WSP Indicator Analysis for the Babine River Watershed:

Stream Crossing Density

Freshwater Atlas (FWA) Assessment Watersheds

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Note to reader:

These Wild Salmon Policy (WSP) habitat indicator assessment reports are intended as a coarse filter approach to identify watersheds that are potentially at risk of exceeding thresholds for four WSP habitat indicators (Road Density, Stream Crossing Density, Total Land Cover Alteration, and Riparian Disturbance). These reports present the results of GIS-based (Tier 1) methods for assessing the status of a particular freshwater aquatic habitat pressure indicator and determining the watershed indicator "risk" status by comparing the measured values to indicator benchmarks. Pressure indicators are identified by Canada's WSP as proactive measures of identifying potential impacts to salmon habitat within a watershed. Additional information on the WSP is available at https://www.pac.dfo-mpo.gc.ca/fm-gp/salmon-saumon/wsp-pss/ip-pmo/ip-smm-pmo-eng.html#assessment.

The analysis presented in this report was carried out using standardized provincial datasets and did not integrate field-based (Tier 2) information or industry datasets. The results are presented for informational purposes and are not intended to replace operational watershed assessments.

Acknowledgements

We would like to thank Sarah Railton, Greg Knox, and Julia Hill Sorochan for their contributions and feedback, and to Mary Robinson, Glen Buhr, Craig Mount, and Simon Norris for providing input datasets and supporting information.

WSP Indicator Analysis for the Babine River Watershed

Pressure Indicator: Stream Crossing Density

Assessment Units: FWA Assessment Watersheds

Description of Pressure Indicator

Stream crossings at road intersections present potential barriers to fish passage as well as potential inputs of fine sediment into waterways and interruptions to natural flow regimes (Porter et al., 2019). Fish passage barriers interfere with or block access to upstream spawning or rearing habitats, and thereby decrease the total amount of available salmon habitat in a watershed (Pacific Salmon Foundation [PSF], 2020). The stream crossings indicator is used in this analysis to address the fish passage concern from stream crossings rather than sedimentation (this is addressed by the road density indicator) so stream crossing density is measured here as the number of stream crossings per kilometer of modelled salmon habitat, as opposed to a similar metric which is reported as stream crossings per watershed area. This approach was followed in order to maintain consistency with the methodology used by the PSF in the development of relative thresholds for the Skeena Region (PSF, 2020).

Study Area

The Babine River Watershed is situated in the interior of northwest BC and covers an area of 3,895 km^2 (Figure 1). The Babine River connects Babine Lake to the southeast with the Skeena River to the west and is an important salmon migration corridor. The Babine River Watershed falls within the Kispiox and the Bulkley Timber Supply Areas.

This report presents results for BC Freshwater Atlas (FWA) assessment watersheds within the Babine River Watershed. FWA assessment watersheds are mesoscale groupings of fundamental watersheds with a target size of between 2,000 ha and 10,000 ha (Province of BC, 2020). A reference map of the study area with FWA assessment watersheds identified is included as Appendix A.

Figure 1: The study area is indicated in red. The grey polygon indicates the outline of the Skeena River watershed.

Methodology

Data layers used to perform the spatial analysis include:

- Kispiox Road Inventory (BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development [BC MFLNRORD], 2019)
- Bulkley Strategic Road Inventory (BC Ministry of Forests, 2022)
- BC Timber Sales (BCTS) Aggregated Road Layer (BCTS, 2022)
- Digital Road Atlas (BC Ministry of Land, Water and Resource Stewardship [MLWRS], 2022)
- Forest Tenure Road Section Lines (BC Ministry of Forests, 2022)
- Fish Habitat and Road Crossings Model (BC Ministry of Environment and Climate Change Strategy [MECCS], 2022)
- Freshwater Atlas Assessment Watersheds (BC MFLNRORD, 2019)

The Kispiox Road Inventory and Bulkley Strategic Road Inventory data layers were developed by BC MFLNRORD Skeena-Stikine District staff using information sourced from provincial TRIM base mapping, the Digital Road Atlas (DRA), Forest Tenure Road Section Lines (FTEN), and major licensee digital road files within the Kispiox Timber Supply Area (TSA) and Bulkley TSA, respectively. The datasets were refined using best available orthophoto and satellite imagery and non-existent roads were removed (e.g. phantom duplicate or parallel road sections and planned roads that were never constructed) while deactivated roads were left in the data set (G. Buhr, personal communication, October 15, 2020).

