Design Considerations for In-stream Wood and Boater Safety

Presented To:

River Restoration Northwest

Stevenson, WA January 31, 2012

Presented By:

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Presentation Objectives

Inform restoration practitioners and river managers:

- Background on river hazards
- Boater perspectives and LWD
- Design Considerations
  - Reach scale
  - Element scale
- Mitigation Considerations

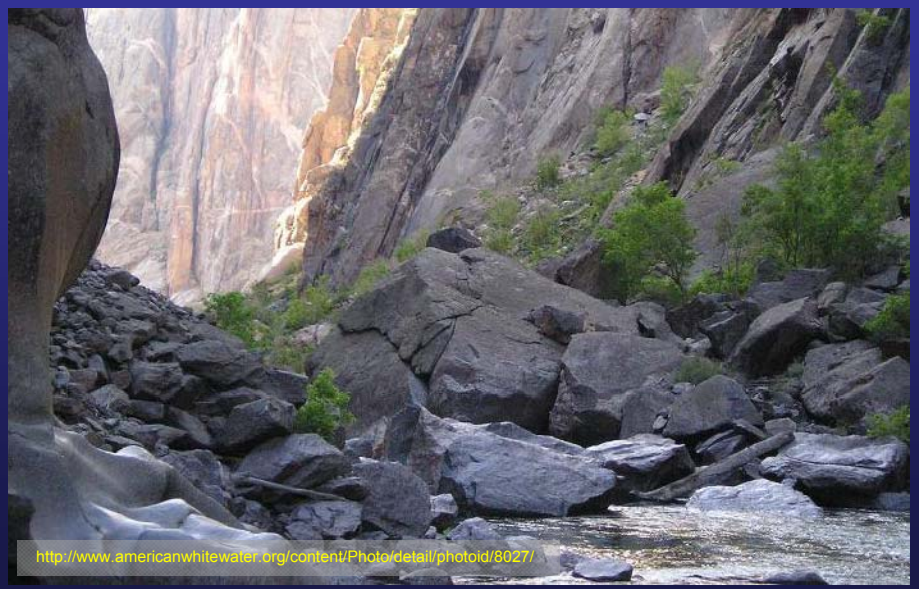
Disclaimers:

- Presented for consideration, not from a “Do” or “Do not” perspective
- Ecological functions of LWD are well-established and not covered
- Material is not presented as a policy position of the Yakama Nation

Speaker Background

- Recreational Boater
  - approximately 400 river-days over the last 10 years
  - over 3,300 miles on 60 different rivers/streams in 8 states
  - Class I to Class V+
  - conducted / participated in ~60 rescues / recoveries
- Stream Restoration Practitioner
  - 11 years professionally as a project manager and designer
  - placed ~ 2000 pieces of LWD in rivers & streams
- Volunteer firefighter
- Husband
- Father

Rivers Present a Variety of Hazards: Some Natural…



…Some Not

Putting the Risk in Perspective

Rivers are dynamic and inherently dangerous, yet fatality rates are comparable to or lower than many common activities

Activity	Annual Fatality Rate [A]
Passenger Automobile	**15.2**
Falls at home	4.0
Pedestrians	2.2
Fires at home	1.2
Drowning in public places	0.9
Firearms (accidental)	0.1
Lightning	0.02

[A] per 100,000 population

Activity	Annual Fatality Rate [B]
Climbing / Mountaineering	3.2
Kayaking	2.9
Swimming	2.6
Bicycling	1.6
Whitewater boating	**0.86**
Hunting	0.7
Skiing and snowboarding	0.4

[B] per 100,000 participants

Tables adapted from:
Kayaking is Safer Than You Might Think (really!) *By Laura Wittmann*
American Whitewater Journal *Sep/Oct 2000*

