Dam Removal Webinar Series

Oct 27 **Part 1: Overview of Dam Removal**

Nov 3 **Part 2: Sediment Management**

Nov 10 **Part 3: Assessment Methods**

Nov 19 **Part 4: Modeling Techniques**

This webinar series is provided through the USACE's Ecosystem Management and Restoration Research Program.

Webinars will be posted at:
https://emrrp.el.erdc.dren.mil/webinars.html

http://archive.vcstar.com/news/matilija-dam-others-across-nation-featured-in-new-film-ep-459265401-351467581.html

Part 1 - Overview of Dam Removal

Today's Agenda

Part 1A:
Overview of Dam Removal

Dr. Kyle McKay and Ms. Susan Bailey
(ERDC Environmental Laboratory)

Short Break (~ 10 min)

Part 1B:
Dam Removal Case Studies

Mr. Jeff Duda (US Geological Survey)
Ms. Jennifer Bountry (Bureau of Reclamation)

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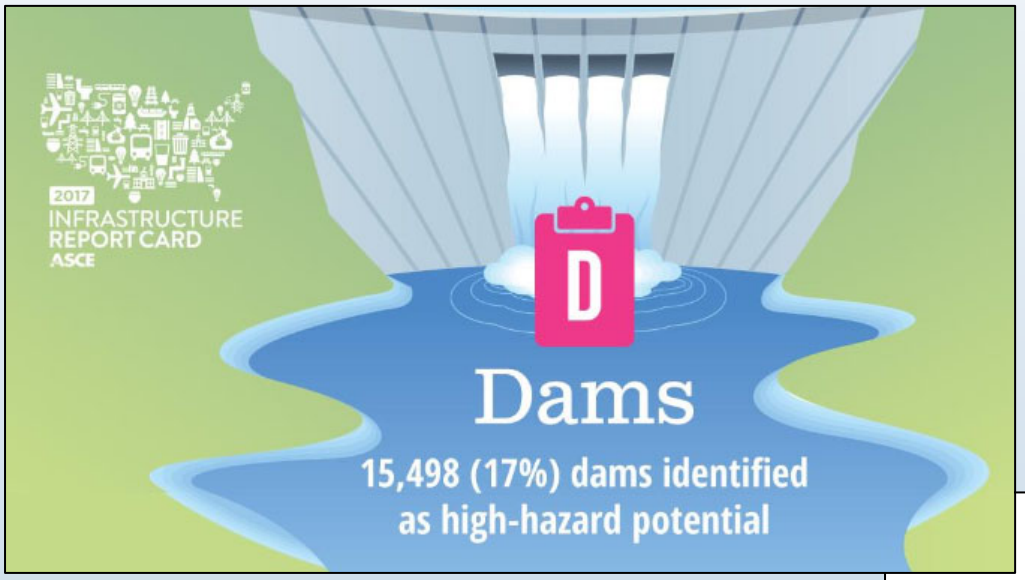
Dam Removal Webinar Series

Part 1A:
Overview of Dam Removal

October 27, 2020

Dr. Kyle McKay and Ms. Susan Bailey
(ERDC Environmental Laboratory)

America's infrastructure portfolio is aging!

