Welcome

Riparian Book Club Hosts

Julie Ash, PE | Colorado Riparian Association (CRA) | Education & Outreach Committee Lead
Maria Brandt | Coalitions & Collaboratives (COCO) | Outreach & Development Director
Colin Barry, PG, CFM (Ayres) | Geomorphologist
Sarah Hinshaw Fancher, Ph.D | Fluvial Geomorphologiest

Welcome to Riparian Book Club 2025

Book Club Hosts:

Colorado Riparian Association (CRA)

&

Coalitions & Collaboratives (COCO)

April 2025 Book Club

The Natural Flow Regime with Dr. LeRoy Poff

Friday 4/4/25 12p-1p MDT

Riparian Book Club helps bridge the gap between academic research on stream & wetland systems and applied restoration design in Colorado

Colorado Stream Restoration Network (CSRN)

- *ca 2014-2020 launched after September 2013 Front Range flood*
- *CRA teamed with the City of Longmont*
- *Inspired by the Colorado Weed Network (CWN)*
- *Local forum to raise awareness, connect us, and advance the science and practice of stream restoration*
- *Created a space to share information and discuss important topics across the restoration community*
- *Half-day in-person workshops in Longmont*
- *2020 included the River Ethic workshop & Urban Resiliency webinar*

CSRN Riparian Book Club

- *2023 on Process-Based Restoration (PBR) papers and applications*
- *2025 "the trifecta": Natural Flow Regime, Natural Sediment Regime, Natural Wood Regime*

Riparian Book Club

- *Seeks to bridge the gap between academic research & applied restoration design*
- *By connecting our riparian community to pivotal scientific papers on stream & wetland systems to support our work*
- *Tailored to leaders of stream-wetland project planning & restoration design*

April 2025 Book Club

The Natural Flow Regime with Dr. LeRoy Poff

Friday 4/4/25 12p-1p MDT

July 2025 Book Club

The Natural Sediment Regime with Dr. Sara Rathburn

Thursday 7/24/25 12p-1p MDT

November 2025 Book Club

The Natural Wood Regime with Dr. Ellen Wohl

Wednesday 11/5/25 12p-1p MDT

COLORADO RIPARIAN ASSOCIATION

COCO

The Colorado Riparian Association was formed in 1989 by a small group of dreamers who believed that our riparian zones should not become sacrifice areas.

Our Mission:

To promote the conservation, restoration, and preservation of Colorado's riparian areas and wetlands.

GET INVOLVED WITH CRA!

Membership: www.coloradoriparian.org

Amy Scherman, Membership Chair: amy@flywater.com

2025 CRA Committees:

- MEMBERSHIP COMMITTEE
- CONFERENCE COMMITTEE
- SCHOLARSHIP COMMITTEE
- AWARDS COMMITTEE
- ENGAGEMENT & OUTREACH COMMITTEE (includes CSRN, website, blog)

Upcoming Events:

- April 24th (Thu) 5-8p CRA Spring Social
  Sanitas Brewing in Boulder - RIPARIAN JEOPARDY
- August 21st (Thu) 5-8p CRA Summer Social
  Fort Collins - TBD
- Oct 7th - 9th Sustaining Colorado Watersheds (SCW) conference in Avon – SCW's 20th ANNIVERSARY
- CSRN Kids (ongoing)

CRA SPRING SOCIAL

Please join us for a free beverage, snacks and fun river trivia at the Sanitas Brewing company
Come show your talents and play Riparian Jeopardy with CRA!

Thursday April 24 2025
5-8 pm
Sanitas Brewing- Boulder Taproom
3550 Frontier Avenue, Boulder, CO 80301

A fun educational and networking opportunity for CRA members and anyone who loves or works with rivers!
We look forward to meeting you!

COLORADO
RIPARIAN
ASSOCIATION

CSRN Kids

- CRA's Watershed Model hits the road
- CRA members work with K-5 teachers to introduce students to concepts of:
  - *Watersheds*
  - *Rainfall-runoff*
  - *Flood risk reduction*
  - *Watershed resilience*
  - *Careers in watershed restoration*
- CRA also loans the model to watershed coalitions

IN PERSON

BIANNUAL CONFERENCE & WORKSHOP

FIELD DAYS

training on-site

WEBINARS

& ONLINE

This ATF event is the nation's l...

After the Flames

brought to you by Coalitions & Collaboratives

ATF

GOALS

Provide Direct Non-Federal Post Fire Support

Build a Skilled Post Wildfire Workforce
Increase leadership capacity to help communities respond to & recover from wildfires.

Expand Post Wildfire Support Systems
Strengthen post-fire response to reduce impacts on communities & ecosystems.

Raise Awareness & Share Resources
Convene non-federal post-fire experts & practitioners to share resources, collaborate, & learn.

After the Flames is a comprehensive suite of services, too... resources aimed at providing direct support to communities... wildfire.

Over the last 38 years, wildfires have burned an average of 5.2 ... acres annually in the United States. Many remain inconsequent... some exceed 300,000 acres, accompanied by the need to reb... homes, businesses & infrastructure. The long-term costs to co... & ecosystems include flooding, debris flows & long-term imp... incurring costs well beyond the year of the burn. Loss of hom... infrastructure due to flooding are examples of post-wildfire's ... impacts on people, communities & economies. These events... major shifts in ecosystem composition & structure, often pe... changing the landscape. Much of the recovery & restoration... borne by state & local entities, & by residents & businesses... the fire scar.

Drawing on over 20 years of experience in post-wildfire re... Coalitions & Collaboratives (COCO) established After the ... in 2019. This initiative offers a range of programs designe... national capacity for wildfire recovery, ultimately aiming ... impact on communities and ecosystems.

PROGRAM CONTACT
Maria Brandt | Maria.Brandt@co-co.org

Scholarships (Conference & Wor...
- Fund scholarships for indi... communities, ensuring div...
- Support professional deve... emerging leaders in the fi...

Agenda Development (Conferen...
- Partner with us in shaping... addresses the most pressi...
- Suggest & coordinate key... session topics to enhance...

Staffing (Conference & Worksho...
- Volunteer or staff to assist... registration & participant ...
- Offer expertise & manpow... hands-on training is impac...

Donation Support (Conference &...
- Establish partnerships wit... & businesses

COMMUNITY WILDFIRE MITIGATION BEST PRACTICES TRAINING

The CWMBP national-level training is designed for current or future mitigation specialists, wildfire program leads and others who work with residents and their communities, to become more efficient and effective at reducing wildfire risk.

COMMUNITY NAVIGATORS

Community Navigators support community-based partners to access federal funding opportunities, create partnerships, and build capacity for wildfire risk mitigation and climate resilience.

AFTER THE FLAMES

After the Flames" signifies not just a... strategic framework. This framewo... our approach to post-disaster resp... encompassing a holistic strategy fo... workforce development, policy refinement, program innovation, and resource provision.

REVOLVING LOAN FUND

Bridge funding for project implementation for conservation collaboratives. Funding is designed to increase the efficiency and impact of existing investments.

AIM GRANT

CCOCO offers a unique wildfire mitigation funding opportunity for a wide variety of capacity-building activities, including personnel, planning and wildfire risk reduction work on non-federal land.

CO-CO.ORG

COMMUNITY MITIGATION ASSISTANCE TEAM

The CMAT works closely with Incident Management Teams, the U.S. Forest Service or other land management agencies, and community residents and leaders to identify mitigation opportunities before fire impacts the community.

