Lesson 31: River Planforms

53:171

Water Resources Engineering

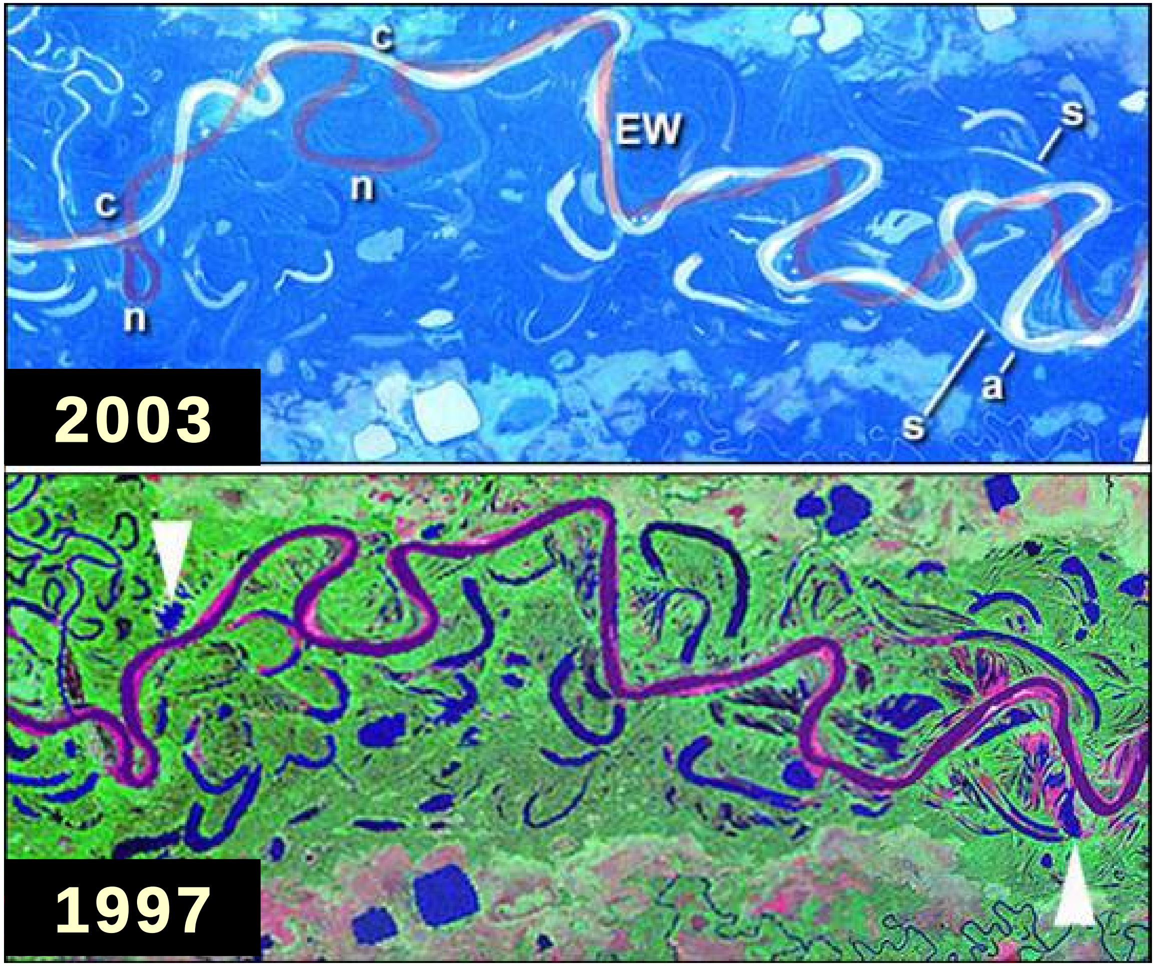
Straight Channels

Waal River in the Netherlands

Meandering Channels

Williams River in Alaska

Planform Migration



Down valley translation

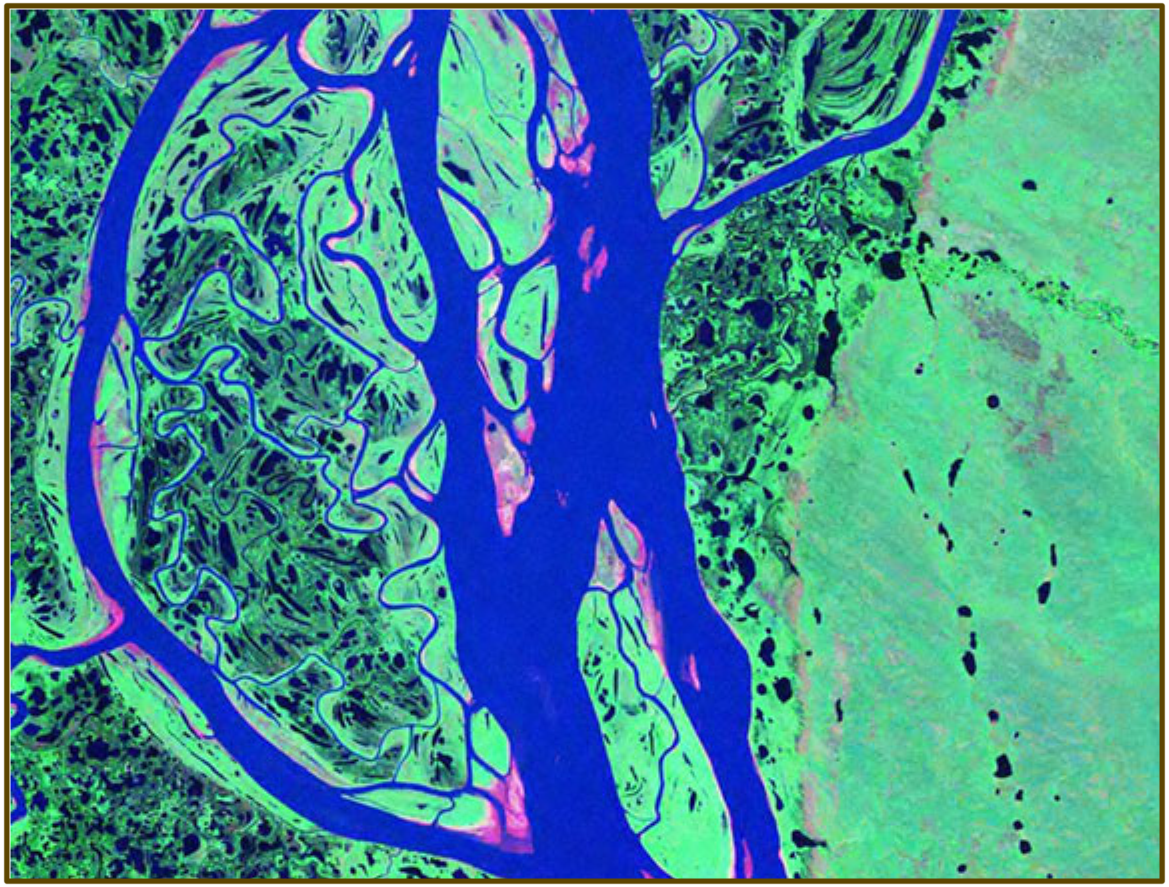
Lateral expansion

(Mamore River, Bolivia)

