

# FLUVIAL GEOMORPHOLOGY: BASIC CHANNEL RATIOS

ZACH HILGENDORF

# OBJECTIVES

- Understand Different Ratios
- Understand How Those Ratios Are Used

The geo-nerd currently talking...

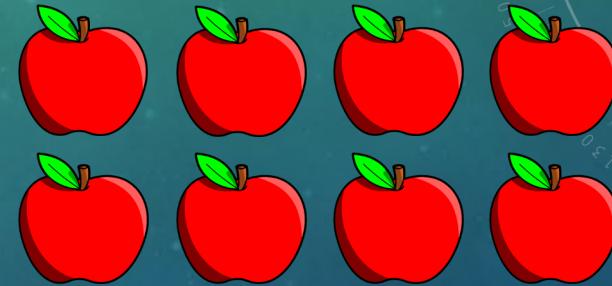


# BACKGROUND: RATIOS

- Ratio: Comparison of two values as a quotient

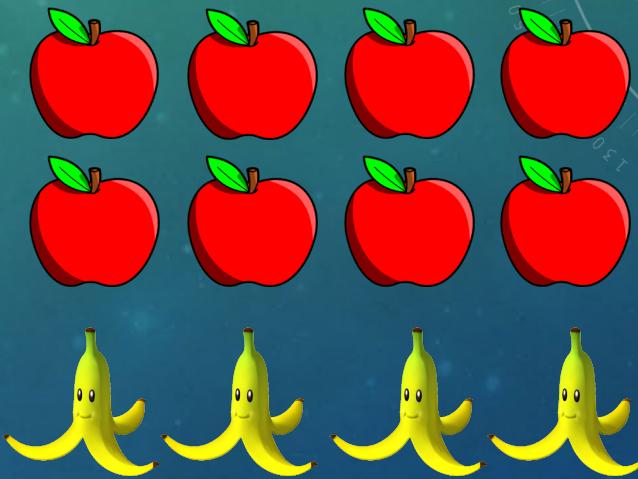
# BACKGROUND: RATIOS

- Ratio: Comparison of two values as a quotient
- 8 Apples



# BACKGROUND: RATIOS

- Ratio: Comparison of two values as a quotient
- 8 Apples
- 4 Bananas



# BACKGROUND: RATIOS

- Ratio: Comparison of two values as a quotient
- 8 Apples
- 4 Bananas
- Great Smoothie



# BACKGROUND: RATIOS

- Ratio: Comparison of two values as a quotient
- 8 Apples
- 4 Bananas
- Great Smoothie
- 8:4 Ratio (2:1 Simplified)



**8:4  
(2:1)**

# BACKGROUND: RATIOS

- Ratio: Comparison of two values as a quotient
- 8 Apples
- 4 Bananas
- Great Smoothie
- 8:4 Ratio (2:1 Simplified)
- Wind Ripples



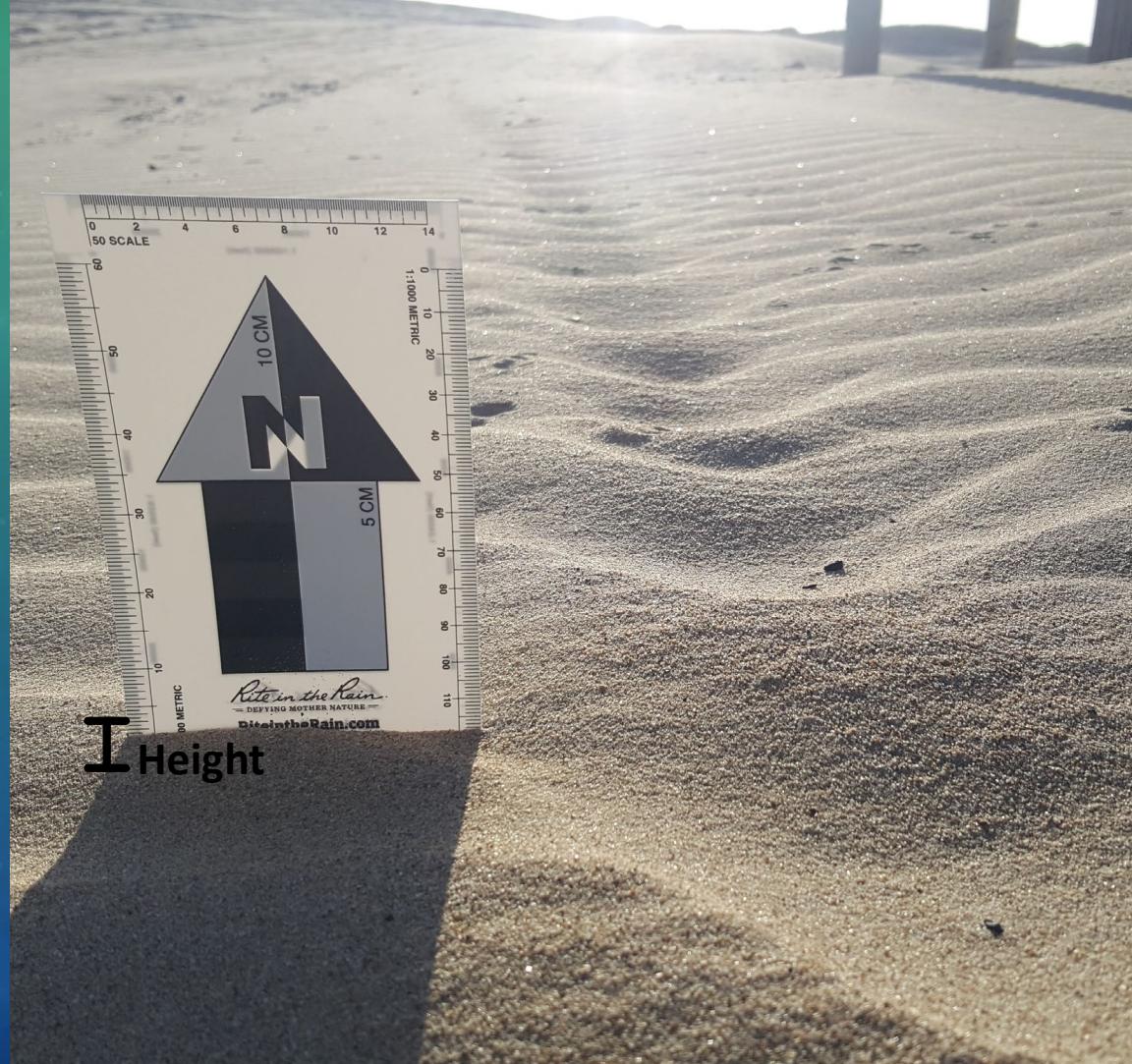
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# BACKGROUND: BANKFULL STAGE

- Initial Point of Flooding



Chippewa River, Wisconsin, USA

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Chippewa River, Wisconsin, USA  
Photo Credit. Dr. Doug Faulkner

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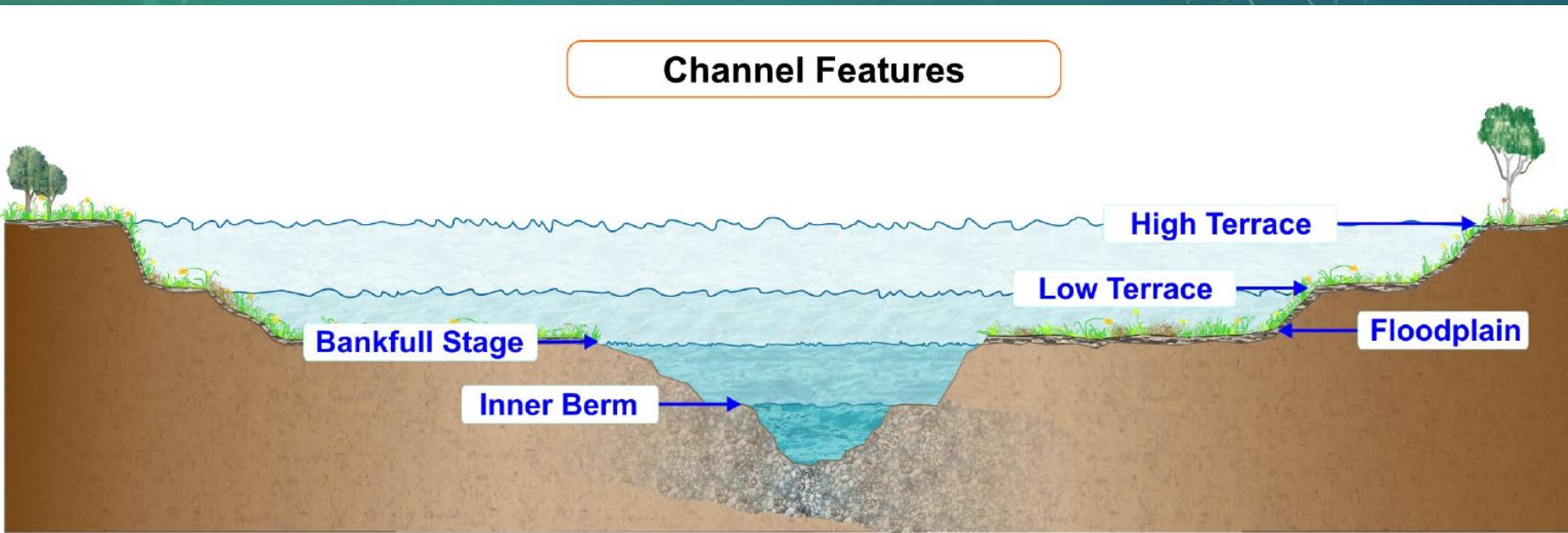
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Chippewa River, Wisconsin, USA  
Photo Credit. Dr. Doug Faulkner

