WSP Indicator Analysis for the Kispiox TSA:

Riparian Disturbance

Interior Watershed Assessment Protocol (IWAP) 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 the 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: Riparian Disturbance

Assessment Units: IWAP Assessment Watersheds

Description of Pressure Indicator

Riparian disturbance is used to describe streamside changes which may affect stream shade and water temperature, wood and organic matter inputs, bank stability, and many other riparian processes, and is considered an important pressure indicator by the Wild Salmon Policy (WSP) Habitat Working Group (Stalberg et al., 2009). Riparian disturbance is defined as the percentage of the riparian zone (30 m buffer around all water bodies) that has been altered by land use activities (Porter et al., 2014; Stalberg et al., 2009). Riparian disturbance is related to total land cover alteration and road development.

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 Interior Watershed Assessment Protocol (IWAP) watersheds within the Kispiox TSA and the neighbouring upper Kispiox River and Swan Lake watersheds. The IWAP watersheds are primarily fourth order historical assessment watersheds delineated by the Kispiox Expert Water Panel and used as reporting units for 2004-2019 watershed assessment and monitoring projects (BC Ministry of Environment and Climate Change Strategy [BC MECCS], 2004). Reporting watershed assessment results by IWAP watershed allows for continuity and comparison with historical results. Reference maps showing the study area with Kispiox TSA and IWAP boundaries 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)
- BC Transmission Lines (BC MFLNRORD, 2020c)
- Harvested Areas of BC (Consolidated Cutblocks) (BC MFLNRORD, 2020d)
- TANTALIS – Crown Tenures (BC MFLNRORD, 2020e)
- Railway Track Line (BC MFLNRORD, 2019a)
- Municipalities - Legally Defined Administrative Areas of BC (BC Ministry of Municipal Affairs and Housing, 2019)
- Reserves & Band Names - Administrative Boundaries (BC MFLNRORD, 2019b)
- Permitted Mine Areas - Major Mine (BC MEMPR, 2020)
- Fire Perimeters - Historical (BC FLNRORD, 2020f)
- Fish Habitat and Road Crossings Model (BC MECCS, 2019)
- Freshwater Atlas Rivers (BC MFLNRORD, 2019c)
- Freshwater Atlas (FWA) Rivers (BC MFLNRORD, 2019c)
- FWA Lakes (BC MFLNRORD, 2019d)
- FWA Wetlands (BC MFLNRORD, 2019e)
- IWAP Watersheds (BC MECCS, 2004)

Riparian Area Identification

Riparian areas within the study area were calculated using the methodology developed by the Pacific Salmon Foundation ([PSF], 2020):

- A buffer of 30 m (60 m corridor width) was applied to all features in the fish habitat and road crossings model (BC MECCS, 2019) classified as stream/river, ditch or canal. Ditch and canal features (if present) were inspected visually to confirm intersection with the stream network. Isolated ditch and canal features were removed if present.

- Features within the fish habitat and road crossings model with a FWA stream network feature code of WA24111170 (construction line – flow inferred) were visually inspected for intersection with the stream network. Isolated stream segments were removed from the dataset if present. Interconnected lake and wetland features were identified through intersection with the inspected fish habitat and road crossings model, and the selected lakes and wetlands were merged into one layer. The resultant layer was buffered by 30 m, the areas covered by lakes and wetlands were removed, and island or donut features were also removed.

- River polygons were buffered by 30 m, the areas covered by river features were removed, and buffer features around islands or donuts were also removed.
- The stream, lake/wetland, and river riparian layers were merged, overlaid with the assessment unit boundaries, and dissolved to produce the total riparian area within each assessment unit.

Disturbance Characterization

For the purposes of this study, anthropogenic alterations to the land base were calculated as well as natural disturbance from wildfires. Principal sources of human disturbance identified within the study area include settlements, forest harvesting (cutblocks), and road, railway, and electric powerline corridors.

Linear Disturbance Characterization

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 dataset (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.

Calculated road, railway, and transmission line right-of-way buffer widths were applied to the respective disturbance layers as set out below, where buffer width refers to the total width of each right-of-way:

Description	Modelled Buffer Width (m)
Trail	0
Overgrown Road	5
Unimproved Road	10
Resource Road	15
Main Resource Road	20
Local Road	25
Highways Road	50
Railway	15
Transmission Line	30

The KRI roads layer is published with modelled buffer width as an attribute in the dataset according to the characterization above. Modelled buffer width was derived for DRA and FTEN road features with characterization estimated based on road class, road surface, and number of lanes in the case of the DRA and file type for the FTEN road segments. Refer to Appendix B for details on the method applied.

Land cover alteration along pipeline rights-of-way and other utility corridors was estimated from the TANTALIS – Crown Tenures dataset selected for utility and transportation with a tenure stage of "tenure" (i.e. active tenures). The utility category does not include the Prince Rupert Gas Transmission Project, which has been permitted but to our knowledge not constructed.

Forestry Disturbance Characterization

The Consolidated Cutblocks layer was used to identify disturbance from forest harvesting within the last 60 years (i.e. harvested since 1959). This is consistent with the approach used by the Pacific Salmon Foundation (2020).

Other Anthropogenic Disturbance Characterization

Municipal and reserve boundaries were used to estimate disturbance from settlements in the study area. Additional sources of land cover alteration were estimated from the TANTALIS – Crown Tenures dataset selected for agriculture, industrial, commercial, quarrying, residential, and community tenure purposes with a tenure stage of "tenure" (i.e. active tenures). Mine footprints were estimated from the Permitted Mine Areas - Major Mine layer.

For the purposes of this analysis, 'other' disturbance includes disturbance from settlements, agriculture, industrial and commercial areas, mines, pipelines, transmission lines, and railways.

Natural Disturbance Characterization

The Fire Perimeters layer was used to estimate fire disturbance within the last 25 years (i.e. fires post 1994), consistent with the approach used by the Pacific Salmon Foundation (2020).

Riparian Disturbance Calculation

In order to report estimated total disturbed areas by disturbance type without overlaps, a hierarchy based on predicted degree of disturbance was applied: overlapping 'other' disturbances (railways, transmission lines, mines, settlements, and tenures) were removed from harvested areas, 'other' disturbances and harvested areas were removed from road areas, and 'other' disturbances, harvested areas, and road areas were removed from fire disturbance areas.

Riparian disturbance was calculated by merging all the disturbance layers into a total disturbance layer which was divided by the riparian area within each assessment unit using IWAP assessment watersheds as assessment units. Figure 2 shows the location and types of land cover alteration with respect to the assessment units.

This analysis follows the methodology set out by PSF (2020) for Riparian Disturbance with the following adaptions:

- Substitution of the updated Kispiox Road Inventory for the DRA and FTEN datasets as it is considered to be the more accurate road layer for the study area;
- Application of the linear disturbance buffer widths provided by G. Buhr as they were considered more accurate for roads and more conservative for rail and transmission line disturbance;
- Use of agricultural Crown tenures to estimate agricultural land area instead of the outdated Baseline Thematic Mapping dataset; and
- Use of the municipality and reserves layers in order to estimate urban areas and settlements instead of the Vegetation Resource Index dataset.

Fish Habitat Characterization

The fish habitat and road crossings model (version 2.3.1) developed by Mount et al. (2011) and revised by Norris and Mount (2016) was used to identify and characterize streambank riparian habitat by fish presence. The model uses input data extracted from the BC Geographic Data Warehouse including the Freshwater Atlas Stream Network and Known Fish Observations among others to classify FWA stream features as fish habitat or non-fish habitat. Output from the fish habitat model classifies fish habitat as fish presence observed, fish presence inferred, or no fish presence inferred. For the purpose of this assessment, inferred fish presence includes habitat up to a 15% grade, the threshold for salmon habitat.

Riparian zones for streams and rivers were identified through the application of a 30 m buffer to stream/river features in the fish habitat and road crossings model and to river polygons, for which fish presence attributes were extrapolated through intersection with the fish habitat and road crossings model. Buffer features around islands or donuts were removed. Stream riparian area was calculated and summed for each assessment unit by fish habitat.

Stream riparian area and fish habitat characterization is provided for context only and is not used to assess or qualify riparian habitat disturbance in this analysis.

