WSP Indicator Analysis for the Kispiox TSA:

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 Glen Buhr for his assistance and guidance.

WSP Indicator Analysis for the Kispiox TSA

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 and intercepted flow (Porter et al., 2019). Open-bottom structures, such as bridges and some larger culverts, typically retain or emulate natural stream channel morphology and fish habitat, whereas smaller closed-bottom structures (CBS), such as culverts (corrugated metal pipes), often do not. The change to stream morphology created by installation of a CBS often creates a barrier to fish passage (Mount et al., 2011). The stream crossings indicator is used to address the fish passage concern rather than sedimentation (this is addressed by the road density indicator) and so stream crossing density is only reported for CBS within observed or inferred fish habitat areas (Stalberg et al., 2009). Stream crossing density is measured as crossings per square kilometer (km^2), and is related to road development, which has been ranked as a high value indicator by the Wild Salmon Policy (WSP) Habitat Working Group (Stalberg et al., 2009).

Study Area

The Kispiox timber supply area (TSA) is situated in the interior of northwest BC and encompasses the District of New Hazelton and the communities of Hazelton, South Hazelton, Kitwanga, Cedarvale, Kispiox, Gitsegukla, Gitwangak, Gitanyow, Hagwilget, Glen Vowell and Gitanmaax (Figure 1). The Kispiox TSA is part of the Skeena Natural Resource Region and is administered by the Skeena Stikine Natural Resource District office in Smithers.

The Kispiox TSA is comprised of seven TSA supply blocks (12A to 12G), with the Cranberry TSA consolidated with the Kispiox TSA on March 31, 2009 as Block 12G. The current allowable annual cut for the Kispiox TSA is 1,087,000 cubic metres (Province of BC, 2019).

This report presents results for BC Freshwater Atlas (FWA) assessment watersheds within the Kispiox TSA and the neighbouring upper Kispiox River and Swan Lake watersheds. The 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, 2019). A reference key for the identification of assessment units was developed based on groupings by major watershed, and reference maps of the study area with Kispiox TSA and FWA assessment watersheds are 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], 2017)
- Digital Road Atlas (BC MFLNRORD, 2020a)
- Forest Tenure Road Section Lines (BC MFLNRORD, 2020b)
- Fish Habitat and Road Crossings Model (BC MECCS, 2019)
- Freshwater Atlas Assessment Watersheds (BC MFLNRORD, 2019)

The Kispiox Road Inventory data layer was 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. The dataset was 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).

An updated roads layer was developed for the purposes of this analysis by adding new (post-2017) road segments from the DRA and FTEN data layers that do not appear in the Kispiox Road Inventory as well as all DRA and FTEN roads within the study area but outside of the extent of the Kispiox Road Inventory dataset. These additional segments were extracted from the 2020 DRA and FTEN datasets by applying a buffer of 30 m to the Kispiox Road Inventory and selecting DRA and FTEN roads outside of this buffer added since 2017. 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 to produce the input roads dataset.

Stream crossings were computed through the intersection of the updated Kispiox Road Inventory and Fish Habitat and Road Crossings Model (BC MECCS, 2019) data layers. The crossings were compared with the stream crossings in the Fish Habitat and Road Crossings Model in order to categorize the crossings as closed-bottomed structures (culverts) or open crossings, where open crossings consist of all points that are likely bridges or other open-bottomed structures (Norris and Mount, 2016). Where intersection points did not overlap with the reference data sets, points falling on single-lined streams were classified as culverts and points falling on double-lined streams as open crossings, following the methodology of Norris and Mount (2016). Stream crossings along railways from the Fish Habitat and Road Crossings Model were added to complete the dataset. The stream crossing data does not include any culvert information collected directly by industry.

Prior to analysis, the culvert crossings were filtered by fish habitat type, with crossings identified within observed or inferred salmon habitat (i.e. with a gradient of less than or equal to 15%) retained for use in the stream crossing density analysis.

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 Kispiox Road Inventory dataset.

FWA assessment watersheds were used as assessment units for the stream crossing density analysis. The total number of CBS (culverts) within observed or inferred salmon habitat was summed for each FWA assessment watershed. Stream crossing density (CBS crossings/km^2) was calculated by dividing the total number of CBS crossings by the area of each assessment unit. An overview of culverts within fish habitat and all open stream crossing locations for the study area is provided as Figure 2.

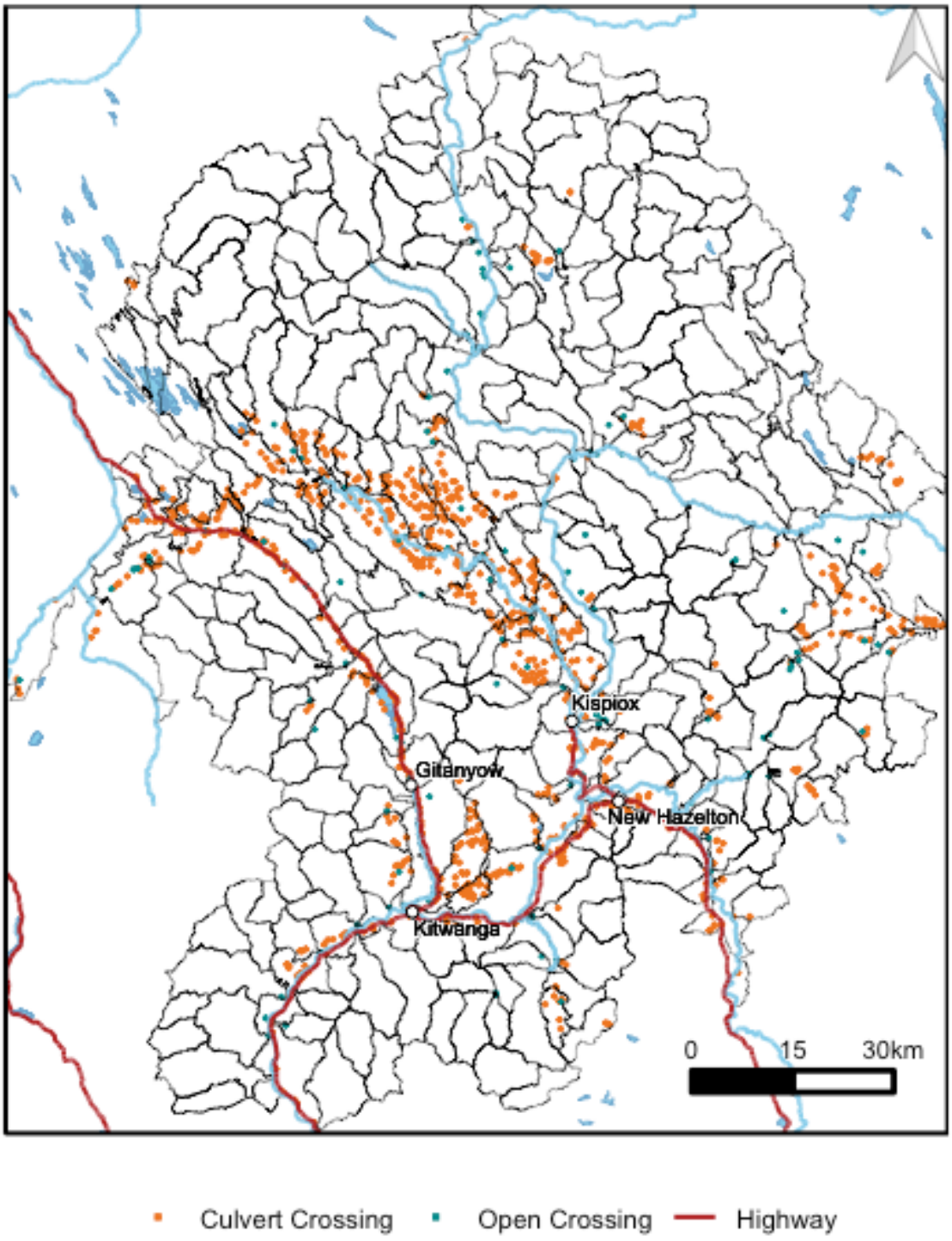

Figure 2: Stream crossings located within in the study area are shown, with closed-bottom (culvert) stream crossings within observed or inferred salmon habitat shown in red and open-bottom crossings (primarily bridges) shown in green.

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 / km²)
Low	< 0.20
Moderate	0.20 - 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.