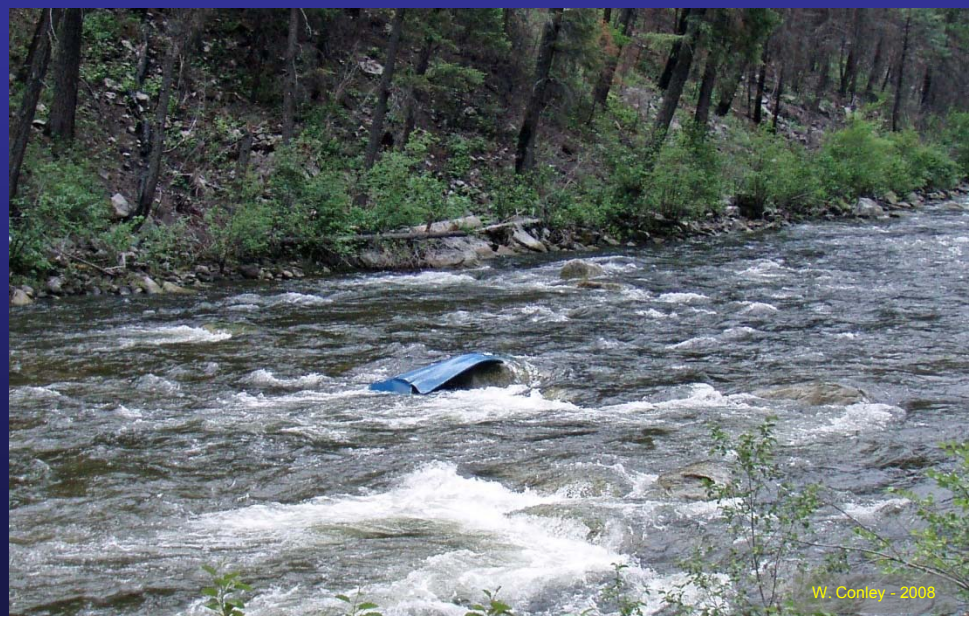
Common Denominators of River Incidents

Environmental

- High Water
- Cold
- Strainers, Sweepers, and Sieves
  - Rock sieves
  - Undercut rocks
  - Pilings / Abutments
  - Overhanging Limbs
  - Brush
  - **LWD**
- Dams, weirs, holes, etc.

Human Factor

- Lack of preparedness
- Drugs / alcohol
- Bad judgment



Boater Antipathy Toward LWD

"Logs are the predators of paddlers and we treat them how our ancestors in this country treated wolves and mountain lions. They are generally disliked, their importance to the ecosystem is completely misunderstood, they are removed whenever possible, and if one is ever implicated in the injury or death of a human it is ceremoniously destroyed."

From: How Much Wood Does a Paddler Chuck? *By Kevin Colburn*
American Whitewater Journal *Mar/Apr 2001*

LWD Entrapment

(a.k.a. “pin”)