# BACKGROUND: BANKFULL STAGE

- Initial Point of Flooding
- ~1.5 Year Recurrence



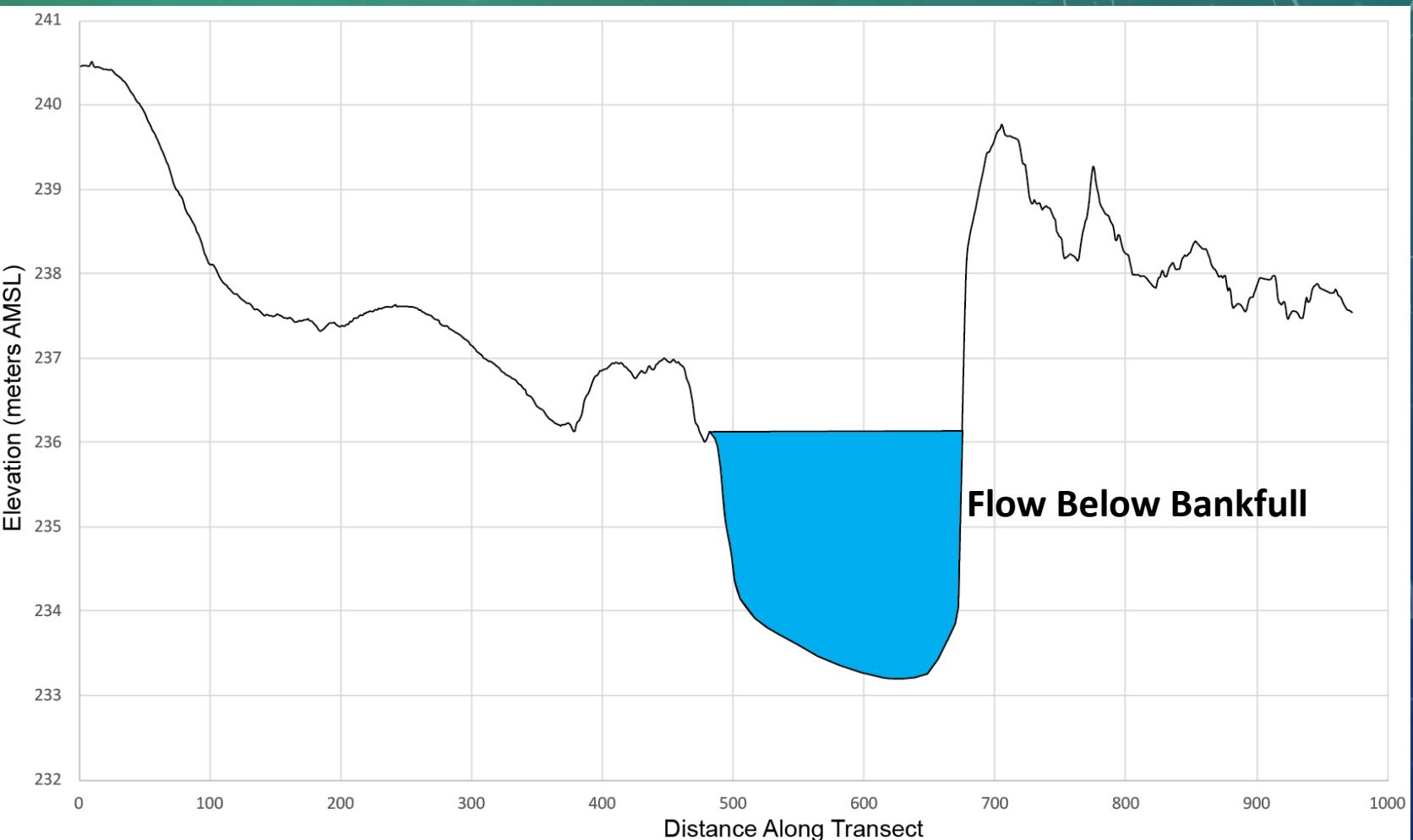
Wildlands Hydrology: Cross Section handout

# BACKGROUND: BANKFULL STAGE

- Initial Point of Flooding
- ~1.5 Year Recurrence
- Important for Classification

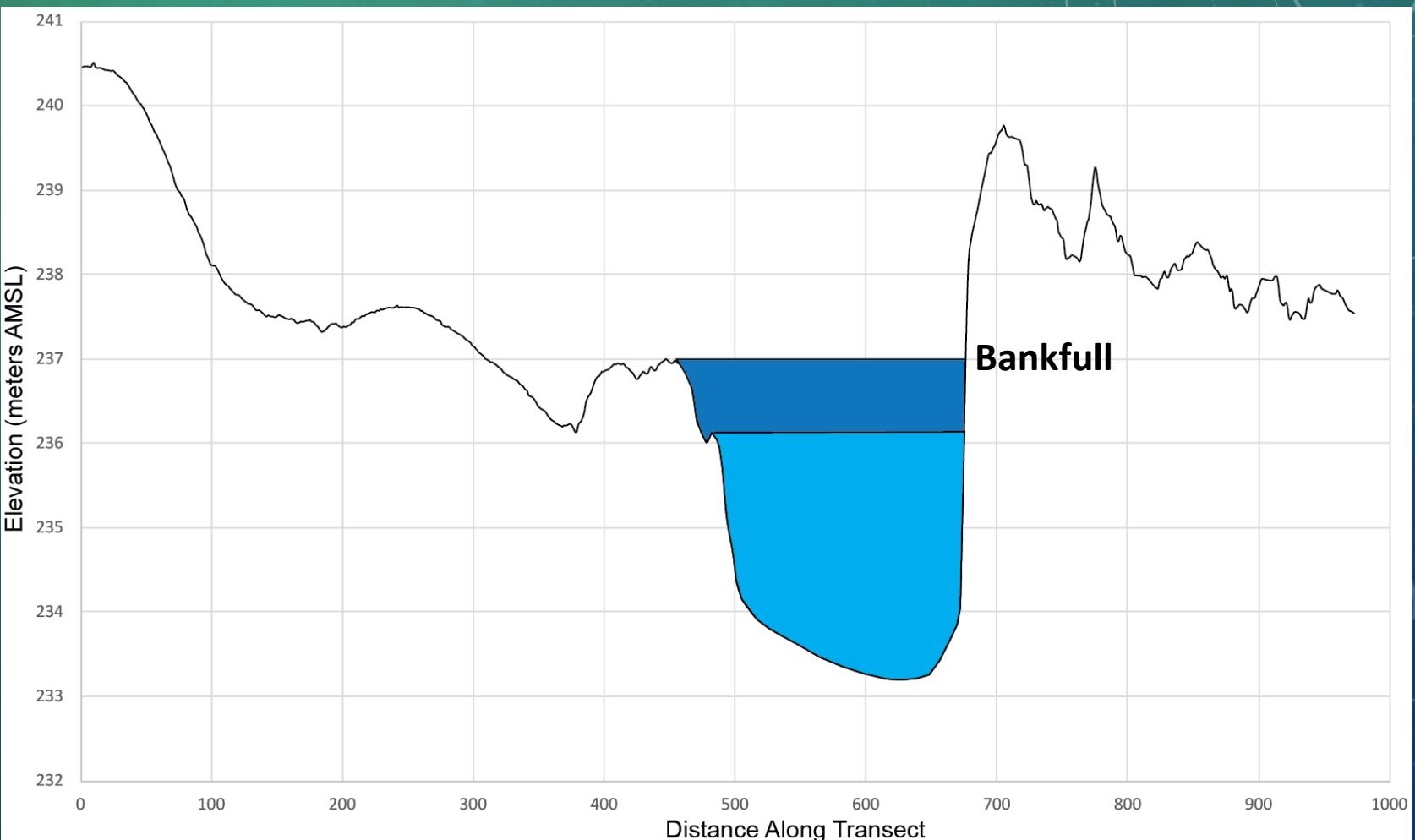
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- ~1.5 Year Recurrence
- Important for Classification
- 2D Example