COLDFIRE SEQUESTRATION

Coldfire is a group of mycology researchers investigating the use of native fungi to heal and improve our forests with the forest ecology itself.
Fungal-produced composts have been scientifically proven to hold twice as much carbon. This could provide an opportunity in which to increase our carbon stores naturally and safely.

CO-CO.ORG

CO-CO.ORG   NEWSLETTER   DONATE

WE ARE TEAM COCO

Here to mentor and support, or connect you to the appropriate resources. Email us at coco@co-co.org.

2432 S. Downing St. Suite 200 | Denver, Colorado 80210 | 719-412-3747

Using Mentimeter

- Scan the QR code or enter menti.com into your computer's web browser
- Enter the code given in the QR box or info bar above
- Follow along and participate in the webinar
- Polling is anonymous. Please be respectful and professional.
- You'll be able to type in questions throughout the presentation.

We ask that you please...

- take care of yourself
- practice confident humility – the self-awareness that we all have wisdom and we will always have more to learn
- listen actively and with an ear to understanding others' views
- speak your truth using "I" statements
- avoid assumptions
- commit to learning, not debating
- embrace paradox

I'm a

0
11
9
2
1
Researcher
Practitioner
Project Proponent/Lead
Student
Landowner

23

What geographic location are you joining us from?

23

What do you hope to get from this online workshop?

Knowledge!

I hope to learn!

Others insights and thoughts on the paper and how it related to our work!

Refresh on a paper I cite all the time!

learn more about river restoration

Great discussion about the best way to retore and advocate for the natural flow regime as a part of stream function!

Learn more about riparian ecology principles

Better understanding of flow regime and the impacts altered flow regimes can have

13

What do you hope to get from this online workshop?

Learn more about river ecosystems!

How to apply concepts to restoration.

Is the natural flow regime possible anymore

Relationship between natural flow regime and native fish needs.

Mimic natural flow regimes.

13

Dr. LeRoy Poff

Dr. Poff is a professor at Colorado State University in the Department of Biology and has a partial appointment as a Distinguished Professor at the University of Canberra in Australia. His research interests are broadly related to how habitat structure and environmental variability, especially hydrologic variability, affect ecological processes.

Dr. Poff is a foundational leader in the field of Environmental Flows and has contributed enormously (and globally) to the progression of science-based management of streams and rivers. He is the lead author of the landmark 1997 paper, The Natural Flow Regime, which defined a new paradigm for how we think about river flow and has been cited over 8800 times!

Introduction

Prior to 1990s – “biologically protective” flow management in streams based on simple hydrologic measures, like minimum flow

Little appreciation of importance of dynamic flow variation in sustaining stream/river ecosystems (aquatic + riparian components)

1996

- I was working at University of Maryland and at Trout Unlimited national office; David Allan was advising American Rivers.
- NGOs needed a scientific basis to advocate for whole ecosystem management, not just minimum flows for valued fish species

The Natural Flow Regime

A paradigm for river conservation and restoration

N. LeRoy Poff, J. David Allan, Mark B. Bain, James R. Karr, Karen L. Prestegaard, Brian D. Richter, Richard E. Sparks, and Julie C. Stromberg

Humans have long been fascinated by the dynamism of free-flowing waters. Yet we have expended great effort to tame rivers for transportation, water supply, flood control, agriculture, and power generation. It is now recognized that harnessing of streams and rivers comes at great cost: Many rivers no longer support socially valued native species or sustain healthy ecosystems that provide important goods and services (Naiman et al. 1995, NRC 1992).

The ecological integrity of river ecosystems depends on their natural dynamic character

The extensive ecological degradation and loss of biological diversity resulting from river exploitation is eliciting widespread concern for conservation and restoration of healthy river ecosystems among scientists and the lay public alike (Allan and Flecker 1993, Hughes and Noss 1992, Karr et al. 1985, TNC 1996, Williams et al. 1996). Extirpation of species, closures of fisheries, groundwater deple-

ing. However, current management approaches often fail to recognize the fundamental scientific principle that the integrity of flowing water systems depends largely on their natural dynamic character; as a result, these methods frequently prevent successful river conservation or restoration. Streamflow quantity and timing are critical components of water supply, water quality, and the ecological integrity of river systems. Indeed, streamflow, which is strongly correlated with many critical physicochemical characteristics of rivers, such as water temperature, channel geomorphology, and habitat diversity, can be considered a “master variable” that limits the distribution and abundance of riverine species (Power et al. 1995, Resh et al. 1988)

N. LeRoy Poff is an assistant professor in the Department of Biology, Colorado State University, Fort Collins, CO 80523-1878 and formerly senior scientist at Trout Unlimited, Arlington, VA 22209. J. David Allan is a professor at the School of Natural Resources & Environment,

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The structure and function of river ecosystems, and the **adaptations** of constituent species, are dictated by the pattern of temporal variation in river flows.
(Similar to natural disturbance regime.)

entire river ecosystem (Karr 1991). However, environmental dynamism is now recognized as central to sustaining and conserving native species diversity and ecological integrity in rivers and other ecosystems (Holling and Meffe 1996, Hughes 1994, Pickett et al. 1992, Stanford et al. 1996), and coordinated actions are therefore necessary to protect and restore a river's natural flow variability.

In this article, we synthesize existing scientific knowledge to argue that the natural flow regime plays a critical role in sustaining native biodiversity and ecosystem integrity in rivers. Decades of observation of the effects of human alteration of natural flow regimes have resulted in a well-grounded scientific perspective on

The natural flow regime

The natural flow of a river varies on time scales of hours, days, seasons, years, and longer. Many years of observation from a streamflow gauge are generally needed to describe the characteristic pattern of a river's flow quantity, timing, and variability—that is, its natural flow regime. Components of a natural flow regime can be characterized using various time series (e.g., Fourier and wavelet) and probability analyses of, for example, extremely high or low flows, or of the entire range of flows expressed as average daily discharge (Dunne and Leopold 1978). In watersheds lacking long-term streamflow data, analyses can be extended statistically from gauged streams in the

5 "components" of the NFR: These components can be used to characterize the entire range of flows and specific hydrologic phenomena, such as floods or low flows, that are critical to the integrity of river ecosystems.

Conceptual figure showing ecological role of different flow levels

Figure 4. Geomorphic and ecological functions provided by different levels of flow. Water tables that sustain riparian vegetation and that delineate in-channel baseflow habitat are maintained by groundwater inflow and flood recharge (A). Floods of varying size and timing are needed to maintain a diversity of riparian plant species and aquatic habitat. Small floods occur frequently and transport fine sediments, maintaining high benthic productivity and creating spawning habitat for fishes (B). Intermediate-size floods inundate low-lying floodplains and deposit entrained sediment, allowing for the establishment of pioneer species (C). These floods also import accumulated organic material into the channel and help to maintain the characteristic form of the active stream channel. Larger floods that recur on the order of decades inundate the aggraded floodplain terraces, where later successional species establish (D). Rare, large floods can uproot mature riparian trees and deposit them in the channel, creating high-quality habitat for many aquatic species (E).

and riparian (Nilsen et al. 1984) species with special behavioral or physiological adaptations that suit them to these harsh conditions.