The BCTS road layer is a combined road layer originally created in 2014 by combining the DRA and FTEN datasets with BCTS road information. It has been updated yearly by BCTS using ortho imagery to identify and remove overlapping features, creating a more accurate roads layer. The BCTS roads layer was partially updated in 2022, with the Bulkley TSA updated in 2021, the Morice TSA updated in 2022, and the Lakes TSA last updated in 2020 (M. Robinson, personal communication, Nov. 1, 2022). The Bulkley Strategic Road Inventory data layer was used for the Bulkley TSA due to its more recent update date.

An updated roads layer was developed for the purposes of this analysis by adding new (post-update) road segments from the DRA and FTEN data layers that do not appear in the Kispiox Road Inventory, Bulkley Strategic Road Inventory, or BCTS layers as well as all DRA and FTEN roads within the study area but outside of the extents of the road inventory and BCTS datasets. These additional segments were extracted from the 2022 DRA and FTEN datasets by applying a buffer of 30 m to the road inventory and BCTS datasets and selecting DRA and FTEN roads outside of this buffer added since the respective update dates of each TSA extent. Overlapping roads within the DRA and FTEN subsets were removed by applying a 30 m buffer to the DRA subset and selecting FTEN roads outside of the buffer. The extracted DRA and FTEN roads were then merged with the Kispiox Road Inventory, Bulkley Strategic Road Inventory, and BCTS data layers to produce the input roads dataset.

Stream crossing locations were computed through the intersection of the updated roads layer and the streams layer from the Fish Habitat and Road Crossings Model (BC MECCS, 2022). Stream crossings along railways from the crossings layer of the Fish Habitat and Road Crossings Model were added to complete the dataset. The stream crossings were filtered by fish habitat type, with crossings identified within accessible salmon habitat (i.e. with a gradient of less than or equal to 15% and no natural barriers preventing salmon access) retained for use in the stream crossing density analysis (Mount et al., 2011; Norris, 2022). The stream crossing data does not include any stream crossing information collected directly by industry.

Modelled accessible salmon habitat length (km) was calculated using the streams layer from the Fish Habitat and Road Crossings Model (BC MECCS, 2022) filtered by accessible salmon habitat.

FWA assessment watersheds were used as assessment units for the stream crossing density analysis. The total number of stream crossings within salmon habitat and the total length of salmon habitat (km) was summed for each FWA assessment watershed. Stream crossing density (stream crossings/km of accessible salmon habitat) was calculated by dividing the total number of stream crossings by the length of modelled salmon habitat within each assessment unit. An overview of stream crossings within fish habitat for the study area is provided as Figure 2.

This analysis follows the methodology set out by the Pacific Salmon Foundation (2020) for stream crossing density with the addition of the intersection calculation using the more accurate updated roads dataset and allows for results comparison with the thresholds published by PSF based on the relative distribution of values across the Skeena Region (Porter et al., 2014). This approach differs from similar stream crossing analysis methodology (e.g. the BC Cumulative Effects Framework), and previous reports (Eclipse Geomatics Ltd., 2020), which report stream crossing density based on watershed area (Provincial Aquatic Ecosystems Technical Working Group, 2020).