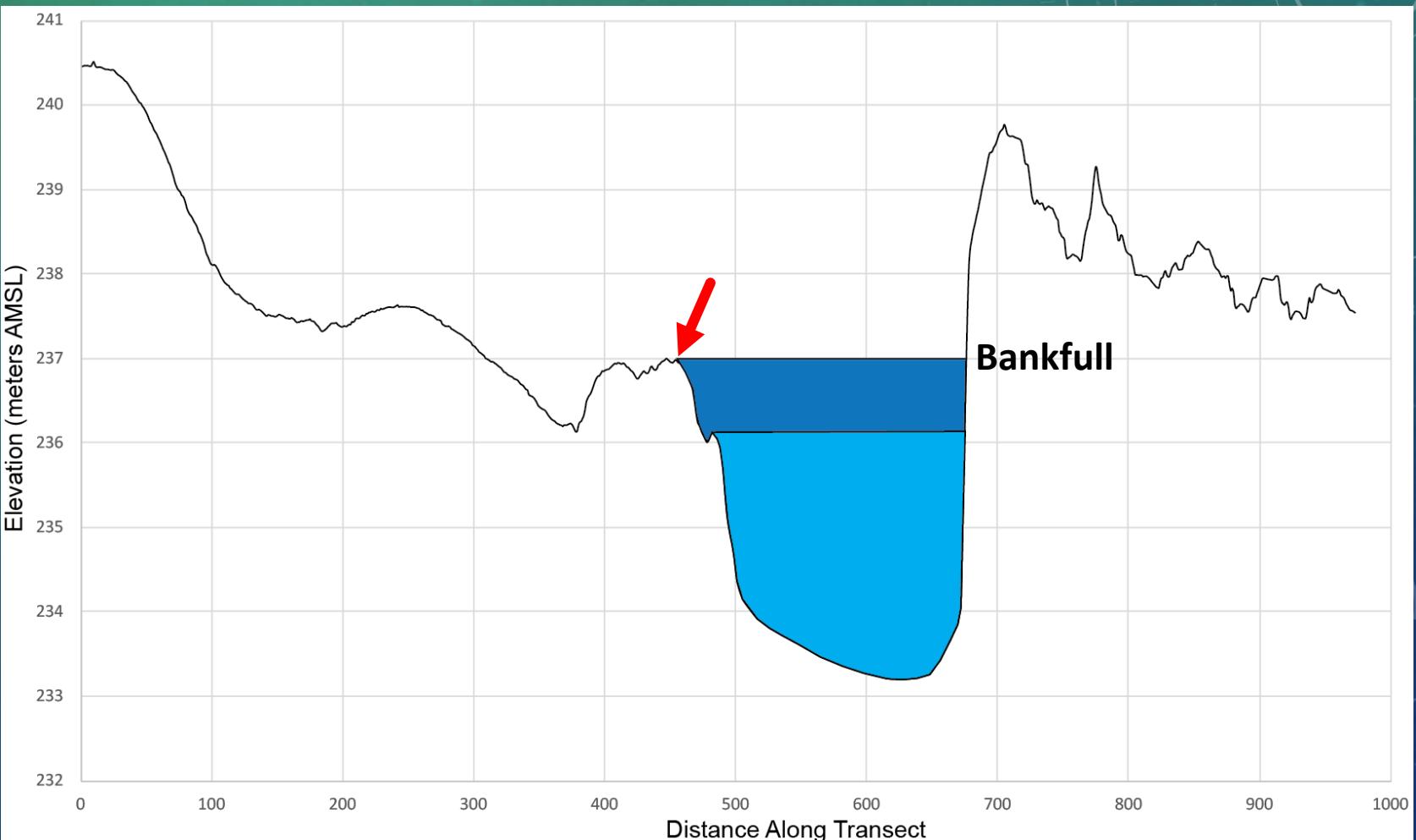
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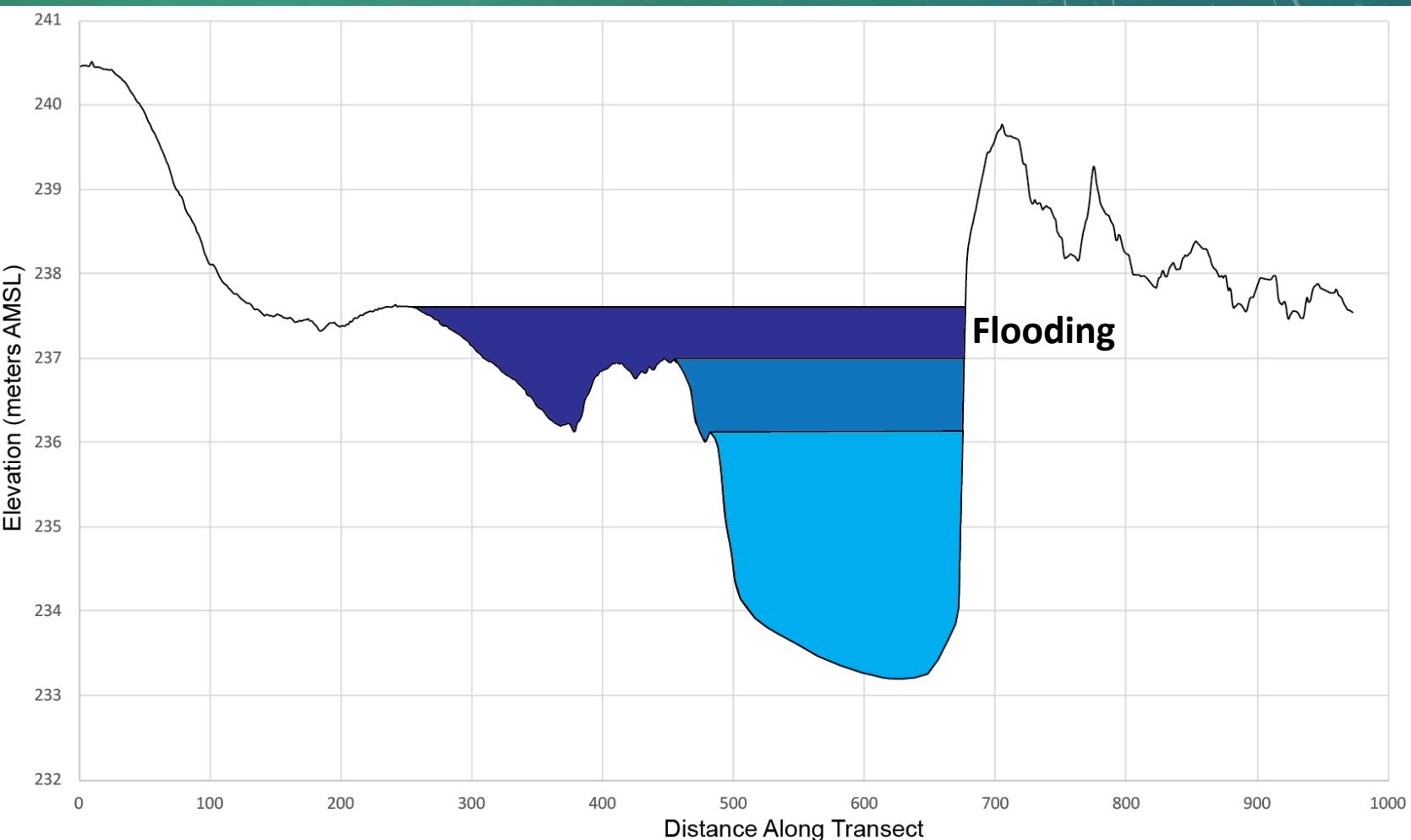
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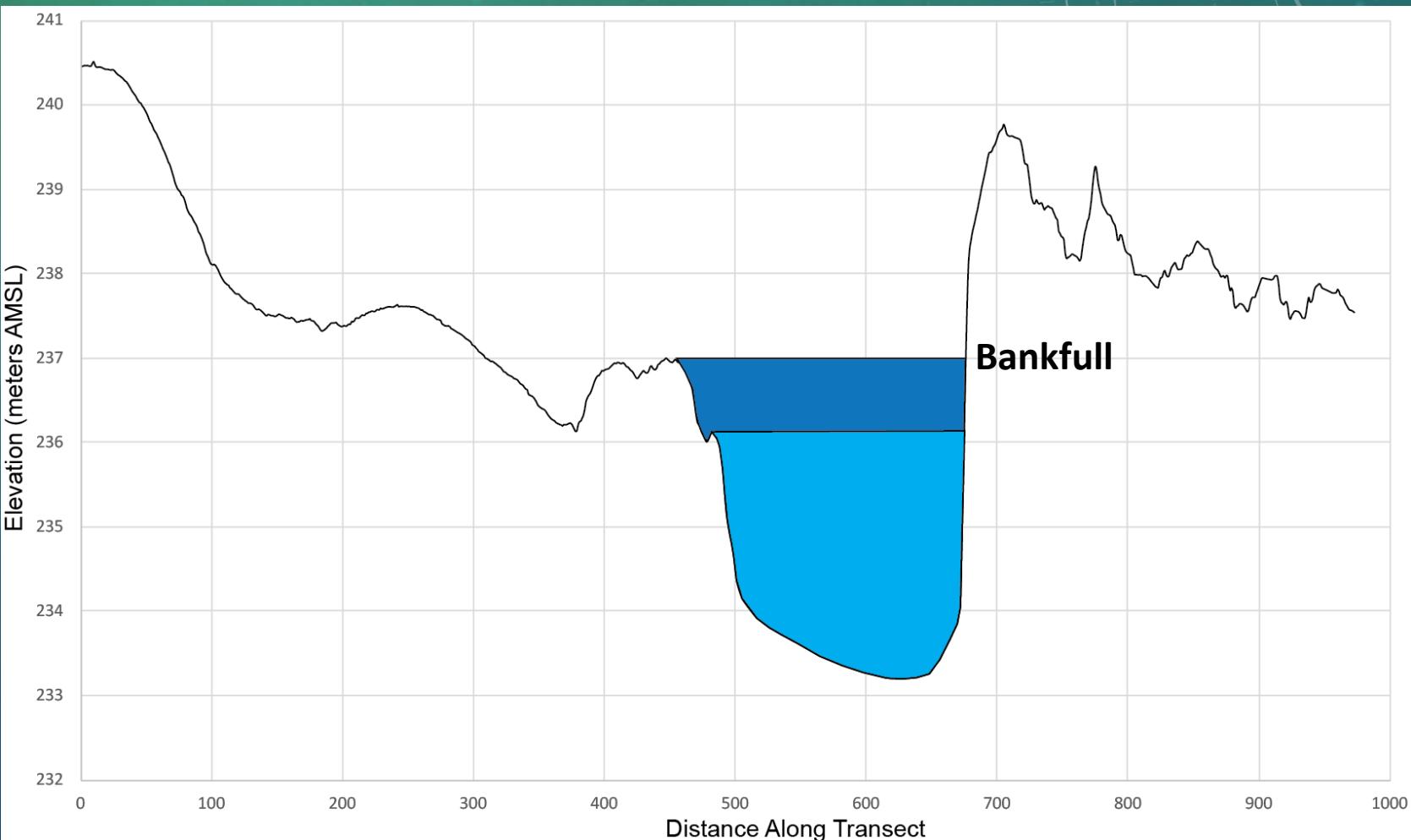
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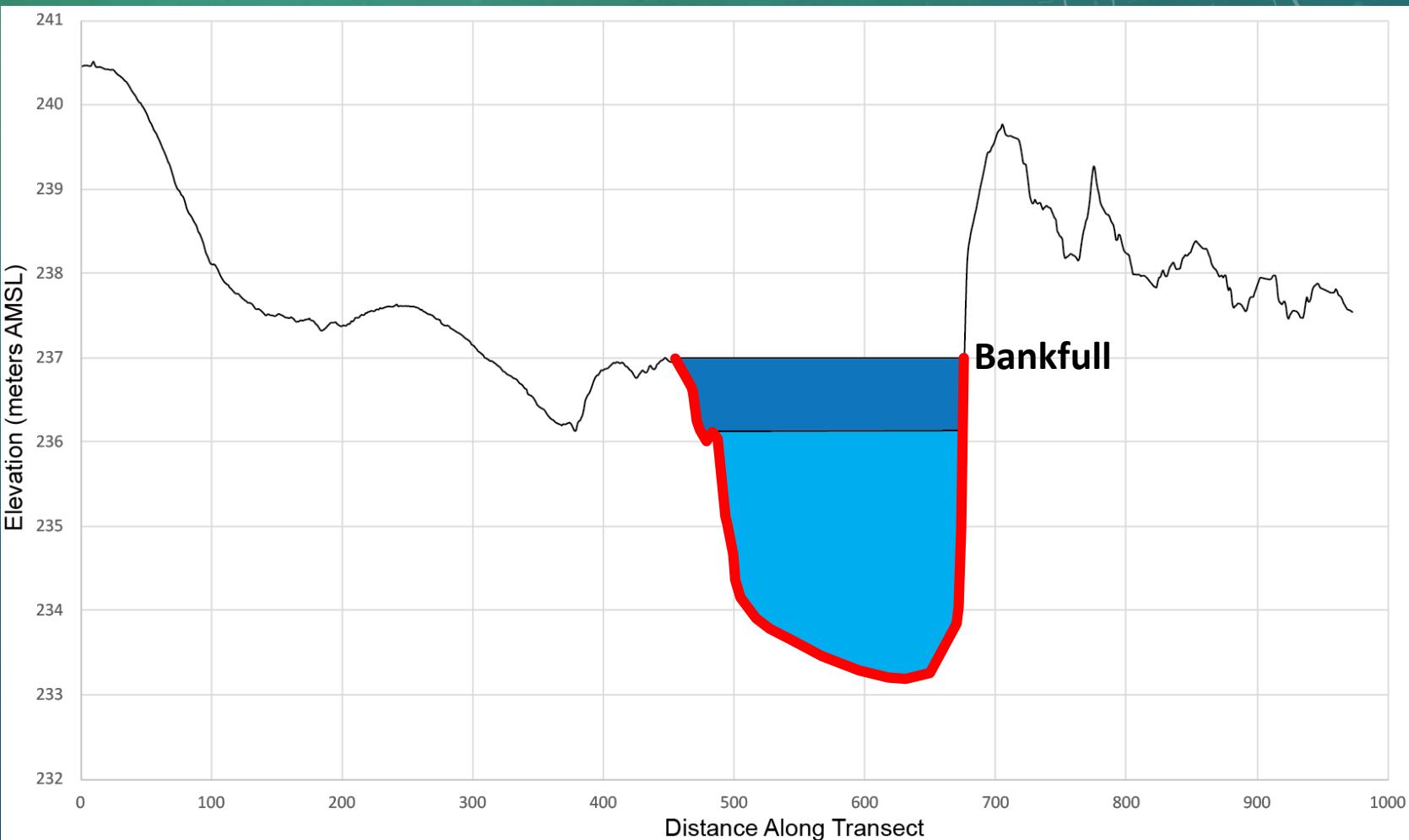
# WIDTH:DEPTH RATIO

