



**ACA PROJECT
REPORT**

Assessment of Waterfall Fish Barriers in the Bow River Watershed, 2020–2021



Alberta Conservation
Association

wildlife | fish | habitat

Assessment of Waterfall Fish Barriers in the Bow River Watershed, 2020–2021

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EXECUTIVE SUMMARY

To effectively safeguard against extirpation of native trout in Alberta, it is essential to protect native populations from hybridization and competition with invasive species. In Alberta, several subpopulations of native trout remain protected from invasive species primarily because of waterfalls (fish barriers) that impede upstream fish movement. Maintaining and isolating these subpopulations from invasion, in balance with the extirpation risks associated with isolation, is critical to the protection and persistence of native trout. Natural waterfall barriers in the Bow River headwaters are known to protect populations of westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) from non-native rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), and brown trout (*Salmo trutta*) invasions. Cataloguing waterfalls is a necessary first step to identify barriers that protect crucial westslope cutthroat trout populations, recognize opportunities to expand their range into secure habitat reaches above barriers, and prioritize future range expansion strategies to restore and reconnect existing populations. We used aerial imagery, GIS searches, the Government of Alberta barrier database, and backcountry hiking and tourism resources to compile a catalogue of potential barriers for assessment in the westslope cutthroat trout watersheds of the Bow River headwaters.

Between 2020 and 2021, we assessed 95 barriers in seven watersheds classed as Hydrologic Unit Code 8 of the Bow River headwaters with potential to provide upstream refuge from non-native fish species invasions. Six additional assessments were compiled into the dataset from previously measured barriers in the Bow River watershed in 2017–2018 for a total of 101 barrier assessments. Of these, 70 were considered impassible to local fish populations during the time of assessment, and 44 were considered absolute barriers based on flood inundation category. An additional 33 barriers were considered effective in terms of flood inundation. Knowing the locations and effectiveness of fish barriers in the Bow River headwaters is a key first step toward recognizing opportunities to expand the westslope cutthroat trout species range into secure habitat reaches, and to prioritize strategies to restore and reconnect existing populations.

Key words: barrier, waterfall, westslope cutthroat trout, native trout, Bow River, invasive species, westslope cutthroat trout recovery.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

Conservation of genetically pure headwater populations is critical to the persistence of native trout (Bingham et al. 2016), and in some cases the only conservation alternative (Novinger and Rahel 2003). Isolation management is a recovery strategy that involves using barriers to upstream movement to prevent invasion of undesirable species, but involves trade-offs between the current extirpation risks associated with isolation versus those of invasion (Peterson et al. 2008). While barriers may guard against invasion by non-native species, isolated populations in small watersheds are more vulnerable to extirpation through stochastic processes (Novinger and Rahel 2003, Fausch et al. 2006). To aid in the recovery of imperiled native fish in Alberta, Alberta Conservation Association (ACA) has developed a barrier assessment methodology to identify, measure, classify, and rank a complex range of fish barriers in the context of invasion risk and conservation potential, to identify those that can be used to prevent hybridization between native and non-native fish species, reduce competition for native trout species, and detect isolated native trout populations that may be at risk of extirpation.

In recent decades, genetically pure populations of westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) (WSCT) have declined to approximately 5% of the historical distribution, and invasive species are among the biggest contributors to the decline through hybridization and competition (Fisheries and Oceans Canada 2014). The historical range of WSCT in Alberta lies entirely within the Oldman and Bow River watersheds, where natural waterfall barriers that impede upstream fish movements are known to protect headwater populations of WSCT from non-native rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), and brown trout (*Salmo trutta*) invasions. Broad-scale inventory and assessment of these barriers is an important conservation measure to identify those protecting crucial populations, recognize opportunities to expand the WSCT range into secure unoccupied habitat reaches above barriers, and prioritize future range expansion strategies to restore and reconnect existing populations. In this study, we assessed waterfall barriers in the Bow River watershed during the 2020 and 2021 field seasons and combined those data with existing barrier assessment data collected in 2017 and 2018.

2.0 STUDY AREA

Core WSCT watersheds of the Bow River basin are located off the eastern slopes of the Alberta Rockies and continental divide southwest of Calgary (Figure 1). The study area encompassed approximately 5,000 km² of watershed area including portions of seven major river systems classed as Hydrologic Unit Code (HUC) 8: the Highwood River, Sheep River, Jumpingpound Creek, Elbow River, Kananaskis River, Spray Lakes River, and the Bow River / Ghost Reservoir. Most of the study area lies within provincial administrative protected area boundaries, which include provincial parks and recreation areas, public land use zones, and wildland parks (Figure 1 and Appendix 1).

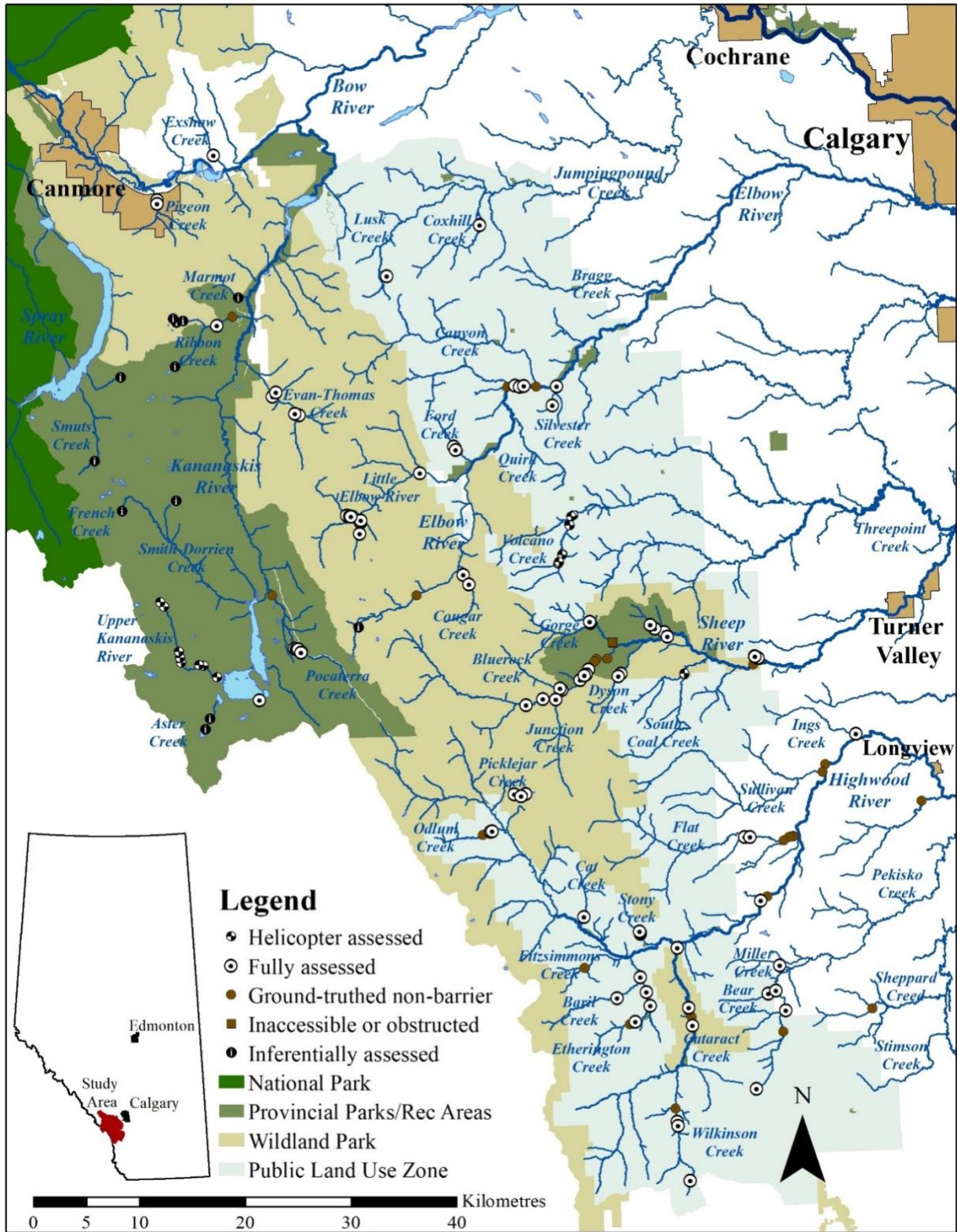


Figure 1. Bow River watershed barrier assessment study area and barrier locations. Inset map shows the location of the study area within the province of Alberta.

3.0 MATERIALS AND METHODS

We assembled a catalogue of potential waterfall fish barrier locations from aerial imagery, GIS searches, the Government of Alberta (GOA) barrier database, and backcountry hiking and tourism resources. In 2020 and 2021, we evaluated 153 potential barrier locations on 61 streams in the Bow River watershed and used the *Guide to Waterfall Fish Barrier Assessment Field Manual* (Blackburn et al. 2021) to assess 95 barriers (Appendix 2). Six additional assessments were compiled into the dataset from previously measured barriers in the Bow River watershed during development of the barrier manual (i.e., 2017 and 2018) for a total of 101 barrier assessments.

We assessed the four main mechanisms that impede fish passage over barriers: 1) height/length obstructions to leaping; 2) water velocity obstructions to swimming; 3) water depth obstructions to swimming; and 4) turbulence obstructions to swimming. We measured barrier dimensions (height, length, and slope) using a TruPulse 200X laser rangefinder, stream depths using measuring poles and sounding lines, water velocities using a HACH FH950 handheld flowmeter, and turbulence using a qualitative literature-based visual assessment method summarized in Blackburn et al. (2021). We also assessed barriers remotely and from helicopter, inferring barrier measurements and evaluations using captured images and similar ground-truthed barriers in the dataset.

We assessed each barrier on a single occasion, and assessments were performed across a range of seasonal flow levels: during spring freshet, summer flows, and late summer/fall flows. To account for the effects of seasonal stream variability on barrier assessments, we assigned barriers to one of four flood inundation categories (Table 1) that best described the relationship between barrier height, bankfull height, and flood level height, characterizing the relative barrier reliability to prevent upstream movement at various flow levels.

Table 1. Flood inundation categories, adapted from Blackburn et al. (2021).

Category	Condition	Predicted effect during flood
Low water barrier	Barrier height (H) is below the stream's bankfull height (H_{bf}), passable during higher flows and freshets ($H < H_{bf}$)	Inundated
Seasonal barrier	Barrier height is above the bankfull height but below the local estimated flood prone height (H_{fp}), passable during flood events ($H > H_{bf}$ but $< H_{fp}$)	Likely inundated
Effective barrier	Barrier height is above estimated flood height but may be reduced during flood. Likelihood of passage during flood depends on local fish sizes and abilities to ascend reduced barriers, ($H > H_{fp}$)	Reduced barrier
Absolute barrier	Barrier height appears far above local estimated flood height or past flooding evidence, well beyond the estimated abilities of the largest fish.	Permanent barrier

Following the methods outlined in Blackburn et al. (2021), we classified barriers as one of three barrier types: 1) waterfall, 2) chute, or 3) cascade. A primary barrier mode (leaping or swimming) was assigned that best described the fish transportation mode of ascension at each barrier feature (Appendix 3). We then assigned scores to barriers in three categories (leaping, swimming, and turbulence), based on the four mechanisms that impede fish passage over barriers to produce an overall barrier score.