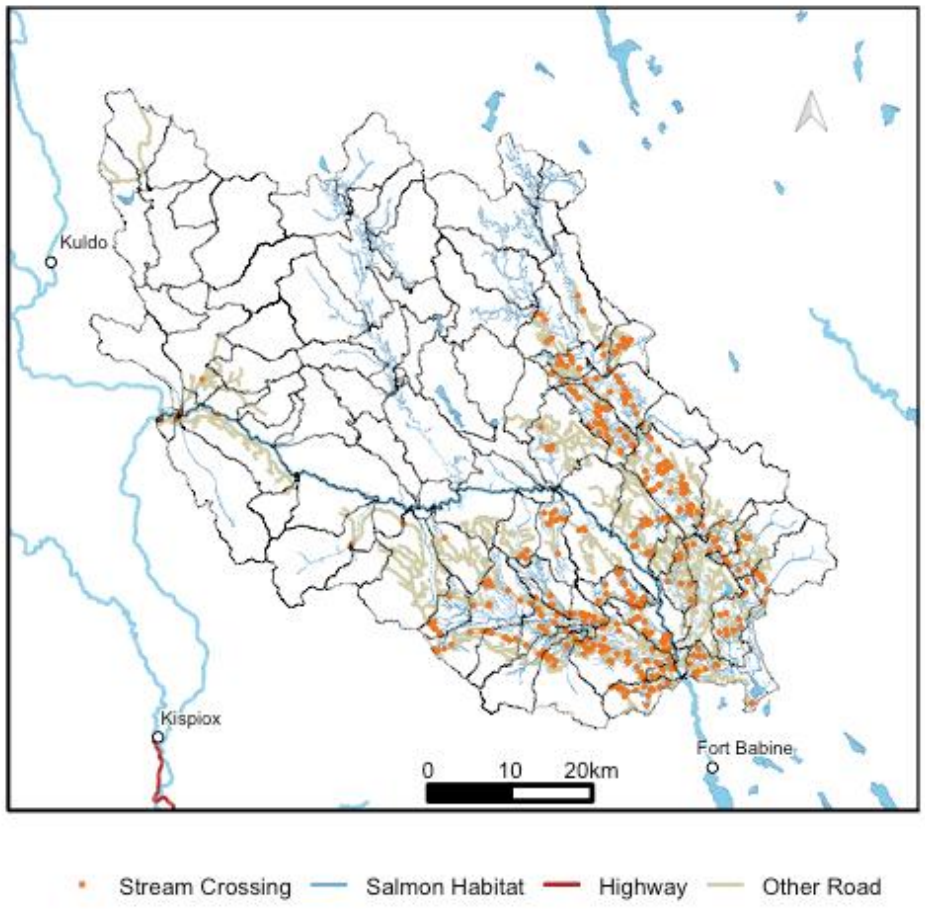

Figure 2: Stream crossings and modelled accessible salmon habitat within in the study area.

Risk Thresholds

Categorical risk thresholds applied were generated by the Pacific Salmon Foundation based on the relative distribution of values across all Skeena River watersheds (Porter et al., 2014) and are tabulated below:

Threshold Rating	Stream Crossing Density (crossings/km)
Low	< 0.20
Moderate	≥ 0.20 and < 0.58
High	≥ 0.58

Results of Analysis

A summary of the results of the stream crossing density analysis with categorical risk thresholds for each assessment unit are shown as Figure 3; Figure 4 provides an overview of the results distribution. Detailed results for each assessment unit are tabulated in Appendix B, and the distribution of the assessment results are shown as a series of figures in Appendix C.

