Flow Quantification Overview

R2Cross

Collect streamflow measurements & channel geometry to model hydraulic Parameters of average depth, velocity, and percent wetted perimeter

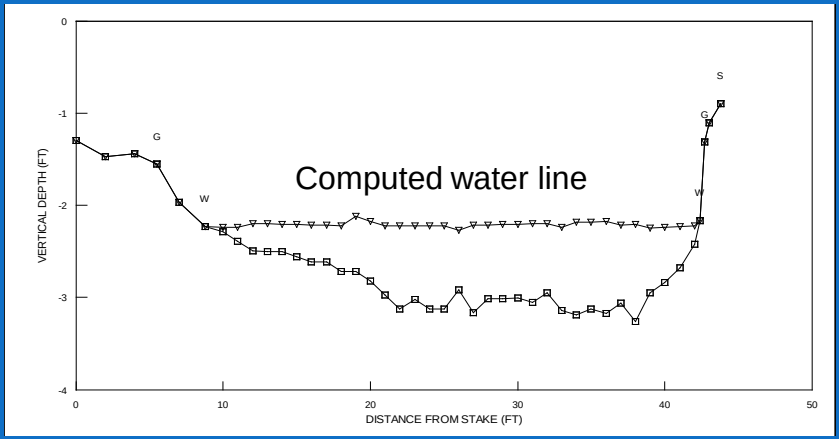
Computations

Manning's Equation

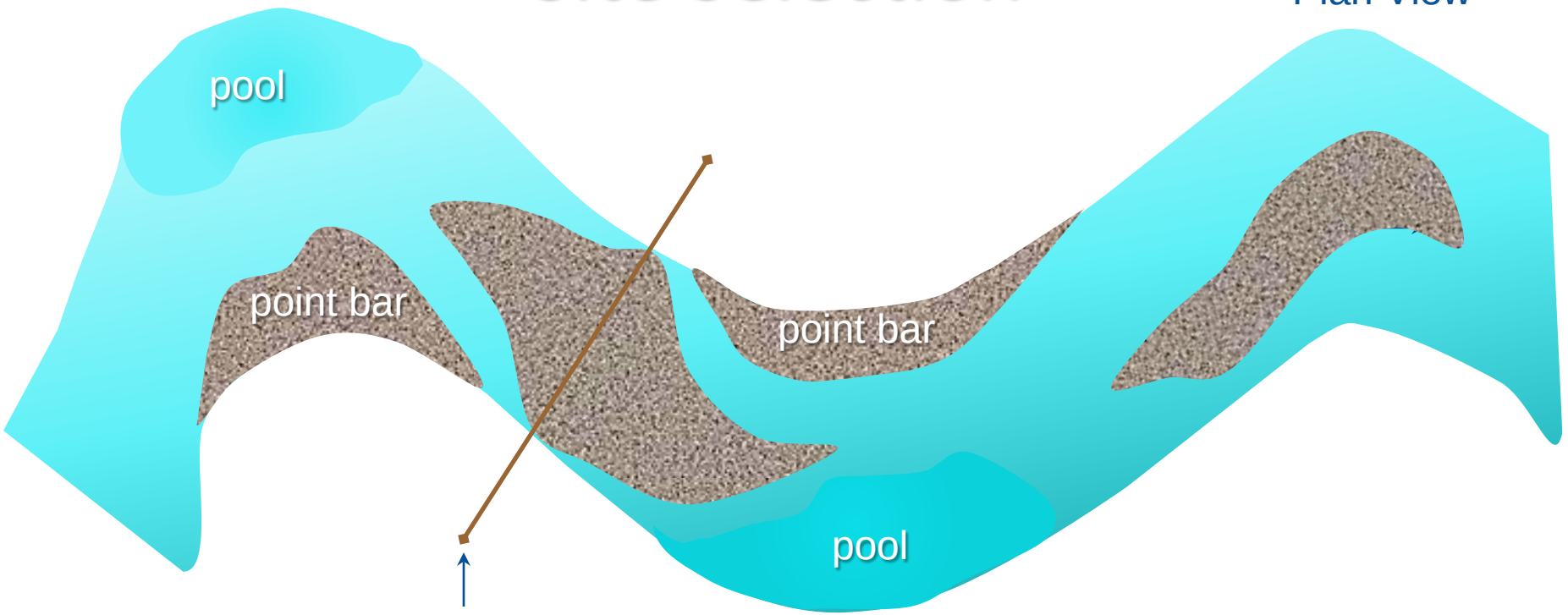
$$Q = \frac{1.486 * A * R^{2/3} * S^{1/2}}{n}$$

where:

Q = discharge (cfs)
A = cross-sectional area (ft)
R = hydraulic radius (ft)
S = slope (ft/ft)
n = Manning's n, a coefficient of roughness



Site Selection



R2Cross Field Survey Data

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*******************************************************
*         COLORADO WATER CONSERVATION BOARD           *
*     INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM      *
*       STREAM CROSS-SECTION AND FLOW ANALYSIS        *
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LOCATION INFORMATION
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STREAM NAME:      Clear Creek
XS LOCATION:      above W. Fork, 2.7 mi u/s Empire
XS NUMBER:        1

DATE:             11/04/87
OBSERVERS:        Skinner,McNeill, Yeager

1/4 SEC:          SW
SECTION:          23
TWP:              3 S
RANGE:            74 W
PM:               6

COUNTY:           Clear Creek
WATERSHED:        Clear Creek
DIVISION:         1
DOW CODE:         10544

USGS MAP:
USFS MAP:         Arapahoe

SUPPLEMENTAL DATA                 *** NOTE ***
=================            Leave TAPE WT and TENSION
                           at defaults for data collected
TAPE WT:          0.0107    with a survey level and rod
TENSION:              21

CHANNEL PROFILE DATA
====================
SLOPE:            0.0018


INPUT DATA CHECKED BY: .....................................DATE.....................
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PROOF SHEET
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INPUT DATA # DATA POINTS= 43

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	TAPE TO WATER
S	0.00	1.30	0.00	0.00	0.00	0.00	0.00
	2.00	1.45	0.00	0.00	0.00	0.00	0.00
	4.00	1.40	0.00	0.00	0.00	0.00	0.00
G	5.50	1.50	0.00	0.00	0.00	0.00	0.00
	7.00	1.90	0.00	0.00	0.00	0.00	0.00
W	8.80	2.15	0.00	0.00	0.00	0.00	0.00
	10.00	2.20	0.05	0.00	0.06	0.00	2.24
	11.00	2.30	0.15	0.03	0.15	0.00	2.24
	12.00	2.40	0.30	0.10	0.30	0.03	2.20
	13.00	2.40	0.30	0.15	0.30	0.05	2.20
	14.00	2.40	0.30	0.13	0.30	0.04	2.21
	15.00	2.45	0.35	0.28	0.35	0.10	2.21
	16.00	2.50	0.40	0.30	0.40	0.12	2.21
	17.00	2.50	0.40	0.35	0.40	0.14	2.22
	18.00	2.60	0.50	0.30	0.50	0.15	2.22
	19.00	2.60	0.60	0.80	0.60	0.48	2.12
	20.00	2.70	0.65	0.95	0.65	0.62	2.17
	21.00	2.85	0.75	1.05	0.75	0.79	2.22
	22.00	3.00	0.90	0.85	0.90	0.77	2.22
	23.00	2.90	0.80	0.95	0.80	0.76	2.22
	24.00	3.00	0.90	1.00	0.90	0.90	2.22
	25.00	3.00	0.90	1.05	0.90	0.95	2.22
	26.00	2.80	0.65	1.10	0.65	0.72	2.27
	27.00	3.05	0.95	1.00	0.95	0.95	2.22
	28.00	2.90	0.80	1.20	0.80	0.96	2.21
	29.00	2.90	0.80	1.10	0.80	0.88	2.21
	30.00	2.90	0.80	0.80	0.80	0.64	2.21
	31.00	2.95	0.85	1.05	0.85	0.89	2.20
	32.00	2.85	0.75	1.15	0.75	0.86	2.20
	33.00	3.05	0.90	1.05	0.90	0.95	2.24
	34.00	3.10	1.00	1.05	1.00	1.05	2.18
	35.00	3.05	0.95	1.10	0.95	1.05	2.18
	36.00	3.10	1.00	1.10	1.00	1.10	2.17
	37.00	3.00	0.85	1.08	0.85	0.92	2.21
	38.00	3.20	1.05	0.90	1.05	0.95	2.21
	39.00	2.90	0.70	1.00	0.70	0.70	2.25
	40.00	2.80	0.60	0.80	0.60	0.48	2.24
	41.00	2.65	0.45	0.70	0.45	0.32	2.23
	42.00	2.40	0.20	0.10	0.14	0.01	2.22
W	42.40	2.15	0.00	0.00	0.00	0.00	0.00
G	42.70	1.30	0.00	0.00	0.00	0.00	0.00
	43.00	1.10	0.00	0.00	0.00	0.00	0.00
S	43.80	0.90	0.00	0.00	0.00	0.00	0.00
				TOTALS	21.50	19.29	