Barrier scores were constructed in the context of invasion risk using the theoretical jumping and swimming abilities of Subcarangiform swimmers and their ability to ascend the barrier, relative to known fish size structure by location (i.e., determined from Alberta's Fish and Wildlife Information Management System [FWIMS]). Each of the three barrier modes was scored in increments of 0.25 with a maximum of 1.0. The maximum theoretical barrier score was 3.0 and the minimum was 0.75. Where the primary barrier mode was leaping, the swimming and turbulence modes received maximum mode scores of 1.0 by default, assuming that free-falling water is not a suitable swimming medium. For barriers with multiple features and/or pathways, we assigned scores based on the most passible passage route. To score individual barrier modes, we incorporated two scales of invader risk based on the maximum stream-salmonid fish size found at both the stream scale, and the watershed scale, relative to the barrier location (i.e., local, and regional invader maximums, respectively). Barrier modes that exceeded the swimming and leaping capabilities of both the local and regional invader fish size maximums were assigned full scores of 1.0, whereas those exceeding the capabilities of local invader maximums but not that of the regional invader maximums, were assigned scores of 0.75. Following the flowchart for assigning barriers scores, as outlined in Blackburn et al. (2021), maximum barrier scores of 3.0 were also assigned where there was insufficient plunge pool depth (i.e., D_{pp}) for leaping, or chute depth (i.e., D_{ch}) for swimming and/or leaping over barriers (Appendices 4 and 5). We used existing labels and the labelling nomenclature from the GOA barrier database for assigning unique identifiers to barriers.

4.0 RESULTS

We completed a total of 101 barrier scoring assessments, 79 of which were comprehensive ground assessments consisting of 195 barrier features. We assessed 17 potential barriers from helicopter of which nine were scored, five were determined as non-barriers and three were obstructed from view. We scored an additional 13 barriers remotely from available internet images and information. We ground-truthed 36 barrier locations that we determined to be not barriers, eliminated nine existing barriers from the government database as non-barriers, and an additional two barrier locations were not evaluated due to inaccessibility by foot because of highly confined canyon geography.

Of 101 scored barriers, 70 were considered impassible to local fish populations during the time of assessment with scores between 2.75–3.00, and 44 were considered absolute barriers based on flood inundation category (Table 2). An additional 33 barriers were considered effective in terms of flood inundation, whereas 24 barriers provide little protection from invasion during high water events with seasonal or low-water flood inundation category designations. We scored the most barriers in the Highwood River HUC 8 watershed (n = 29); however, the Kananaskis River HUC 8 had the most impassible barriers scoring 2.75 or greater (n = 21), as well as the most reliable barriers with the greatest number of absolute flood inundation designations (n =17) (Table 2).

Table 2. Summary of barrier efficacy and reliability by HUC 8 in the Bow River watershed, 2017–2021.

Hydrologic Unit Code 8 watershed	Number of scored barriers	Barriers scored 2.75–3.00	Flood inundation category summary of all scored barriers by HUC 8			
			Absolute	Effective	Seasonal	Low water
Highwood River	29	18	7	14	5	3
Kananaskis River	24	21	17	4	3	0
Sheep River	22	14	8	8	6	0
Elbow River	18	10	7	5	5	1
Bow River / Ghost Reservoir	3	3	3	0	0	0
Jumpingpound Creek	3	2	0	2	1	0
Spray Lakes River	2	2	2	0	0	0
Total	101	70	44	33	20	4

5.0 SUMMARY

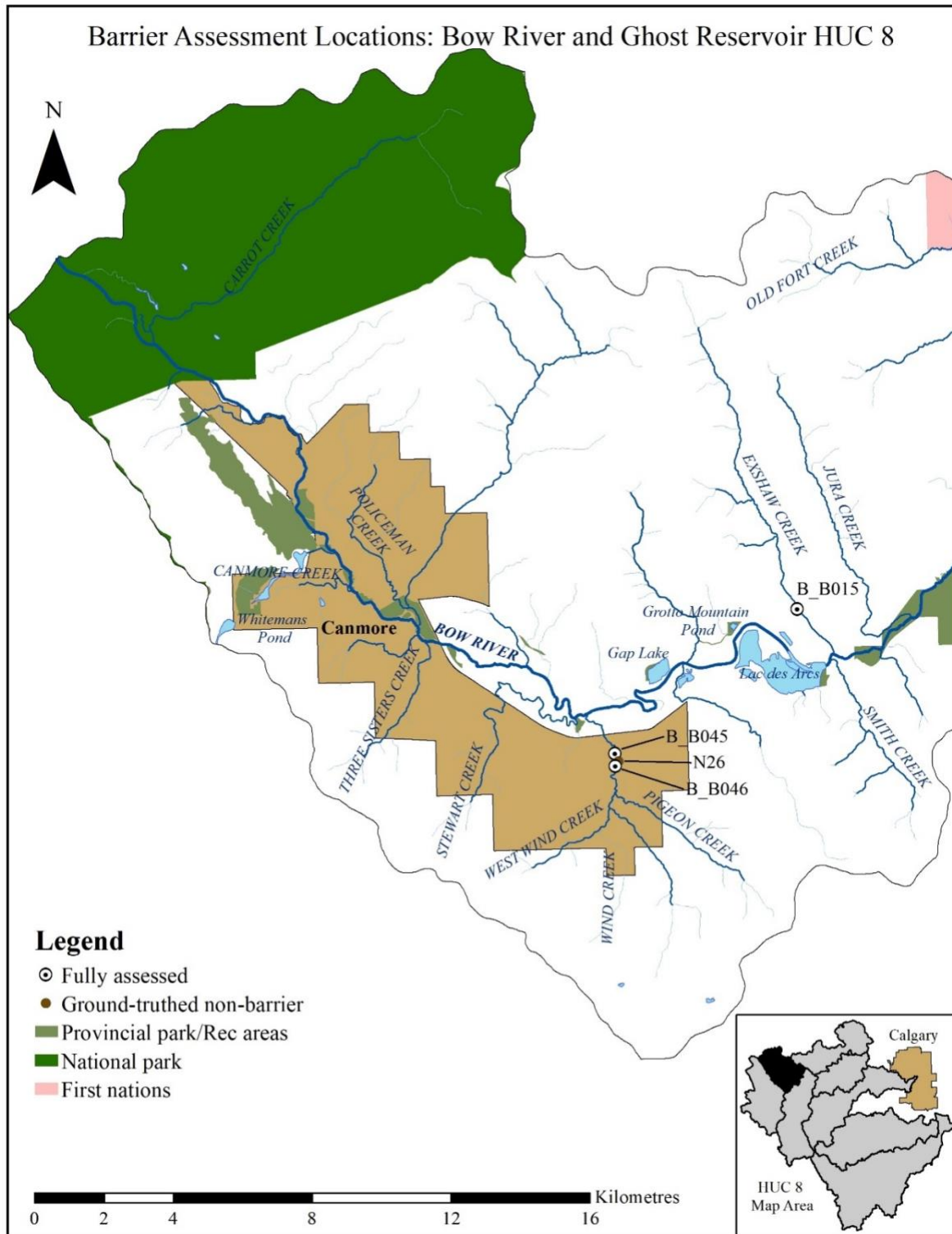
Between 2017 and 2021, we assessed 101 barriers in seven HUC 8 watersheds of the Bow River headwaters with potential to provide upstream refuge from non-native fish species invasions. Of these, 70 barriers spread across all HUC 8 watersheds were considered impassible to local fish populations during the time of assessment, and 44 (many in the Kananaskis River watershed) were considered absolute barriers based on flood inundation category. An additional 33 barriers are considered effective in terms of flood inundation. Knowing the locations and effectiveness of fish barriers in the Bow River headwaters is a key first step toward recognizing opportunities to expand the westslope cutthroat trout species range into secure habitat reaches, and to prioritize strategies to restore and reconnect existing populations.

6.0 LITERATURE CITED

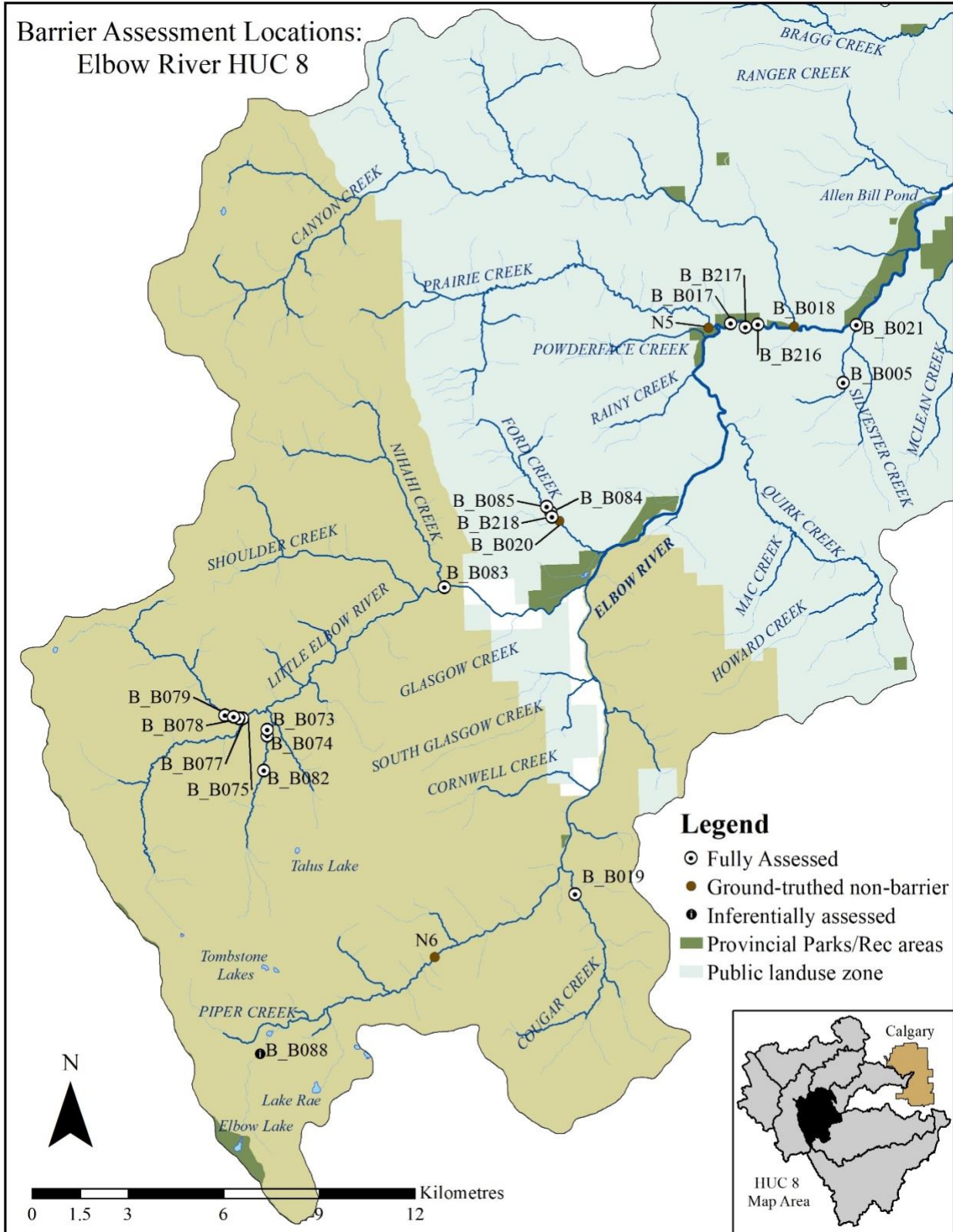
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7.0 APPENDICES

