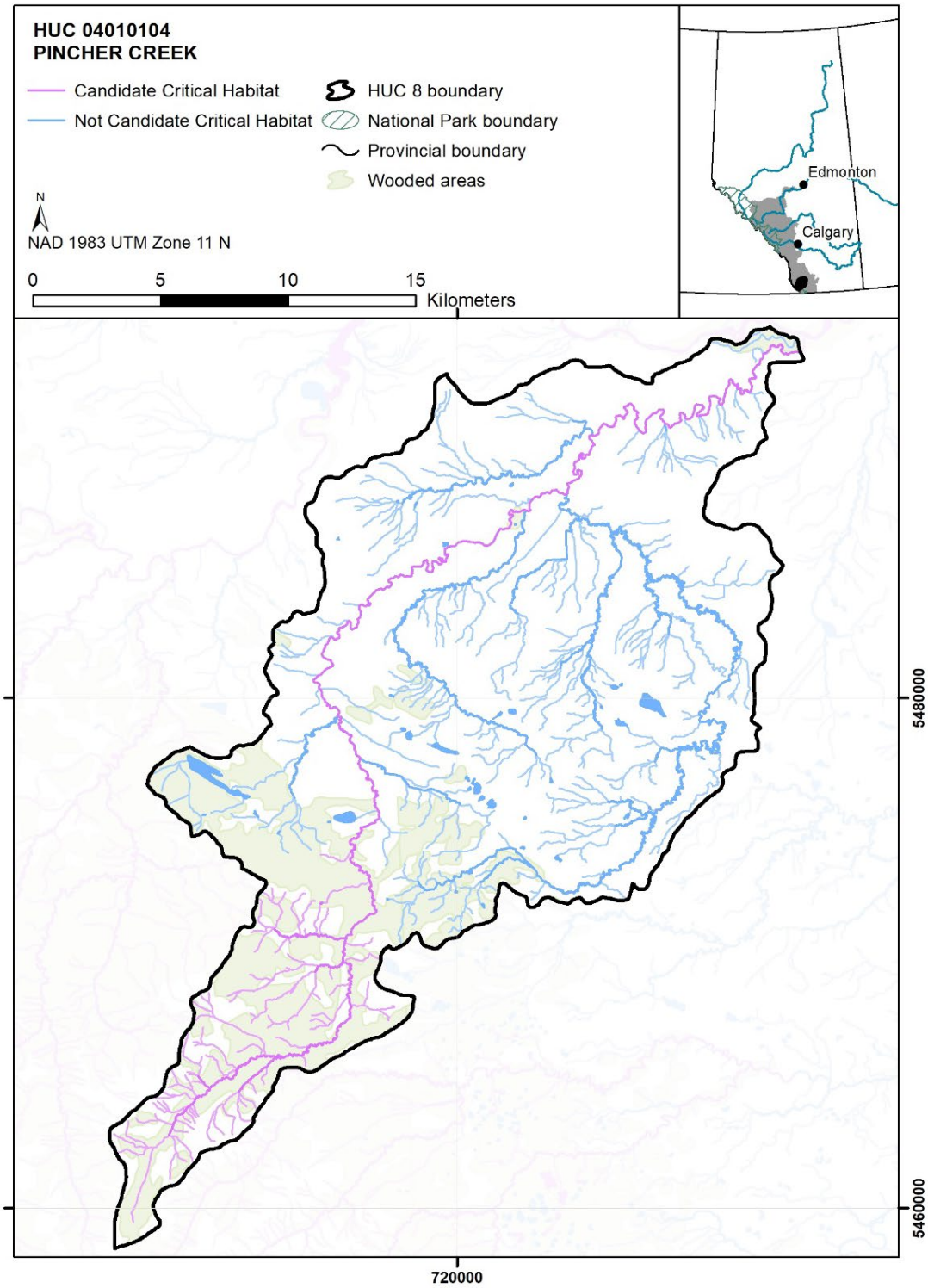

Figure A1.4. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04010104) Pincher Creek. All first and second order streams are reduced to improve visibility.

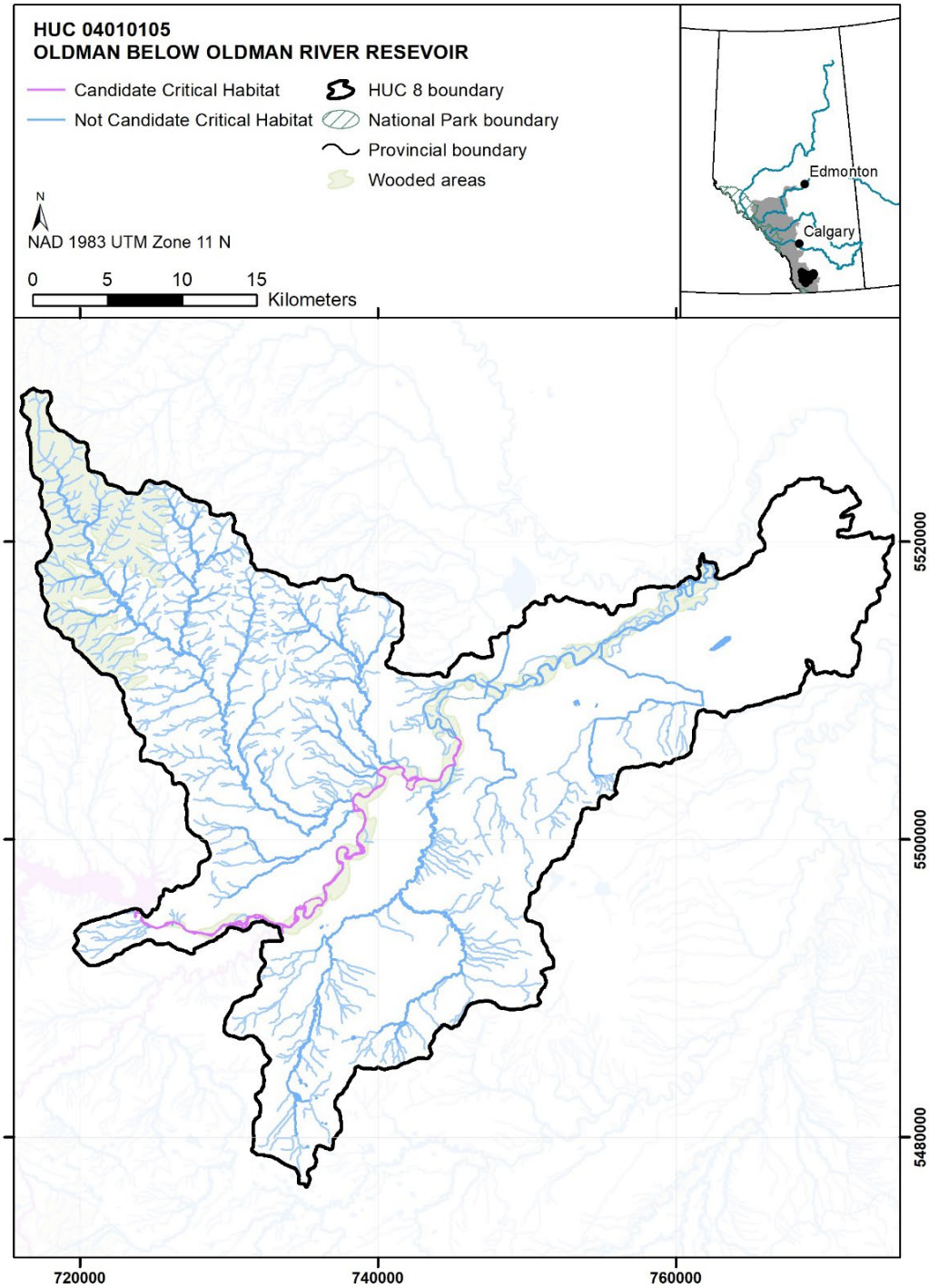

Figure A1.5. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04010105) Oldman below Oldman River reservoir. All first and second order streams are reduced to improve visibility.

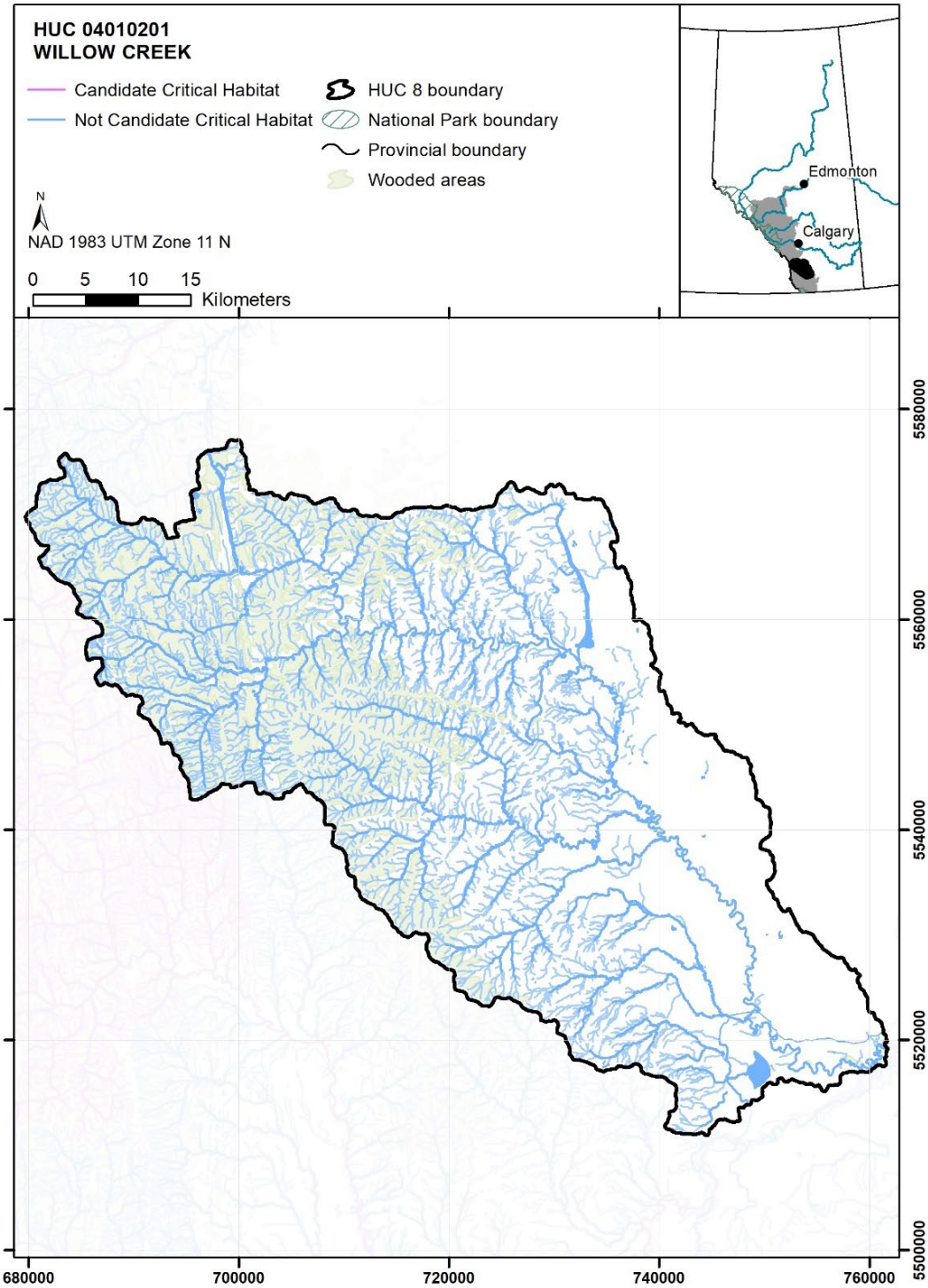

Figure A1.6. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04010201) Willow Creek. All first and second order streams are reduced to improve visibility.

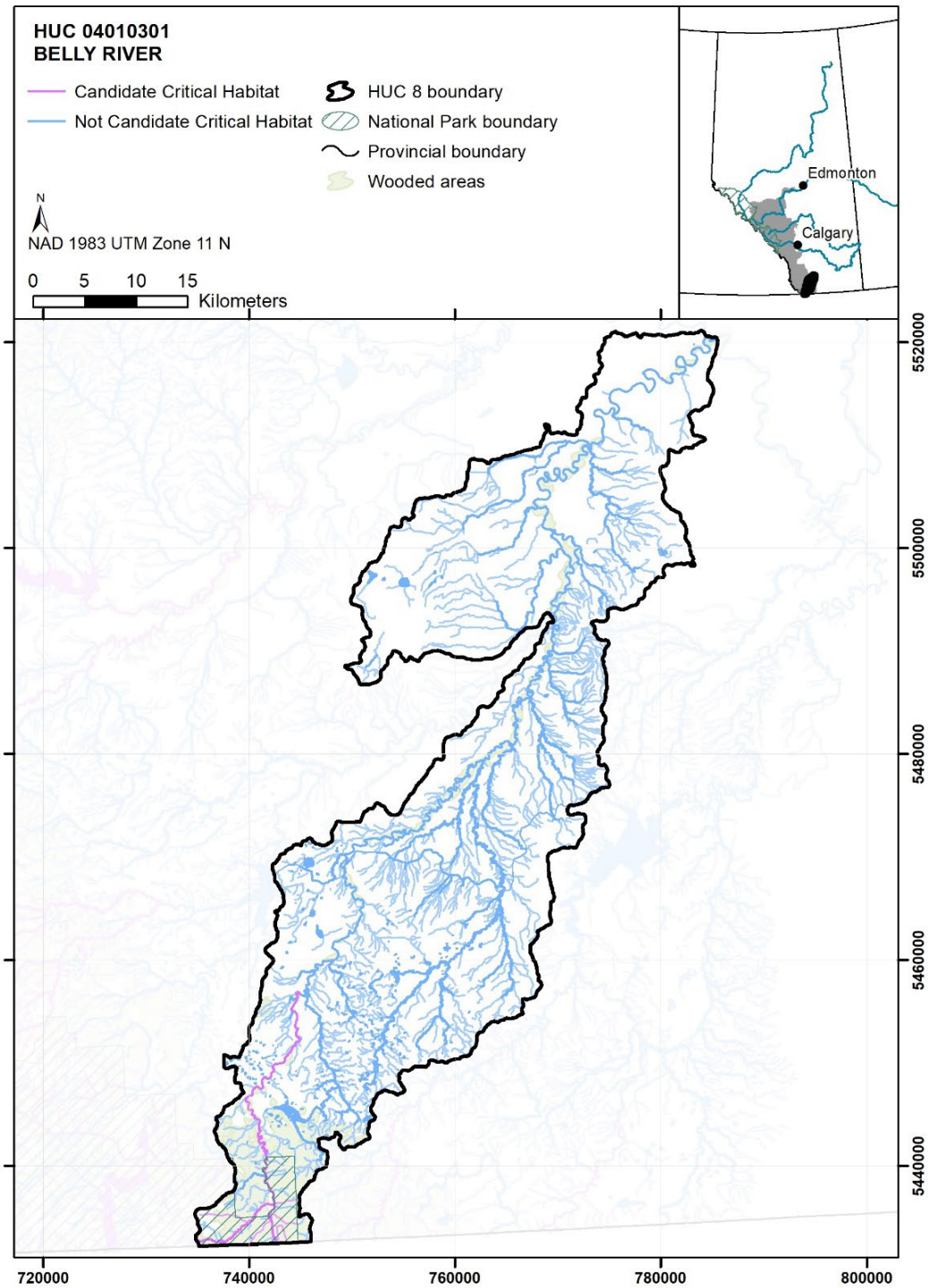

Figure A1.7. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04010301) Belly River. All first and second order streams are reduced to improve visibility. For designations inside Waterton Lakes National Park boundaries see Figure A1.43.

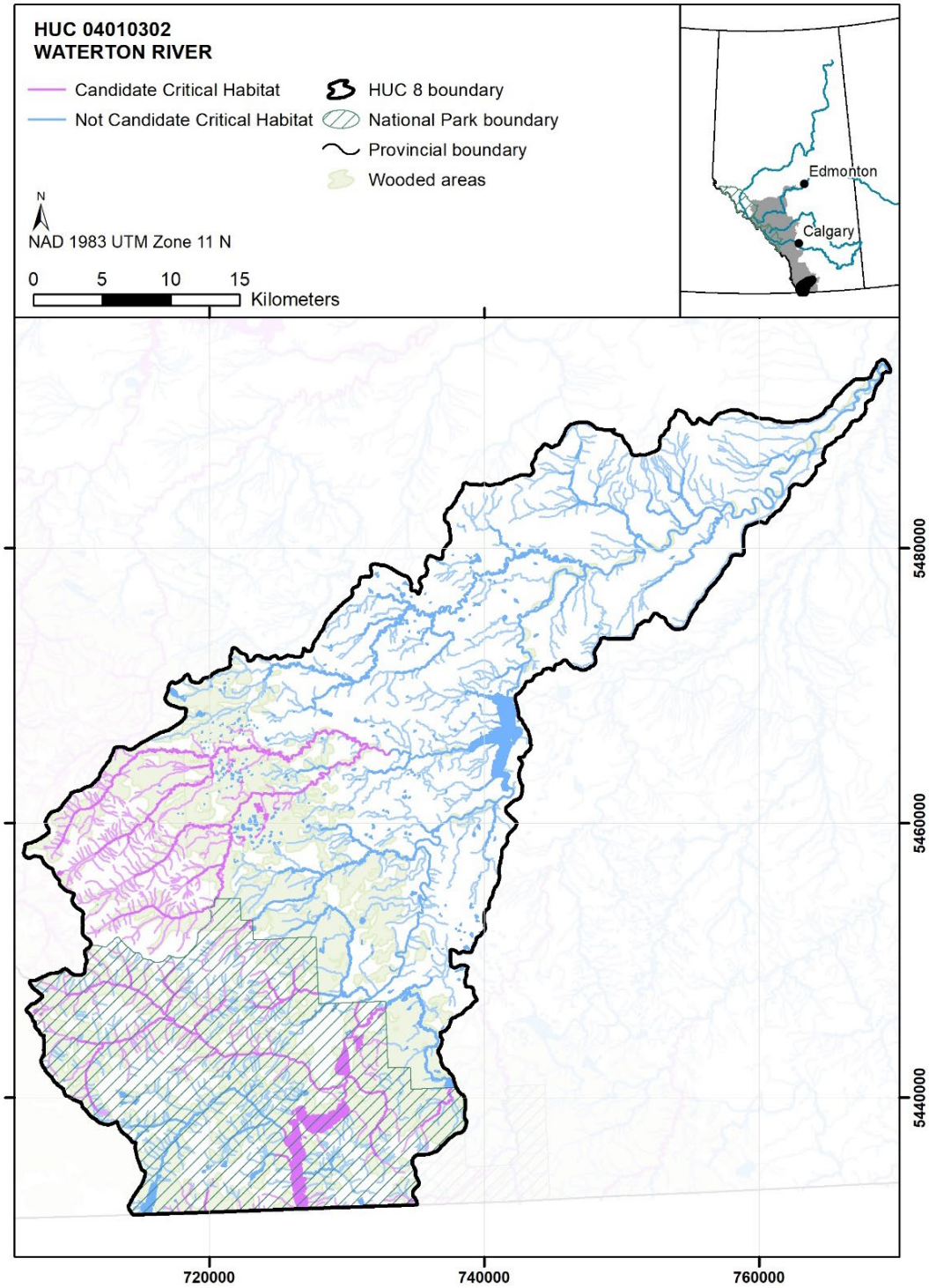

Figure A1.8. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04010302) Waterton River. All first and second order streams are reduced to improve visibility. For designations inside Waterton Lakes National Park boundaries see Figure A1.43.

