Introduction to River Architect

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Ecohydraulics

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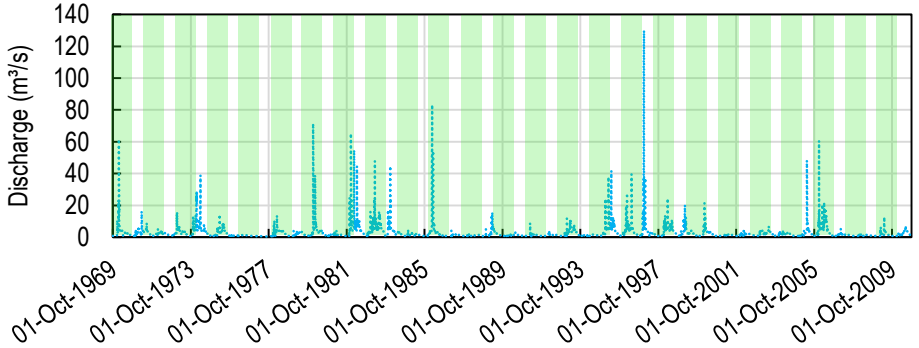
Ecohydraulic Assessments with River Architect

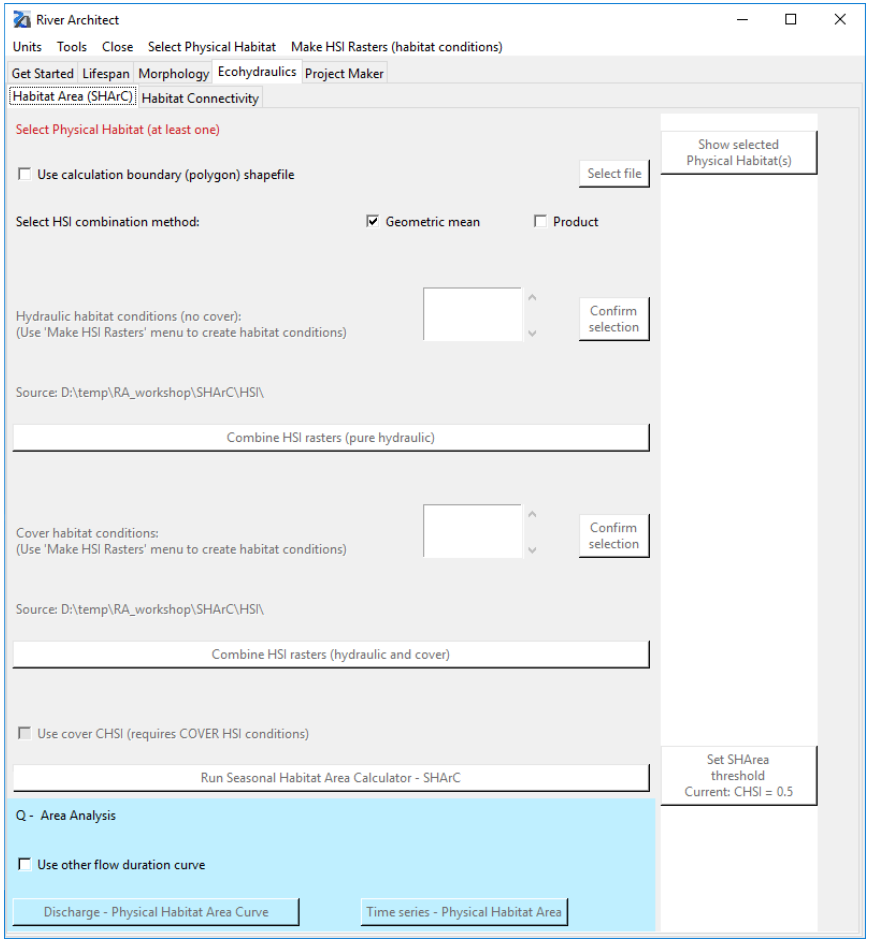
Definitions https://riverarchitect.github.io/RA_wiki/SHArC

Physical Habitat = Preferred depth & velocity (+ cover) of target fish species & lifestages