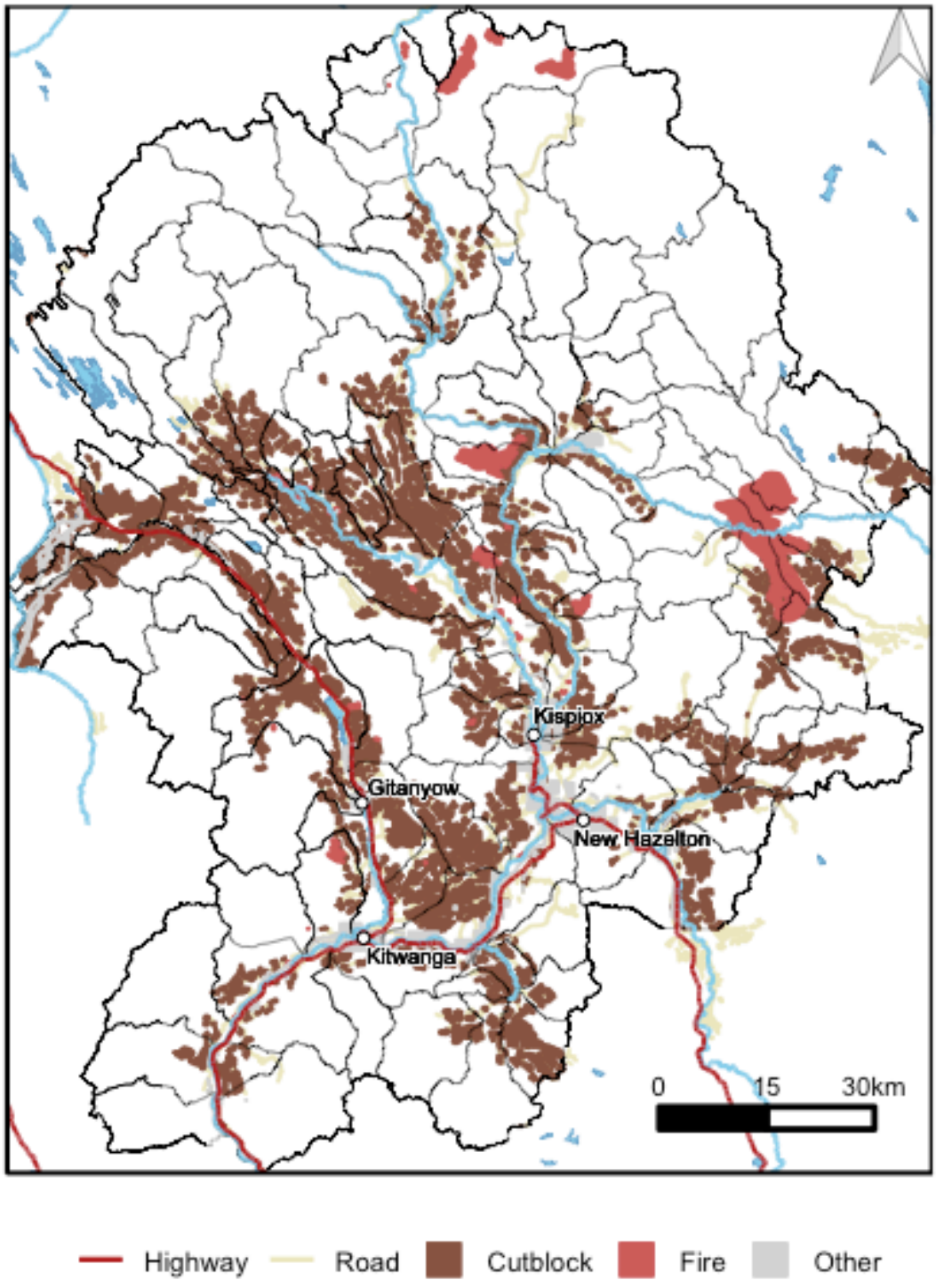

Figure 2: Assessment units and disturbance type located within the study area, including roads; forest harvesting; wildfire; and agricultural, industrial, utility, transportation, commercial, quarrying, residential and community land tenures, railways, powerlines, and settlements, shown collectively as other disturbance.

Risk Thresholds

Categorical risk thresholds applied were generated by the Pacific Salmon Foundation based on recommendations from the Wild Salmon Policy Habitat Working Group (Porter et al., 2014; Stalberg et al., 2009) and are tabulated below:

Threshold Rating	Percent of Riparian Area Disturbed (%)
Low	< 5 %
Moderate	5 - 15 %
High	> 15 %

Results of Analysis

A summary of the results of the riparian disturbance 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 C, and the distribution of the assessment results are shown as a series of figures in Appendix D. Riparian habitat characterization for each assessment unit is included as Appendix E.

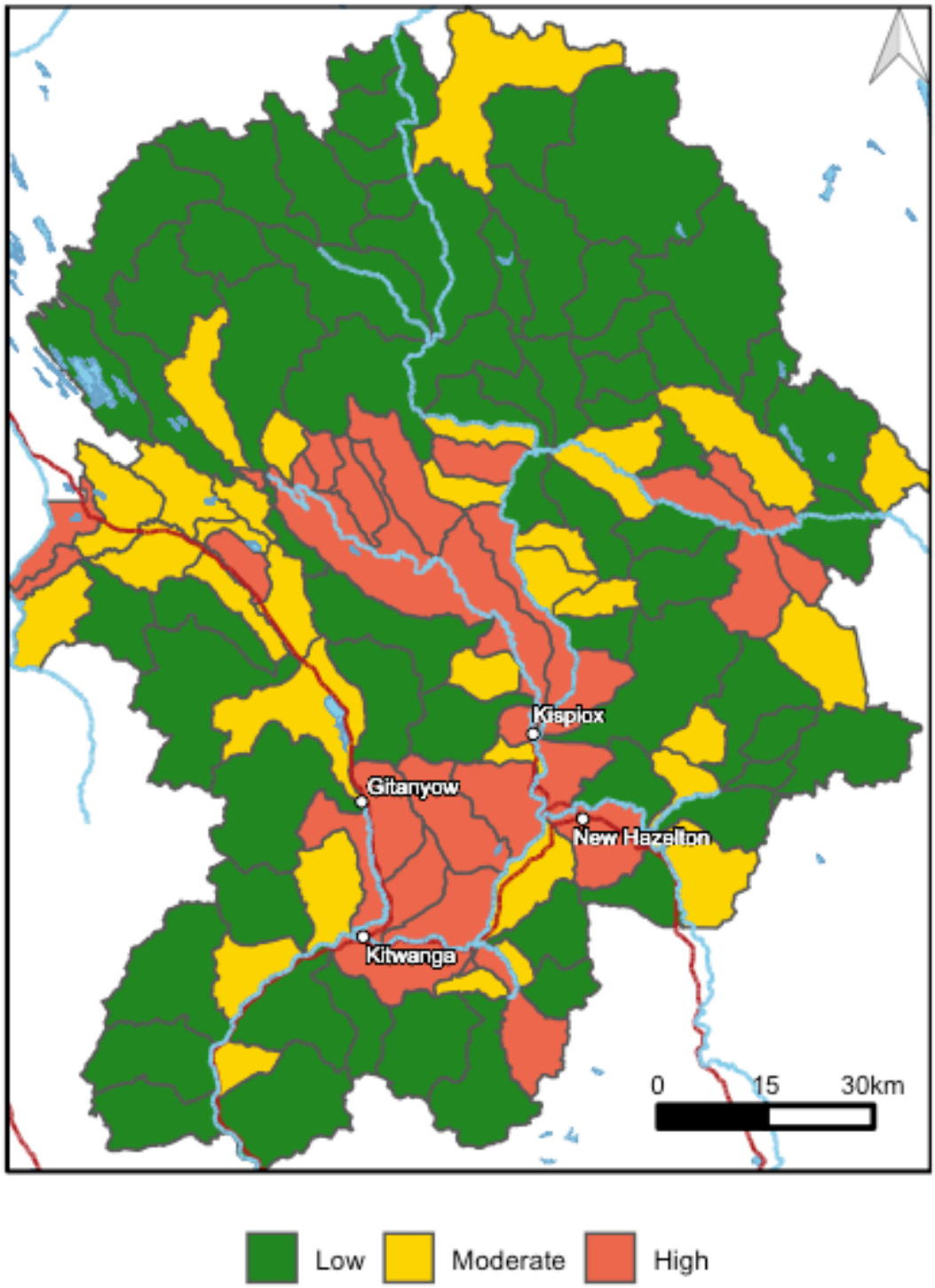

Figure 3: Riparian disturbance for each boundary in the study area is shown on a study area map. The results are colourized by risk threshold (low risk <5% disturbed, moderate risk 5-15% disturbed, and high risk >15% disturbed).

