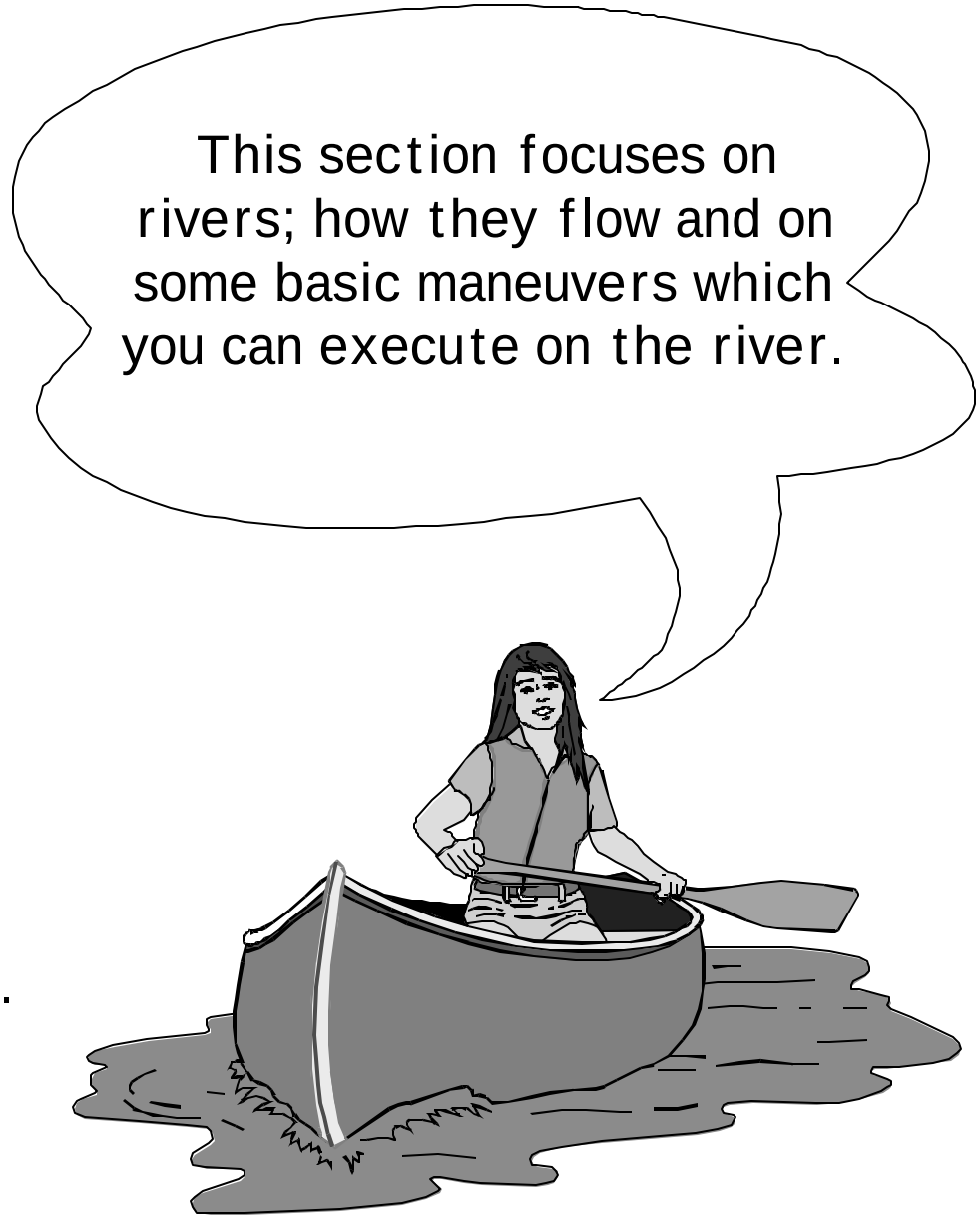
River Dynamics Canoeing:

By Robert B. Kauffman, Ph.D.

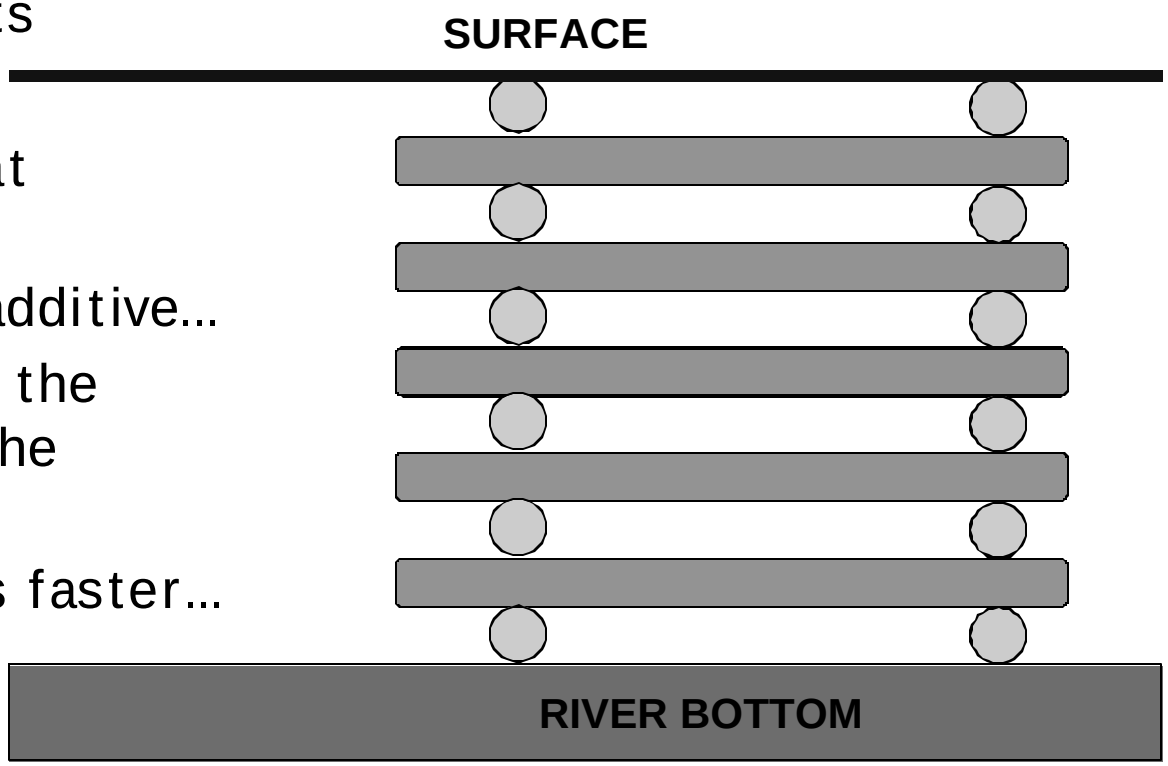


Topics -

- Laminar and shore to center flows
- High and low flows
- Current piling up on the bends
- Strainers
- Pillows
- Eddys
- Hydraulics
- Running the river.

Laminar Flows:

- Imagine several sheets of plywood with wooden dowels between the sheets
- Push the stack
- The sheets move at different speeds
- Their speeds are additive...
- With the sheet on the bottom traveling the slowest
- Each sheet travels faster...
  (continued next slide)



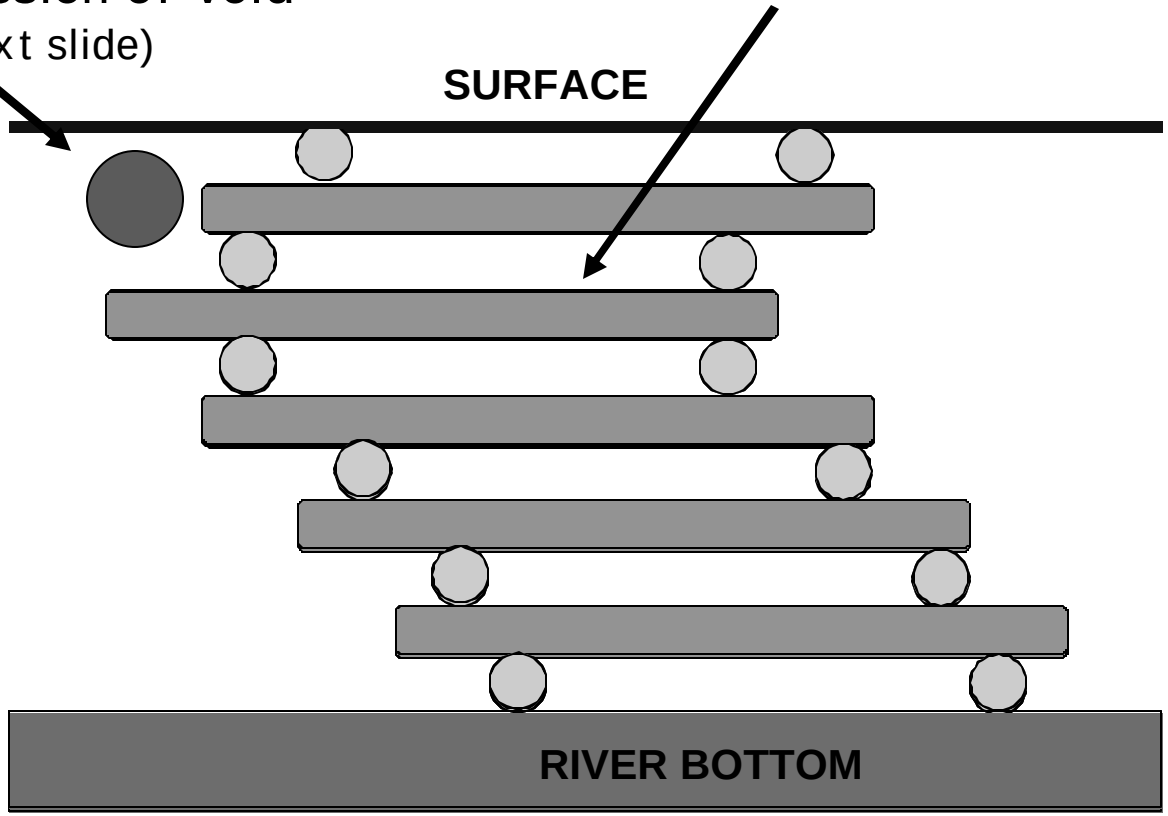
Laminar Flows:

The surface air offers resistance - slowing slightly the sheet just below the surface

This creates a depression or void

(shore to center flows - next slide)

Fastest water is just below the surface.



The stack is pushed

The bottom sheet moves the slowest, slowed by the bottom

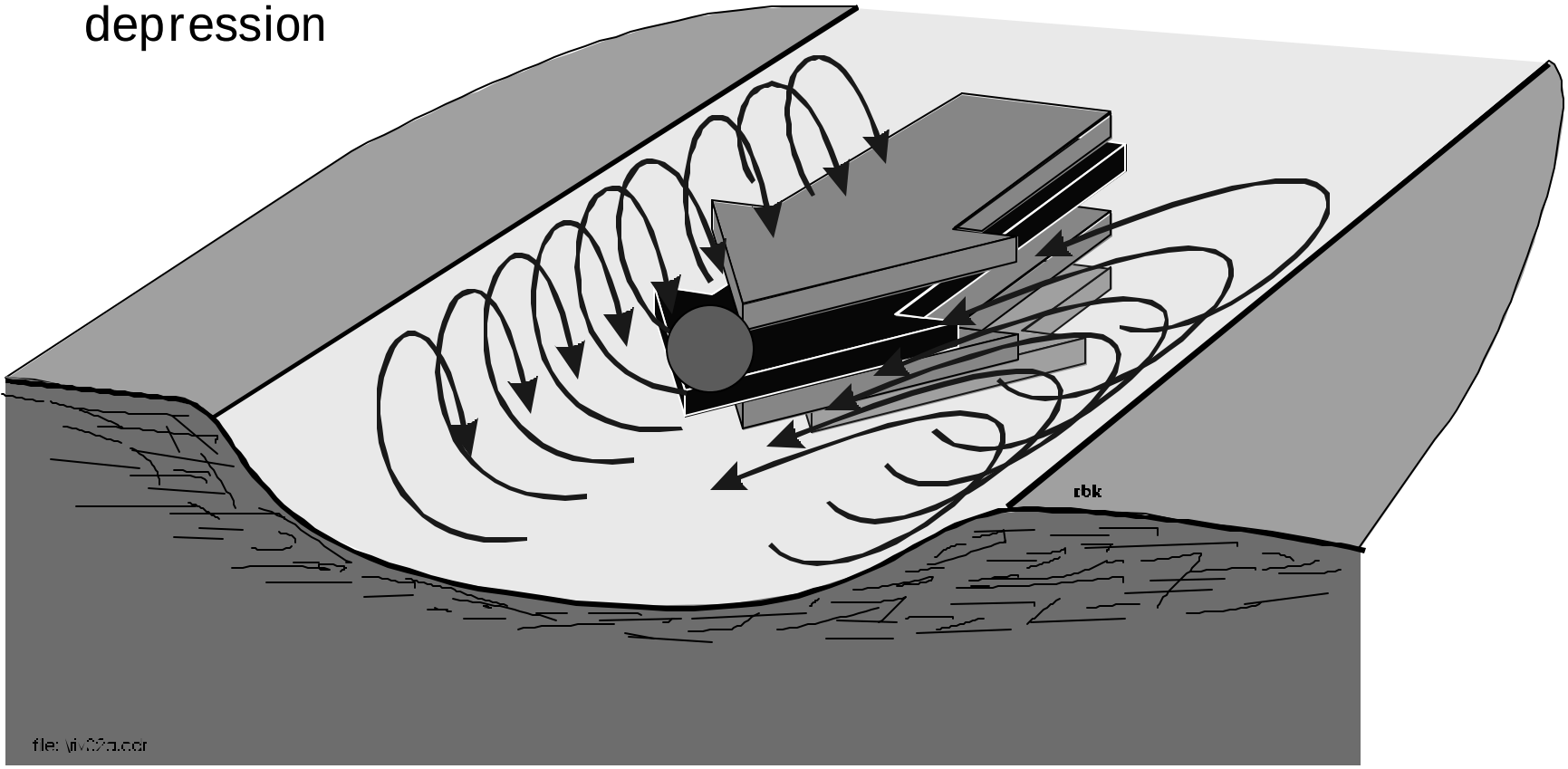
The next sheet moves its speed plus the speed of the sheet below it

Shore to Center Flows:

Laminar flow in center of an unobstructed channel

Slower surface flow creates a slight depression which draws water in from sides to fill the depression

Most likely to occur in drainage ditches and irrigation channels; fastest water is just below surface.