Braided Channels

Slims River in Kluane National Park, Yukon, Canada

Anastomosing Channels



Mackenzie River in northern Canada

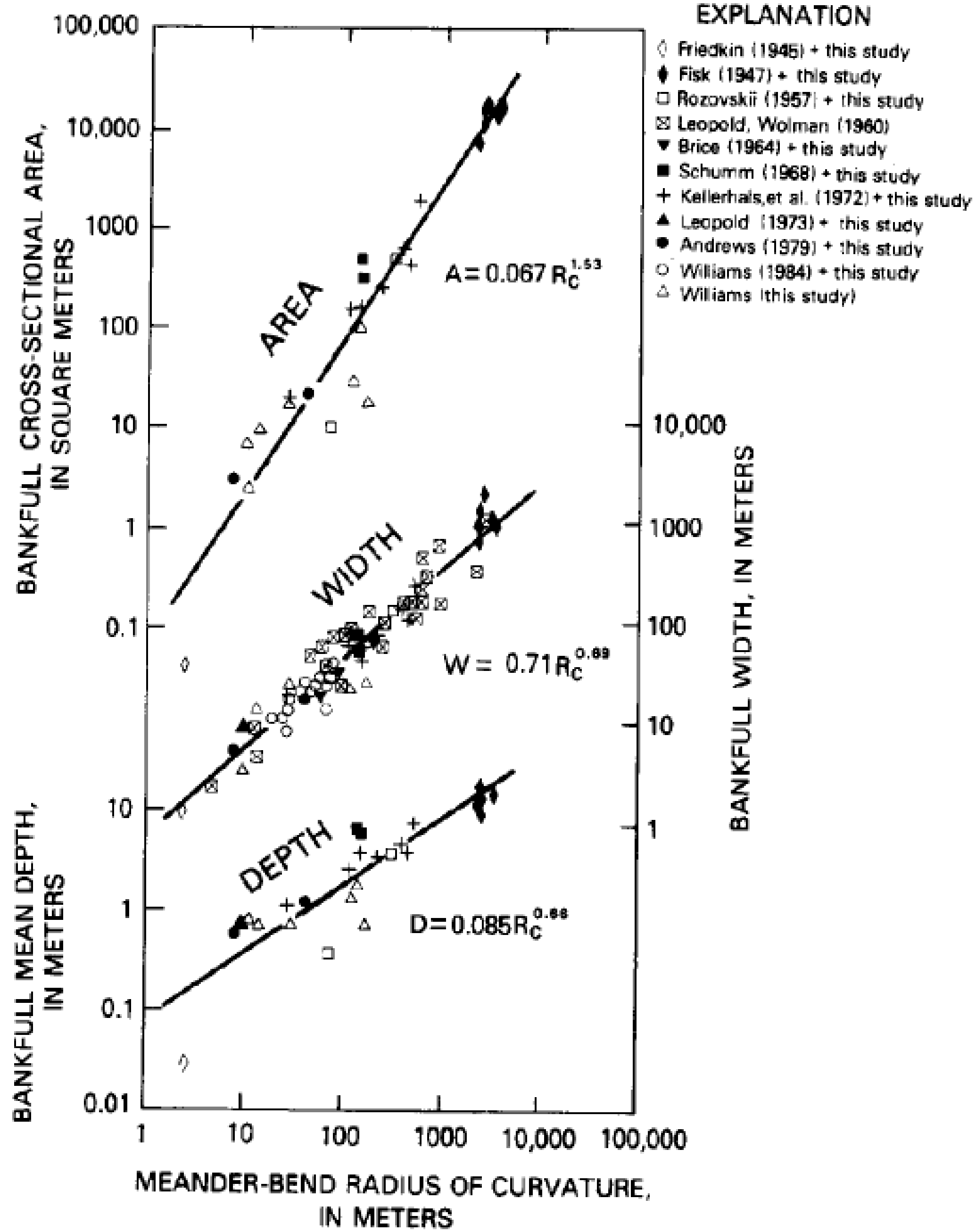


Fig. 4. Graph of typical data for bankfull cross-sectional area, width, and mean depth related to meander-bend radius of curvature.

TABLE 2

Derived empirical equations for river-meander and channel-size features (A = bankfull cross-sectional area, W = bankfull width, D = bankfull mean depth, L_m = meander wavelength, L_b = along-channel bend length, B = meander belt width, R_c = loop radius of curvature, K = channel sinuosity, m = meters)

Equation number	Equation	Standard deviation of residuals, in percent +	−	Sample correlation coefficient r	Number of data points	Applicable range
Interrelations between meander features						
2	$L_m = 1.25L_b$	32	24	0.99	102	$5.5 \leq L_b \leq 13{,}300$ m
3	$L_m = 1.63B$	31	24	0.99	155	$3.7 \leq B \leq 13{,}700$ m
4	$L_m = 4.53R_c$	21	17	0.99	78	$2.6 \leq R_c \leq 3{,}600$ m
5	$L_b = 0.80L_m$	32	24	0.99	102	$8 \leq L_m \leq 16{,}500$ m
6	$L_b = 1.29B$	31	24	0.99	102	$3.7 \leq B \leq 10{,}000$ m
7	$L_b = 3.77R_c$	35	26	0.98	78	$2.6 \leq R_c \leq 3{,}600$ m
8	$B = 0.61L_m$	31	24	0.99	155	$8 \leq L_m \leq 23{,}200$ m
9	$B = 0.78L_b$	31	24	0.99	102	$5.5 \leq L_b \leq 13{,}300$ m
10	$B = 2.88R_c$	42	29	0.98	78	$2.6 \leq R_c \leq 3{,}600$ m
11	$R_c = 0.22L_m$	21	17	0.99	78	$10 \leq L_m \leq 16{,}500$ m
12	$R_c = 0.26L_b$	35	26	0.98	78	$6.8 \leq L_b \leq 13{,}300$ m
13	$R_c = 0.35B$	42	29	0.98	78	$5 \leq B \leq 10{,}000$ m
Relations of channel size to meander features						
14	$A = 0.0054L_m^{1.53}$	103	51	0.96	66	$10 \leq L_m \leq 23{,}200$ m
15	$A = 0.0085L_b^{1.53}$	140	58	0.95	41	$6 \leq L_b \leq 13{,}300$ m
16	$A = 0.012B^{1.53}$	97	49	0.97	63	$5 \leq B \leq 11{,}600$ m