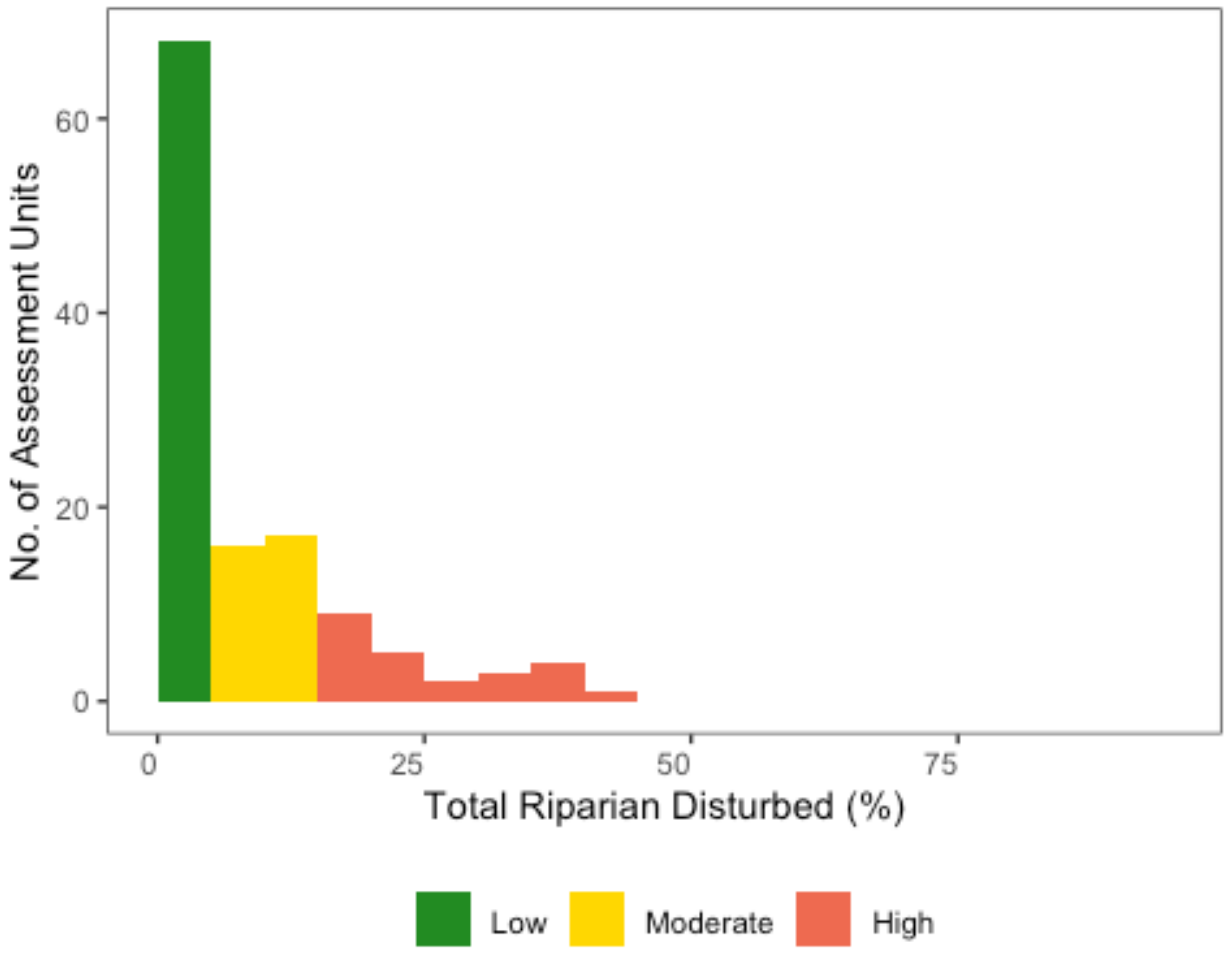

Figure 4: Distribution of results showing the number (count) of assessment units by riparian disturbance. The results are colorized by risk threshold (low risk <5% disturbed, moderate risk 5-15% disturbed, and high risk >15% disturbed).

Riparian disturbance was calculated for a total of 125 IWAP watersheds. Values ranged from 0 to a maximum of 41.4% (Figure 4; Appendix C and Appendix D). Twenty-four assessment units had riparian disturbance values above the threshold for high risk, and thirty-three assessment units were above the moderate risk threshold, with the majority situated within the central portion of the study area (Figure 3; Appendix C and Appendix D).

Total streambank riparian habitat for each assessment unit was characterized by modelled fish presence and is provided as Appendix E. Characterized habitat type is provided for context only and is not related to riparian disturbance in this analysis.

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

Riparian habitat was characterized and riparian disturbance estimations from forestry activities, roads, utility and railway corridors, and settlements were calculated for 125 IWAP 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 based on recommendations from the Wild Salmon Policy Habitat Working Group were used to assess risk to freshwater habitat as a result of riparian disturbance.

Results of the analysis indicated riparian disturbance ranged from 0 to 41.4% of riparian area disturbed, with IWAP watersheds within the central portion of the study area at moderate and high risk from riparian disturbance-related impacts to fish habitat.

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Appendix A: Reference Maps

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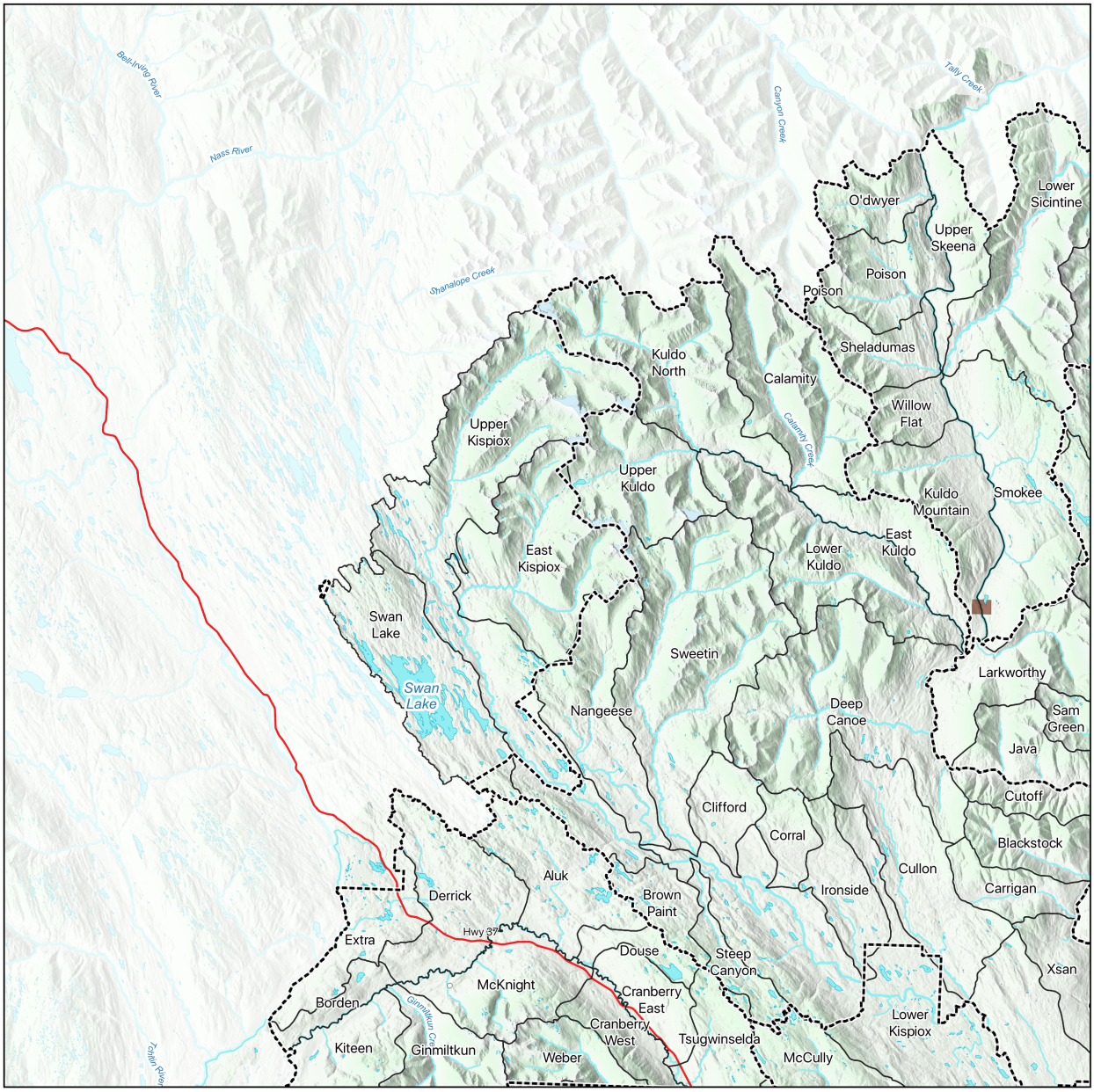
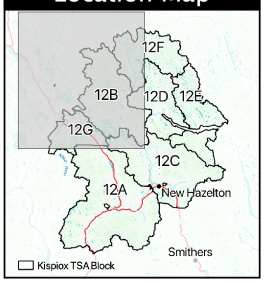
Kispiox Study Area Reference Map - Northwest



Location Map



Legend

Boundary

- IWAP Watershed Boundary
- Kispiox TSA Block
- Reserve Boundary

0 5 10 15 km

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June 2020

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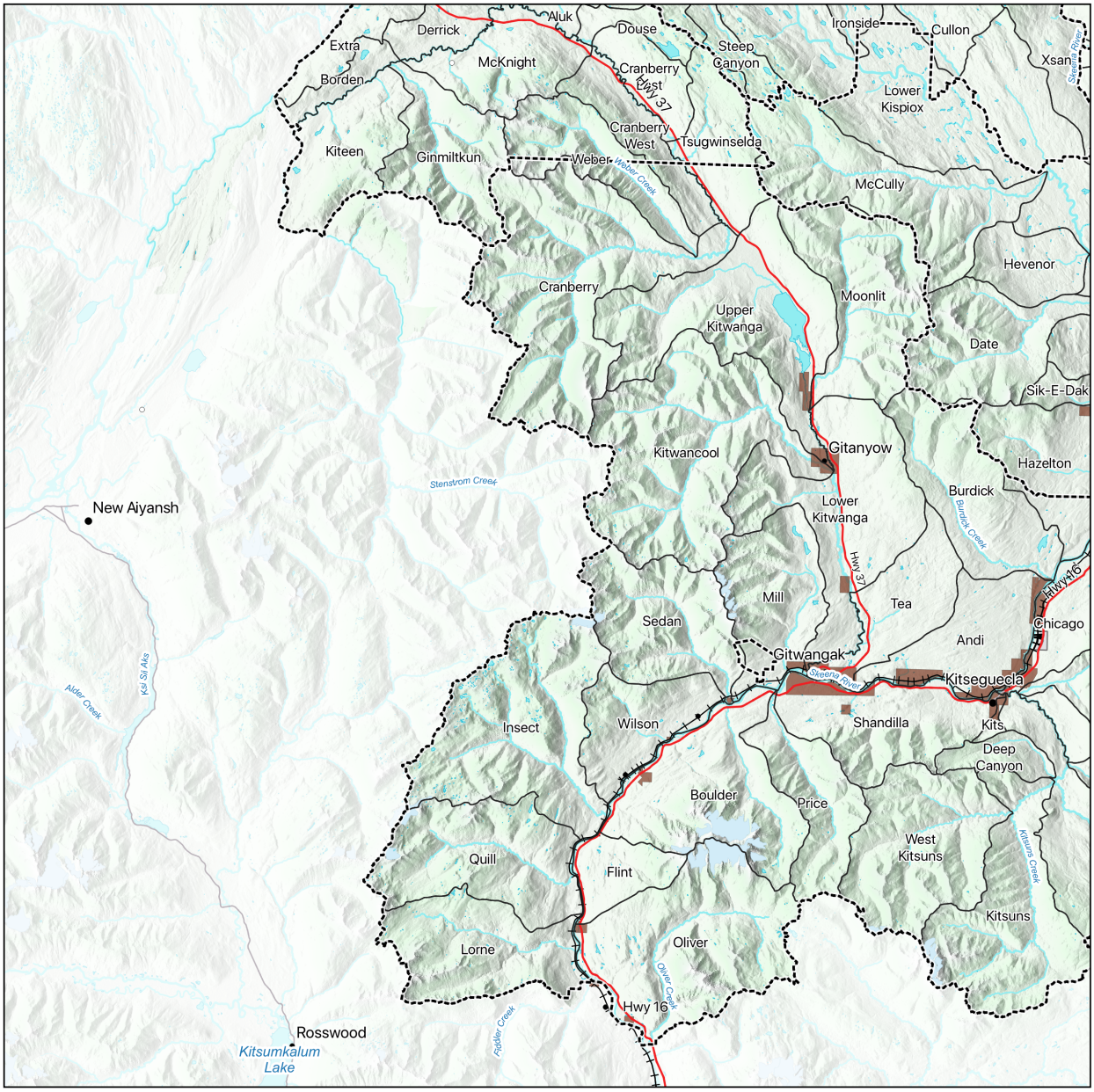
Kispiox Study Area Reference Map - Southwest