What we try to avoid as boaters and designers

Rocks cause wraps & entrapments too…

…but, we've managed to (mostly) move past altering them for convenience sake

Historic Prevalence of LWD

Logs and log jams commonly blocked navigation

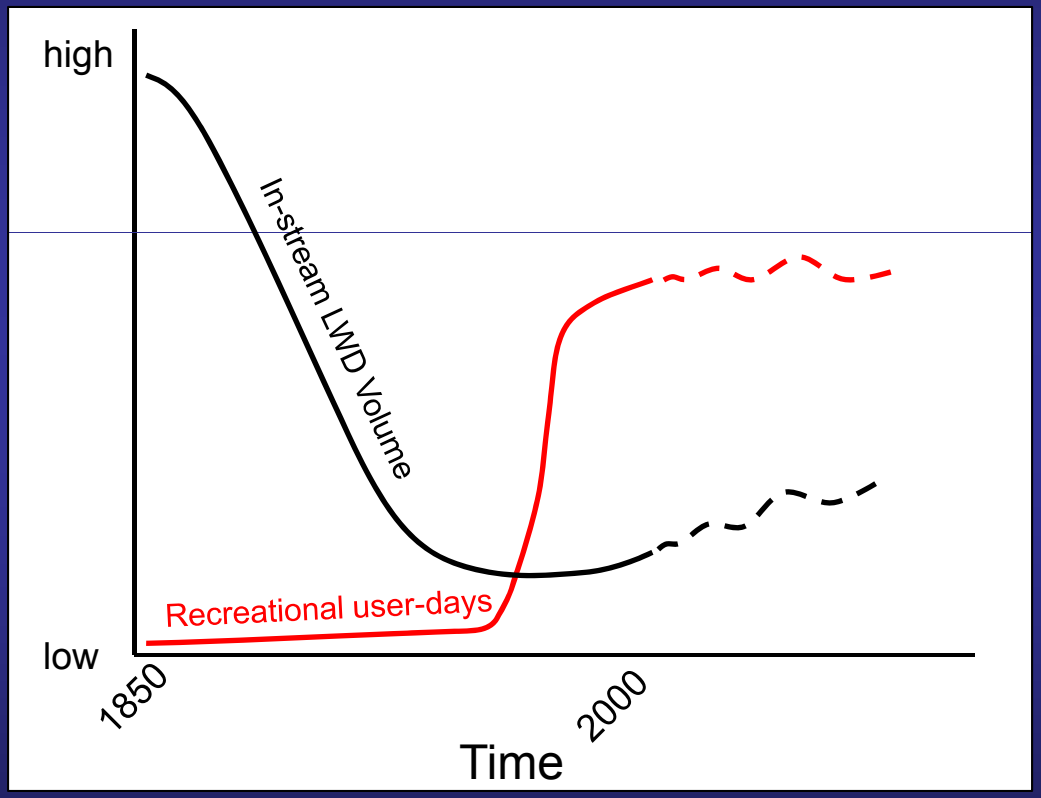
Skagit River logjams, 1873
Courtesy U.S. Bureau of Land Management

- Two large jams on the Skagit River appear on the GLO maps in 1873
- One jam had been in place sufficient to block river traffic for nearly 100 years
- A second, younger jam was “rapidly increasing in size at the rate of a quarter mile every three years.”
- The only way around the jam was “A rude skid road built by Upper Skagit Indians to haul their canoes…”
- Removal of “five to eight tiers of logs three to eight feet in diameter, totaling 30 feet deep” between 1876 and 1879.