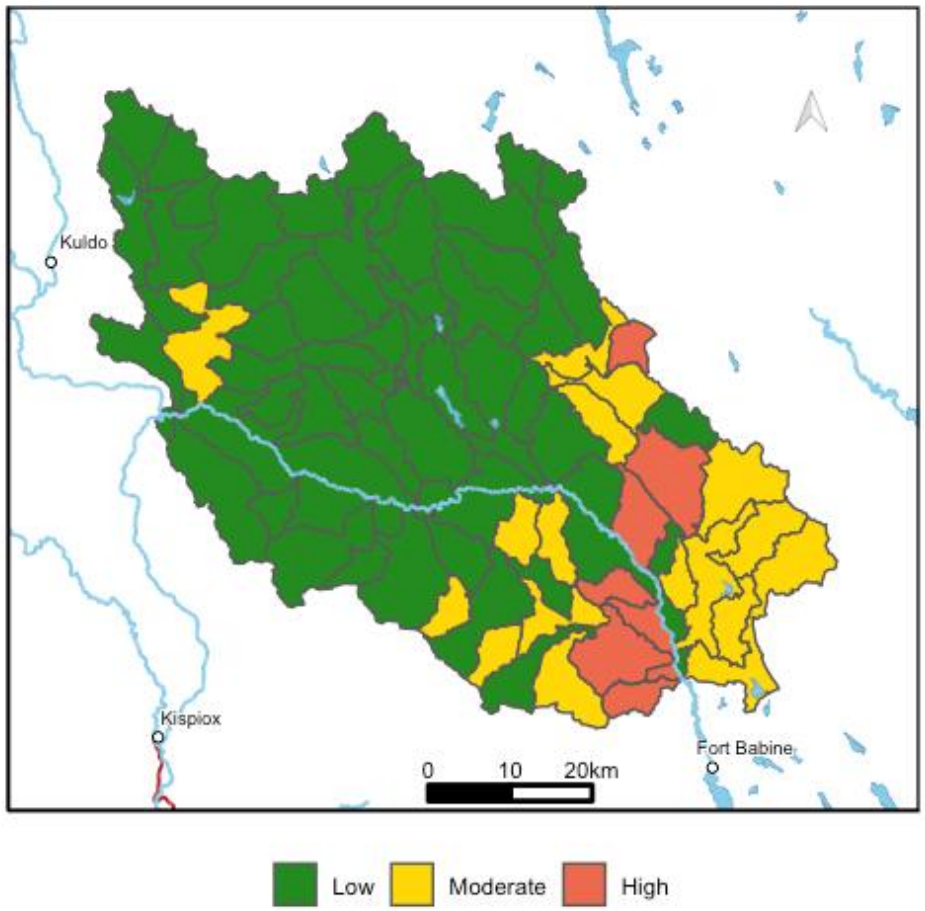

Figure 3: Stream crossing density (stream crossings/km) for each boundary in the study area is shown on a study area map. The results are colorized by risk threshold (low risk < 0.2 crossings/km, moderate risk ≥ 0.2 and < 0.58 crossings/km, high risk ≥ 0.58 crossings/km).

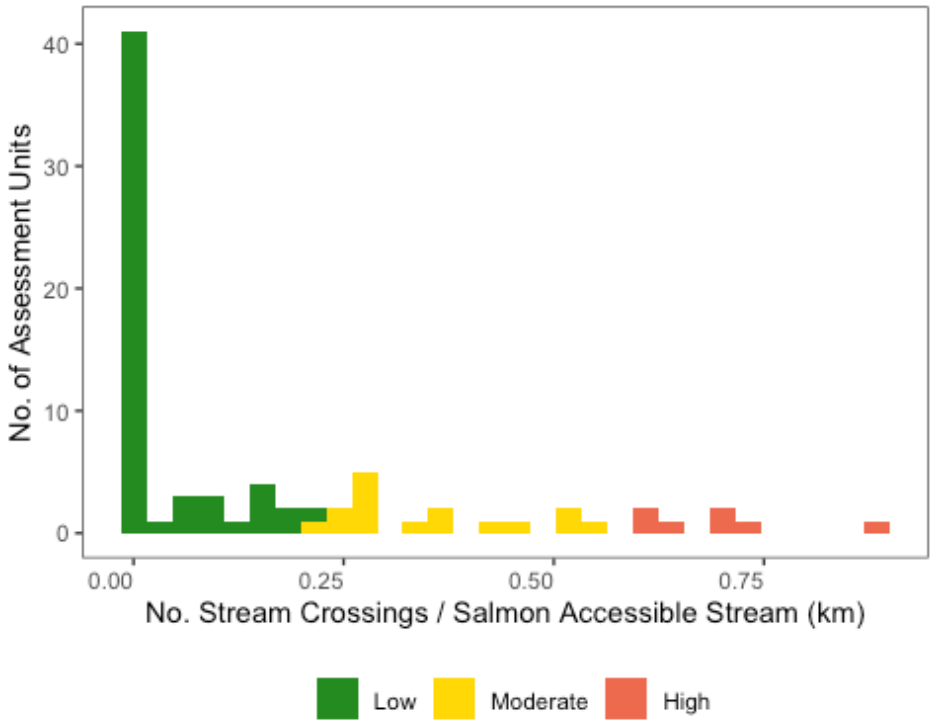

Figure 4: Distribution of results showing the number (count) of assessment units by stream crossing density. The results are colourized by risk threshold (low risk < 0.2 crossings/km, moderate risk ≥ 0.2 and < 0.58 crossings/km, high risk ≥ 0.58 crossings/km).