R2CROSS Parameters

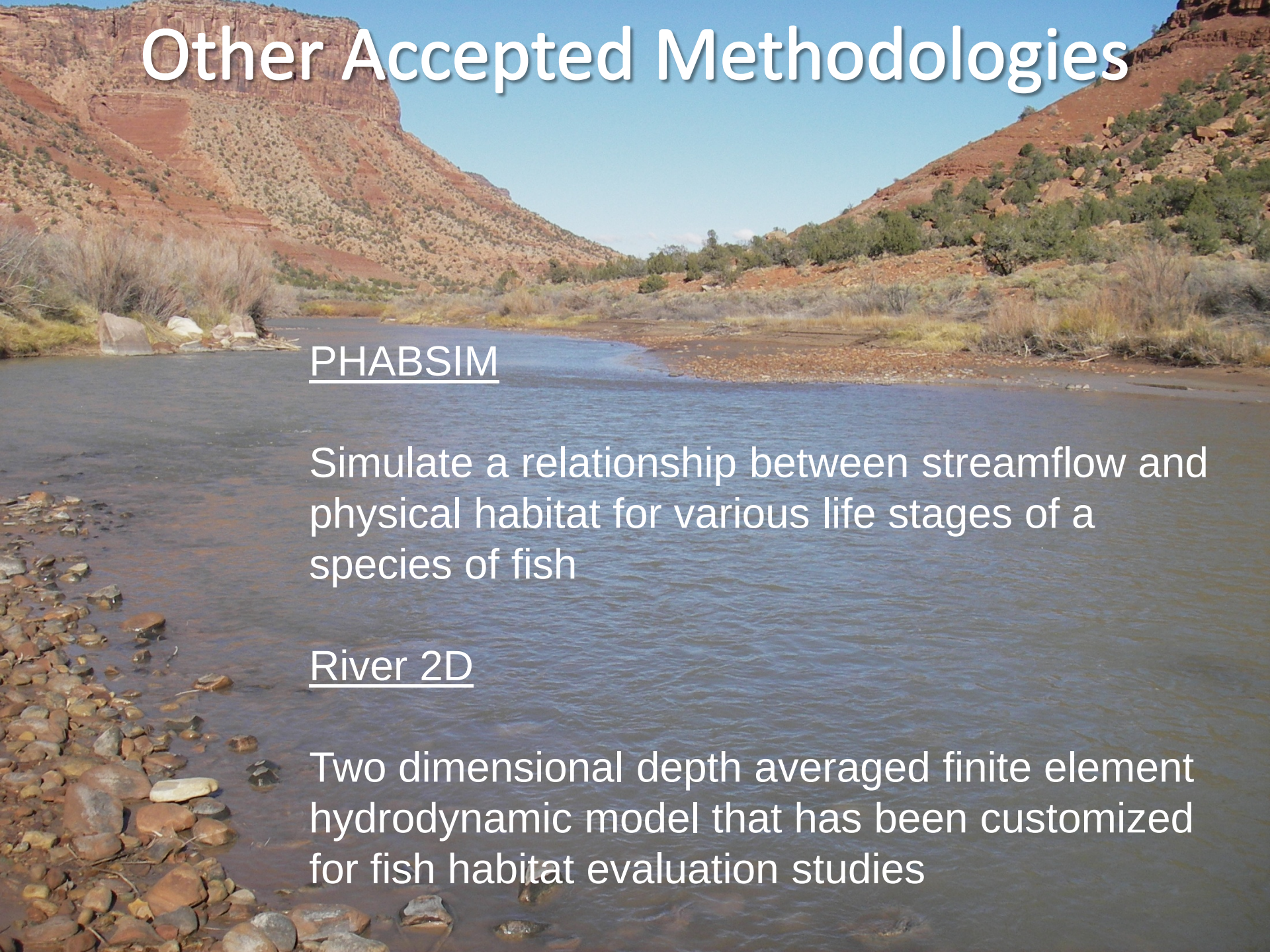
Key Flow Parameters Used To Determine Minimum Flow Requirements Using R2CROSS Transect Method (Nehring 1979)