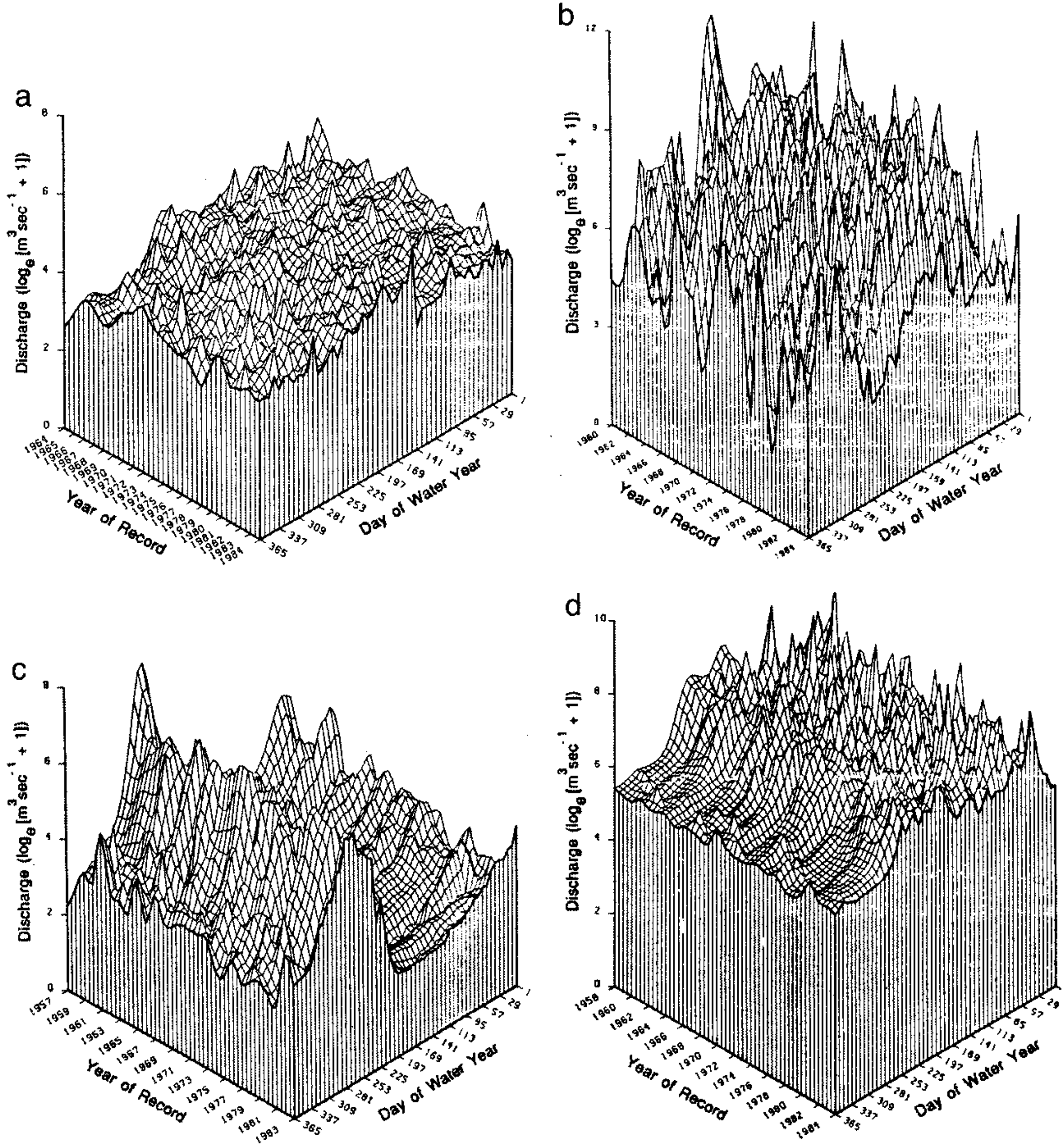
The duration of a specific flow condition often determines its ecological significance. For example, differences in tolerance to prolonged flooding in riparian plants (Chapman

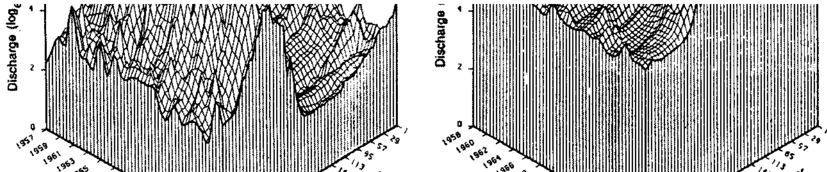
the successful establishment of nonnative species with flow-dependent spawning and egg incubation requirements, such as striped bass (*Morone saxatilis*; Turner and Chadwick 1972) and brown trout (*Salmo trutta*; Moyle and Light 1996, Strange et al. 1992).

Seasonal access to floodplain wet-

These different flow volumes (magnitudes) vary in frequency, duration and timing in different climatic and geologic settings.

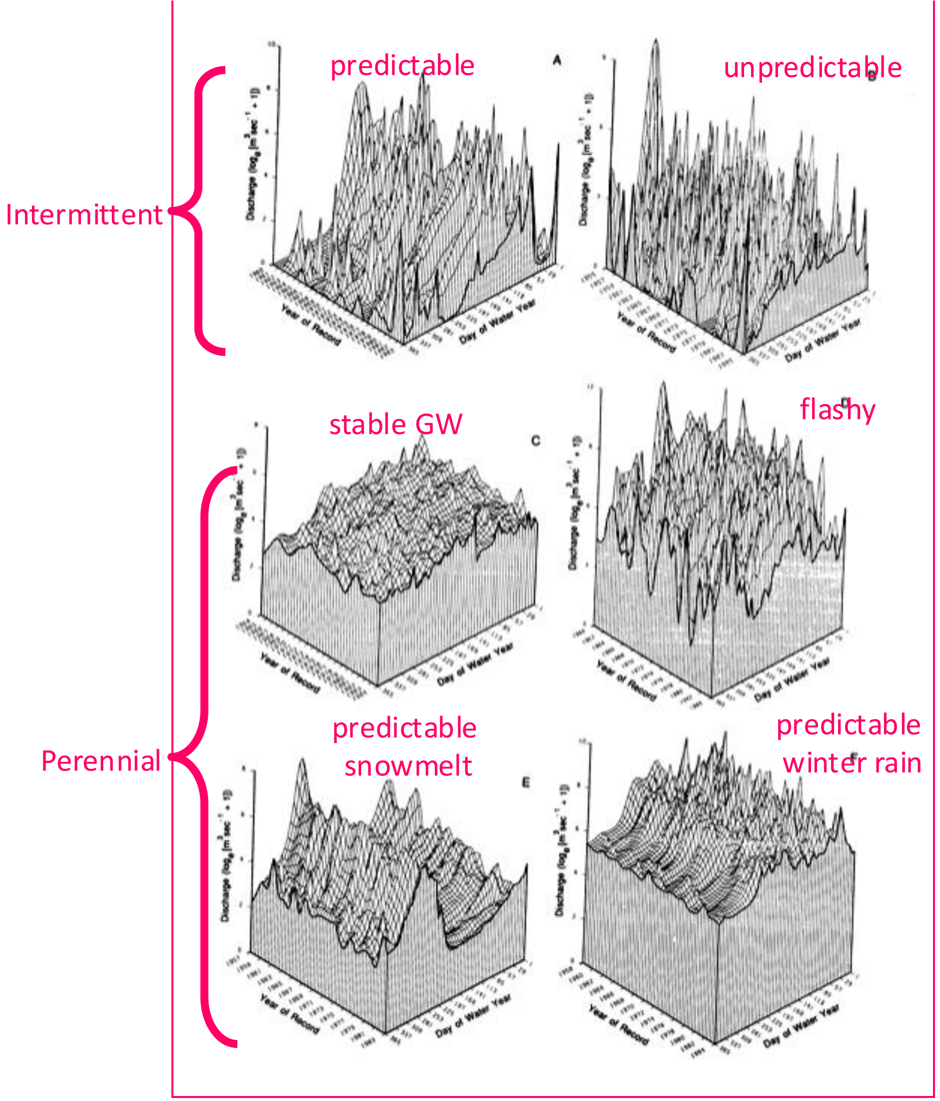
3-D hydrographs showing different patterns of daily hydrologic variation over multiple years