Stream crossing density of crossings situated within accessible salmon habitat was calculated for a total of 79 FWA watersheds within the study area. Stream crossing density ranged from 0 to 0.88 crossings/km (Figure 4). Stream crossing densities for seven assessment units were above the upper threshold of 0.58 crossings/km and 16 assessment units had stream crossing densities in the moderate risk threshold rating (Figure 4; Appendix B and Appendix C).

The majority of assessment units with moderate and high stream crossing densities are concentrated in the southeastern portion of the study area (Figures 2 and 3).

Summary

Stream crossing density estimations were calculated for 79 FWA watersheds within the Babine River Watershed using datasets sourced from the Province of BC and BC Timber Sales. Risk categories derived by the Pacific Salmon Foundation were used to assess risk to freshwater habitat from stream crossings.

Stream crossing density for FWA watersheds within the study area ranged from 0 to 0.88 crossings/km. Assessment units with stream crossing densities in the high and moderate risk range were concentrated in the central portion of the study area.

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Appendix A: Reference Map

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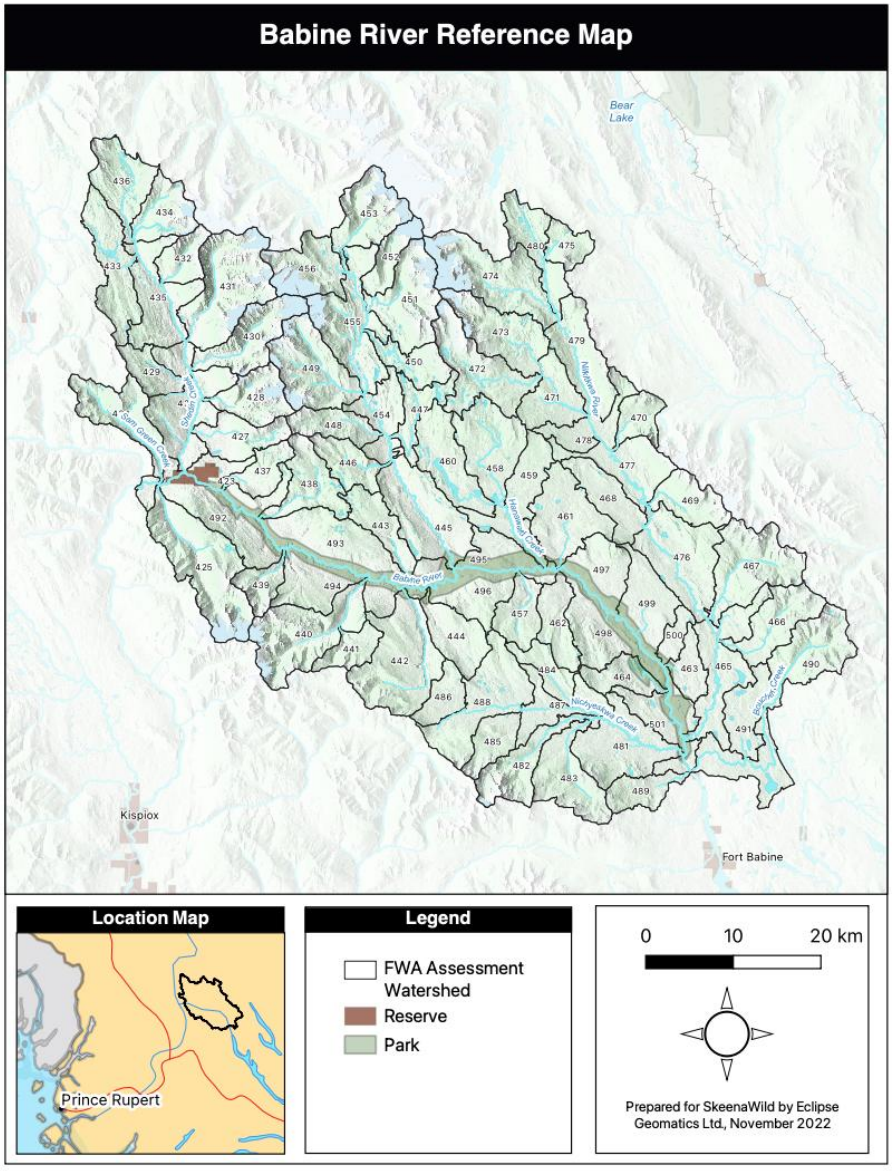