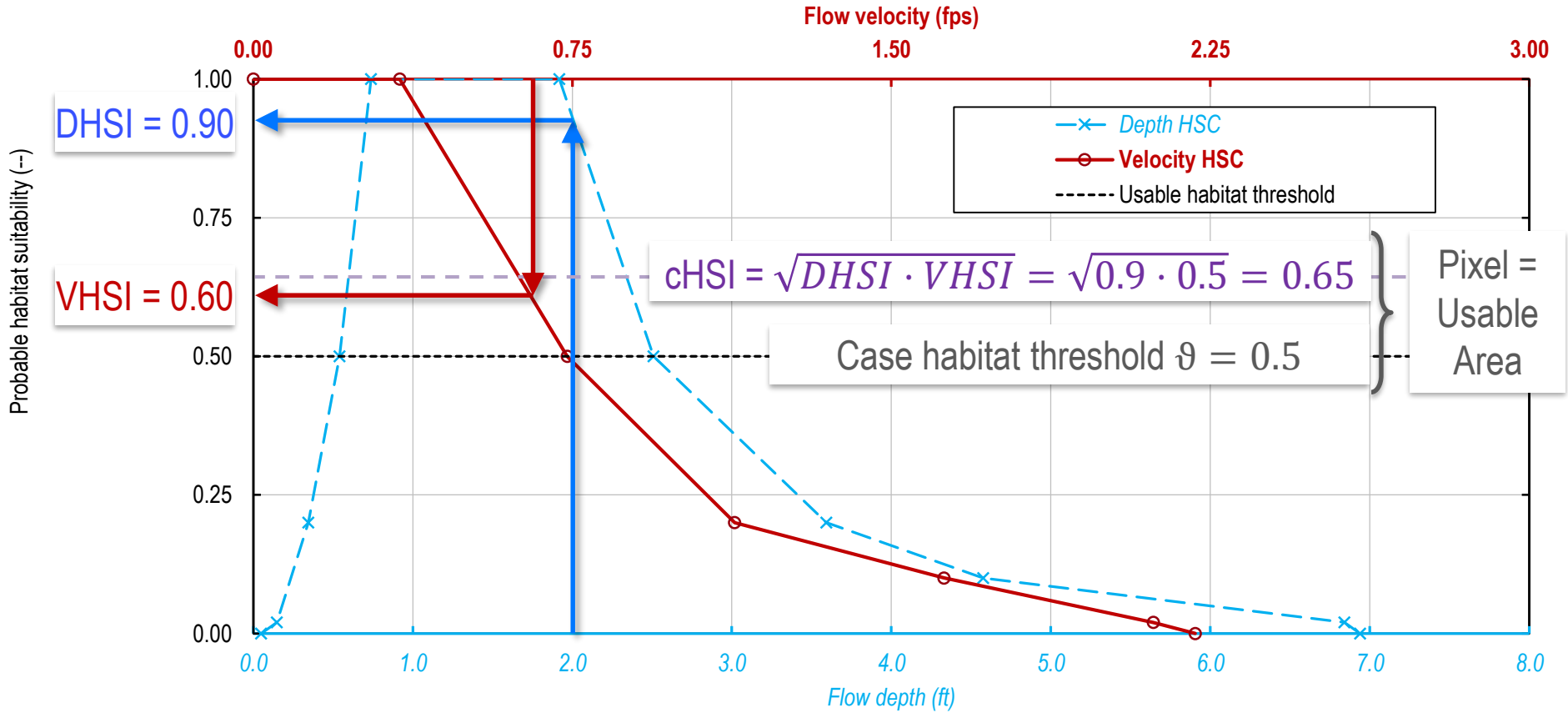
SHArC = **S**easonal **H**abitat **Ar**ea **C**alculator

SHArea = **S**easonal **H**abitat **Area**



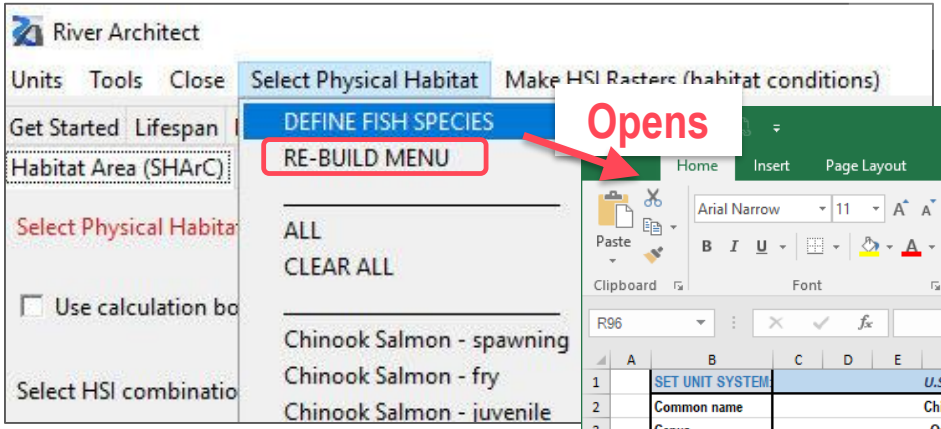


Physical Habitat Evaluation



Also Cover HSI "curves" can be defined (see Wiki)