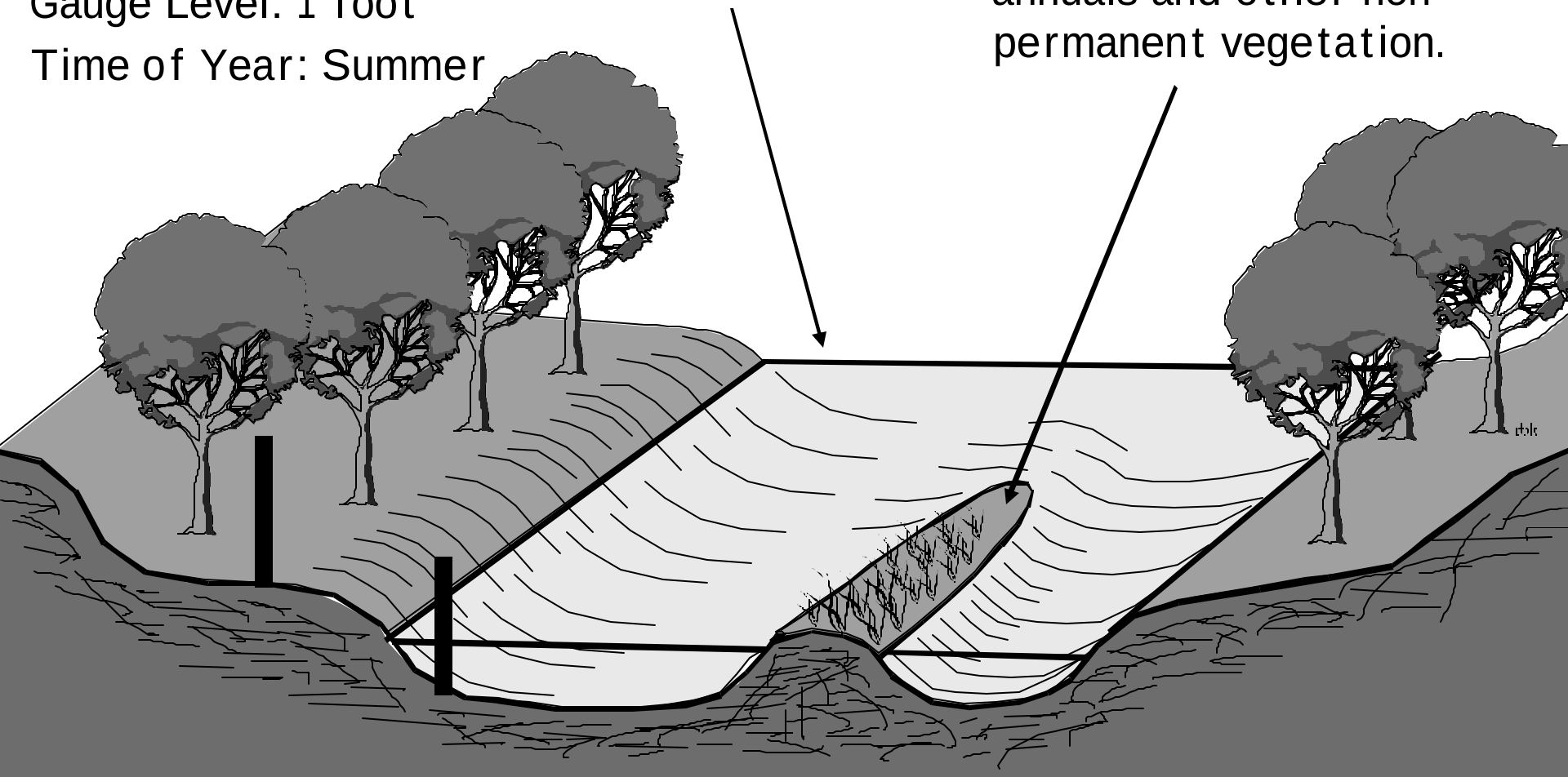
Normal Summer Low Flows:

River has little apparent flow; often seems pool like

Vegetation on gravel bar is summer growth of annuals and other non-permanent vegetation.

Gauge Level: 1 foot

Time of Year: Summer



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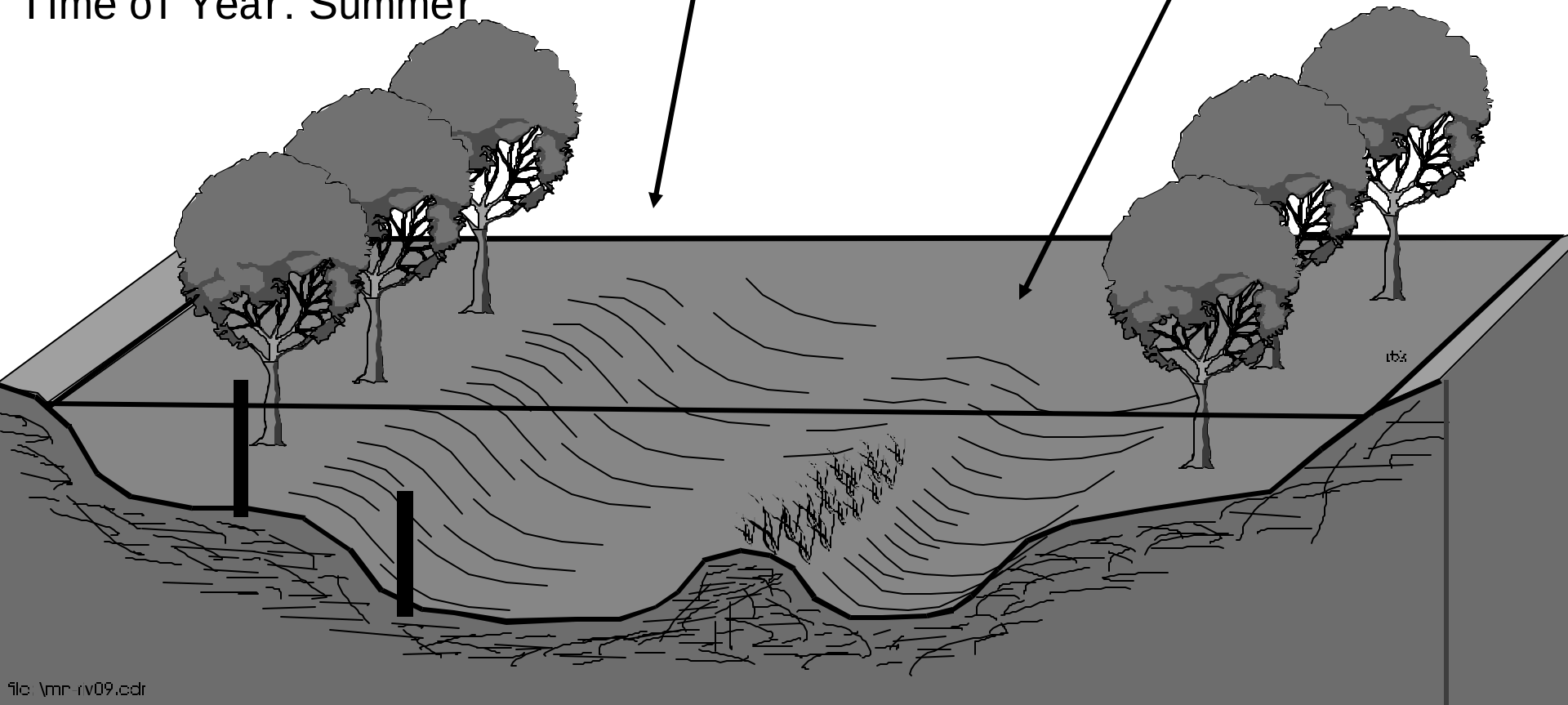
Flood Flows:

River is over its primary banks, into trees and other vegetation along the banks

River looks like it is flooding. Muddy water, big waves, large objects floating down the river.

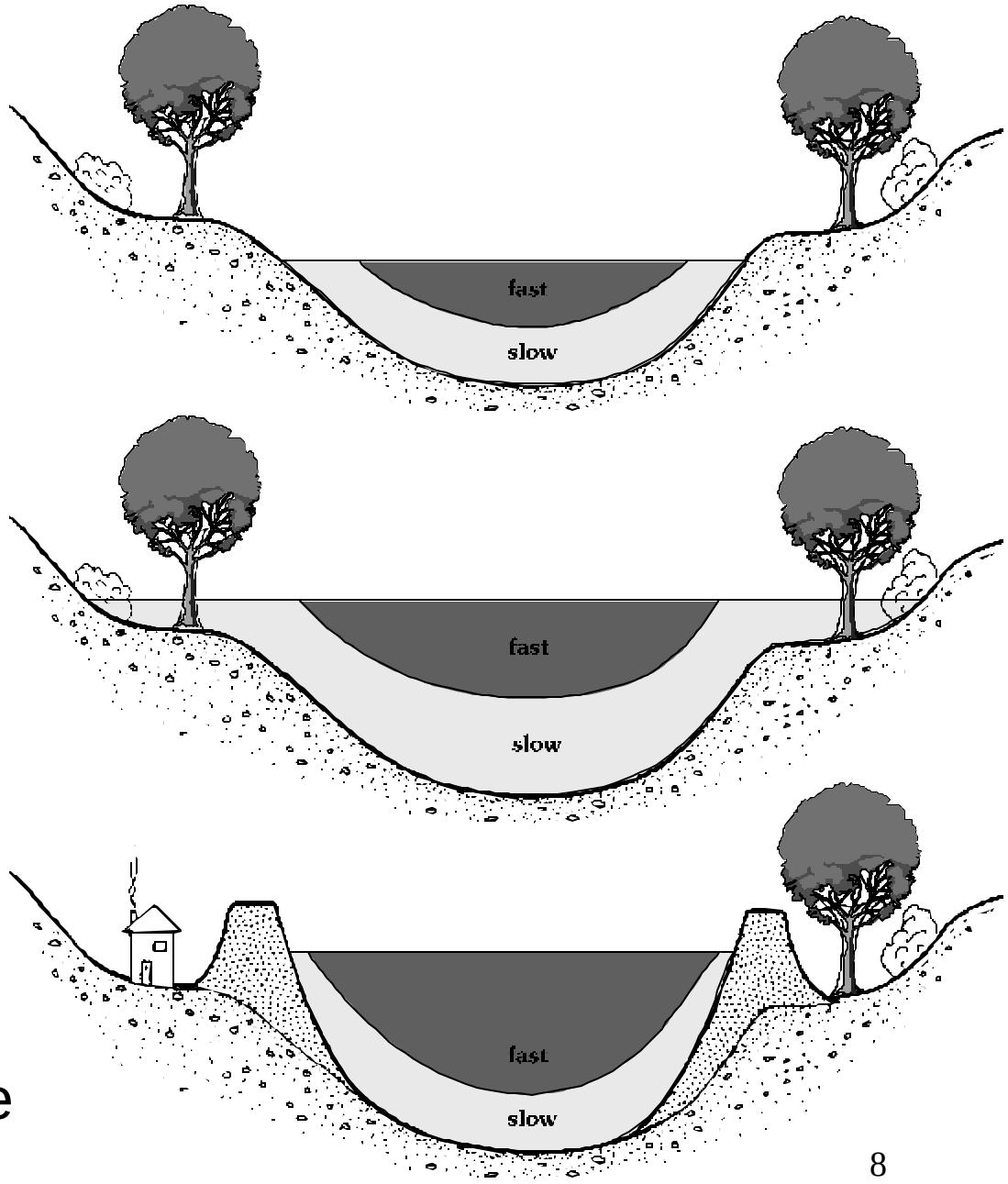
Gauge Level: 16 foot

Time of Year: Summer



Normal, Flood and Channeled Flows:

- Normal flows - note faster current in the middle
- Flood - pooling creates essentially the same effect with faster current
- Channeled - slices center flow of river; same effect on bridge piers and canals.