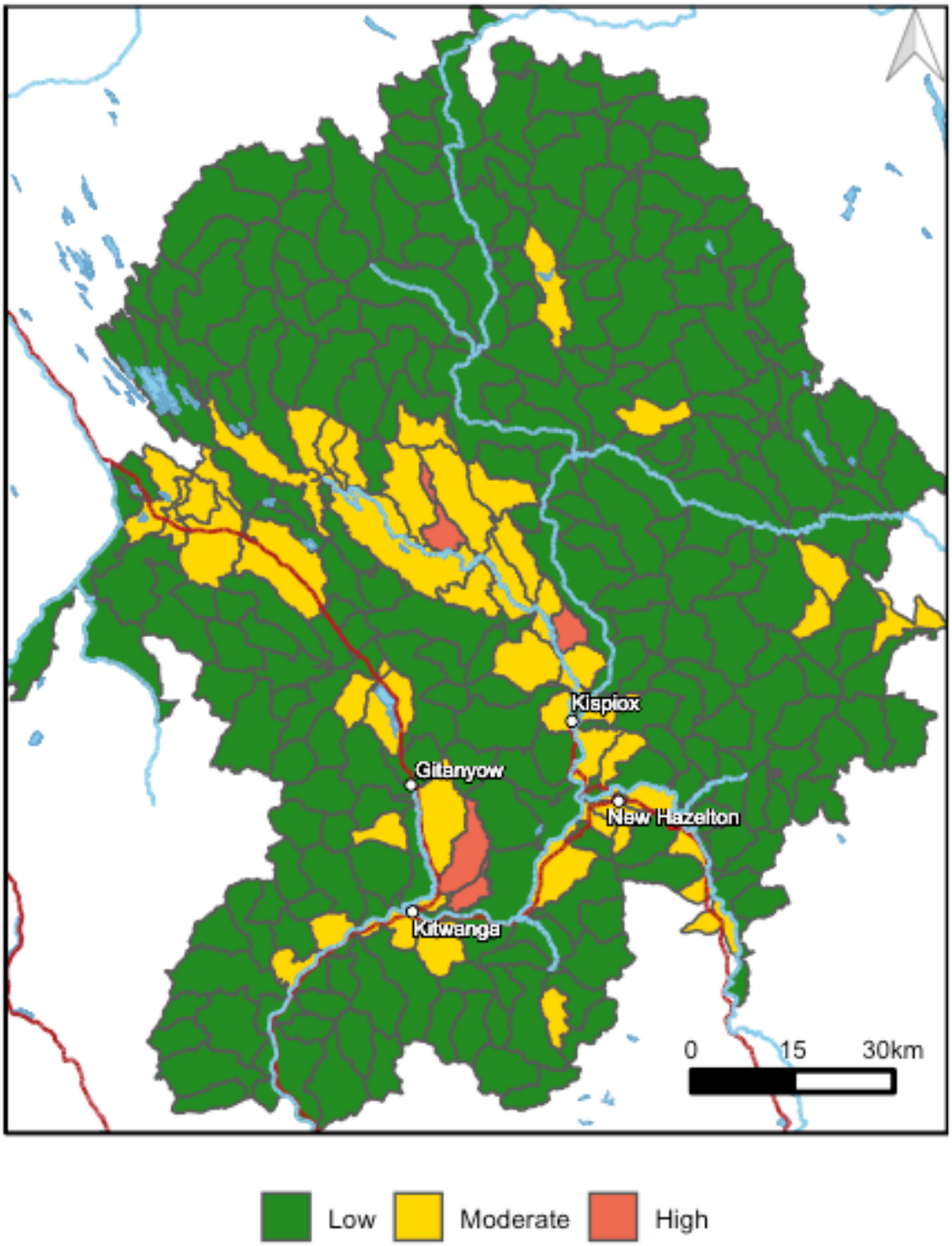

Figure 3: CBS stream crossing density (CBS crossings/km^2) for each boundary in the study area is shown on a study area map. The results are colorized by risk threshold (low risk < 0.2 crossings/km^2, moderate risk 0.2-0.58 crossing/km^2, high risk > 0.58 crossings/km^2).

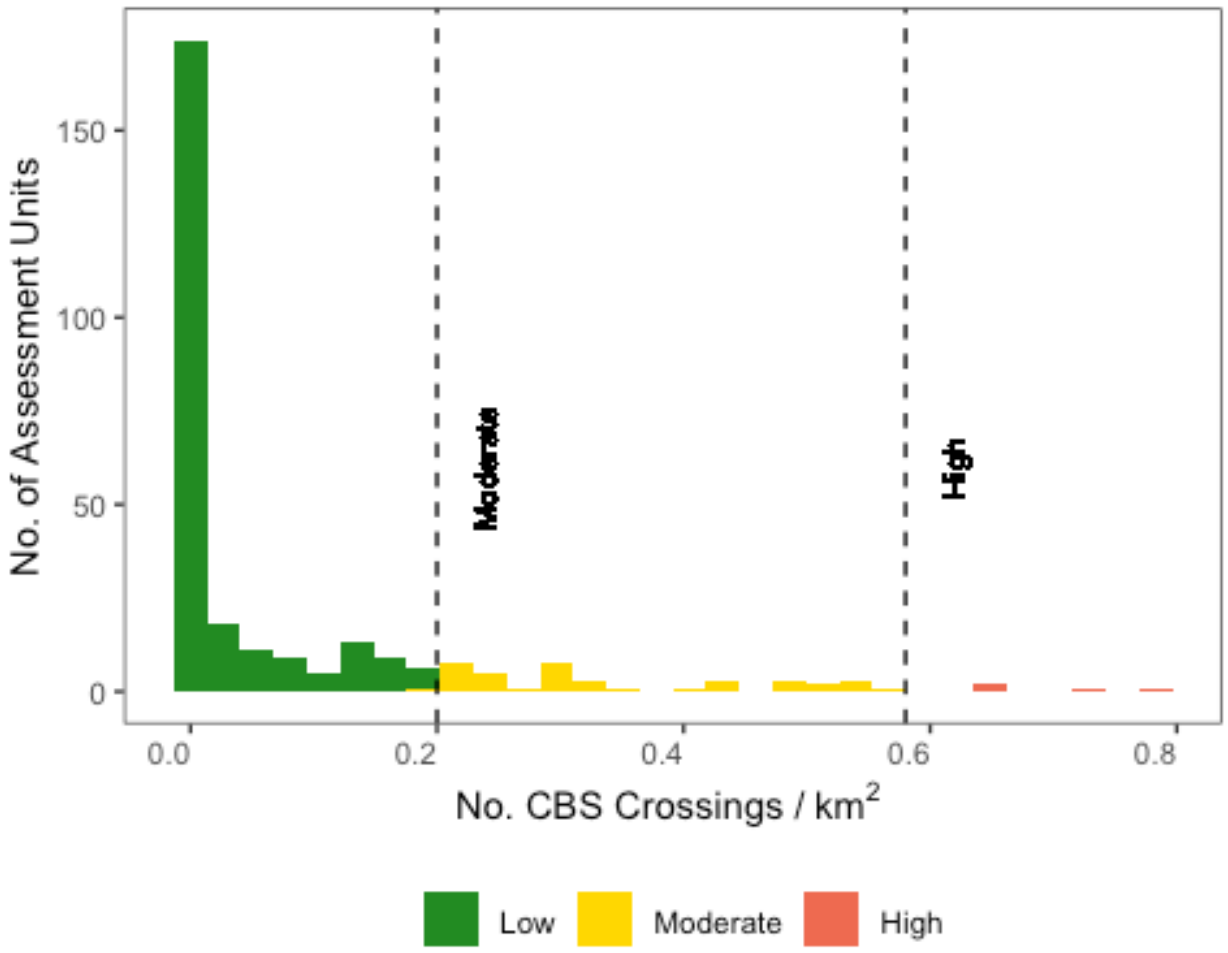

Figure 4: Distribution of results showing the number (count) of assessment units by CBS stream crossing density. The results are colourized by risk threshold (low risk < 0.2 crossings/km^2, moderate risk 0.2-0.58 crossing/km^2, high risk > 0.58 crossings/km^2).

Stream crossing density of CBS (culverts) was calculated for a total of 288 FWA assessment watersheds within the study area. Stream crossing densities ranged from 0 to 0.78 crossings/km^2 with densities for four assessment units above the upper threshold of 0.58 crossings/km^2 and densities for 40 assessment units in the moderate risk threshold range (Figure 4; Appendix B and Appendix C).

The majority of assessment units with moderate and high stream crossing densities are associated with stream crossings within the central portion of the study area (Figure 2 and Figure 3).

Interactive visualizations of the indicator analysis results calculated as part of the Kispiox TSA WSP Indicator Analysis are available at https://data.skeenasalmon.info/dataset/wild-salmon-policy-indicator-analysis-for-the-kispiox-tsa.

Summary

Stream crossing density estimations were calculated for 288 FWA assessment watersheds within the Kispiox TSA and adjacent Swan Lake and upper Kispiox River sub-watersheds using datasets sourced from the Province of BC. Risk categories derived by the Pacific Salmon Foundation were used to assess risk to freshwater habitat from stream crossings.

Results of the analysis indicated stream crossing density within the study area ranged from 0 to 0.78 crossings/km^2 for each assessment unit, with four assessment units at high and 40 assessment units at moderate risk of impacts from fish passage obstruction.

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Appendix A: Reference Maps

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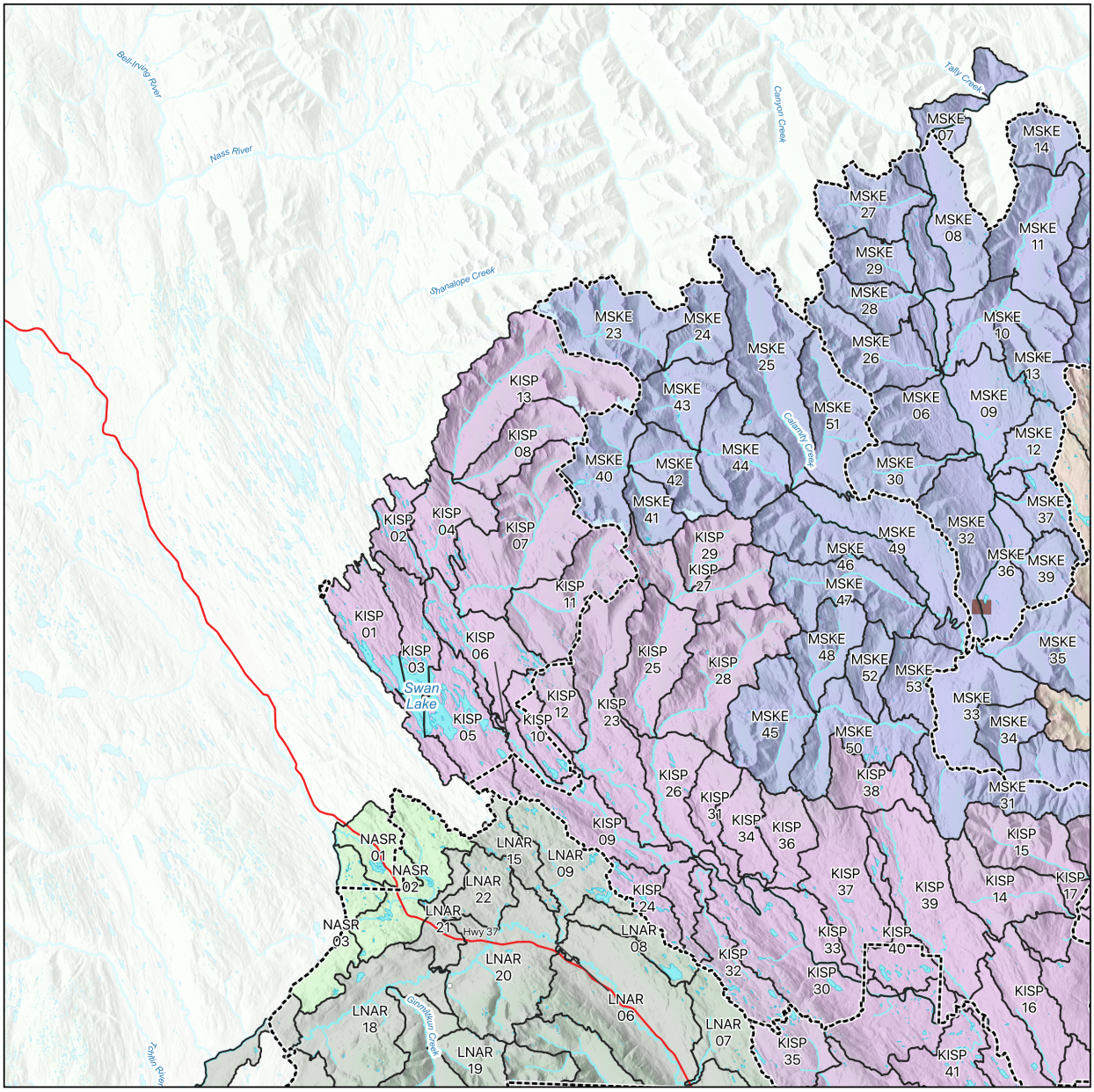
Kispiox Study Area Reference Map - Northwest