- Describes the Shape of the Channel



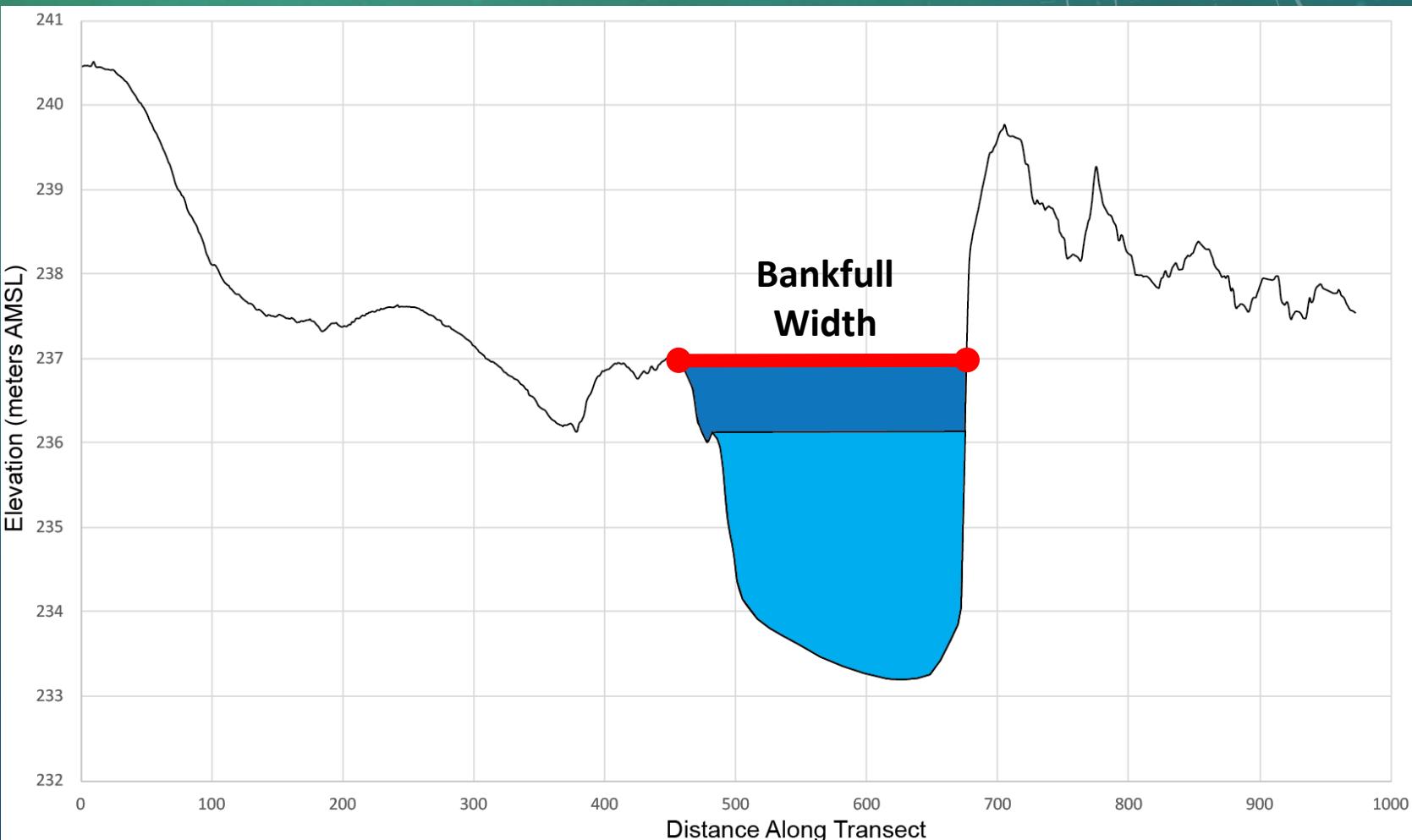
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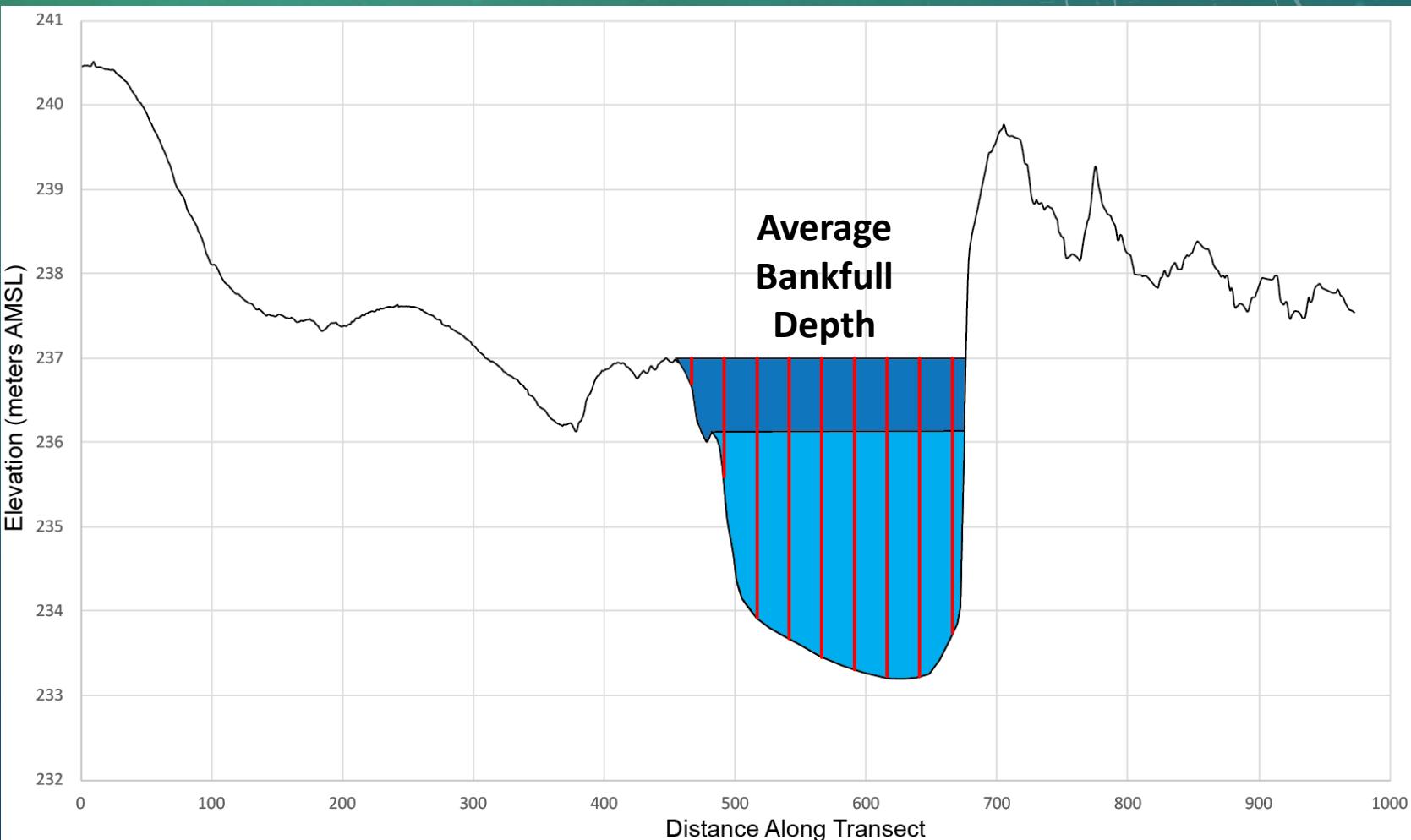
# WIDTH:DEPTH RATIO

- Describes the Shape of the Channel
- Width of the Bankfull Surface



# WIDTH:DEPTH RATIO

- Describes the Shape of the Channel
- Width of the Bankfull Surface
- Mean Depth of the Bankfull Channel



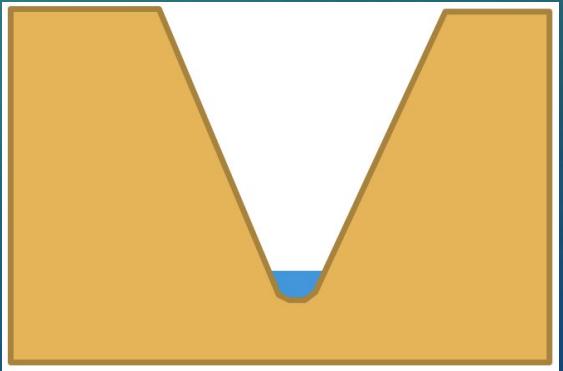
# WIDTH:DEPTH RATIO

- Describes the Shape of the Channel
- Width of the Bankfull Surface
- Mean Depth of the Bankfull Channel
- Large Number: Shallow + Wide