http://crowleyassoc.com/essays/output.cfm?file_id=5652

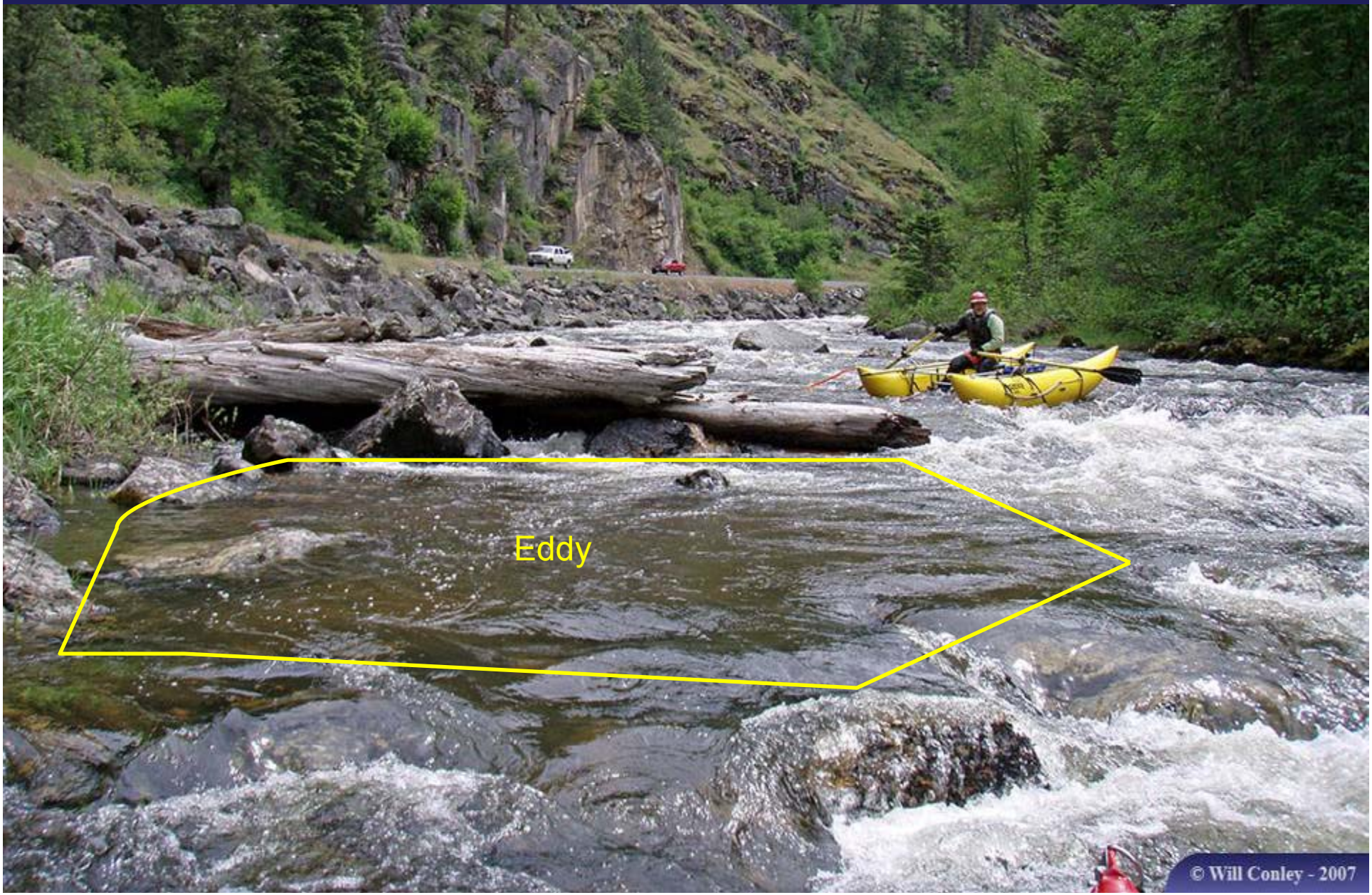
Boaters and LWD in the PNW

Though original instream LWD declines were generally caused by commerce and industry…



…river recreationists today enjoy and, in some cases, help maintain historically-low levels of LWD

Some LWD Is Useful To Boaters



Design Vehicle Concept?

Tempting, but not appropriate in the traditional sense

- Rivers and streams are not highways, roads, or trails
- Who decides?
- Use of pool-toys or other equipment not explicitly designed for rivers is hazardous in and of itself

Stream	Reach	Q Range	Design Vehicle
Wood River	Rock Cr to Horse Cr	<200 cfs	Innertube
		200 – 500 cfs	Kayak
		500 – 1000 cfs	Raft
		> 1000	Barrel

- Widely varying performance characteristics within a craft type
- Widely varying skill levels of boaters
- Selecting the lowest performance craft and/or least-skilled user for design purposes unreasonably shortchanges habitat and riverine processes

Floaters' / Boaters' Responsibilities

- Be a **Competent swimmer**
- Wear proper **personal protective equipment** (life jacket, etc)
- Boat **in control**. Able to stop or reach shore before reaching danger.
- Boat with **companions**. (≥2 two craft recommended)
- Have a **frank knowledge** of their boating **ability**
- Be trained in rescue and **self-rescue**, **CPR**, & first aid.
- Carry equipment needed for unexpected emergencies
- **Knowledge of river conditions**

Adapted from AW's Safety Code http://www.americanwhitewater.org/content/Wiki/safety:start

Reach Scale

Consider “Ambient Hazard” during design

- What is the general character of the reach?
- Contemporary vs Historic conditions?
- What is the nature of pre-existing hazards?