Location Map

Legend

Boundary

- Fresh Water Atlas Assessment Watershed
- Kispiox TSA Block
- Reserve Boundary

Major Watershed Group

- BABR
- BULK
- KISP
- KLUM
- LNAR
- MSKE
- NASR

0 5 10 km

N W E S

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June 2020

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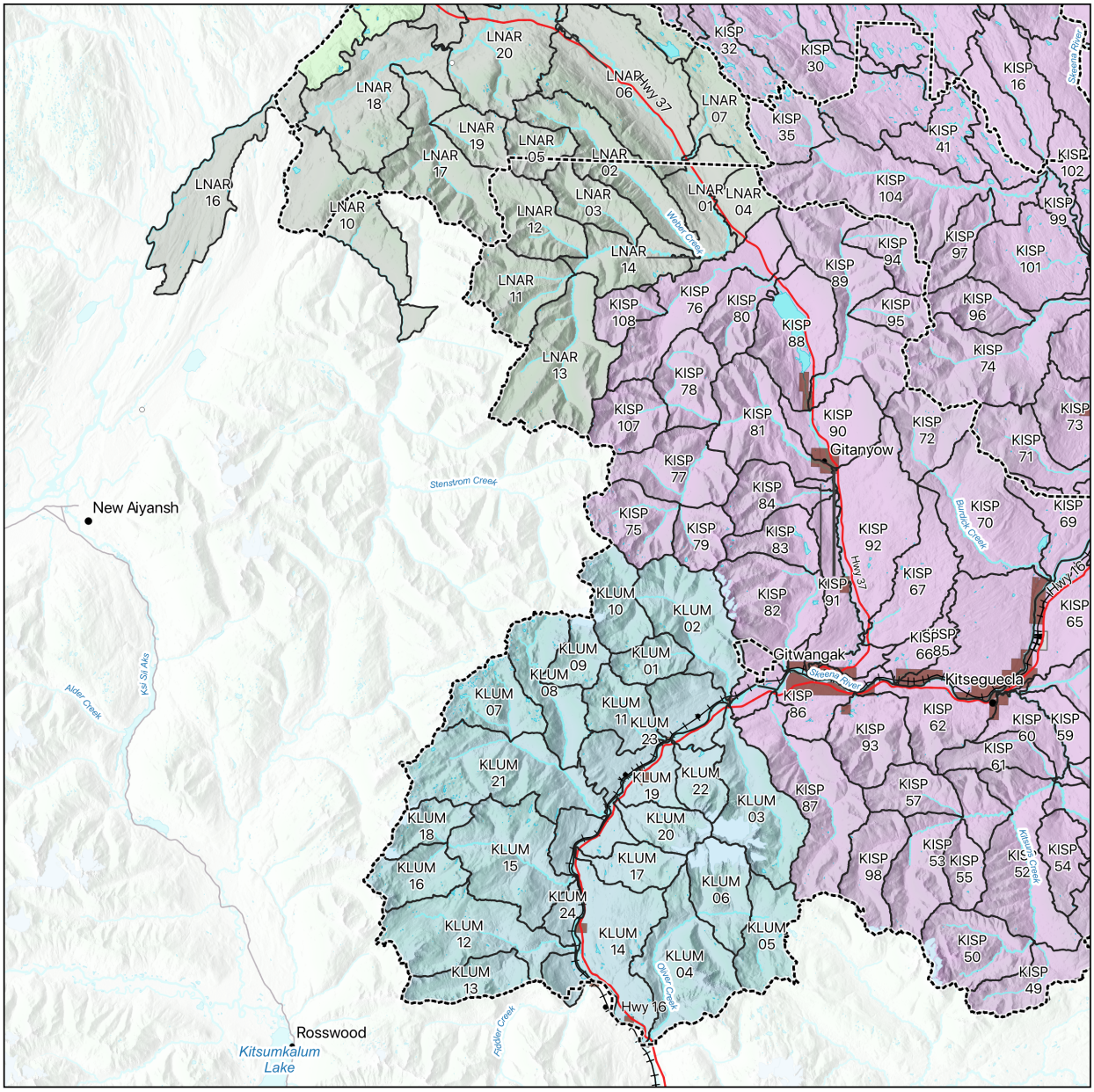
Kispiox Study Area Reference Map - Southwest



Location Map

Legend

Boundary

- Fresh Water Atlas Assessment Watershed
- Kispiox TSA Block
- Reserve Boundary

Major Watershed Group

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- BULK
- KISP
- KLUM
- LNAR
- MSKE
- NASR

0 5 10 km

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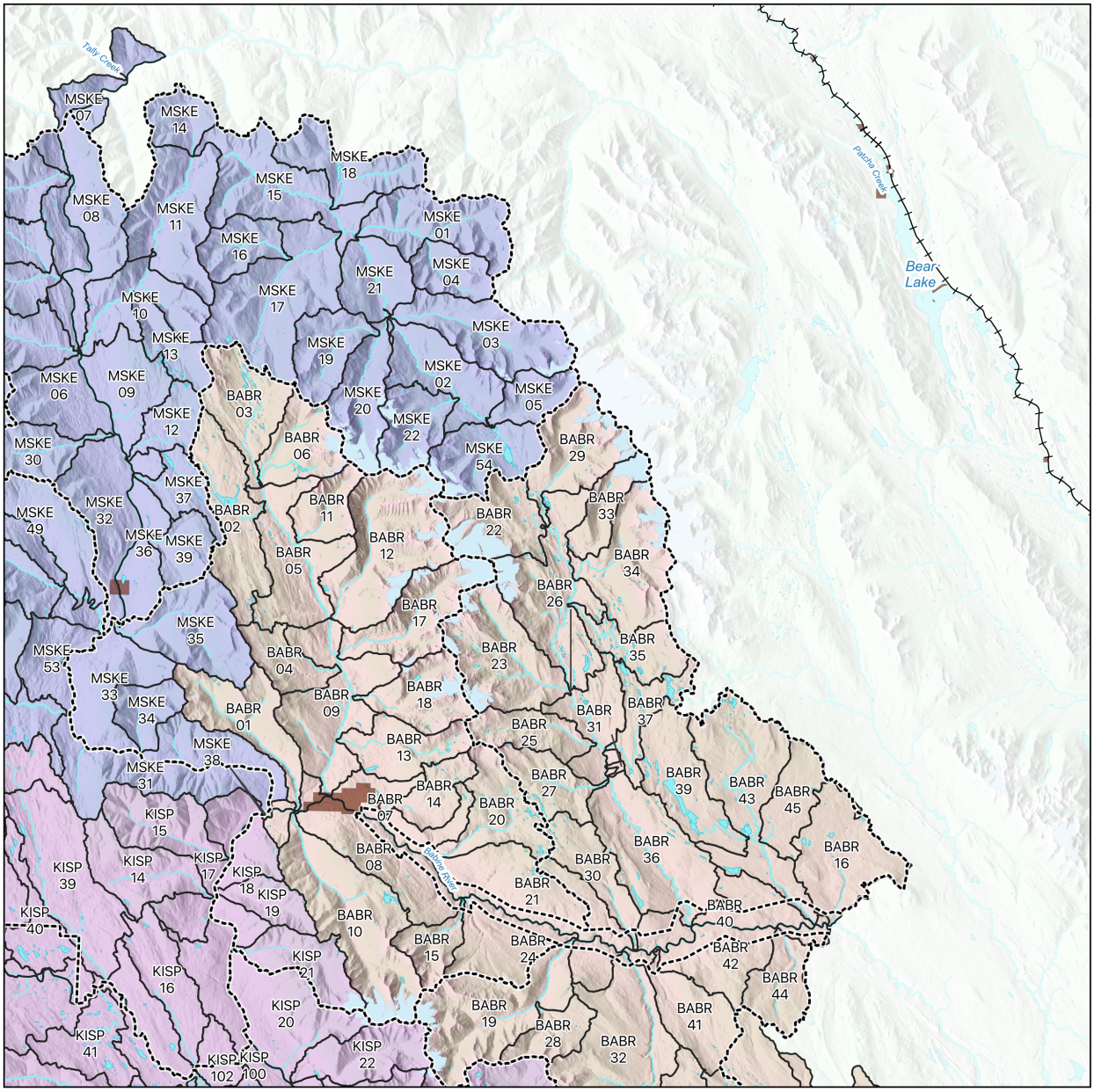
Kispiox Study Area Reference Map - Northeast