Physical Habitat Evaluation



Opens

Defines

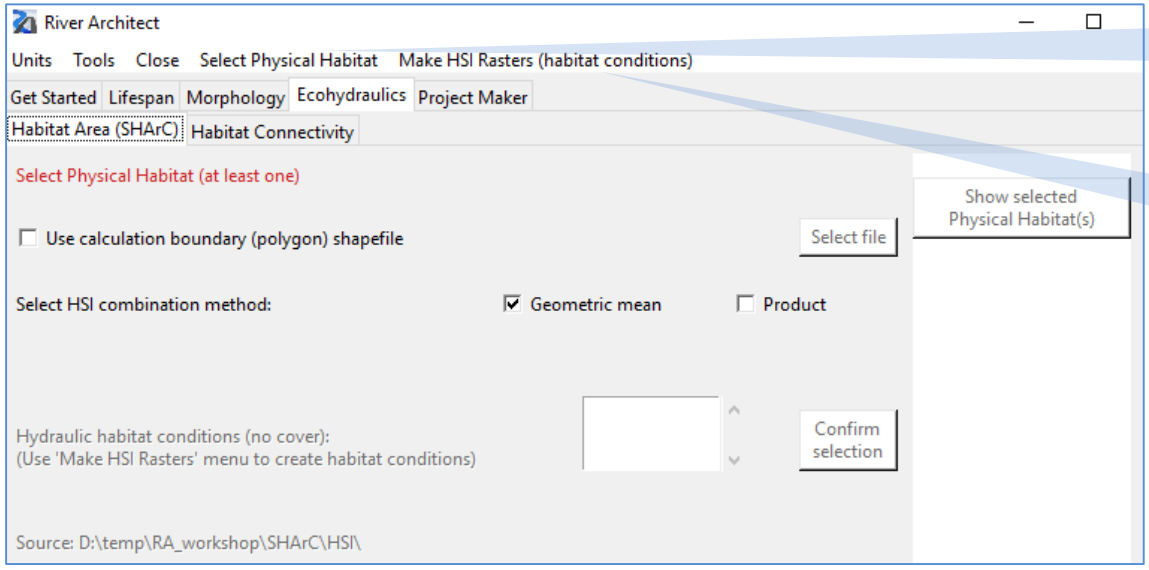
https://riverarchitect.github.io/RA_wiki/SHArC#hefish

Fish.xlsx - Excel

SET UNIT SYSTEM:	U.S. customary								u in (fps)		h in (ft)		D in (inch)		Rad. in (ft)					
Common name	Chinook Salmon								Rainbow / Steelhead Trout											Lamp
Genus	Oncorhynchus								Oncorhynchus											
Species	O. tshawytscha								O. mykiss											
Lifestages	spawning		fry		juvenile		adult		spawning		fry		juvenile		adult		spawning		ammocoetes	
Season start		1-Oct		1-Feb		16-Jun		1-Oct		1-Oct		1-Oct		1-Oct		1-Oct		1-Oct		1-Oct
Season end		30-Sep		15-Jun		29-Nov		30-Sep		30-Sep		30-Sep		30-Sep		30-Sep		30-Sep		30-Sep
	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)
	0.22	0.00	0.00	1.00	0.00	1.00			0.06	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00
	0.85	0.20	0.10	0.99	0.10	1.00			0.77	0.10	0.10	1.00	0.10	1.00	0.50	0.80	0.66	1.00	0.16	0.83
	1.30	0.52	0.20	0.95	0.20	0.99			1.00	0.20	0.20	0.99	0.20	0.99	0.70	1.00	3.28	1.00	0.33	0.38
	1.55	1.00	0.30	0.89	0.30	0.98			1.20	1.00	0.30	0.98	0.30	0.98	1.30	1.00	3.29	0.00	0.66	0.09
	2.95	1.00	0.40	0.81	0.40	0.97			1.50	1.00	0.40	0.97	0.40	0.97	1.80	0.50			0.98	0.00
	3.25	0.50	0.60	0.65	0.50	0.96			3.08	1.00	0.50	0.96	0.50	0.96	2.50	0.20			1.31	0.00
	5.32	0.00	0.70	0.56	0.60	0.94			3.83	0.25	0.60	0.94	0.60	0.94	4.00	0.00			1.64	0.04
LOW VELOCITY			0.80	0.49	0.70	0.92			4.72	0.20	0.70	0.92	0.70	0.92					99.00	0.04
			0.90	0.42	0.80	0.89			5.82	0.10	0.80	0.89	0.80	0.89						
			1.10	0.30	0.90	0.87			6.93	0.00	0.90	0.87	0.90	0.87						
			1.30	0.22	1.00	0.84					1.00	0.84	1.00	0.84						

Cover criteria at the bottom

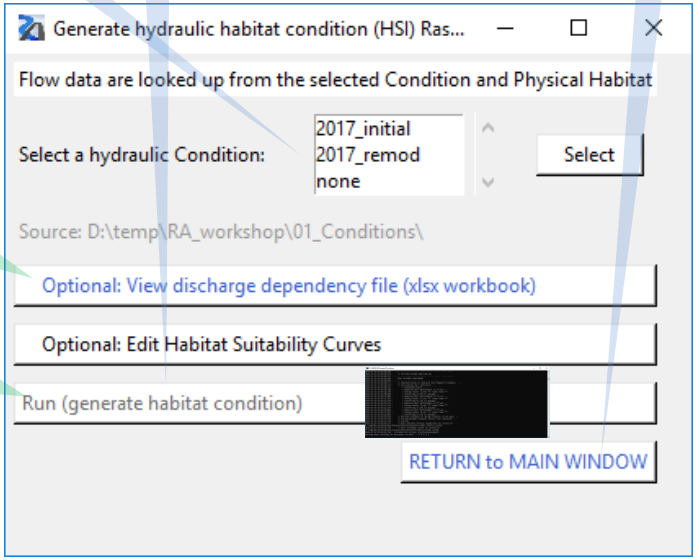
Create Hydraulic Conditions (DHSI & VHSI Rasters)



