

Chapter 6

River Skills

Reading the River

Running water is a truly dynamic medium, made more interesting by irregularities in the riverbed, changes in direction, and the degree of vertical drop. For this reason it is important to approach river with experience and an understanding of moving water.

It is a professional guide's responsibility to "read" the water, meaning he or she will evaluate what the river is doing and use this information to select an appropriate route. This skill involves recognizing the subtle and not so subtle signs, benchmarks, hazards, and currents in a river and understanding their effects on a raft. The ability to navigate any paddle crew through the safest and most challenging channels in a river depends on a guide's skill in reading the water quickly, competently, and accurately.

River Formation

There are three factors influencing the formation of rivers and rapids: (McGinnis)

Gradient: The average rate of descent of a section of river, typically explained by elevation drop (typically feet) over a horizontal distance (typically miles). The gradient of a river or stretch of river impacts the velocity of the water.

Example: The gradient of the South Fork of the American River is 23 feet per mile.

Geomorphology: The various features in a river (rocks, ledges, gravel bars, river banks, canyon walls, and more) that impact the moving water within a river, creating various water features and obstacles. It is said that what lies beneath the water of a rapid is written all over the surface.

Constrictions: The amount a river is compressed into a space on a river impacts the velocity of the water. Constriction is impacted by narrow channels, chutes, or obstructions (rocks, gravel formations, canyon walls, etc). Water is accelerated in a constriction much in the same way water is propelled and accelerated when a nozzle is added to a garden hose.

Water Volume: The amount of water flowing down a river. Water volume (often referred to as flow) is measured in cubic feet per second (CFS), which is the volume of water that passes a given point on the riverbank in one second.

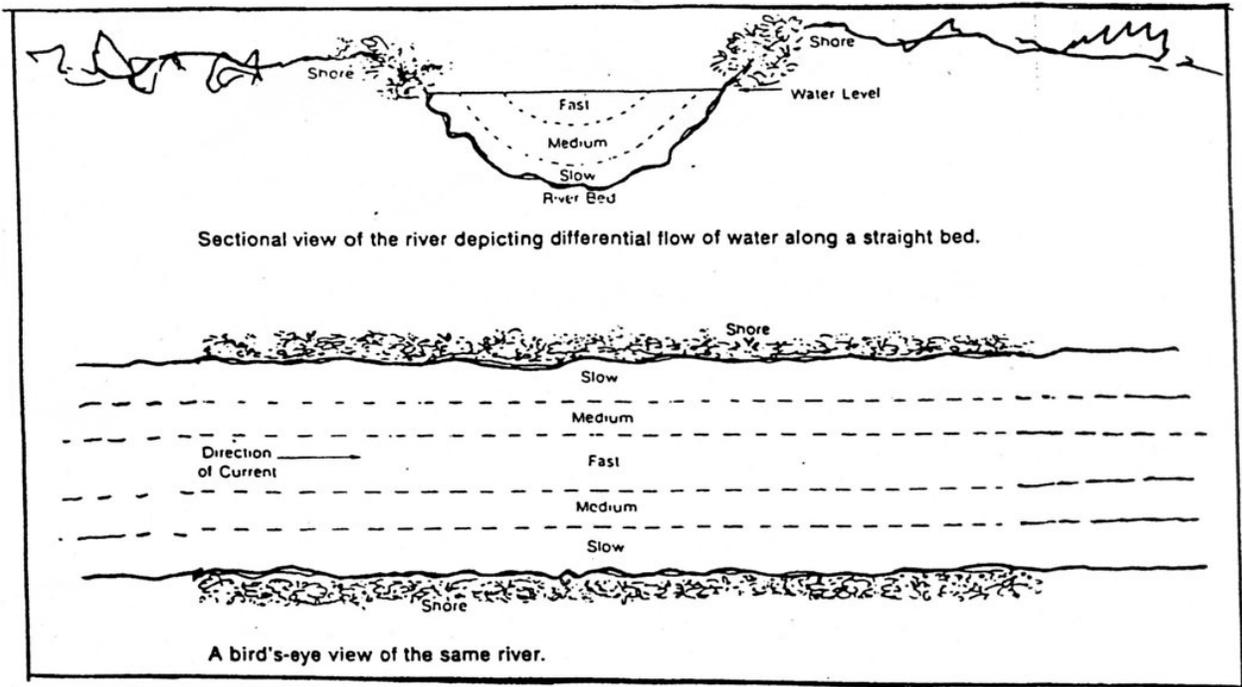
Higher volumes often bring about dramatic changes in a given rapid or river