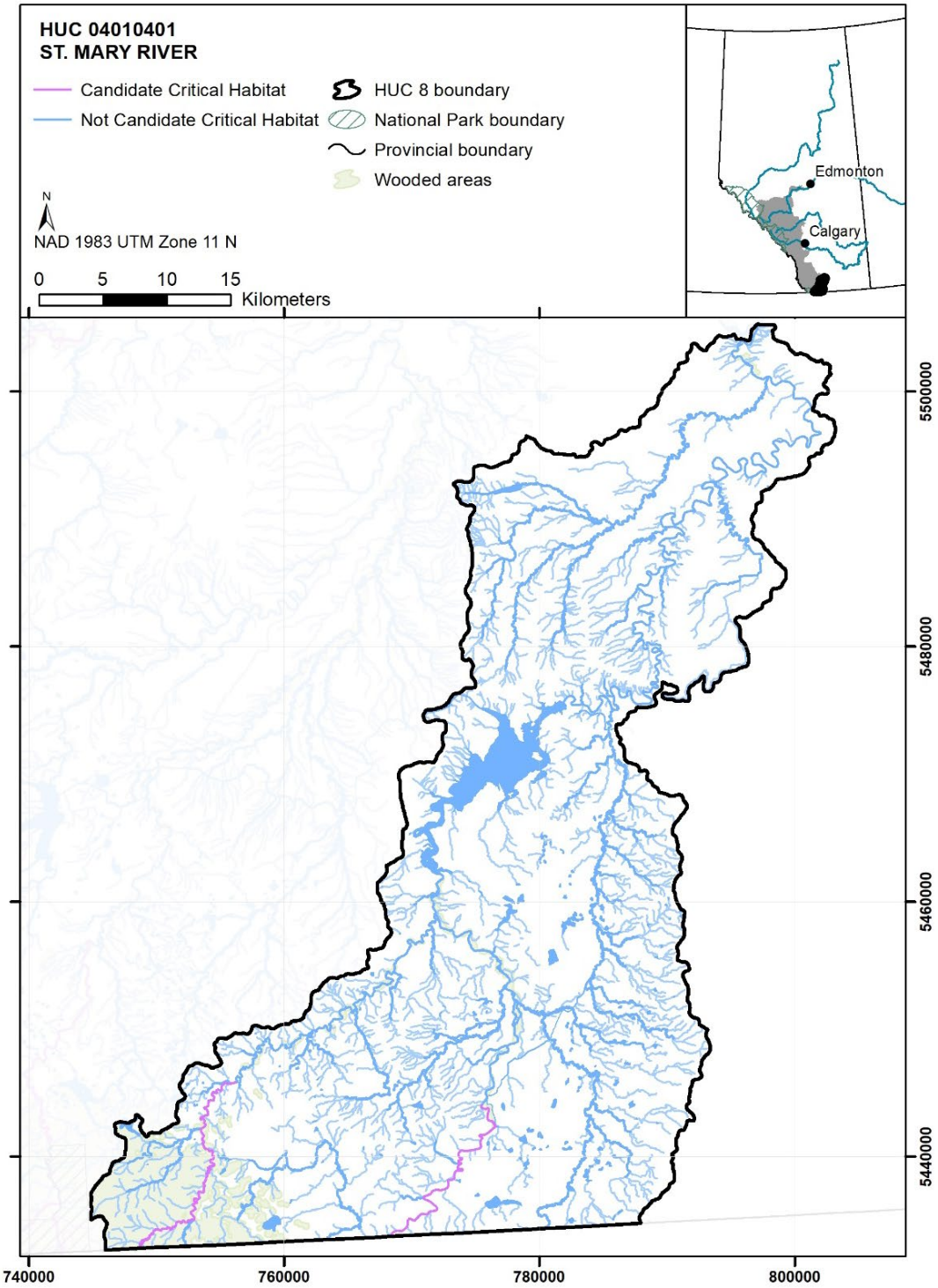

Figure A1.9. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04010401) St. Mary River. All first and second order streams are reduced to improve visibility.

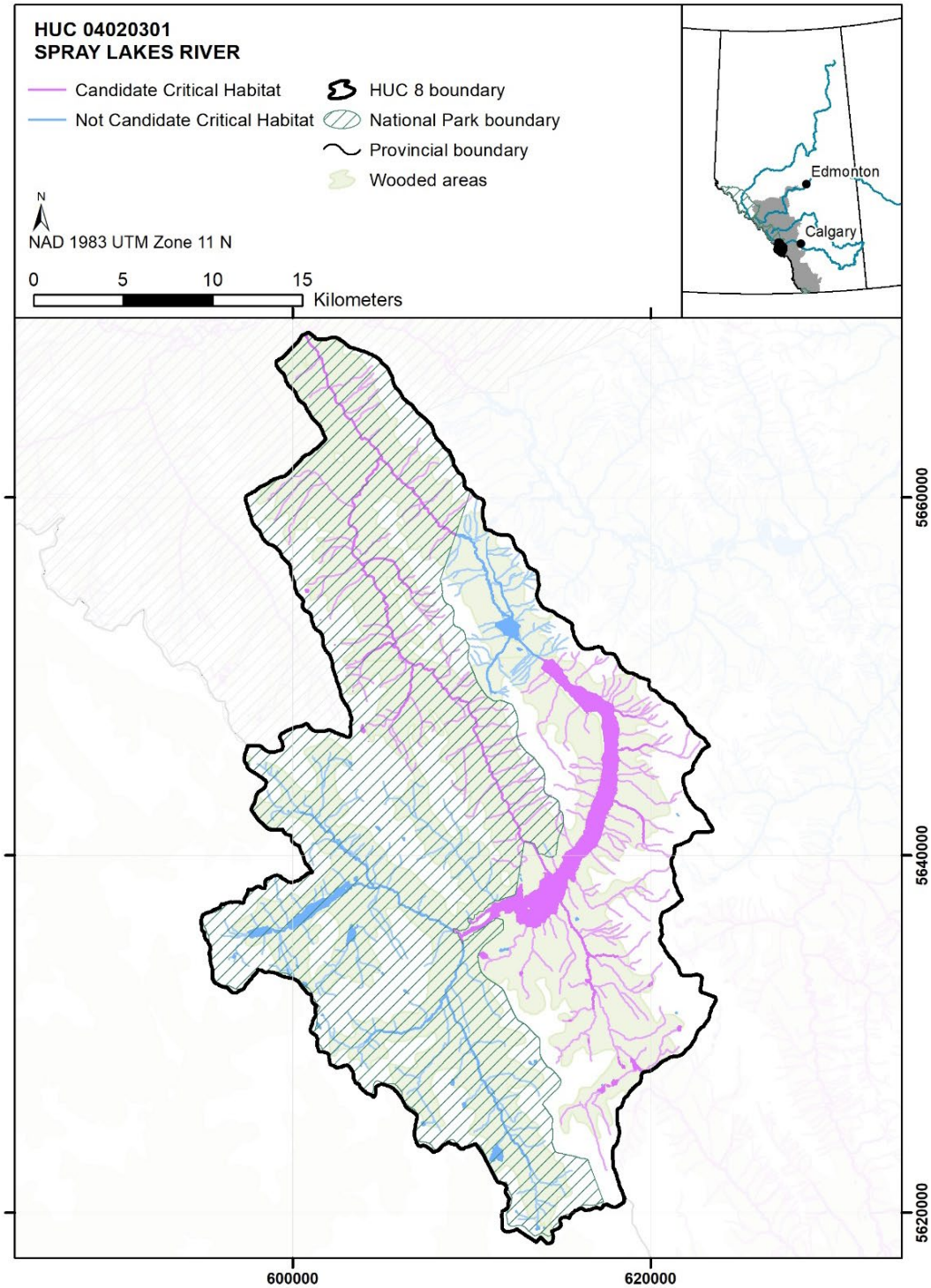

Figure A1.10. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04020301) Spray Lakes River. All first and second order streams are reduced to improve visibility. For designations inside Banff National Park boundaries see Figure A1.43.

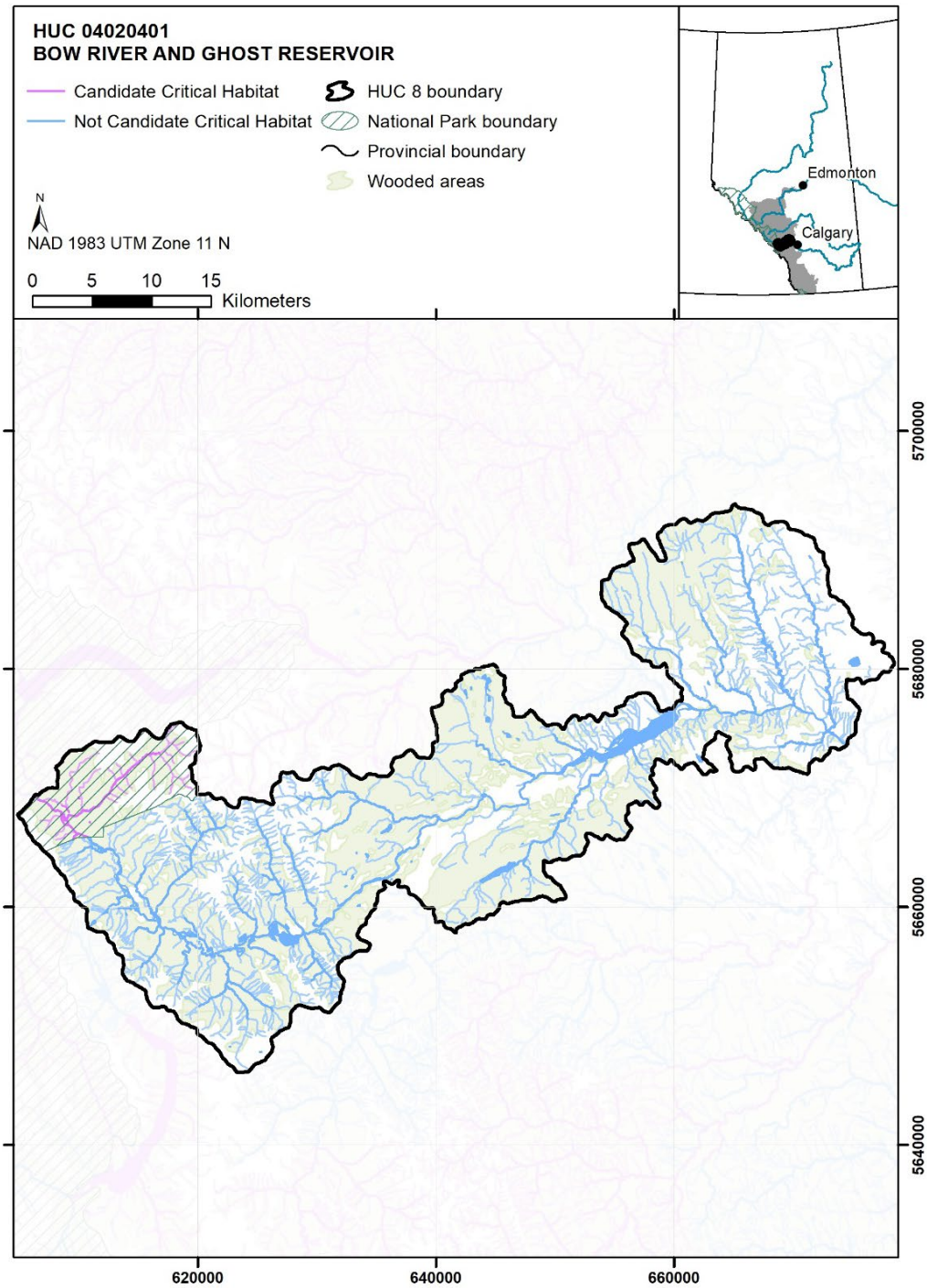

Figure A1.11. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04020401) Bow River and Ghost Reservoir. All first and second order streams are reduced to improve visibility. For designations inside Banff National Park boundaries see Figure A1.43.

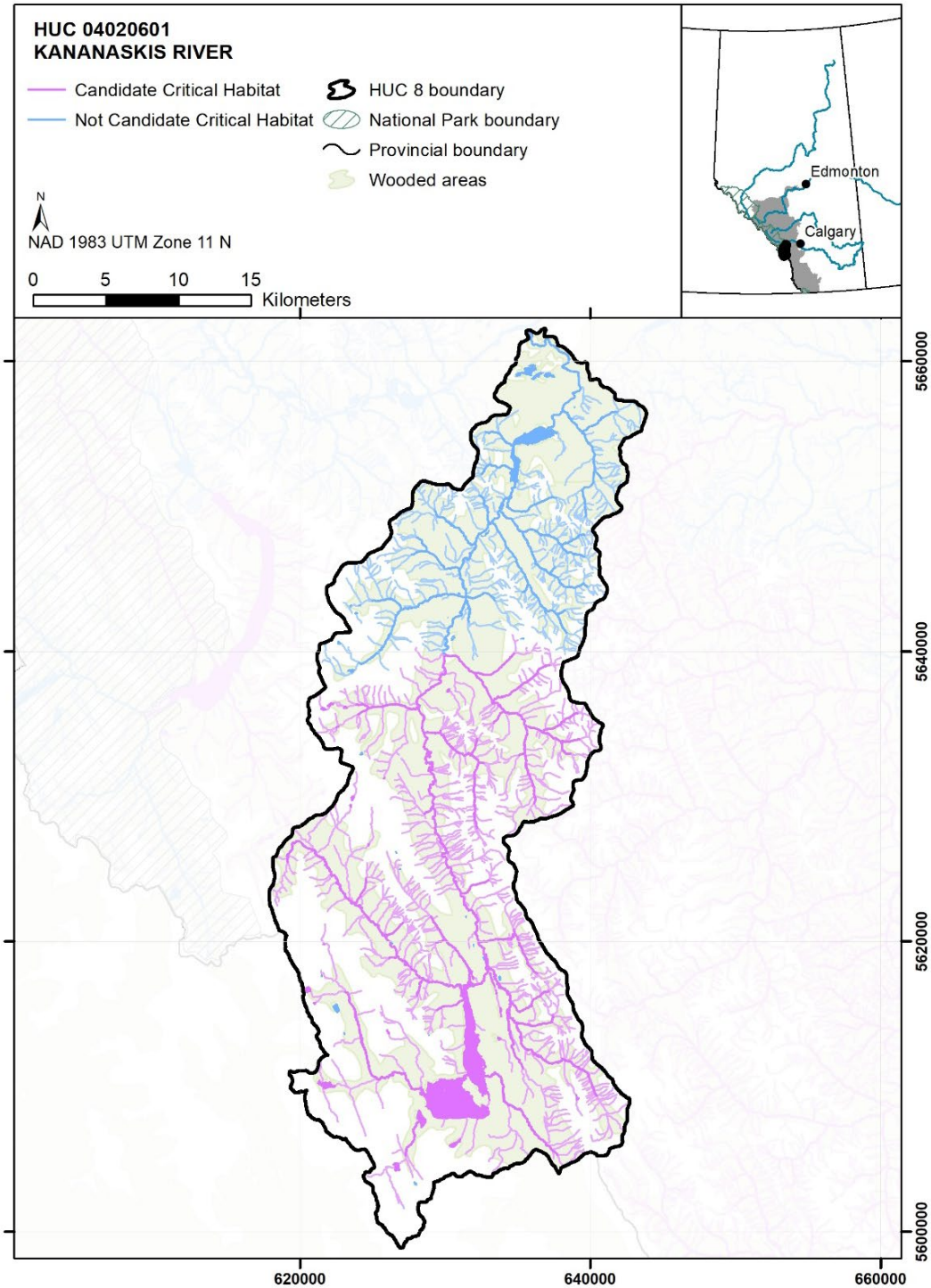

Figure A1.12. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04020601) Kananaskis River. All first and second order streams are reduced to improve visibility.

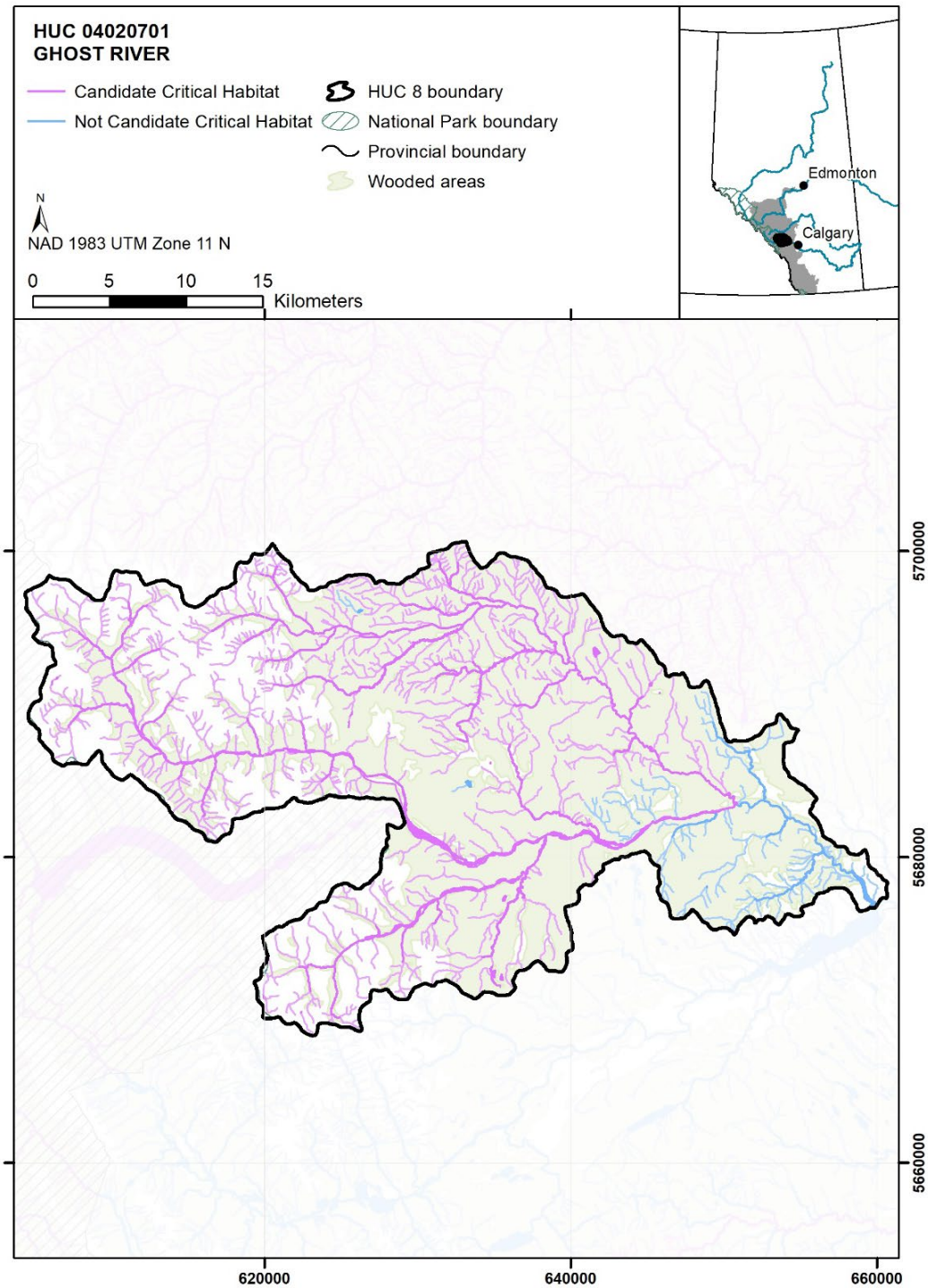

Figure A1.13. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04020701) Ghost River. All first and second order streams are reduced to improve visibility.