Location Map

Legend

Boundary

- IWAP Watershed Boundary
- Kispiox TSA Block
- Reserve Boundary

0 5 10 15 km

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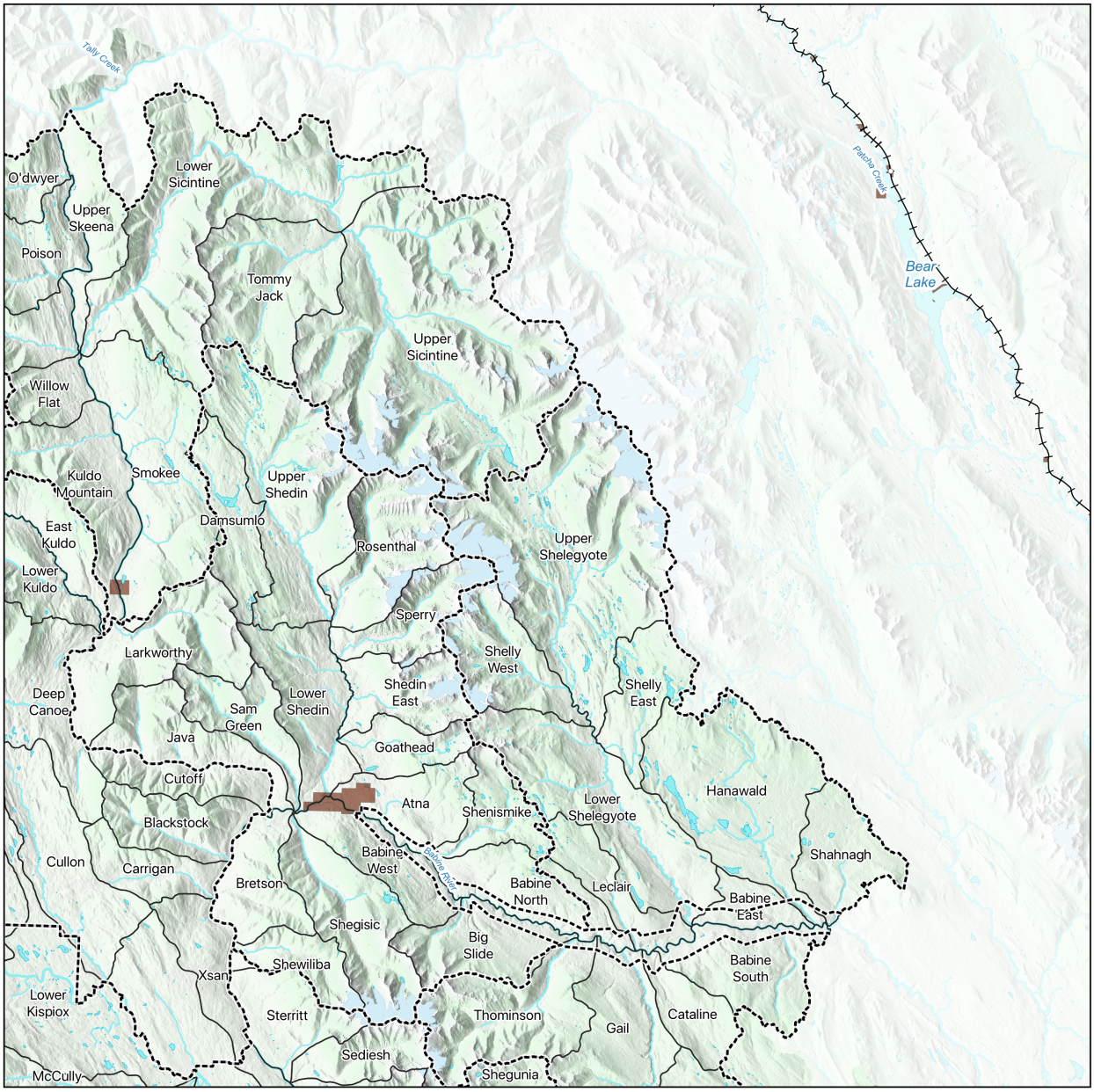
Kispiox Study Area Reference Map - Northeast



Location Map

Legend

Boundary

- IWAP Watershed Boundary
- Kispiox TSA Block
- Reserve Boundary

0 5 10 15 km

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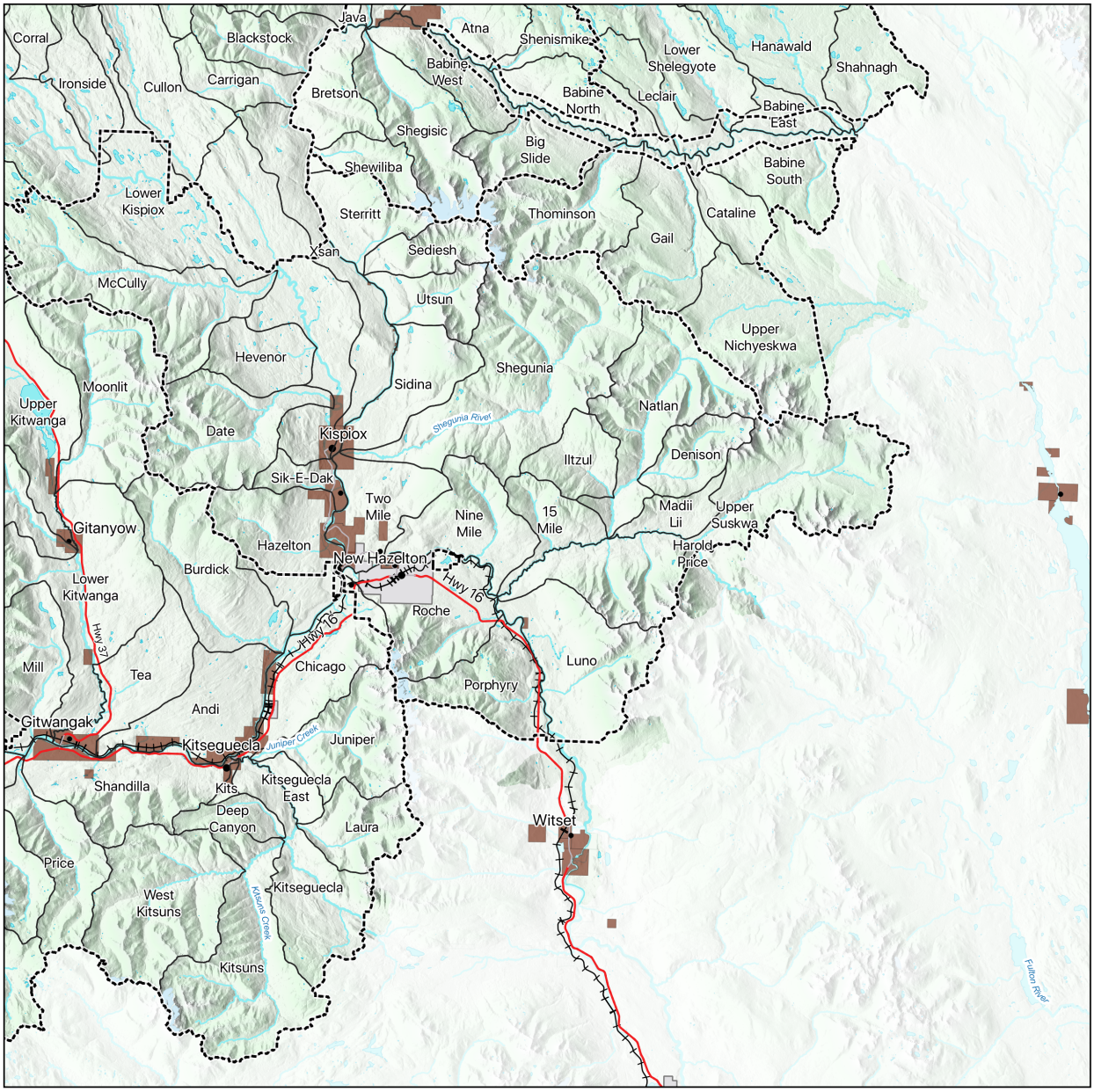
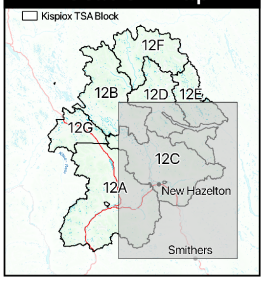
Kispiox Study Area Reference Map - Southeast