River Anatomy

Current (Evans & Evans)

If it were possible to cut a cross section in a riverbed and examine it, you would notice that the deepest portion of the river would be found in the middle of the channel and the water becomes shallower at the edges of the riverbed. Therefore, the fastest current will be found just below the surface of the water in the middle of the channel. Towards the edges and bottom of the channel

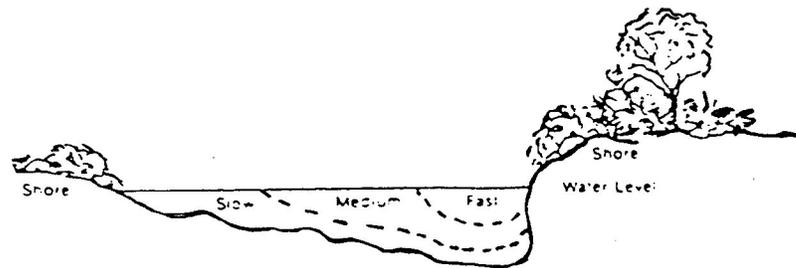
the current slows down due to friction as the water contacts the solid bottom structure. At the surface, friction due to wind and air pressure tends to slow down the surface current somewhat.



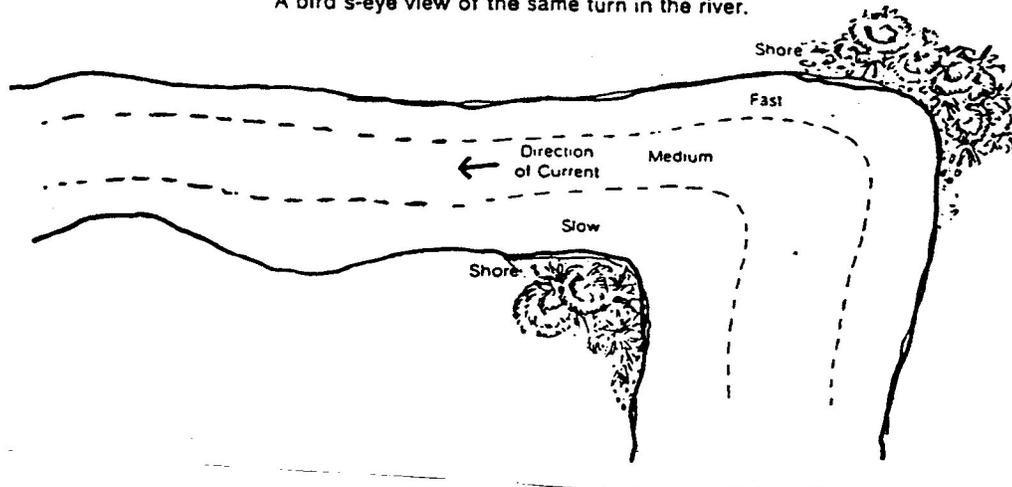
A person in the water with their legs extending into the fast subsurface current will generally move faster than a boat traveling on the surface

There are, however, some notable exceptions to this general current phenomenon. The simplest variation occurs when the river bends around a corner and travels in a different direction. Just as an unrestrained passenger sitting on the front seat of a car slides toward the outside of a turn as the car speeds through the turn, similarly the fastest current in a river bend tends to travel to the outer most portion of the bend (explained by centrifugal force). As a result, the outsides of most river bends tend to be deeper due the scouring effect of the faster current.