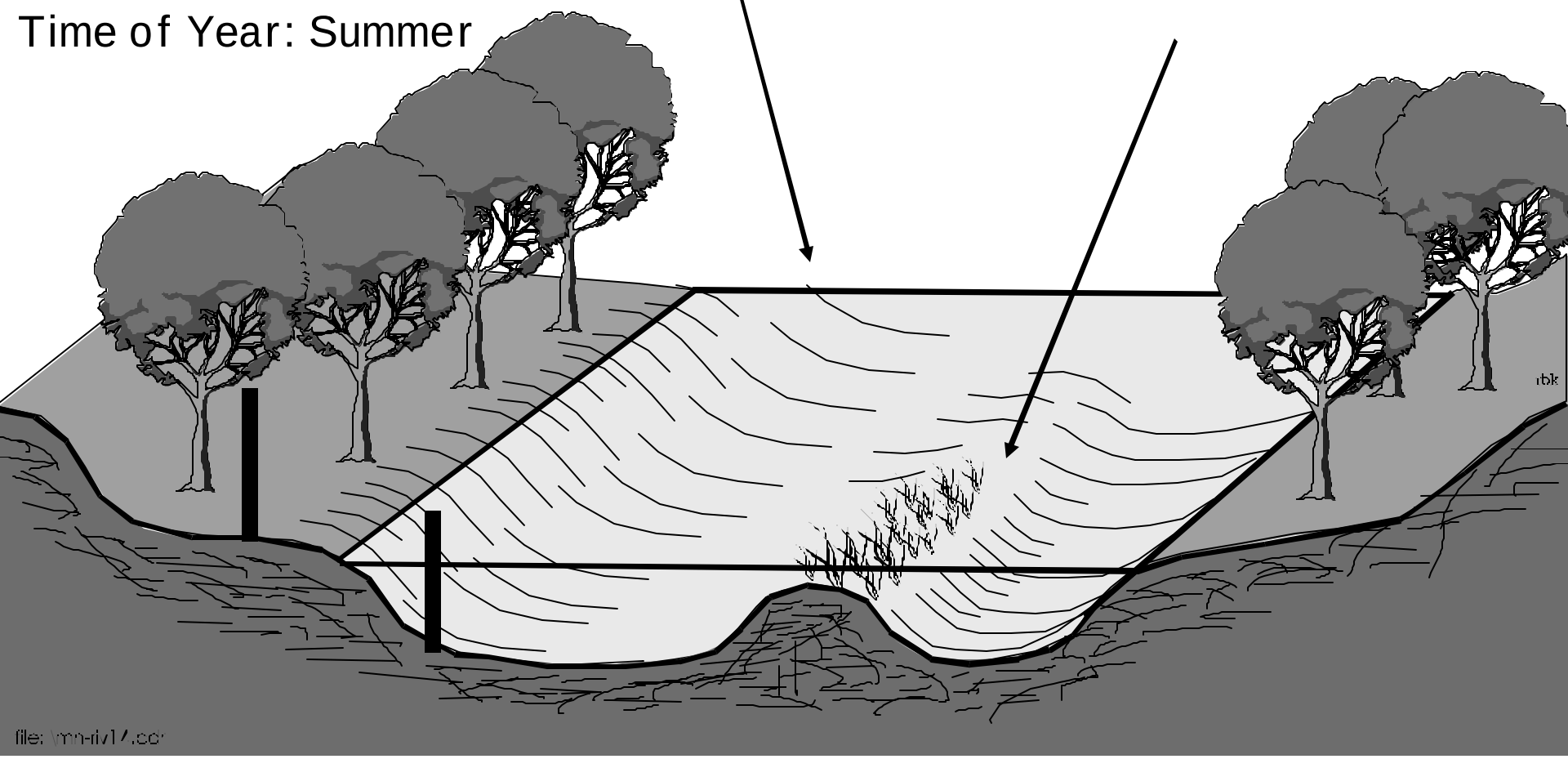
Drowning Trap Flows:

Close examination reveals a distinct current. The river is not over its primary banks

Gauge Level: 4 foot

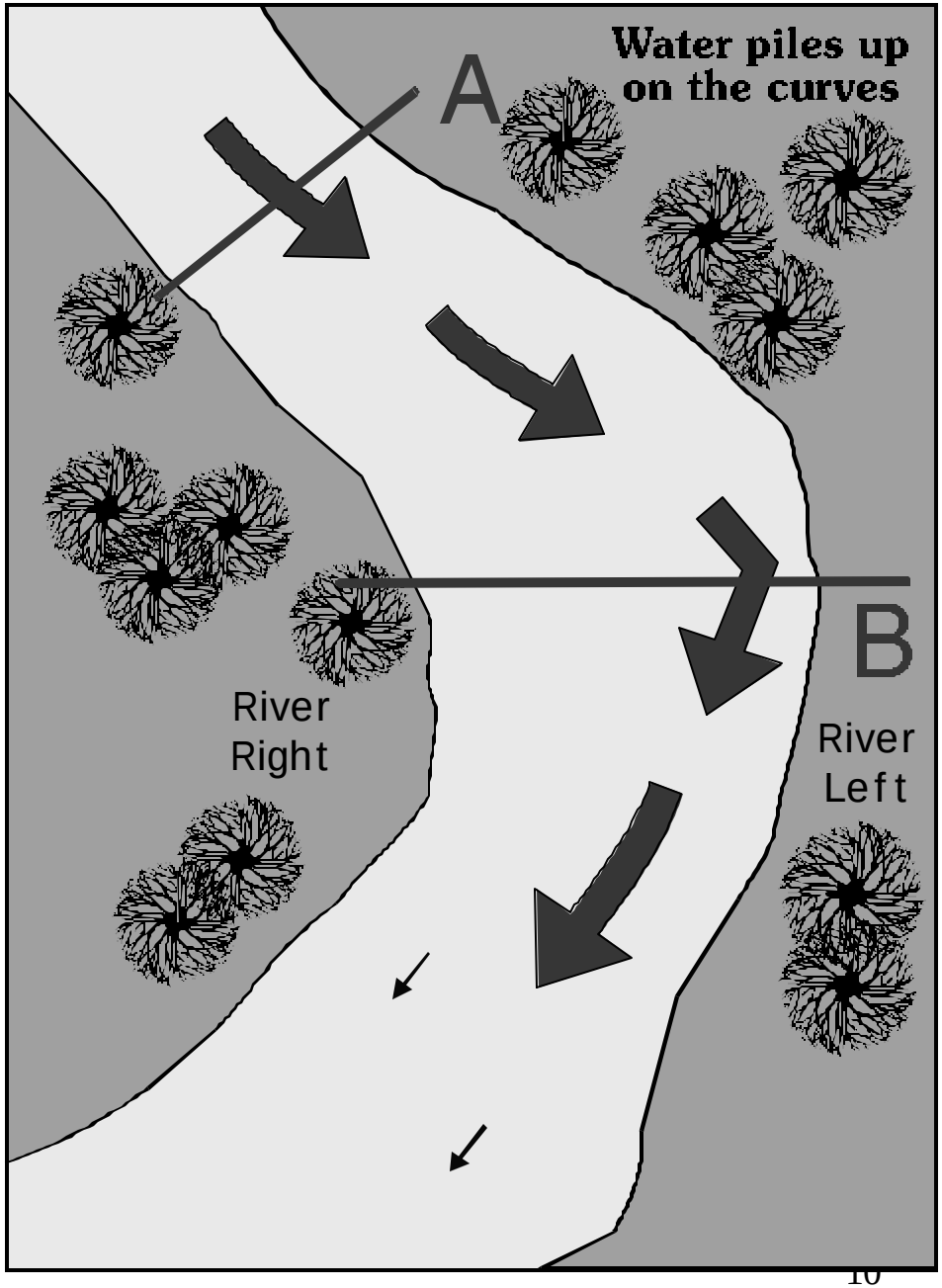
Time of Year: Summer

Summer growth on gravel bar is usually covered with water indicating higher summer flows than normal.



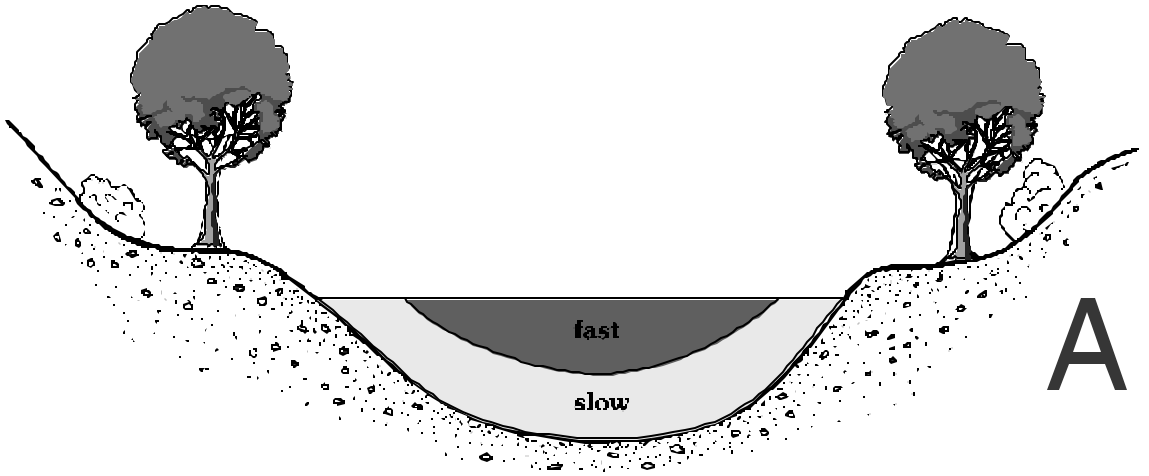
The Current Piles Up on the River Bends:

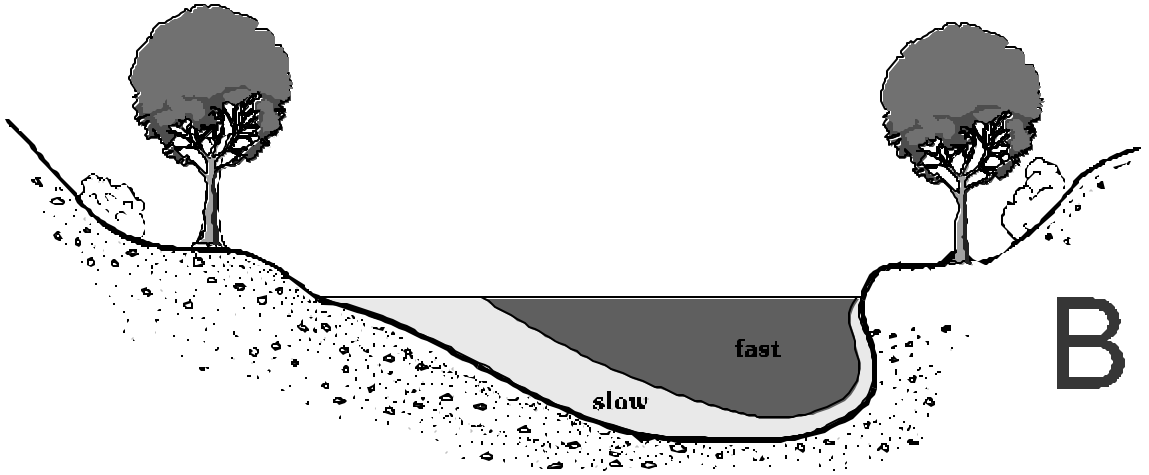
- Main current starts center and plows into bend
- Under cuts bend
- Encourages strainers and undercut rocks
- Profiles (A,B) next slide.