Commented [MOU1]: Is it possible to add a label for Shenismike Creek onto this reference map?

Appendix B: Results Tables

Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
423	Babine River	11.14	1	0.09	Low
424	Sam Green Creek	6.53	1	0.15	Low
425	Shegisic Creek	21.17	1	0.05	Low
426	Shedin Creek	3.92	1	0.26	Moderate
427	Goathead Creek	0.00	0	0.00	Low
428		0.00	0	0.00	Low
429		0.00	0	0.00	Low
430	Sperry Creek	0.00	0	0.00	Low
431	Rosenthal Creek	0.00	0	0.00	Low
432		0.00	0	0.00	Low
433	Damsumlo Creek	0.00	0	0.00	Low
434		0.00	0	0.00	Low
435	Shedin Creek	0.00	0	0.00	Low
436	Shedin Creek	0.00	0	0.00	Low
437		0.00	0	0.00	Low
438	Shenismike Creek	3.75	0	0.00	Low
439		0.70	0	0.00	Low
440	Thomlinson Creek	21.92	1	0.05	Low
441		2.45	0	0.00	Low
442	Gail Creek	20.48	1	0.05	Low
443	Le Clair Creek	2.28	0	0.00	Low
444	Cataline Creek	7.17	1	0.14	Low

Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
445	Shelagyote River	54.38	0	0.00	Low
446		2.93	0	0.00	Low
447		0.95	0	0.00	Low
448	Cayuse Jack Creek	11.30	0	0.00	Low
449		26.84	0	0.00	Low
450		0.59	0	0.00	Low
451	Barger Creek	36.21	0	0.00	Low
452		16.20	0	0.00	Low
453		26.33	0	0.00	Low
454	Shelagyote River	41.81	0	0.00	Low
455	Shelagyote River	79.26	0	0.00	Low
456	Shelagyote River	35.90	0	0.00	Low
457		18.37	7	0.38	Moderate
458	Hanawald Creek	5.35	0	0.00	Low
459		0.00	0	0.00	Low
460		0.00	0	0.00	Low
461	Shahnagh Creek	35.18	7	0.20	Low
462		41.93	11	0.26	Moderate
463		30.11	13	0.43	Moderate
464		49.66	32	0.64	High
465	Nilkitkwa River	49.93	13	0.26	Moderate