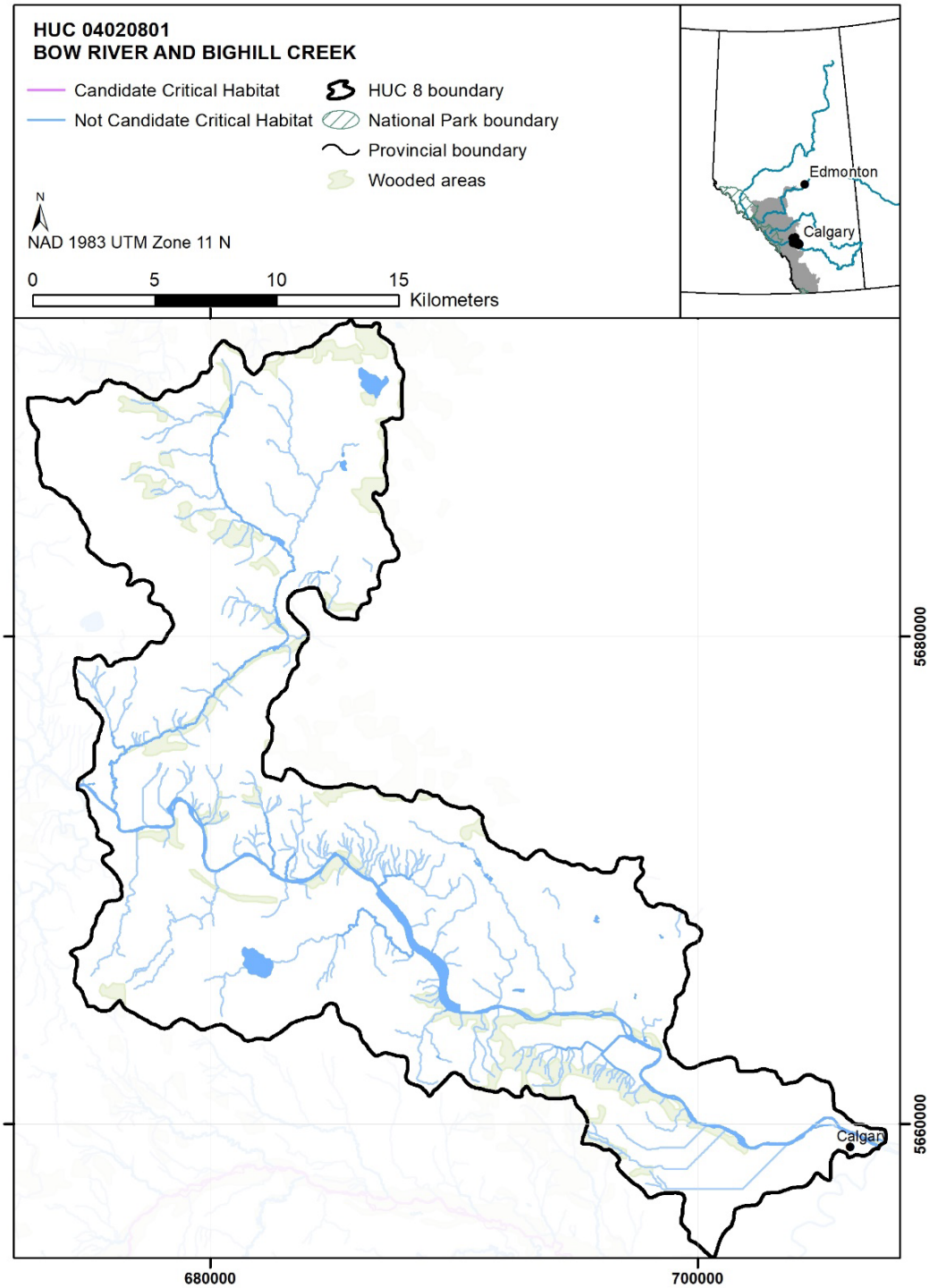

Figure A1.14. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04020801) Bow River and Bighill Creek. All first and second order streams are reduced to improve visibility.

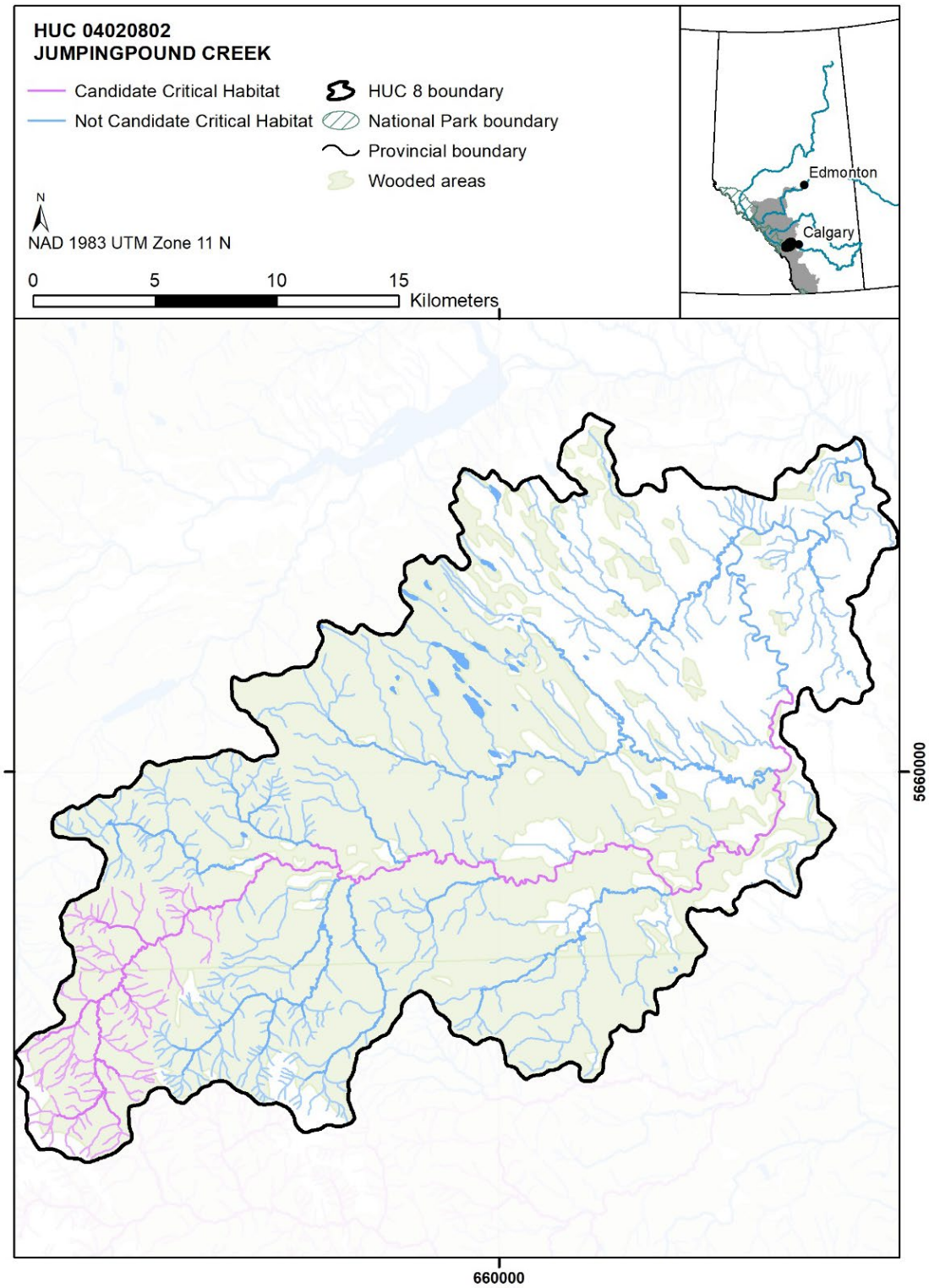

Figure A1.15. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04020802) Jumpingpound Creek. All first and second order streams are reduced to improve visibility.

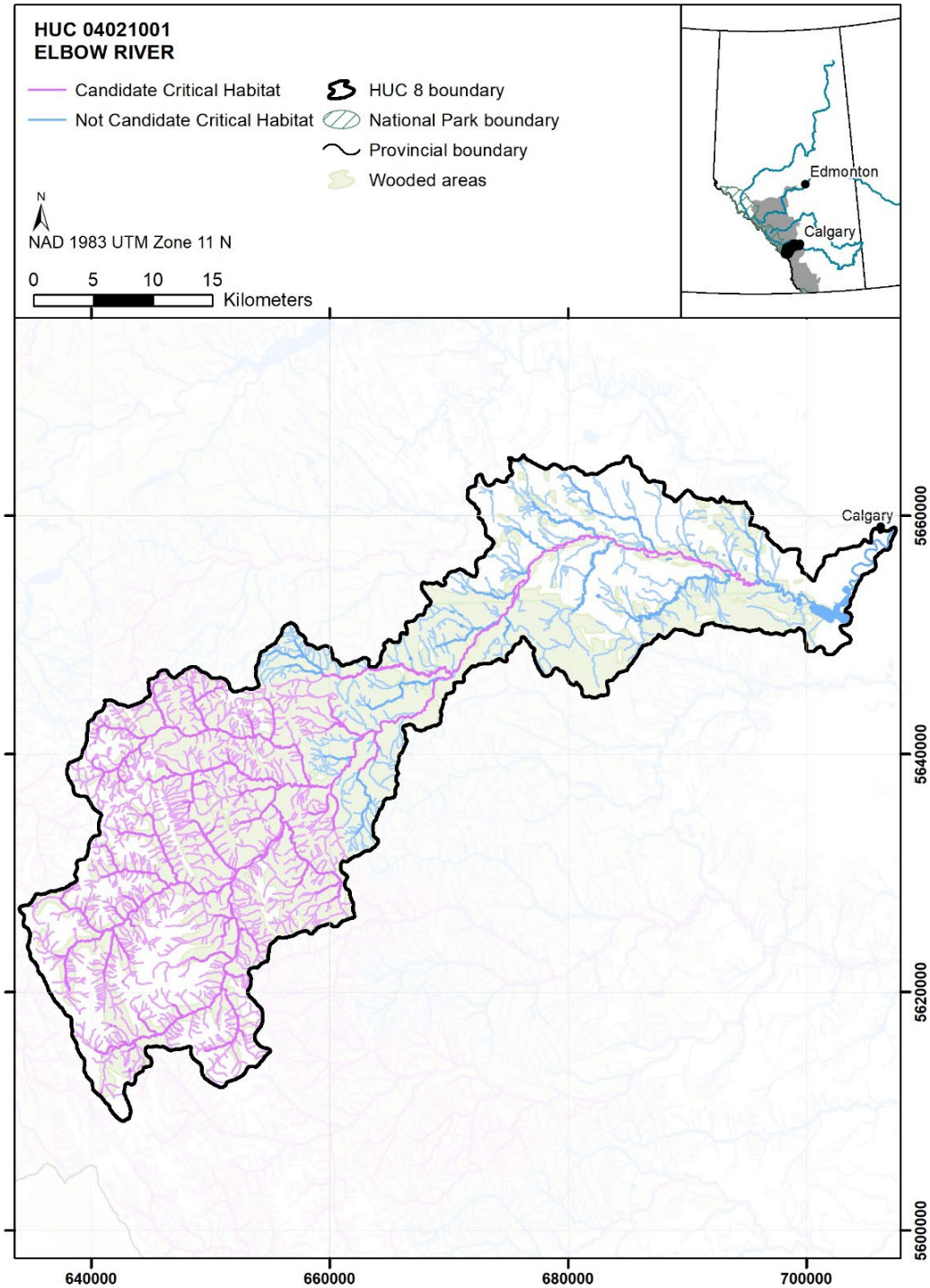

Figure A1.16. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04021001) Elbow River. All first and second order streams are reduced to improve visibility.

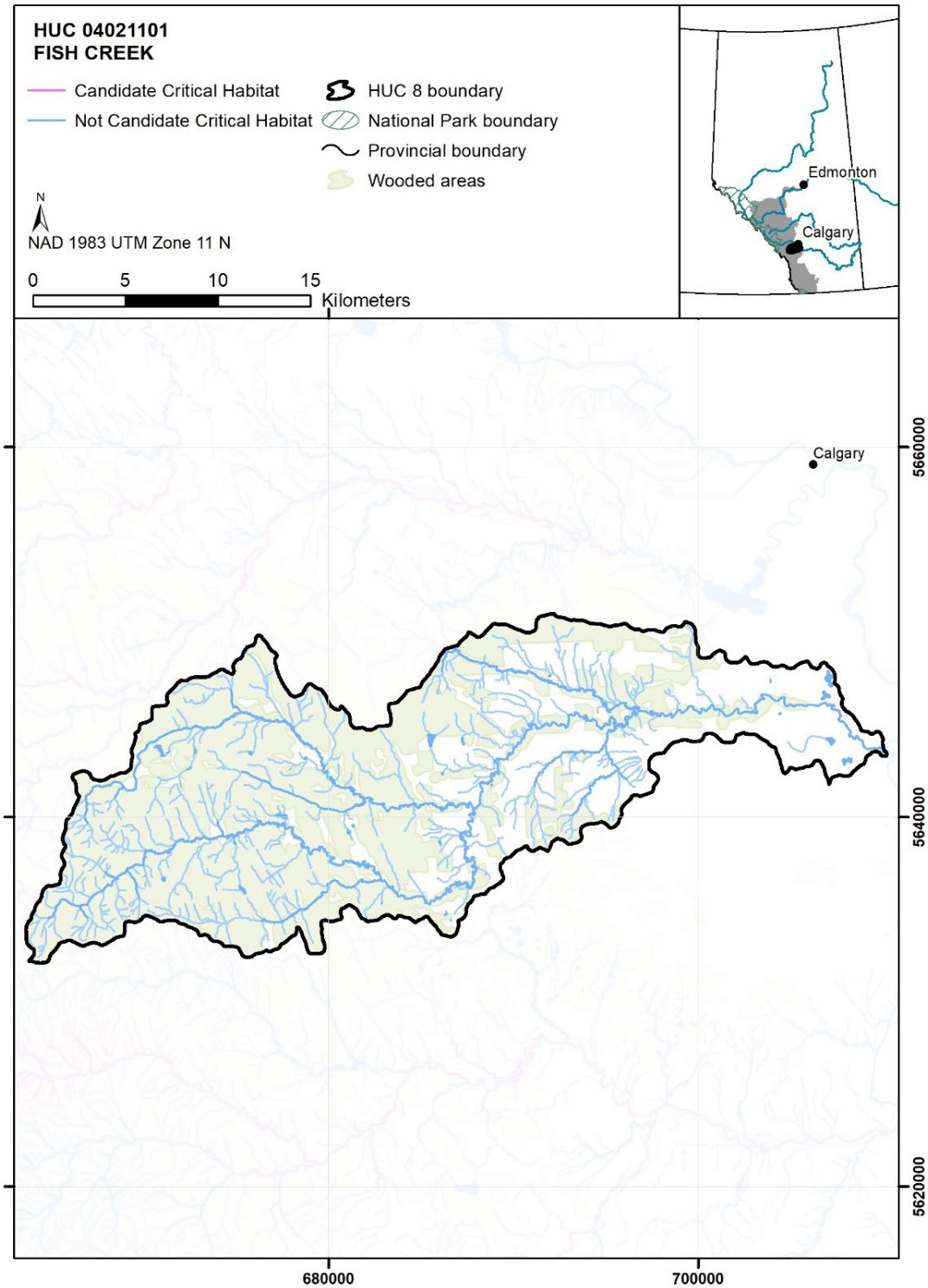

Figure A1.17. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04021101) Fish Creek. All first and second order streams are reduced to improve visibility.

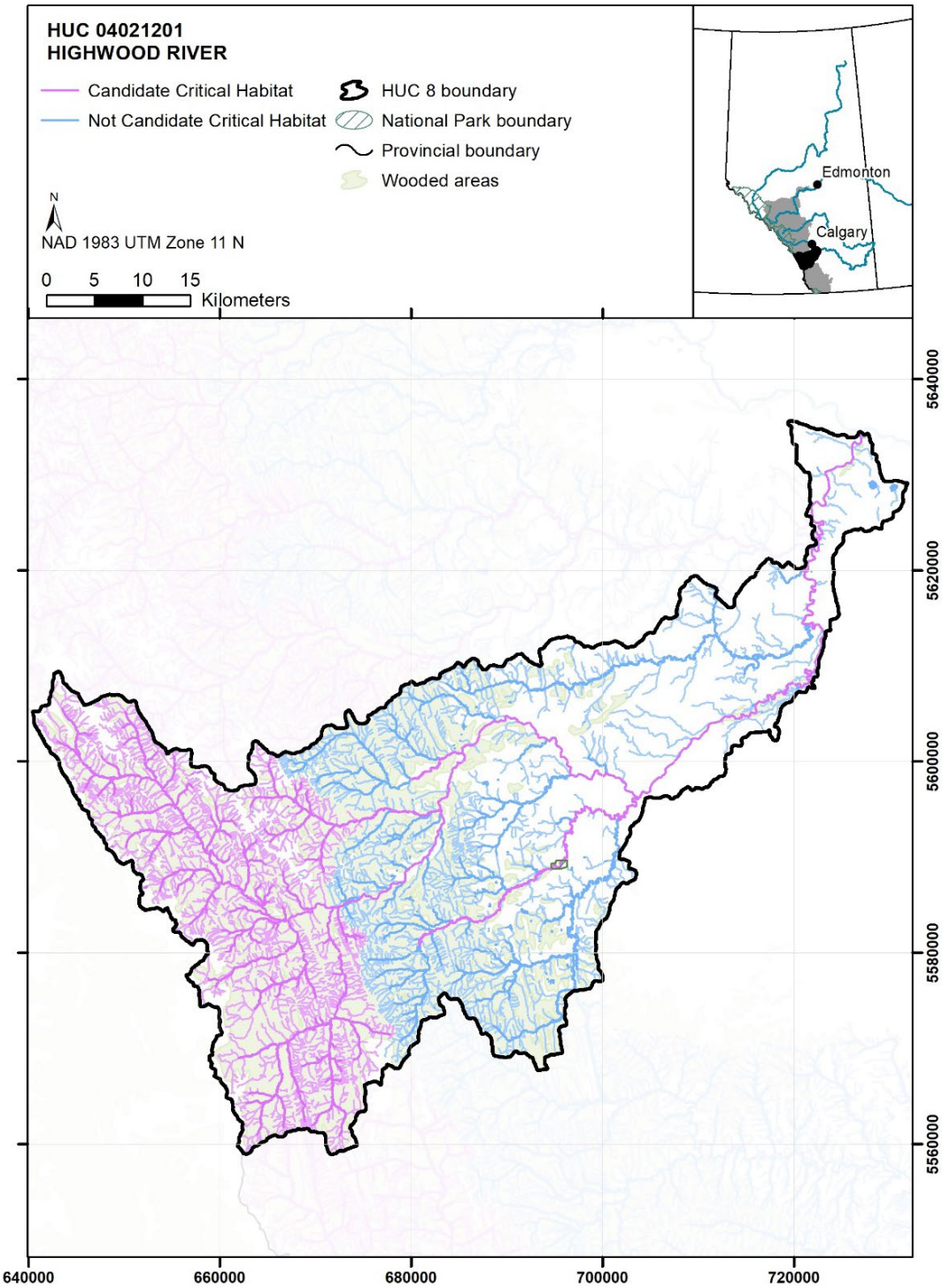

Figure A1.18. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04021201) Highwood River. All first and second order streams are reduced to improve visibility. For designations inside Bar-U Ranch National Historic Site boundaries see Figure A1.43.