Sectional view of a river seen from the upstream side at the beginning of a turn



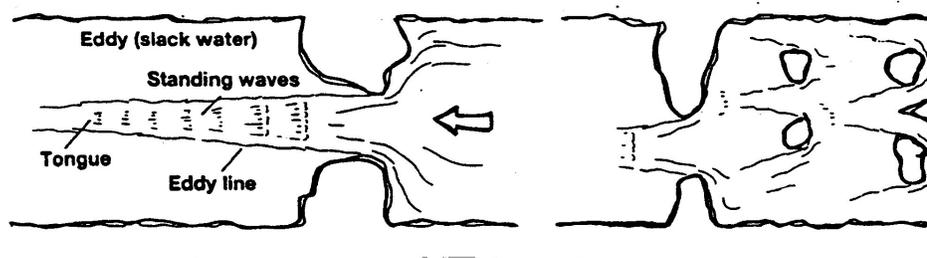
A bird's-eye view of the same turn in the river.



As current increases, the Guide must be prepared to read water faster. For this reason, it is important to look both immediately in front of the raft as well as further down stream. A competent guide can recognize and identify the main channels and currents and anticipate what maneuvers need to be made to ensure safe runs. (McGinnis)

An inverted V where the wide part of the V lies upstream and the narrow part of the V points downstream can identify the main current flowing between two obstructions. This main channel or V is often called a tongue. Due to a gentle but perceptible descent, the raft will gain speed in the V as it narrows to a point.

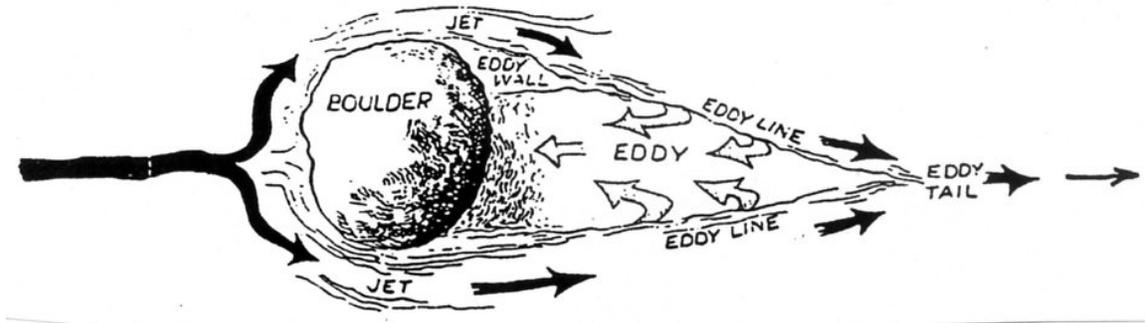
THE DOWNSTREAM 'V'



Eddys (Evans & Evans):

An eddy is a river feature that forms downstream of an obstruction, such as a boulder or a change in the riverbank. As the water passes an obstacle in the river, it builds speed. As water fills behind the obstruction, it creates a space where water is following opposite of the main current. This is called an eddy. Between the main current and eddy there is an eddy line or eddy fence. Depending on the strength of the current, an eddy line may be quite turbulent.