5 components of the flow regime that define the pattern of variability important to ecological performance

- *Magnitude*
- *Frequency*
- *Duration*
- *Timing (or predictability)*
- *Rate of change in flow*



- Streams can be characterized and contrasted in these terms.
- Leads to a priori prediction about differences in strength of biotic interactions and species traits across streams.

Some geographic coherence to flow regime types across U.S.

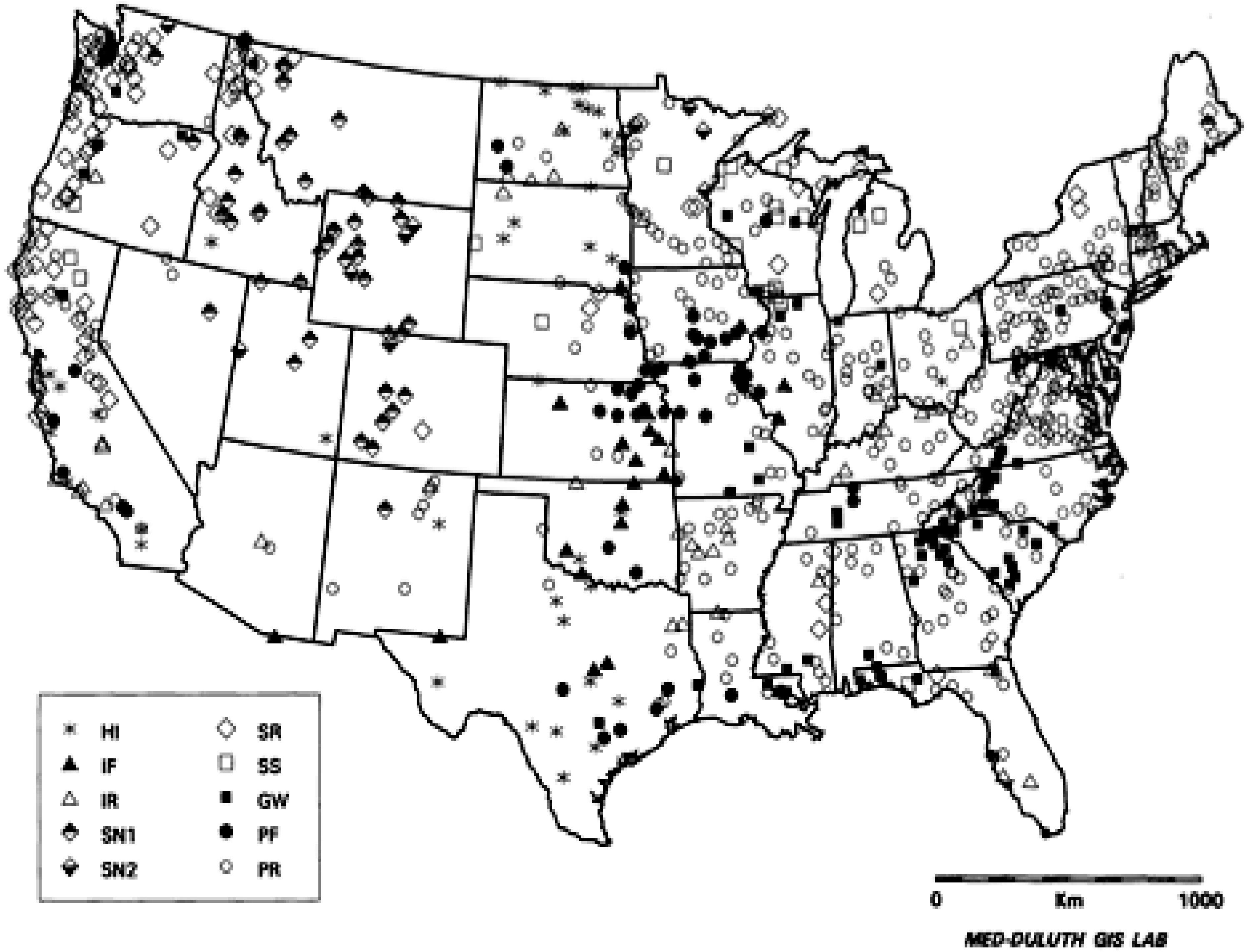
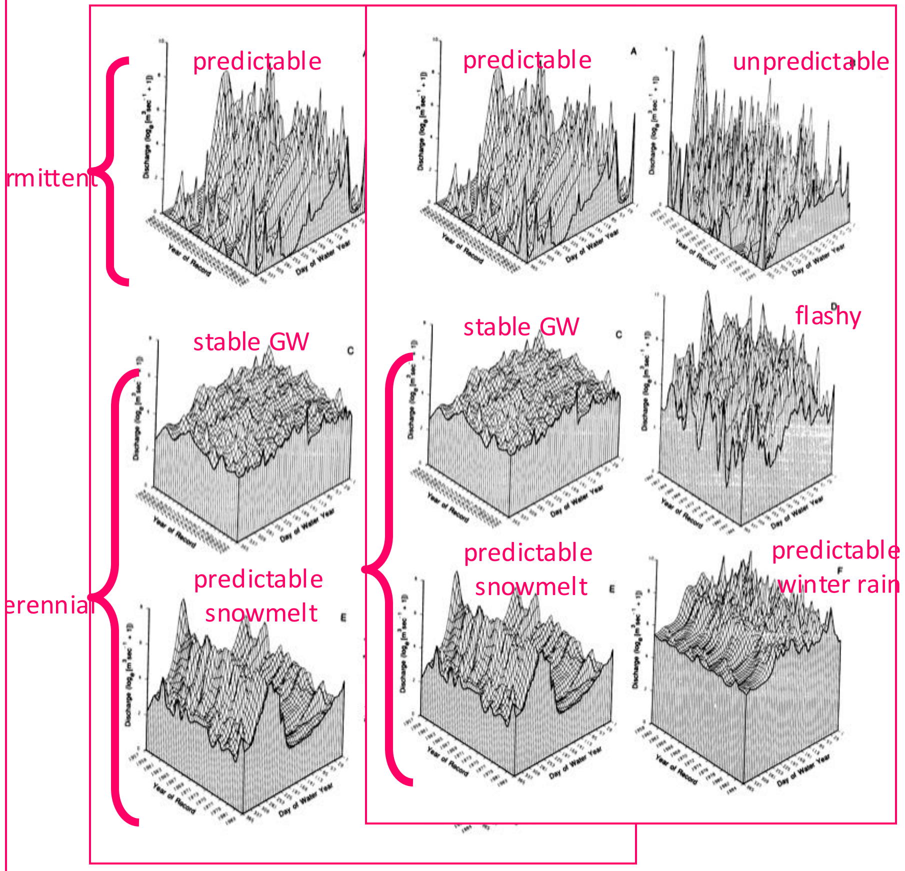


Fig. 3 Geographical locations of all 806 gauged streams grouped into ten clusters based on ten hydrological descriptors. HI = harsh intermittent, IF = intermittent flashy, IR = intermittent run-off, SR = snow + rain (types 1 and 2), SN = snowmelt, SS = superstable groundwater, GW = stable groundwater, PF = perennial flashy, PR = perennial run-off.