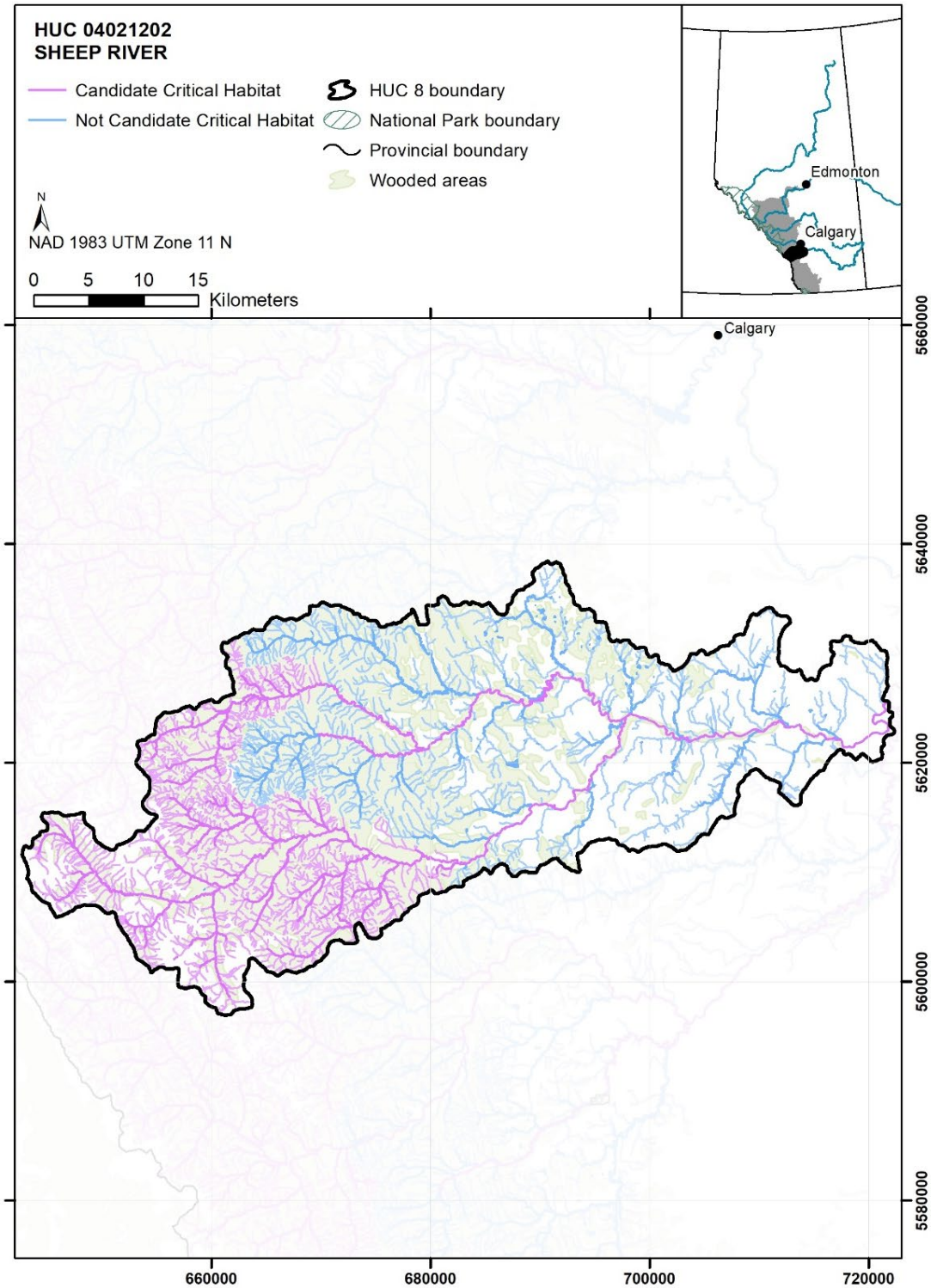

Figure A1.19. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (04021202) Sheep River. All first and second order streams are reduced to improve visibility.

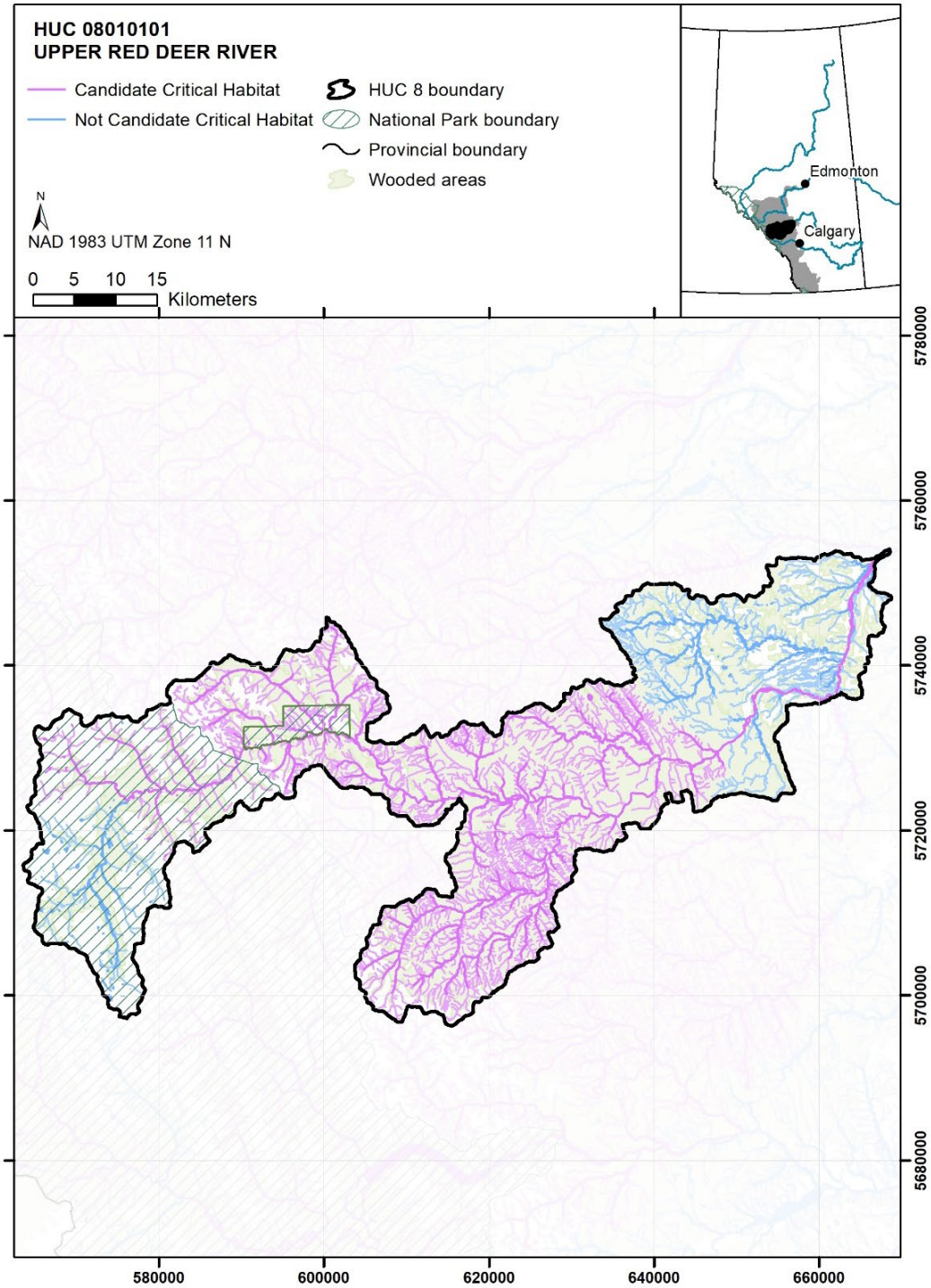

Figure A1.20. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (08010101) Upper Red Deer River. All first and second order streams are reduced to improve visibility. For designations inside Banff National Park and Ya Ha Tinda Ranch boundaries see Figure A1.43.

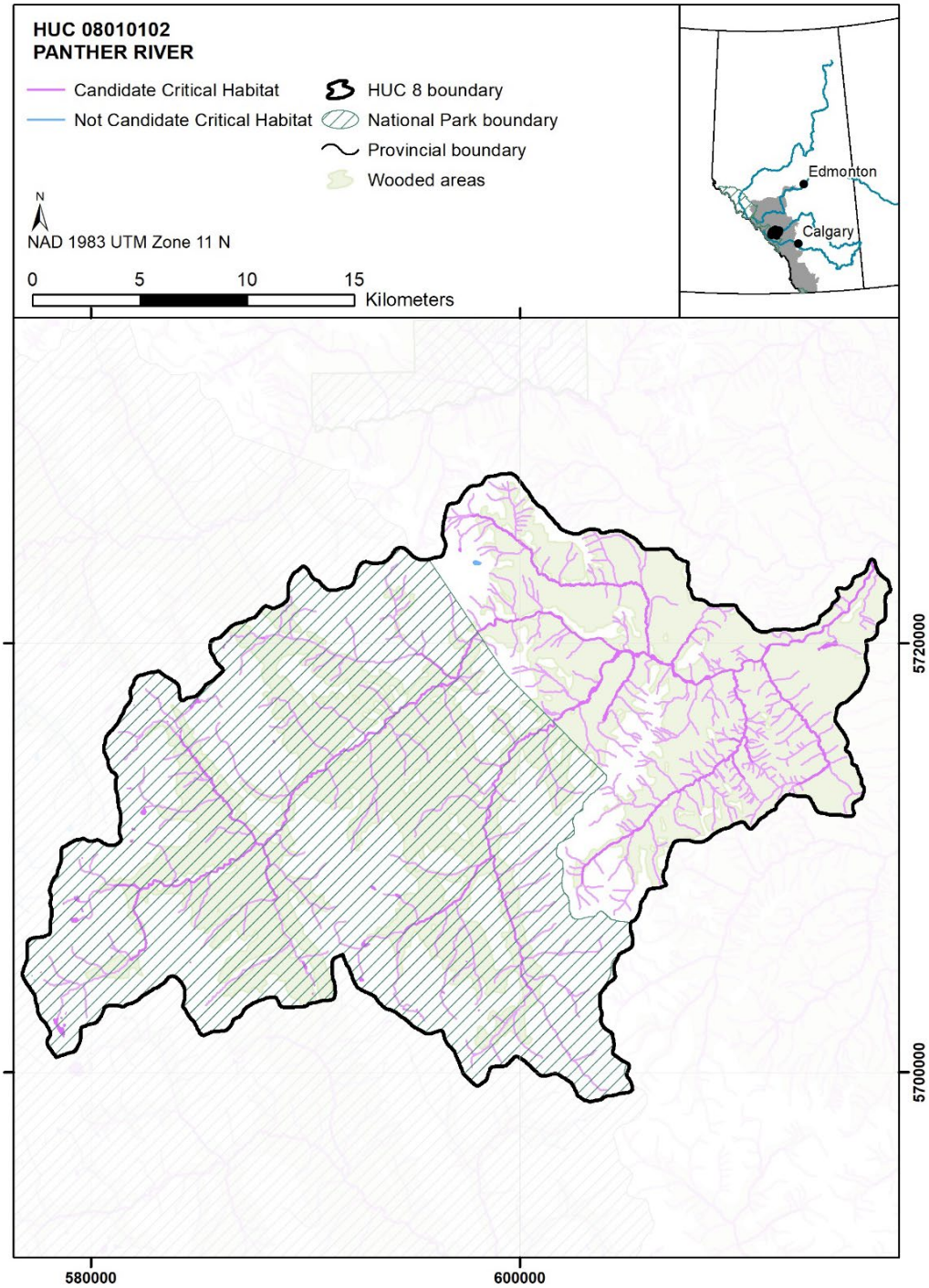

Figure A1.21. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (08010102) Panther River. All first and second order streams are reduced to improve visibility. For designations inside Banff National Park boundaries see Figure A1.43.

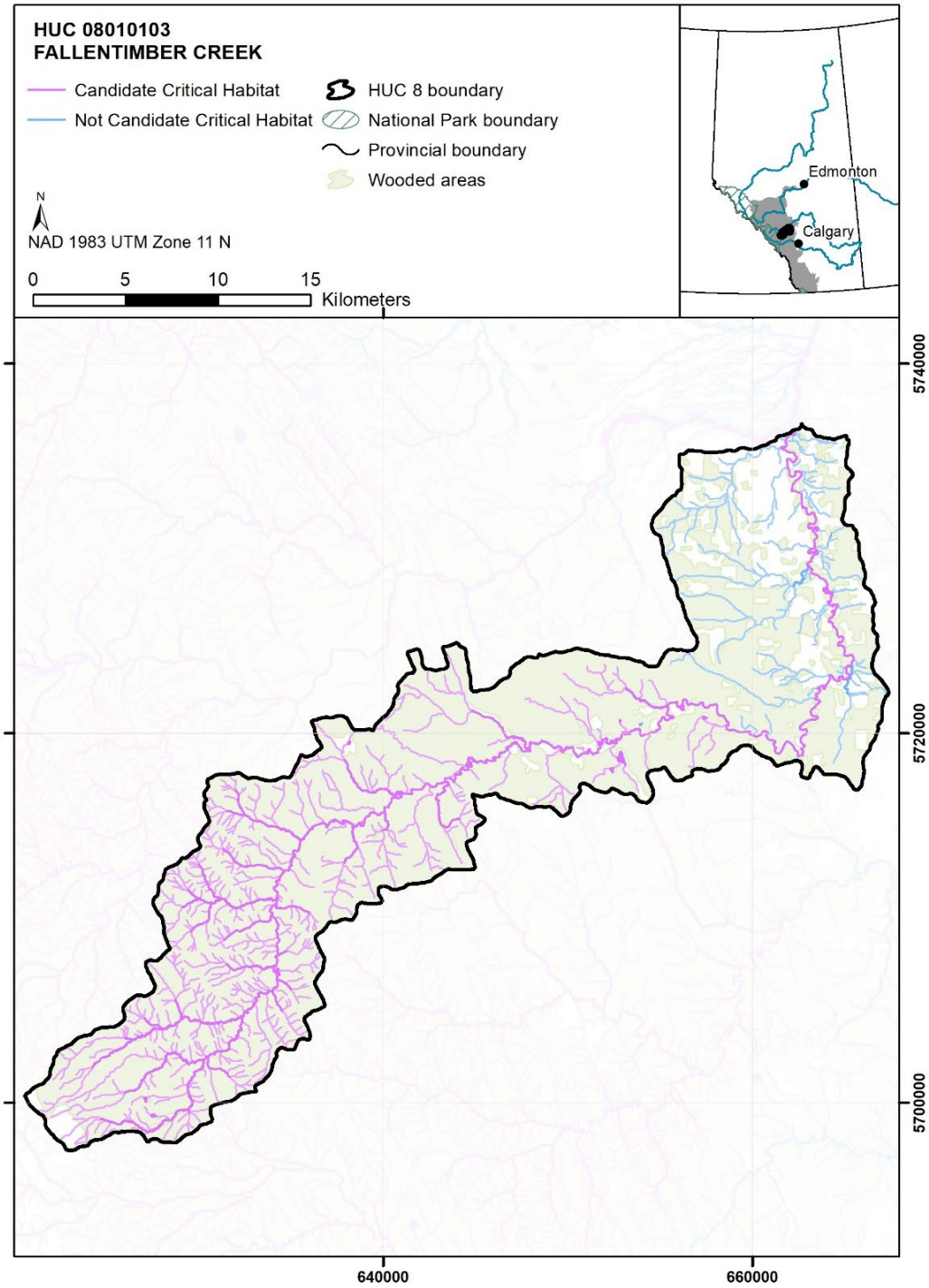

Figure A1.22. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (08010103) Fallentimber Creek. All first and second order streams are reduced to improve visibility.

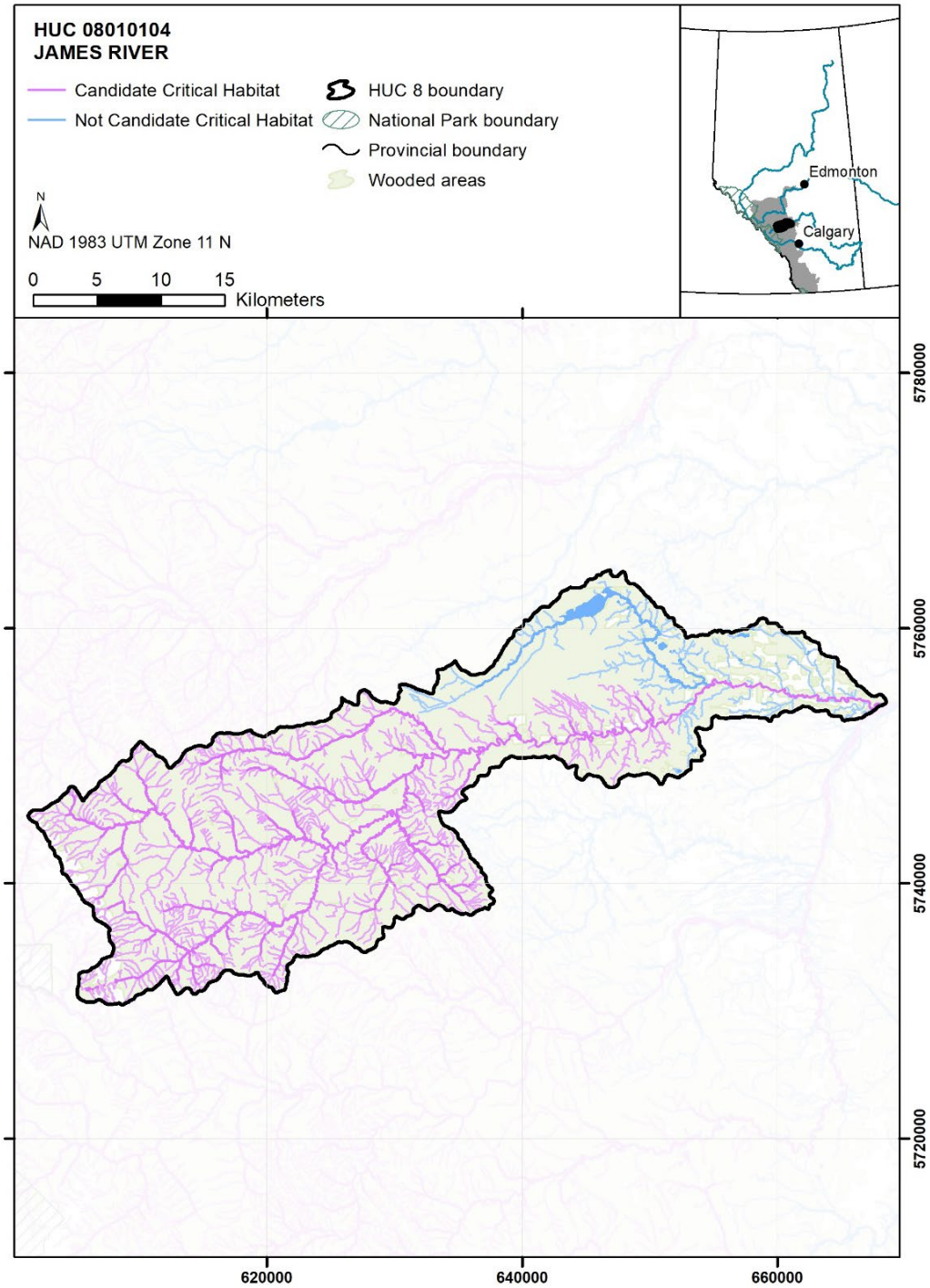

Figure A1.23. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (08010104) James River. All first and second order streams are reduced to improve visibility.