Stream Width (ft)	Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter (%)
1 - 20	0.2	1.0	50
21 - 40	0.21 - 0.40	1.0	50
41 - 60	0.41 - 0.60	1.0	50 - 60
61 - 100	0.61 - 1.00	1.0	70 or greater

Staging Table

DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
1.55	37.12	1.21	1.7	44.95	37.97	100.00%	1.18	61.22	1.36
1.56	37.08	1.2	1.69	44.66	37.93	99.90%	1.18	60.6	1.36
1.61	36.88	1.16	1.64	42.81	37.69	99.30%	1.14	56.71	1.32
1.66	36.68	1.12	1.59	40.97	37.45	98.60%	1.09	52.94	1.29
1.71	36.48	1.07	1.54	39.14	37.2	98.00%	1.05	49.27	1.26
1.76	36.28	1.03	1.49	37.32	36.96	97.40%	1.01	45.71	1.22
1.81	36.09	0.98	1.44	35.51	36.72	96.70%	0.97	42.26	1.19
1.86	35.89	0.94	1.39	33.71	36.48	96.10%	0.92	38.93	1.15
1.91	35.69	0.89	1.34	31.92	36.24	95.40%	0.88	35.7	1.12
1.96	35.49	0.85	1.29	30.14	36	94.80%	0.84	32.59	1.08
2.01	35.14	0.81	1.24	28.38	35.61	93.80%	0.8	29.68	1.05
2.06	34.78	0.77	1.19	26.63	35.21	92.70%	0.76	**26.9**	**1.01**
2.11	34.42	0.72	1.14	24.9	34.81	91.70%	0.72	**24.24**	**0.97**
2.16	34.06	0.68	1.09	23.19	34.41	90.60%	0.67	21.69	0.94
2.21	33.64	0.64	1.04	21.49	33.98	89.50%	0.63	19.28	0.9
2.26	32.76	0.61	0.99	19.83	33.08	87.10%	0.6	17.16	0.87
2.31	31.93	0.57	0.94	18.22	32.23	84.90%	0.57	15.16	0.83
2.36	31.38	0.53	0.89	16.63	31.66	83.40%	0.53	13.18	0.79
2.41	30.83	0.49	0.84	15.08	31.09	81.90%	0.49	11.33	0.75
2.46	30.18	0.45	0.79	13.55	30.43	80.10%	0.45	9.62	0.71
2.51	27.55	0.44	0.74	12.08	27.79	73.20%	0.43	8.44	0.7
2.56	26.42	**0.41**	0.69	10.73	26.66	70.20%	0.4	**7.12**	0.66
2.61	25.29	**0.37**	0.64	9.44	25.52	67.20%	0.37	**5.92**	0.63
2.66	23.62	0.35	0.59	8.24	23.85	62.80%	0.35	4.94	0.6
2.71	22.86	0.31	0.54	7.07	23.08	60.80%	0.31	3.91	0.55
2.76	21.07	0.28	0.49	5.99	21.28	56.10%	0.28	3.13	0.52
2.81	20.27	0.24	0.44	4.96	20.47	53.90%	0.24	2.35	0.47
2.86	19.52	0.2	0.39	3.96	19.72	**51.90%**	0.2	1.66	0.42
2.91	18.73	0.16	0.34	3.01	18.92	**49.80%**	0.16	1.07	0.36
2.96	17.41	0.12	0.29	2.1	17.57	46.30%	0.12	0.62	0.3
3.01	13.93	0.09	0.24	1.28	14.07	37.00%	0.09	0.31	0.25
3.06	10.03	0.07	0.19	0.69	10.13	26.70%	0.07	0.14	0.2
3.11	6.81	0.04	0.14	0.27	6.87	18.10%	0.04	0.04	0.14
3.16	2.11	0.02	0.09	0.05	2.13	5.60%	0.02	0.01	0.1
3.21	0.38	0.02	0.04	0.01	0.39	1.00%	0.02	0	0.09

Other Accepted Methodologies



PHABSIM

Simulate a relationship between streamflow and physical habitat for various life stages of a species of fish

River 2D

Two dimensional depth averaged finite element hydrodynamic model that has been customized for fish habitat evaluation studies