Whitewater runs are generally categorized by International Scale of River Difficulty

- The majority of a “run” (by length) is usually easier than rating
- Ratings usually increase with discharge
- A class II or III river could be class IV or V during high water
- A single channel-spanning log can turn a class III into class V

Increasing importance of LWD for fish habitat & channel morphology

Increasing boater skill / rapid difficulty

Note: Class I (flatwater) and Class VI intentionally excluded

Can Boaters be Avoided Geographically?

The short answer is “not really”*

Class I to II Runs

- typically <30 ft/mi (0.006 ft/ft), w/exceptions (e.g. Grand Canyon)
- Probably good benefit to fisheries
- Probably some recreational conflict (but slower water)

Class III to IV Runs

- typically <80 ft/mi (0.015 ft/ft), w/exceptions
- Probably good benefit to fisheries (for non-“continuous” runs)
- Probably greatest potential for recreational conflict

Class V to VI Runs

- Typically 80-300 ft/mi (0.019 - 0.057 ft/ft)
- Generally steeper than most restoration project reaches
- Palouse Falls (~180’) has been run; kayakers have run 600-800 fpm

* Some areas have administrative closures (e.g. municipal watersheds, tribal and military reservations, etc)

Site Scale

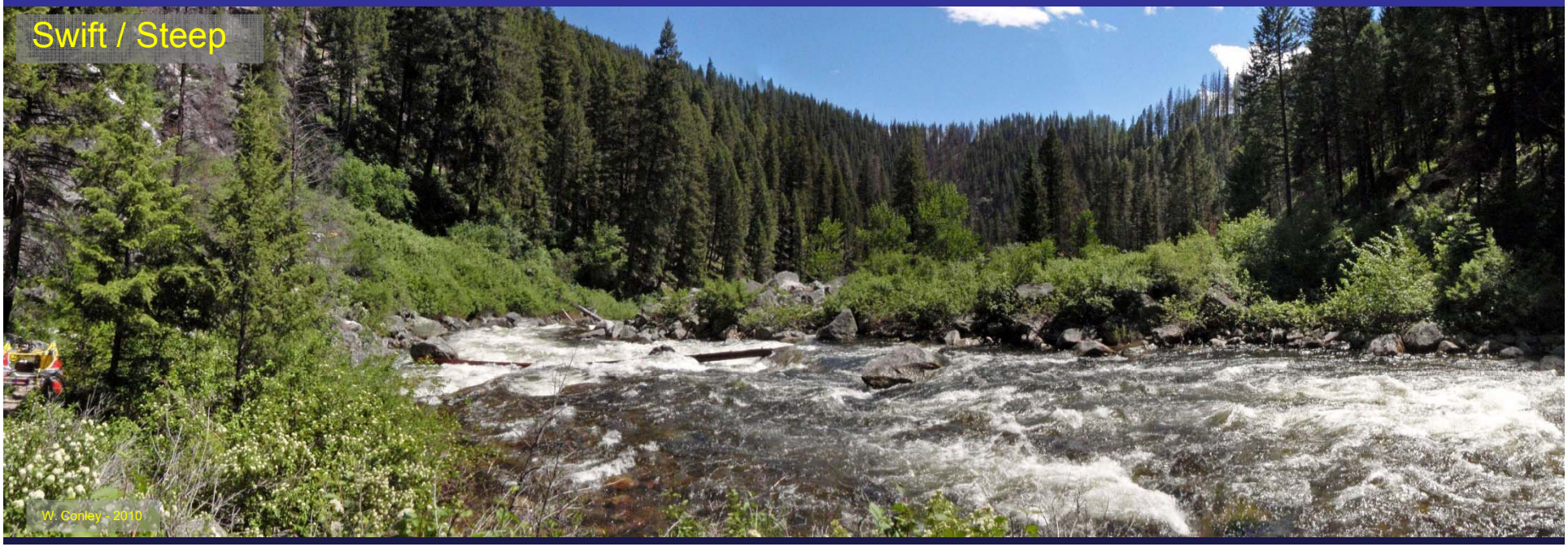
Degree of hazard is a function of:

- Approach velocity (speed and angle)
- Porosity
- Position in the water column
- Percent of cross-section obstructed
- Juxtaposition of objects

Porosity

- Is it well-sealed and acting as a deflector?
  - Less-likely to be hazardous
  - More likely to create hydraulic features like eddies
- Is it porous and acting like a sieve?
  - Flow is entrained into or underneath
  - More likely to cause vessel and/or human entrapment

Approach Velocity: Speed



Approach Velocity: Angle

Juxtaposition to Other Objects

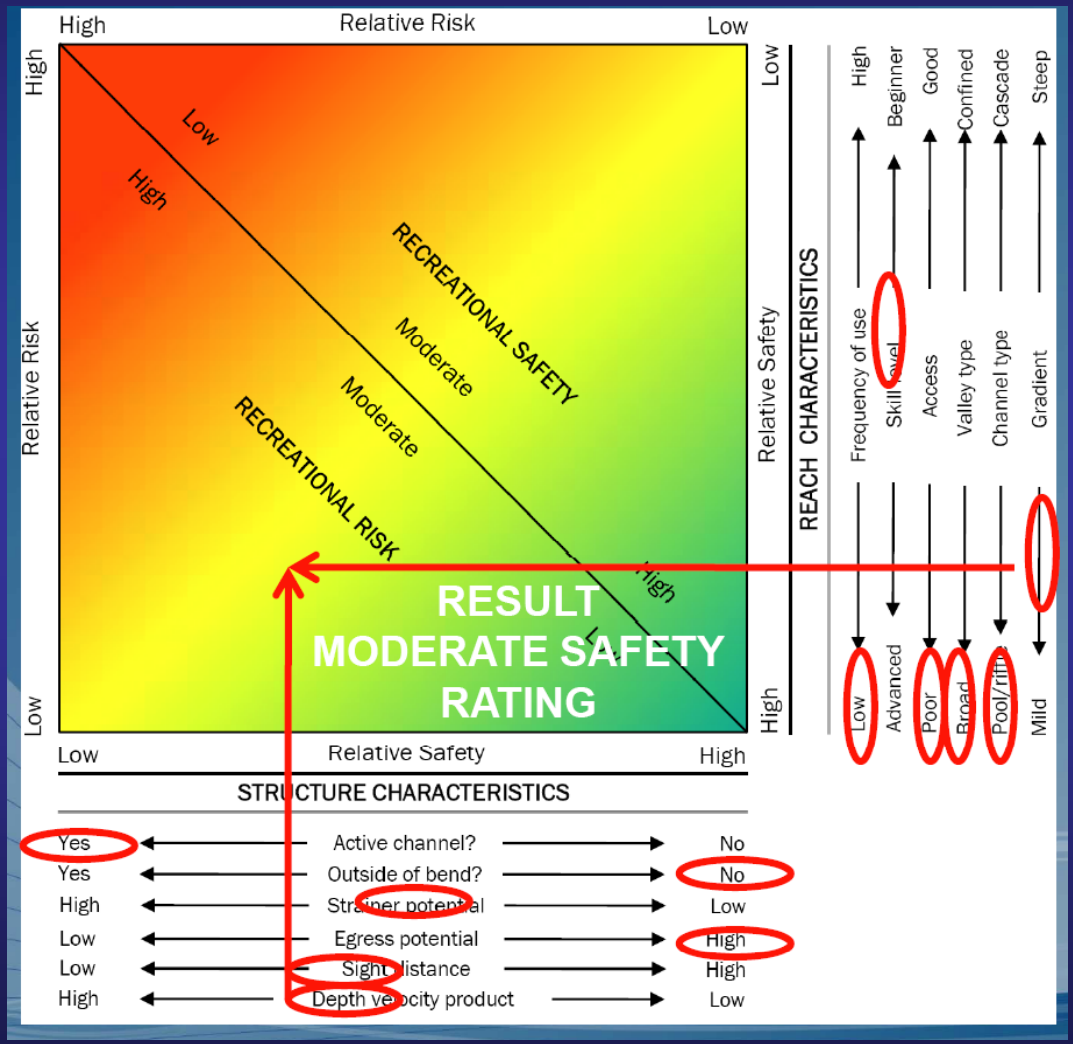
Relates to:

- Increased ‘exposure’ (the probability side of risk evaluation)
- velocity vector (covered in other slides)

Position in Water Column

Percent of X.S. Obstructed

Hazard Assessment / Evaluation
Example 1: Recreational Safety Focus



Courtesy of Leif Embertson / GeoEngineers

(From a Practical Perspective)
the Hazard is Mitigated if:

1) It can be avoided with a degree of skill consistent with the character of the reach & discharge

Or

2) It's visible from upstream, *and* opportunity exists to stop and get to bank

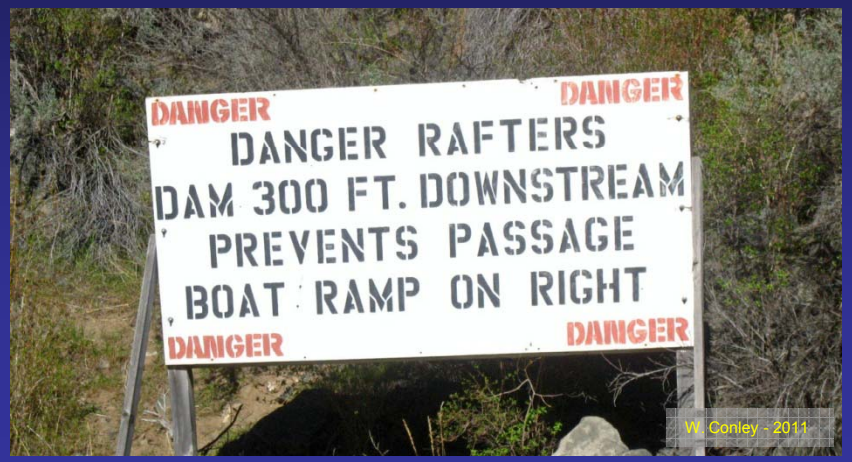
Or

3) It's signed upstream, *and* opportunity exists to stop and get to bank

In the case of constructed LWD, it should be probably be portageable if it presents a navigation impediment during some established period of use

Signage

- May be appropriate in some instances, if:
  - Human-constructed, and
  - Out of geomorphic context
  - Channel-spanning



- Problematic in many instances:
  - LWD moves…naturally; rivers move…naturally
  - Once you start, you can't stop
    - creates expectations
    - requires maintenance
  - Expectations may be problematic when folks travel to other rivers where expectations are different
- Education and outreach is more important than signage

Signs?

July 2009 – NF Payette River (V)

- Lakewood, WA family in Idaho for family reunion
- Decide to go whitewater rafting with extended family; “had been rafting before”
- The put-in at Banks for the class III run was too crowded, so they drove upstream
- Drove past two class V rapids plainly visible from the highway (photo below)
- Used an improvised put-in; warned, in-person not to launch on NF
- Launched a single, rented raft with 10 people (5 minors) on board
- 3 people (2 minors, 1 adult) fall-out in first (class IV+) rapid; minors OK
- Adult (conscious & alert) last observed drifting passively in runout of rapid (class III)
- Body of adult recovered ~½ mile downstream
- Family comments on-line, “…There were no signs classifying the river as IV or V level posted anywhere to warn us…”

(http://www.nwcn.com/statenews/idaho/stories/NW_072609IDN-raft-accident-KS.7c06b3\e4.html)

Was this preventable?