This drawing illustrates the characteristic circular motion of water in a mainstream eddy. (Walter Richardson)

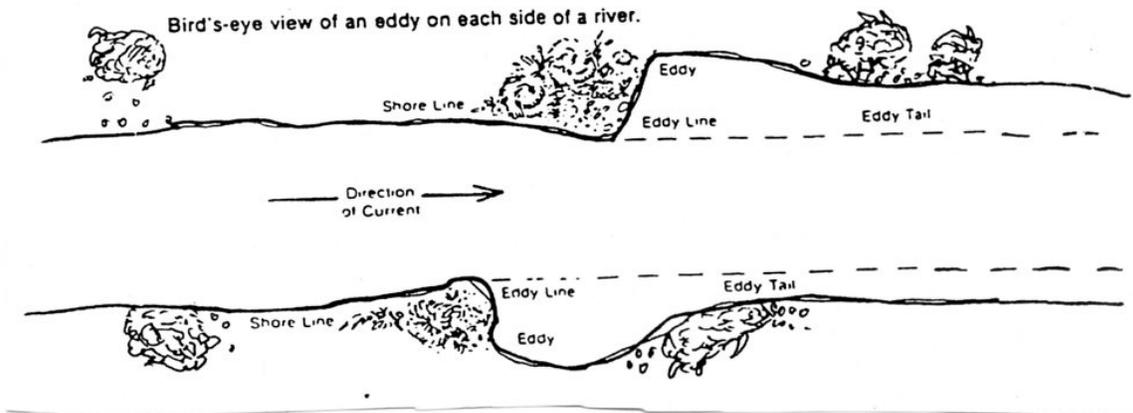


Eddys can be valuable tools for rafters when navigating a river. Eddys can be used to navigate a rapid, re-group as a pod of rafts, or scout a rapid. Eddys can also be turbulent with boils and swirls that present a hazard to rafts.

Consider two locations:

Midstream Eddy: is often caused by an obstruction like a large boulder. Mainstream eddys can be valuable tools when running a rapid to examine the remainder of a rapid, execute a difficult maneuver, or set safety for another raft.

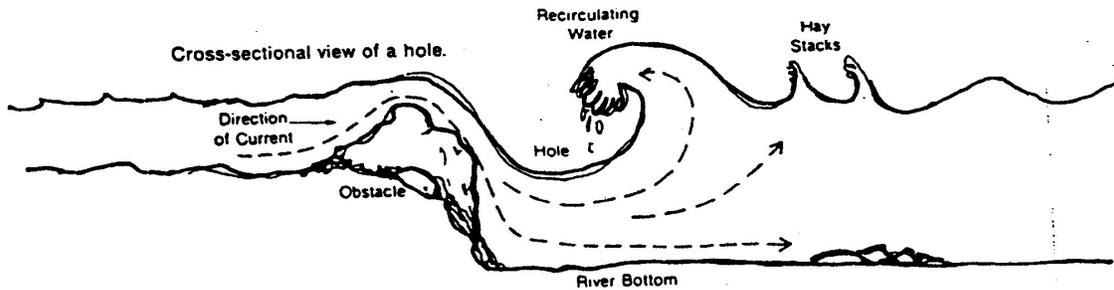
Side Eddy: is commonly caused by the jut of a large boulder or by a portion of land extending out into the river, or by a sharp bend in the river that creates an open space at the inside of the bend where water swirls and moves upstream to fill that space.



Holes (Evans & Evans):

Holes are water features downstream of an obstacle where water recirculates back toward the obstacle counter to the main current. Holes are often formed by boulders and ledges. As water moves over an obstacle, it divides into two main components:

1. **Laminar Blow:** Water that surges deep and continues downstream
2. **Recirculating Flow:** Water that curls and recirculates upstream toward the obstacle, creating turbulent water.



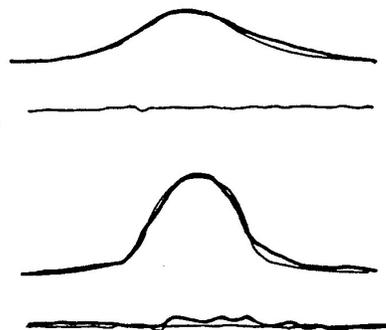
Standing Waves and Haystacks (Evans & Evans):

A **standing wave** is a permanent wave in a river that is formed when water flows over a submerged obstacle. Successions of standing waves often found toward the ends of rapids are called **haystacks**.