The Current Piles Up on the River Bends:

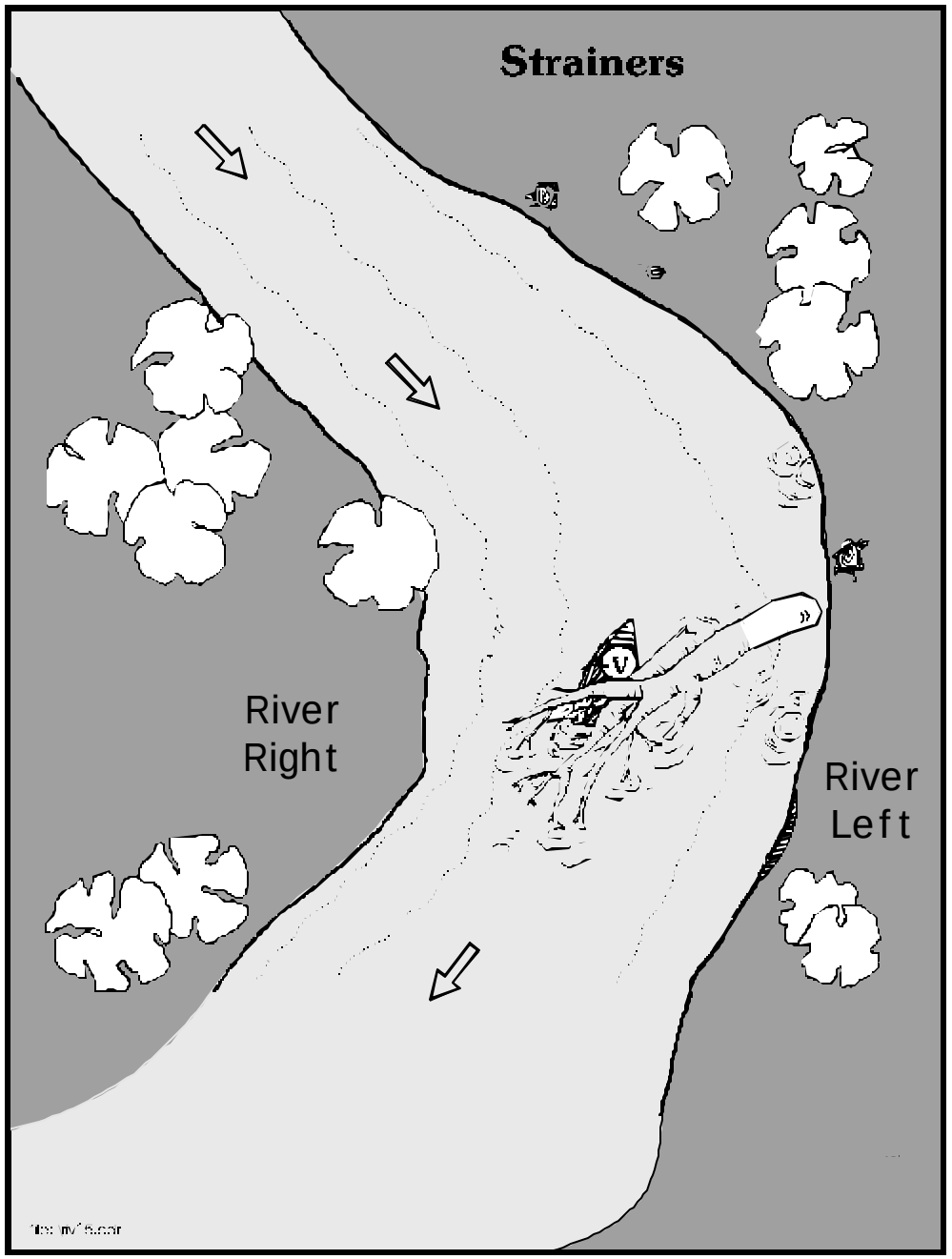
- Undercuts bank on right
- Fastest current close to bank
- Shallower and slower water on left- inside of bend.





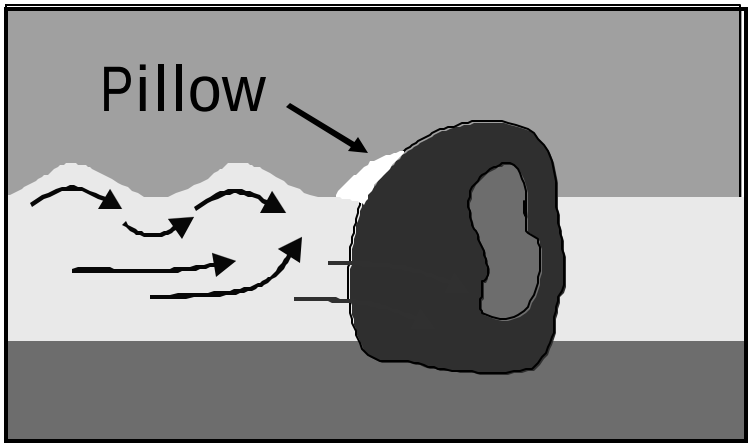
Strainers:

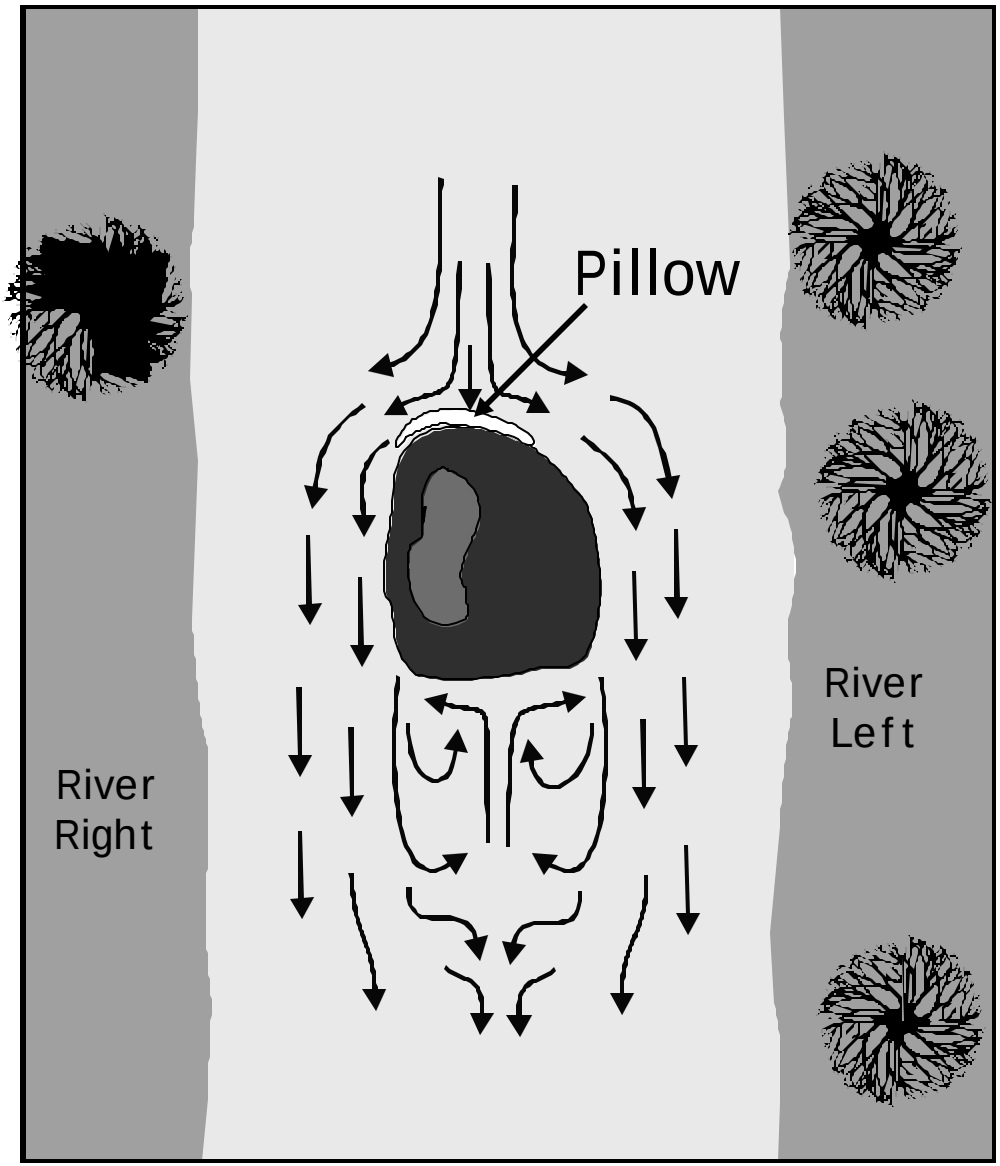
- A strainer is anything which allows water to pass through but not you
- Examples: tree, branches, old bridges, just about anything
- Current forces you to outside of bend and into the strainer.



Pillows -

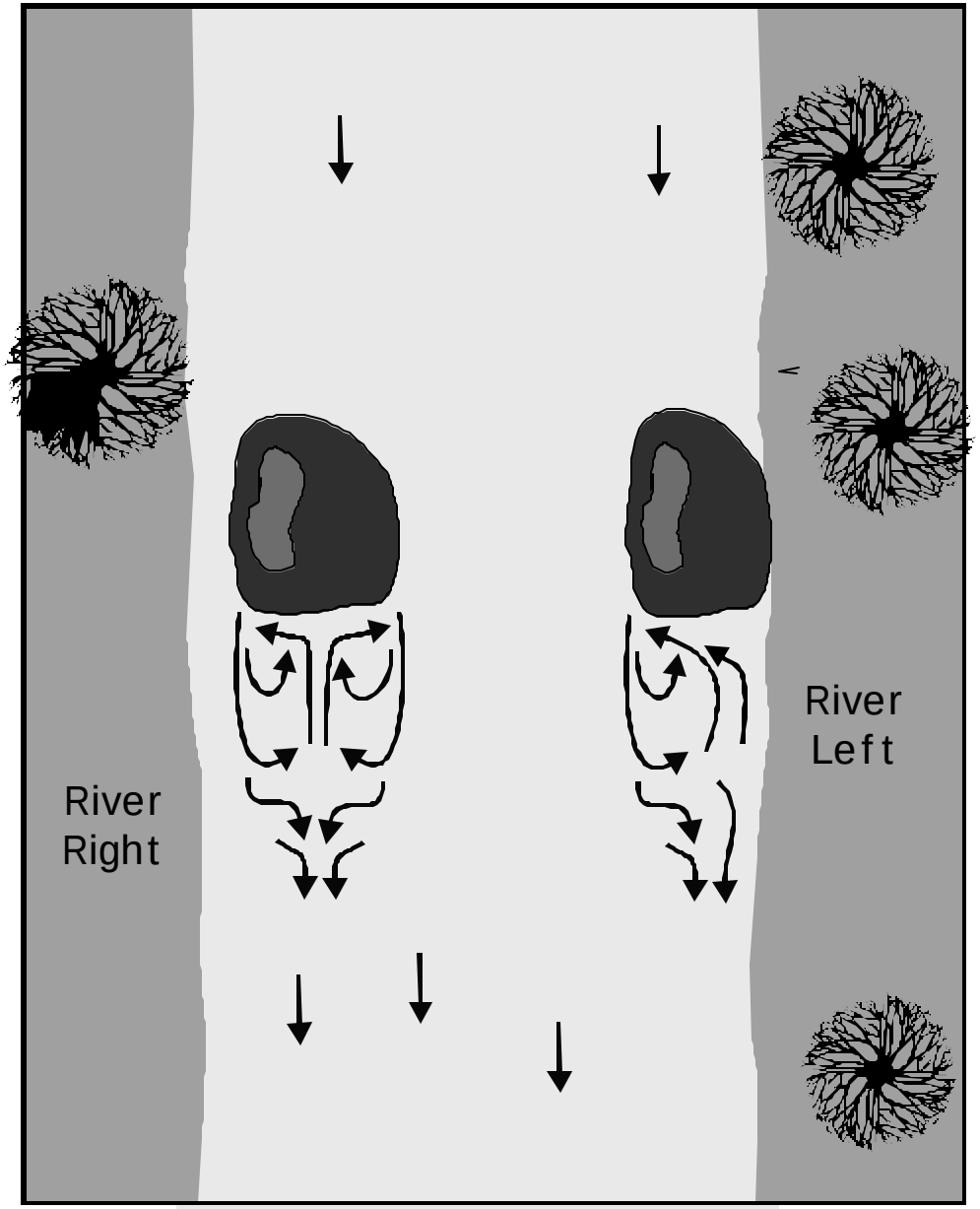
- Water flows downstream and piles up against rock obstruction
- This water or “pillow” can create a cushion for boaters and swimmers.