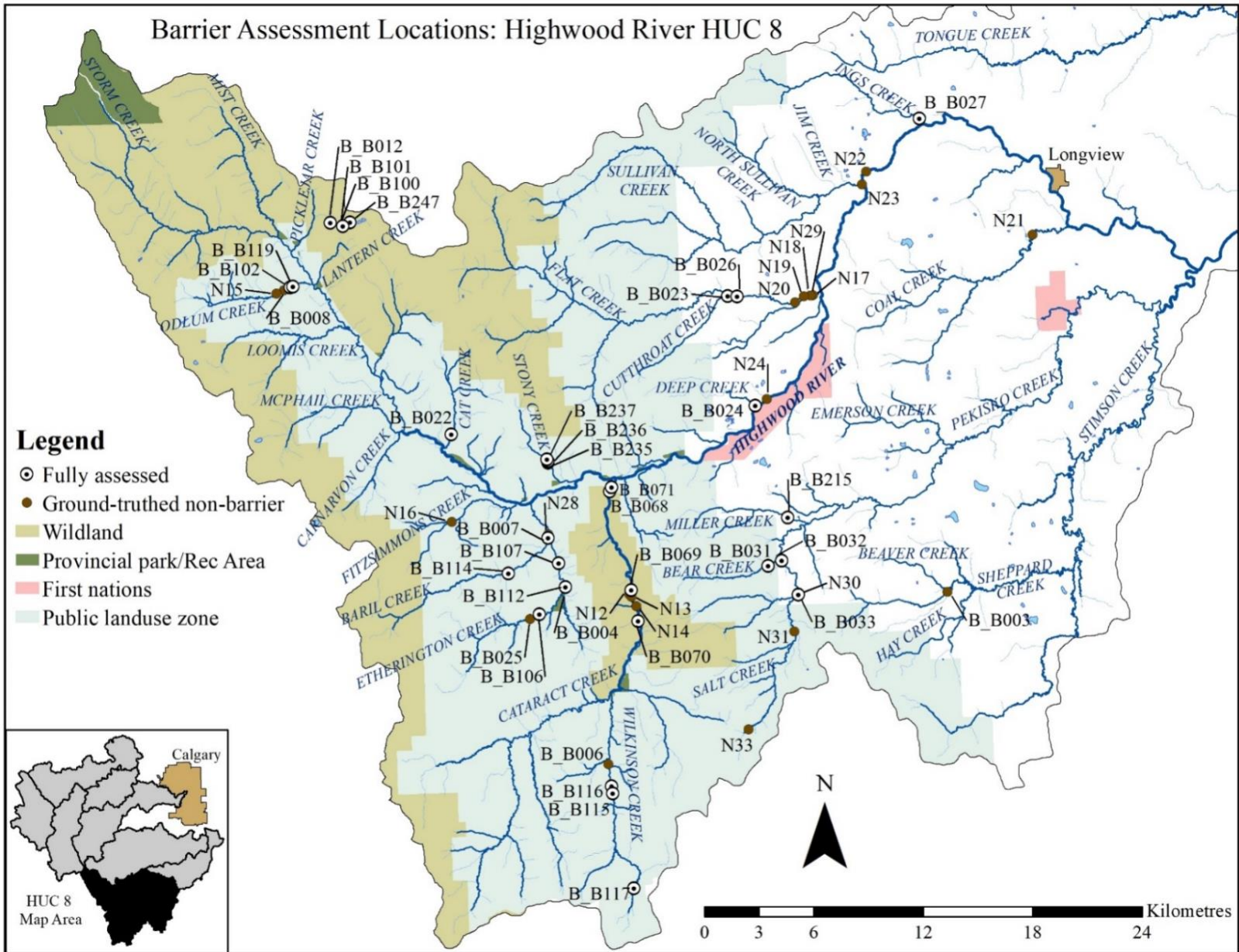
Appendix 1. Bow River drainage fish barrier locations by HUC 8. Inset maps show the location of the depicted HUC 8 within the study area.



Barrier Assessment Locations:
Elbow River HUC 8



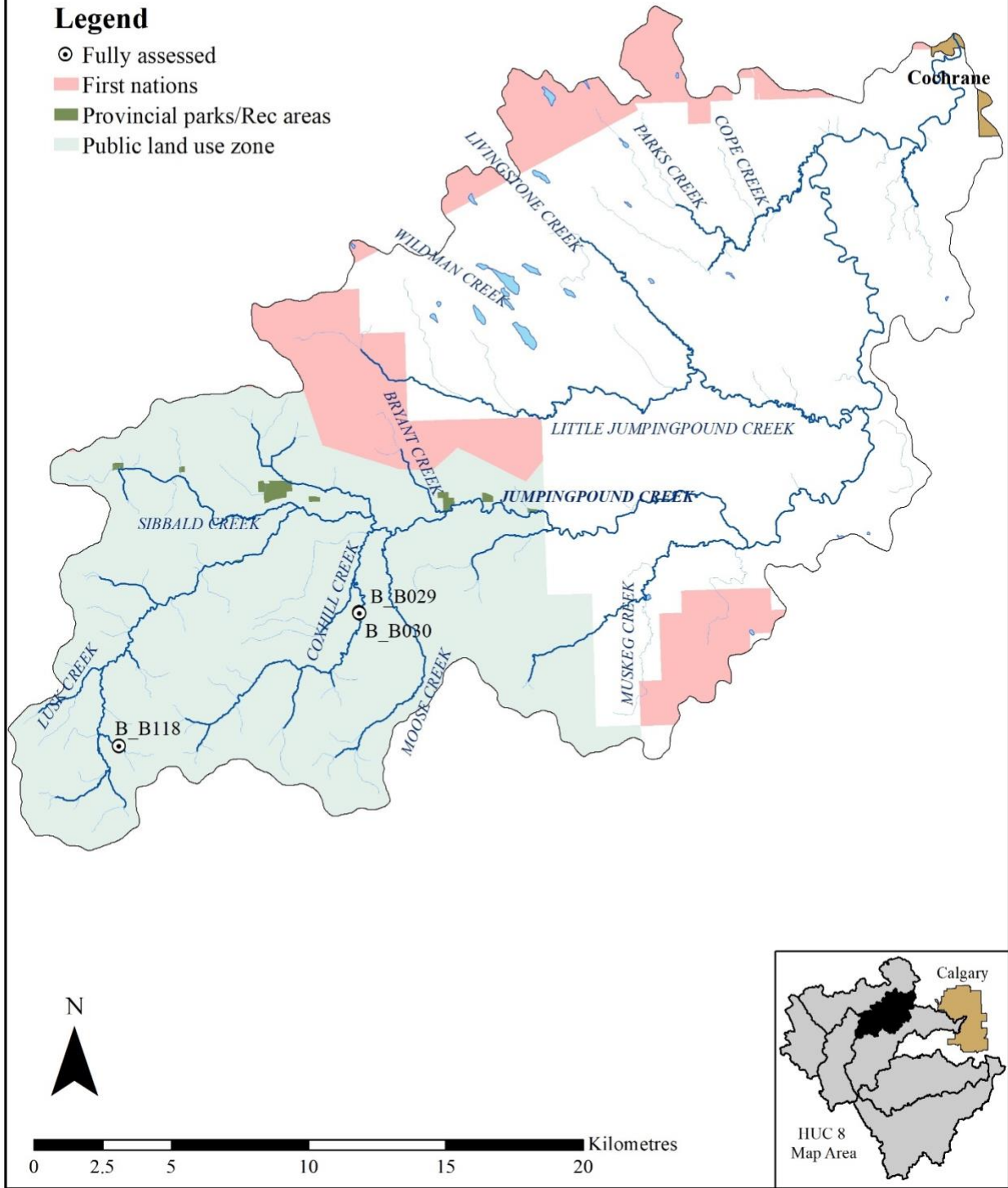
Barrier Assessment Locations: Highwood River HUC 8



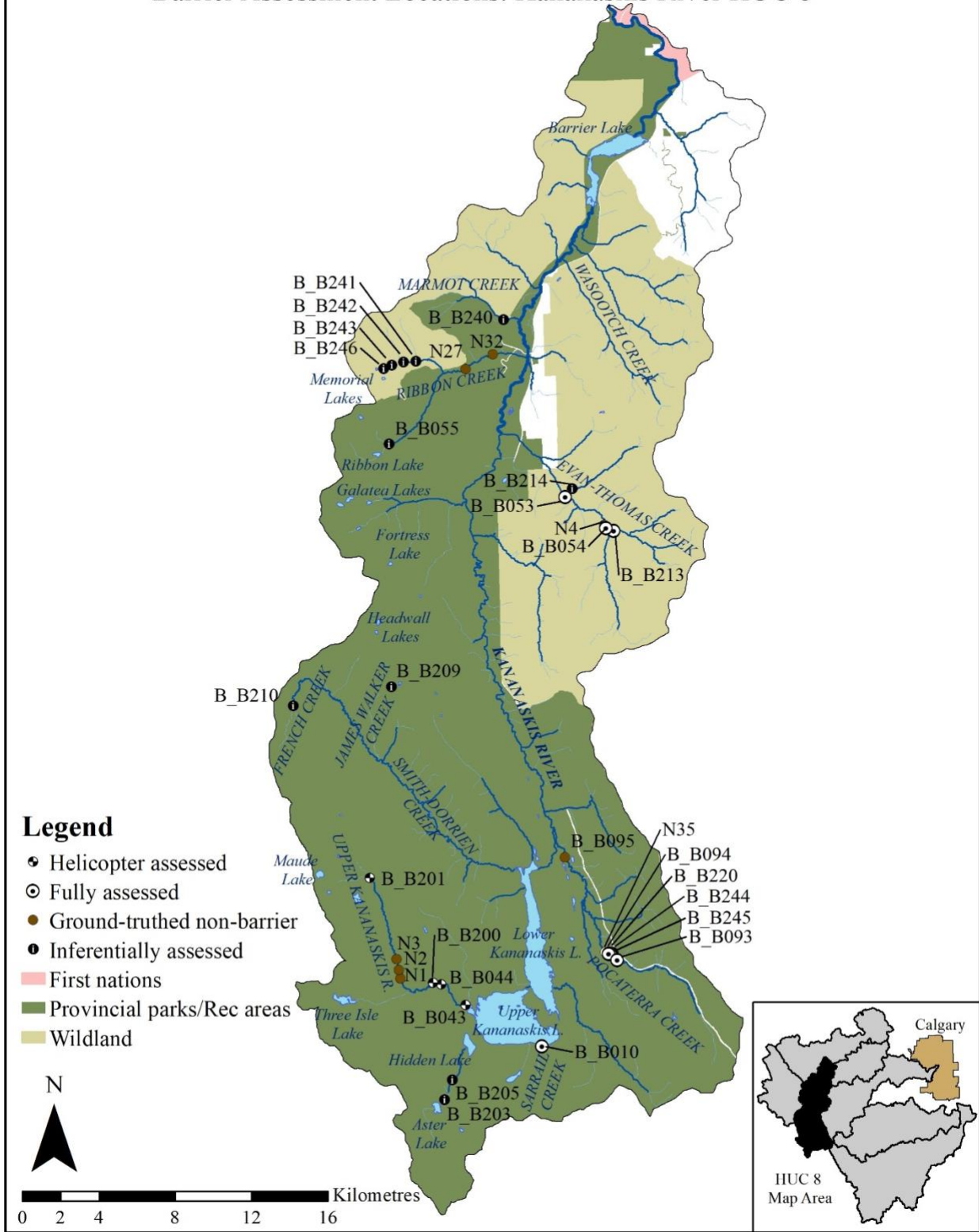
Barrier Assessment Locations: Jumpingpound Creek HUC 8