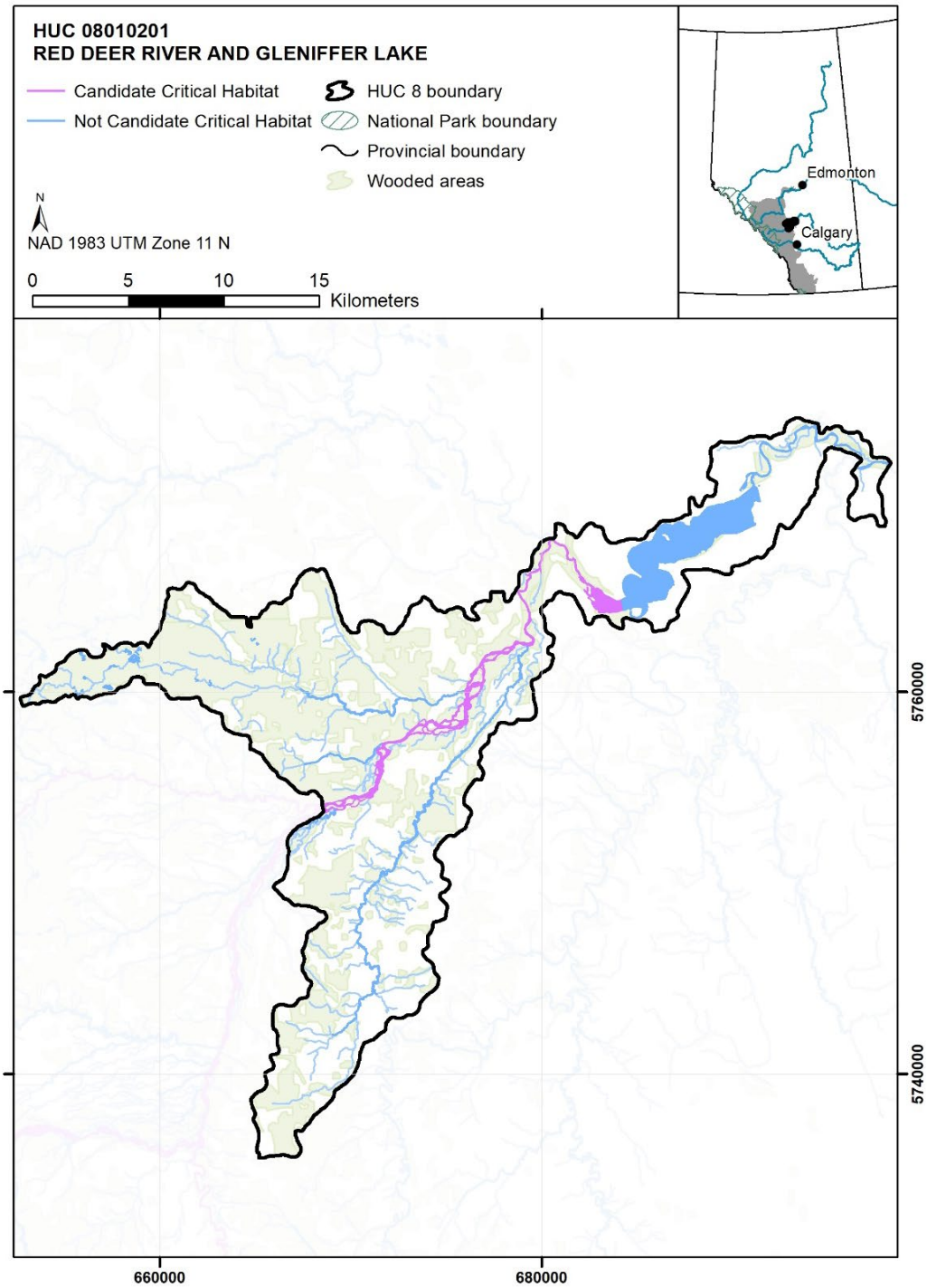

Figure A1.24. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (08010201) Red Deer River and Gleniffer Lake. All first and second order streams are reduced to improve visibility.

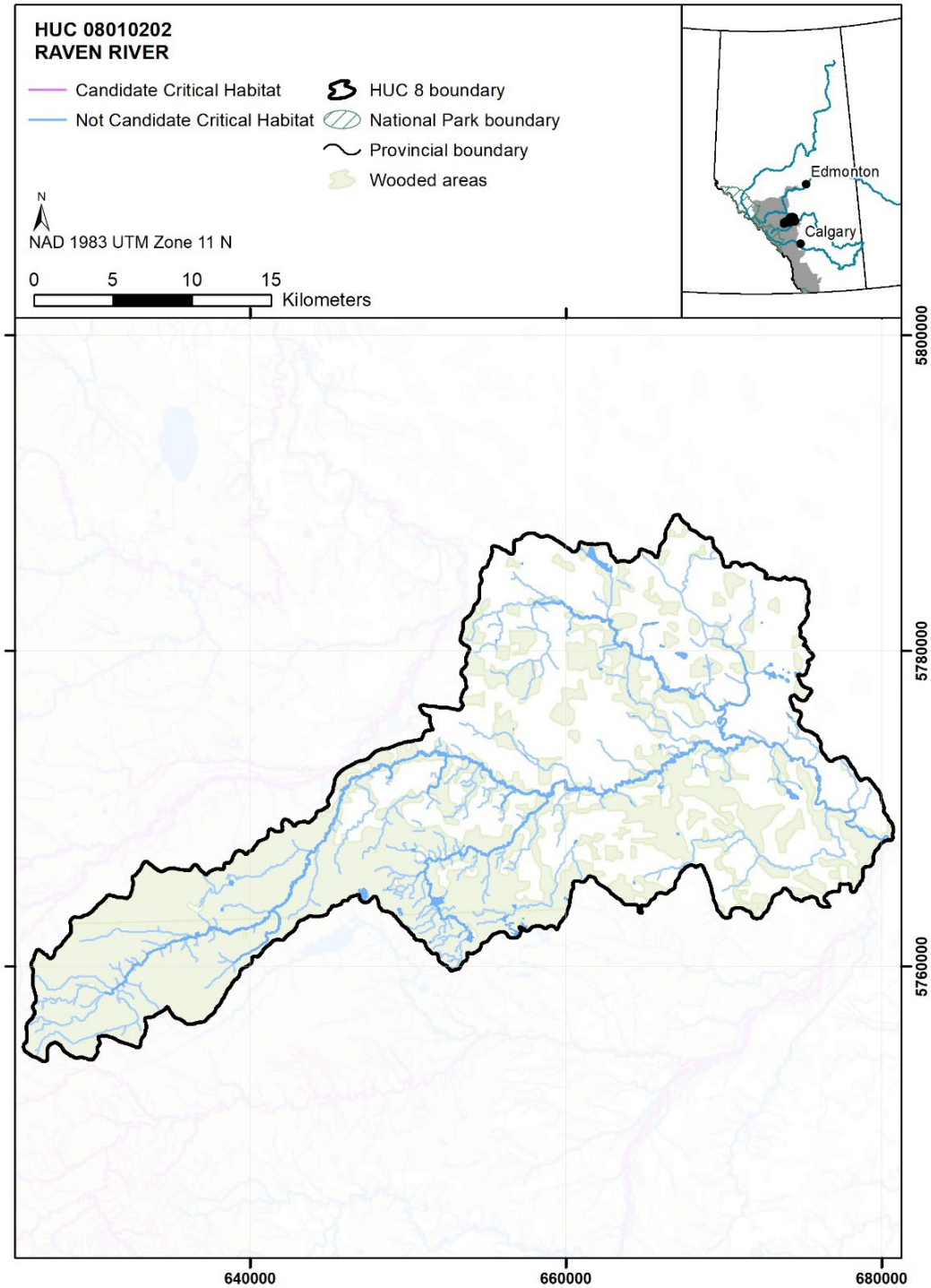

Figure A1.25. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (08010202) Raven River. All first and second order streams are reduced to improve visibility.

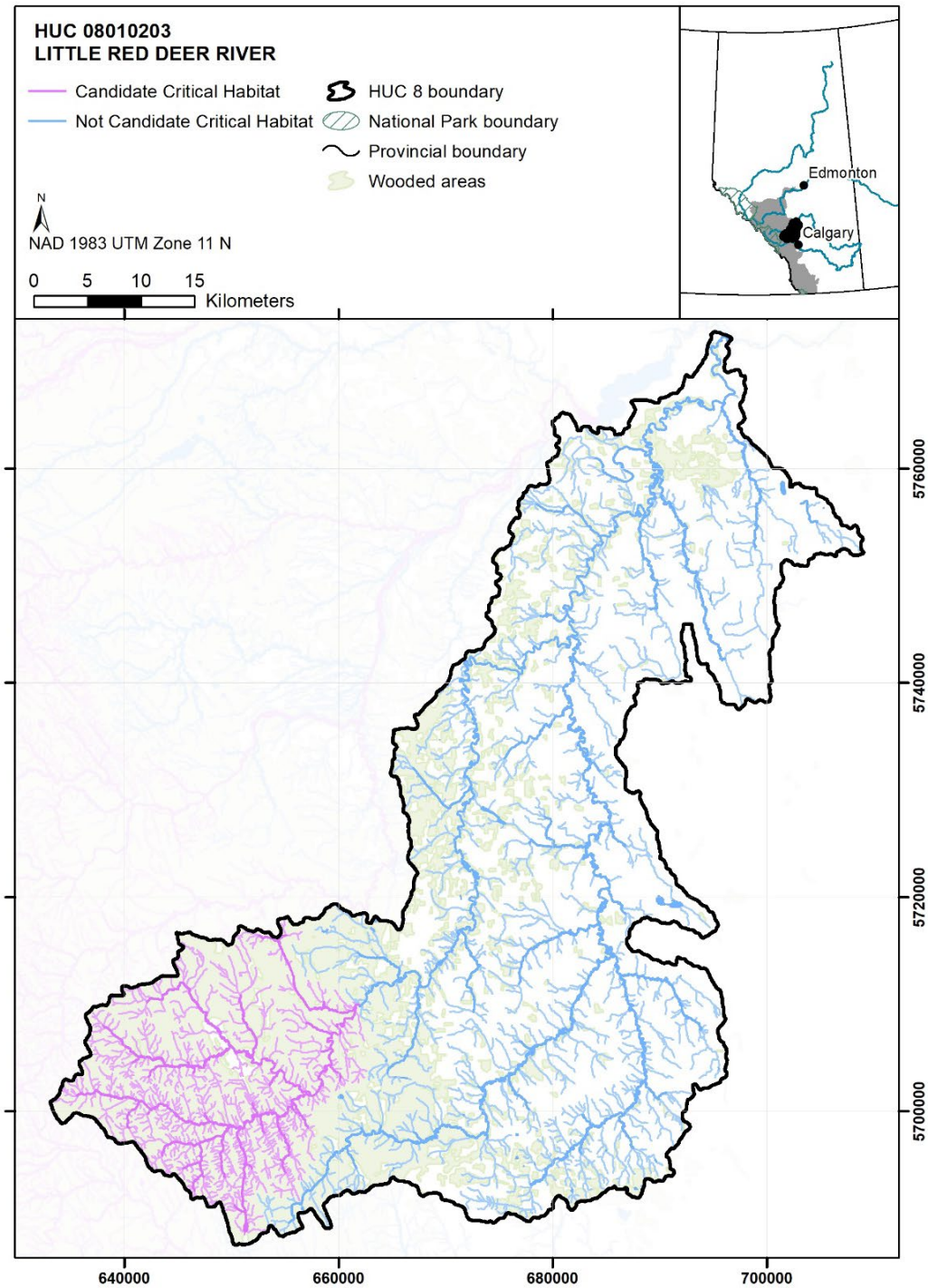

Figure A1.26. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (08010203) Little Red Deer River. All first and second order streams are reduced to improve visibility.

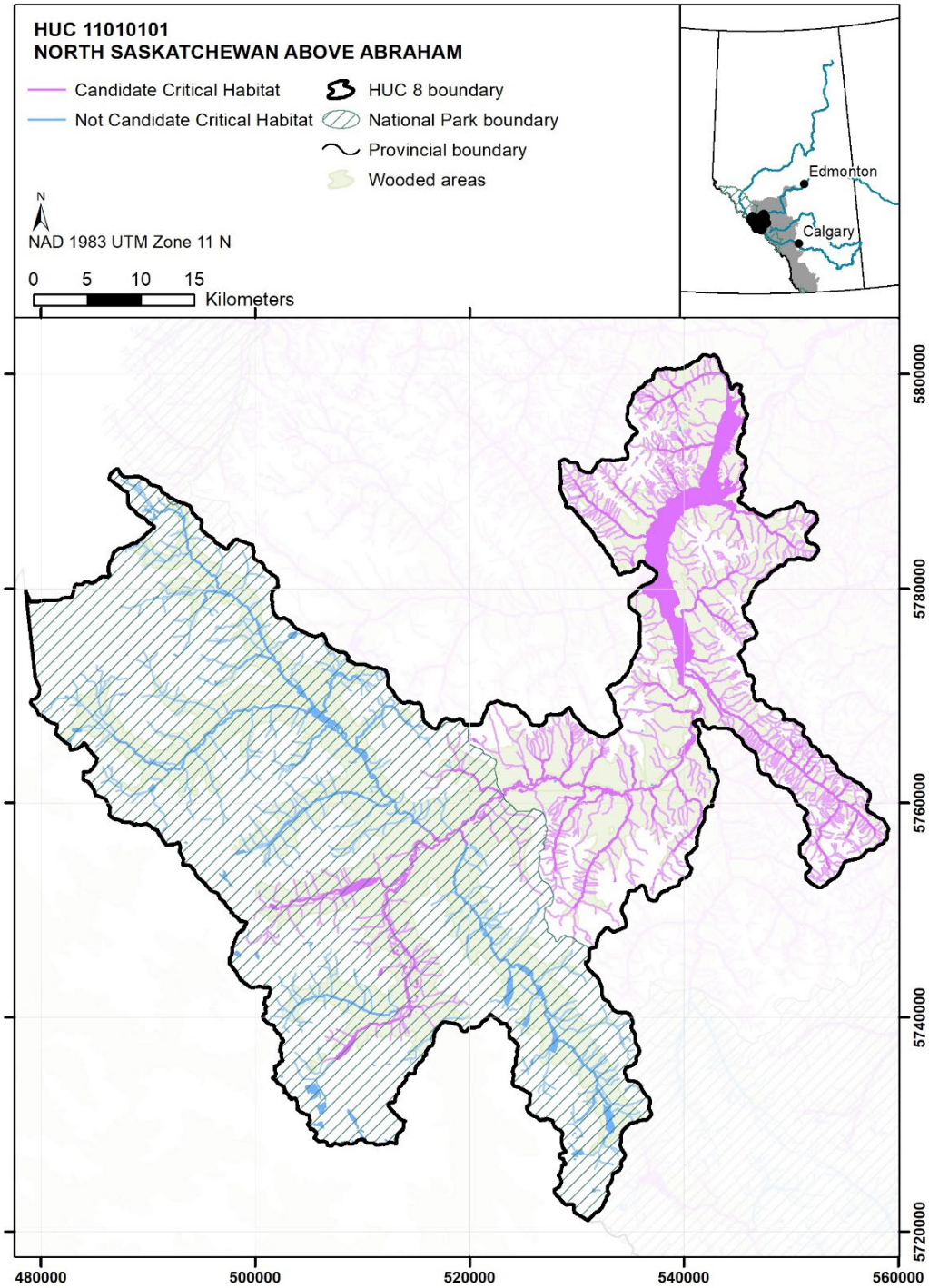

Figure A1.27. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010101) North Saskatchewan above Abraham. All first and second order streams are reduced to improve visibility. For designations inside Banff National Park boundaries see Figure A1.43.

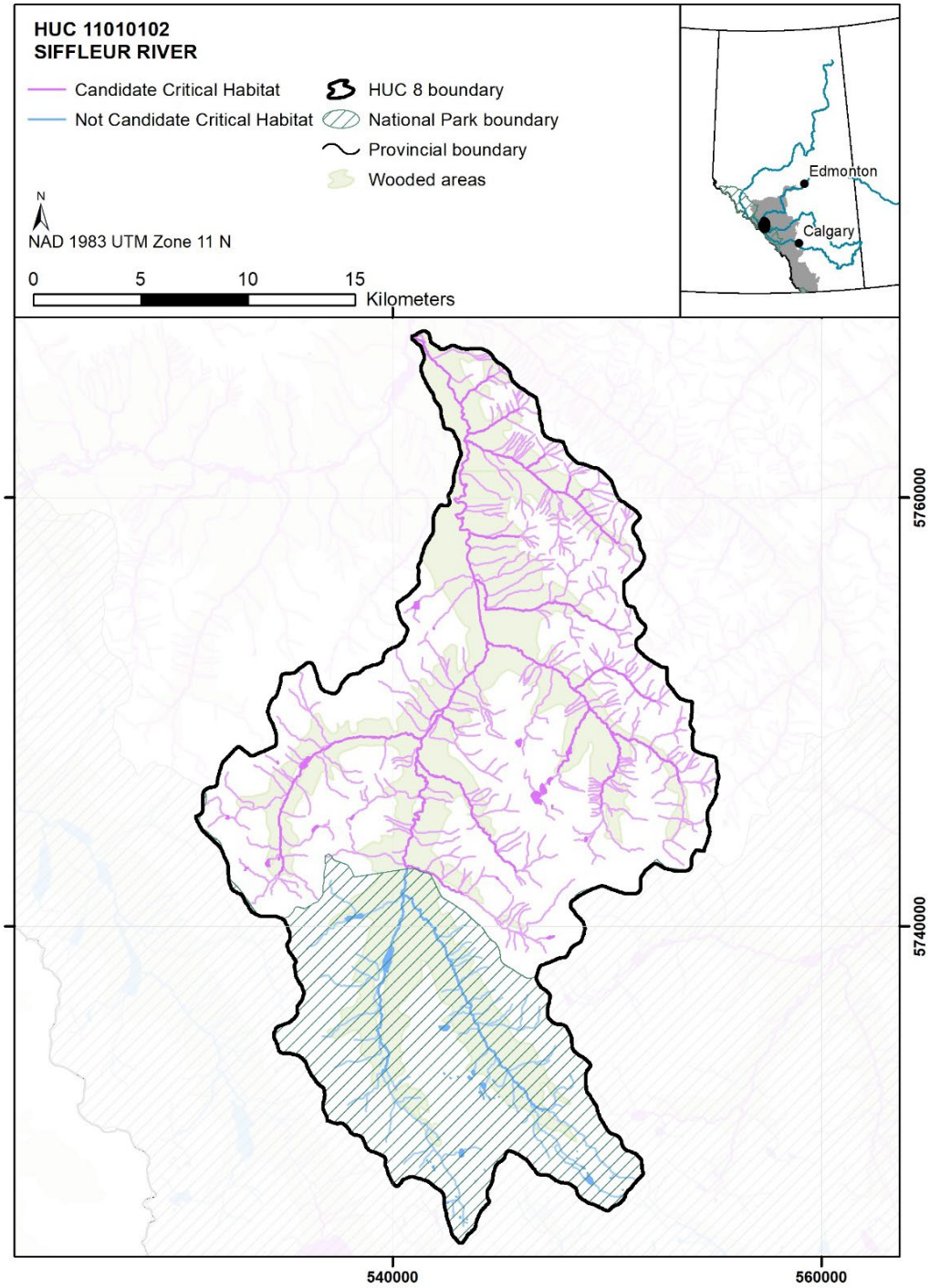

Figure A1.28. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010102) Siffleur River. All first and second order streams are reduced to improve visibility. For designations inside Banff National Park boundaries see Figure A1.43.