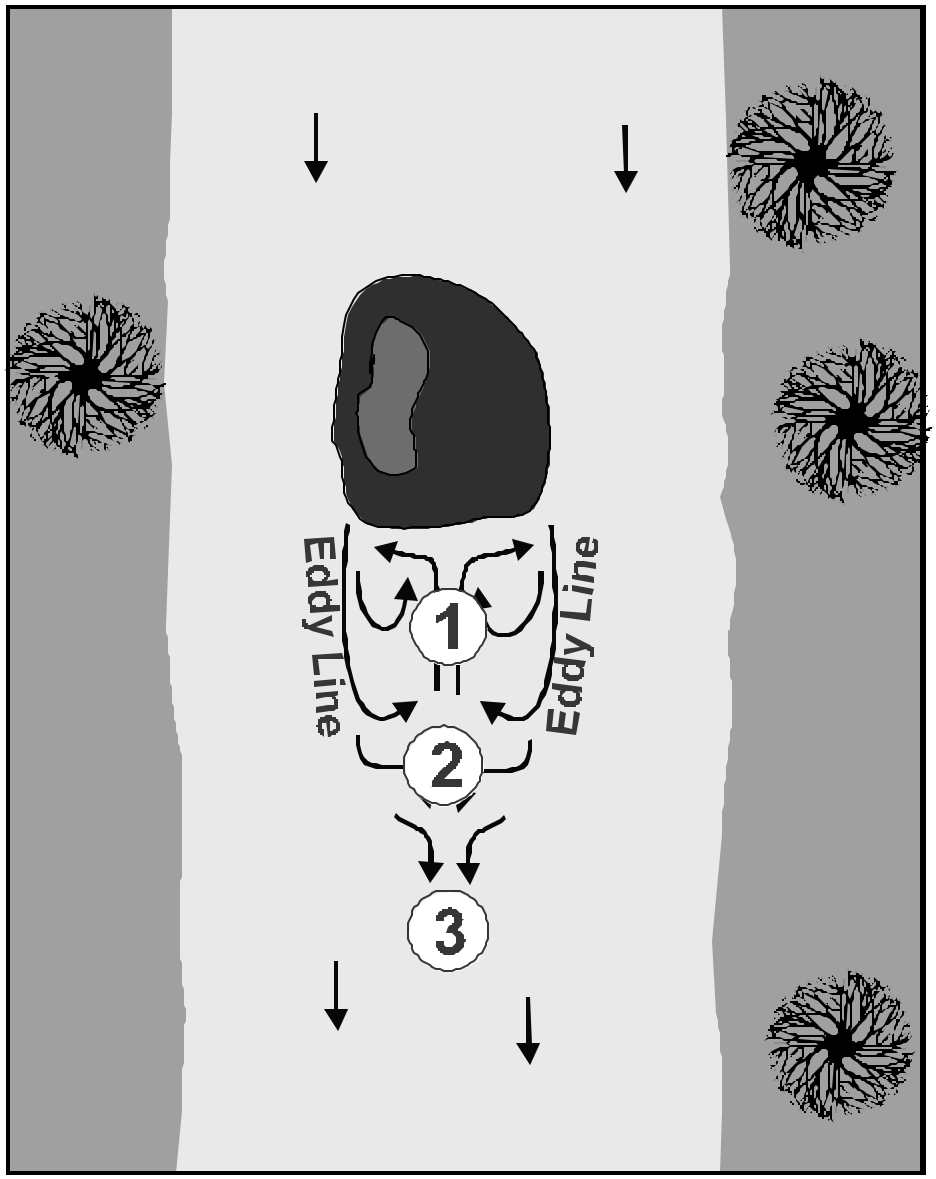
Eddies:

- Formed behind an obstruction (e.g. rock, bridge abutment, etc.
- Current fills in void behind the rock
- Eddy line occurs where the two currents interface (see parts on next slide)
- Current flows out rear of eddy.



Parts of an Eddy:

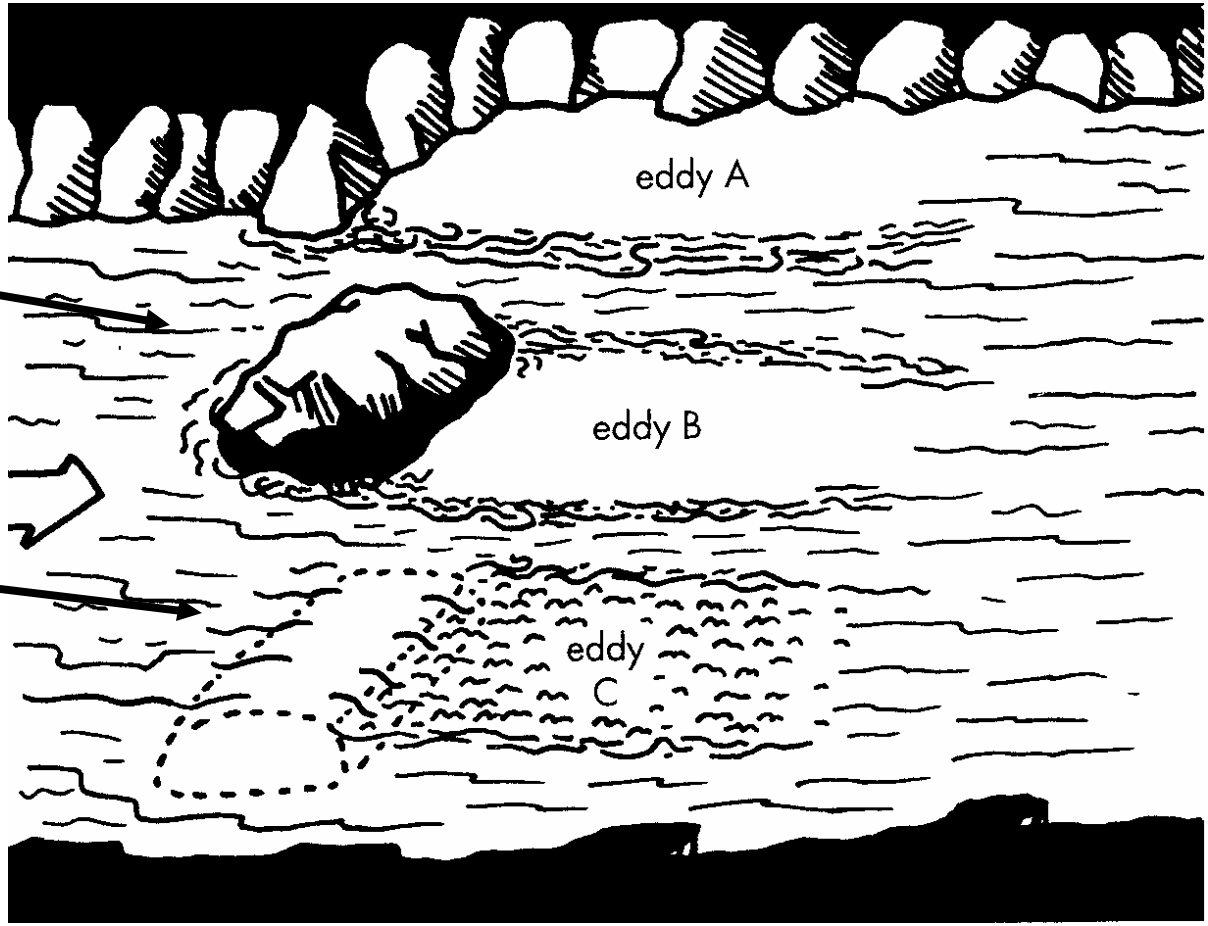
- Current rushing past rock creating a void behind it; it attempts to fill void; does one of three things:
- Upstream current (1) - current attempt to fill the void
- Neutral Current (2) - current doesn't flow upstream or downstream
- Downstream Current (3) - initially a slight movement
- Eddy Line - where downstream and upstream currents interface or meet.



Eddy/Micro Currents:

Current fills in behind the obstruction (Eddy A/B)

Submerged obstruction creates a hydraulic/eddy/still water current (Eddy C).



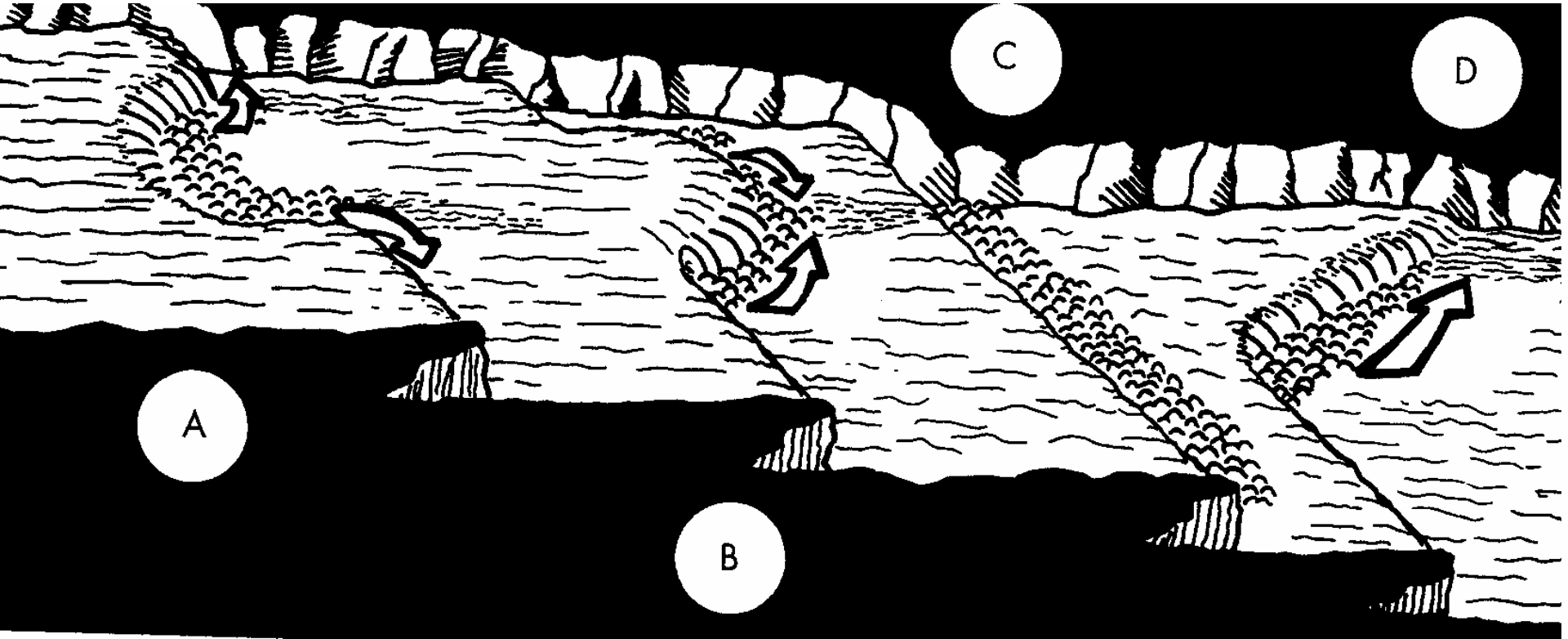
Types of Holes:

Smiling Hole – Easy exit at sides (A)

Frowning Hole – Moves you to center and maximizes hole's force (B)

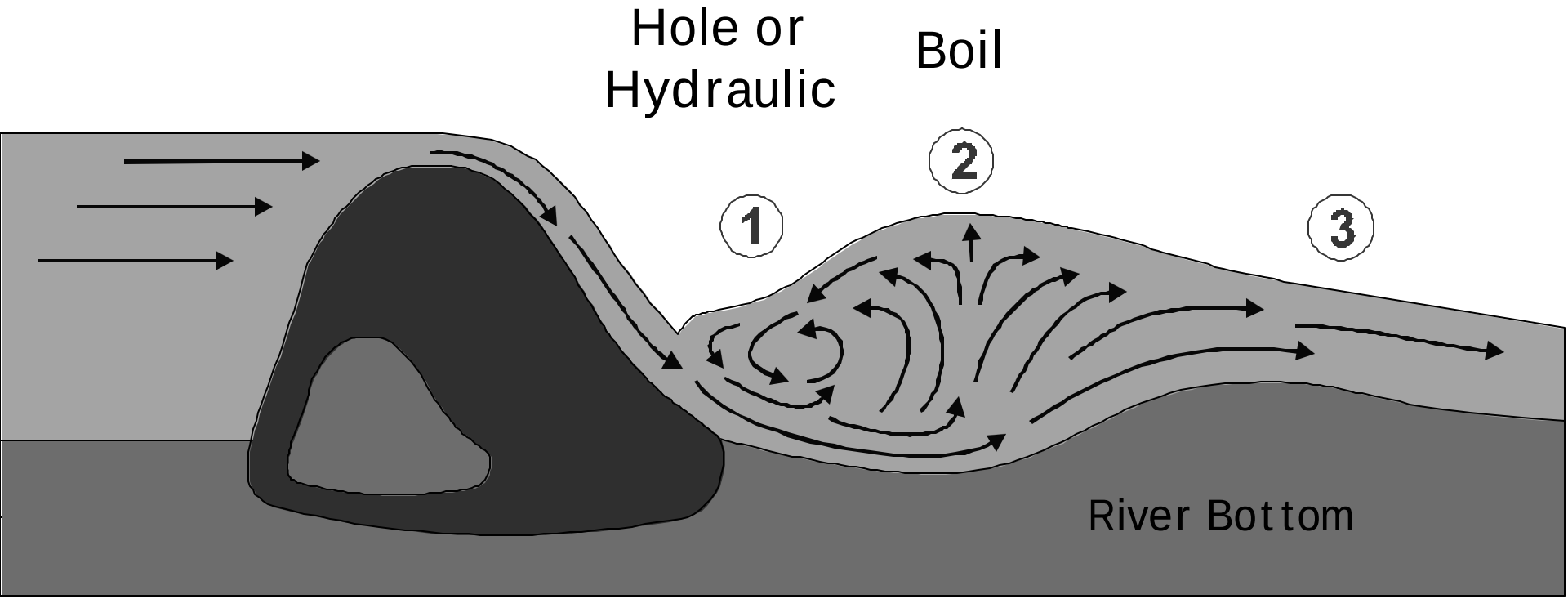
Horizontal Hole – Similar to low head dam… can be nasty (C)