Legend

- ⊙ Fully assessed
- First nations
- Provincial parks/Rec areas
- Public land use zone



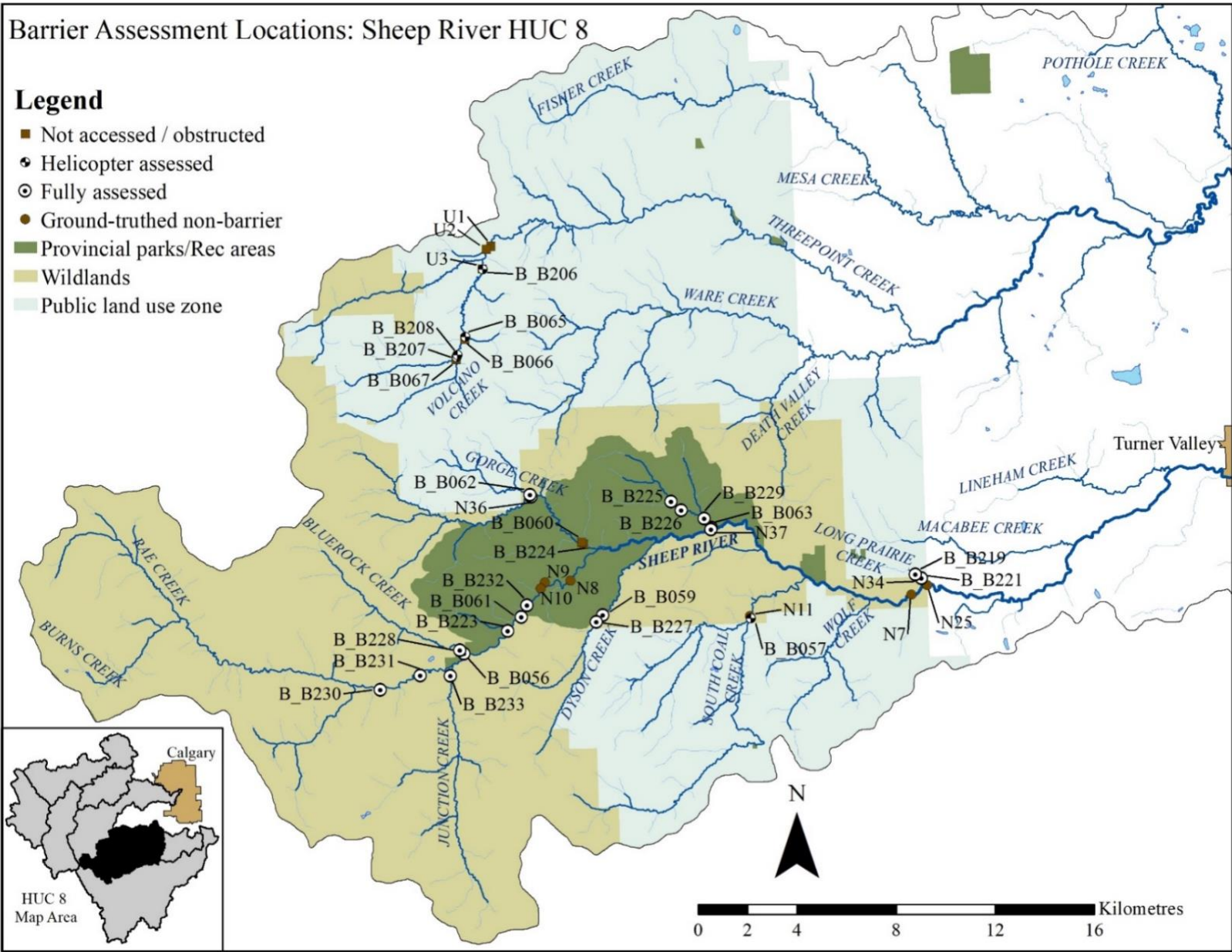
Barrier Assessment Locations: Kananaskis River HUC 8



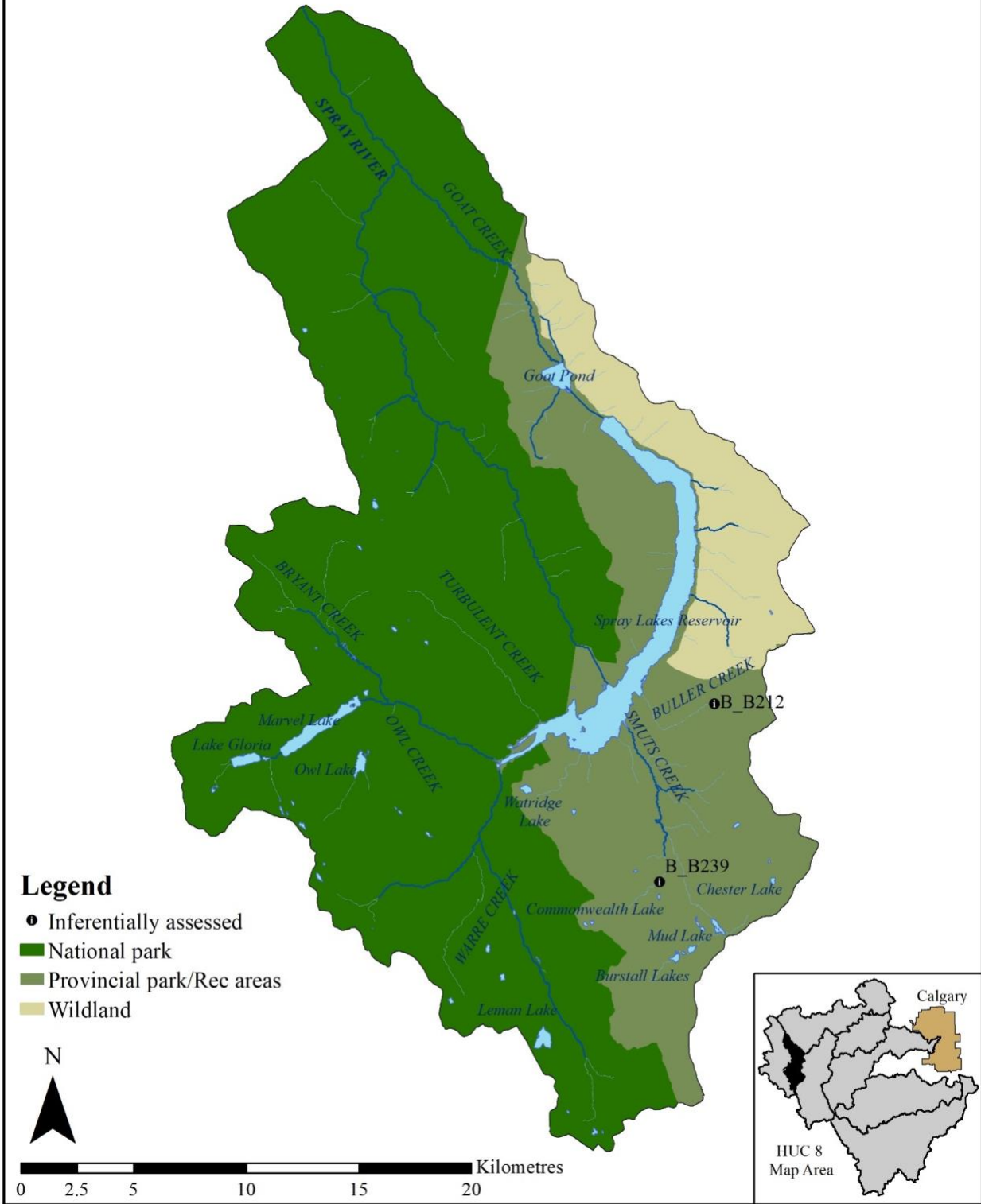
Barrier Assessment Locations: Sheep River HUC 8

Legend

- Not accessed / obstructed
- ⬢ Helicopter assessed
- ⊙ Fully assessed
- Ground-truthed non-barrier
- Provincial parks/Rec areas
- Wildlands
- Public land use zone



Barrier Assessment Locations: Spray River HUC 8



Appendix 2. Summary of barriers evaluated by HUC 8 and by stream in the Bow River watershed, 2017–2021.

Hydrologic Unit Code 8 Watersheds	Streams Evaluated	Number of Barriers
Bow River / Ghost Reservoir	Exshaw Creek	1
	Pigeon Creek	3
Elbow River	Canyon Creek	1
	Cougar Creek	1
	Elbow River	5
	Ford Creek	3
	Ford Creek tributary	1
	Little Elbow River	4
	North Fork Little Elbow	4
	Prairie Creek	1
	Sylvester Creek	1
	Sylvester Creek tributary	1
Highwood River	Baril Creek	2
	Bear Creek	1
	Beaver Creek	1
	Cat Creek	1
	Cataract Creek	7
	Coal Creek	1
	Cutthroat creek	1
	Deep Creek	1
	Etherington Creek	6
	Fitzsimmons Creek	1
	Flat Creek	6
	Highwood River	2
	Ings Creek	1
	Miller Creek	1
	Odlum Creek	4
	Pekisko Creek	5
	Picklejar Creek tributary	3
	Picklejar Lake-3 Outlet	1
	Stony Creek	3
	Sullivan Creek	1
Wilkinson Creek	4	
Jumpingpound Creek	Coxhill Creek	2

Hydrologic Unit Code 8 Watersheds	Streams Evaluated	Number of Barriers
	Jumpingpound Creek tributary	1
Kananaskis River	Aster Creek	1
	Evan-Thomas Creek	3
	Evan-Thomas Creek tributary	2
	Foch Creek	1
	French Creek	1
	James Walker Creek	1
	Marmot Creek	1
	North Ribbon Creek	4
	Pocaterra Creek	7
	Ribbon Creek	3
	Sarrail Creek	1
Upper Kananaskis River	7	
Sheep River	Blue Rock Creek	2
	Dyson Creek	2
	Gorge Creek	2
	Gorge Creek tributary	1
	James Walker Creek	1
	Junction Creek	1
	Long Prairie Creek	3
	Sheep River	10
	Sheep River tributary	4
	South Coal Creek	2
	Threepoint Creek	2
Volcano Creek	7	
Spray Lakes River	Buller Creek	1
	Commonwealth Creek	1
Total	61 streams	153 barriers

Appendix 3. Bow River drainage barrier locations and descriptions by barrier ID, as assessed in 2017–2021.