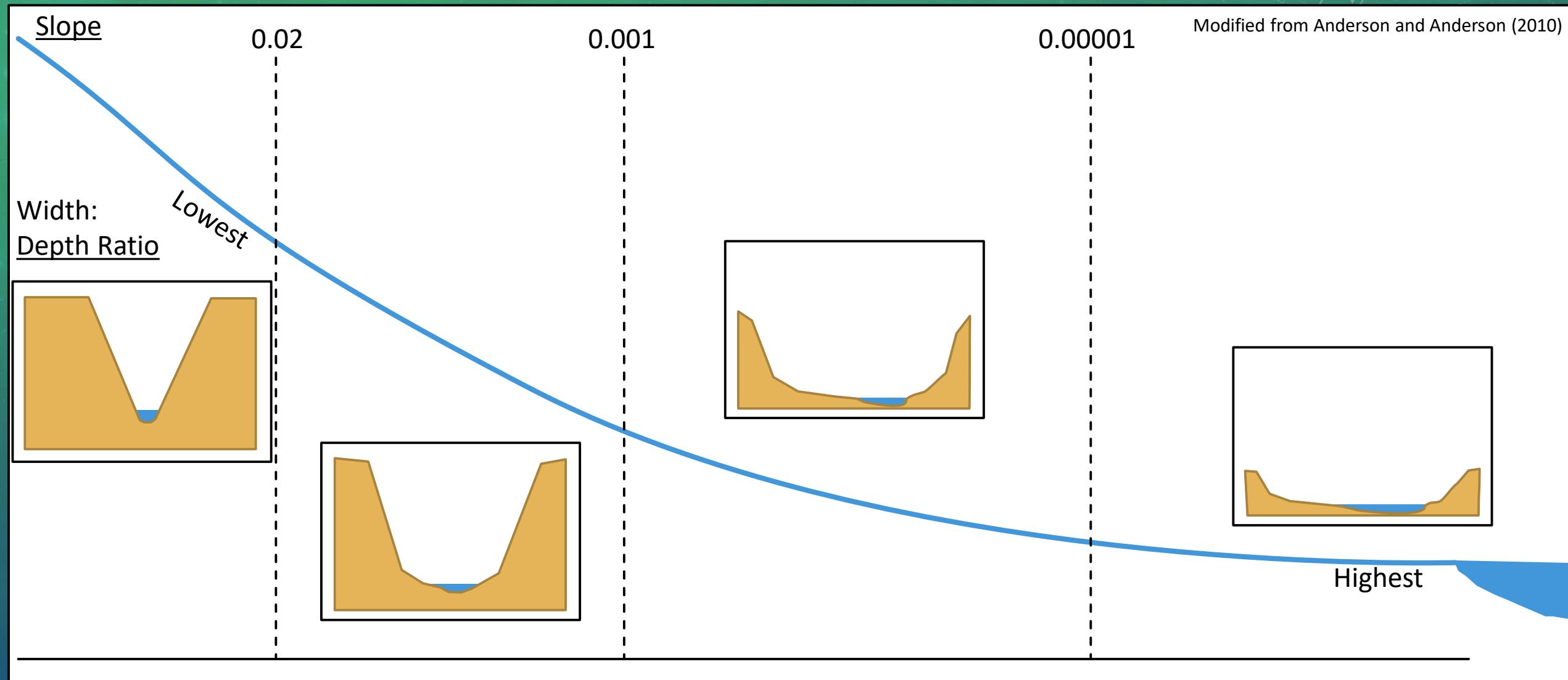


# WIDTH:DEPTH RATIO

- Describes the Shape of the Channel
- Width of the Bankfull Surface
- Mean Depth of the Bankfull Channel
- Large Number: Shallow + Wide
- Small Number: Narrow + Deep



# Longitudinal Profile



# ENTRENCHMENT RATIO

- Defined by Rosgen (1994)

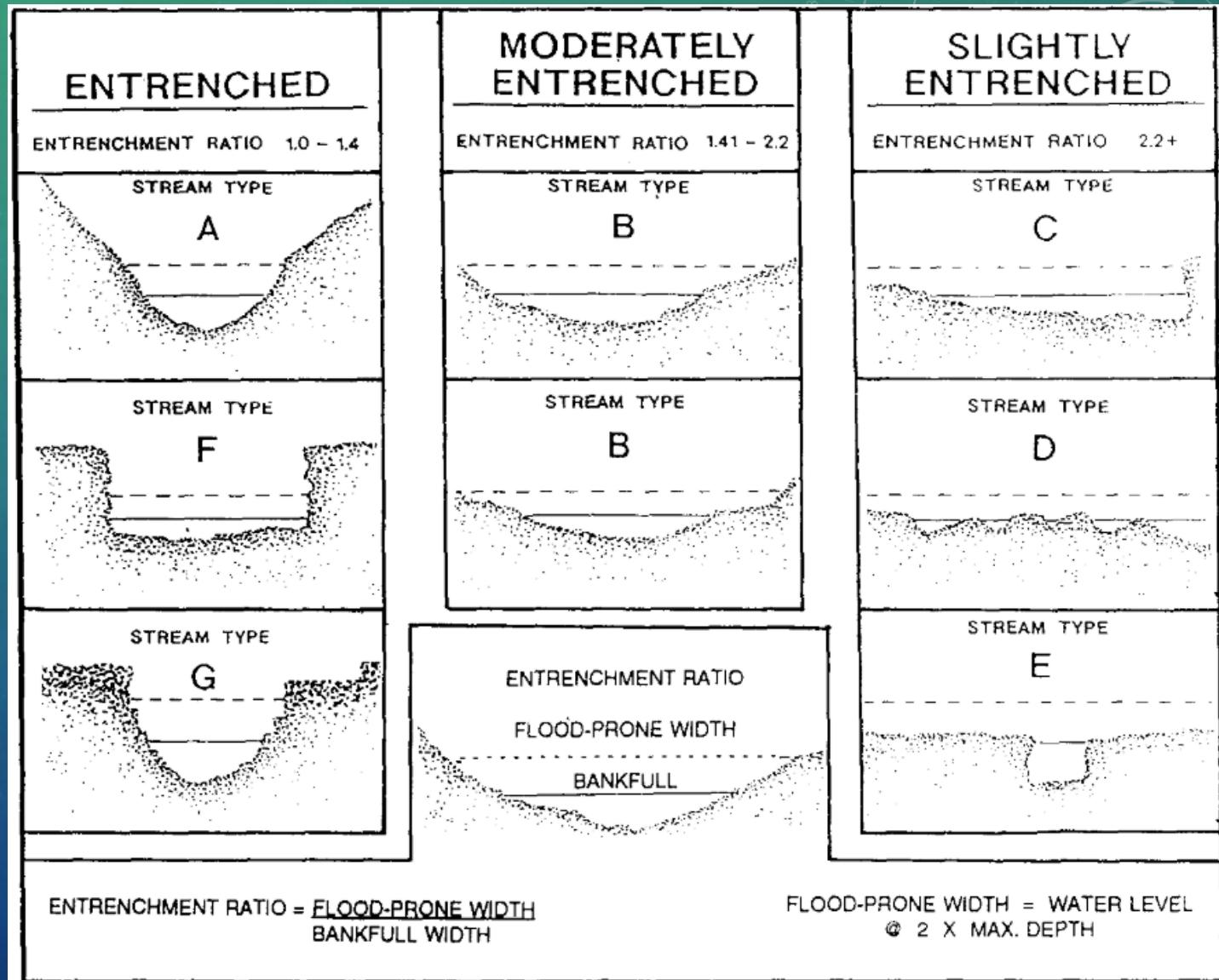


Figure 6, Rosgen (1994)

# ENTRENCHMENT RATIO

- Defined by Rosgen (1994)
- Vertical Containment of the River

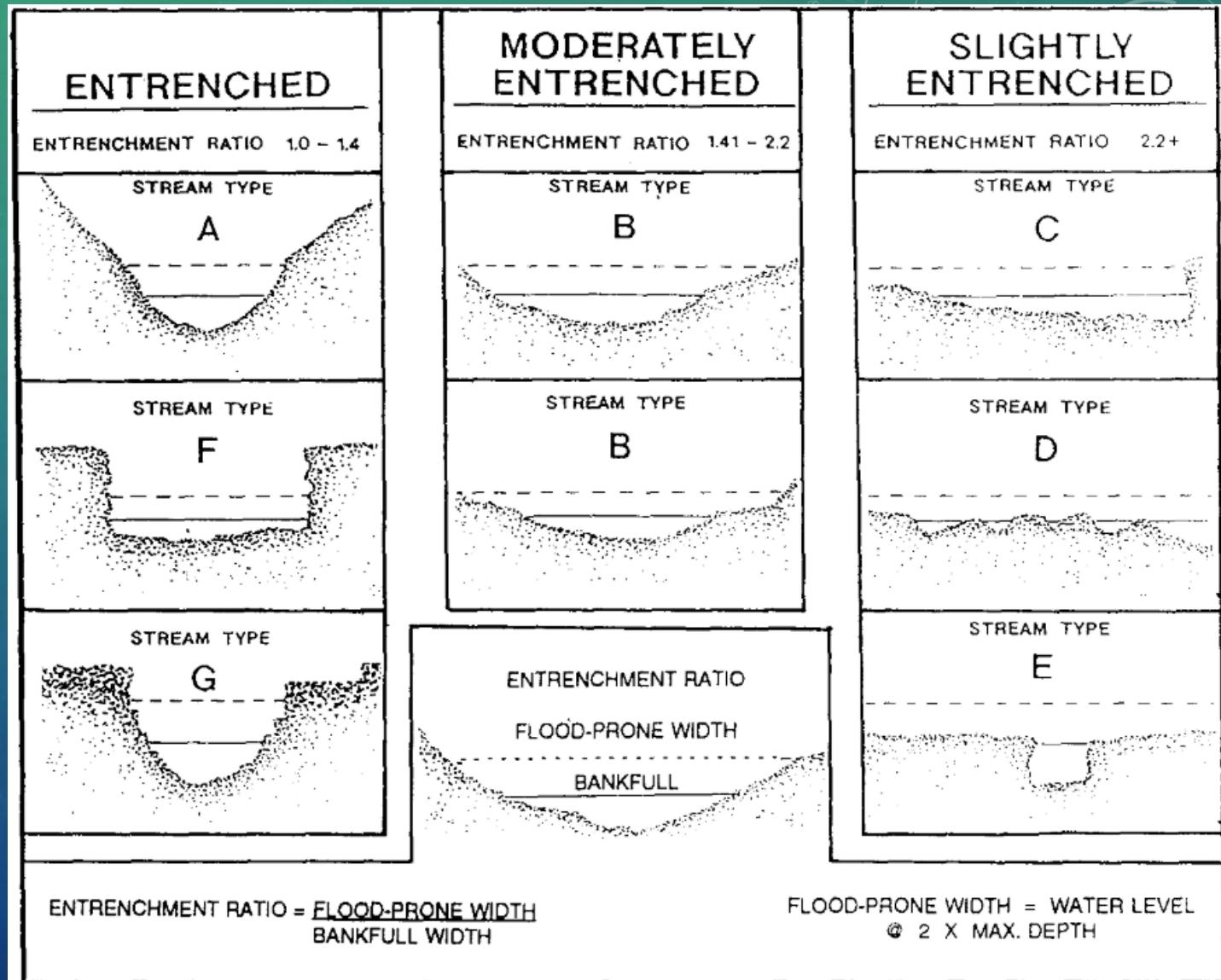
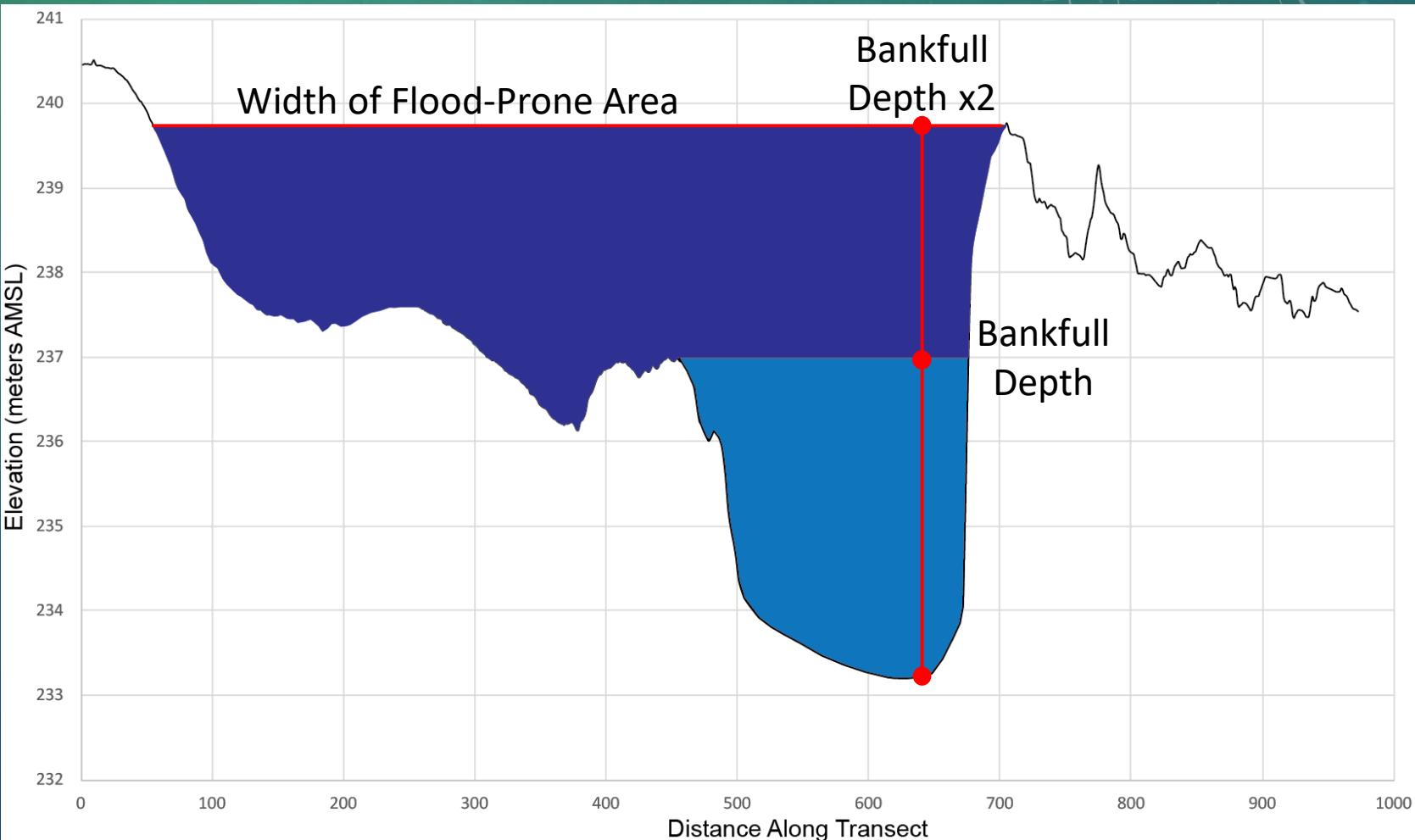