Location Map



Legend

Boundary

- IWAP Watershed Boundary
- Kispiox TSA Block
- Reserve Boundary

0 5 10 15 km

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Appendix B: Modelled Road Buffer Width Methodology

Description	Modelled Buffer Width (m)	FTEN Attributes	DRA Attributes
Trail	0	-	ROAD_CLASS = trail, driveway or proposed
Overgrown Road	5	-	RDSURFACE = overgrown or seasonal
Unimproved Road	10	-	ROAD_CLASS = resource or unclassified, RDSURFACE ≠ paved or overgrown, AND NUMLANES = 1
Resource Road	15	FIL_TP_DSC = Road Permit	ROAD_CLASS = resource, recreation or unclassified, RDSURFACE ≠ rough, paved, overgrown or seasonal, AND NUMLANES = 2
Main Resource Road	20	FIL_TP_DSC = Forest Service Road	ROAD_CLASS = resource or unclassified, AND RDSURFACE = rough, AND NUMLANES = 2
MOT/Local Road	25	-	ROAD_CLASS = local, arterial, service, or strata, OR RDSURFACE = paved, AND ROAD_CLASS ≠ trail or highway
Highways	50	-	ROAD_CLASS = highway

Notes:

FIL_TP_DSC = file type description

RDSURFACE = road surface

NUMLANE = number of lanes

Appendix C: Results Tables

The following table presents results of riparian disturbance analysis by reference assessment unit. Calculated fields include total riparian area, disturbed riparian area by type with overlaps removed, total riparian area disturbed, percent of riparian area disturbed, and risk for each assessment unit as determined by Pacific Salmon Foundation thresholds.

Assessment Unit	Total Riparian (km^2)	Riparian				Total Riparian Disturbed (km^2)	Percent Disturbed (%)	Risk
		Roads	Harvested (Post 1959)	Other	Fire Disturbance (Post 1994)			
15 Mile	4.65	0.03	0.23	0.00	0.00	0.26	5.65	Moderate
Aluk	12.05	0.03	1.22	0.08	0.00	1.33	11.03	Moderate
Andi	9.82	0.03	2.90	1.14	0.00	4.07	41.45	High
Atna	7.91	0.01	0.08	0.74	0.00	0.83	10.52	Moderate
Babine East	3.52	0.00	0.00	0.00	0.00	0.00	0.00	Low
Babine North	11.04	0.00	0.00	0.00	2.33	2.33	21.12	High
Babine South	9.20	0.04	0.21	0.00	0.10	0.35	3.81	Low
Babine West	6.02	0.03	0.19	0.36	0.00	0.58	9.67	Moderate
Big Slide	9.23	0.00	0.01	0.00	0.00	0.01	0.11	Low
Blackstock	8.39	0.00	0.76	0.00	2.54	3.30	39.31	High
Borden	2.84	0.01	0.50	0.05	0.00	0.56	19.61	High
Boulder	11.96	0.14	0.20	0.11	0.00	0.45	3.74	Low
Bretson	7.40	0.05	0.19	0.00	0.00	0.24	3.22	Low
Brown Paint	4.93	0.02	0.69	0.00	0.00	0.71	14.39	Moderate
Burdick	14.24	0.05	2.72	0.02	0.00	2.80	19.63	High
Calamity	25.27	0.00	0.00	0.00	0.00	0.00	0.00	Low
Carrigan	5.70	0.03	0.65	0.00	0.00	0.68	11.93	Moderate
Cataline	3.33	0.02	0.33	0.00	0.92	1.26	38.02	High
Chicago	10.10	0.12	0.05	0.51	0.00	0.68	6.74	Moderate
Clifford	5.22	0.01	0.64	0.02	0.00	0.67	12.90	Moderate
Corral	3.85	0.01	0.58	0.00	0.00	0.60	15.53	High
Cranberry	35.61	0.01	0.19	0.00	0.00	0.20	0.56	Low
Cranberry East	4.90	0.04	0.90	0.02	0.00	0.97	19.88	High
Cranberry West	7.84	0.03	0.88	0.00	0.00	0.91	11.64	Moderate
Cullon	16.04	0.04	4.79	0.00	0.00	4.82	30.08	High
Cutoff	6.01	0.00	0.28	0.00	0.03	0.31	5.20	Moderate
Damsumlo	12.85	0.03	0.07	0.00	0.00	0.09	0.74	Low
Date	16.59	0.03	0.37	0.09	0.00	0.50	3.02	Low
Deep Canoe	31.90	0.10	1.05	0.00	0.00	1.15	3.61	Low
Deep Canyon	3.16	0.00	0.36	0.00	0.00	0.37	11.67	Moderate

Assessment Unit	Total Riparian (km^2)	Riparian				Total Riparian Disturbed (km^2)	Percent Disturbed (%)	Risk
		Roads	Harvested (Post 1959)	Other	Fire Disturbance (Post 1994)			
Denison	9.52	0.00	0.21	0.00	0.00	0.22	2.29	Low
Derrick	12.68	0.06	1.69	0.00	0.00	1.75	13.78	Moderate
Douse	3.55	0.00	0.29	0.04	0.00	0.33	9.38	Moderate
East Kispiox	29.89	0.00	0.00	0.00	0.00	0.00	0.00	Low
East Kuldo	9.86	0.00	0.16	0.00	0.00	0.17	1.72	Low
Extra	6.38	0.02	1.78	0.33	0.00	2.13	33.39	High
Flint	2.75	0.12	0.26	0.01	0.00	0.39	14.27	Moderate
Gail	10.46	0.02	0.56	0.00	2.87	3.45	32.99	High
Ginmiltkun	14.87	0.00	0.52	0.00	0.00	0.52	3.52	Low
Goathead	5.73	0.01	0.11	0.00	0.00	0.12	2.07	Low
Hanawald	23.53	0.00	0.06	0.00	0.00	0.06	0.27	Low
Harold Price	0.29	0.00	0.00	0.00	0.00	0.01	3.11	Low
Hazelton	11.51	0.11	1.24	0.58	0.00	1.93	16.77	High
Hevenor	6.27	0.04	0.80	0.00	0.00	0.84	13.42	Moderate
Iltzul	5.95	0.03	0.36	0.00	0.00	0.39	6.56	Moderate
Insect	25.01	0.00	0.00	0.03	0.00	0.04	0.15	Low
Ironside	6.69	0.01	1.43	0.00	0.00	1.45	21.61	High
Java	10.53	0.03	0.16	0.00	0.00	0.18	1.74	Low
Juniper	10.55	0.04	0.02	0.01	0.00	0.08	0.74	Low
Kiteen	10.05	0.02	1.15	0.08	0.00	1.25	12.39	Moderate
Kits	0.36	0.00	0.02	0.11	0.00	0.13	37.01	High
Kitseguecla	11.49	0.02	2.69	0.01	0.00	2.73	23.76	High
Kitseguecla East	0.98	0.01	0.13	0.00	0.00	0.13	13.38	Moderate
Kitsuns	23.83	0.01	0.40	0.00	0.00	0.41	1.72	Low
Kitwancool	31.85	0.01	0.25	0.21	0.01	0.47	1.47	Low
Kuldo Mountain	12.43	0.04	0.24	0.09	0.00	0.37	2.98	Low
Kuldo North	31.32	0.00	0.00	0.00	0.00	0.00	0.00	Low
Larkworthy	14.35	0.00	0.00	0.00	0.00	0.00	0.01	Low
Laura	7.66	0.01	0.15	0.00	0.00	0.16	2.06	Low
Leclair	7.56	0.00	0.00	0.00	2.06	2.06	27.28	High
Lorne	13.53	0.00	0.00	0.03	0.00	0.03	0.19	Low
Lower Kispiox	46.83	0.26	6.83	0.86	0.77	8.73	18.64	High
Lower Kitwanga	16.79	0.15	1.84	0.58	0.00	2.57	15.31	High
Lower Kuldo	23.13	0.00	0.07	0.00	0.00	0.07	0.30	Low