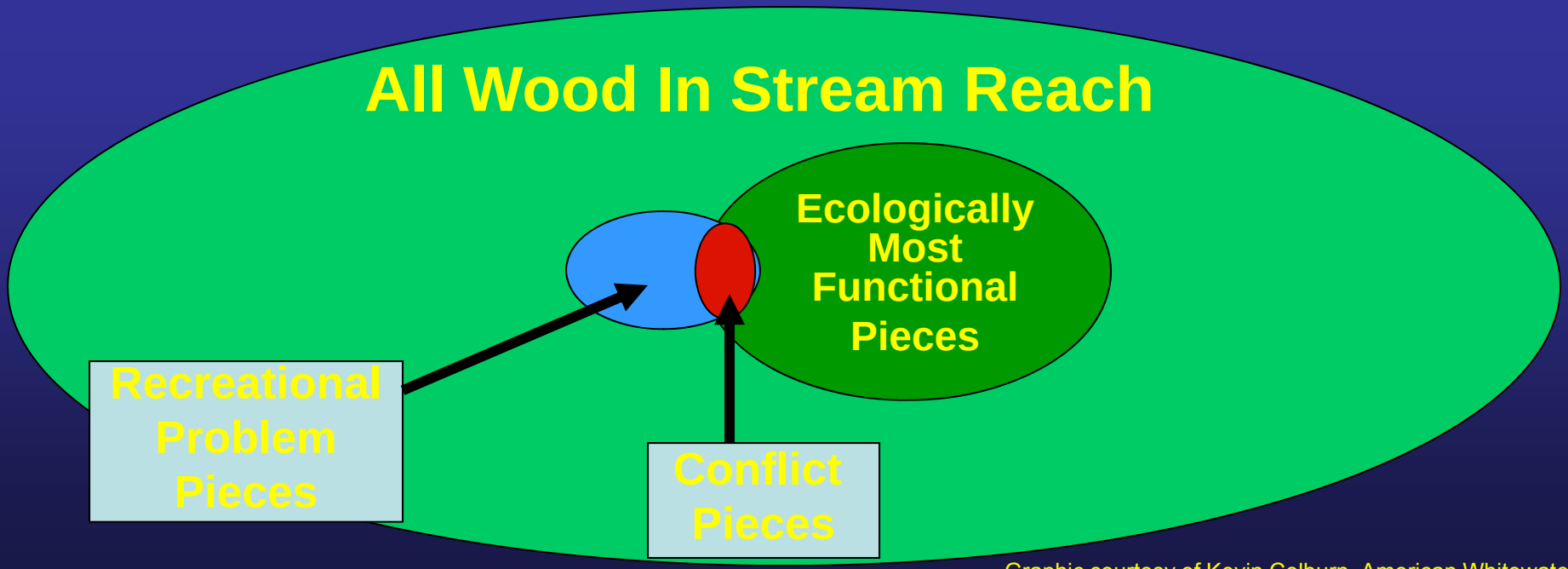
Without signs?

Origin of signage expectation?

Is this guy gonna read your sign?

Take-Home Points:

- ***There is no guarantee of safety in any natural environment***
- There is a knee-jerk tendency to label LWD as “dangerous” or “hazardous”…most is neither
- Most “hazardous” LWD is really just inconvenient
- LWD facilitates physical and biological processes 24 hrs/day, 365 days/yr; inconvenience to boaters is minutes or hours



Graphic courtesy of Kevin Colburn, American Whitewater

Take-Home Points (cont'd):

- ***Design to the ambient hazard of the reach / "run"***
- Elements beyond the run's present hazard level may be OK, (even desirable from a habitat and/or geomorphic perspective).
- Projects involving restoration to "historic ambient" conditions should probably have more outreach
- Mitigation = Awareness + Opportunity to stop & portage (or line)
- Awareness may = visibility and/or outreach and/or signage

Take-Home Points (cont'd):

- ***When designing, be concerned about "hazards" and "safety" issues, but not intimidated by them***
- Be cautious with channel-spanning and porous designs
- Be particularly mindful of elements that become more hazardous at low flows / during warm weather