Poff & Ward (1989, 1990), Poff (1996)

Alteration of natural flow regime in streams/rivers modifies sediment transport capacity and channel habitats

Table 1. Physical responses to altered flow regimes.

Source(s) of alteration	Hydrologic change(s)	Geomorphic response(s)	Reference(s)
Dam	Capture sediment moving downstream	Downstream channel erosion and tributary headcutting	Chien 1985, Petts 1984, 1985, Williams and Wolman 1984
		Bed armoring (coarsening)	Chien 1985
Dam, diversion	Reduce magnitude and frequency of high flows	Deposition of fines in gravel	Sear 1995, Stevens et al. 1995
		Channel stabilization and narrowing	Johnson 1994, Williams and Wolman 1984
		Reduced formation of point bars, secondary channels, oxbows, and changes in channel planform	Chien 1985, Copp 1989, Fenner et al. 1985
Urbanization, tiling, drainage	Increase magnitude and frequency of high flows	Bank erosion and channel widening	Hammer 1972
		Downward incision and floodplain disconnection	Prestegaard 1988
	Reduced infiltration into soil	Reduced baseflows	Leopold 1968
Levees and channelization	Reduce overbank flows	Channel restriction causing downcutting	Daniels 1960, Prestegaard et al. 1994
		Floodplain deposition and erosion prevented	Sparks 1992
		Reduced channel migration and formation of secondary channels	Shankman and Drake 1990
Groundwater pumping	Lowered water table levels	Streambank erosion and channel downcutting after loss of vegetation stability	Kondolf and Curry 1986

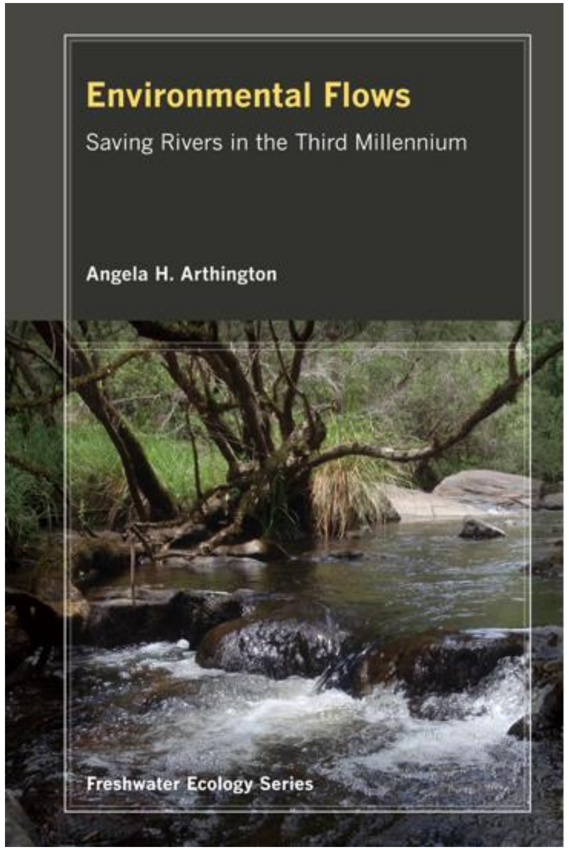
Alteration of natural flow regime in streams/rivers modifies ecological structure and function of aquatic and riparian communities

Table 2. Ecological responses to alterations in components of natural flow regime.[a]

Flow component	Specific alteration	Ecological response	Reference(s)
Magnitude and frequency	Increased variation	Wash-out and/or stranding	Cushman 1985, Petts 1984
		Loss of sensitive species	Gehrke et al. 1995, Kingsolving and Bain 1993, Travnichek et al. 1995
		Increased algal scour and wash-out of organic matter	Petts 1984
		Life cycle disruption	Scheidegger and Bain 1995
		Altered energy flow	Valentin et al. 1995
	Flow stabilization	Invasion or establishment of exotic species, leading to:	
		Local extinction	Kupferberg 1996, Meffe 1984
		Threat to native commercial species	Stanford et al. 1996
		Altered communities	Busch and Smith 1995, Moyle 1986, Ward and Stanford 1979
		Reduced water and nutrients to floodplain plant species, causing:	
		Seedling desiccation	Duncan 1993
		Ineffective seed dispersal	Nilsson 1982
		Loss of scoured habitat patches and secondary channels needed for plant establishment	Fenner et al. 1985, Rood et al. 1995, Scott et al. 1997, Shankman and Drake 1990
		Encroachment of vegetation into channels	Johnson 1994, Nilsson 1982
Timing	Loss of seasonal flow peaks	Disrupt cues for fish:	
		Spawning	Fausch and Bestgen 1997, Montgomery et al. 1993, Nesler et al. 1988
		Egg hatching	Næsje et al. 1995
		Migration	Williams 1996
		Loss of fish access to wetlands or backwaters	Junk et al. 1989, Sparks 1995
		Modification of aquatic food web structure	Power 1992, Wootton et al. 1996
		Reduction or elimination of riparian plant recruitment	Fenner et al. 1985
		Invasion of exotic riparian species	Horton 1977
		Reduced plant growth rates	Reily and Johnson 1982
Duration	Prolonged low flows	Concentration of aquatic organisms	Cushman 1985, Petts 1984
		Reduction or elimination of plant cover	Taylor 1982
		Diminished plant species diversity	Taylor 1982
		Desertification of riparian species composition	Busch and Smith 1995, Stromberg et al. 1996
		Physiological stress leading to reduced plant growth rate, morphological change, or mortality	Kondolf and Curry 1986, Perkins et al. 1984, Reily and Johnson 1982, Rood et al. 1995, Stromberg et al. 1992
	Prolonged baseflow "spikes"	Downstream loss of floating eggs	Robertson 1997
	Altered inundation duration	Altered plant cover types	Auble et al. 1994
	Prolonged inundation	Change in vegetation functional type	Bren 1992, Connor et al. 1981
		Tree mortality	Harms et al. 1980
		Loss of riffle habitat for aquatic species	Bogan 1993
Rate of change	Rapid changes in river stage	Wash-out and stranding of aquatic species	Cushman 1985, Petts 1984
	Accelerated flood recession	Failure of seedling establishment	Rood et al. 1995