Haystacks are formed when a fast jet of water passes over a submerged obstacle and piles up and slows down in a rapid.

Haystacks can also form when two currents within the same river meet at an angle, for instance at a bend in a river where the main current piles into the outside wall hard enough to be deflected back on itself - often called a pillow.

FORMATION OF A STANDING WAVE



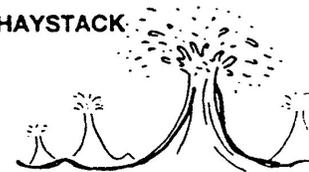
This river profile shows what happens to a standing wave as the volume of water increases. The initial small hump increases in height until it forms a continuous breaking wave.

FLAT-TOPPED WAVE



A paddler's-eye view approaching a standing wave.

HAYSTACK



The pyramid-shaped base and spraying top of a haystack.

Common River Terminology

- **Blind Drop:** Usually a rapid where the end cannot be seen from the top. Usually recognized by a distinct horizon line. These rapids must be scouted!
- **Boil:** A water current welling up into a convex mound. Typically found in big eddy's on high volume rivers (10,000 cfs or more).
- **CFS:** Cubic feet per second, measurement for the volume of flow in a river (1 cfs = 64 lbs./sq. in)
- **Chute:** A gap or drop in a rapid, often steeper than the surrounding river.
- **Eddy:** A river feature created by an obstacle in the river where water is flowing counter to the main current. Eddys can be found directly downstream of exposed or partly submerged obstacles or downstream from an outcropping in the riverbank.
- **Eddy Line:** The line demarcating the main current and an eddy. Depending on the strength of the opposing two current, eddy lines can be marked by turbulence and small whirlpools. In higher volume rivers, an eddy line can be called an *eddy fence or wall*.
- **Haystack:** A succession of standing waves often found toward the end of a rapid.
- **Hole:** A river feature where water flows over and obstruction (such as a rock or ledge) and a portion of the current recirculates on itself.
- **Ledge:** The edge of a rock stratum in the riverbed that acts as a natural low head dam or a series of dams.
- **Left Bank/River Left:** The left side of a river as you look downstream.
- **Right Bank/River Right:** The right side of a river as you look downstream.
- **Riffle:** A stretch of shallow water producing small waves and a little turbulence.
- **Scout:** To stop and survey a rapid to choose a safe route (preferably a good vantage point where the entire rapid can be seen).
- **Standing Wave:** A permanent wave in a river that is formed when water flows over a submerged obstacle.
- **Strainer:** A river obstacle, such as partially submerged trees, branches, or roots. As current flows through or under a strainer it is possible for a boat and/or swimmer to become trapped.
- **Tongue:** A stream of fast water between two obstacles. Usually a downstream **V** is created.
- **Trough:** A hollow depression between two waves.
- **“V”:** The angle formed by flat water as the river approaches the top of rapids. The pointed part of the **V** extends down into the rapid a short way.

A rapid's difficulty is determined by how hard it is to avoid obstacles. This is affected by the volume, water speed, turbulence, wave formations, gradient, pattern of obstructions, width of runnable channels, etc. These factors will change for any given rapid at every water level. Therefore, as a guide it is important not to “memorize” a rapid, but to analyze its currents and features. Guides must be familiar with some of the common terms used to help describe a rapid or stretch of river. What follows are several of the common terms that will be helpful for you to know while developing the skill to “read” water. (Evans & Evans)

River Classification

Whitewater rivers are classified in six general categories with several factors determining classification: the complexity of the riverbed (geomorphology), elevation drop per mile (gradient), the river's course, the volume of water (CFS), difficulty of maneuvers required to navigate the river, and potential consequences.