Figure 6, Rosgen (1994)

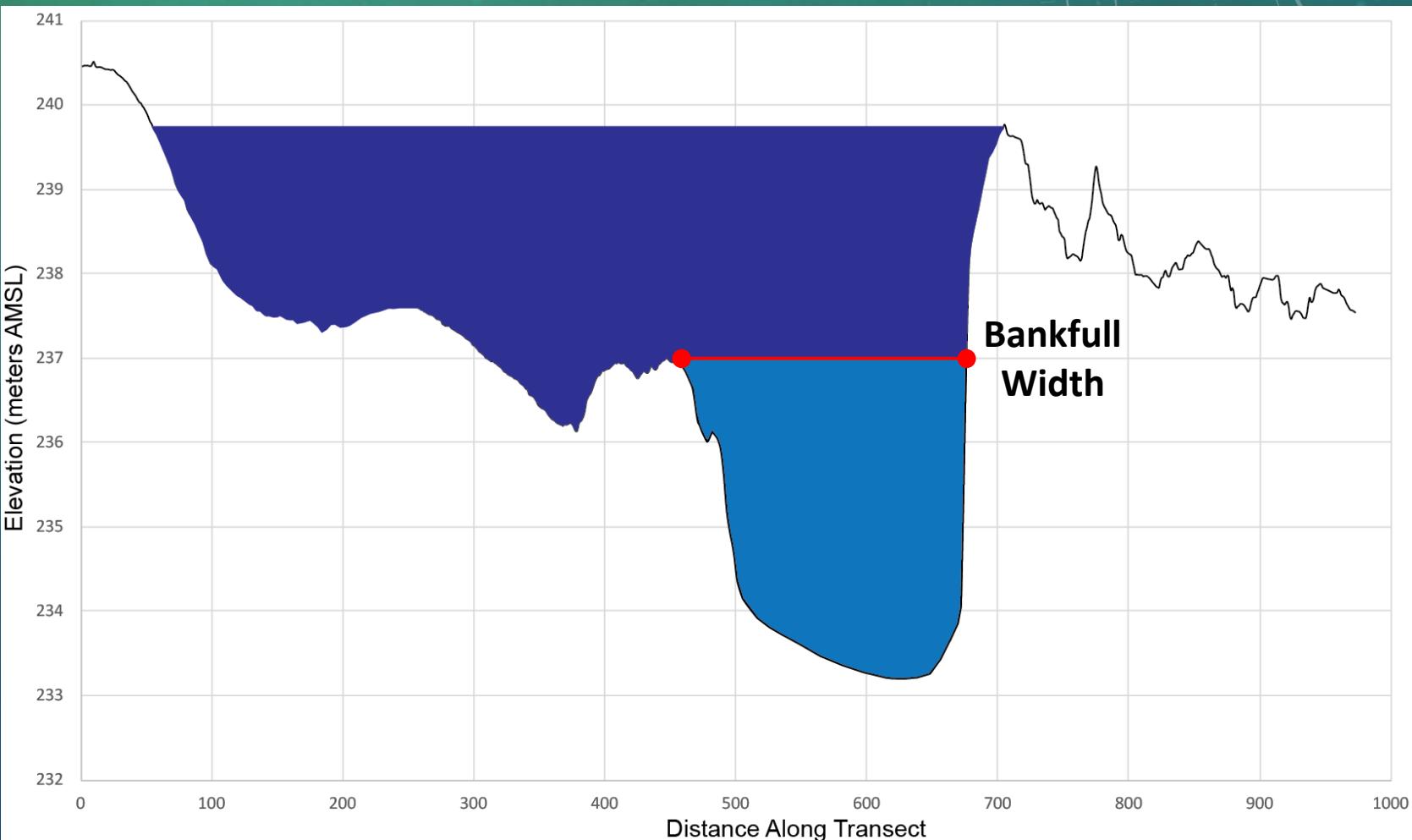
# ENTRENCHMENT RATIO

- Defined by Rosgen (1994)
- Vertical Containment of the River
  - Width of Flood-Prone Area



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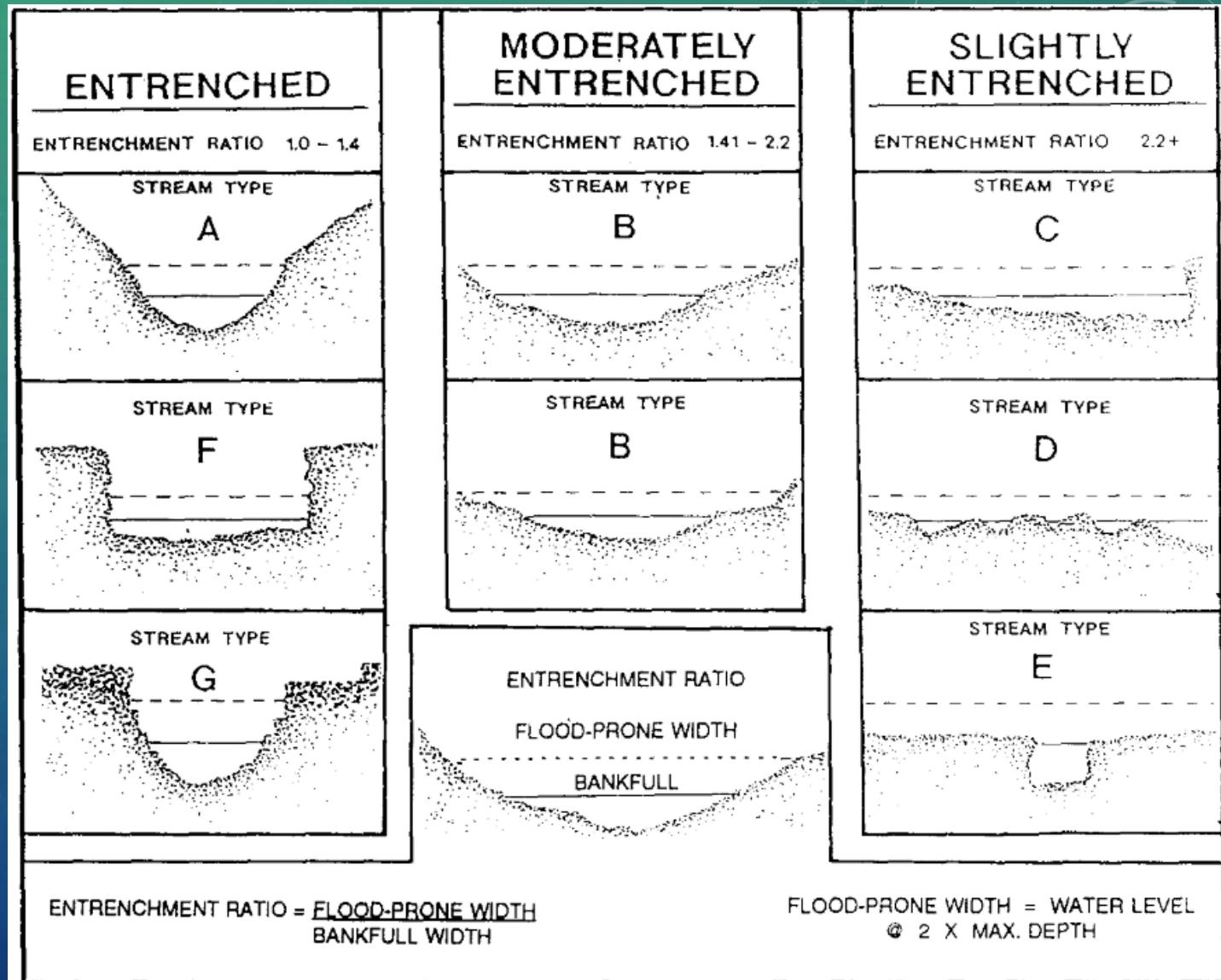