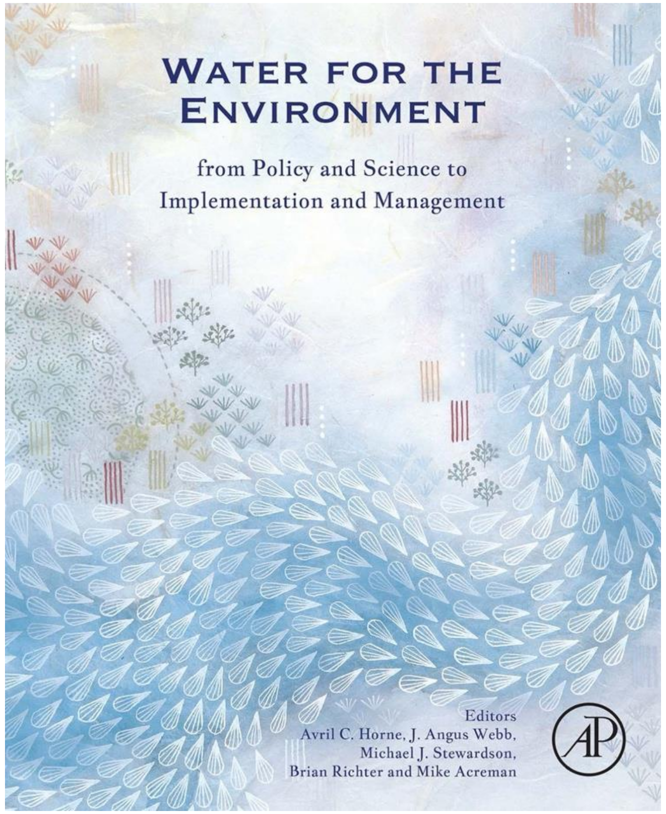
[a]Only representative studies are listed here. Additional references are located on the Web at http://lamar.colostate.edu/~poff/natflow.html.

Natural Flow Regime concept and principles adopted into framing of "Environmental Flows"



2012

includes rivers, groundwater systems, wetlands, estuaries

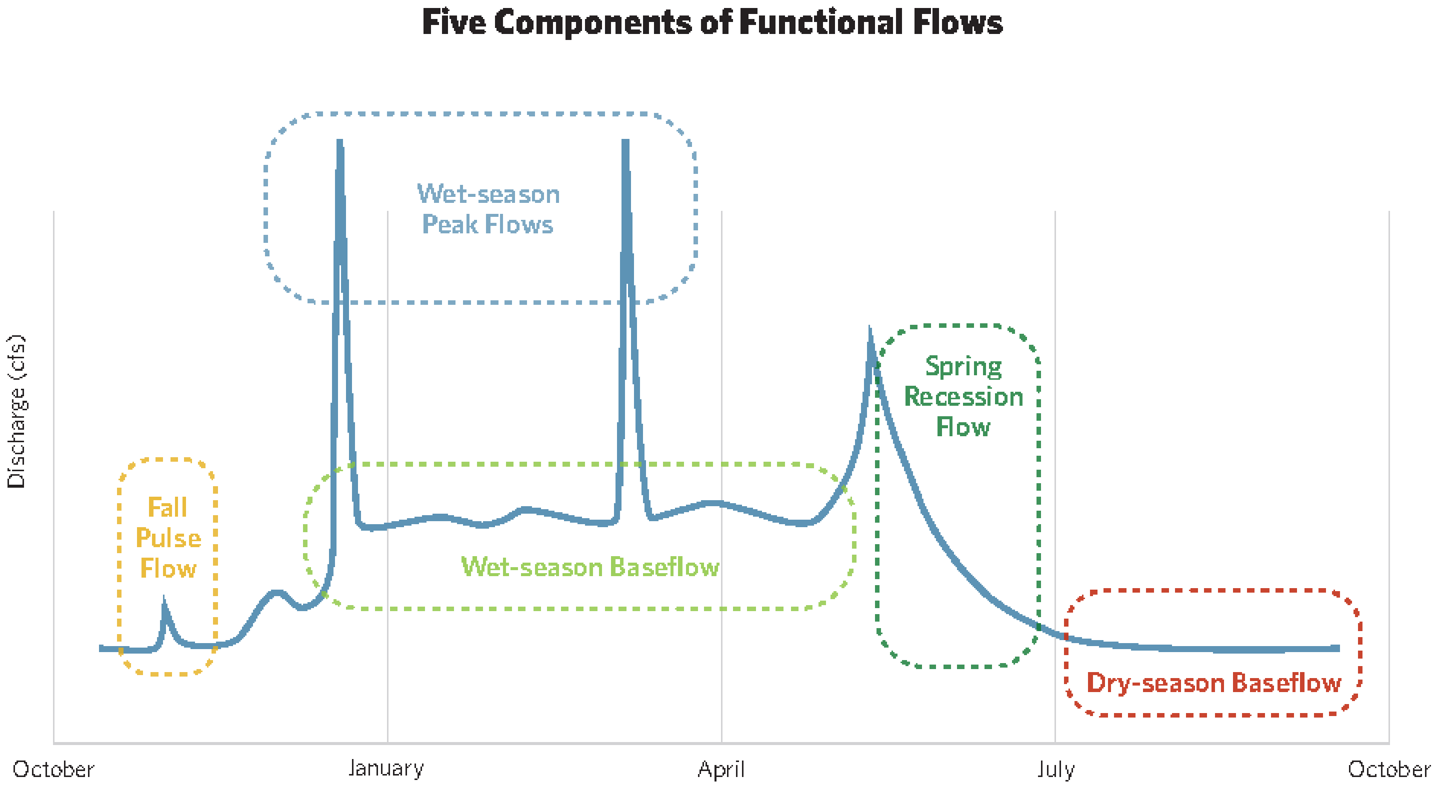


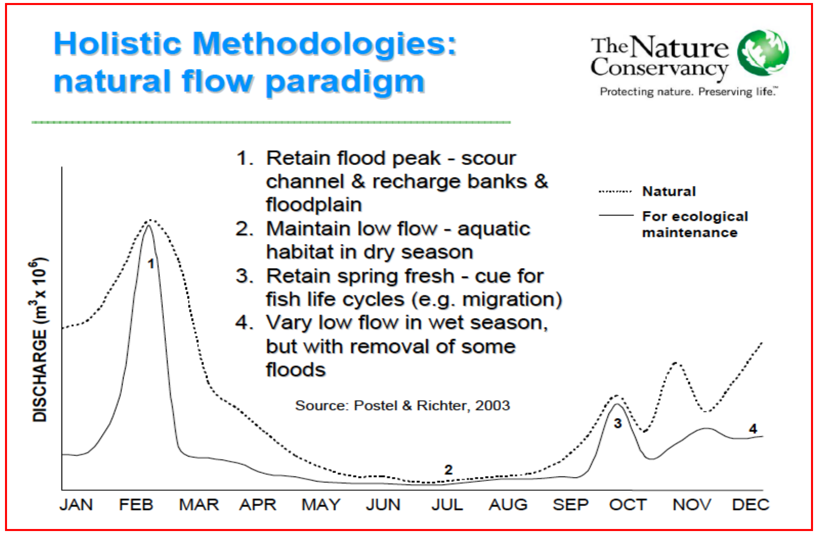
2017

Mutli-authored, comprehensive, from science, policy, implementation, cultural water

“Functional Flows”

-- term often used to define specific magnitude, timing and duration of specific flows that provide specific geomorphic or ecological function





(http://iwlearn.net/publications/ll/methods-and-tools-for-defi
environmental-flows-de-freitas)