Location Map

Legend

Boundary

- Fresh Water Atlas Assessment Watershed
- Kispiox TSA Block
- Reserve Boundary

Major Watershed Group

- BABR
- BULK
- KISP
- KLUM
- LNAR
- MSKE
- NASR

0 5 10 km

N
W E
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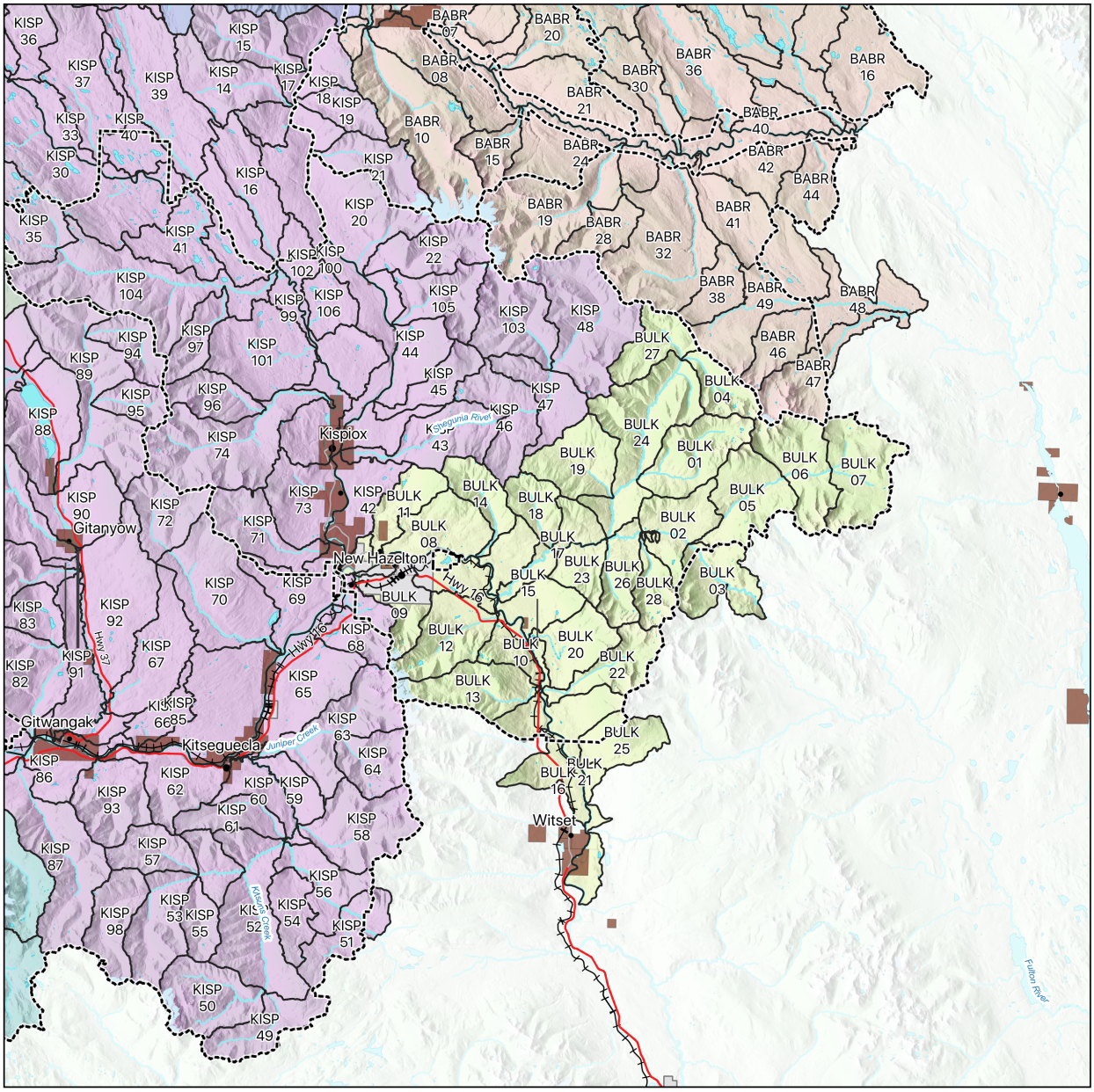
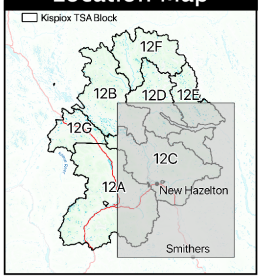
Kispiox Study Area Reference Map - Southeast



Location Map



Legend

Boundary

- Fresh Water Atlas Assessment Watershed
- Kispiox TSA Block
- Reserve Boundary

Major Watershed Group

- BABR
- BULK
- KISP
- KLUM
- LNAR
- MSKE
- NASR

0 5 10 km

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June 2020

Appendix B: Results Tables

The following tables present total area for each boundary studied, number of closed-bottom (culvert) and open-bottom (primarily bridges) crossings, culvert density (crossings per km^2), and risk (determined by Wild Salmon Policy thresholds).

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
BABR-01	Sam Green Creek	424	51.41	0	1	0.00	Low
BABR-02	Damsumlo Creek	433	59.43	12	0	0.20	Moderate
BABR-03	Shedin Creek	436	48.48	0	1	0.00	Low
BABR-04		429	25.00	0	0	0.00	Low
BABR-05	Shedin Creek	435	61.63	0	0	0.00	Low
BABR-06		434	38.12	0	0	0.00	Low
BABR-07	Babine River	423	40.04	0	2	0.00	Low
BABR-08	Babine River	492	62.22	0	1	0.00	Low
BABR-09	Shedin Creek	426	73.86	0	1	0.00	Low
BABR-10	Shegisic Creek	425	98.45	1	0	0.01	Low
BABR-11		432	25.74	0	0	0.00	Low
BABR-12	Rosenthal Creek	431	91.95	0	0	0.00	Low
BABR-13	Goathead Creek	427	37.83	11	1	0.29	Moderate
BABR-14		437	25.91	0	0	0.00	Low
BABR-15		439	22.06	0	0	0.00	Low
BABR-16	Shahnagh Creek	461	63.26	7	0	0.11	Low
BABR-17	Sperry Creek	430	54.23	0	0	0.00	Low
BABR-18		428	40.13	0	0	0.00	Low
BABR-19	Thomlinson Creek	440	82.86	0	2	0.00	Low

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
BABR-20	Shenismike Creek	438	45.51	0	0	0.00	Low
BABR-21	Babine River	493	73.51	0	0	0.00	Low
BABR-22	Shelagyote River	456	48.30	0	0	0.00	Low
BABR-23		449	71.44	0	0	0.00	Low
BABR-24	Babine River	494	60.65	0	0	0.00	Low
BABR-25	Cayuse Jack Creek	448	30.36	0	0	0.00	Low
BABR-26	Shelagyote River	455	77.32	0	0	0.00	Low
BABR-27		446	31.02	0	0	0.00	Low
BABR-28		441	23.39	0	0	0.00	Low
BABR-29		453	53.77	0	0	0.00	Low
BABR-30	Le Clair Creek	443	33.99	0	0	0.00	Low
BABR-31	Shelagyote River	454	35.97	0	0	0.00	Low
BABR-32	Gail Creek	442	92.08	1	1	0.01	Low
BABR-33		452	25.69	0	0	0.00	Low
BABR-34	Barger Creek	451	64.93	0	0	0.00	Low
BABR-35		450	29.62	0	0	0.00	Low
BABR-36	Shelagyote River	445	81.34	0	0	0.00	Low
BABR-37		447	27.67	0	0	0.00	Low
BABR-38		486	24.75	8	0	0.32	Moderate
BABR-39		460	54.97	0	0	0.00	Low
BABR-40	Babine River	495	41.81	0	0	0.00	Low
BABR-41	Cataline Creek	444	39.81	13	0	0.33	Moderate

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
BABR-42	Babine River	496	47.39	0	1	0.00	Low
BABR-43	Hanawald Creek	458	87.27	1	0	0.01	Low
BABR-44		457	32.07	5	1	0.16	Low
BABR-45		459	32.14	5	0	0.16	Low
BABR-46		485	27.92	4	1	0.14	Low
BABR-47		482	46.24	4	1	0.09	Low
BABR-48	Nichyeskwa Creek	487	37.47	20	1	0.53	Moderate
BABR-49	Nichyeskwa Creek	488	75.82	15	0	0.20	Low
BULK-01	Denison Creek	1275	48.43	0	1	0.00	Low
BULK-02	Suskwa River	1298	37.64	4	0	0.11	Low
BULK-03	Harold Price Creek	1279	40.73	6	0	0.15	Low
BULK-04		1276	23.95	0	1	0.00	Low
BULK-05	Suskwa River	1299	49.78	0	0	0.00	Low
BULK-06	Suskwa River	1300	50.81	5	1	0.10	Low
BULK-07	Suskwa River	1301	54.65	0	0	0.00	Low
BULK-08	Bulkley River	1267	48.69	0	1	0.00	Low
BULK-09	Station Creek	1268	29.63	13	0	0.44	Moderate
BULK-10	Bulkley River	1413	50.03	11	0	0.22	Moderate
BULK-11	Two Mile Creek	1269	26.93	6	0	0.22	Moderate
BULK-12	Mudflat Creek	1302	47.41	6	1	0.13	Low

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
BULK-13	Porphyry Creek	1304	44.11	1	0	0.02	Low
BULK-14	Nine Mile Creek	1270	26.52	1	0	0.04	Low
BULK-15	Bulkley River	1414	49.43	2	1	0.04	Low
BULK-16	Bulkley River	1415	39.18	9	0	0.23	Moderate
BULK-17	Suskwa River	1271	26.13	0	2	0.00	Low
BULK-18	Fifteen Mile Creek	1272	23.38	0	0	0.00	Low
BULK-19	Iltzul Creek	1274	43.66	2	1	0.05	Low
BULK-20	Corduroy Creek	1303	34.91	5	1	0.14	Low
BULK-21	Bulkley River	1416	46.12	4	0	0.09	Low
BULK-22	Luno Creek	1305	33.95	0	1	0.00	Low
BULK-23	Suskwa River	1296	20.30	0	0	0.00	Low
BULK-24	Natlan Creek	1273	84.75	2	5	0.02	Low
BULK-25	Kwun Creek	1307	30.73	2	0	0.07	Low
BULK-26	Suskwa River	1297	30.26	0	1	0.00	Low
BULK-27	Natlan Creek	1277	30.22	0	1	0.00	Low
BULK-28		1278	21.06	0	1	0.00	Low
KISP-01		6252	43.80	0	0	0.00	Low
KISP-02		6255	23.32	3	0	0.13	Low
KISP-03		6251	43.88	0	0	0.00	Low
KISP-04	Kispiox River	6262	40.23	0	0	0.00	Low
KISP-05	Stephens Creek	6250	56.57	0	0	0.00	Low