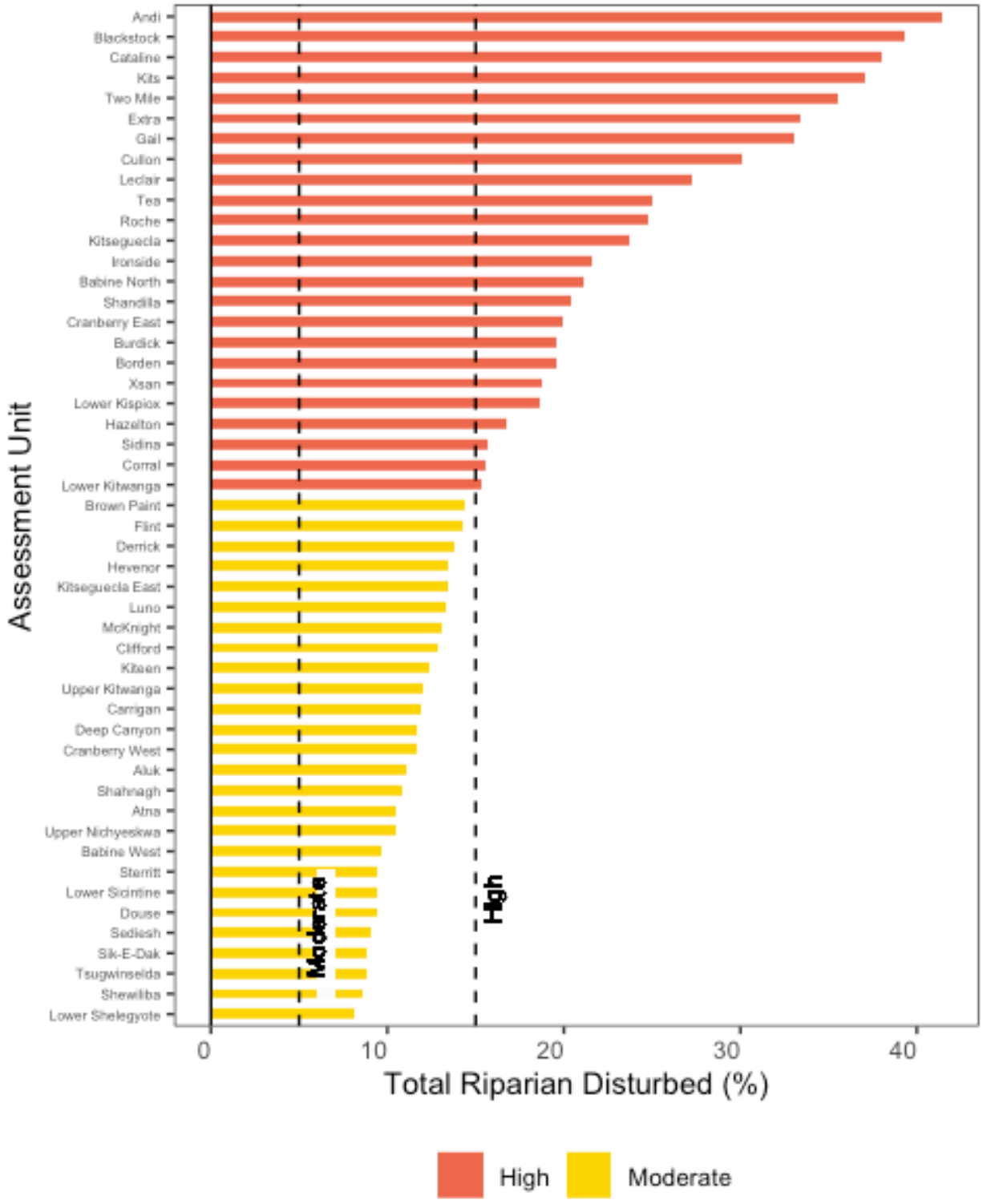
eclipse GEOMATICS

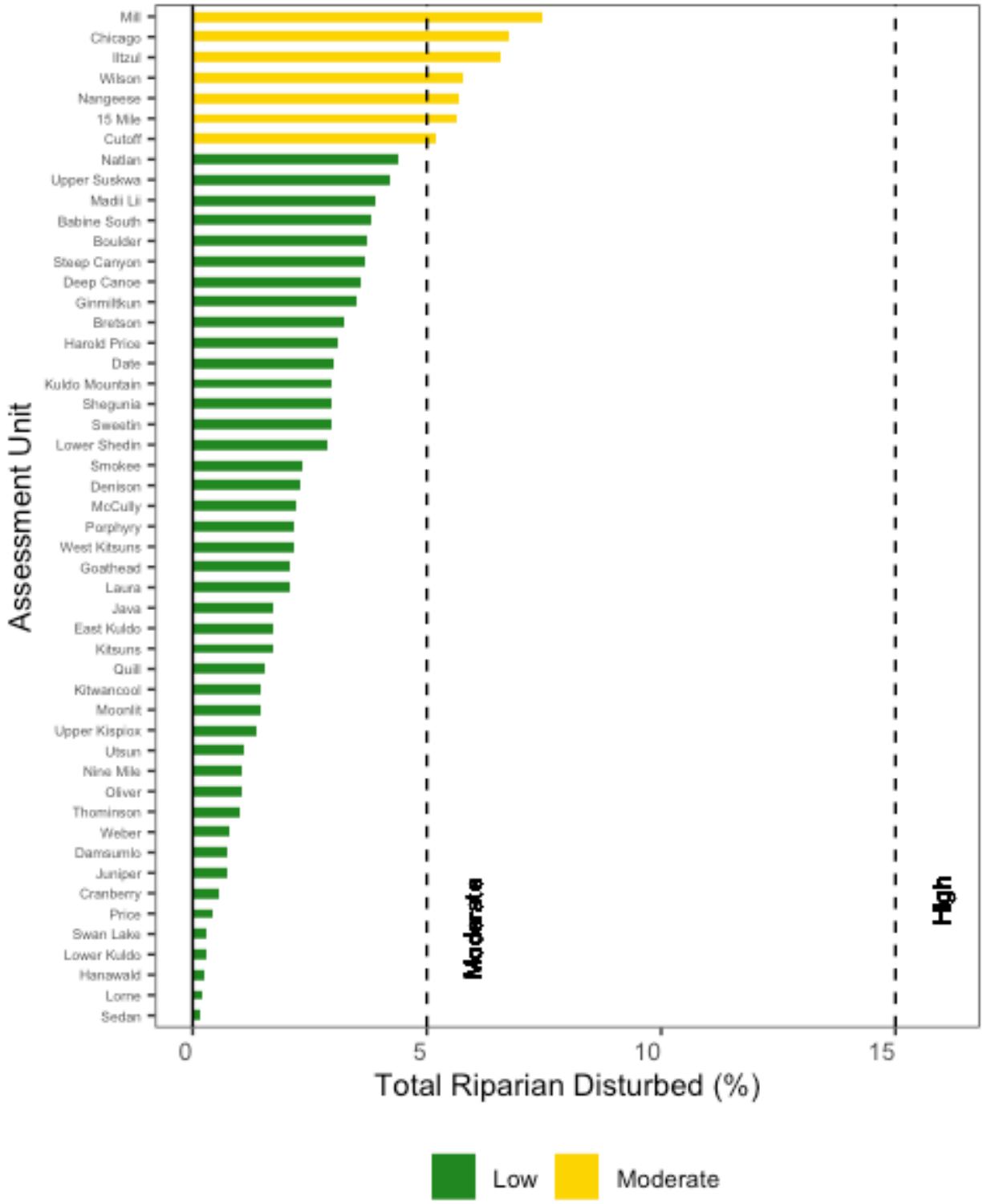
Assessment Unit	Total Riparian (km^2)	Riparian				Total Riparian Disturbed (km^2)	Percent Disturbed (%)	Risk
		Roads	Harvested (Post 1959)	Other	Fire Disturbance (Post 1994)			
Lower Shedin	11.65	0.02	0.19	0.13	0.00	0.34	2.89	Low
Lower Shelegyote	23.22	0.00	0.00	0.00	1.88	1.88	8.08	Moderate
Lower Sicintine	37.84	0.00	0.00	0.00	3.57	3.57	9.43	Moderate
Luno	13.69	0.03	1.71	0.08	0.00	1.82	13.29	Moderate
Madii Lii	2.81	0.01	0.10	0.00	0.00	0.11	3.92	Low
McCully	23.42	0.06	0.45	0.00	0.00	0.52	2.21	Low
McKnight	13.37	0.10	1.64	0.01	0.00	1.75	13.07	Moderate
Mill	11.41	0.02	0.46	0.13	0.24	0.85	7.48	Moderate
Moonlit	20.89	0.03	0.21	0.06	0.00	0.30	1.43	Low
Nangeese	14.70	0.02	0.80	0.01	0.00	0.84	5.68	Moderate
Natlan	24.28	0.04	1.03	0.00	0.00	1.07	4.41	Low
Nine Mile	8.85	0.04	0.02	0.04	0.00	0.09	1.07	Low
O'dwyer	6.56	0.00	0.00	0.00	0.00	0.00	0.00	Low
Oliver	20.76	0.09	0.05	0.07	0.00	0.21	1.03	Low
Poison	9.97	0.00	0.00	0.00	0.00	0.00	0.00	Low
Porphyry	9.86	0.06	0.00	0.15	0.00	0.21	2.16	Low
Price	8.41	0.00	0.03	0.00	0.00	0.04	0.42	Low
Quill	11.05	0.00	0.10	0.07	0.00	0.17	1.52	Low
Roche	11.60	0.04	0.11	2.72	0.00	2.88	24.81	High
Rosenthal	14.87	0.00	0.00	0.00	0.00	0.00	0.00	Low
Sam Green	8.44	0.00	0.00	0.00	0.00	0.00	0.02	Low
Sedan	17.04	0.00	0.00	0.03	0.00	0.03	0.18	Low
Sediesh	4.88	0.00	0.22	0.00	0.22	0.44	9.06	Moderate
Shahnagh	8.57	0.01	0.92	0.00	0.00	0.93	10.87	Moderate
Shandilla	13.44	0.07	1.54	1.13	0.00	2.74	20.35	High
Shedin East	9.19	0.00	0.01	0.00	0.00	0.01	0.11	Low
Shegisic	12.12	0.00	0.01	0.00	0.00	0.02	0.13	Low
Shegunia	33.28	0.07	0.82	0.10	0.00	0.99	2.96	Low
Sheladumas	8.07	0.00	0.00	0.00	0.00	0.00	0.00	Low
Shelly East	10.84	0.00	0.00	0.00	0.00	0.00	0.00	Low
Shelly West	12.05	0.00	0.00	0.00	0.00	0.00	0.00	Low
Shenismike	7.51	0.00	0.00	0.00	0.00	0.00	0.00	Low
Shewiliba	4.76	0.01	0.40	0.00	0.00	0.41	8.62	Moderate
Sidina	6.55	0.02	0.61	0.40	0.00	1.03	15.70	High
Sik-E-Dak	2.29	0.00	0.00	0.20	0.00	0.20	8.87	Moderate