Barrier ID	Waterbody	UTM Easting	UTM Northing	Barrier type	Barrier class	Barrier mode	Barrier descriptor	Number of Features	Flow level	Assessment method
B_B003	Beaver Creek	690046	5578550	Non-barrier	NA	NA	NA	NA	Summer	ground
B_B004	Etherington Creek	669032	5578735	Non-barrier	NA	NA	NA	NA	Spring	ground
B_B005	Sylvester Creek tributary	659830	5635607	Waterfall	multiple	leaping	multistep/stepped	2	Summer	ground
B_B006	Wilkinson Creek	671444	5569102	Non-barrier	NA	NA	NA	NA	Spring	ground
B_B007	Baril Creek	668144	5581551	Waterfall	single	leaping	horsetail	1	Low	ground
B_B008	Odlum Creek	653662	5595101	Non-barrier	NA	NA	NA	NA	Summer	ground
B_B010	Sarrail Creek	632193	5607703	Cascade	compound	leaping	horsetail	4	Spring	ground
B_B012	Picklejar Creek tributary	656216	5598840	Waterfall	single	leaping	cascading	1	Summer	ground
B_B015	Exshaw Creek	627833	5659206	Other	single	leaping	other	2	Low	ground
B_B017	Elbow River	656288	5637465	Waterfall	single	leaping	plunge	1	Summer	ground
B_B018	Canyon Creek	658280	5637340	Non-barrier	NA	NA	NA	NA	Summer	ground
B_B019	Cougar Creek	651402	5619552	Waterfall	single	leaping	plunge	1	Summer	ground
B_B020	Ford Creek	650912	5631240	Non-barrier	NA	NA	NA	NA	Summer	ground
B_B021	Sylvester Creek	660238	5637412	Waterfall	single	leaping	horsetail	2	Summer	ground
B_B022	Cat Creek	662822	5587225	Waterfall	multiple	leaping	tiered/terraced	2	Summer	ground
B_B023	Cutthroat creek	677999	5594809	Waterfall	single	swimming	block	1	Spring	ground
B_B024	Deep Creek	679504	5588800	Waterfall	single	leaping	segmented	1	Spring	ground
B_B025	Etherington Creek	667140	5577069	Non-barrier	NA	NA	NA	NA	Spring	ground
B_B026	Flat Creek	678509	5594792	Waterfall	single	leaping	plunge	1	Spring	ground
B_B027	Ings Creek	688514	5604561	Chute	complex	swimming	chute/flume	1	Spring	ground
B_B029	Coxhill Creek	652946	5652643	Chute	simple	swimming	slide	2	Summer	ground
B_B030	Coxhill Creek	652963	5652614	Waterfall	single	leaping	horsetail	4	Summer	ground
B_B031	Bear Creek	680219	5580016	Waterfall	single	leaping	horsetail	1	Summer	ground
B_B032	Pekisko Creek	680953	5580289	Waterfall	single	leaping	punchbowl	1	Low	ground
B_B033	Pekisko Creek	681876	5578422	Cascade	compound	leaping	cascading	2	Low	ground
B_B043	Upper Kananaskis River	628181	5609850	Waterfall	single	leaping	block	1	Summer	helicopter
B_B044	Upper Kananaskis River	626901	5610922	Cascade	turbulent	leaping	chute/flume	several	Summer	helicopter
B_B045	Pigeon Creek	622529	5655008	Waterfall	single	leaping	plunge	1	Low	ground
B_B046	Pigeon Creek	622531	5654636	Waterfall	multiple	leaping	multistep/stepped	3	Low	ground
B_B053	Evan-Thomas Creek	633409	5636441	Waterfall	multiple	leaping	tiered/terraced	2	Spring	ground
B_B054	Evan-Thomas Creek	635548	5634813	Cascade	compound	swimming	multistep/stepped	4	Spring	ground
B_B055	Ribbon Creek	624183	5639162	Waterfall	single	leaping	fan/veil	1	NA	inferred





Barrier ID	Waterbody	UTM Easting	UTM Northing	Barrier type	Barrier class	Barrier mode	Barrier descriptor	Number of Features	Flow level	Assessment method
B_B056	Blue Rock Creek	660717	5608696	Cascade	compound	leaping	multistep/stepped	3	Summer	ground
B_B057	South Coal Creek	672292	5610095	Waterfall	single	leaping	fan/veil	3	Summer	helicopter
B_B059	Dyson Creek	666315	5610243	Waterfall	single	leaping	plunge	4	Summer	ground
B_B060	Gorge Creek	665453	5613169	Unassessed	NA	NA	NA	NA	Summer	ground
B_B061	Sheep River	663032	5610170	Waterfall	multiple	leaping	segmented	4	Summer	ground
B_B062	Gorge Creek tributary	663372	5615109	Cascade	compound	swimming	cascading	6	Summer	ground
B_B063	Sheep River tributary	670713	5613784	Waterfall	single	leaping	horsetail	1	Summer	ground
B_B065	Volcano Creek	660761	5621461	Waterfall	single	leaping	horsetail	1	Low	helicopter
B_B066	Volcano Creek	660733	5621383	Non-barrier	NA	NA	NA	NA	Low	helicopter
B_B067	Volcano Creek	660384	5620564	Non-barrier	NA	NA	NA	NA	Low	helicopter
B_B068	Cataract Creek	671528	5584101	Cascade	turbulent	swimming	cascading	1	Low	ground
B_B069	Cataract Creek	672715	5578686	Waterfall	single	leaping	plunge	1	Summer	ground
B_B070	Cataract Creek	673069	5576978	Waterfall	multiple	leaping	multistep/stepped	2	Summer	ground
B_B071	Cataract Creek	671227	5584390	Waterfall	single	leaping	block	1	Low	ground
B_B073	Little Elbow River	641761	5624706	Waterfall	multiple	leaping	tiered/terraced	2	Summer	ground
B_B074	Little Elbow River	641753	5624521	Waterfall	multiple	leaping	segmented	2	Summer	ground
B_B075	North Fork Little Elbow	640982	5625061	Waterfall	single	leaping	plunge	1	Summer	ground
B_B077	North Fork Little Elbow	640873	5625069	Waterfall	single	leaping	segmented	2	Summer	ground
B_B078	North Fork Little Elbow	640708	5625106	Chute	simple	swimming	chute/flume	1	summer	ground
B_B079	North Fork Little Elbow	640429	5625160	Cascade	compound	leaping	multistep/stepped	1	summer	ground
B_B082	Little Elbow River	641647	5623422	Chute	complex	swimming	segmented	2	Summer	ground
B_B083	Little Elbow River	647308	5629173	Waterfall	multiple	leaping	multistep/stepped	3	Summer	ground
B_B084	Ford Creek	650646	5631525	Waterfall	multiple	leaping	horsetail	2	Summer	ground
B_B085	Ford Creek	650518	5631705	Waterfall	single	leaping	horsetail	1	Summer	ground
B_B088	Elbow River	641518	5614511	Waterfall	single	leaping	fan/veil	1	NA	inferred
B_B093	Pocaterra Creek	636124	5612212	Waterfall	multiple	leaping	multistep/stepped	4	Summer	ground
B_B094	Pocaterra Creek	635682	5612535	Waterfall	single	leaping	fan/veil	2	Summer	ground
B_B100	Picklejar Creek tributary	656898	5598595	Non-barrier	NA	NA	NA	NA	Summer	ground
B_B101	Picklejar Creek tributary	656898	5598650	Chute	simple	leaping	cascading	4	summer	ground
B_B102	Odlum Creek	654012	5595303	Waterfall	multiple	leaping	segmented	3	summer	ground
B_B106	Etherington Creek	667666	5577349	Waterfall	single	leaping	plunge	2	Spring	ground
B_B107	Etherington Creek	668717	5580147	Waterfall	single	leaping	cataract	2	Spring	ground
B_B112	Etherington Creek	669095	5578846	Chute	simple	swimming	segmented	2	spring	ground

Barrier ID	Waterbody	UTM Easting	UTM Northing	Barrier type	Barrier class	Barrier mode	Barrier descriptor	Number of Features	Flow level	Assessment method
B_B114	Baril Creek	665963	5579589	Cascade	turbulent	leaping	segmented	2	spring	ground
B_B115	Wilkinson Creek	671693	5567524	Cascade	turbulent	swimming	chute/flume	2	Spring	ground
B_B116	Wilkinson Creek	671622	5567908	Cascade	compound	swimming	segmented	4	Spring	ground
B_B117	Wilkinson Creek	672860	5562320	Cascade	compound	leaping	cascading	7	Spring	ground
B_B118	Jumpingpound Creek	644194	5647784	Waterfall	single	leaping	horsetail	1	Low	ground
B_B119	Odlum Creek	654161	5595336	Cascade	compound	leaping	other	6	Summer	ground
B_B200	Upper Kananaskis River	626479	5610997	Chute	complex	swimming	chute/flume	several	Summer	helicopter
B_B201	Upper Kananaskis River	623181	5616493	Waterfall	single	leaping	plunge	several	Summer	helicopter
B_B203	Aster Creek	627067	5604867	Waterfall	multiple	leaping	tiered/terraced	several	NA	inferred
B_B205	Foch Creek	627477	5605889	Waterfall	single	leaping	horsetail	several	NA	inferred
B_B206	Volcano Creek	661455	5624190	Waterfall	single	leaping	plunge	1	Low	helicopter
B_B207	Volcano Creek	660407	5620637	Waterfall	single	leaping	horsetail	1	Low	helicopter
B_B208	Volcano Creek	660432	5620735	Waterfall	single	leaping	plunge	3	Low	helicopter
B_B209	James Walker Creek	624272	5626458	Cascade	compound	leaping	segmented	several	NA	inferred
B_B210	French Creek	619153	5625474	Waterfall	single	leaping	plunge	2	NA	inferred
B_B212	Buller Creek	619027	5638157	Waterfall	single	leaping	punchbowl	1	NA	inferred
B_B213	Evan-Thomas Creek	635941	5634679	Cascade	compound	leaping	horsetail	3	spring	ground
B_B214	Evan-Thomas Creek	633760	5636825	Cascade	compound	leaping	multistep/stepped	2	Spring	ground
B_B215	Miller Creek	681300	5582660	Chute	complex	swimming	chute/flume	3	Summer	ground
B_B216	Elbow River	657149	5637425	Chute	simple	swimming	slide	4	Summer	ground
B_B217	Elbow River	656754	5637350	Cascade	turbulent	swimming	cascading	2	Summer	ground
B_B218	Ford Creek tributary	650679	5631379	Waterfall	single	leaping	plunge	1	Summer	ground
B_B219	Long Prairie Creek	678957	5611897	Waterfall	single	leaping	horsetail	1	Summer	ground
B_B220	Pocaterra Creek	635762	5612541	Waterfall	multiple	leaping	multistep/stepped	2	Summer	ground
B_B221	Long Prairie Creek	679194	5611739	Waterfall	single	leaping	fan/veil	3	Summer	ground
B_B223	Sheep River	662475	5609614	Waterfall	single	leaping	block	1	Summer	ground
B_B224	Gorge Creek	665529	5613094	Unassessed	multiple	leaping	multistep/stepped	1	Summer	ground
B_B225	Sheep River tributary	669083	5614838	Chute	complex	swimming	multistep/stepped	2	Summer	ground
B_B226	Sheep River tributary	669494	5614484	Chute	complex	swimming	slide	2	Summer	ground
B_B227	Dyson Creek	666063	5609966	Cascade	compound	swimming	cascading	3	Low	ground
B_B228	Blue Rock Creek	660541	5608827	Cascade	turbulent	swimming	chute/flume	6	Summer	ground
B_B229	Sheep River tributary	670419	5614145	Waterfall	multiple	leaping	horsetail	4	Summer	ground
B_B230	Sheep River	657332	5607226	Cascade	compound	leaping	segmented	2	Summer	ground