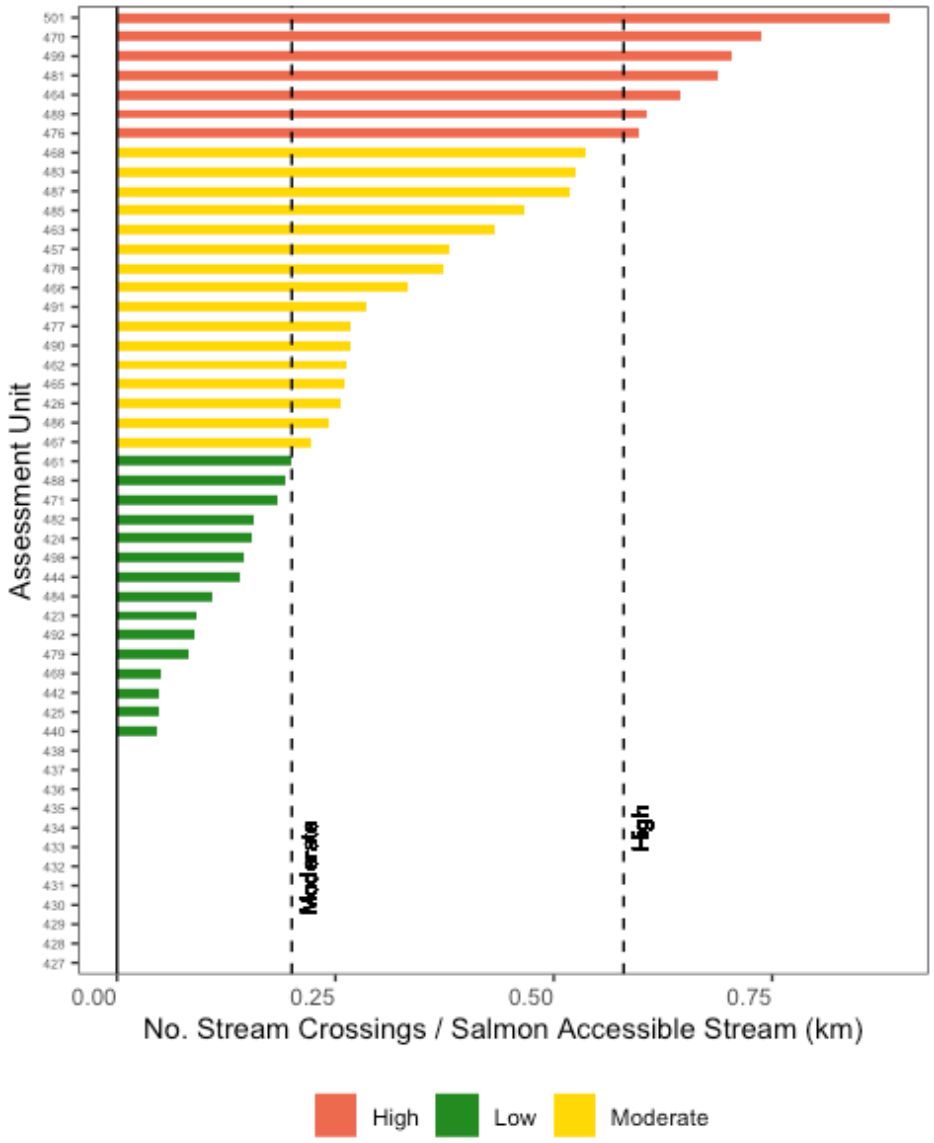
Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
466	Coyle Creek	48.17	16	0.33	Moderate
467	Charleston Creek	4.49	1	0.22	Moderate
468		76.42	41	0.54	Moderate
469		20.18	1	0.05	Low
470		25.74	19	0.74	High
471	West Nilkitkwa River	32.73	6	0.18	Low
472	Mero Creek	35.99	0	0.00	Low
473	West Nilkitkwa River	52.02	0	0.00	Low
474	Barbeau Creek	68.72	0	0.00	Low
475		30.82	0	0.00	Low
476	Nilkitkwa River	88.84	53	0.60	High
477	Nilkitkwa River	78.74	21	0.27	Moderate
478	Nilkitkwa River	37.56	14	0.37	Moderate
479	Nilkitkwa River	36.53	3	0.08	Low
480	Nilkitkwa River	57.03	0	0.00	Low
481	Nichyeskwa Creek	85.81	59	0.69	High
482		32.17	5	0.16	Low
483		28.56	15	0.53	Moderate
484		45.51	5	0.11	Low
485		15.02	7	0.47	Moderate
486		45.54	11	0.24	Moderate
487	Nichyeskwa Creek	54.07	28	0.52	Moderate