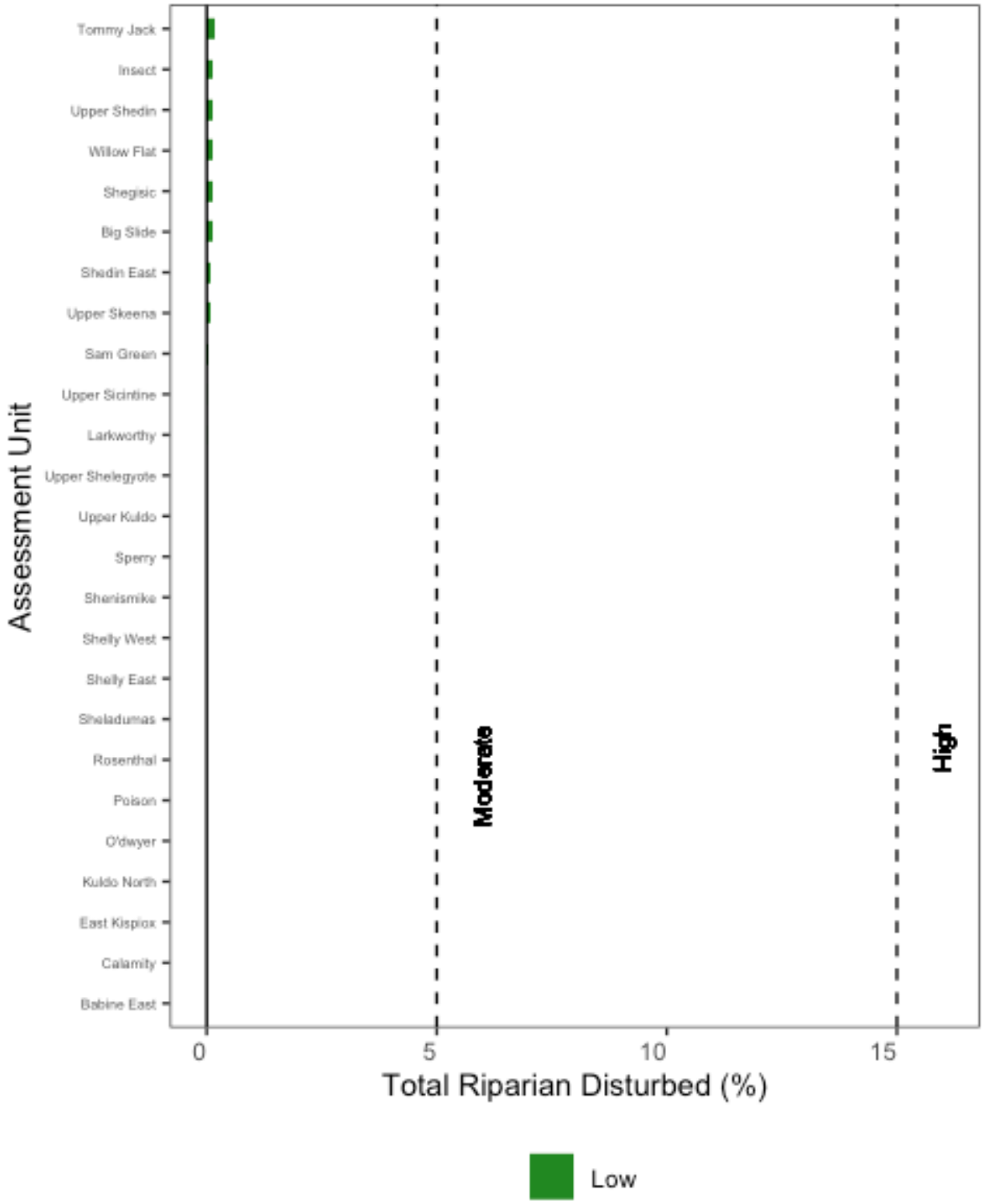
Assessment Unit	Total Riparian (km^2)	Riparian				Total Riparian Disturbed (km^2)	Percent Disturbed (%)	Risk
		Roads	Harvested (Post 1959)	Other	Fire Disturbance (Post 1994)			
Smokee	21.35	0.06	0.40	0.04	0.00	0.50	2.35	Low
Sperry	8.41	0.00	0.00	0.00	0.00	0.00	0.00	Low
Steep Canyon	4.96	0.01	0.17	0.00	0.00	0.18	3.68	Low
Sterritt	6.93	0.02	0.64	0.00	0.00	0.66	9.48	Moderate
Swan Lake	21.04	0.00	0.06	0.00	0.00	0.06	0.31	Low
Sweetin	34.80	0.03	0.99	0.00	0.00	1.03	2.95	Low
Tea	9.07	0.15	1.81	0.30	0.00	2.27	25.02	High
Thominson	10.51	0.01	0.00	0.00	0.09	0.10	0.99	Low
Tommy Jack	15.40	0.02	0.00	0.00	0.00	0.02	0.16	Low
Tsugwinselda	7.83	0.04	0.65	0.01	0.00	0.69	8.86	Moderate
Two Mile	5.47	0.11	0.35	1.48	0.00	1.94	35.53	High
Upper Kispiox	54.58	0.03	0.65	0.06	0.00	0.74	1.36	Low
Upper Kitwanga	20.20	0.18	1.80	0.43	0.02	2.43	12.00	Moderate
Upper Kuldo	17.05	0.00	0.00	0.00	0.00	0.00	0.00	Low
Upper Nichyeskwa	16.63	0.03	0.69	0.00	1.03	1.75	10.52	Moderate
Upper Shedin	32.41	0.04	0.00	0.00	0.00	0.04	0.13	Low
Upper Shelegyote	49.86	0.00	0.00	0.00	0.00	0.00	0.00	Low
Upper Sicintine	55.17	0.00	0.00	0.00	0.00	0.00	0.01	Low
Upper Skeena	5.27	0.00	0.00	0.00	0.01	0.01	0.10	Low
Upper Suskwa	30.99	0.04	1.27	0.00	0.00	1.31	4.22	Low
Utsun	7.16	0.00	0.07	0.01	0.00	0.08	1.11	Low
Weber	12.50	0.00	0.09	0.00	0.00	0.10	0.79	Low
West Kitsuns	18.97	0.02	0.39	0.00	0.00	0.41	2.15	Low
Willow Flat	3.86	0.00	0.00	0.00	0.00	0.00	0.13	Low
Wilson	7.01	0.03	0.23	0.12	0.03	0.40	5.76	Moderate
Xsan	8.72	0.05	1.35	0.20	0.03	1.63	18.74	High

Appendix D: Results Distribution

Results are colourized by risk threshold (low risk < 0.40 km/km^2, moderate risk 0.40-1.2 km/km^2, high risk >1.2 km/km^2).




Assessment Unit
Mill
Chicago
Itzul
Wilson
Nangeese
15 Mile
Cutoff
Natlan
Upper Suskwa
Madli Lli
Babine South
Boulder
Steep Canyon
Deep Canoe
Ginmiltkun
Bretson
Harold Price
Date
Kuldo Mountain
Shegunia
Sweatin
Lower Shedin
Smokee
Denison
McCully
Porphyry
West Kitsuns
Goathead
Laura
Java
East Kuldo
Kitsuns
Quill
Kitwancool
Moonlit
Upper Kispiox
Utsun
Nine Mile
Oliver
Thominson
Weber
Damsumlo
Juniper
Cranberry
Price
Swan Lake
Lower Kuldo
Hanawald
Lorne
Sedan
0
5
10
15
Total Riparian Disturbed (%)
Moderate
High
Low
Moderate


Assessment Unit
Tommy Jack
Insect
Upper Shedin
Willow Flat
Shegisic
Big Slide
Shedin East
Upper Skeena
Sam Green
Upper Sicintine
Larkworthy
Upper Shelegyote
Upper Kuldo
Sperry
Shenismike
Shelly West
Shelly East
Sheladumas
Rosenthal
Poison
O'dwyer
Kuldo North
East Kispiox
Calamity
Babine East
0
5
10
15
Total Riparian Disturbed (%)
Moderate
High
Low

Appendix E: Riparian Habitat Characterization

Results of stream and river riparian characterization based on the Fish Habitat and Road Crossings Model (BC MECCS, 2019). Characterized habitat type is provided for context only and is not related to riparian disturbance in this analysis.