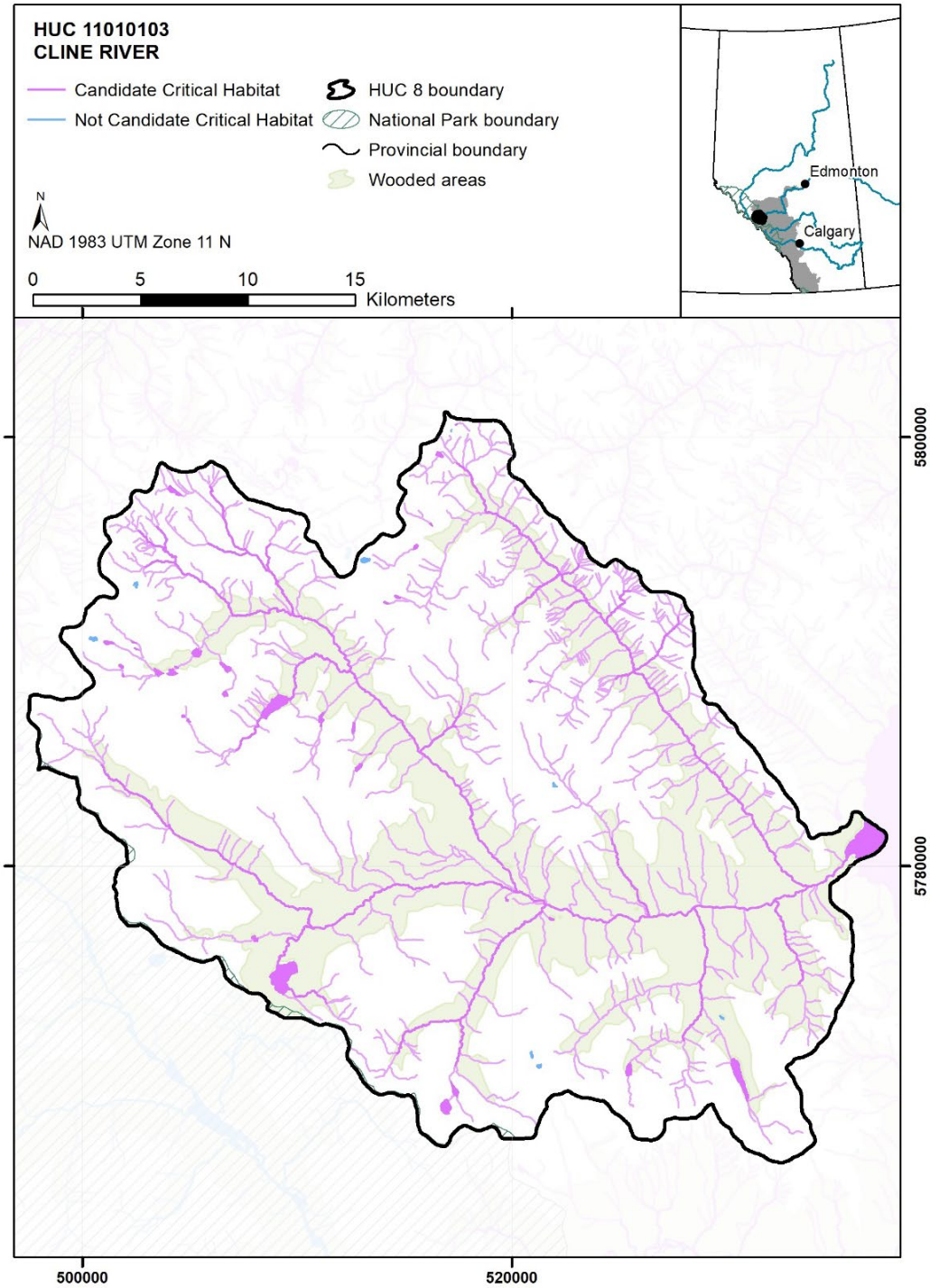

Figure A1.29. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010103) Cline River. All first and second order streams are reduced to improve visibility.

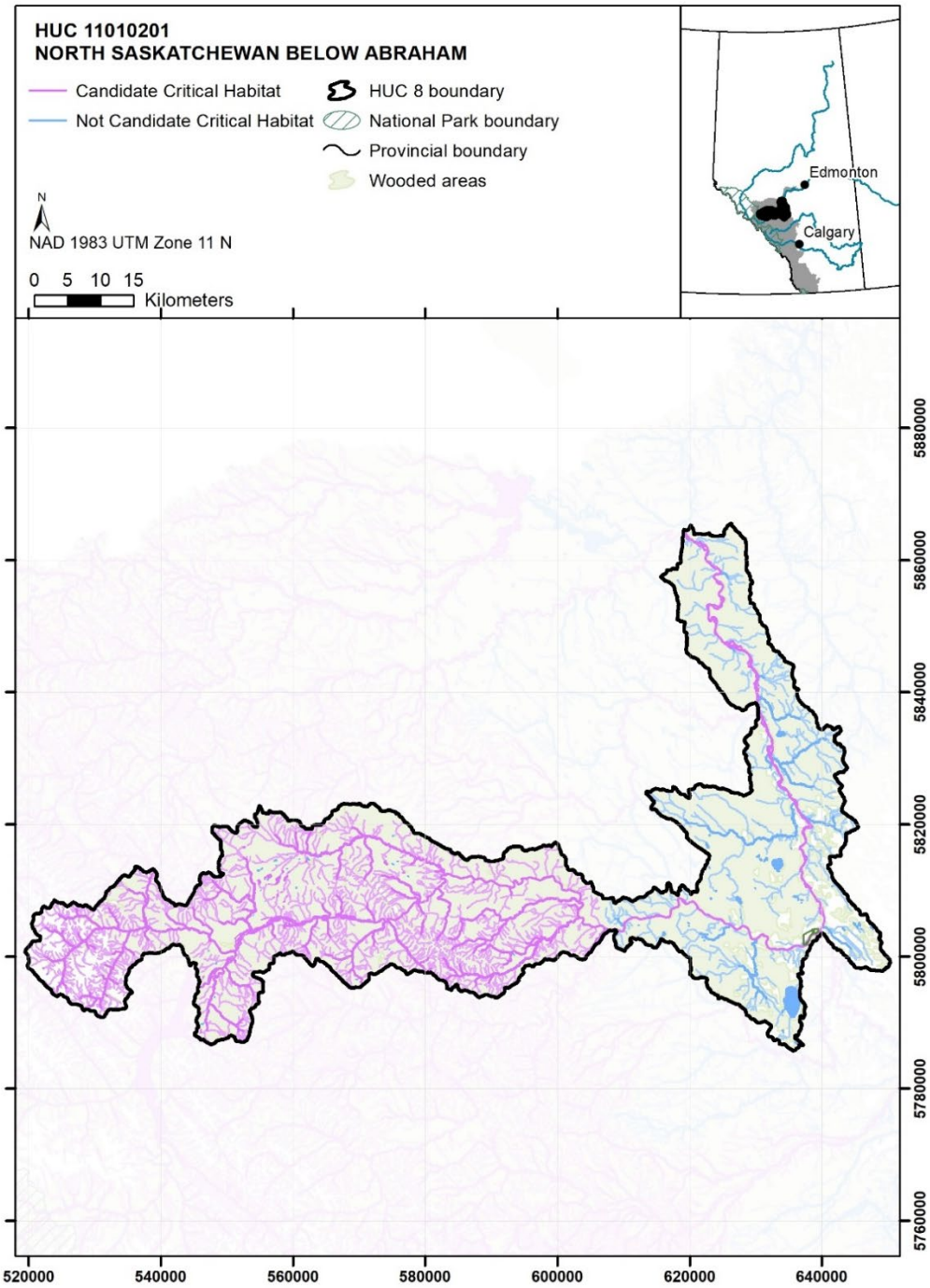

Figure A1.30. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010201) North Saskatchewan below Abraham. All first and second order streams are reduced to improve visibility. For designations inside Rocky Mountain House National Historic Site see Figure A1.43.

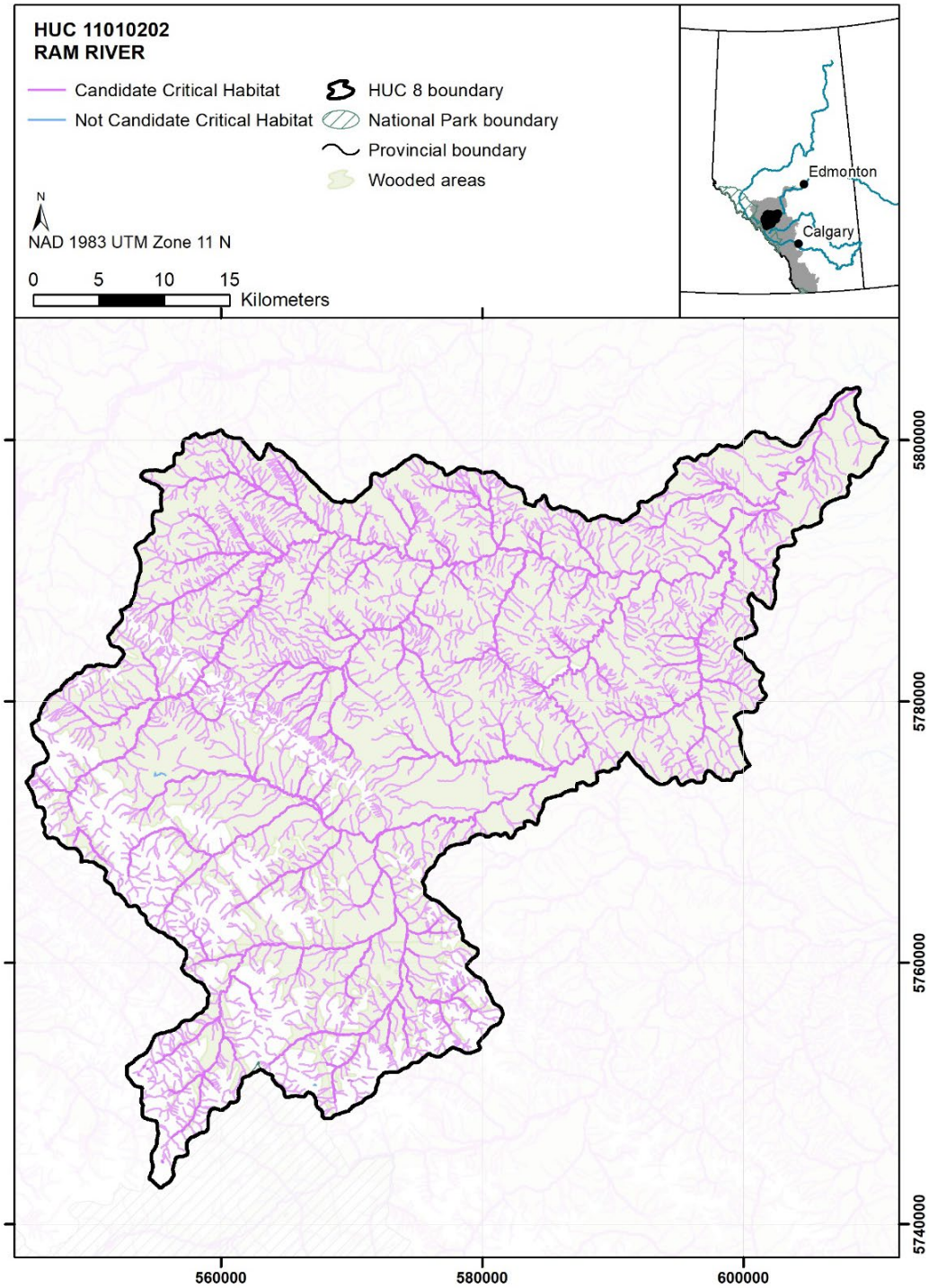

Figure A1.31. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010202) Ram River. All first and second order streams are reduced to improve visibility.

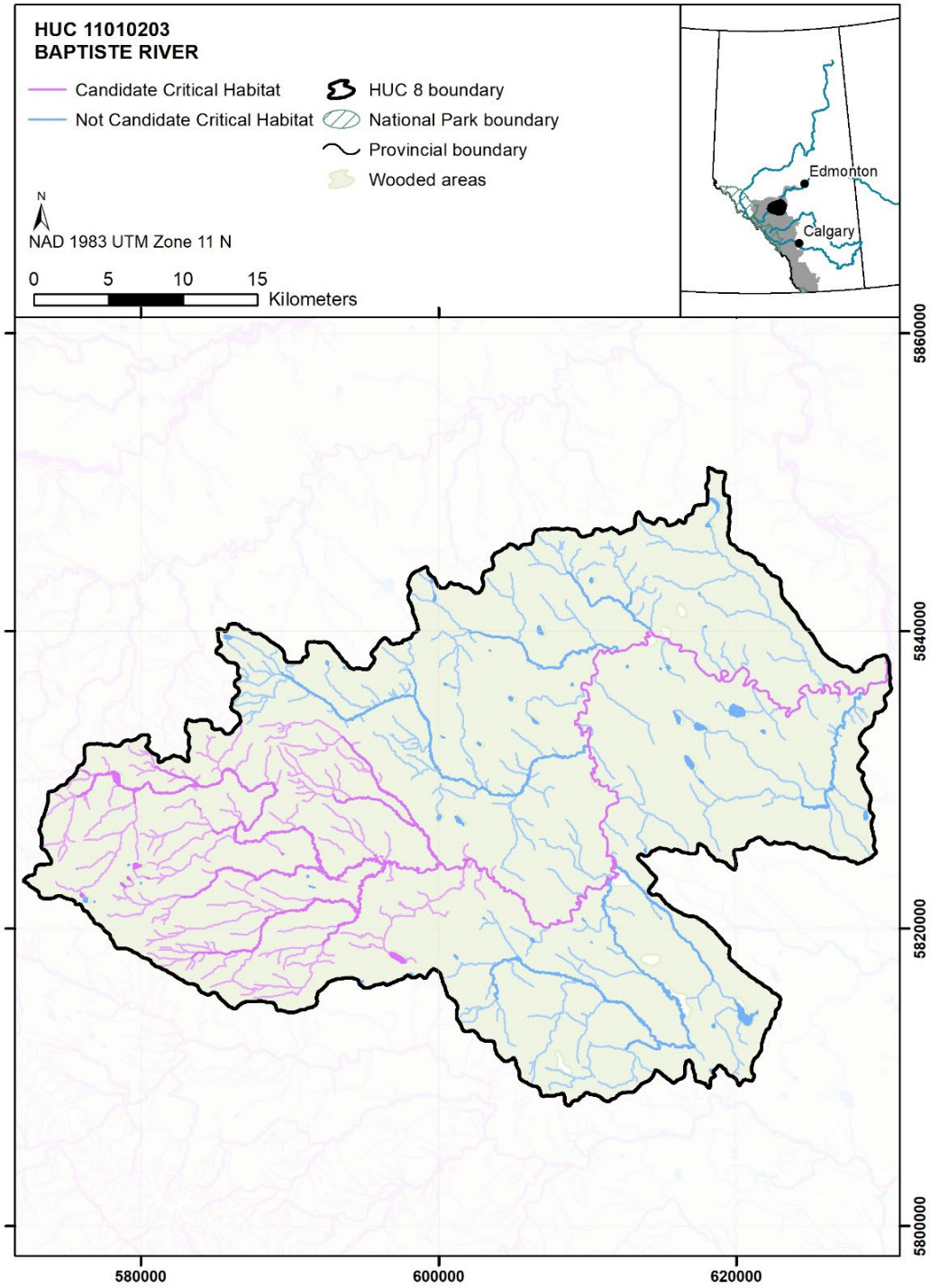

Figure A1.32. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010203) Baptiste River. All first and second order streams are reduced to improve visibility.

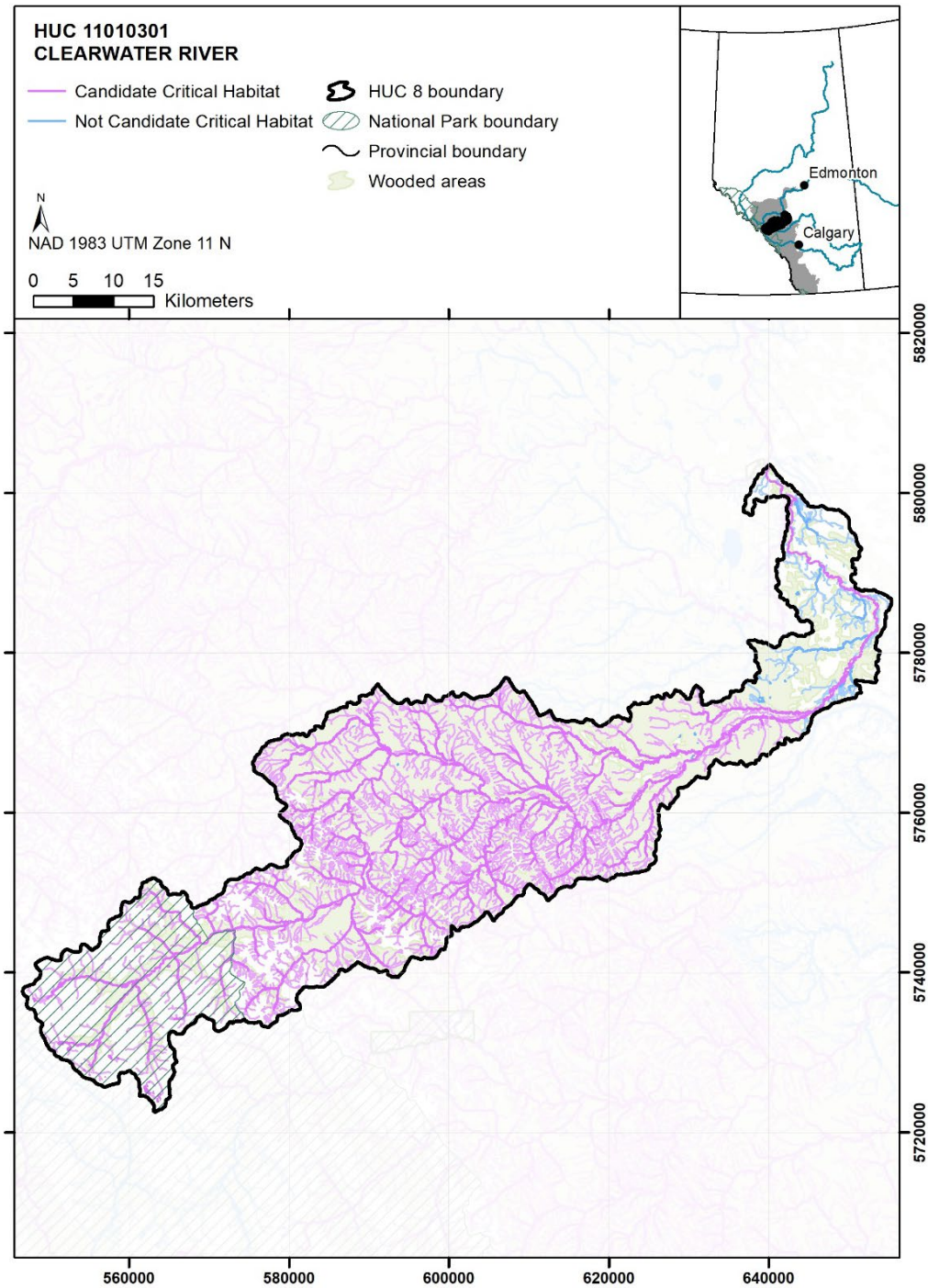

Figure A1.33. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010301) Clearwater River. All first and second order streams are reduced to improve visibility. For designations inside Banff National Park boundaries see Figure A1.43.