17	$A = 0.067R_c^{1.53}$	138	58	0.97	28	$2 \leq R_c \leq 3{,}600$ m
18	$W = 0.17L_m^{0.89}$	56	36	0.96	191	$8 \leq L_m \leq 23{,}200$ m
19	$W = 0.23L_b^{0.89}$	56	36	0.97	102	$5 \leq L_b \leq 13{,}300$ m
20	$W = 0.27B^{0.89}$	63	39	0.96	153	$3 \leq B \leq 13{,}700$ m
21	$W = 0.71R_c^{0.89}$	48	32	0.97	79	$2.6 \leq R_c \leq 3{,}600$ m
22	$D = 0.027L_m^{0.66}$	79	44	0.86	66	$10 \leq L_m \leq 23{,}200$ m
23	$D = 0.036L_b^{0.66}$	72	42	0.90	41	$7 \leq L_b \leq 13{,}300$ m
24	$D = 0.037B^{0.66}$	66	40	0.90	63	$5 \leq B \leq 11{,}600$ m
25	$D = 0.085R_c^{0.66}$	90	47	0.90	28	$2.6 \leq R_c \leq 3{,}600$ m
Relations of meander features to channel size						
26	$L_m = 30A^{0.65}$	59	37	0.96	66	$0.04 \leq A \leq 20{,}900$ m^2
27	$L_b = 22A^{0.65}$	77	43	0.95	41	$0.04 \leq A \leq 20{,}900$ m^2
28	$B = 18A^{0.65}$	56	36	0.97	63	$0.04 \leq A \leq 20{,}900$ m^2
29	$R_c = 5.8A^{0.65}$	76	43	0.97	28	$0.04 \leq A \leq 20{,}900$ m^2
30	$L_m = 7.5W^{1.12}$	65	39	0.96	191	$1.5 \leq W \leq 4{,}000$ m
31	$L_b = 5.1W^{1.12}$	65	39	0.97	102	$1.5 \leq W \leq 2{,}000$ m
32	$B = 4.3W^{1.12}$	74	42	0.96	153	$1.5 \leq W \leq 4{,}000$ m
33	$R_c = 1.5W^{1.12}$	55	35	0.97	79	$1.5 \leq W \leq 2{,}000$ m
34	$L_m = 240D^{1.52}$	142	59	0.86	66	$0.03 \leq D \leq 18$ m
35	$L_b = 160D^{1.52}$	128	56	0.90	41	$0.03 \leq D \leq 17.6$ m
36	$B = 148D^{1.52}$	115	53	0.90	63	$0.03 \leq D \leq 18$ m
37	$R_c = 42D^{1.52}$	165	62	0.90	28	$0.03 \leq D \leq 17.6$ m
Relations between channel width, channel depth, and channel sinuosity						
38	$W = 21.3D^{1.45}$	160	62	0.81	67	$0.03 \leq D \leq 18$ m
39	$D = 0.12W^{0.69}$	94	48	0.81	67	$1.5 \leq W \leq 4{,}000$ m
40	$W = 96D^{1.23}K^{-2.35}$	121	55	0.87	66	$0.03 \leq D \leq 18$ m and $1.20 \leq K \leq 2.60$
41	$D = 0.09W^{0.59}K^{1.46}$	73	42	0.86	66	$1.5 \leq W \leq 4{,}000$ m and $1.20 \leq K \leq 2.60$