Barrier ID	Waterbody	UTM Easting	UTM Northing	Barrier type	Barrier class	Barrier mode	Barrier descriptor	Number of Features	Flow level	Assessment method
B_B231	Sheep River	658937	5607806	Waterfall	multiple	leaping	segmented	2	Summer	ground
B_B232	Sheep River	663252	5610641	Cascade	compound	leaping	cascading	4	Summer	ground
B_B233	Junction Creek	660169	5607788	Chute	simple	swimming	punchbowl	1	Summer	ground
B_B235	Stony Creek	668138	5585666	Cascade	compound	leaping	segmented	6	Spring	ground
B_B236	Stony Creek	668085	5585862	Waterfall	multiple	leaping	horsetail	1	Summer	ground
B_B237	Stony Creek	668133	5585754	Waterfall	simple	leaping	tiered/terraced	1	Summer	ground
B_B239	Commonwealth Creek	616577	5630241	Waterfall	multiple	leaping	segmented	2	NA	inferred
B_B240	Marmot Creek	630160	5645690	Waterfall	single	leaping	plunge	2	NA	inferred
B_B241	North Ribbon Creek	625556	5643513	Cascade	compound	leaping	multistep/stepped	several	NA	inferred
B_B242	North Ribbon Creek	624912	5643483	Waterfall	multiple	leaping	fan/veil	several	NA	inferred
B_B243	North Ribbon Creek	624307	5643320	Waterfall	multiple	leaping	horsetail	several	NA	inferred
B_B244	Pocaterra Creek	635830	5612546	Waterfall	single	leaping	block	1	Summer	ground
B_B245	Pocaterra Creek	635860	5612550	Chute	complex	swimming	chute/flume	1	Summer	ground
B_B246	North Ribbon Creek	623890	5643128	Waterfall	multiple	leaping	tiered/terraced	several	NA	inferred
B_B247	Picklejar Lake-3 Outlet	657303	5598854	Chute	simple	swimming	slide	1	low	ground
N1	Upper Kananaskis River	624769	5611218	Non-barrier	NA	NA	NA	NA	Low	helicopter
N2	Upper Kananaskis River	624687	5611665	Non-barrier	NA	NA	NA	NA	Low	helicopter
N3	Upper Kananaskis River	624569	5612230	Non-barrier	NA	NA	NA	NA	Low	helicopter
N4	Evan-Thomas Creek	635448	5634959	Non-barrier	NA	NA	NA	NA	Spring	ground
N5	Prairie Creek	655597	5637309	Non-barrier	NA	NA	NA	NA	Summer	ground
N6	Elbow River	646998	5617560	Non-barrier	NA	NA	NA	NA	Summer	ground
N7	Sheep River	678782	5611052	Non-barrier	NA	NA	NA	NA	Summer	ground
N8	Sheep River	665006	5611611	Non-barrier	NA	NA	NA	NA	Summer	ground
N9	Sheep River	663979	5611549	Non-barrier	NA	NA	NA	NA	Summer	ground
N10	Sheep River	663808	5611295	Non-barrier	NA	NA	NA	NA	Summer	ground
N11	South Coal Creek	672267	5610182	Non-barrier	NA	NA	NA	NA	Low	helicopter
N12	Cataract Creek	672589	5578426	Non-barrier	NA	NA	NA	NA	Summer	ground
N13	Cataract Creek	672703	5578276	Non-barrier	NA	NA	NA	NA	Summer	ground
N14	Cataract Creek	672973	5577766	Non-barrier	NA	NA	NA	NA	Summer	ground
N15	Odlum Creek	653246	5594922	Non-barrier	NA	NA	NA	NA	Summer	ground
N16	Fitzsimmons Creek	662848	5582389	Non-barrier	NA	NA	NA	NA	Summer	ground
N17	Flat Creek	682655	5594834	Non-barrier	NA	NA	NA	NA	Spring	ground
N18	Flat Creek	682540	5594806	Non-barrier	NA	NA	NA	NA	Spring	ground

Barrier ID	Waterbody	UTM Easting	UTM Northing	Barrier type	Barrier class	Barrier mode	Barrier descriptor	Number of Features	Flow level	Assessment method
N19	Flat Creek	682165	5594765	Non-barrier	NA	NA	NA	NA	Spring	ground
N20	Flat Creek	681685	5594447	Non-barrier	NA	NA	NA	NA	Spring	ground
N21	Coal Creek	694710	5598160	Non-barrier	NA	NA	NA	NA	Low	helicopter
N22	Highwood River	685587	5601629	Non-barrier	NA	NA	NA	NA	Spring	ground
N23	Sullivan Creek	685356	5600923	Non-barrier	NA	NA	NA	NA	Spring	ground
N24	Highwood River	680130	5589130	Non-barrier	NA	NA	NA	NA	Spring	ground
N25	Sheep River	679425	5611436	Non-barrier	NA	NA	NA	NA	Summer	ground
N26	Pigeon Creek	622624	5654755	Non-barrier	NA	NA	NA	NA	Low	ground
N27	Ribbon Creek	628174	5643136	Non-barrier	NA	NA	NA	NA	Summer	ground
N28	Etherington Creek	668132	5581699	Non-barrier	NA	NA	NA	NA	Spring	ground
N29	Flat Creek	682548	5594816	Non-barrier	NA	NA	NA	NA	Spring	ground
N30	Pekisko Creek	681876	5578442	Non-barrier	NA	NA	NA	NA	Summer	ground
N31	Pekisko Creek	681650	5576366	Non-barrier	NA	NA	NA	NA	Summer	ground
N32	Ribbon Creek	629605	5643904	Non-barrier	NA	NA	NA	NA	summer	ground
N33	Pekisko Creek	679128	5571011	Non-barrier	NA	NA	NA	NA	Summer	ground
N34	Long Prairie Creek	678991	5611862	Non-barrier	NA	NA	NA	NA	Summer	ground
N35	Pocaterra Creek	635498	5612612	Non-barrier	NA	NA	NA	NA	Summer	ground
N36	Gorge Creek	663427	5615032	Non-barrier	NA	NA	NA	NA	summer	ground
U1	Threepoint Creek	661775	5625129	Unassessed	NA	NA	NA	NA	Low	helicopter
U2	Threepoint Creek	661591	5625020	Unassessed	NA	NA	NA	NA	Low	helicopter
U3	Volcano Creek	661427	5624228	Unassessed	NA	NA	NA	NA	Low	helicopter










Appendix 4. Bow River watershed barrier catalogue by HUC 8, as assessed in 2017–2021.

Bow River and Ghost Reservoir HUC 8		
		
<p>ID: B_B015 - Exshaw Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 678 mm Regional invader max: 678 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B045 - Pigeon Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 678 mm Regional invader max: 678 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B046 - Pigeon Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 678 mm Regional invader max: 678 mm Inundation category: absolute Score: 3.00</p>
Elbow River HUC 8		
		
<p>ID: B_B005 - Sylvester Creek Trib. Primary mode: leaping Passable fish size: leap barrier Local invader max: 256 mm Regional invader max: 616 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B017 - Elbow River Primary mode: leaping Passable fish size: >600 mm Local invader max: 616 mm Regional invader max: 689 mm Inundation category: effective Score: 2.75</p>	<p>ID: B_B019 - Cougar Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 327 mm Regional invader max: 616 mm Inundation category: absolute Score: 3.00</p>
		
<p>ID: B_B021 - Sylvester Creek Primary mode: leaping Passable fish size: >200 mm Local invader max: 616 mm Regional invader max: 689 mm Inundation category: effective Score: 2.5</p>	<p>ID: B_B073 - Little Elbow River Primary mode: leaping Passable fish size: >550 mm Local invader max: 310 mm Regional invader max: 616 mm Inundation category: effective Score: 2.75</p>	<p>ID: B_B074 - Little Elbow River Primary mode: leaping Passable fish size: leap barrier Local invader max: 310 mm Regional invader max: 616 mm Inundation category: absolute Score: 3.00</p>

Elbow River HUC 8		
		
<p>ID: B_B075 - Little Elbow River Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 310 mm Regional invader max: 616 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B077 - Little Elbow River Primary mode: leaping Passable fish size: >400 mm Local invader max: 310 mm Regional invader max: 616 mm Inundation category: absolute Score: 2.75</p>	<p>ID: B_B078 - Little Elbow River Primary mode: swimming Passable fish size: >200 mm Local invader max: 310 mm Regional invader max: 616 mm Inundation category: seasonal Score: 1.75</p>
		
<p>ID: B_B079 - Little Elbow River Primary mode: leaping Passable fish size: >150 mm Local invader max: 310 mm Regional invader max: 616 mm Inundation category: seasonal Score: 2.50</p>	<p>ID: B_B082 - Little Elbow River Primary mode: swimming Passable fish size: >100 mm Local invader max: 310 mm Regional invader max: 616 mm Inundation category: effective Score: 2.50</p>	<p>ID: B_B083 - Little Elbow River Primary mode: leaping Passable fish size: >250 mm Local invader max: 310 mm Regional invader max: 585 mm Inundation category: seasonal Score: 2.25</p>
		<p>Image source: www.10adventures.com</p> 
<p>ID: B_B084 - Ford Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 274 mm Regional invader max: 689 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B085 - Ford Creek Primary mode: leaping Passable fish size: >200 mm Local invader max: 274 mm Regional invader max: 689 mm Inundation category: seasonal Score: 2.25</p>	<p>ID: B_B088 - Upper Elbow River Primary mode: leaping Passable fish size: leap barrier Local invader max: 267 mm Regional invader max: 312 mm Inundation category: absolute Score: 3.00</p>









Elbow River HUC 8		
		
<p>ID: B_B216 - Elbow River Primary mode: swimming Passable fish size: 250 – 750 mm Local invader max: 616 mm Regional invader max: 689 mm Inundation category: seasonal Score: 1.25</p>	<p>ID: B_B217 - Elbow River Primary mode: swimming Passable fish size: 150 – 750 mm Local invader max: 616 mm Regional invader max: 689 mm Inundation category: low water Score: 2.00</p>	<p>ID: B_B218 - Ford Creek trib. Primary mode: leaping Passable fish size: leap barrier Local invader max: 274 mm Regional invader max: 689 mm Inundation category: absolute Score: 3.00</p>
Highwood River HUC 8		
		
<p>ID: B_B007 - Baril Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 249 mm Regional invader max: 571mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B012 - Picklejar Creek trib. Primary mode: leaping Passable fish size: >300 mm Local invader max: 377 mm Regional invader max: 571 mm Inundation category: seasonal Score: 2.25</p>	<p>ID: B_B022 - Cat Creek Primary mode: leaping Passable fish size: >400 mm Local invader max: 229 mm Regional invader max: 571 mm Inundation category: effective Score: 2.75</p>
		
<p>ID: B_B023 - Cutthroat Creek Primary mode: leaping Passable fish size: >200 mm Local invader max: 430 mm Regional invader max: 571 mm Inundation category: low water Score: 1.25</p>	<p>ID: B_B024 - Deep Creek Primary mode: leaping Passable fish size: >350 mm Local invader max: 571 mm Regional invader max: 571 mm Inundation category: effective Score: 2.50</p>	<p>ID: B_B026 - Flat Creek Primary mode: leaping Passable fish size: >500 mm Local invader max: 430 mm Regional invader max: 574 mm Inundation category: effective Score: 2.75</p>