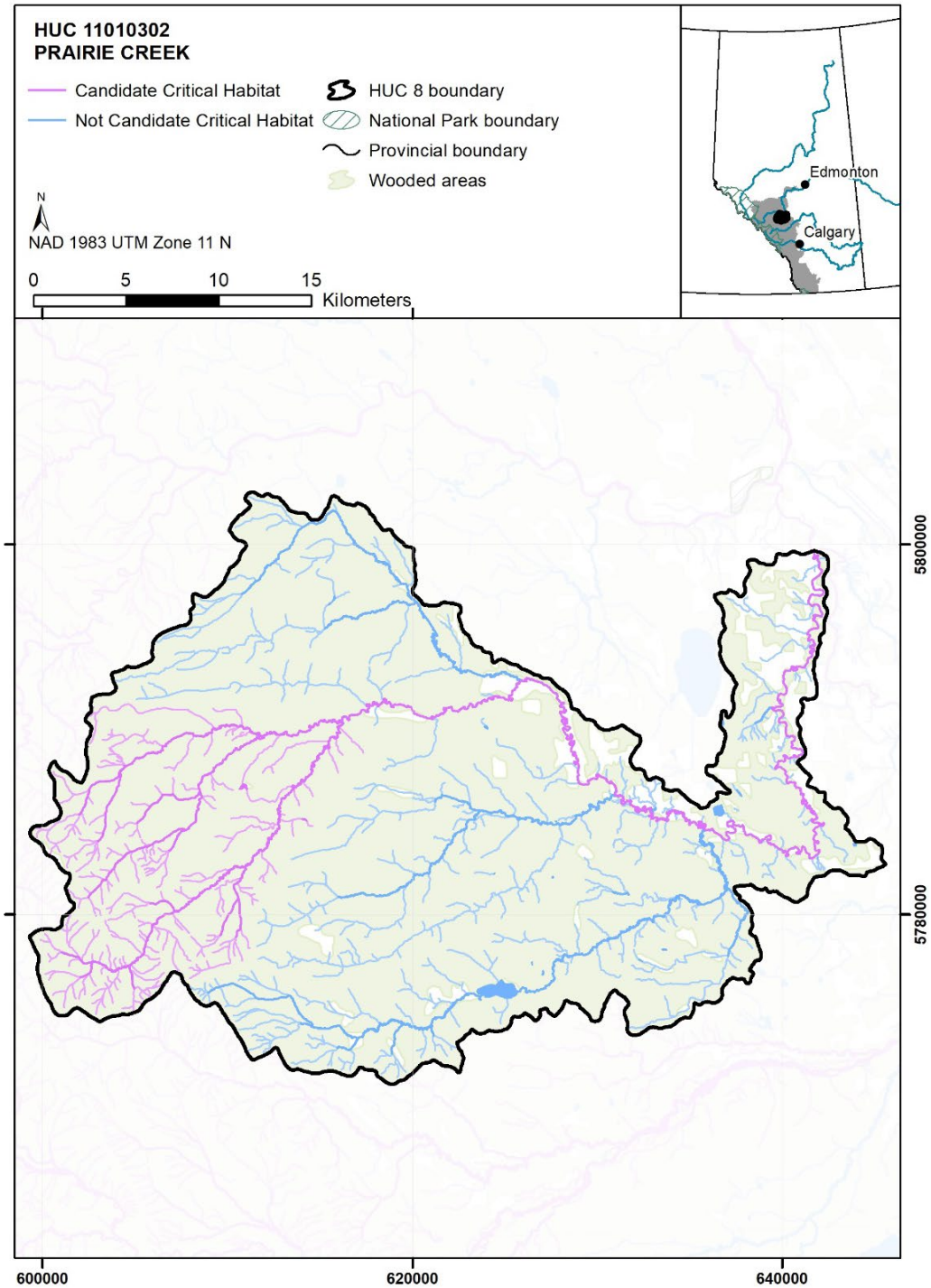

Figure A1.34. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010302) Prairie Creek. All first and second order streams are reduced to improve visibility.

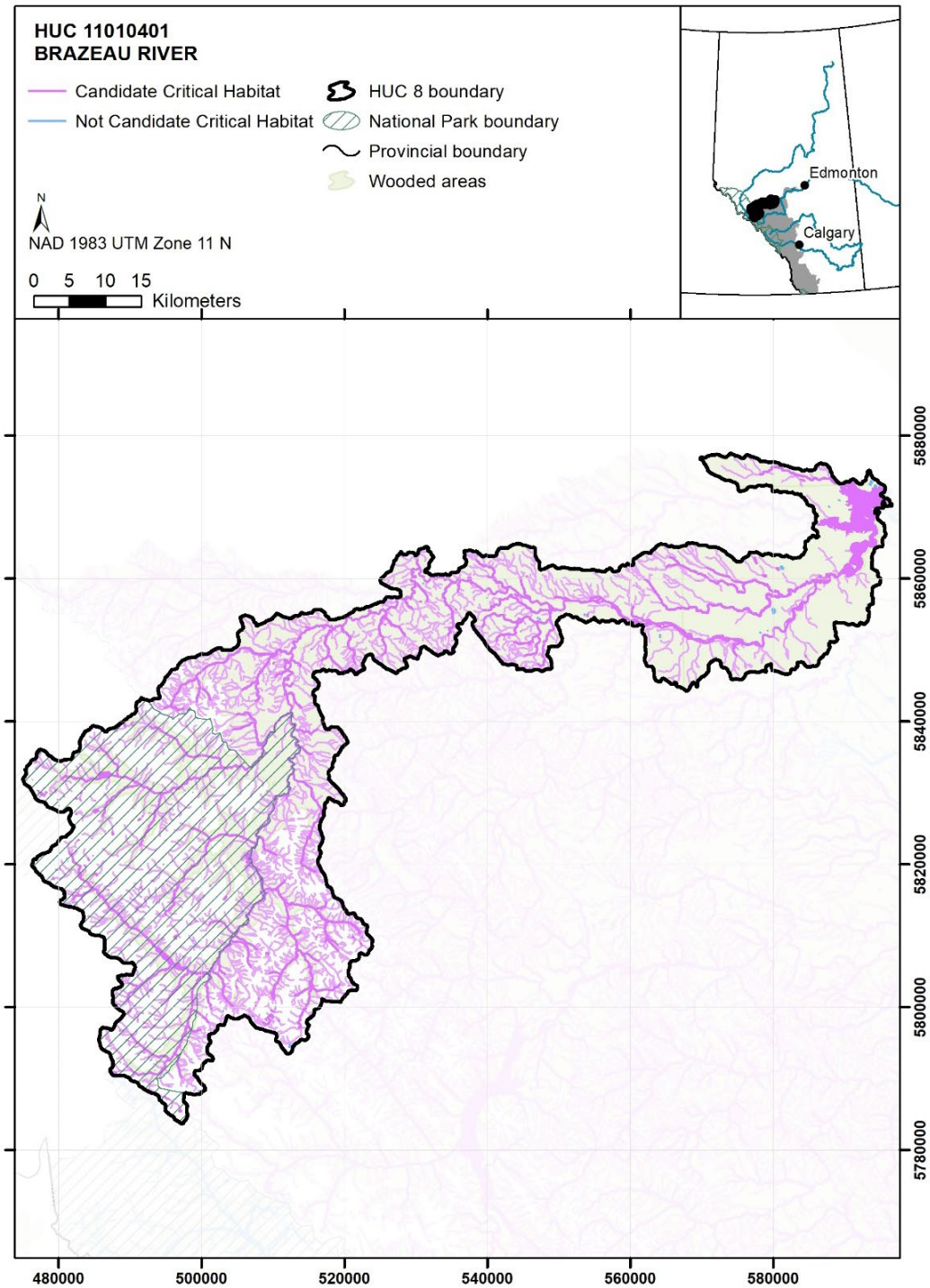

Figure A1.35. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010401) Brazeau River. All first and second order streams are reduced to improve visibility. For designations inside Jasper National Park boundaries see Figure A1.43.

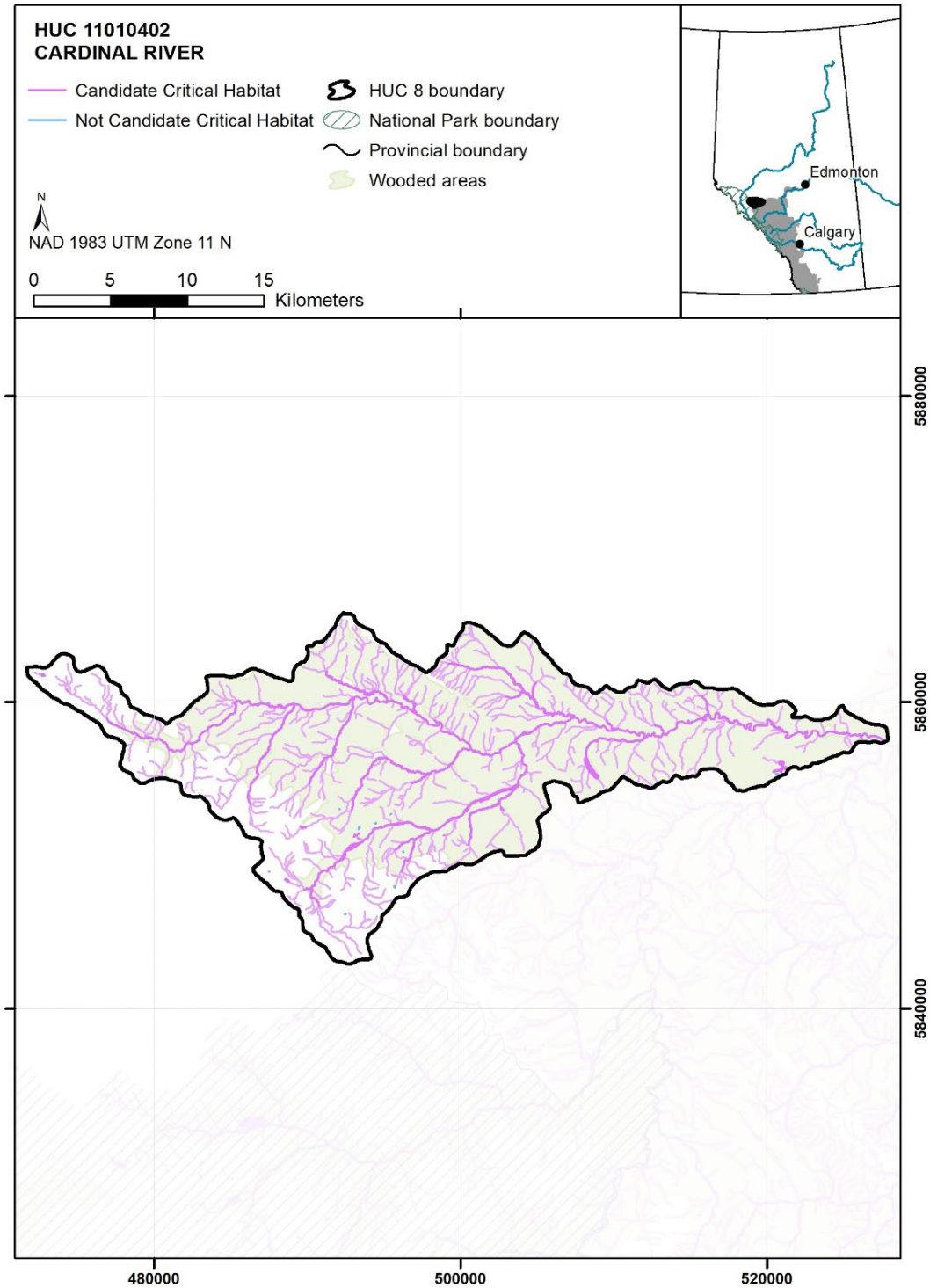

Figure A1.36. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010402) Cardinal River. All first and second order streams are reduced to improve visibility.

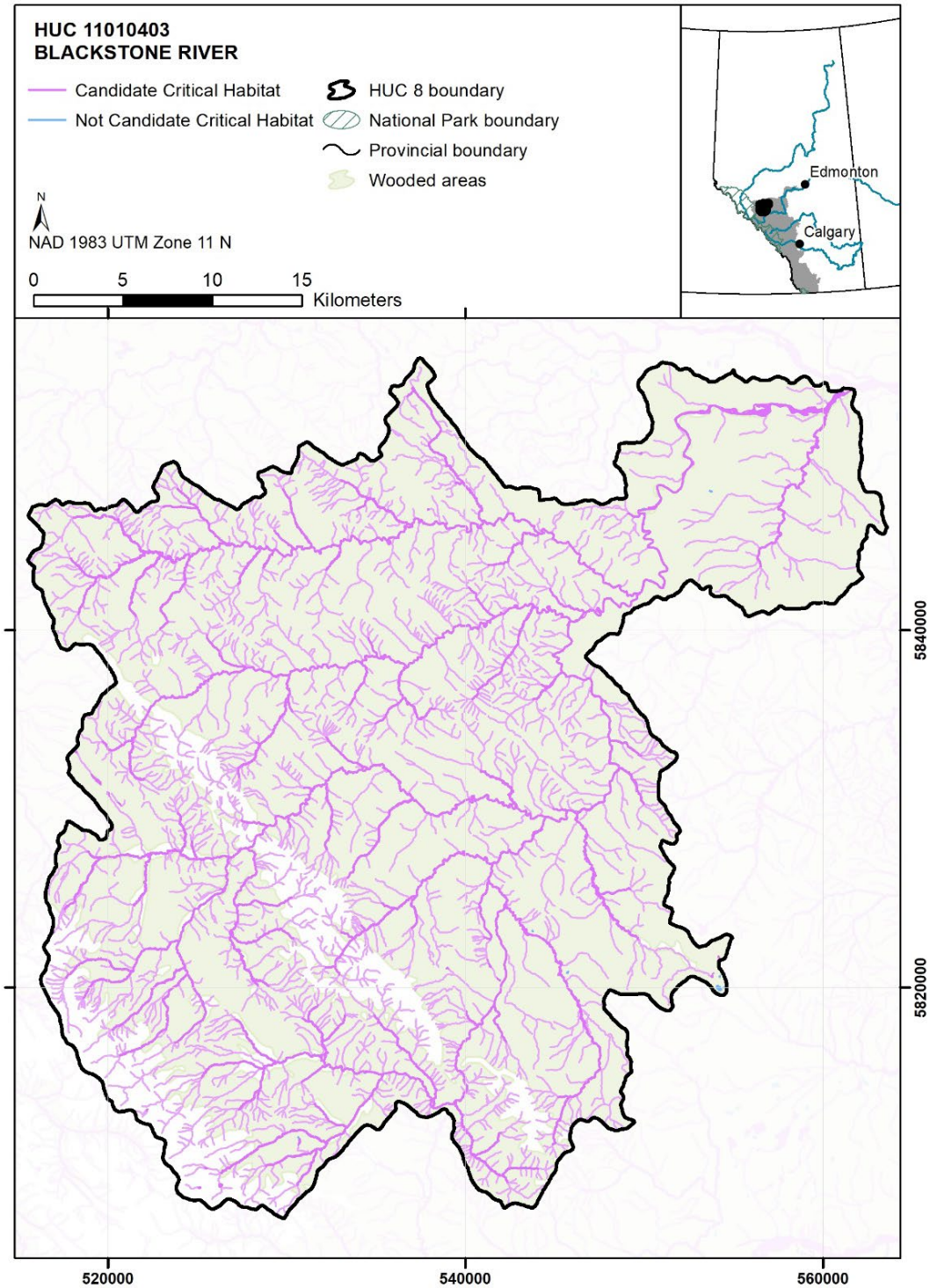

Figure A1.37. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010403) Blackstone River. All first and second order streams are reduced to improve visibility.

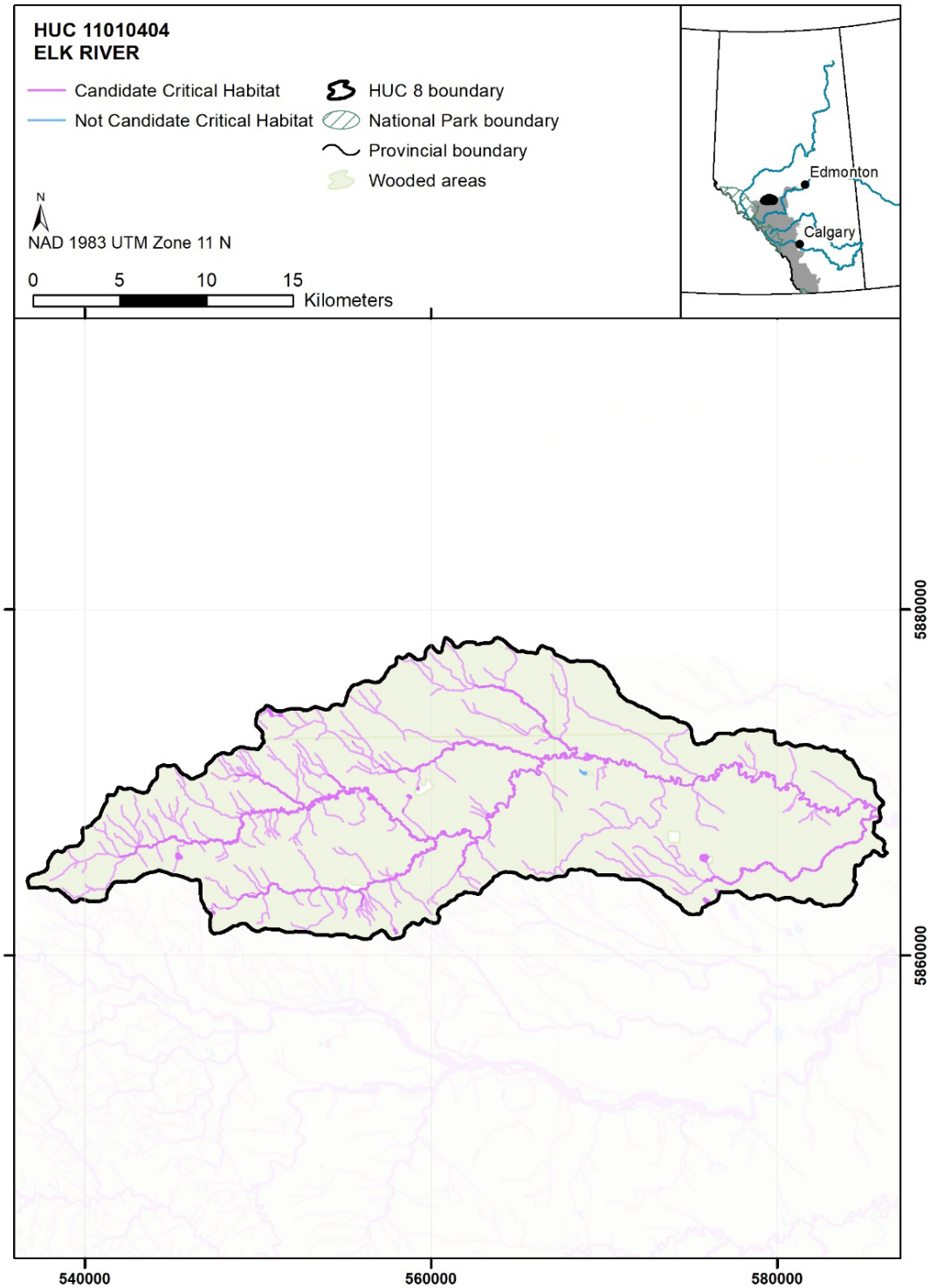

Figure A1.38. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010404) Elk River. All first and second order streams are reduced to improve visibility.