Channel Patterns

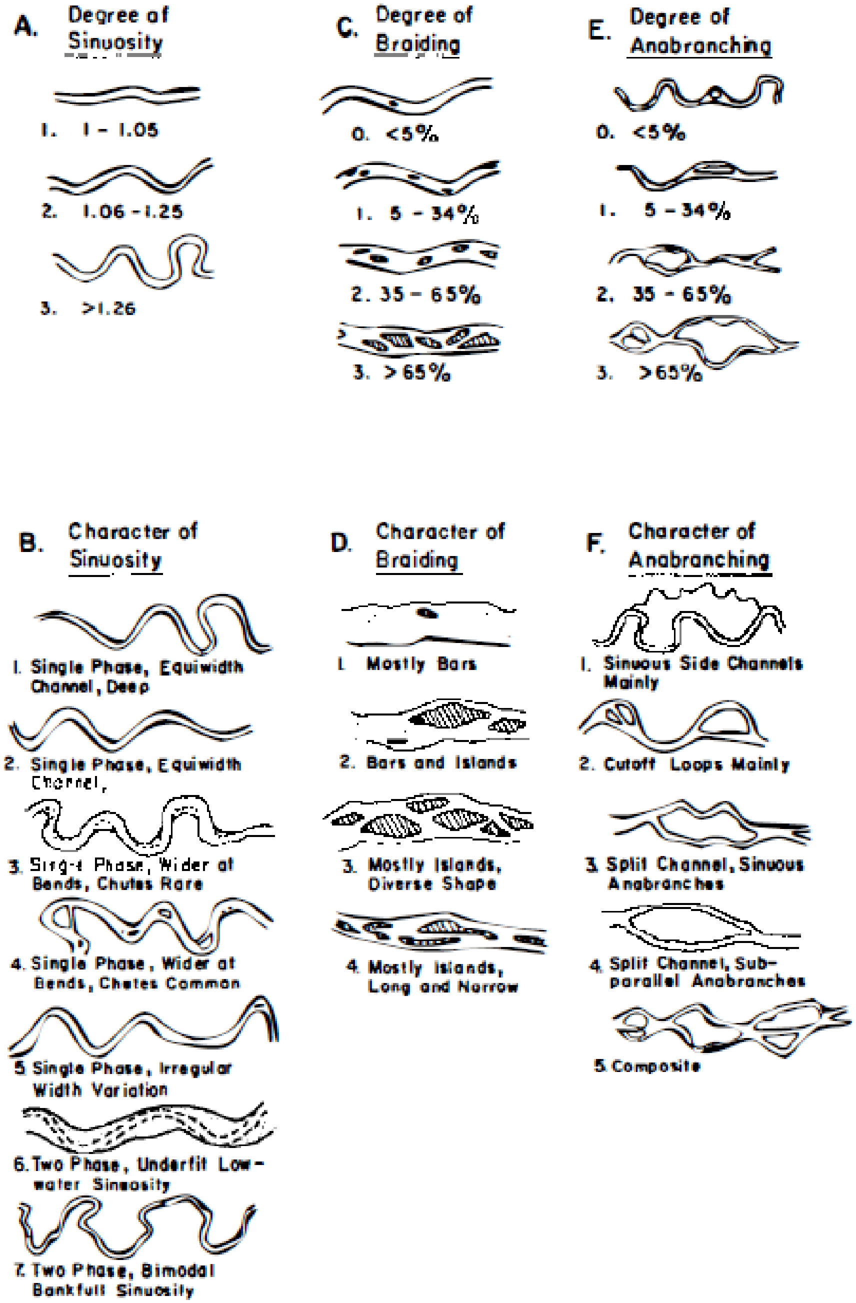


Figure 2 Types of channel patterns. (From Brice et al 1978.)