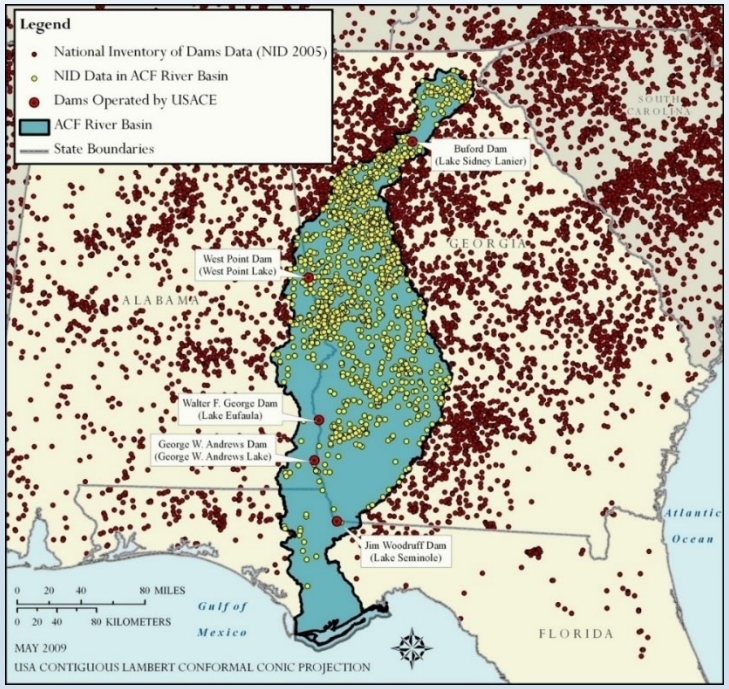


Federal Agency	Number of Dams[1]	Age, in 2013 (in years) Range	Median
BOR	97	20-106	62
TVA	30	34-102	70
USACE	359	18-129	49

Figures: ASCE (2017), Juracek (2013)

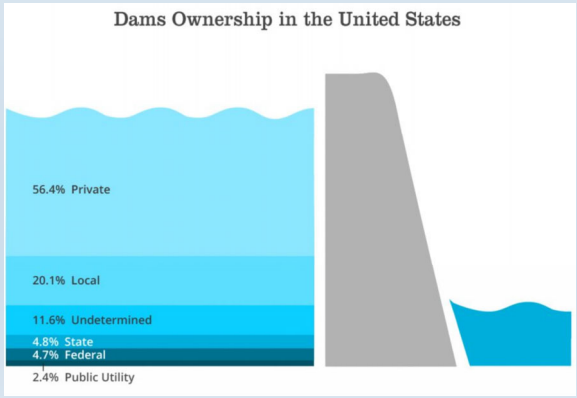
And there are more than a few dams on the landscape

(Relatively few of which are large, federal structures)



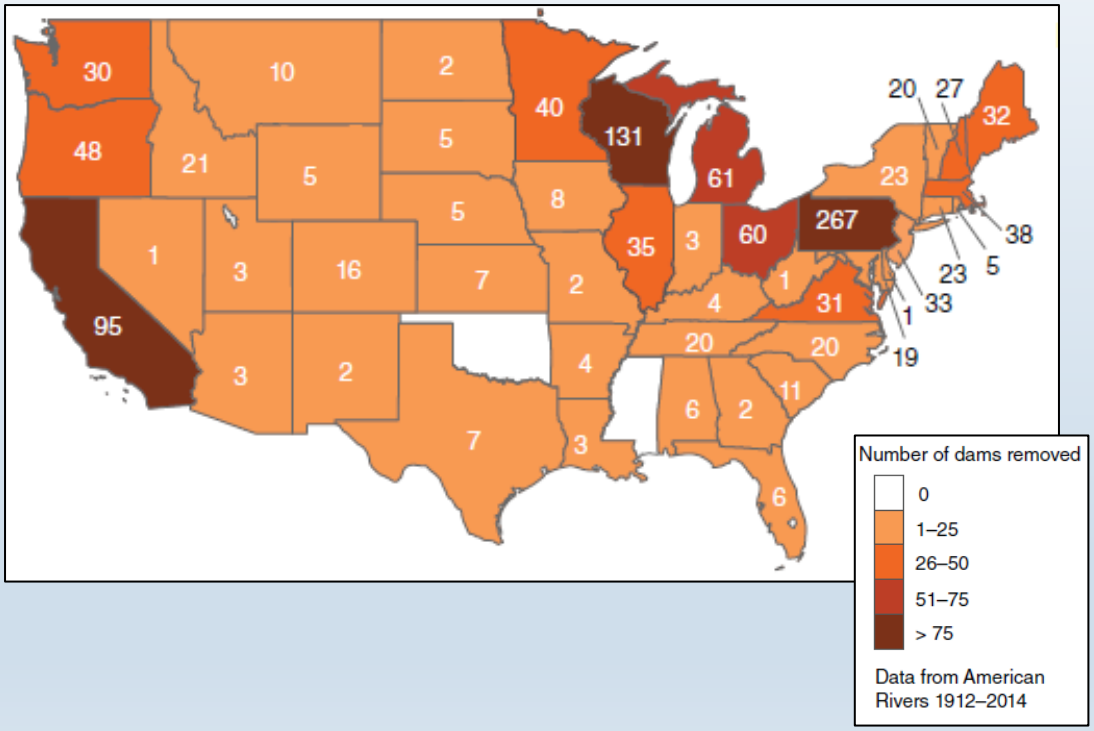
ACF Example: Amber Ignatius (2009)
NID Ownership Summary: ASCE (2017)