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Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
KISP-06	Kispiox River	6261	48.91	0	0	0.00	Low
KISP-07	East Kispiox River	6253	96.94	0	0	0.00	Low
KISP-08		6256	38.99	0	0	0.00	Low
KISP-09	Kispiox River	6260	72.48	22	0	0.30	Moderate
KISP-10		6249	24.27	1	0	0.04	Low
KISP-100	Skeena River	6283	69.00	0	0	0.00	Low
KISP-101	Hevenor Creek	6226	62.79	31	1	0.49	Moderate
KISP-102	Kispiox River	6257	75.33	36	0	0.48	Moderate
KISP-103		6265	51.63	0	0	0.00	Low
KISP-104	McCully Creek	6228	111.17	13	2	0.12	Low
KISP-105	Utsun Creek	6270	39.41	0	1	0.00	Low
KISP-106		6227	23.00	15	0	0.65	High
KISP-107		6186	33.46	0	0	0.00	Low
KISP-108		6193	20.27	0	1	0.00	Low
KISP-11		6254	60.45	0	0	0.00	Low
KISP-12		6248	22.25	2	0	0.09	Low
KISP-13	Kispiox River	6263	106.02	0	0	0.00	Low
KISP-14	Carrigan Creek	6273	44.91	10	0	0.22	Moderate
KISP-15	Blackstock Creek	6275	43.50	1	0	0.02	Low
KISP-16	Murder Creek	6231	40.63	21	1	0.52	Moderate
KISP-17	Skeena River	6287	35.54	0	0	0.00	Low

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Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
KISP-18	Skeena River	6286	30.87	2	0	0.06	Low
KISP-19	Bretson Creek	6274	21.97	0	1	0.00	Low
KISP-20	Skeena River	6285	61.32	3	2	0.05	Low
KISP-21	Shewililba Creek	6272	36.63	0	3	0.00	Low
KISP-22	Sediesh Creek	6271	42.46	0	2	0.00	Low
KISP-23	Nangeese River	6247	87.17	8	2	0.09	Low
KISP-24	Brown Paint Creek	6246	21.64	2	0	0.09	Low
KISP-25	Sweetin River	6244	51.88	0	0	0.00	Low
KISP-26	Sweetin River	6241	39.23	19	1	0.48	Moderate
KISP-27	Sweetin River	6245	48.42	0	0	0.00	Low
KISP-28		6242	77.46	0	0	0.00	Low
KISP-29		6243	27.89	0	0	0.00	Low
KISP-30	Kispiox River	6259	117.93	41	1	0.35	Moderate
KISP-31	Clifford Creek	6239	24.21	6	1	0.25	Moderate
KISP-32	Steep Canyon Creek	6240	36.61	1	0	0.03	Low
KISP-33	Kispiox River	6258	35.86	18	1	0.50	Moderate
KISP-34	Skunsnat Creek	6238	26.47	8	0	0.30	Moderate
KISP-35	McCully Creek	6230	33.29	0	0	0.00	Low
KISP-36	Corral Creek	6237	28.69	5	0	0.17	Low

eclipse GEOMATICS

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
KISP-37	Ironside Creek	6236	66.26	38	0	0.57	Moderate
KISP-38	Cullon Creek	6233	33.56	10	2	0.30	Moderate
KISP-39	Cullon Creek	6232	81.61	35	2	0.43	Moderate
KISP-40		6235	30.70	20	1	0.65	High
KISP-41		6234	37.94	15	1	0.40	Moderate
KISP-42	Skeena River	6281	69.60	19	8	0.27	Moderate
KISP-43	Shegunia River	6264	48.20	1	1	0.02	Low
KISP-44	Skeena River	6284	38.61	0	0	0.00	Low
KISP-45	Pinenut Creek	6269	24.84	1	0	0.04	Low
KISP-46	Shegunia River	6266	43.44	0	0	0.00	Low
KISP-47	Shegunia River	6267	34.82	6	0	0.17	Low
KISP-48	Shegunia River	6268	83.75	1	0	0.01	Low
KISP-49	Kitsuns Creek	6212	35.39	0	0	0.00	Low
KISP-50		6211	51.59	0	0	0.00	Low
KISP-51	Kitseguecla River	6217	33.88	3	0	0.09	Low
KISP-52	Kitsuns Creek	6206	76.76	0	0	0.00	Low
KISP-53		6207	64.75	0	1	0.00	Low
KISP-54		6213	26.07	8	1	0.31	Moderate
KISP-55		6209	20.17	0	1	0.00	Low
KISP-56	Kitseguecla River	6216	34.35	1	0	0.03	Low
KISP-57		6208	27.82	0	1	0.00	Low

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
KISP-58		6204	57.80	2	1	0.03	Low
KISP-59	Kitseguecla River	6201	22.15	0	1	0.00	Low
KISP-60	Kitseguecla River	6215	22.58	4	1	0.18	Low
KISP-61	Deep Canyon Creek	6205	25.58	0	1	0.00	Low
KISP-62	Skeena River	6278	42.24	4	0	0.09	Low
KISP-63	Juniper Creek	6202	60.50	1	1	0.02	Low
KISP-64	Brian Boru Creek	6203	32.22	0	0	0.00	Low
KISP-65	Skeena River	6279	64.72	19	0	0.29	Moderate
KISP-66	Andi Creek	6200	20.44	16	0	0.78	High
KISP-67		6182	52.71	38	1	0.72	High
KISP-68	Chicago Creek	6221	21.01	4	0	0.19	Low
KISP-69	Skeena River	6280	44.15	8	0	0.18	Low
KISP-70	Burdick Creek	6219	78.51	6	1	0.08	Low
KISP-71	Hazelton Creek	6222	41.68	6	1	0.14	Low
KISP-72	Burdick Creek	6220	37.89	5	0	0.13	Low
KISP-73	Skeena River	6282	45.79	6	0	0.13	Low
KISP-74	Date Creek	6224	87.75	0	1	0.00	Low
KISP-75	Kitwancool Creek	6189	40.26	0	0	0.00	Low
KISP-76	Kitwanga River	6198	66.48	11	0	0.17	Low
KISP-77	Kitwancool Creek	6188	50.99	0	0	0.00	Low

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
KISP-78		6185	37.18	0	1	0.00	Low
KISP-79		6187	24.07	0	0	0.00	Low
KISP-80	Kitwanga River	6197	33.78	7	0	0.21	Moderate
KISP-81	Kitwancool Creek	6184	60.58	0	0	0.00	Low
KISP-82	Mill Creek	6179	63.11	9	2	0.14	Low
KISP-83		6180	27.47	6	0	0.22	Moderate
KISP-84	Deuce Creek	6183	31.89	1	1	0.03	Low
KISP-85	Skeena River	6277	100.62	14	2	0.14	Low
KISP-86	Skeena River	6276	32.07	7	1	0.22	Moderate
KISP-87		6178	85.42	0	1	0.00	Low
KISP-88	Kitwanga River	6196	61.90	18	1	0.29	Moderate
KISP-89	Moonlit Creek	6190	91.77	2	1	0.02	Low
KISP-90	Kitwanga River	6195	42.28	7	1	0.17	Low
KISP-91	Kitwanga River	6181	38.89	0	2	0.00	Low
KISP-92	Kitwanga River	6194	94.23	20	7	0.21	Moderate
KISP-93	Shandilla Creek	6199	45.24	11	0	0.24	Moderate
KISP-94		6192	26.00	0	0	0.00	Low
KISP-95		6191	20.07	0	0	0.00	Low
KISP-96		6225	28.52	0	1	0.00	Low
KISP-97		6229	23.72	4	1	0.17	Low
KISP-98		6210	37.64	0	0	0.00	Low
KISP-99	Kispiox River	6223	62.80	16	2	0.25	Moderate
KLUM-01		6741	20.82	0	0	0.00	Low

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
KLUM-02	Sedan Creek	6740	63.64	0	1	0.00	Low
KLUM-03		6743	66.62	0	1	0.00	Low
KLUM-04	Oliver Creek	6721	71.92	0	1	0.00	Low
KLUM-05	Oliver Creek	6723	38.80	0	0	0.00	Low
KLUM-06	Oliver Creek	6722	40.47	0	0	0.00	Low
KLUM-07		6736	39.29	0	0	0.00	Low
KLUM-08		6734	49.34	0	0	0.00	Low
KLUM-09		6735	22.14	0	0	0.00	Low
KLUM-10		6742	36.67	0	0	0.00	Low
KLUM-11	Wilson Creek	6738	30.88	4	1	0.13	Low
KLUM-12	Lorne Creek	6727	76.37	0	0	0.00	Low
KLUM-13	South Lorne Creek	6728	30.80	0	0	0.00	Low
KLUM-14	Skeena River	6752	67.50	6	0	0.09	Low
KLUM-15	Quill Creek	6729	74.47	0	1	0.00	Low
KLUM-16	Quill Creek	6731	32.41	0	0	0.00	Low
KLUM-17	Flint Creek	6732	24.90	1	1	0.04	Low
KLUM-18		6730	22.13	0	0	0.00	Low
KLUM-19	Skeena River	6754	38.26	3	0	0.08	Low
KLUM-20	CoyoteCreek	6737	25.14	0	1	0.00	Low
KLUM-21	Insect Creek	6733	89.68	0	1	0.00	Low
KLUM-22		6739	22.46	1	0	0.04	Low
KLUM-23	Skeena River	6755	50.29	15	0	0.30	Moderate
KLUM-24	Skeena River	6753	40.39	0	2	0.00	Low