Channel Classification

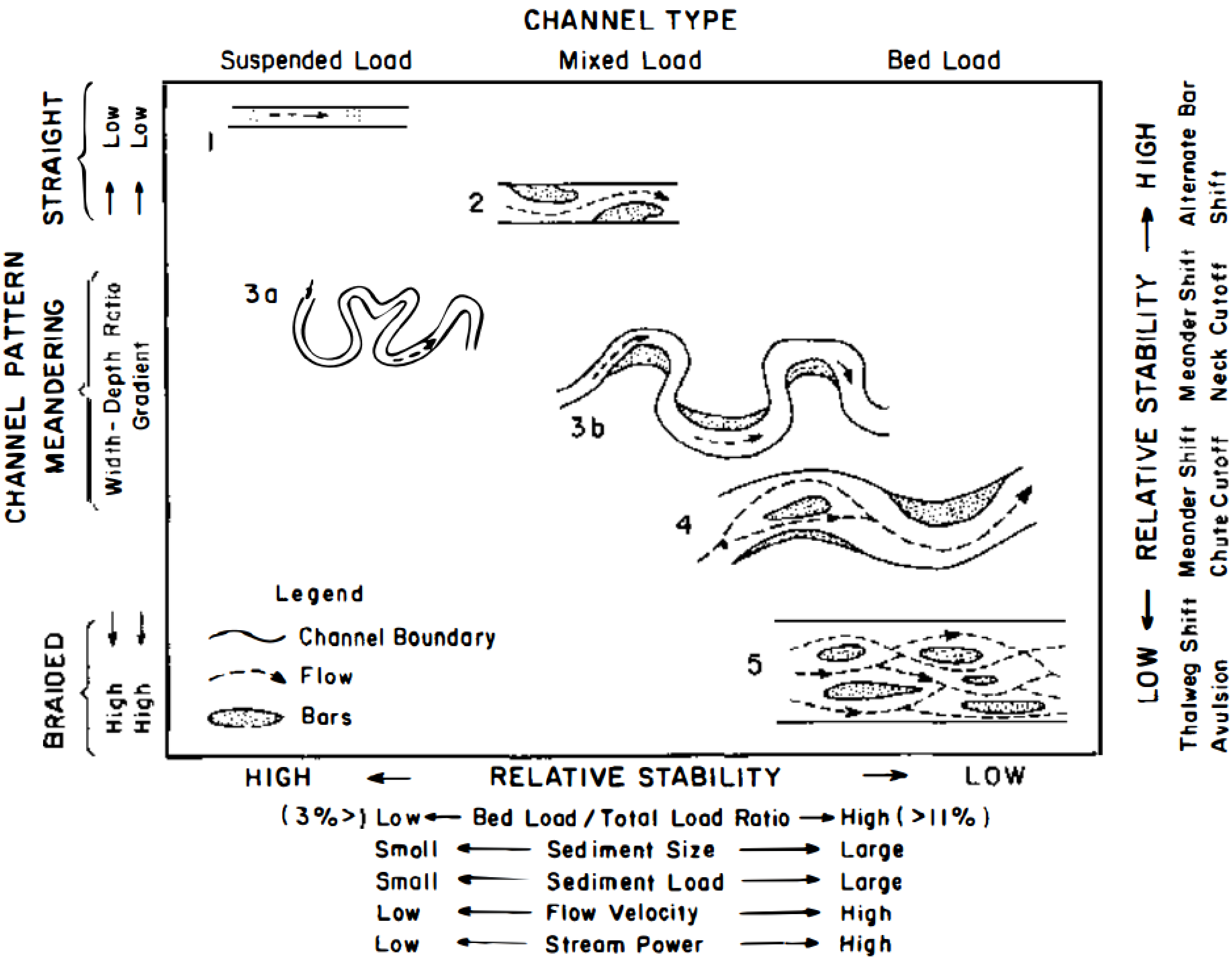