1) Select Physical Habitat > Chinook Salomon Juvenile

2) Make HSI Rasters (…) > HYDRAULIC Flow depth & velocity HSI

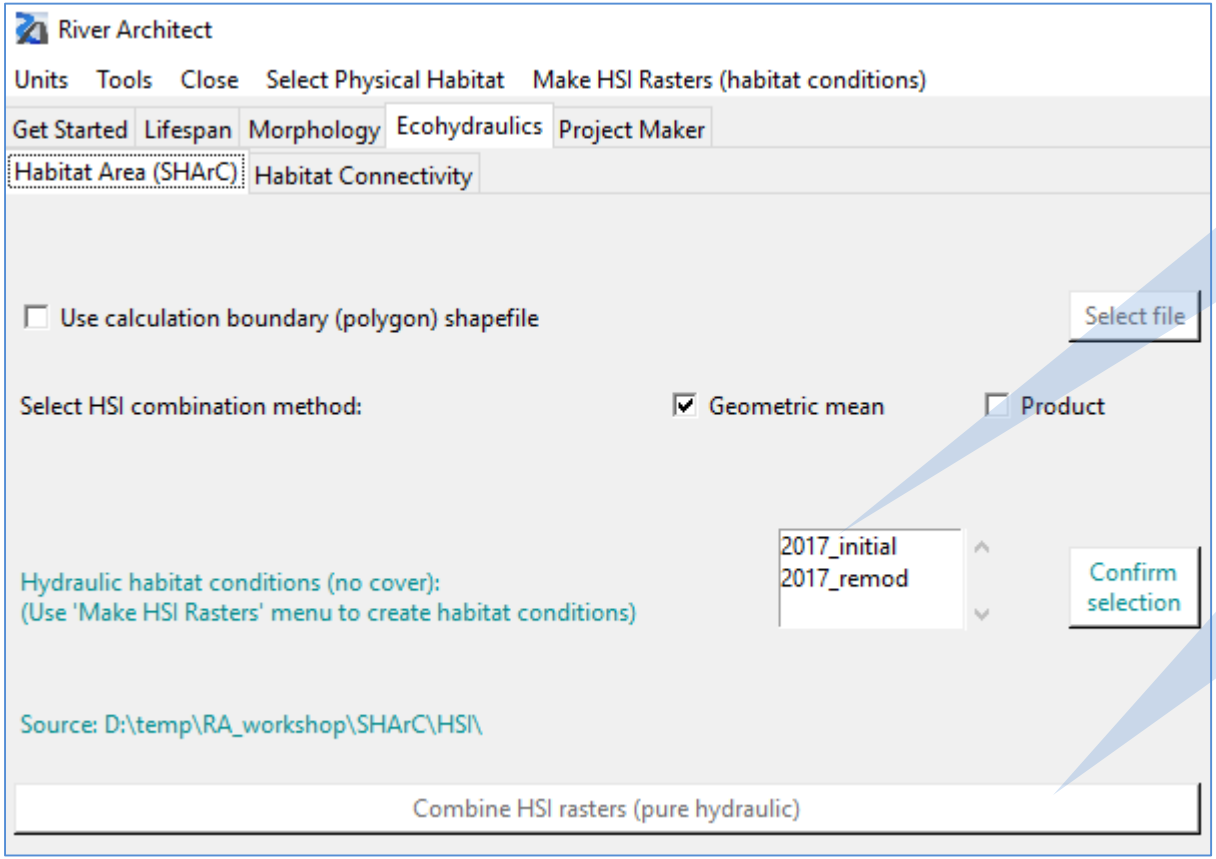
3) I. II. III. Repeat for remod IV.



Flow frequencies are associated here as defined in 01_Conditions/CONDITION/flow_definitions.xlsx (Get Started!)

Creates SHArC/SHArea/CONDITION_sharea_chju.xlsx with name convention: **CH**inook **JU**venile → **chju** (FILI)

Combine Hydraulic Conditions (DHSI & VHSI → cHSI Rasters)