Diagonal Hole – Moves you downstream and out of hole (D)



Holes and Hydraulics:

- **Boil (2)** – neutral area where water neither flows upstream or downstream
- **Downstream Flow (3)** – some water continues to flow downstream
- **Hole or Hydraulic (1)** – some water flows back upstream and catches the downstream flow



Holes and Hydraulics:

- **Boil (2)** – neutral area where water neither flows upstream or downstream
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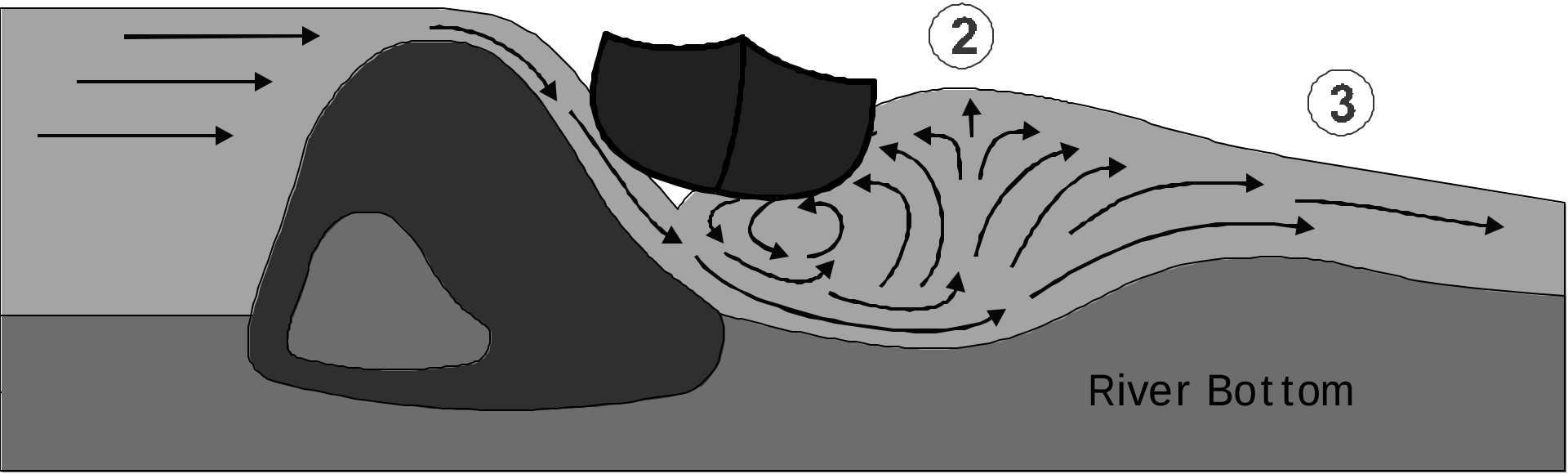
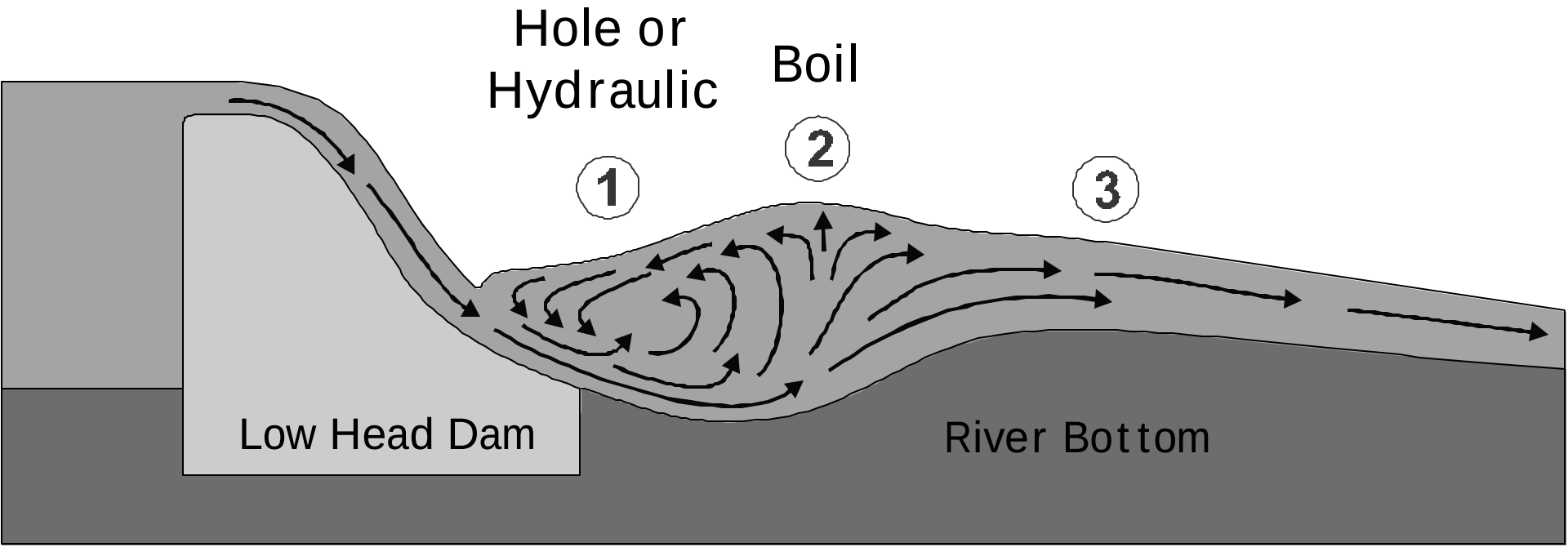
- **Hole or Hydraulic (1)** – some water flows back upstream and catches the downstream flow
- Canoe side surfing a hole.



Hydraulics/Low Head Dam:

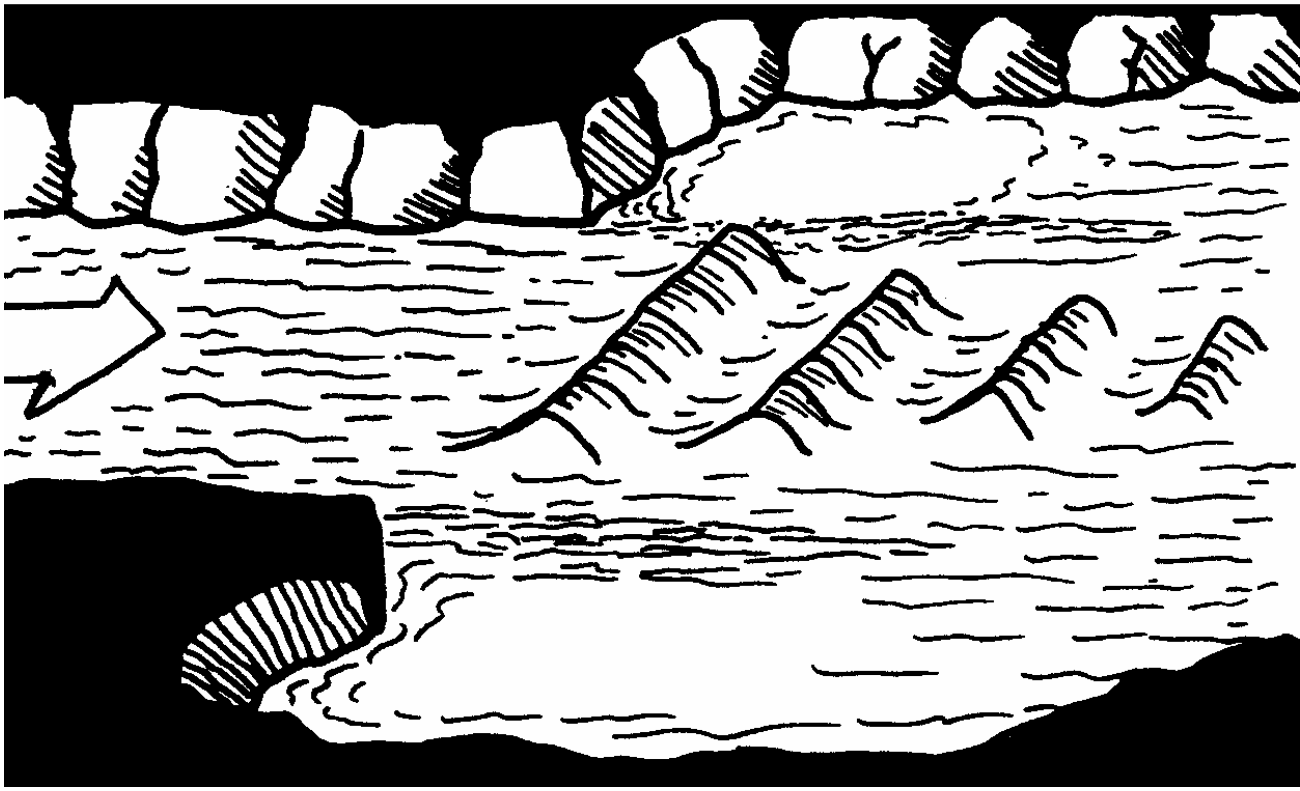
- **Boil (2)** – neutral area where water neither flows upstream or downstream
- **Downstream Flow (3)** – some water continues to flow downstream
- **Hole or Hydraulic (1)** – some water flows back upstream and catches the downstream flow
- **To avoid** – portage, portage, portage…
- Paddle hard - up and over the boil (hopefully you will make it).



Standing Waves:

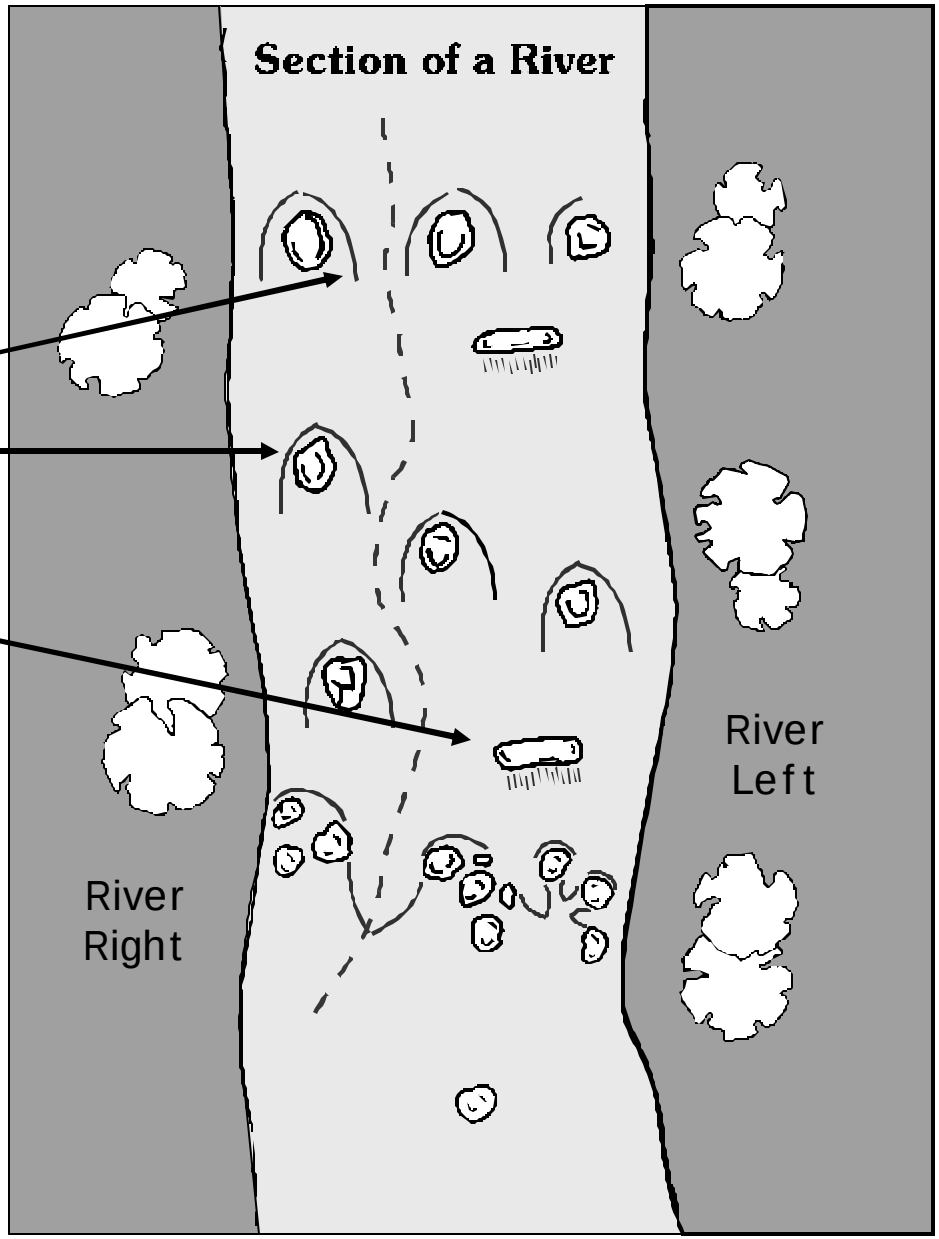
Channel constriction followed by widening in the channel dissipates energy into waves

This scene has two eddies on each side of main current; you can use these to surf the waves.