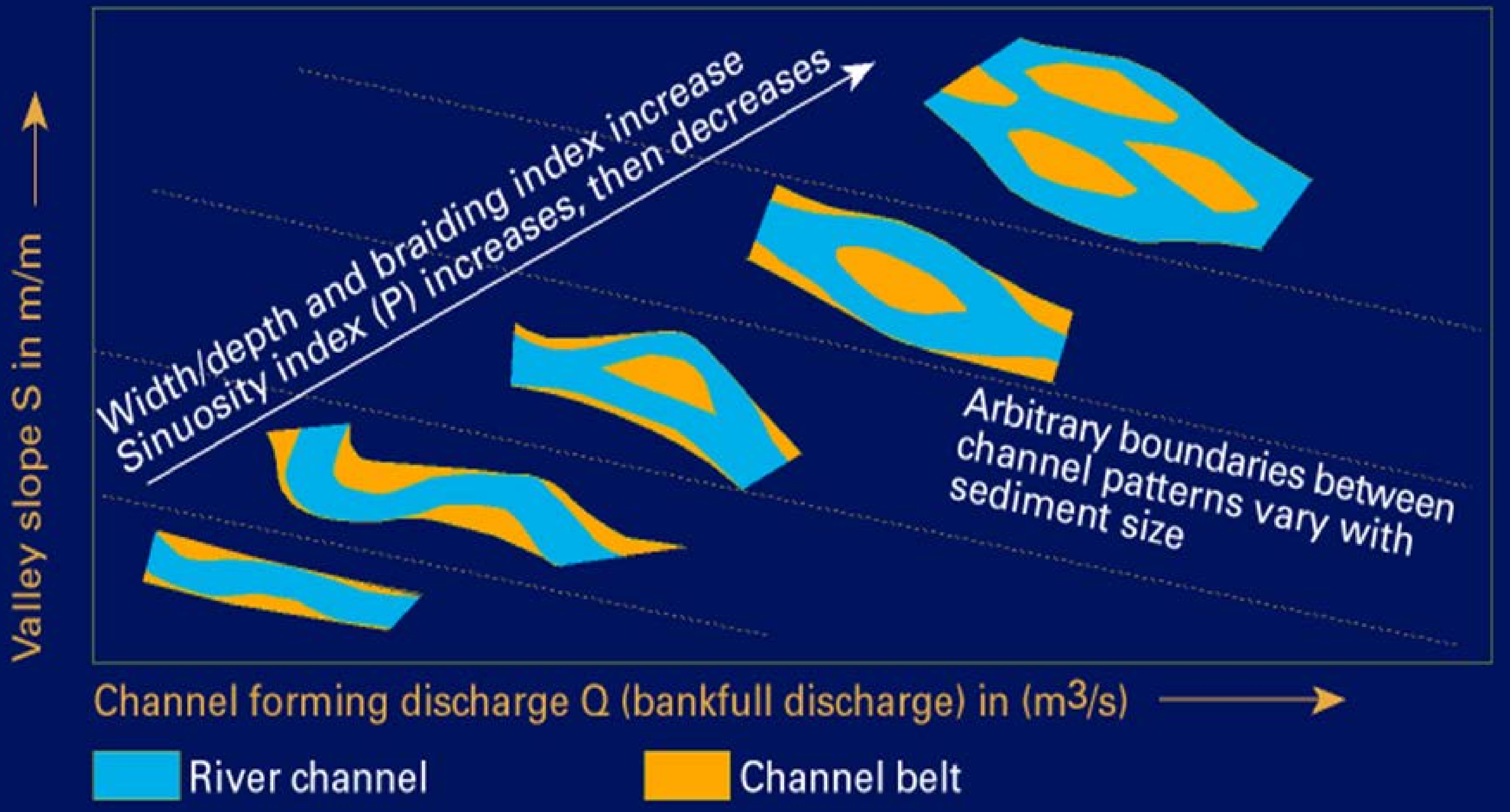
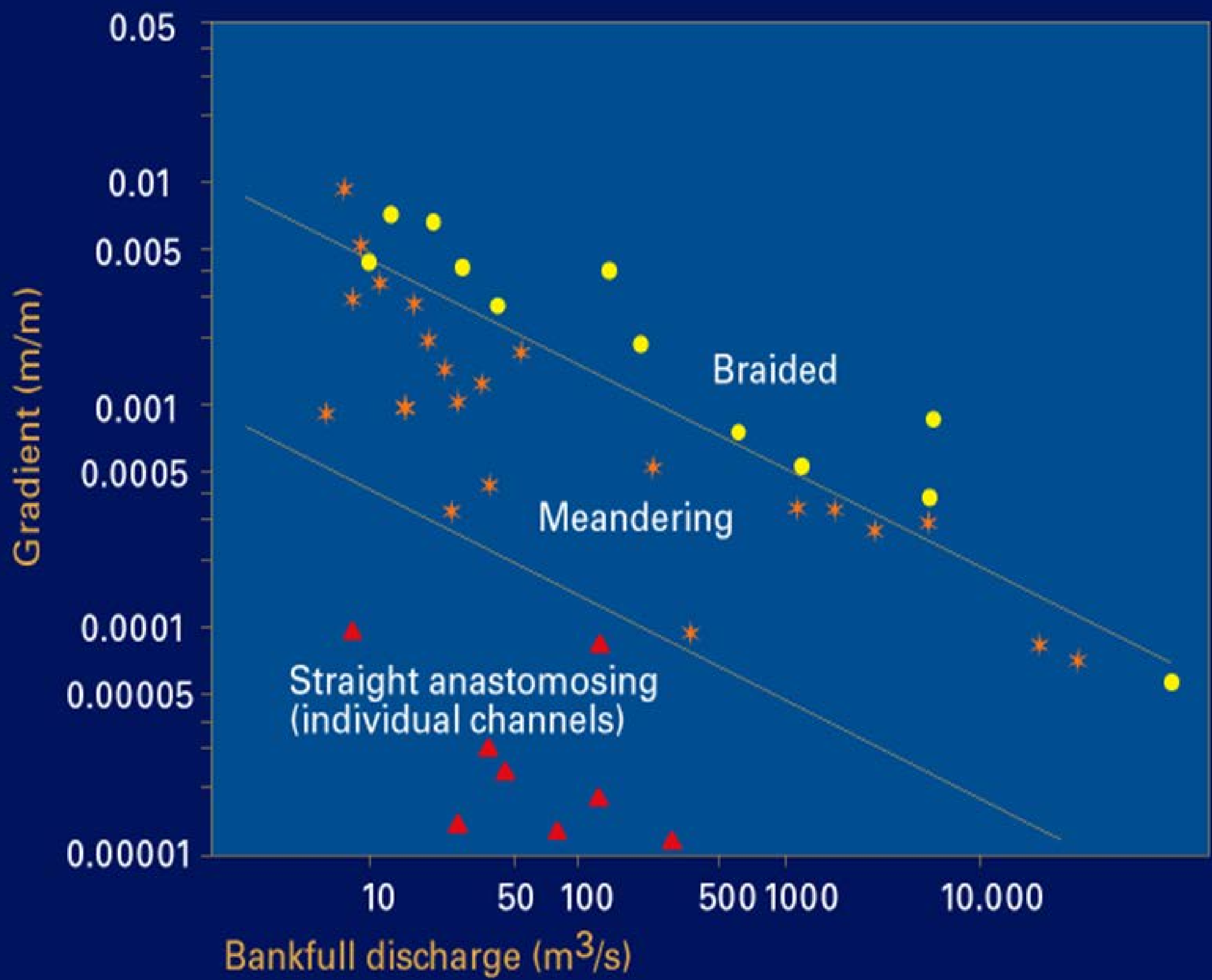