Size	Number	Percent
Small	24,613	97
Medium	736	3
Large	13	1
Total	25,362	



Over 1,700 removals nationwide

- Scientific evaluations at less than 10% of dam removals
- BUT the body of knowledge is growing every day!
  - Dam Removal Information Portal (Duda et al. 2016)
  - American Rivers project tracking
  - USGS Powell Center Group
  - United States Society on Dams, Decommissioning Working Group



Bellmore et al. (2016)

Dam removal represents a growing intersection of interests

White Dam: Athens Banner Herald, Duncan Elkins, Big Dogs on the River

In dam removal, perspective and mission matter!

USACE Planner

- Restore nationally scarce ecosystems
- Invest limited restoration funding to get the most "bang for their buck"

USACE Engineer

- Assess the safety of the Nation's dams
- Prioritize actions relative to potential flood risk and loss of life

USACE Regulator

- Ensure actions of others avoid, minimize, and mitigate impacts
- Fairly quantify mitigation credits

What actors often appear in discussions about dam removal?

Actor	Motivations	Common Criteria	Potential Challenges
Environmental Professionals	• Flow of organisms, matter, & energy • Focus on imperiled / migratory taxa	• Aquatic organism passage • Continuity of flow, sediment, wood, carbon,…	• Endangered Species Act • Invasive species spread
Dam Owners	• Maintain infrastructure purpose • Minimize long-term costs	• Infrastructure revenue • Probability / liability of failure	• Hydropower relicensing • Loss of revenue
Dam Safety Officials	• Protect the public from hazards	• Infrastructure condition • Hazard from failure	• Potential security issues • Funding constraints
River Recreationists	• Increase boater safety • Expand “open” river for paddling	• Prior loss of life due to a “roller” • Connectivity to existing use	• State laws about river access • Trade-offs with reservoir use
Mitigation Bankers	• Open market sale of credits	• Quantity / quality of habitat • Profit margin of actions	• Calculating credits • Engages regulatory world
Historical Preservationists	• Maintenance of historic assets	• Location within a historic district • Historic use and significance	• Historical finds uncovered • Cultural mitigation costs
Residents	• Maintaining sense of place	• Public preference	• Preservation of status quo
Infrastructure Managers	• Relocation can be costly and burdensome to operations	• Role of structure in other networks • Redundancy	• Relocation costs

McKay et al. (2020, *River Research and Applications*)

How do interests translate into decision criteria?

What people hope to accomplish

Goals	Common Criteria
Revenue and Utility of Structure	• Benefit/cost ratio under "normal" operations • Life span of structure relative to asset management expense • Redundancy of infrastructure purpose
Hazard and Liability	• Probability of failure • Downstream flood risk
Ecological Benefits	• Extent of reconnected habitat • Taxa benefiting from action (e.g., anadromous salmon vs. resident darter) • Changes in flow, sediment, or temperature regimes

What derails projects

Constraint	Common Criteria
Removal Cost	• Total construction cost • Planning and permitting • "Gotchas": sediment management, contaminants, infrastructure relocation • Who pays
Sediment	• Volume of stored sediment • Sediment quality (fines, nutrients, contaminants)
Public Opinion	• Dam owner opposition • Lake-front resident opinions • Political cloud of property owners
Regulatory Issues	• Turbidity release (401 permits) • Endangered Species relocation • Loss of (novel) reservoir habitats • Invasive species spread • Cultural resources (SHPO)

Now you have a coalition of the willing…what's next?