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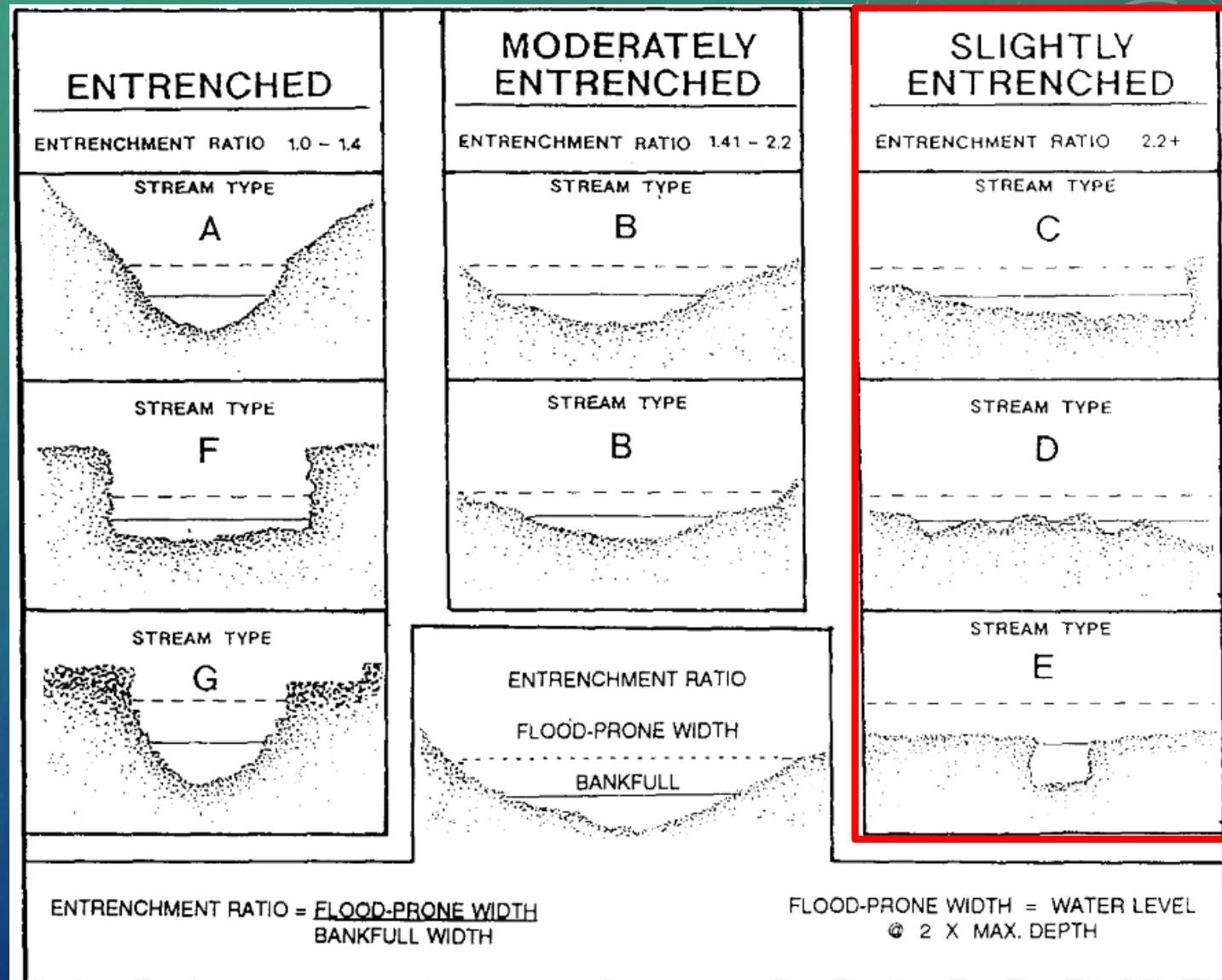


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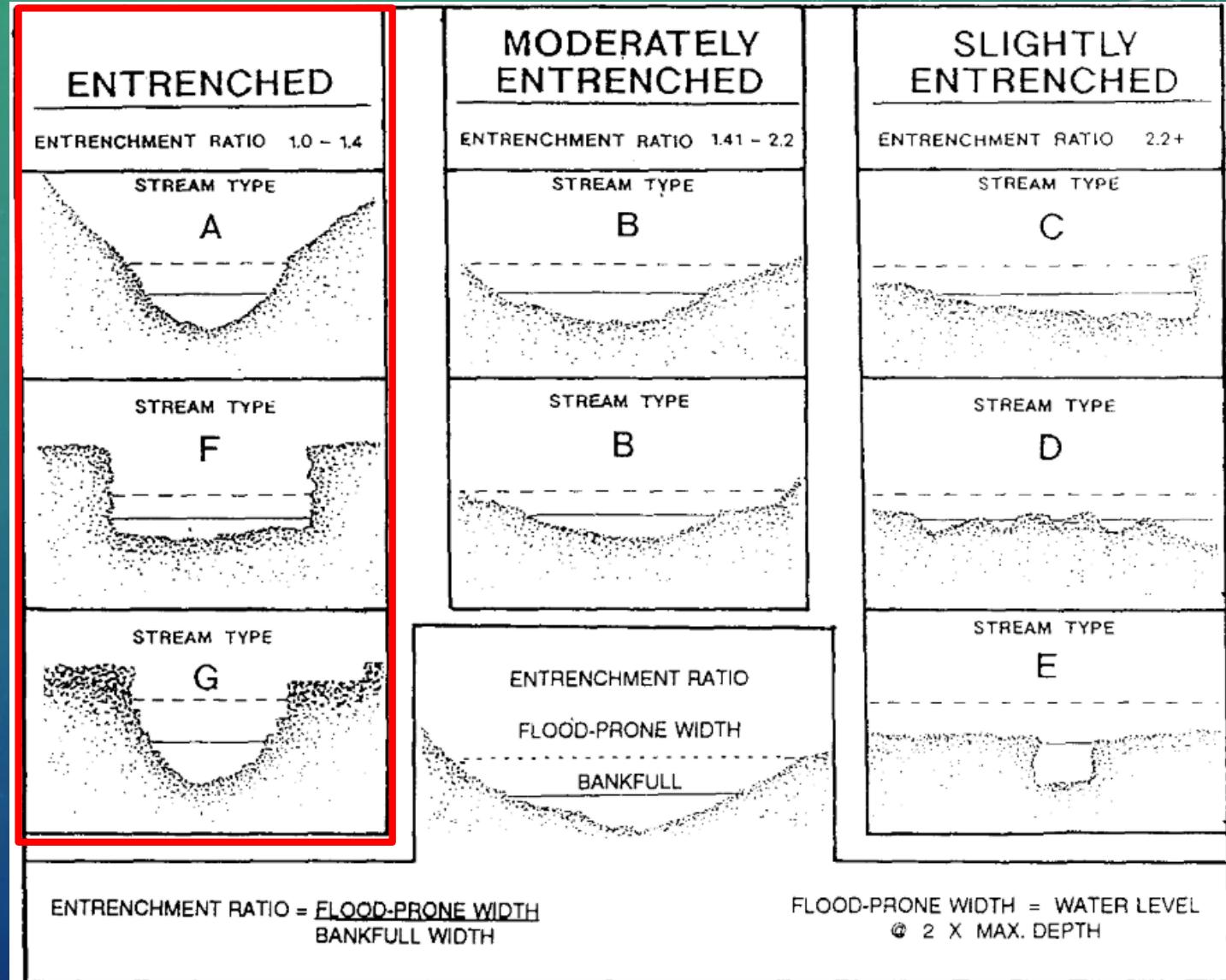
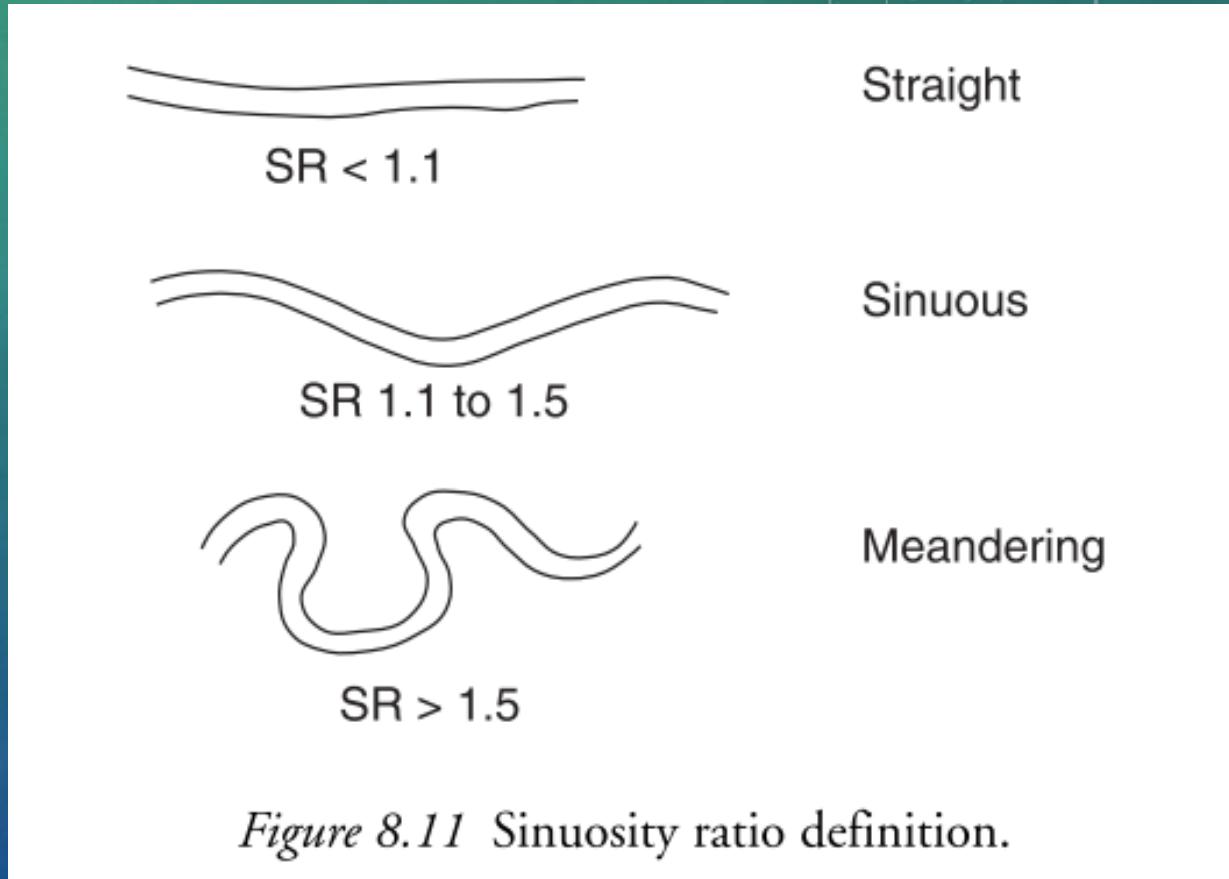


Figure 6, Rosgen (1994)