Figure 3 Channel classification based on pattern and type of sediment load, showing types of channels, their relative stability, and some associated variables. (After Schumm 1981.)

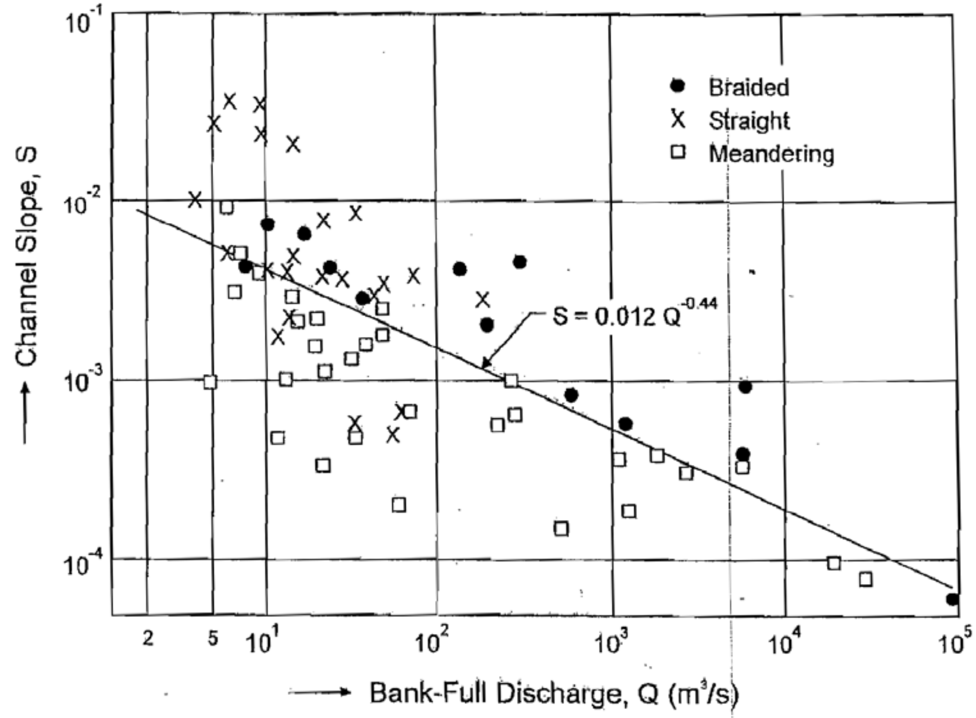


Gradual variation of equilibrium channel patterns with channel-forming water discharge, valley slope and sediment size (Bridge 1996)