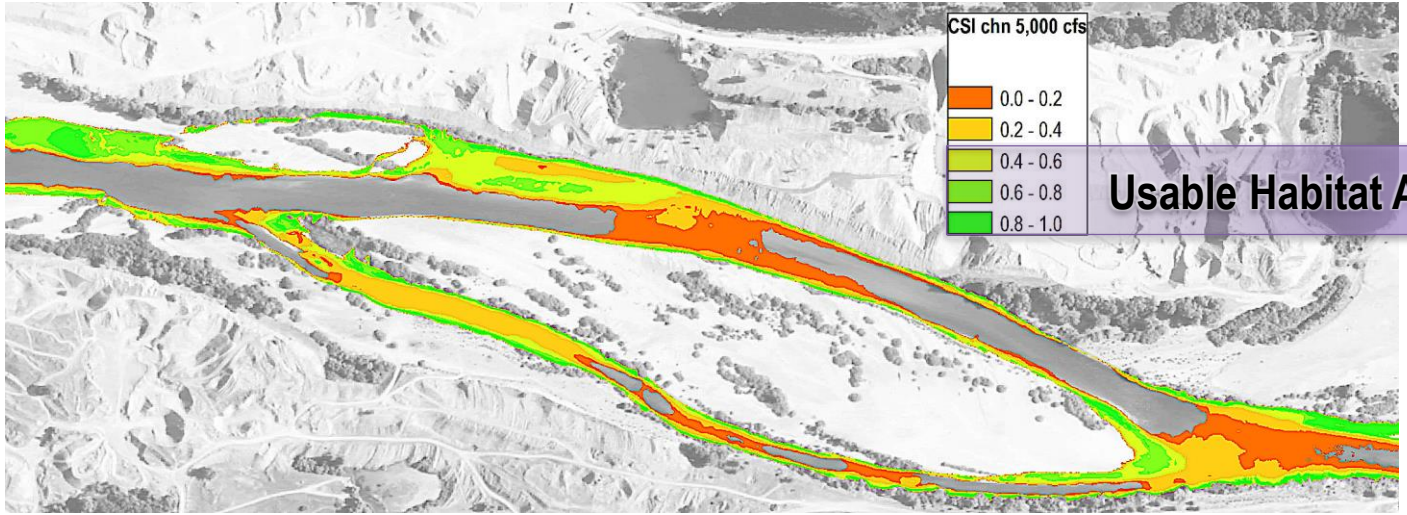
1) Select initial > Confirm selection

2) Combine HSI Rasters (…)

3) Repeat 1)&2) for remod condition

Creates SHArC/CHSI/CONDITION/no_cover/csi_chjuQQQ.tif

Calculate SHArea

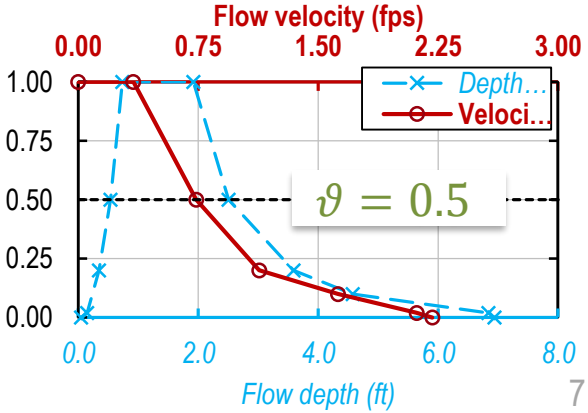


→ Repeat operation for multiple discharges (apply flow duration curve)

→ Calculate usable habitat area (e.g., cHSI > $\vartheta = 0.5$)

→ Sum of usable areas for one discharge = Usable Area

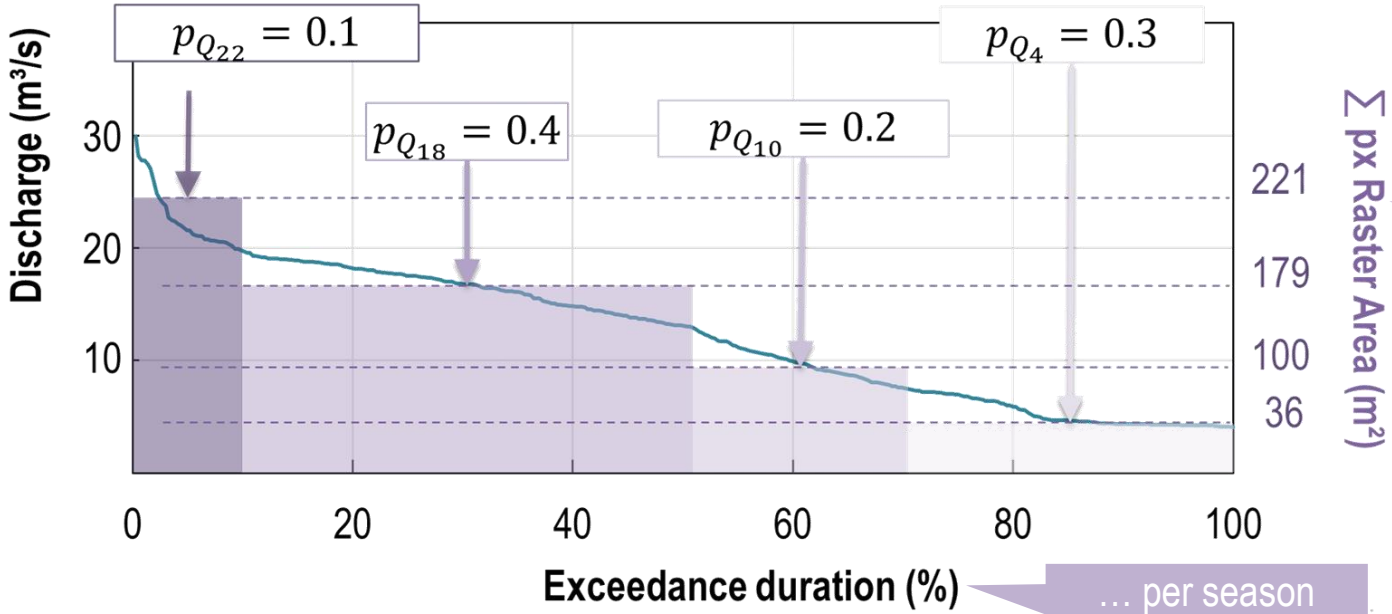
→ Sum of multiple season-specific discharges = **S**easonal **H**abitat **Area** (**SHArea**)