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
LNAR-01	Cranberry River	9034	40.16	6	1	0.15	Low
LNAR-02	Weber Creek	9025	63.18	0	0	0.00	Low
LNAR-03		9027	31.75	0	0	0.00	Low
LNAR-04		9024	20.68	3	0	0.15	Low
LNAR-05		9026	22.83	0	0	0.00	Low
LNAR-06	Cranberry River	9033	117.46	26	3	0.22	Moderate
LNAR-07	Tsugwinsel da Creek	9023	37.66	1	1	0.03	Low
LNAR-08		9021	25.28	0	0	0.00	Low
LNAR-09	Aluk Creek	9020	46.51	8	0	0.17	Low
LNAR-10	Kiteen River	8998	83.65	4	0	0.05	Low
LNAR-11		9029	46.97	0	0	0.00	Low
LNAR-12		9028	41.90	0	0	0.00	Low
LNAR-13	Cranberry River	9036	87.01	0	0	0.00	Low
LNAR-14	Cranberry River	9035	39.72	0	0	0.00	Low
LNAR-15	Weegett Creek	9022	22.38	12	0	0.54	Moderate
LNAR-16	Nass River	9047	67.51	4	2	0.06	Low
LNAR-17	Ginmiltkun Creek	9016	76.18	2	1	0.03	Low
LNAR-18	Cranberry River	9031	90.18	13	6	0.14	Low
LNAR-19		9017	23.62	0	0	0.00	Low
LNAR-20	Cranberry River	9032	85.23	27	1	0.32	Moderate
LNAR-21		9018	20.70	11	0	0.53	Moderate
LNAR-22	Calmin Creek	9019	26.00	11	0	0.42	Moderate
MSKE-01	Endless Creek	11076	57.26	0	0	0.00	Low

eclipse GEOMATICS

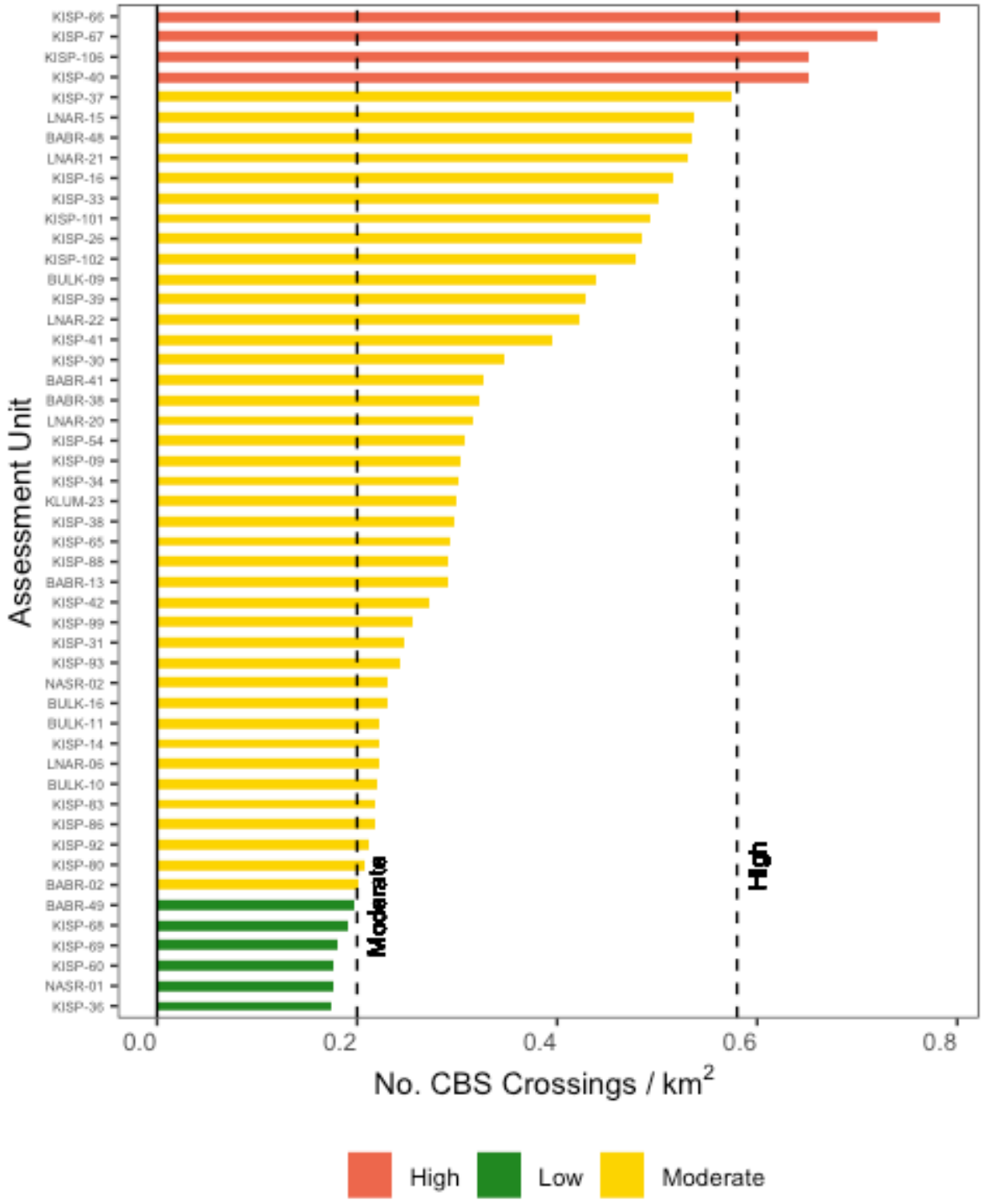
Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
MSKE-02	Sicintine River	11086	48.48	0	0	0.00	Low
MSKE-03		11078	62.72	0	0	0.00	Low
MSKE-04		11077	26.32	0	0	0.00	Low
MSKE-05		11082	23.56	0	0	0.00	Low
MSKE-06	Skeena River	11146	48.99	2	1	0.04	Low
MSKE-07	Skeena River	11148	47.41	1	0	0.02	Low
MSKE-08	Skeena River	11147	58.16	0	0	0.00	Low
MSKE-09	Skeena River	11145	43.23	0	0	0.00	Low
MSKE-10	Sicintine River	11070	46.74	0	0	0.00	Low
MSKE-11	Sicintine River	11083	68.27	0	0	0.00	Low
MSKE-12		11068	23.12	0	0	0.00	Low
MSKE-13		11071	24.40	0	0	0.00	Low
MSKE-14		11072	23.32	0	0	0.00	Low
MSKE-15	Sicintine River	11084	72.07	0	0	0.00	Low
MSKE-16		11075	28.05	0	0	0.00	Low
MSKE-17	Tommy Jack Creek	11074	91.17	2	0	0.02	Low
MSKE-18		11073	44.85	0	0	0.00	Low
MSKE-19		11080	35.90	0	0	0.00	Low
MSKE-20		11079	43.25	0	0	0.00	Low
MSKE-21	Sicintine River	11085	36.10	0	0	0.00	Low
MSKE-22		11081	35.59	0	0	0.00	Low
MSKE-23		11059	65.73	0	0	0.00	Low
MSKE-24		11058	27.97	0	0	0.00	Low