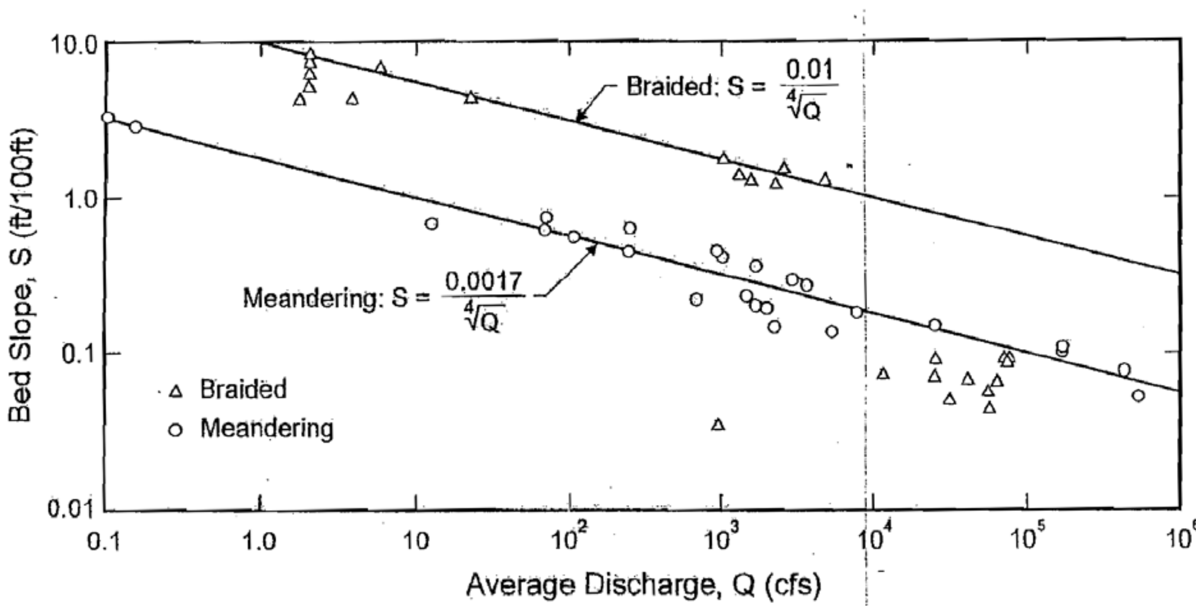


Classification of channel pattern based on bankfull discharge and gradient

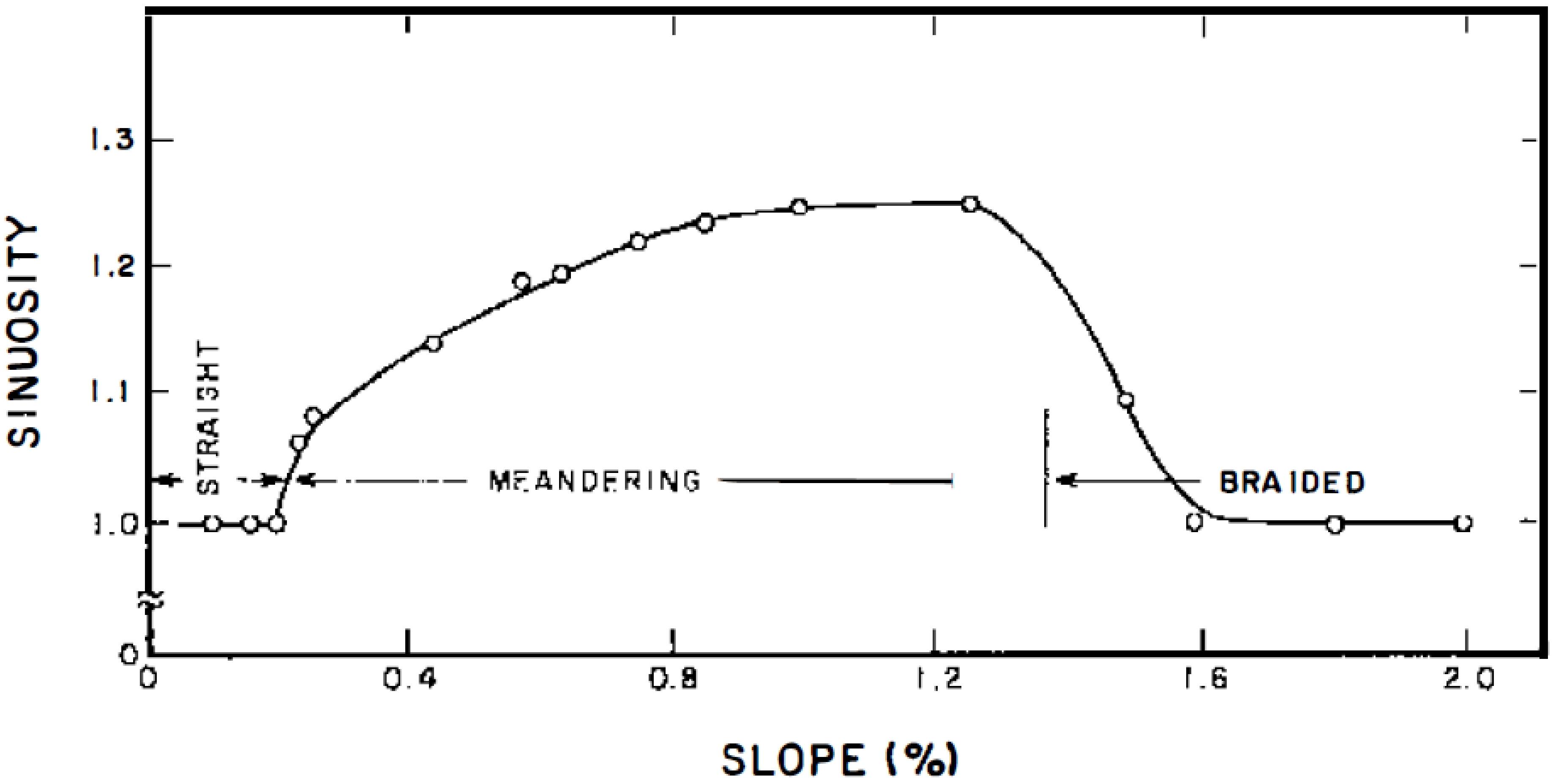
After Smith 1993



Braided
Straight
Meandering
Channel Slope, S
S = 0.012 Q^-0.44
Bank-Full Discharge, Q (m³/s)



Braided: S = 0.01 / ⁴√Q
Meandering: S = 0.0017 / ⁴√Q
Braided
Meandering
Bed Slope, S (ft/100ft)
Average Discharge, Q (cfs)



SINUOSITY
1.3
1.2
1.1
1.0
0
STRAIGHT
MEANDERING
BRAIDED
0
0.4
0.8
1.2
1.6
2.0
SLOPE (%)