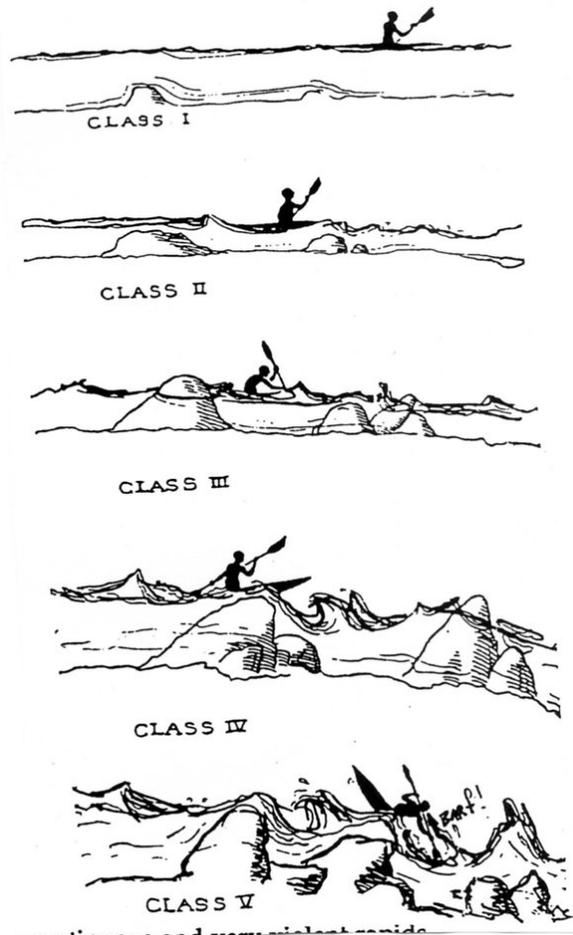
Class I: Moving water with few or no obstructions.

Class II: Small rapids with waves up to 3 feet high, and wide, clear channels that are obvious without scouting. Some basic maneuvering is required.

Class III: Rapids with high, irregular waves or narrow passages that require maneuvering. Rapids of this magnitude might need to be scouted from the shore to determine the best route.

Class IV: Long, difficult rapids with constricted passages that can require precise maneuvering in very turbulent waters. Scouting from shore is recommended and rescue may be difficult.

Class V: Extremely difficult, long, continuous and very violent rapids with highly congested routes that must be scouted from the shore before attempting. Often, Class V rapids have high consequences in the event of a swim or other mishap.



Class VI: Difficulties of **Class V** carried to the extreme of navigability. Unrunnable!

paddling Technique & Running Rapids

Paddle boating is a team effort between captain and crew. Crewmembers sit on the main tubes, with their paddling strength divided equally on the two sides. The captain sits at the stern (back of boat) and uses his/her paddle as a rudder to steer the boat. He/She is responsible for determining the course of the raft and calling the paddle commands (forward, back, left, right, stop) to control the momentum and direction of the raft.

Basic Paddle Strokes:

- Forward paddle
- Back paddle

Basic Paddle Commands:

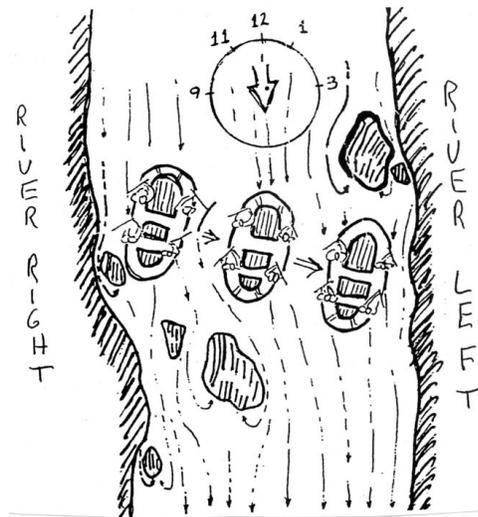
- Forward
- Back
- Left turn
- Right turn
- Stop