# OTHER RATIOS

- Sinuosity
  - Length of Channel / Length of Valley Center

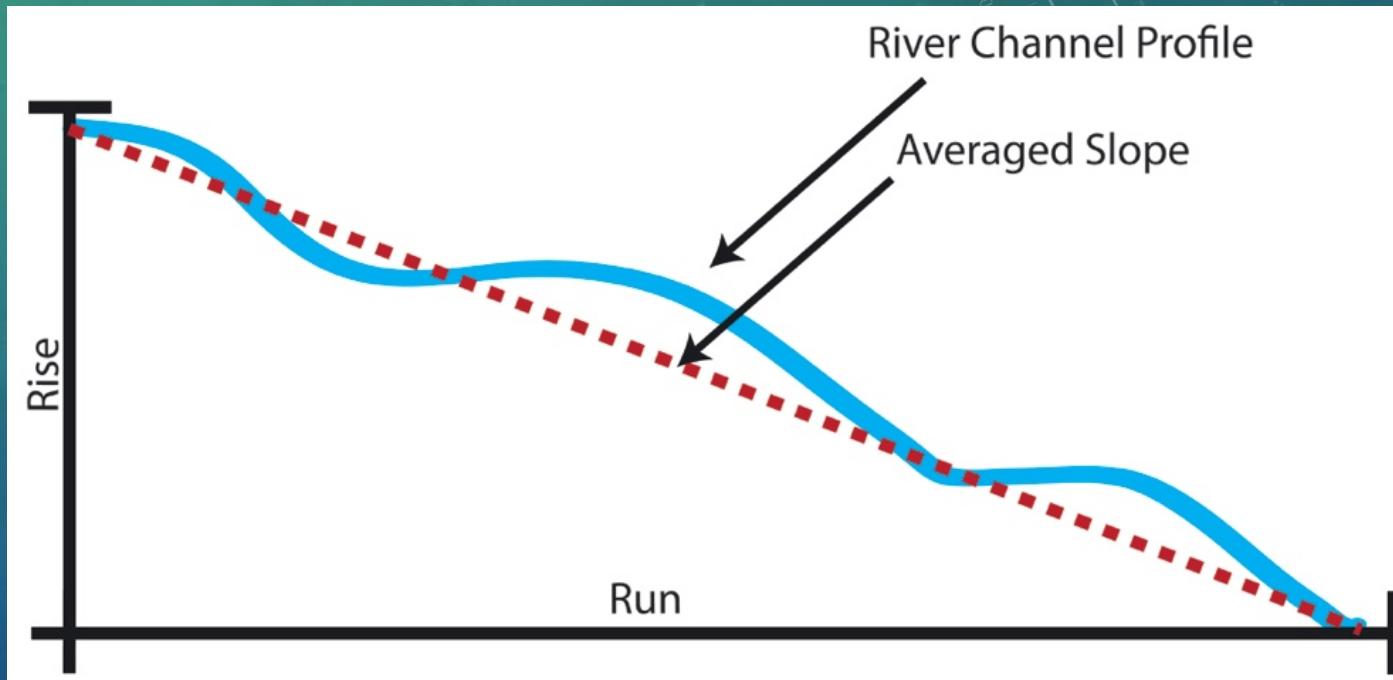


*Figure 8.11* Sinuosity ratio definition.

Charlton (2008): *Fundamentals of Fluvial Geomorphology*

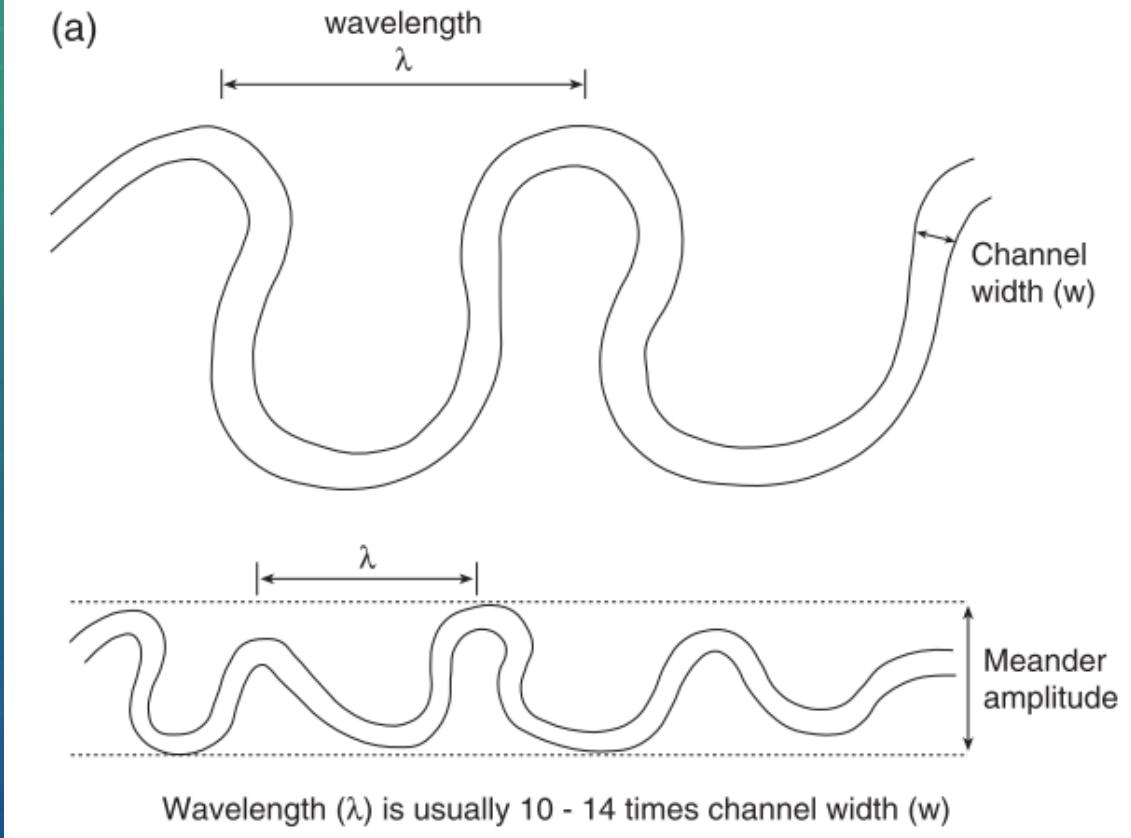
# OTHER RATIOS

- Sinuosity
  - Length of Channel / Length of Valley Center
- Slope
  - Change in Elevation / Change in Distance



# OTHER RATIOS

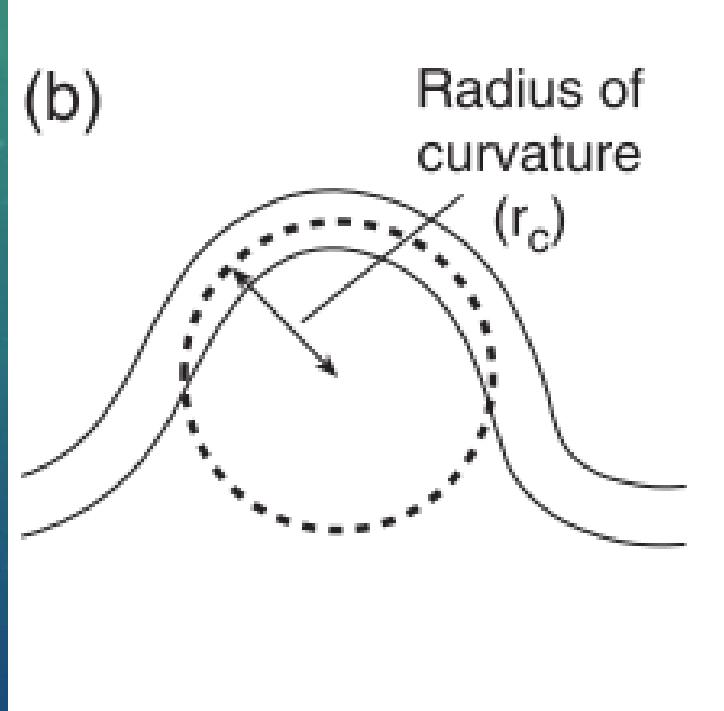
- Sinuosity
  - Length of Channel / Length of Valley Center
- Slope
  - Change in Elevation / Change in Distance
- Meander Wavelength
  - Meander Bend Wavelength
  - Channel Width



Charlton (2008): *Fundamentals of Fluvial Geomorphology*

# OTHER RATIOS

- Sinuosity
  - Length of Channel / Length of Valley Center
- Slope
  - Change in Elevation / Change in Distance
- Meander Wavelength
  - Meander Bend Wavelength
  - Channel Width
- Radius of Curvature
  - Radius of the meander bend
  - Channel Width



Charlton (2008): *Fundamentals of Fluvial Geomorphology*

# RATIOS AND CLASSIFICATIONS

Dominant Bed Material	A	B	C	D	DA	E	F	G
1 BEDROCK								
2 BOULDER								
3 COBBLE								
4 GRAVEL								
5 SAND								
6 SILT/CLAY								
Entrenchment	<1.4	1.4–2.2	>2.2	N/A	>2.2	>2.2	<1.4	<1.4
Sinuosity	<1.2	>1.2	>1.4	<1.1	1.1-1.6	>1.5	>1.4	>1.2
Width:Depth	<12	>12	>12	>40	<40	<12	>12	<12
Slope	.04–.099	.02–.039	<.02	<.02	<.005	<.02	<.02	.02–.039

Figure 4, Rosgen (1994)

# RECAP

RESEARCH ARTICLE

## The Blurred Line between Form and Process: A Comparison of Stream Channel Classification Frameworks

Alan Kasprak<sup>1✉‡\*</sup>, Nate Hough-Snee<sup>1,2‡\*</sup>, Tim Beechie<sup>3✉‡</sup>, Nicolaas Bouwes<sup>4✉‡</sup>,  
Gary Brierley<sup>5✉‡</sup>, Reid Camp<sup>1,4✉‡</sup>, Kirstie Fryirs<sup>6✉‡</sup>, Hiroo Imaki<sup>7✉‡</sup>, Martha Jensen<sup>1,2✉‡</sup>,  
Gary O'Brien<sup>1✉‡</sup>, David Rosgen<sup>8✉‡</sup>, Joseph Wheaton<sup>1,2✉‡</sup>

# RECAP

- Definitions
- Ratios
- How to Use Ratios

Dominant Bed Material	A	B	C	D	DA	E	F	G
1 BEDROCK								
2 BOULDER								
3 COBBLE								
4 GRAVEL								
5 SAND								
6 SILT/CLAY								
ENTRH.	<1.4	1.4-2.2	>2.2	N/A	>2.2	>2.2	<1.4	<1.4
SIN.	<1.2	>1.2	>1.4	<1.1	1.1-1.6	>1.5	>1.4	>1.2
W/D	<12	>12	>12	>40	<40	<12	>12	<12
SLOPE	.04-.099	.02-.039	<.02	<.02	<.005	<.02	<.02	.02-.039

Figure 4, Rosgen (1994)