Highwood River HUC 8





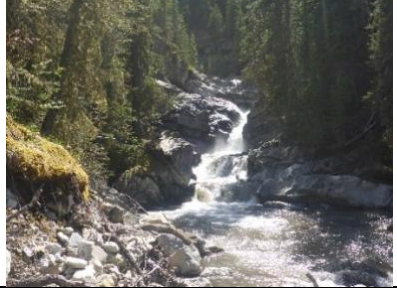




		
<p>ID: B_B027 - Ings Creek Primary mode: swimming Passable fish size: D_{ch} barrier Local invader max: 430 mm Regional invader max: 574 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B031 - Bear Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 265 mm Regional invader max: 615 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B032 - Pekisko Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 615 mm Regional invader max: 615 mm Inundation category: absolute Score: 3.00</p>
		
<p>ID: B_B033 - Pekisko Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 615 mm Regional invader max: 615 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B068 - Cataract Creek Primary mode: swimming Passable fish size: leap barrier Local invader max: 340 mm Regional invader max: 574 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B069 - Cataract Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 340 mm Regional invader max: 574 mm Inundation category: absolute Score: 3.00</p>
		
<p>ID: B_B070 - Cataract Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 340 mm Regional invader max: 574 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B071 - Cataract Creek Primary mode: leaping Passable fish size: >250 mm Local invader max: 340 mm Regional invader max: 574 mm Inundation category: seasonal Score: 2.25</p>	<p>ID: B_B101 - Picklejar Creek trib. Primary mode: leaping Passable fish size: >100mm Local invader max: 377 mm Regional invader max: 571 mm Inundation category: low water Score: 1.75</p>





Highwood River HUC 8





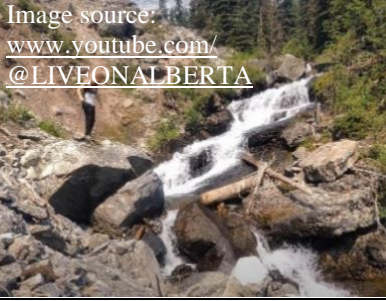

		
<p>ID: B_B102 - Odium Creek Primary mode: leaping Passable fish size: >300 mm Local invader max: 356 mm Regional invader max: 571 mm Inundation category: seasonal Score: 2.50</p>	<p>ID: B_B106 - Etherington Creek Primary mode: leaping Passable fish size: >250 mm Local invader max: 356 mm Regional invader max: 571 mm Inundation category: effective Score: 2.25</p>	<p>ID: B_B107 - Etherington Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 356 mm Regional invader max: 571 mm Inundation category: absolute Score: 3.00</p>
		
<p>ID: B_B112 - Etherington Creek Primary mode: swimming Passable fish size: >100 mm Local invader max: 356 mm Regional invader max: 574 mm Inundation category: low water Score: 1.50</p>	<p>ID: B_B114 - Baril Creek Primary mode: leaping Passable fish size: >600 mm Local invader max: 249 mm Regional invader max: 574 mm Inundation category: effective Score: 2.75</p>	<p>ID: B_B115 - Wilkinson Creek Primary mode: swimming Passable fish size: >250 mm Local invader max: 356 mm Regional invader max: 574 mm Inundation category: seasonal Score: 1.75</p>
		
<p>ID: B_B116 - Wilkinson Creek Primary mode: swimming Passable fish size: >200 mm Local invader max: 340 mm Regional invader max: 574 mm Inundation category: seasonal Score: 1.75</p>	<p>ID: B_B117 - Wilkinson Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 340 mm Regional invader max: 574 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B119 - Odium Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 356 mm Regional invader max: 571 mm Inundation category: effective Score: 3.00</p>







Highwood River HUC 8		
		
<p>ID: B_B215 - Miller Creek Primary mode: swimming Passable fish size: 100 – 250 mm Local invader max: 127 mm Regional invader max: 615 mm Inundation category: effective Score: 2.25</p>	<p>ID: B_B235 - Stony Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 571 mm Regional invader max: 571 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B236 - Stony Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 571 mm Regional invader max: 571mm Inundation category: absolute Score: 3.00</p>
		
<p>ID: B_B237 - Stony Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 571 mm Regional invader max: 571 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B247 - Picklejar-3 outlet Primary mode: swimming Passable fish size: D_{ch} barrier Local invader max: 377 mm Regional invader max: 571mm Inundation category: absolute Score: 3.00</p>	
Jumpingpound Creek HUC 8		
		
<p>ID: B_B029 - Coxhill Creek Primary mode: swimming Passable fish size: >100 mm Local invader max: 422 mm Regional invader max: 422 mm Inundation category: effective Score: 2.75</p>	<p>ID: B_B030 - Coxhill Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 422 mm Regional invader max: 422 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B118 - Jumpingpound trib. Primary mode: leaping Passable fish size: >200 mm Local invader max: 271 mm Regional invader max: 519 mm Inundation category: seasonal Score: 2.50</p>

Kananaskis River HUC 8

		
<p>ID: B_B010 - Sarrail Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 689 mm Regional invader max: 689 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B043 – U. Kananaskis R. Primary mode: leaping Passable fish size: >300 mm Local invader max: 598 mm Regional invader max: 598 mm Inundation category: effective Score: 2.50</p>	<p>ID: B_B044 – U. Kananaskis R. Primary mode: leaping Passable fish size: leap barrier Local invader max: 598 mm Regional invader max: 598 mm Inundation category: absolute Score: 3.00</p>
		<p>Image source: www.rockiesfamilyadventures.com</p> 
<p>ID: B_B053 - Evan Thomas Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 339 mm Regional invader max: 551 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B054 - Evan Thomas Trib. Primary mode: leaping Passable fish size: leap barrier Local invader max: 339 mm Regional invader max: 551 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B055 - Ribbon Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 205 mm Regional invader max: 528 mm Inundation category: absolute Score: 3.00</p>
		
<p>ID: B_B093 - Pocaterra Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 336 mm Regional invader max: 551 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B094 - Pocaterra Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 336 mm Regional invader max: 551 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B200 – U. Kananaskis R. Primary mode: swimming Passable fish size: >200 mm Local invader max: 598 mm Regional invader max: 598 mm Inundation category: seasonal Score: 2.25</p>




Kananaskis River HUC 8		
	Image source: https://willski.ca	Image source: www.albertawow.com
ID: B_B201 - Upper Kananaskis R. Primary mode: leaping Passable fish size: leap barrier Local invader max: 598 mm Regional invader max: 598 mm Inundation category: absolute Score: 3.00	ID: B_B203 - Aster Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 435 mm Regional invader max: 598 mm Inundation category: absolute Score: 3.00	ID: B_B205 - Foch Creek Primary mode: Leaping Passable fish size: leap barrier Local invader max: 435 mm Regional invader max: 598 mm Inundation category: absolute Score: 3.00
Image source: www.youtube.com/@masonlindquist819	Image source: http://bobspinko.ca	
ID: B_B209 - James Walker Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 650 mm Regional invader max: 650 mm Inundation category: absolute Score: 3.00	ID: B_B210 - French Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 650 mm Regional invader max: 650 mm Inundation category: absolute Score: 3.00	ID: B_B213 - Evan Thomas creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 339 mm Regional invader max: 551 mm Inundation category: absolute Score: 3.00
		Image source: www.rockiesfamilyadventures.com
ID: B_B214 - Evan Thomas Trib. Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 339 mm Regional invader max: 551 mm Inundation category: effective Score: 3.00	ID: B_B220 - Pocatererra Creek Primary mode: leaping Passable fish size: >350 mm Local invader max: 336 mm Regional invader max: 551 mm Inundation category: effective Score: 2.75	ID: B_B240 - Marmot Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 528 mm Regional invader max: 528 mm Inundation category: absolute Score: 3.00

Kananaskis River HUC 8		
 Image source: www.lydiadicaprio.com	 Image source: www.youtube.com/@LIVEONALBERTA	 Image source: https://trailtopeaktheadventurouspath.com
ID: B_B241 – N. Ribbon Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 205 mm Regional invader max: 528 mm Inundation category: effective Score: 3.00	ID: B_B242 – N. Ribbon Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 205 mm Regional invader max: 528 mm Inundation category: absolute Score: 3.00	ID: B_B243 – N. Ribbon Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 205 mm Regional invader max: 528 mm Inundation category: absolute Score: 3.00
		 Image source: www.youtube.com/@LIVEONALBERTA
ID: B_B244 - Pocaterra Creek Primary mode: leaping Passable fish size: >250 mm Local invader max: 336 mm Regional invader max: 551 mm Inundation category: seasonal Score: 2.50	ID: B_B245 - Pocaterra Creek Primary mode: swimming Passable fish size: 100 – 600 mm Local invader max: 336 mm Regional invader max: 551 mm Inundation category: seasonal Score: 2.25	ID: B_B246 – N. Ribbon Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 205 mm Regional invader max: 528 mm Inundation category: absolute Score: 3.00
Sheep River HUC 8		
		
ID: B_B056 - Bluerock Creek Primary mode: leaping Passable fish size: >350 mm Local invader max: 647 mm Regional invader max: 689 mm Inundation category: seasonal Score: 2.25	ID: B_B057 - South Coal Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 395 mm Regional invader max: 689 mm Inundation category: effective Score: 3.00	ID: B_B059 - Dyson Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 647 mm Regional invader max: 689 mm Inundation category: absolute Score: 3.00

Sheep River HUC 8		
		
<p>ID: B_B061 - Sheep River Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 647 mm Regional invader max: 689 mm Inundation category: seasonal Score: 3.00</p>	<p>ID: B_B062 - Gorge Creek trib. Primary mode: leaping Passable fish size: leap barrier Local invader max: 394 mm Regional invader max: 689 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B063 - Sheep River trib. Primary mode: leaping Passable fish size: leap barrier Local invader max: 647 mm Regional invader max: 689 mm Inundation category: absolute Score: 3.00</p>
		
<p>ID: B_B065 - Volcano Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 565 mm Regional invader max: 565 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B206 - Volcano Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 565 mm Regional invader max: 565 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B207 - Volcano Creek Primary mode: leaping Passable fish size: >350 mm Local invader max: 565 mm Regional invader max: 565 mm Inundation category: effective Score: 2.50</p>
		
<p>ID: B_B208 - Volcano Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 565 mm Regional invader max: 565 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B219 - Long Prairie Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 647 mm Regional invader max: 689 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B221 - Long Prairie Creek Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 647 mm Regional invader max: 689 mm Inundation category: effective Score: 3.00</p>

Sheep River HUC 8

		
<p>ID: B_B223 - Sheep River Primary mode: leaping Passable fish size: >400 mm Local invader max: 647 mm Regional invader max: 689 mm Inundation category: effective Score: 2.50</p>	<p>ID: B_B225 - Sheep River trib. Primary mode: swimming Passable fish size: 100 – 550 mm Local invader max: 647 mm Regional invader max: 689 mm Inundation category: seasonal Score: 1.75</p>	<p>ID: B_B226 - Sheep River trib. Primary mode: leaping Passable fish size: leap barrier Local invader max: 647 mm Regional invader max: 689 mm Inundation category: effective Score: 3.00</p>
		
<p>ID: B_B227 - Dyson Creek Primary mode: swimming Passable fish size: D_{ch} barrier Local invader max: 647 mm Regional invader max: 689 mm Inundation category: effective Score: 3.00</p>	<p>ID: B_B228 - Bluerock Creek Primary mode: swimming Passable fish size: 100 – 200 mm Local invader max: 647 mm Regional invader max: 689 mm Inundation category: seasonal Score: 2.25</p>	<p>ID: B_B229 - Sheep River trib. Primary mode: leaping Passable fish size: D_{pp} barrier Local invader max: 647 mm Regional invader max: 689 mm Inundation category: effective Score: 3.00</p>
		
<p>ID: B_B230 - Sheep River Primary mode: leaping Passable fish size: >200 mm Local invader max: 647 mm Regional invader max: 689 mm Inundation category: seasonal Score: 2.00</p>	<p>ID: B_B231 - Sheep River Primary mode: leaping Passable fish size: >500 mm Local invader max: 647 mm Regional invader max: 689 mm Inundation category: effective Score: 2.50</p>	<p>ID: B_B232 - Sheep River Primary mode: leaping Passable fish size: leap barrier Local invader max: 647 mm Regional invader max: 689 mm Inundation category: absolute Score: 3.00</p>

Sheep River HUC 8:		
		
<p>ID: B_B233 - Junction Creek Primary mode: swimming Passable fish size: >150 mm Local invader max: 387 mm Regional invader max: 689 mm Inundation category: seasonal Score: 1.50</p>		
Spray River HUC 8:		
<p>Image source: www.edventureblog.com</p> 	<p>Image source: http://sonnybou.ca</p> 	
<p>ID: B_B212 - Buller Creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 62 mm Regional invader max: 258 mm Inundation category: absolute Score: 3.00</p>	<p>ID: B_B239 - Commonwealth creek Primary mode: leaping Passable fish size: leap barrier Local invader max: 260 mm Regional invader max: 336 mm Inundation category: absolute Score: 3.00</p>	

Appendix 5. Bow River watershed barrier mode scoring by barrier ID, as assessed in 2017–2021.