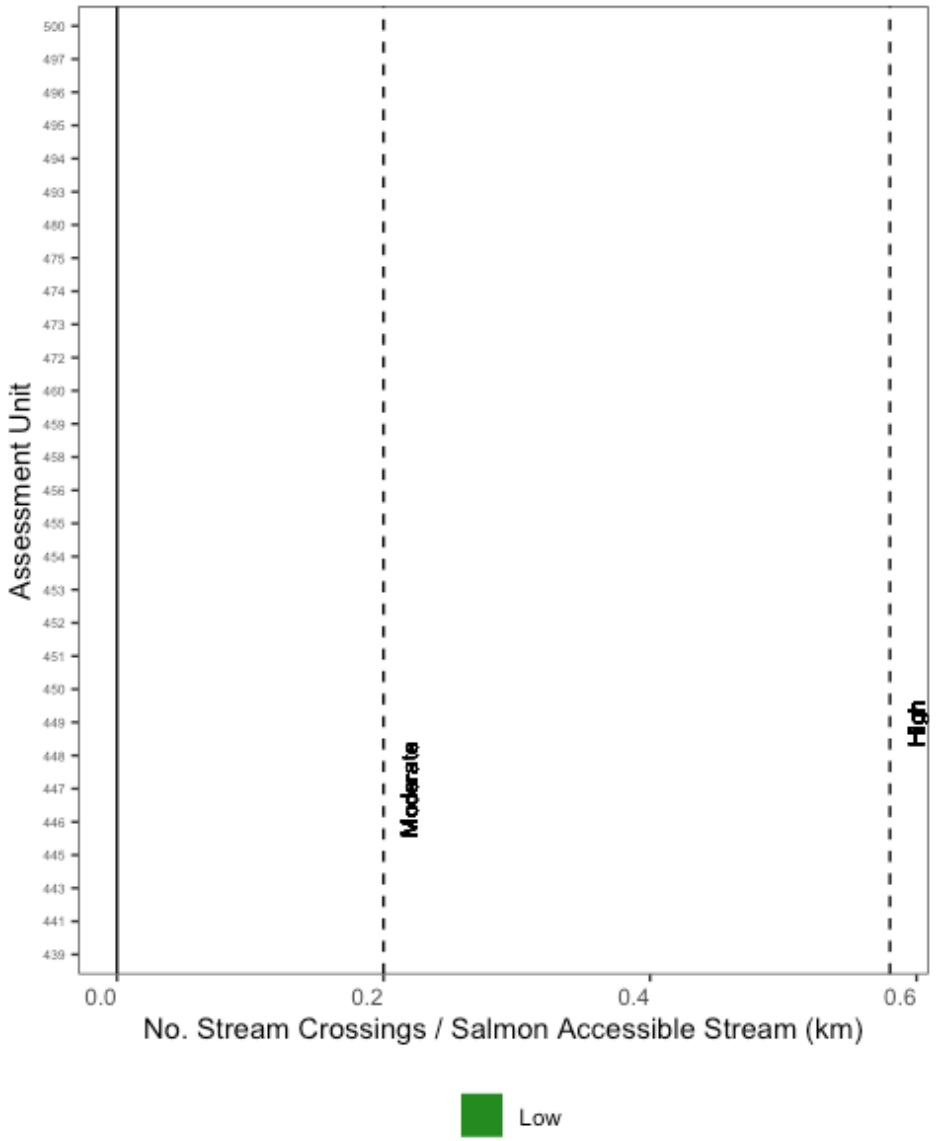
Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
488	Nichyeskwa Creek	114.72	22	0.19	Low
489	Bairnsfather Creek	29.65	18	0.61	High
490	Boucher Creek	105.10	28	0.27	Moderate
491		52.68	15	0.28	Moderate
492	Babine River	11.40	1	0.09	Low
493	Babine River	18.09	0	0.00	Low
494	Babine River	14.19	0	0.00	Low
495	Babine River	24.45	0	0.00	Low
496	Babine River	18.54	0	0.00	Low
497	Babine River	5.63	0	0.00	Low
498	Babine River	20.51	3	0.15	Low
499	Babine River	37.00	26	0.70	High
500	Babine River	10.31	0	0.00	Low
501	Babine River	48.60	43	0.88	High

Note: Values were rounded to two decimal places following risk characterization.

Appendix C: Results Distribution

Results are colourized by risk threshold (low risk < 0.2 crossings/km, moderate risk ≥ 0.2 and < 0.58 crossing/km, high risk ≥ 0.58 crossings/km).




Assessment Unit
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No. Stream Crossings / Salmon Accessible Stream (km)
Moderate
High
Low