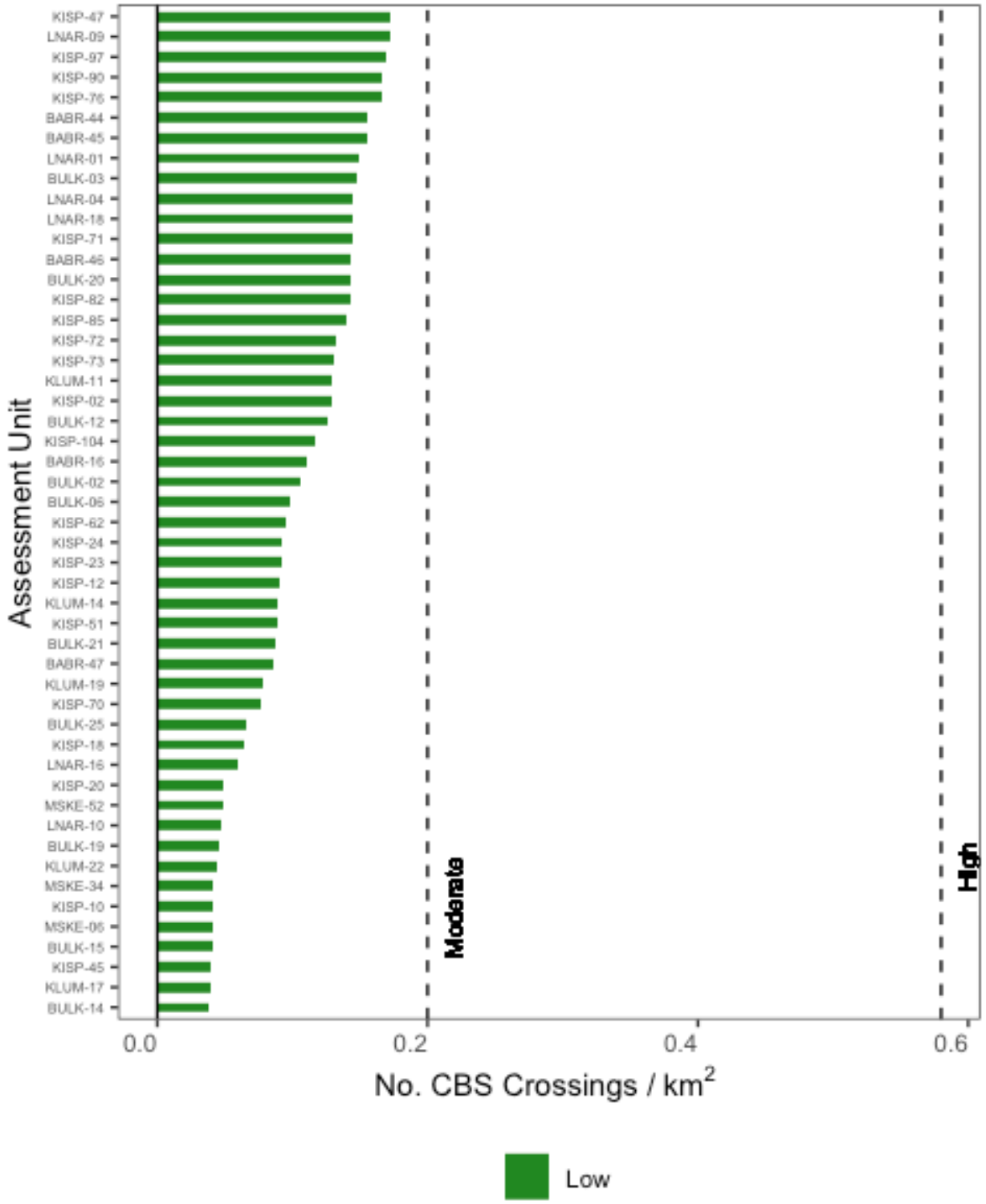
Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
MSKE-25	Calamity Creek	11055	91.55	0	0	0.00	Low
MSKE-26	Sheladamus Creek	11088	48.70	0	0	0.00	Low
MSKE-27	O'Dwyer Creek	11091	41.60	0	0	0.00	Low
MSKE-28	Poison Creek	11089	27.53	0	0	0.00	Low
MSKE-29		11090	25.21	0	0	0.00	Low
MSKE-30		11069	32.01	0	1	0.00	Low
MSKE-31	Skeena River	11139	60.04	0	0	0.00	Low
MSKE-32	Skeena River	11143	55.70	0	6	0.00	Low
MSKE-33	Skeena River	11141	52.48	0	0	0.00	Low
MSKE-34		11048	23.98	1	0	0.04	Low
MSKE-35	Larkworthy Creek	11065	60.87	0	0	0.00	Low
MSKE-36	Skeena River	11144	35.99	0	1	0.00	Low
MSKE-37		11067	23.41	0	1	0.00	Low
MSKE-38	Skeena River	11140	35.09	0	0	0.00	Low
MSKE-39		11066	24.04	0	0	0.00	Low
MSKE-40	Kuldo Creek	11064	46.77	0	0	0.00	Low
MSKE-41		11060	20.32	0	0	0.00	Low
MSKE-42	Kuldo Creek	11063	33.79	0	0	0.00	Low
MSKE-43		11057	37.52	0	0	0.00	Low
MSKE-44	Kuldo Creek	11062	56.41	0	0	0.00	Low
MSKE-45		11052	58.36	0	0	0.00	Low
MSKE-46	Kuldo Creek	11053	57.62	0	1	0.00	Low
MSKE-47		11054	54.36	0	0	0.00	Low
MSKE-48		11051	34.68	0	0	0.00	Low

Reference AU	Sub-Watershed Name	FWA FID	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
MSKE-49	Kuldo Creek	11061	58.40	0	1	0.00	Low
MSKE-50	Deep Canoe Creek	11049	53.85	0	1	0.00	Low
MSKE-51		11056	51.81	0	0	0.00	Low
MSKE-52		11050	20.56	1	0	0.05	Low
MSKE-53	Skeena River	11142	31.31	0	1	0.00	Low
MSKE-54	Sicintine River	11087	44.91	0	0	0.00	Low
NASR-01		11840	28.26	5	0	0.18	Low
NASR-02	Derrick Creek	11839	56.34	13	0	0.23	Moderate
NASR-03	Nass River	11879	35.43	0	0	0.00	Low

Appendix C: Results Distribution

Results are colourized by risk threshold (low risk < 0.2 crossings/km^2, moderate risk 0.2-0.58 crossing/km^2, high risk > 0.58 crossings/km^2).