NISP and Glade Reservoir

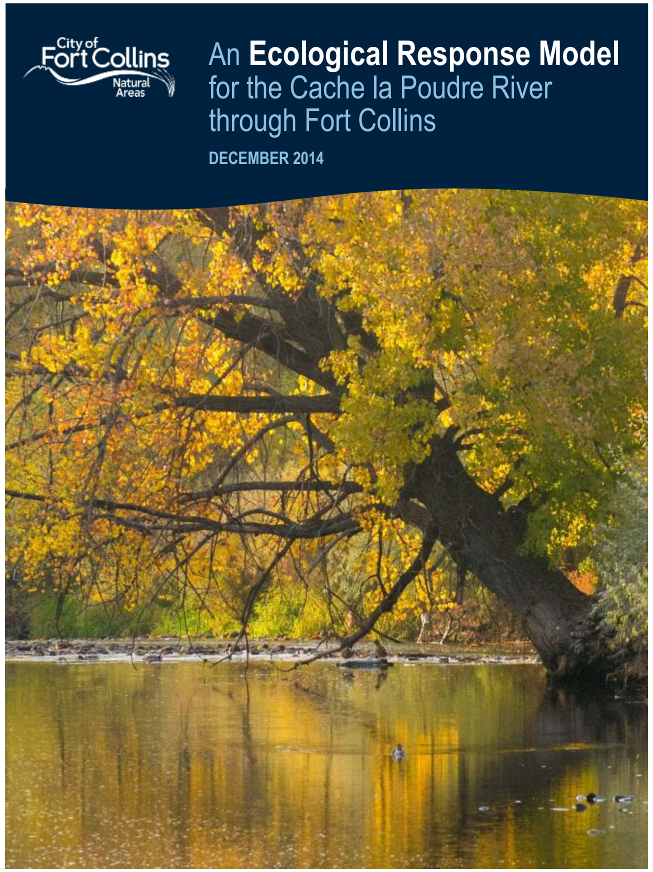
- Science advisory team to City of Fort Collins (Ecological Response Team)

- Modeled ecosystem responses to scenarios of different hydrologic futures

  - Minimum flows without dry outs to keep river perennial with enhanced low flows

  - Peak flows (let enough water pass during peak snowmelt)
    - scour channel through Fort Collins (and thus provide clean gravel bed substrate for inverts and fish) and to
    - provide some overbank flows to sustain riparian functions

- Rubber meets the road



https://www.fcgov.com/naturalareas/eco-response.php

1750 Prior to 1776, widespread beaver dams naturally control streamflow; dams gradually disappear as beavers are hunted to near extinction; mill dams replace beaver dams as territory is settled.

1824 - Creation of Army Corps of Engineers, with task of keeping rivers navigable; federal government begins support of commercial navigation on the Mississippi.

1825 - Completion of Erie Canal, creating transport route from the Hudson River to the Great Lakes.

1849, 1850, 1860 - Swamp Land Acts, transferring 65 million acres of wetlands in 15 states from federal to state administration for purpose of drainage;. 1850 Act gives Everglades to Florida.

1880's - ditching and draining of wetlands in tributaries to the Mississippi River begins.

1900

1901 - canal built from Colorado River to Salton Sink and the Imperial Valley is born. Floods of 1904-1905 create Salton Sea, and the river is put back in its original channel.

1902 - Reclamation Project Act, establishing Reclamation Service to "nationalize the works of irrigation".

1920 - Federal Power Act authorizes licensing of non-federal hydropower dams.

1925 1927 - Mississippi River floods, proving existing levees inadequate and leading to 1928 Flood Control Act.

1928 - Colorado River Compact ratified, partitioning the river's water

1933 - Tennessee Valley Authority Act passed, and nation embarks on first multipurpose project for controlling and using a river.

1935 - Hoover Dam dedicated by FDR.

1930-1940 - U.S. Army Corps constructs 9-Foot Channel Project, turning upper Mississippi into an intra-continental channel.

1940 - channel straightening of tributaries to the Mississippi River begins.

1944 - Flood Control Act authorizes federal participation in flood control projects, and establishes recreation as a full purpose for flood control projects.

1950 1953 - building of flood control dams begins on the Mississippi River. 750 miles channelized upstream from mouth.

1954 - Watershed Protection and Flood Prevention Act, begins active Soil Conservation Service involvement in helping farmers to channelize streams.

1963 - Glen Canyon Dam completed; 1964 - U.S. and Canada ratify Columbia River Treaty; 1965 - California State Water Project approved.

1968 - Wild and Scenic Rivers Act passed to preserve certain rivers in "free-flowing condition".

1975 1978 - PURPA passed, providing market for small-scale hydropower generation.

1986 - Electric Consumers Protection Act - amends Federal Power Act, requires FERC to give equal consideration to power generation potential and fish, wildlife, recreation, and other aspects of environmental quality during dam licensing/relicensing.

1992 - legislation approved for federal purchase and removal of 2 private dams on the Elwha River, to restore fish passage.

1993 - major flood on Mississippi River causes extensive damage.

1996 - Controlled flood of Colorado River at Grand Canyon; restoration of Everglades begins.

2000

Figure 5. A brief history of flow alteration in the United States.

1750

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1935 - Hoover Dam dedicated by FDR.

1930-1940 - U.S. Army Corps constructs 9-Foot Channel Project, turning upper Mississippi into an intra-continental channel.

1940 - channel straightening of tributaries to the Mississippi River begins.

1944 - Flood Control Act authorizes federal participation in flood control projects, and establishes recreation as a full purpose for flood control projects.

1950

1953 - building of flood control dams begins on the Mississippi River. 750 miles channelized upstream from mouth.

1954 - Watershed Protection and Flood Prevention Act, begins active Soil Conservation Service involvement in helping farmers to channelize streams.

1963 - Glen Canyon Dam completed; 1964 - U.S. and Canada ratify Columbia River Treaty; 1965 - California State Water Project approved.

1968 - Wild and Scenic Rivers Act passed to preserve certain rivers in "free-flowing condition".

1975

1978 - PURPA passed, providing market for small-scale hydropower generation.

1986 - Electric Consumers Protection Act - amends Federal Power Act, requires FERC to give equal consideration to power generation potential and fish, wildlife, recreation, and other aspects of environmental quality during dam licensing/relicensing.

1992 - legislation approved for federal purchase and removal of 2 private dams on the Elwha River, to restore fish passage.

1993 - major flood on Mississippi River causes extensive damage.

1996 - Controlled flood of Colorado River at Grand Canyon; restoration of Everglades begins.

2000

Figure 5. A brief history of flow alteration in the United States.