Guide Strokes

- Sweep
- Pry
- Draw
- J-Stroke
- Rudder

Ferrying:

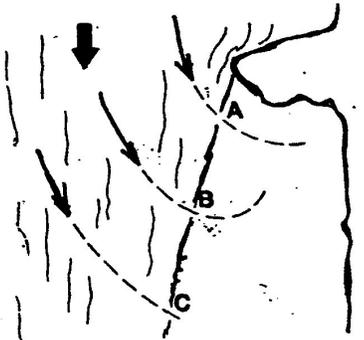
Ferrying is a whitewater/paddle technique used to move a raft left and right in a river channel while accounting for the river current. Ferrying is used to avoid downstream obstacles, position the raft to run a line in a rapid, cross from one side of the river or current to another, or recover swimmers.



Eddy Exits/Entrances (Evans & Evans)

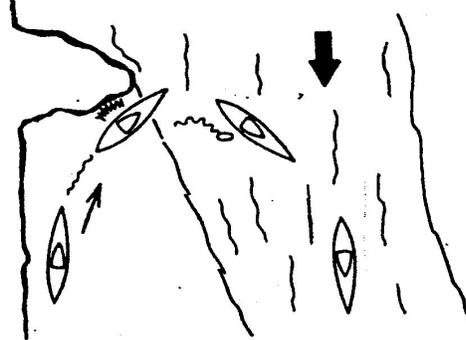
Entering the current from an eddy is called an **eddy exit** or peel out. To exit an eddy into the main current, accelerate across the eddy line with the bow facing upstream, aiming to hit the eddy line at an angle of 45 degrees.

THE EDDY LINE TARGET



Set your target correctly. B is the best. A leaves no room to turn the boat. At C the eddy line is indistinct.

eddy exit

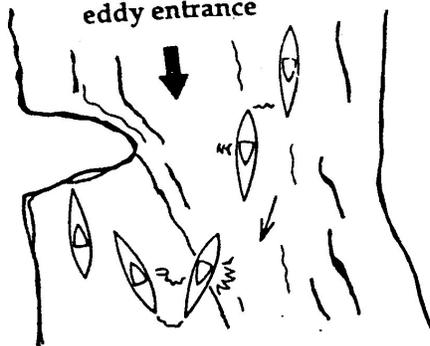


Start from an eddy and drive into the current by crossing the eddy line and turning downstream.

Drive the bow of the boat across the eddy line using the power of the crew. The captain will need to rudder hard to maintain the 45-degree angle. As more of the boat enters the main current the bow will be swept downstream until the raft is positioned in the main current and are heading downstream.

Pulling out of the current into an eddy is called an **eddy entrance**. To enter an eddy from the main current, accelerate across the eddy line with the bow facing downstream, aiming to hit as close to the head of the eddy at an angle of 45 degrees. Drive the bow of the boat across the eddy line using the momentum of the paddling crew. As the bow of the boat enters the eddy it will be swept upstream until the entire boat has entered the eddy.

eddy entrance



Move towards the eddy well in advance. Push the boat across the eddy line.

Eddy entrances and exits can be done using a forward to back paddle command.

Running Waves (Evans & Evans)

The size of the wave will dictate whether the guide will “hit” the wave with the raft or if the guide should skirt or avoid the raft. If the Guide is going to run the wave or wave train, he or she will steer the boat straight into the wave and use forward momentum to crest the wave, ruddering to keep the boat perpendicular to the wave.

Large waves can stall the momentum of a raft, preventing it from passing through the wave. This can cause the raft to flip. In the event of a large wave, the guide may steer to one side to avoid larger waves found in the middle.

Riding waves with the stern first is also perfectly acceptable, but it is important for the captain to continually look over his/her shoulder to avoid any hazards downstream.