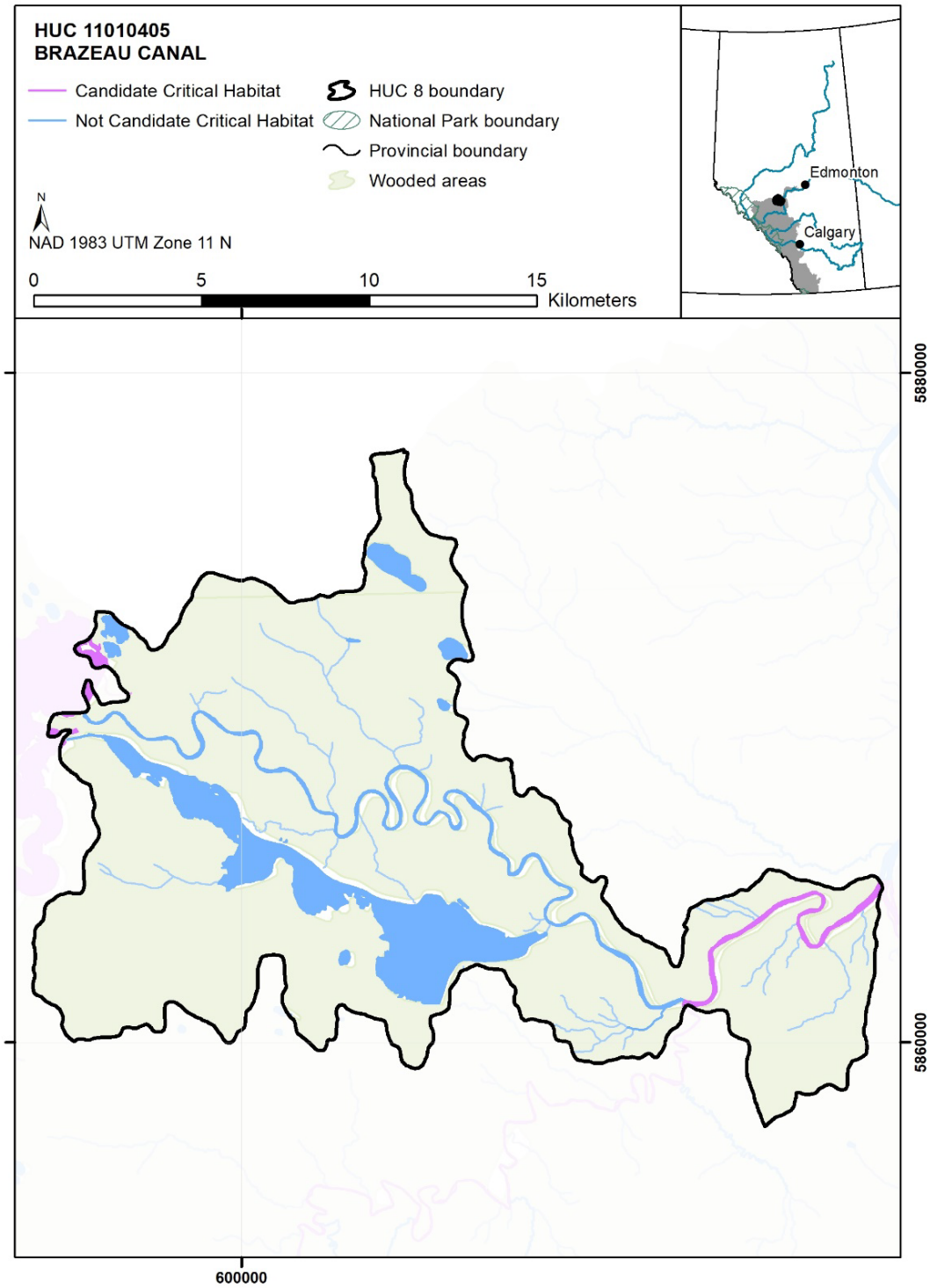

Figure A1.39. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010405) Brazeau Canal. All first and second order streams are reduced to improve visibility.

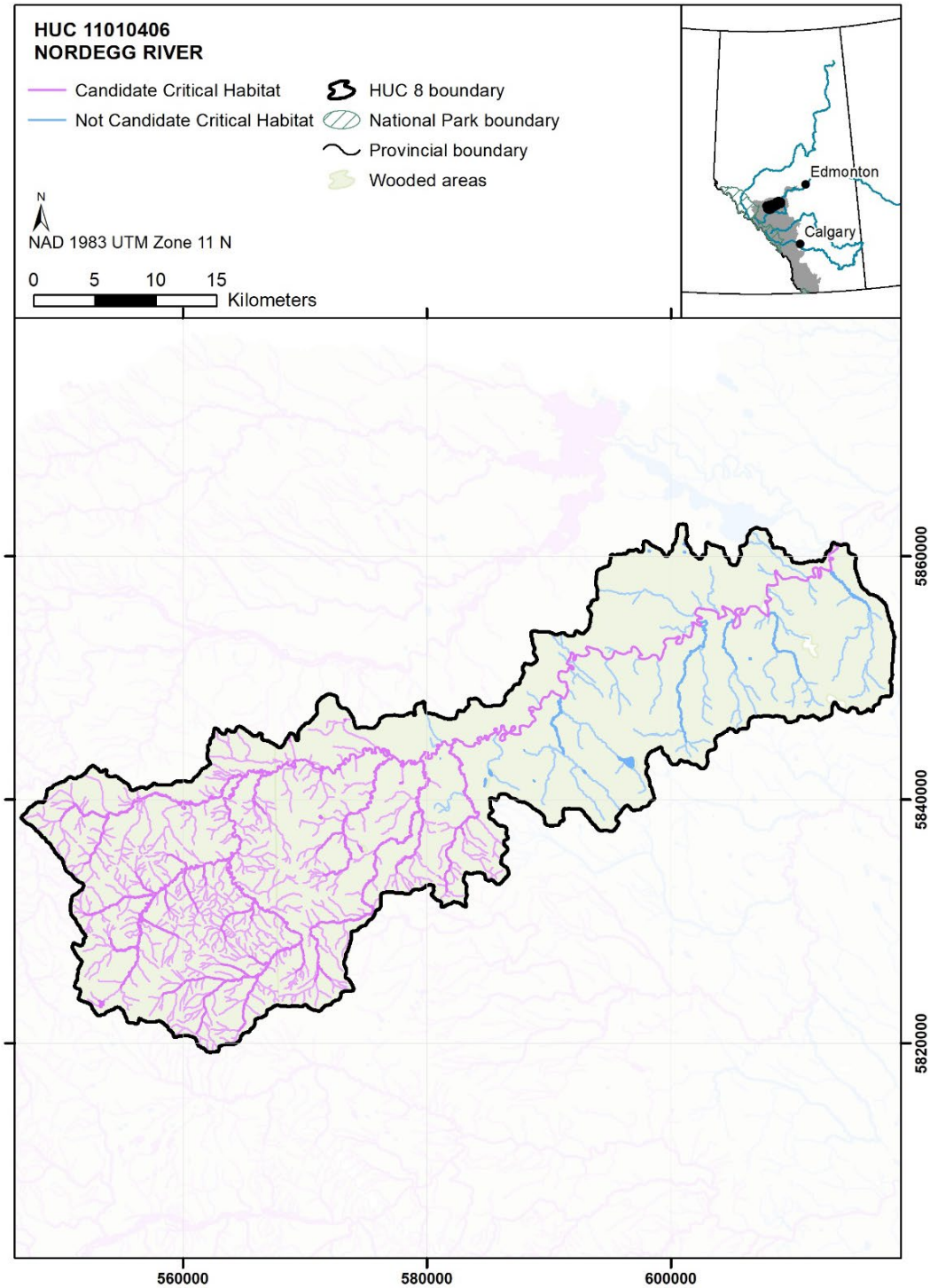

Figure A1.40. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11010406) Nordegg River. All first and second order streams are reduced to improve visibility.

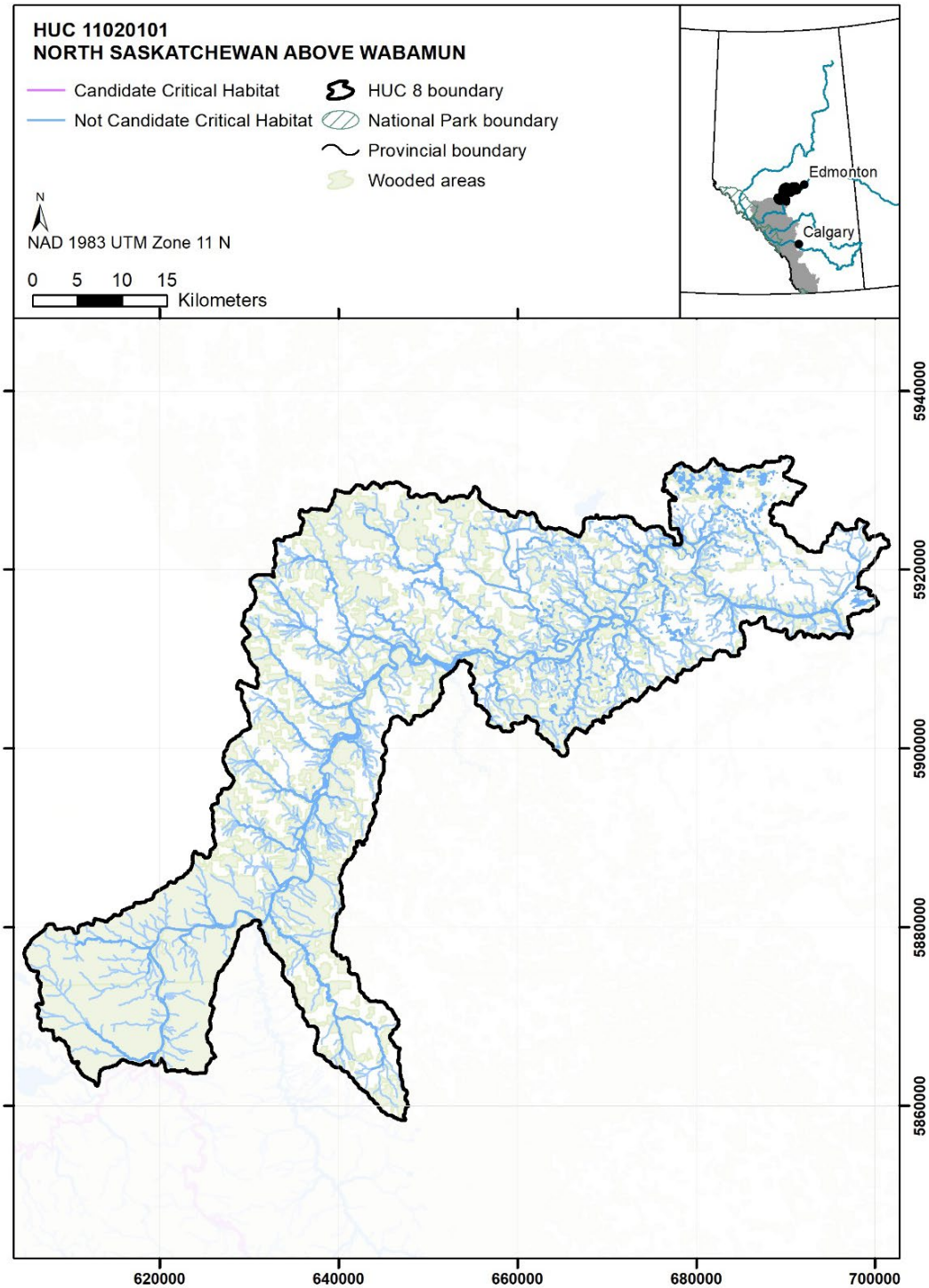

Figure A1.41. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11020101) North Saskatchewan above Wabamum. All first and second order streams are reduced to improve visibility.

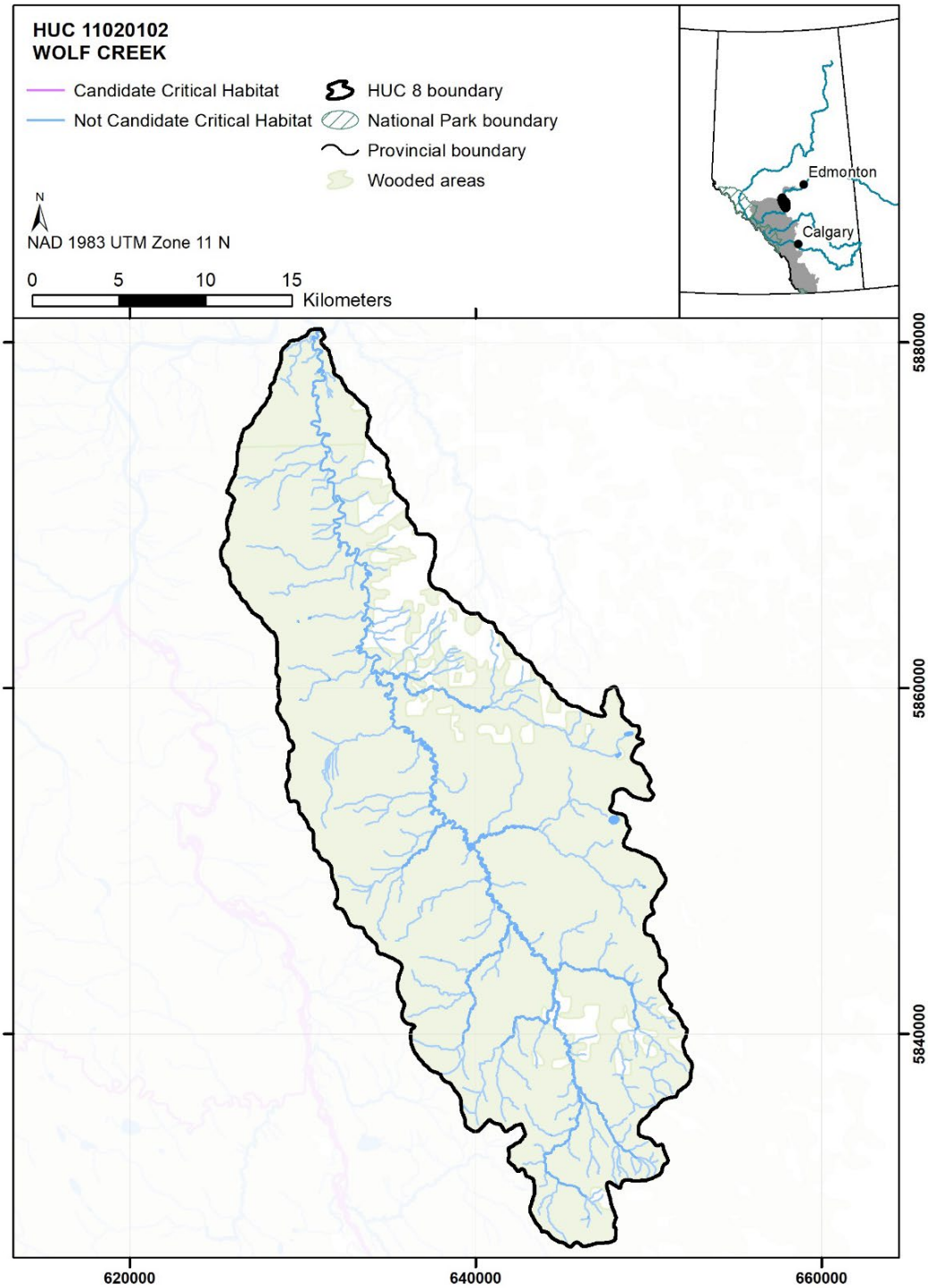

Figure A1.42. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 8 (11020102) Wolf Creek. All first and second order streams are reduced to improve visibility.

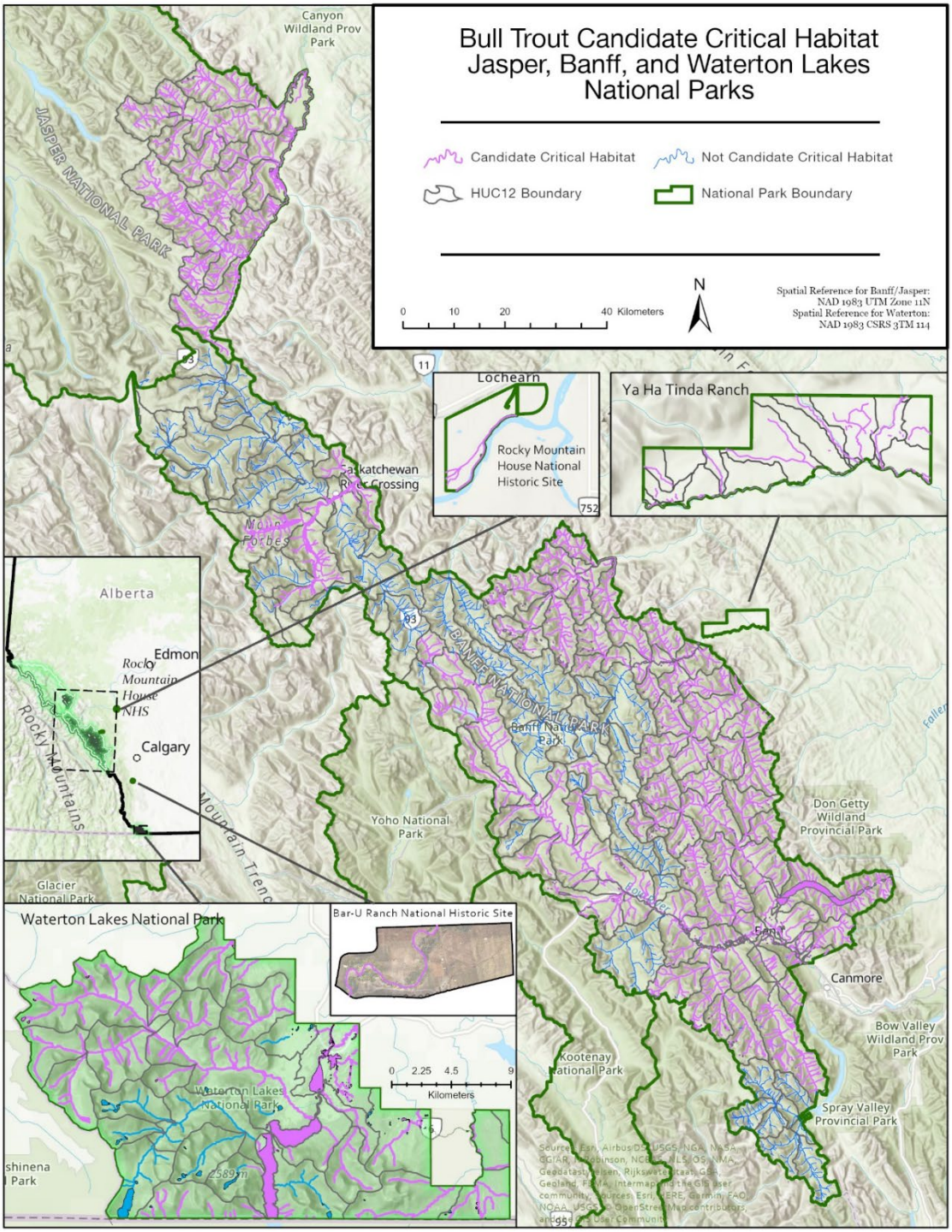

Figure A1.43. Candidate Critical Habitat for Bull Trout (Saskatchewan-Nelson rivers populations) within HUC 12 boundaries for all National Park and National Historic Sites.

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DFO. 2020. Information for Identification of Candidate Critical Habitat of Bull Trout, *Salvelinus confluentus* (Saskatchewan-Nelson rivers populations). DFO Can. Sci. Advis. Sec. Sci. Resp. 2020/044.

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