Upstream and Downstream Vs:

- Look for upstream Vs
- And avoid downstream Vs
- Hydraulics
- Best route: upstream Vs shown in red.



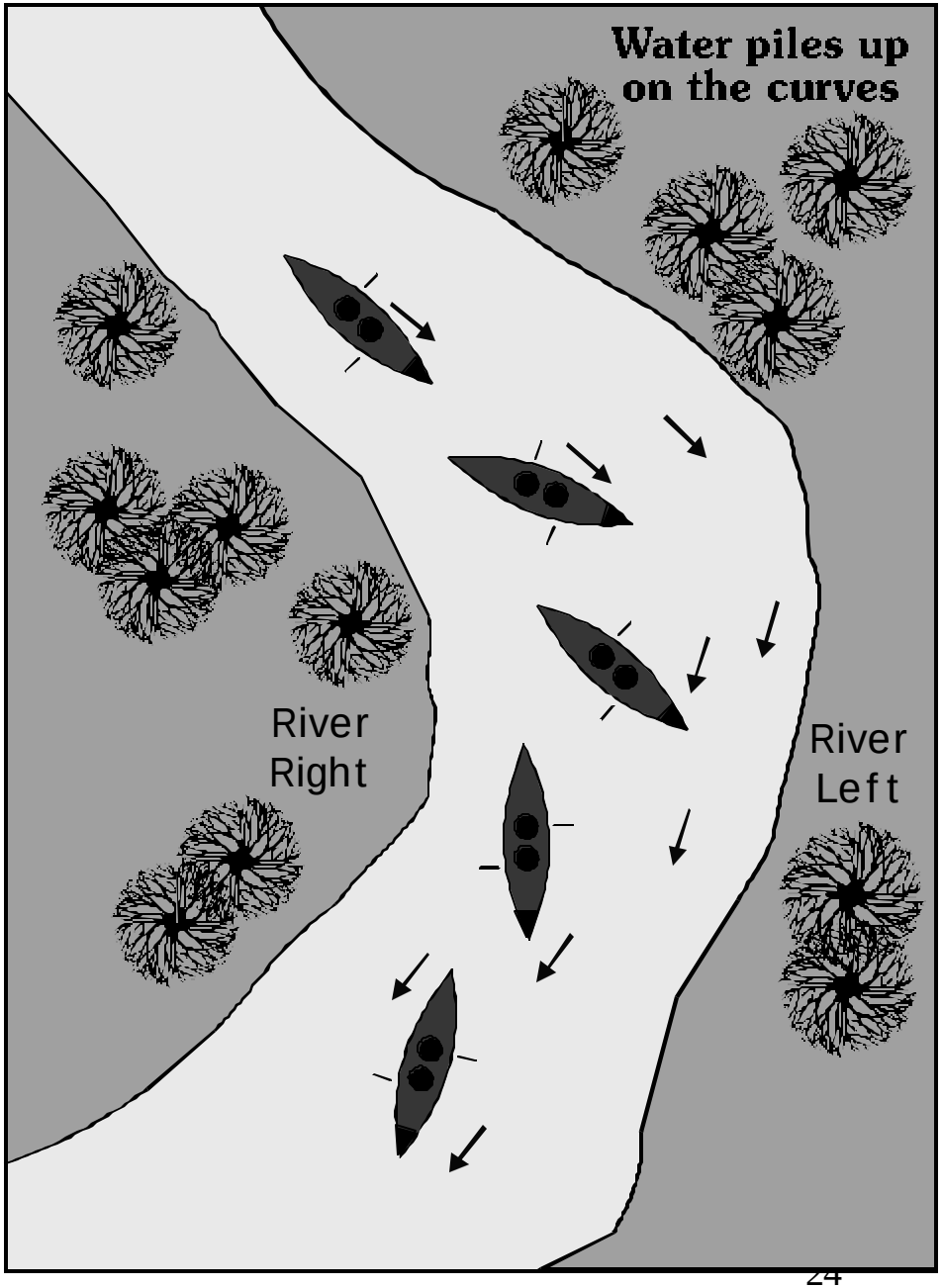
River Running Topics -

- Negotiating a river bend
- Eddy turns and peel outs
- Ferrying
- Running the river.

The items on the left provide a general discussion of the topics in this section.

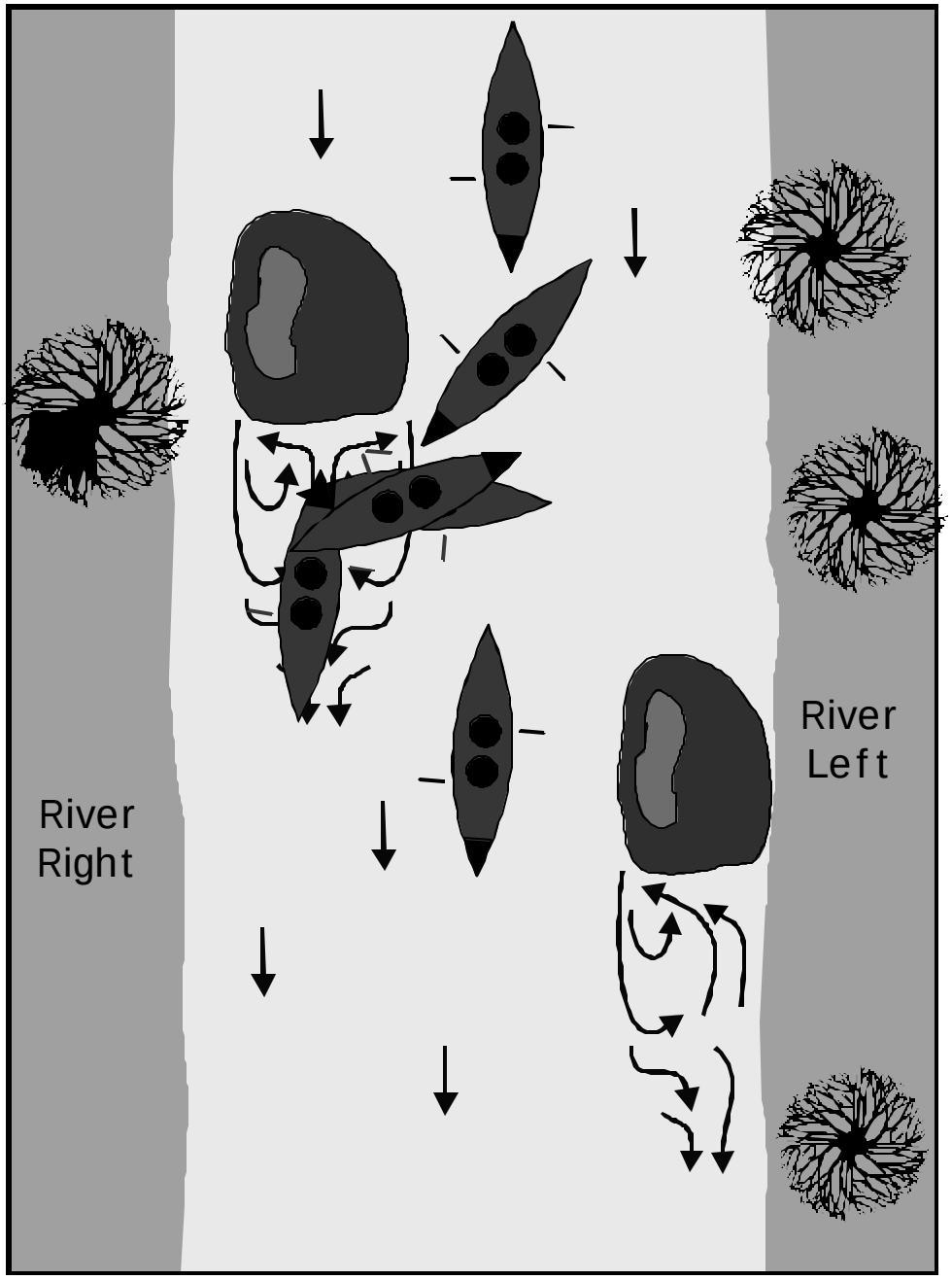
Negotiating a River Bend:

- Slower current is on inside of bend
- Set ferry angle toward the inside of the bend…
- Paddle “back left; slight forward right”
- As current pushes you to outside, back paddle
- Straighten boat with “forward left” and “back right”
- Continue down the river.



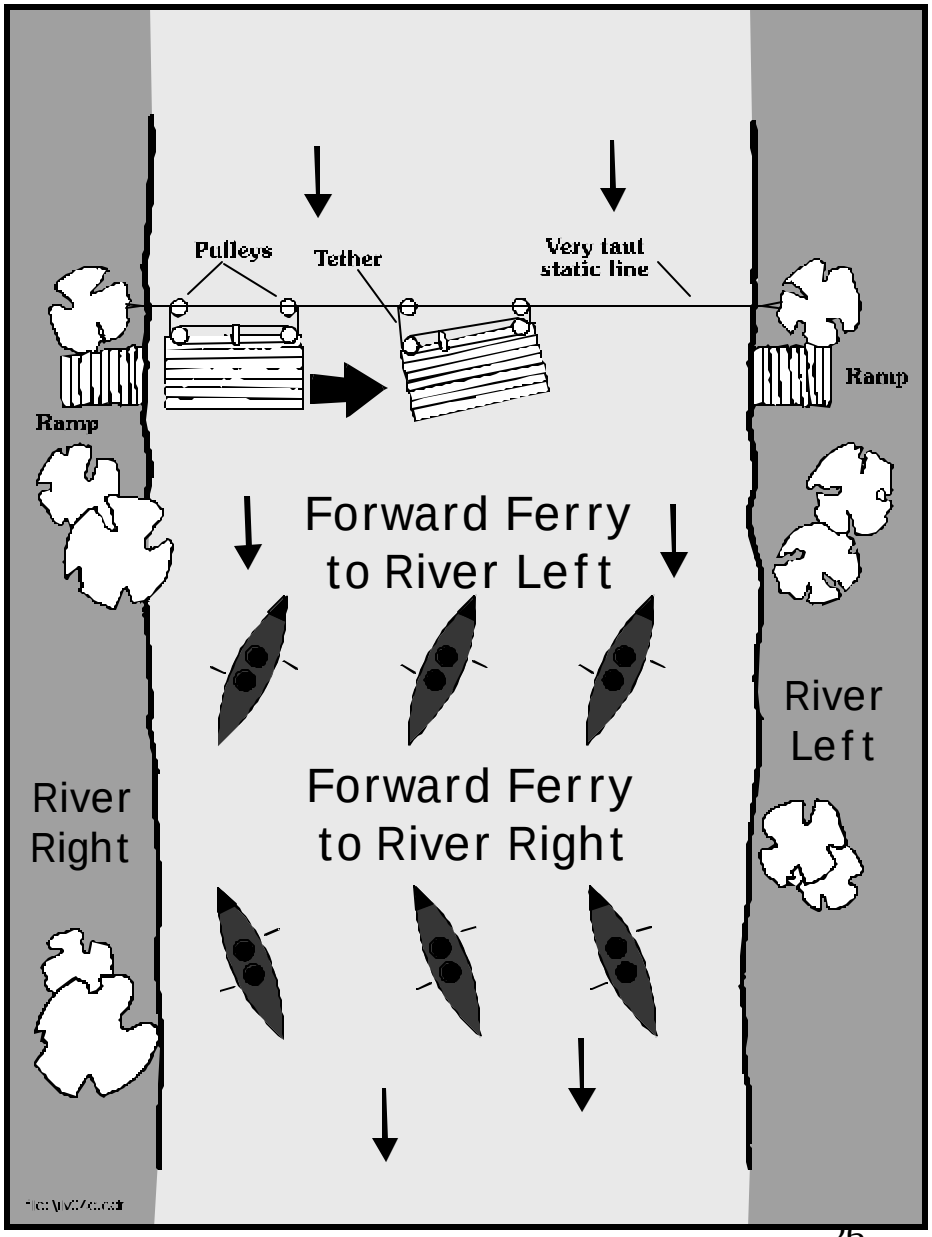
Eddy Turn and Peel Out:

- Boat heading down the river
- Set boat angle at approximately 45% angle to current
- Paddle across eddy line into eddy; bow plants paddle; canoe rotates around paddle
- Peel Out: “stationary draw in bow; drive stern into current”
- Straighten boat out and continue down the river.