Running Holes (Evans & Evans)

Due to the recirculating effect of the water in a hole, often a boat’s momentum will be stopped immediately upon entry. If holes are unavoidable it is crucial that guides enter the hole with the bow or stern driving directly and straight into and through the hole with momentum. If the boat does not have enough momentum to make it through the hole, the recirculating water pulls will hold the boat and can cause it to surf or flip. Rafts should never enter holes sideways.

If a swimmer is getting recirculated in a hole there are two techniques that can be used to get out:

- Attempts to swim to one side of the hole and place a hand or arm into the laminar flow just outside the hole to get pulled out of the hole.
- Propel down in the hole to end the laminar flow that flushes through the bottom of the hole and into the main current.

Scouting Rapids

Taken from the NOLS River Educator Notebook edited by Nate Ostis & John Gookin

Scouting usually occurs in two different ways, eddy scouting or land scouting. Eddy scouting occurs when you stay in your boat and look at the rapid from the eddy at the top of the rapid. More experienced paddlers tend to eddy scout. What you do at any given rapid will depend on your skill, the skill of the group and the difficulty of the rapid.

Land scouting is an excellent way to get a complete picture of a rapid. Give yourself plenty of space to pull over above the rapid. Secure your boats properly so they do not accidentally run the rapid without you. Sometimes scouting the rapid can be more challenging than running the rapid. Be careful walking on rocks. When scouting look for the path of least resistance to get to the rapid. Keep your PFD and helmet on. They provide excellent protection in case of a fall on rocks or an accidental slip into the river. Take several throw bags with you. They can be used if someone falls into the river or if a throw bag is required for part of the safety system.

WORMS is a tool used to organize how to read the river, make good decisions about running rapids, and develop leadership skills, competence and judgment. Boaters can use this acronym at rapids to guide in making safe, informed and efficient decisions about running rapids. Boaters may ultimately use their increasing awareness, experience and knowledge rather than strict

WORMS format to achieve good river judgment and decision-making, but will always have this tool to rely upon.

Water: Examine the river to determine where the main current is flowing

Obstacles: Identify obstacles within the rapid

Route: Accounting for the main current and obstacles, identify and appropriate route through a rapid.

Markers & Maneuver: Identify markers in the rapid that will help the guide know the location of the boat in the rapid when he or she is running it. Also, identify moves that need to be made and the guide's confidence in executing these maneuvers.

Safety: Consider potential consequences, identify if the leave of risk warrants not running the rapid, and put into place a safety plan if the group decides to run the rapid.

River Signals

In a **Rafting** location where distance and the noise of the rapids overcome the sound of words, hand signals are a valuable tool for communicating.



Are you OK?

This is a question and an answer. A person will tap his or her head to ask if someone is ok. If the person he or she is asking is ok, the person will tap their head back. If the person is not ok, he or she should not tap their head in response.

Eddy Out: Spinning one's hand around their head and pointing in a direction. This signals to the rest of the group to eddy out and where they should eddy out.

Lets Go: With a fist pulling down as a trucker would on their horn. This signals to the other boats in the pod that they should move down river.

Tighten Up: Two hands raised above the head pushing together. This signals to the other boats in the pod that they should tighten up.

First Aid: Two arms crossed over to the head. This signals that first aid is needed.

Point Positive: When pointing on rivers, people should always point in the direction someone should travel. Never point toward a hazard or obstacle to avoid.

Whistles: When traveling in a pod of rafts, Guides should regularly make eye contact with the Guide of the boat in front and behind them so hand signals can be passed within the pod. To alert to attention of another guide, the following whistle signals should be used:

- One blast: There is a situation requiring attention like a swimmer or stuck boat.
- Three blasts: There is an emergency requiring immediate action.

Whistle signals should be accompanied by hand signals to further communicate between rafts.

Effective communication greatly helps in making certain that you will have a safe and enjoyable whitewater rafting trip. As different Guides are familiar with different River Signals, it is critical to review these before any trip to ensure proper communication