Assessment Unit	Total Area (km^2)	Riparian Area by Type (km^2)			Total Stream Riparian (km^2)	Stream Riparian as % of Total Area
		Fish Presence Observed	Fish Presence Inferred	No Fish Presence Inferred		
15 Mile	44.17	0.46	0.10	3.99	4.54	10.29
Aluk	92.47	0.33	3.15	7.17	10.65	11.52
Andi	95.46	0.80	2.68	5.98	9.46	9.91
Atna	59.47	0.33	0.04	7.10	7.48	12.58
Babine East	27.33	0.36	0.58	2.35	3.29	12.02
Babine North	71.80	0.73	0.28	9.52	10.53	14.67
Babine South	79.19	0.63	1.41	6.71	8.75	11.05
Babine West	58.02	0.61	0.00	4.96	5.58	9.61
Big Slide	66.94	0.38	0.13	8.49	9.00	13.44
Blackstock	58.65	0.17	0.03	7.94	8.14	13.89
Borden	24.06	0.50	0.56	1.69	2.75	11.43
Boulder	157.08	0.66	1.02	9.76	11.44	7.28
Bretson	57.83	0.57	0.03	6.54	7.14	12.36
Brown Paint	36.41	0.36	0.75	2.96	4.07	11.18
Burdick	125.74	0.18	2.67	10.75	13.60	10.82
Calamity	143.52	0.00	2.52	22.22	24.74	17.24
Carrigan	42.75	0.25	0.51	4.80	5.56	13.00
Cataline	40.65	0.34	1.45	1.33	3.12	7.67
Chicago	97.58	1.33	1.78	6.60	9.70	9.95
Clifford	39.54	0.68	1.59	2.73	4.99	12.63
Corral	29.92	0.47	0.70	2.56	3.73	12.48
Cranberry	258.28	1.87	1.50	31.15	34.52	13.37
Cranberry East	44.19	0.57	0.51	3.45	4.54	10.27
Cranberry West	57.15	0.84	1.04	5.55	7.43	13.00
Cullon	122.83	1.78	6.07	7.59	15.44	12.57
Cutoff	40.70	0.63	0.01	5.29	5.93	14.56
Damsumlo	59.14	0.35	2.53	8.00	10.88	18.39
Date	114.07	0.46	1.35	14.42	16.23	14.23
Deep Canoe	221.24	1.18	1.63	27.82	30.63	13.84
Deep Canyon	26.81	0.03	0.50	2.56	3.09	11.52
Denison	48.43	0.06	0.74	8.43	9.23	19.06
Derrick	104.65	1.25	3.81	6.76	11.83	11.30
Douse	23.68	0.07	0.51	2.43	3.01	12.72

Assessment Unit	Total Area (km^2)	Riparian Area by Type (km^2)			Total Stream Riparian (km^2)	Stream Riparian as % of Total Area
		Fish Presence Observed	Fish Presence Inferred	No Fish Presence Inferred		
East Kispiox	159.70	0.01	1.17	26.80	27.99	17.53
East Kuldo	58.96	0.75	0.11	8.66	9.52	16.15
Extra	59.56	0.34	0.81	4.34	5.49	9.22
Flint	44.50	0.34	0.02	2.14	2.49	5.61
Gail	101.39	0.15	1.27	8.57	9.99	9.85
Ginmiltkun	100.37	0.17	1.40	12.87	14.44	14.39
Goathead	37.89	0.00	1.20	4.16	5.36	14.14
Hanawald	171.46	0.36	14.01	5.75	20.12	11.74
Harold Price	2.36	0.06	0.03	0.18	0.28	11.82
Hazelton	105.88	0.54	1.67	8.93	11.13	10.51
Hevenor	53.93	1.07	3.29	1.49	5.85	10.85
Iltzul	46.48	0.54	0.24	5.13	5.91	12.72
Insect	206.96	1.00	0.43	21.53	22.96	11.09
Ironside	54.75	2.11	2.71	1.49	6.32	11.54
Java	66.66	0.73	0.06	9.56	10.34	15.52
Juniper	92.62	0.58	0.51	9.22	10.31	11.13
Kiteen	93.65	1.24	1.00	7.26	9.50	10.14
Kits	3.80	0.00	0.01	0.34	0.35	9.29
Kitseguecla	105.43	2.02	1.04	8.13	11.19	10.61
Kitseguecla East	18.43	0.29	0.01	0.66	0.96	5.21
Kitsuns	163.67	2.19	0.95	20.23	23.37	14.28
Kitwancool	242.75	1.38	2.54	27.15	31.07	12.80
Kuldo Mountain	96.84	0.76	0.34	10.91	12.02	12.41
Kuldo North	161.22	0.33	3.08	27.14	30.55	18.95
Larkworthy	105.27	0.65	0.62	12.68	13.95	13.25
Laura	58.15	0.09	0.16	7.21	7.46	12.82
Leclair	47.45	0.33	0.71	5.52	6.56	13.82
Lorne	121.90	0.61	0.26	12.07	12.94	10.62
Lower Kispiox	445.68	9.55	18.71	13.57	41.82	9.38
Lower Kitwanga	178.59	1.97	1.31	12.94	16.23	9.09
Lower Kuldo	138.84	1.07	0.88	20.30	22.24	16.02
Lower Shedin	82.54	0.99	0.92	9.43	11.34	13.74
Lower Shelegyote	154.43	2.09	3.11	16.39	21.59	13.98
Lower Sicintine	274.37	2.58	3.58	30.44	36.60	13.34

Assessment Unit	Total Area (km^2)	Riparian Area by Type (km^2)			Total Stream Riparian (km^2)	Stream Riparian as % of Total Area
		Fish Presence Observed	Fish Presence Inferred	No Fish Presence Inferred		
Luno	125.91	1.10	1.63	10.10	12.83	10.19
Madii Lii	28.68	0.33	0.54	1.90	2.76	9.63
McCully	169.02	0.85	2.68	18.09	21.62	12.79
McKnight	82.84	1.11	1.56	10.05	12.73	15.37
Mill	107.54	1.75	1.03	7.93	10.72	9.96
Moonlit	142.82	0.41	1.71	18.20	20.32	14.23
Nangeese	109.48	1.95	2.54	9.17	13.66	12.48
Natlan	137.62	1.46	1.56	20.75	23.78	17.28
Nine Mile	84.59	0.53	0.22	7.91	8.66	10.23
O'dwyer	48.44	0.13	0.31	5.78	6.23	12.86
Oliver	205.76	0.63	1.97	17.30	19.91	9.68
Poison	70.84	0.39	0.47	8.59	9.44	13.33
Porphyry	77.36	0.65	1.13	7.61	9.40	12.15
Price	80.93	0.03	0.54	7.62	8.19	10.12
Quill	145.76	0.30	0.01	10.15	10.46	7.17
Roche	111.68	1.76	2.07	7.13	10.97	9.82
Rosenthal	92.51	0.14	1.03	13.30	14.47	15.64
Sam Green	51.12	0.18	0.22	7.69	8.09	15.82
Sedan	121.55	1.23	0.16	15.21	16.60	13.66
Sediesh	43.50	0.00	0.16	4.59	4.75	10.92
Shahnagh	64.31	0.00	1.96	5.47	7.44	11.56
Shandilla	114.22	0.76	1.39	10.81	12.96	11.35
Shedin East	58.85	0.41	0.33	8.08	8.82	14.98
Shegisic	98.27	0.08	1.13	10.22	11.42	11.62
Shegunia	263.15	1.39	4.26	26.95	32.59	12.39
Sheladumas	55.83	0.21	0.13	7.55	7.89	14.13
Shelly East	59.22	0.12	2.68	6.02	8.81	14.88
Shelly West	75.86	0.55	1.14	9.86	11.54	15.21
Shenismike	44.67	0.19	0.05	6.18	6.42	14.36
Shewiliba	38.89	0.08	0.00	4.51	4.59	11.81
Sidina	70.72	0.42	1.20	4.77	6.39	9.03
Sik-E-Dak	22.10	0.18	0.27	1.71	2.16	9.76
Smokee	152.36	1.02	0.43	18.41	19.85	13.03
Sperry	56.19	0.17	0.66	7.38	8.21	14.61
Steep Canyon	31.80	0.19	0.56	2.96	3.71	11.68
Sterritt	58.05	0.36	0.15	6.06	6.58	11.33
Swan Lake	145.15	0.35	9.08	6.94	16.38	11.28

Assessment Unit	Total Area (km^2)	Riparian Area by Type (km^2)			Total Stream Riparian (km^2)	Stream Riparian as % of Total Area
		Fish Presence Observed	Fish Presence Inferred	No Fish Presence Inferred		
Sweetin	244.45	2.03	4.45	27.02	33.50	13.70
Tea	79.61	0.68	6.68	1.31	8.67	10.89
Thominson	111.14	0.90	0.63	8.64	10.17	9.15
Tommy Jack	120.82	0.78	1.70	12.25	14.74	12.20
Tsugwinselda	75.11	0.80	0.42	5.82	7.04	9.37
Two Mile	71.46	0.56	1.39	3.23	5.18	7.25
Upper Kispiox	330.67	3.10	10.67	35.26	49.03	14.83
Upper Kitwanga	194.62	1.50	2.69	14.91	19.09	9.81
Upper Kuldo	99.36	0.71	1.41	14.37	16.50	16.61
Upper Nichyeskwa	131.29	1.33	5.63	8.00	14.96	11.40
Upper Shedin	172.60	1.00	0.96	28.28	30.24	17.52
Upper Shelegyote	293.06	3.82	9.23	32.59	45.63	15.57
Upper Sicintine	418.47	1.99	6.63	44.90	53.52	12.79
Upper Skeena	53.04	0.78	0.01	4.35	5.14	9.69
Upper Suskwa	245.81	1.62	2.71	25.60	29.93	12.18
Utsun	49.16	0.18	0.19	6.56	6.93	14.10
Weber	86.32	0.56	0.76	10.62	11.95	13.84
West Kitsuns	149.94	0.38	1.26	16.90	18.54	12.37
Willow Flat	32.61	0.14	0.10	3.54	3.78	11.58
Wilson	80.49	0.78	0.73	5.23	6.74	8.37
Xsan	96.04	1.25	0.75	6.23	8.24	8.58