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LNAR-18
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BABR-46
BULK-20
KISP-82
KISP-85
KISP-72
KISP-73
KLUM-11
KISP-02
BULK-12
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BULK-02
BULK-06
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BULK-21
BABR-47
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KISP-18
LNAR-16
KISP-20
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LNAR-10
BULK-19
KLUM-22
MSKE-34
KISP-10
MSKE-06
BULK-15
KISP-45
KLUM-17
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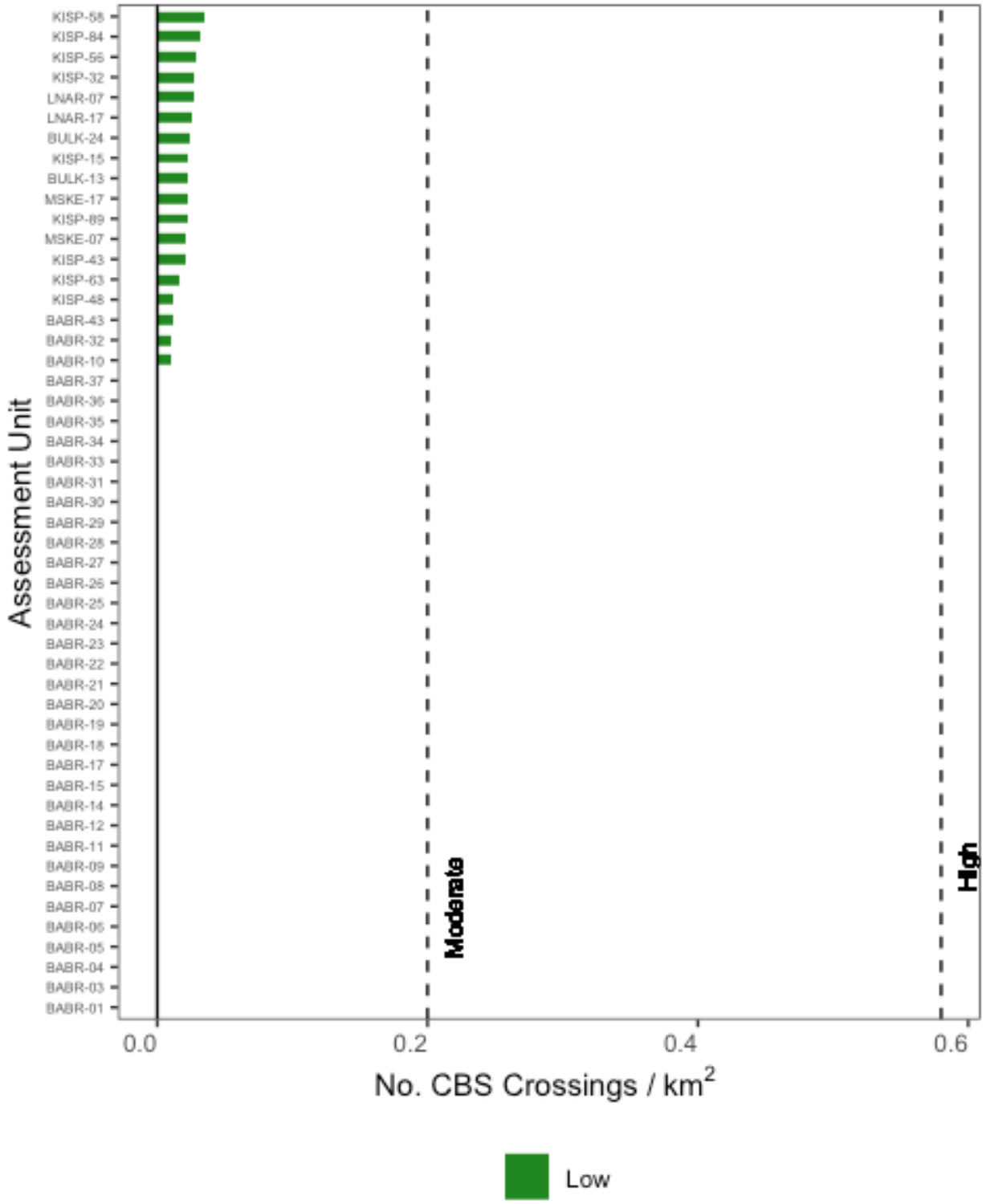
0.4
0.6
No. CBS Crossings / km2
Low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BABR-04
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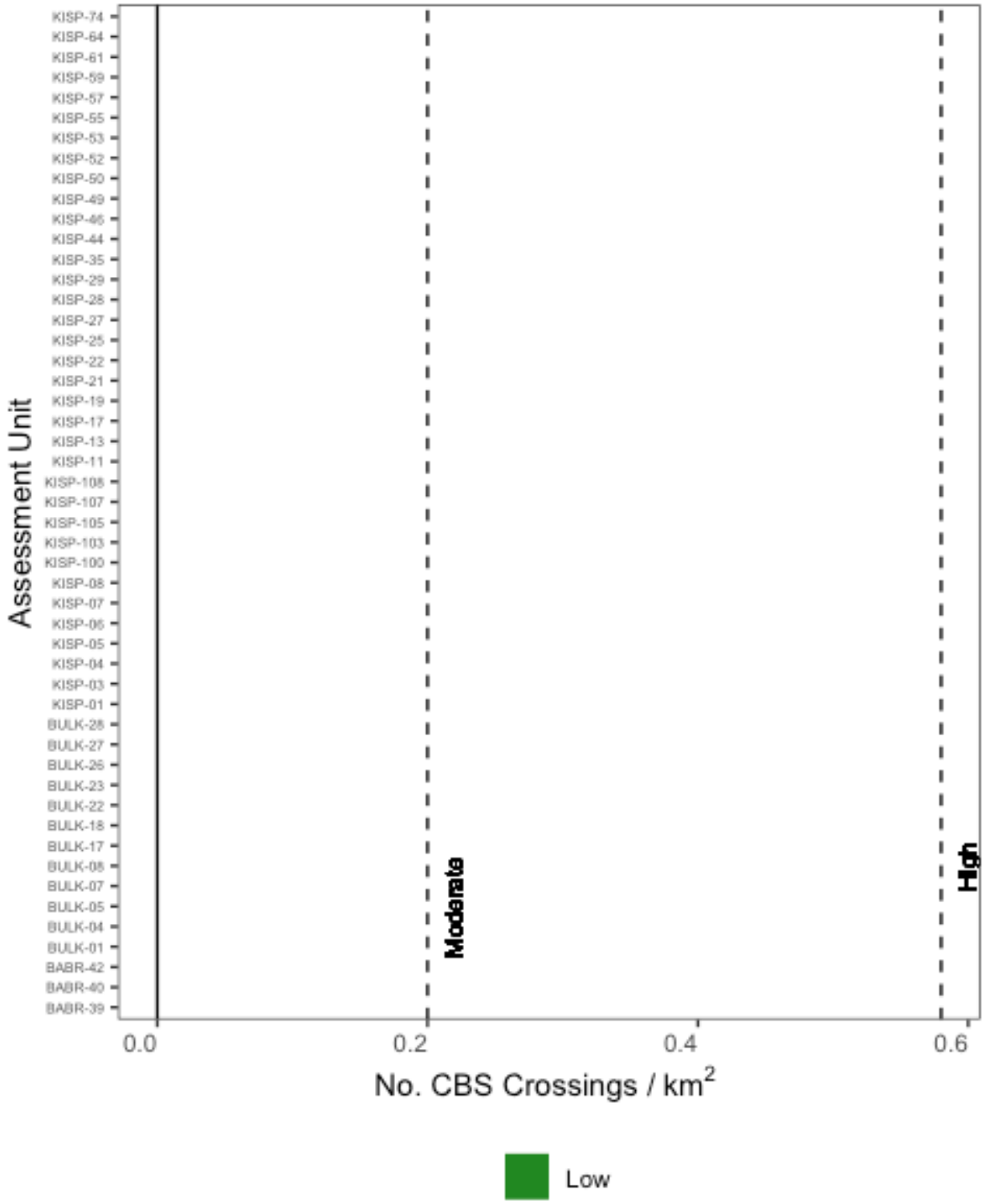
0.2
0.4
0.6
No. CBS Crossings / km2
Moderate
High
Low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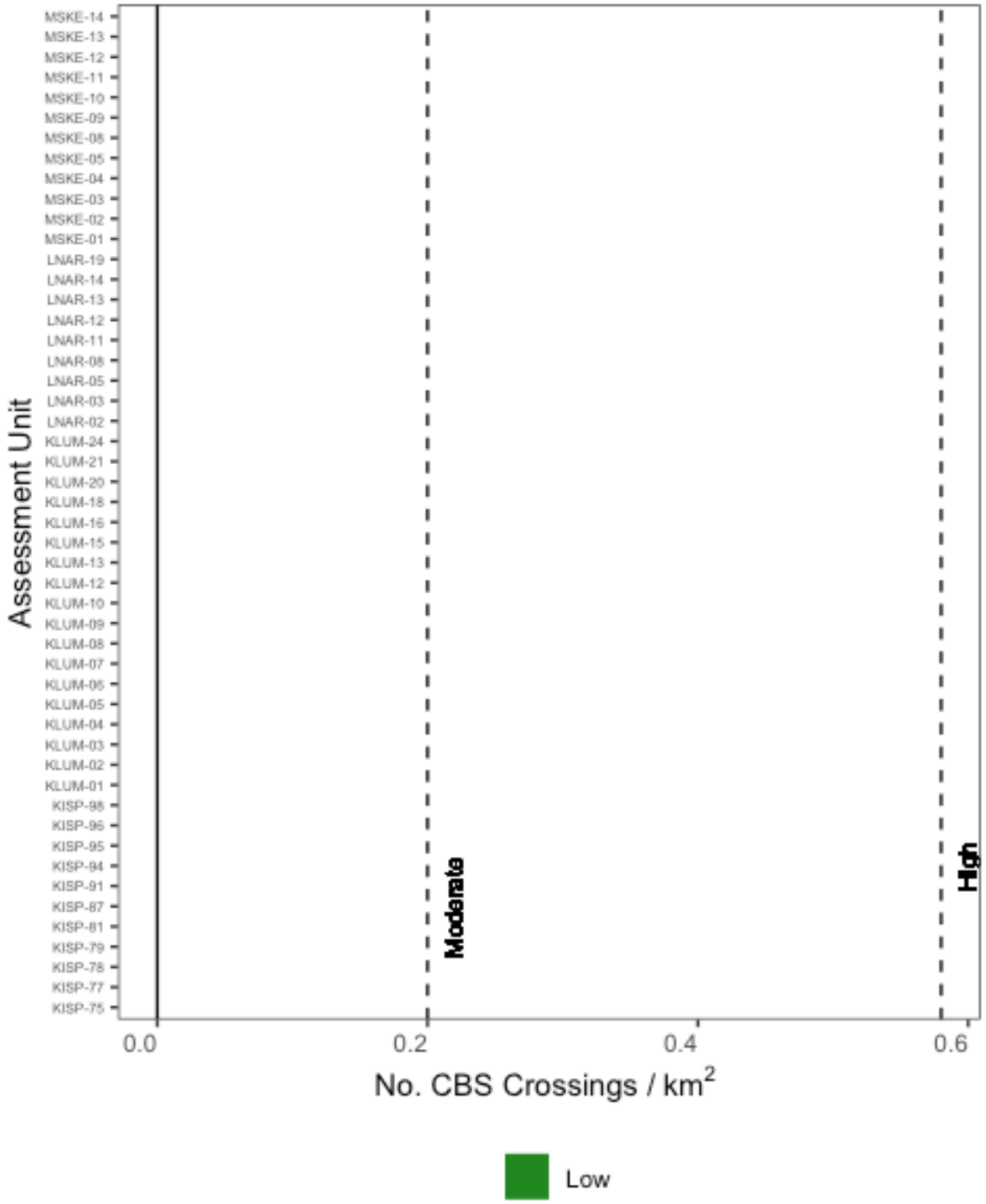
0.6
No. CBS Crossings / km2
Moderate
High
Low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LNAR-02
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KISP-79
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Assessment Unit
Moderate
High
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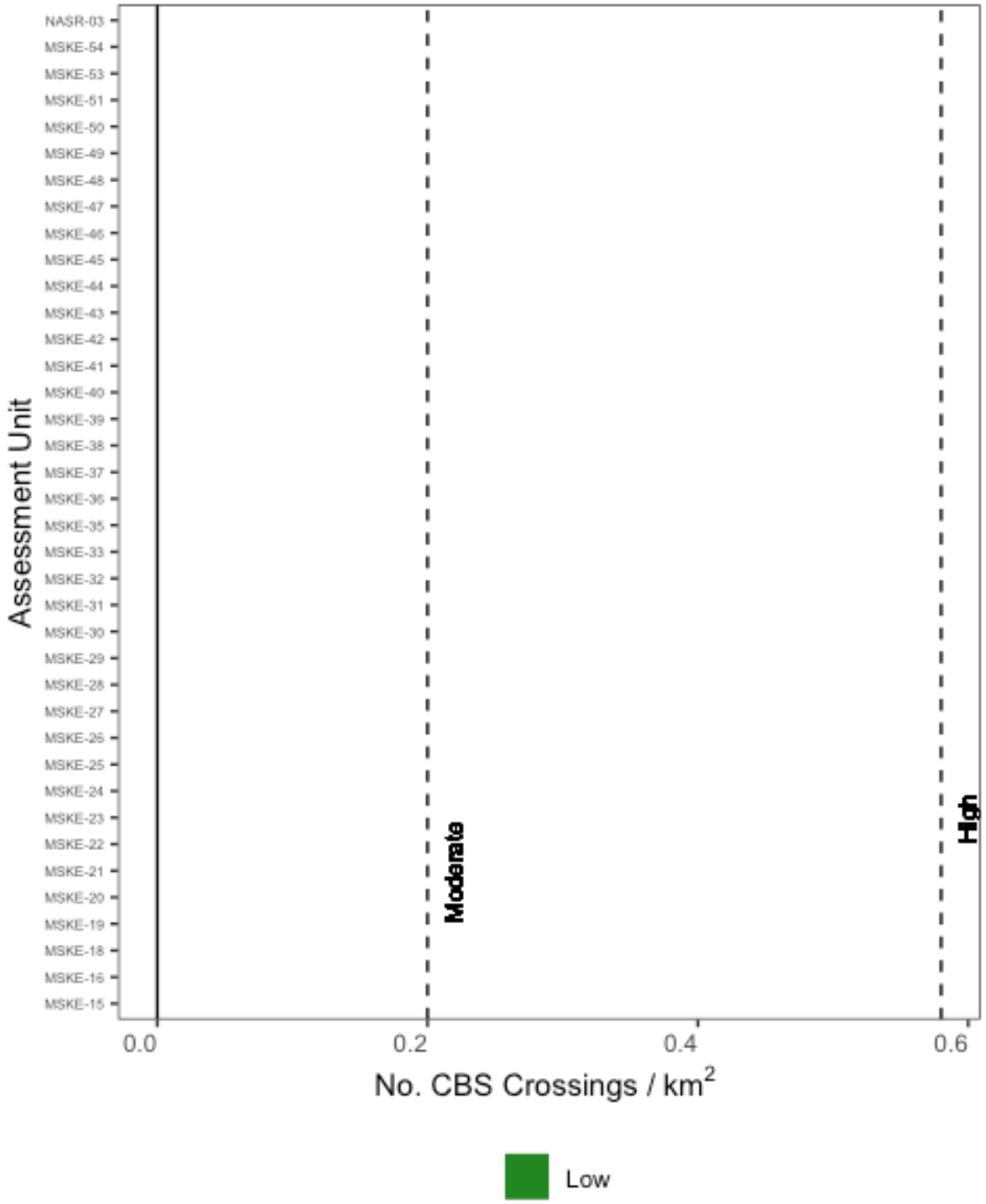
0.2
0.4
0.6
No. CBS Crossings / km2
Low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MSKE-23
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MSKE-15
Moderate
High
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0.2
0.4
0.6
No. CBS Crossings / km^2
Low