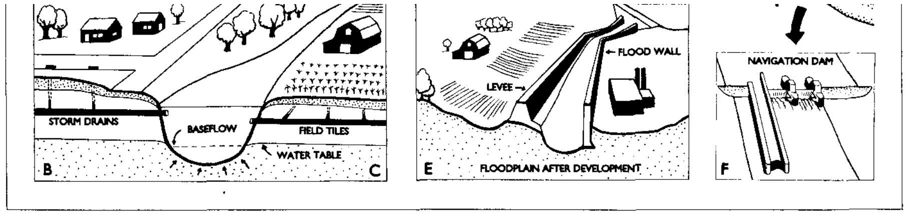

Figure 3. Stream valley cross-sections at various locations in a watershed illustrate basic principles about natural pathways of water moving downhill and human influences on hydrology. Runoff, which occurs when precipitation exceeds losses due to evaporation and plant transpiration, can be divided into four components (**a**): overland flow (1) occurs when precipitation exceeds the infiltration capacity of the soil; shallow subsurface stormflow (2) represents water that infiltrates the soil but is routed relatively quickly to the stream channel; saturated overland flow (3) occurs where the water table is close to the surface, such as adjacent to the stream channel, upstream of first-order tributaries, and in soils saturated by prior precipitation; and groundwater flow (4) represents relatively deep and slow pathways of water movement and provides water to the stream channel even during periods of little or no precipitation. Collectively, overland and shallow subsurface flow pathways create the peaks in the hydrograph that are a river's response to storm events, whereas deeper groundwater pathways are responsible for baseflow. Urbanized (**b**) and agricultural (**c**) land uses increase surface flow by increasing the extent of impermeable surfaces, reducing vegetation cover, and installing drainage systems. Relative to the unaltered state, channels often are scoured to greater depth by unnaturally high flood crests and water tables are lowered, causing baseflow to drop. Side-channels, wetlands, and episodically flooded lowlands comprise the diverse flood-

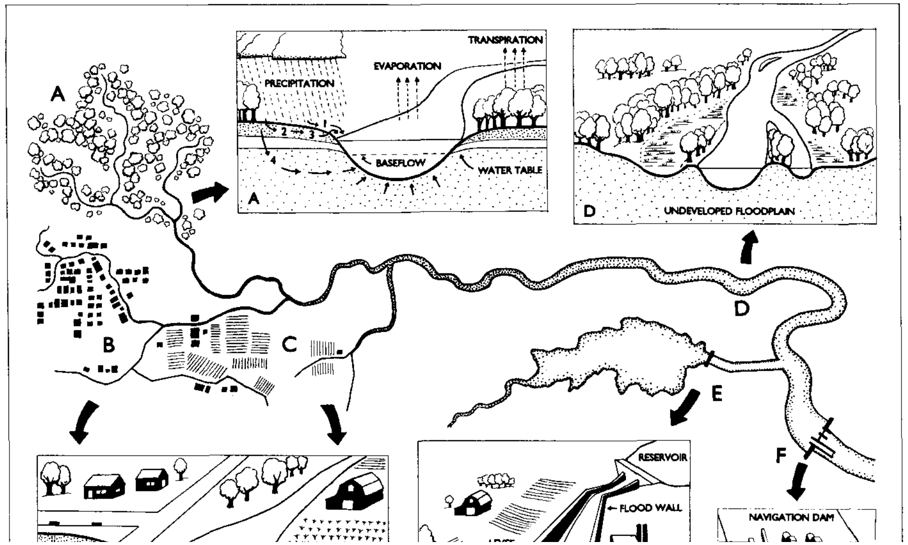

Table 3. Recent projects in which restoration of some component(s) of natural flow regimes has occurred or been proposed for specific ecological benefits.

Location	Flow component(s)	Ecological purpose(s)	Reference
Trinity River, CA	Mimic timing and magnitude of peak flow	Rejuvenate in-channel gravel habitats; restore early riparian succession; provide migration flows for juvenile salmon	Barinaga 1996[a]
Truckee River, CA	Mimic timing, magnitude, and duration of peak flow, and its rate of change during recession	Restore riparian trees, especially cottonwoods	Klotz and Swanson 1997
Owens River, CA	Increase base flows; partially restore overbank flows	Restore riparian vegetation and habitat for native fishes and non-native brown trout	Hill and Platts in press
Rush Creek, CA (and other tributaries to Mono Lake)	Increase minimum flows	Restore riparian vegetation and habitat for waterfowl and non-native fishes	LADWP 1995
Oldman River and tributaries, southern Alberta, Canada	Increase summer flows; reduce rates of postflood stage decline; mimic natural flows in wet years	Restore riparian vegetation (cottonwoods) and cold-water (trout) fisheries	Rood et al. 1995
Green River, UT	Mimic timing and duration of peak flow and duration and timing of nonpeak flows; reduce rapid baseflow fluctuations from hydropower generation	Recovery of endangered fish species; enhance other native fishes	Stanford 1994
San Juan River, UT/NM	Mimic magnitude, timing, and duration of peak flow; restore low winter baseflows	Recovery of endangered fish species	—[b]
Gunnison River, CO	Mimic magnitude, timing, and duration of peak flow; mimic duration and timing of nonpeak flows	Recovery of endangered fish species	—[b]
Rio Grande River, NM	Mimic timing and duration of floodplain inundation	Ecosystem processes (e.g., nitrogen flux, microbial activity, litter decomposition)	Molles et al. 1995
Pecos River, NM	Regulate duration and magnitude of summer irrigation releases to mimic spawning flow "spikes"; maintain minimum flows	Determine spawning and habitat needs for threatened fish species	Robertson 1997
Colorado River, AZ	Mimic magnitude and timing	Restore habitat for endangered fish species and scour riparian zone	Collier et al. 1997
Bill Williams River, AZ (proposed)	Mimic natural flood peak timing and duration	Promote establishment of native trees	USCOE 1996
Pemigewasset River, NH	Reduce frequency (i.e., to no more than natural frequency) of high flows during summer low-flow season; reduce rate of change between low and high flows during hydropower cycles	Enhance native Atlantic salmon recovery	FERC 1995
Roanoke River, VA	Restore more natural patterning of monthly flows in spring; reduce rate of change between low and high flows during hydropower cycles	Increased reproduction of striped bass	Rulifson and Manooch 1993
Kissimmee River, FL	Mimic magnitude, duration, rate of change, and timing of high- and low-flow periods	Restore floodplain inundation to recover wetland functions; reestablish in-channel habitats for fish and other aquatic species	Toth 1995

[a]J. Polos, 1997, personal communication. US Fish & Wildlife Service, Arcata, CA.
[b]F. Pfeifer, 1997, personal communication. US Fish & Wildlife Service, Grand Junction, CO.

Riparian Book Club Discussion

After several decades since the paper was published, is there anything you would change about the message of the paper?

What are some additional examples of where environmental/functional flows are applied?

In practice, what tools do you or your colleagues use to calculate environmental and functional flows?

At the time when the paper was published and beforehand, what was the general opinion of topics covered by The Natural Flow Regime? What was the initial reaction to the paper?

What hurdles do you encounter in Colorado relating to water rights and environmental/functional flows?

Your paper states and I agree, that restoration of the natural flow regime is likely most successful and least expensive way to restore stream processes, so why is it so hard to do?

When tasked to recommend baseflows/peak flows for CO rivers, is it reasonable to look at past annual hydrographs and take an average? What if the only data available are post-flow regulation?

How receptive have dam operators been to environmental/functional flows, and how does that vary by geography or other factors?

5

Riparian Book Club Discussion

Tools to maintain hyd. var. include management of instream flows and reservoir management. Is there a precedent for administration of water rights (I.e. diversion timing) to maintain hyd variability?

Involved with trying to identify ecological/environmental values to "peaking flows", where would you start? A big question, apologize!

5

Thank You

A recording of this webinar will be available at CO-CO.ORG -> Resilient Communities ->Riparian Book Club

The Natural Sediment Regime, Thursday, July 24th, 2025, 12:00 PM - 1:00 PM MDT
Wednesday, November 5th, 2025 12:00 PM - 1:00 PM MDT