Calculate SHArea

Calculate **S**easonal **H**abitat **Area** (***SHArea***) – https://riverarchitect.github.io/RA_wiki/SHArC#herunSHArea

$$SHArea = \sum_{p_{Qi}}^{p_{Qn}} \left[\sum px(cHSI > \vartheta) \cdot A_{px} \right] \cdot p_{Qk} = 0.1 \cdot 221 + 0.4 \cdot 179 + 0.2 \cdot 100 + 0.3 \cdot 36 = 124.5\, m^2$$



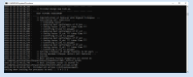
(source: Schwindt et al. 2020)

Calculate SHArea

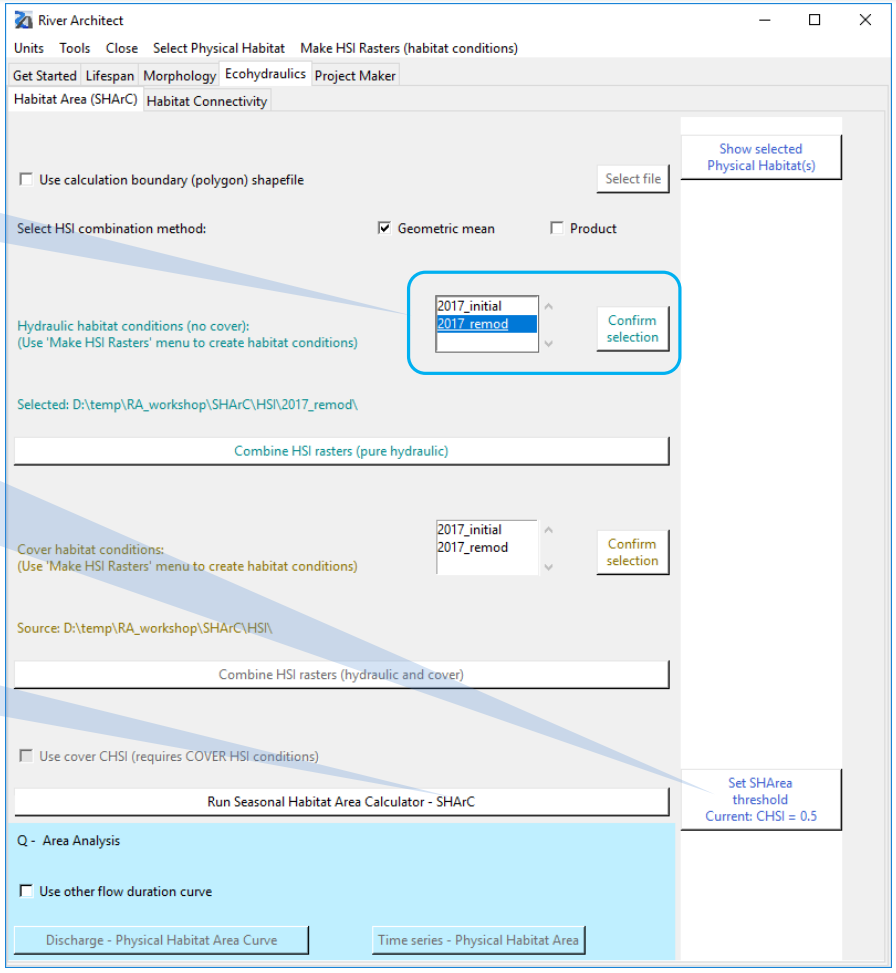
Defines Condition Repeat 1) & 2) for both conditions (click Confirm selection)

1) Set ϑ (default: ϑ = 0.5)

2) Calculate SHArea



Creates: SHArC/SHArea/CONDITION/no_cover/csi_chjuQQQ.tif
Completes: SHArC/SHArea/CONDITION_sharea_chju.xlsx