Barrier ID	Waterbody	Barrier feature passible fish size (mm)	Barrier mode scores			Mode sum	Final barrier score (D_{pp} = plunge pool depth; D_{ch} = chute depth)
			Leaping	Swimming	Turbulence		
B_B005	Sylvester Creek tributary	leap barrier	1	1	1	3.00	3.00
B_B007	Baril Creek	>450	0.75	1	1	2.75	3.00 - D_{pp} barrier
B_B010	Sarrail Creek	leap barrier	1	1	1	3.00	3.00
B_B012	Picklejar Creek tributary	>300	0.25	1	1	2.25	2.25
B_B015	Exshaw Creek	leap barrier	1	1	1	3.00	3.00
B_B017	Elbow River	>600	0.75	1	1	2.75	2.75
B_B019	Cougar Creek	leap barrier	1	1	1	3.00	3.00
B_B021	Sylvester Creek	>200	0.5	1	1	2.50	2.50
B_B022	Cat Creek	>400	0.75	1	1	2.75	2.75
B_B023	Cutthroat creek	>200	0.5	0.5	1	2.00	2.00
B_B024	Deep Creek	>350	0.5	1	1	2.50	2.50
B_B026	Flat Creek	>500	0.75	1	1	2.75	2.75
B_B027	Ings Creek	>600	1	0.5	1	2.50	3.00 - D_{ch} barrier
B_B029	Coxhill Creek	>100	1	1	0.75	2.75	2.75
B_B030	Coxhill Creek	>700	1	1	1	3.00	3.00 - D_{pp} barrier
B_B031	Bear Creek	>400	0.75	1	1	2.75	3.00 - D_{pp} barrier
B_B032	Pekisko Creek	leap barrier	1	1	1	3.00	3.00
B_B033	Pekisko Creek	leap barrier	1	1	1	3.00	3.00
B_B043	Upper Kananaskis River	>300	0.5	1	1	2.50	2.50
B_B044	Upper Kananaskis River	leap barrier	1	1	1	3.00	3.00
B_B045	Pigeon Creek	leap barrier	1	1	1	3.00	3.00
B_B046	Pigeon Creek	leap barrier	1	1	1	3.00	3.00
B_B053	Evan-Thomas Creek	>700	1	1	1	3.00	3.00
B_B054	Evan-Thomas Creek tributary	leap barrier	1	1	1	3.00	3.00
B_B055	Ribbon Creek	leap barrier	1	1	1	3.00	3.00
B_B056	Blue Rock Creek	>350	0.25	1	1	2.25	2.25
B_B057	South Coal Creek	leap barrier	1	1	1	3.00	3.00

Barrier ID	Waterbody	Barrier feature passible fish size (mm)	Barrier mode scores				Final barrier score (D_{pp} = plunge pool depth; D_{ch} = chute depth)
			Leaping	Swimming	Turbulence	Mode sum	
B_B059	Dyson Creek	leap barrier	1	1	1	3.00	3.00
B_B061	Sheep River	>550	0.75	1	1	2.75	3.00 - D_{pp} barrier
B_B062	Gorge Creek tributary	leap barrier	1	1	1	3.00	3.00
B_B063	Sheep River tributary	leap barrier	1	1	1	3.00	3.00
B_B065	Volcano Creek	leap barrier	1	1	1	3.00	3.00
B_B068	Cataract Creek	leap barrier	1	1	1	3.00	3.00
B_B069	Cataract Creek	leap barrier	1	1	1	3.00	3.00
B_B070	Cataract Creek	leap barrier	1	1	1	3.00	3.00
B_B071	Cataract Creek	>250	0.25	1	1	2.25	2.25
B_B073	Little Elbow River	>550	0.75	1	1	2.75	2.75
B_B074	Little Elbow River	leap barrier	1	1	1	3.00	3.00
B_B075	North Fork Little Elbow	>650	1	1	1	3.00	3.00 - D_{pp} barrier
B_B077	North Fork Little Elbow	>400	0.75	1	1	2.75	2.75
B_B078	North Fork Little Elbow	>200	0.5	1	0.25	1.75	1.75
B_B079	North Fork Little Elbow	>150	0.5	1	1	2.50	2.50
B_B082	Little Elbow River	>100	1	0.75	0.75	2.50	2.50
B_B083	Little Elbow River	>250	0.25	1	1	2.25	2.25
B_B084	Ford Creek	leap barrier	1	1	1	3.00	3.00
B_B085	Ford Creek	>200	0.25	1	1	2.25	2.25
B_B088	Elbow River	leap barrier	1	1	1	3.00	3.00
B_B093	Pocaterra Creek	leap barrier	1	1	1	3.00	3.00
B_B094	Pocaterra Creek	>550	0.75	1	1	2.75	3.00 - D_{pp} barrier
B_B101	Picklejar Creek tributary	>100	0.25	1	0.5	1.75	1.75
B_B102	Odlum Creek	>300	0.5	1	1	2.50	2.50
B_B106	Etherington Creek	>250	0.25	1	1	2.25	2.25
B_B107	Etherington Creek	leap barrier	1	1	1	3.00	3.00
B_B112	Etherington Creek	>100	0.5	0.5	0.5	1.50	1.50
B_B114	Baril Creek	>600	0.75	1	1	2.75	2.75
B_B115	Wilkinson Creek	>250	0.25	0.5	1	1.75	1.75
B_B116	Wilkinson Creek	>200	0.25	0.25	0.75	1.25	1.25

Barrier ID	Waterbody	Barrier feature passible fish size (mm)	Barrier mode scores				Mode sum	Final barrier score (D_{pp} = plunge pool depth; D_{ch} = chute depth)
			Leaping	Swimming	Turbulence			
B_B117	Wilkinson Creek	>350	0.75	1	1	2.75	3.00 - D_{pp} barrier	
B_B118	Jumpingpound Creek tributary	>200	0.5	1	1	2.50	2.50	
B_B119	Odlum Creek	>250	0.5	0.25	0.5	1.25	3.00 - D_{pp} barrier	
B_B200	Upper Kananaskis River	>200	1	0.25	1	2.25	2.25	
B_B201	Upper Kananaskis River	leap barrier	1	1	1	3.00	3.00	
B_B203	Aster Creek	leap barrier	1	1	1	3.00	3.00	
B_B205	Foch Creek	leap barrier	1	1	1	3.00	3.00	
B_B206	Volcano Creek	leap barrier	1	1	1	3.00	3.00	
B_B207	Volcano Creek	>350	0.5	1	1	2.50	2.50	
B_B208	Volcano Creek	leap barrier	1	1	1	3.00	3.00	
B_B209	James Walker Creek	leap barrier	1	1	1	3.00	3.00	
B_B210	French Creek	leap barrier	1	1	1	3.00	3.00	
B_B212	Buller Creek	leap barrier	1	1	1	3.00	3.00	
B_B213	Evan-Thomas Creek	leap barrier	1	1	1	3.00	3.00	
B_B214	Evan-Thomas Creek tributary	>300	0.5	1	1	2.50	3.00 - D_{pp} barrier	
B_B215	Miller Creek	100 – 250	1	0.5	0.75	2.25	2.25	
B_B216	Elbow River	250 – 750	0.5	0.25	0.5	1.25	1.25	
B_B217	Elbow River	150 – 750	0.5	0.5	1	2.00	2.00	
B_B218	Ford Creek tributary	leap barrier	1	1	1	3.00	3.00	
B_B219	Long Prairie Creek	leap	1	1	1	3.00	3.00	
B_B220	Pocaterra Creek	>350	0.75	1.00	1.00	2.75	2.75	
B_B221	Long Prairie Creek	>450	0.5	1	1	2.50	3.00 - D_{pp} barrier	
B_B223	Sheep River	>400	0.5	1	1	2.50	2.50	
B_B225	Sheep River tributary	100 – 550	1	0.25	0.5	1.75	1.75	
B_B226	Sheep River tributary	leap barrier	1	0.25	0.75	2.00	2.00	
B_B227	Dyson Creek	>500	1	0.25	0.5	1.75	3.00 - D_{ch} barrier	
B_B228	Blue Rock Creek	100 – 200	0.5	0.5	1	2.00	2.00	
B_B229	Sheep River tributary	>600	0.75	1	1	2.75	3.00 - D_{pp} barrier	
B_B230	Sheep River	>200	0.5	0.5	1	2.00	2.00	
B_B231	Sheep River	>500	0.5	1	1	2.50	2.50	

Barrier ID	Waterbody	Barrier feature passible fish size (mm)	Barrier mode scores				Final barrier score (D_{pp} = plunge pool depth; D_{ch} = chute depth)
			Leaping	Swimming	Turbulence	Mode sum	
B_B232	Sheep River	leap barrier	1	1	1	3.00	3.00
B_B233	Junction Creek	>150	0.5	0.5	0.5	1.50	1.50
B_B235	Stony Creek	>400	0.75	1	1	2.75	3.00 - D_{pp} barrier
B_B236	Stony Creek	leap barrier	1	1	1	3.00	3.00
B_B237	Stony Creek	>450	0.75	1	1	2.75	3.00 - D_{pp} barrier
B_B239	Commonwealth Creek	leap barrier	1	1	1	3.00	3.00
B_B240	Marmot Creek	leap barrier	1	1	1	3.00	3.00
B_B241	North Ribbon Creek	leap barrier	1	1	1	3.00	3.00 - D_{pp} barrier
B_B242	North Ribbon Creek	leap barrier	1	1	1	3.00	3.00
B_B243	North Ribbon Creek	leap barrier	1	1	1	3.00	3.00
B_B244	Pocaterra Creek	>250	0.5	1	1	2.50	3.00
B_B245	Pocaterra Creek	100 – 600	1	0.5	0.75	2.25	2.25
B_B246	North Ribbon Creek	leap barrier	1	1	1	3.00	3.00
B_B247	Picklejar Lake-3 Outlet	leap barrier	1	1	1	3.00	3.00 - D_{ch} barrier



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