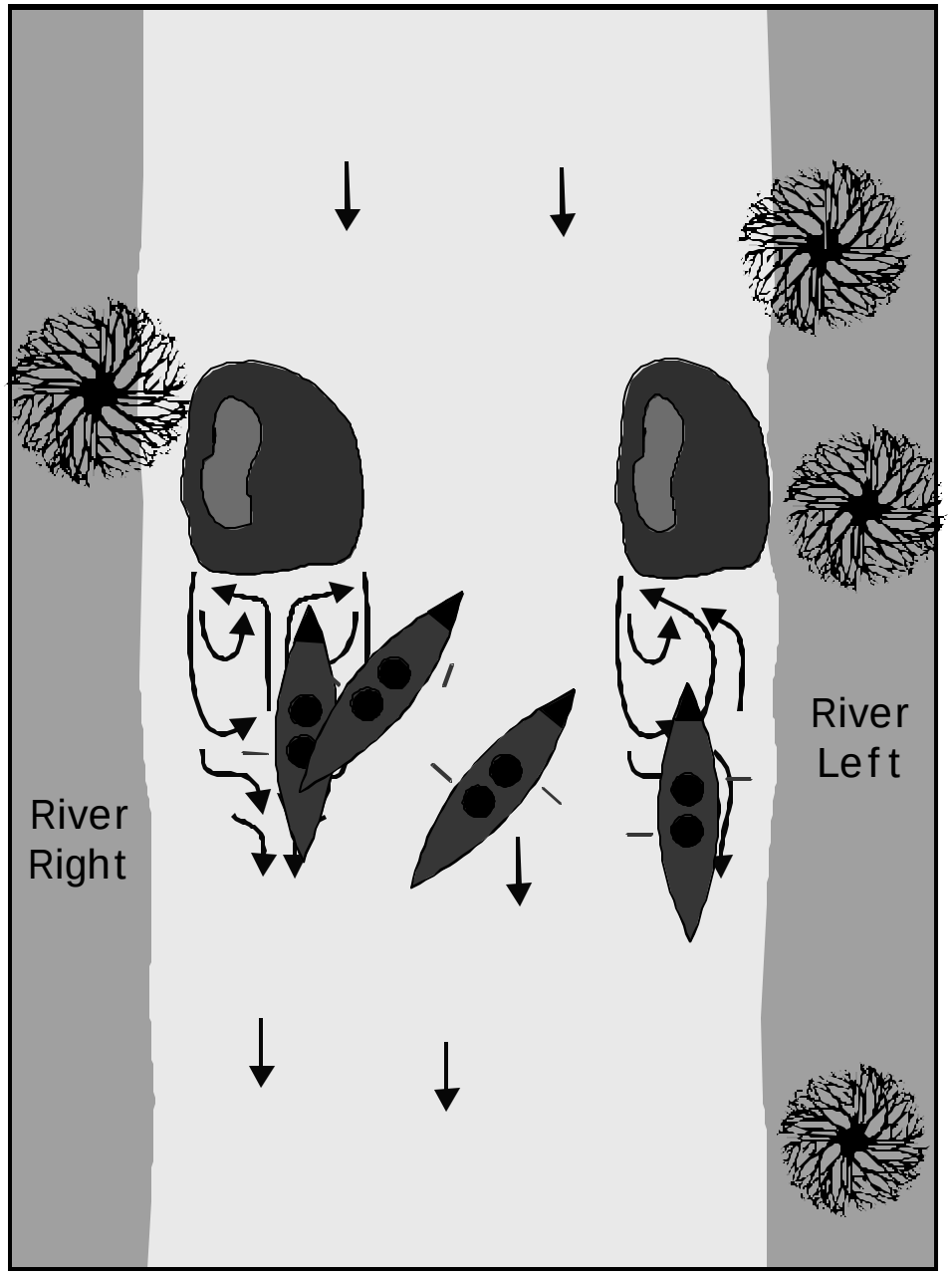
Ferrying:

- Used to traverse a river
- Taught line stretched across the river
- Pulley system lowers one end
- Vector force – downstream and horizontal
- Moves ferry across the river
- Forward Ferries.



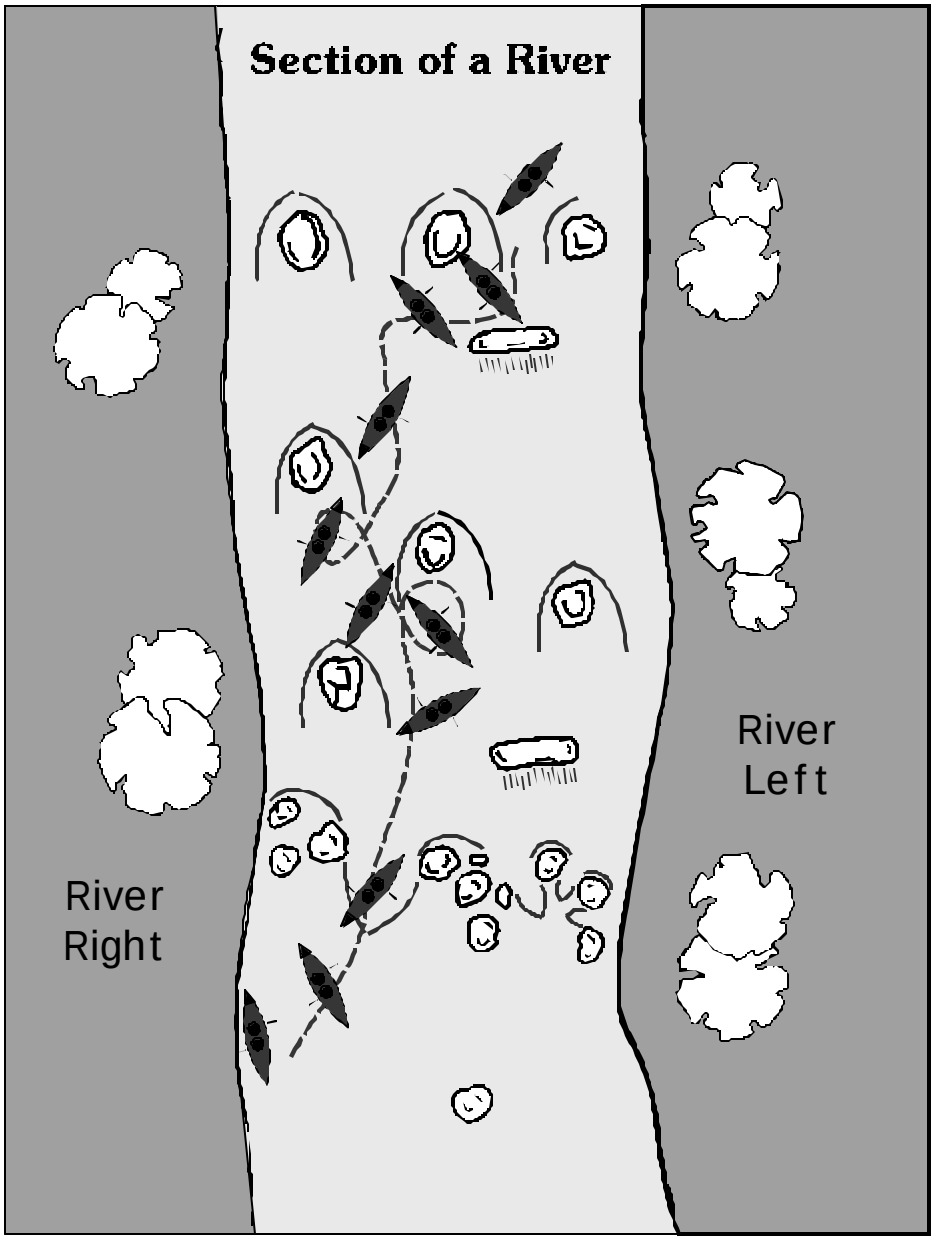
Ferry River Right to River Left -

- Sitting in the eddy
- Peel Out: bow maintains stationary draw; maintains forward momentum
- Maintain momentum and forward ferry into eddy on river left
- Slide into eddy on river left
- Keep enough forward momentum so that you don't drift out of the eddy.

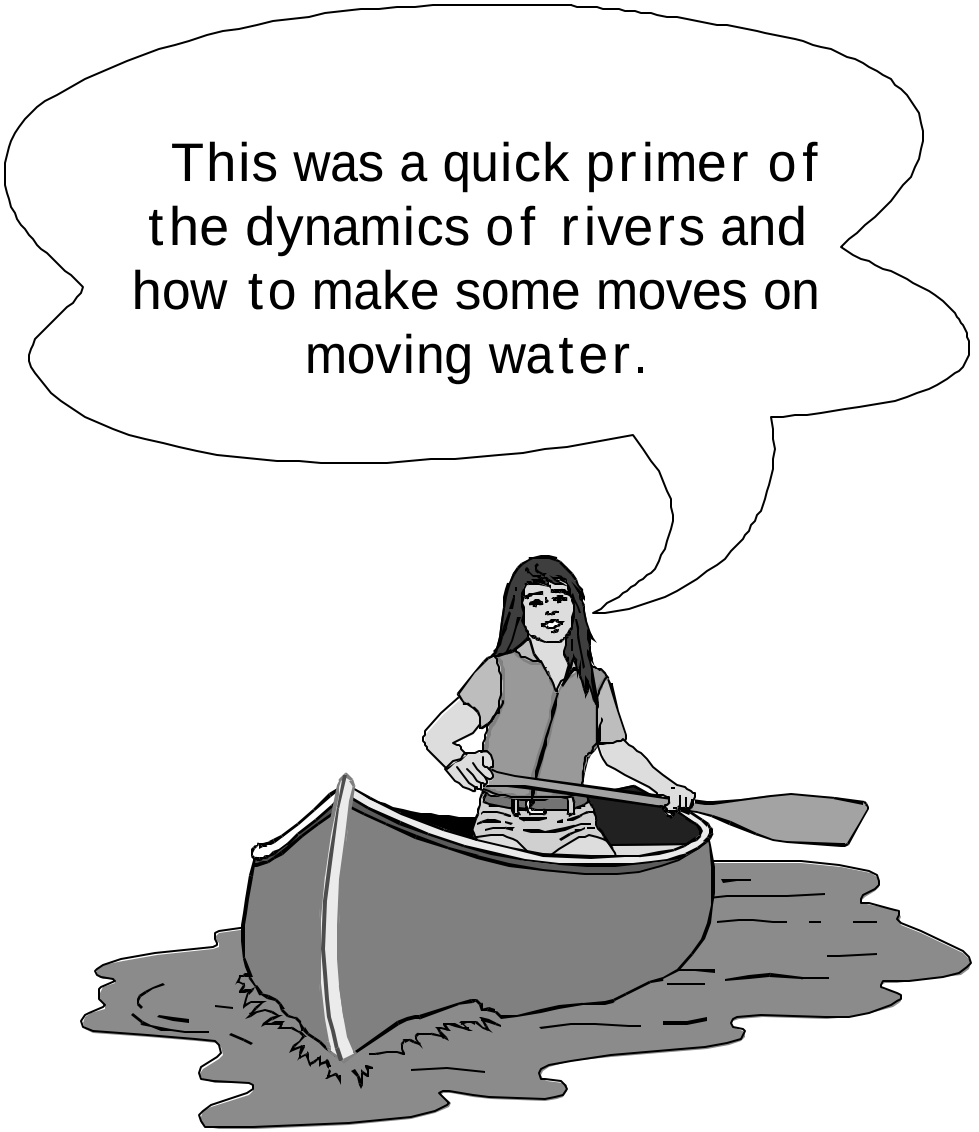


Eddy Turning Your Way Down the River:

- Proposed course
- Set angle and eddy out above hydraulic and forward ferry to river right
- Peel out and catch eddy on river right
- Ferry across current to river left… eddy out… peel out or drift out bottom of eddy
- Drop though drop and forward ferry to shore in eddy current.



The End


This was a quick primer of the dynamics of rivers and how to make some moves on moving water.