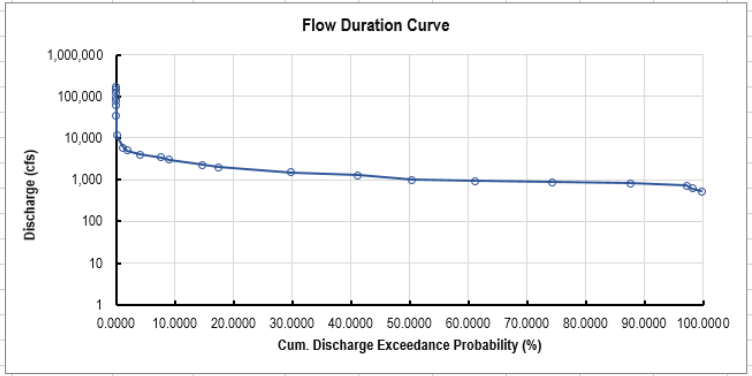
Ecohydraulics Activity

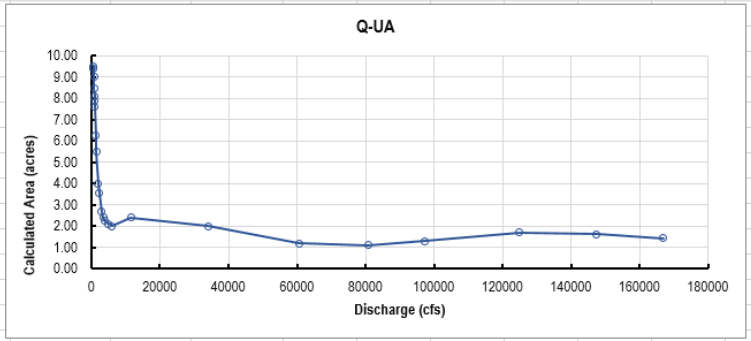
2017_initial_sharea_chju.xlsx - Excel

Sebastian Schwindt

Discharge	Associated depth raster	Associated velocity raster	Exceedance duration	Calculated Area	ive Calculated Are
(cfs)	(filename)	(filename)	(% of a year - cum.)	(ac per discharge)	(ac·%exceed.)
166954	h166954.tif	u166954.tif	0.0000	1.4239	0.0000
147510	h147510.tif	u147510.tif	0.0000	1.6305	0.0000
125012	h125012.tif	u125012.tif	0.0000	1.6902	0.0000
97419	h097419.tif	u097419.tif	0.0000	1.2925	0.0000
80686	h080686.tif	u080686.tif	0.0000	1.1054	0.0000
60514	h060514.tif	u060514.tif	0.0000	1.1748	0.0000
34104	h034104.tif	u034104.tif	0.0000	1.9983	0.0000
11494	h011494.tif	u011494.tif	0.0956	2.4079	0.0023
5984	h005984.tif	u005984.tif	1.1753	1.9893	0.0215
5000	h005000.tif	u005000.tif	1.8989	2.1023	0.0152
4000	h004000.tif	u004000.tif	4.0172	2.2269	0.0472
3455	h003455.tif	u003455.tif	7.6296	2.4083	0.0870
3000	h003000.tif	u003000.tif	9.0175	2.6643	0.0370
2255	h002255.tif	u002255.tif	14.7218	3.5467	0.2023
2000	h002000.tif	u002000.tif	17.4032	3.9870	0.1069
1500	h001500.tif	u001500.tif	29.8087	5.4905	0.6811
1300	h001300.tif	u001300.tif	41.1616	6.2384	0.7082
1004	h001004.tif	u001004.tif	50.4162	7.6223	0.7054
930	h000930.tif	u000930.tif	61.1509	7.8880	0.8467
880	h000880.tif	u000880.tif	74.2953	8.0911	1.0635
815	h000815.tif	u000815.tif	87.6004	8.4541	1.1248
730	h000730.tif	u000730.tif	97.2105	8.9913	0.8641
622	h000622.tif	u000622.tif	98.1987	9.3855	0.0928
530	h000530.tif	u000530.tif	99.7517	9.4886	0.1474

SHArea 6.7534359 (ac/season)





summary

Ready

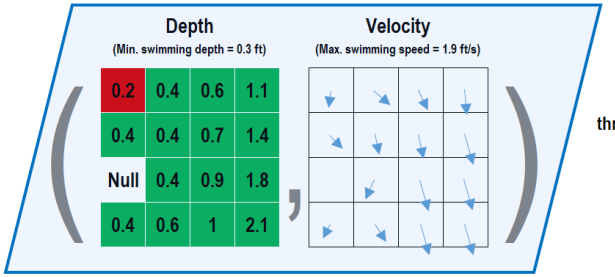
100%

Compare SHArea of initial & remod Conditions →Project Maker

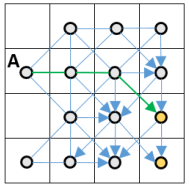
Detailed documentation & reading for this chapter
https://riverarchitect.github.io/RA_wiki/SHArC

Connectivity Analysis

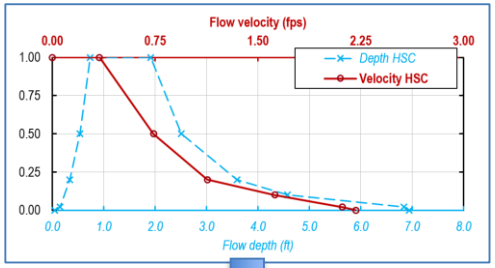
Calculate Stranding Risks: https://riverarchitect.github.io/RA_wiki/Connectivity#Methodology

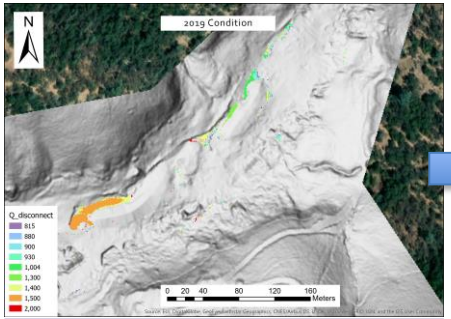


Apply depth/velocity thresholds and calculate costs

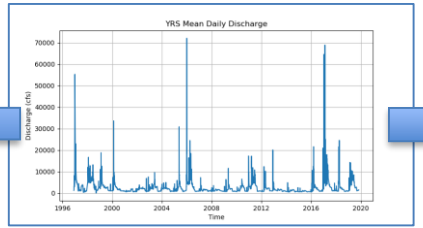


Find least-cost paths
(Dijkstra's algorithm)



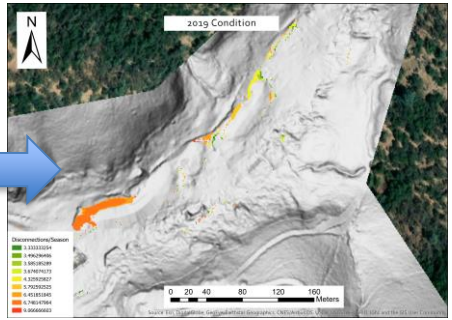


Q_disconnect.tif

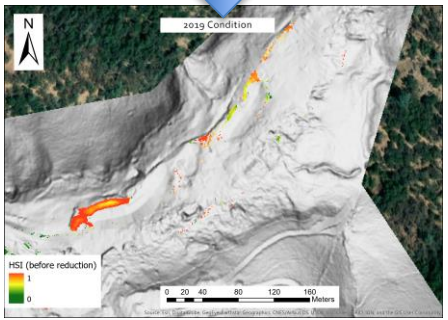


Disconnections/season

Season start	1-Oct
Season end	30-Sep



disc_freq.tif



disconnected_habitat_chju.tif

Calculate Stranding Risks

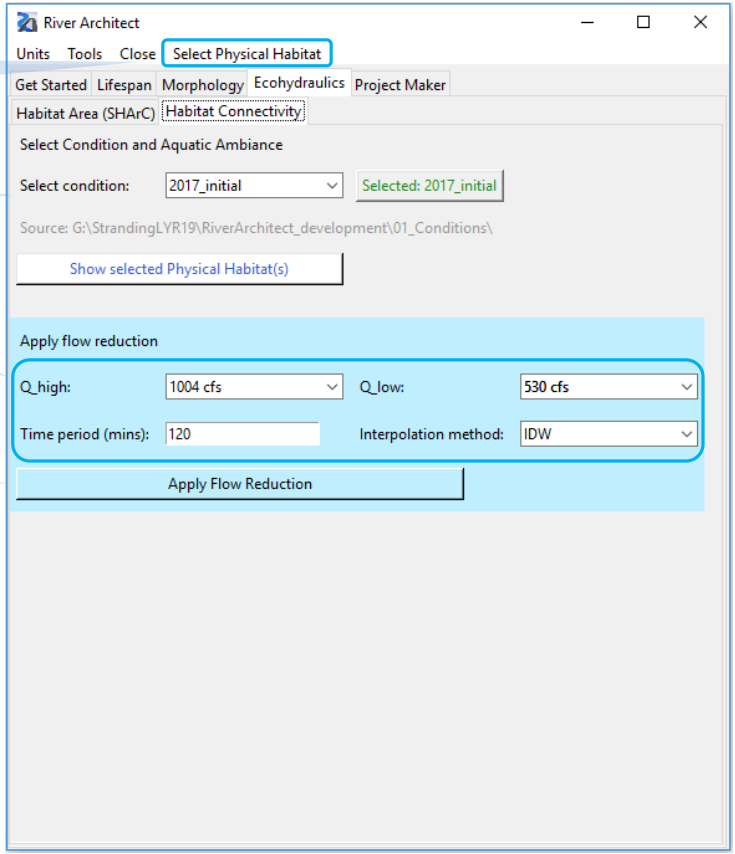
1) Select Physical Habitat (Chinook juvenile)

2) Select Condition

3) Input flow reduction scenario:
2000 cfs → 1004 cfs over 2 hrs

4) Run

5) Repeat 2-4 for remod condition



Creates:
Connectivity/Output/CONDITION/flow_red_2000_1004/

Ecohydraulics | Activity