- What are the methods for dam removal?
- How many alternatives should you consider?
- What are the site constraints?
- How long does it take?

Two General Families of Dam Removal Techniques

The removal itself

- Blow-and-go
- Phased removal
- (Failure/accidental)

Secondary Measures

- Pilot channels
- Mechanical excavation
- Sediment stabilization
- Revegetation
- Grade control installation
- Upstream water management

Additional information on removal techniques can be found in: Morris and Fan (2009), Randle et al. (2015), Randle and Bountry (2017), Graber et al. 2000, and Downs et al. (2009).

Full Removal

- Removal to original streambed level
  - No remaining visible evidence of the dam

Simkins Dam removal site on Patapsco River, MD before (left) and after (right).
Cui et al. 2018

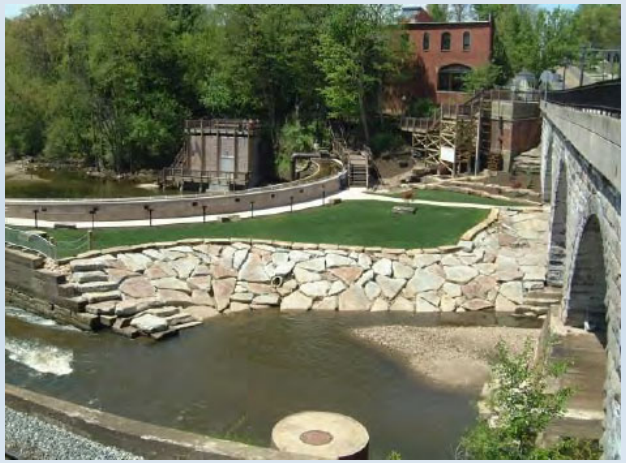
Partial Removal

- A portion of the dam left in place
  - No significant reservoir impoundment
  - Historic preservation

Kent Dam, Middle Cuyahoga River, OH
(photographs courtesy of Ted Johnson, CDM Smith)

Glines Canyon Dam - left-side spillway gates and the right abutment thrust block retained for a public overlook

Photograph courtesy of Tim Randle, Bureau of Reclamation.



Blow-and-Go

- Rapid removal (days to weeks)
  - Generally more cost efficient
  - Rapid release of sediment

Bloede Dam on the Patapsco River, MD

NOAA

Marmot Dam on the Sandy River, OR

https://www.theintertwine.org/outside-voice/ten-years-free-flowing-sandy-river

Condit Dam on the White Salmon River, WA

https://www.knkx.org/post/big-bang-dam-launches-hopes-salmon-and-kayakers; photo by PacifiCorp

https://www.fisheries.noaa.gov/feature-story/noaa-and-partners-blow-bloede-dam-benefitting-maryland-communities-and-fisheries

Staged Removal

- Duration
  - Months to years
  - Time step between stages
    - Depends on sediment volume & rate of removal
- Removal rate
  - Rate at which downstream channel can accept sediment load
  - Limitations imposed by morphology, infrastructure, ecosystems
- Considerations for earth embankment dams

Photograph courtesy of Tim Randle
Bureau of Reclamation

Photograph courtesy of National Park Service, January 14, 2012

Photograph courtesy of National Park Service, July 1, 2012

Glines Canyon Dam
- Removal began September 15, 2011
- Final piece removed August 26, 2014

Demolition Tools

- Concrete
  - Drilling/blasting
  - Hoe rams, wrecking balls, jack-hammers, hydraulic splitters, line-drilling
  - Diamond-wire sawcutting
  - Chemical demolition
  - Hydroblasting or flame-cutting
- Earthen embankment
  - Common excavation and earth-moving equipment

Glines Canyon Dam

Hoe ram employed on a tracked vehicle

Drilling and blasting activities

Photographs courtesy of Barnard Construction

Old Berkshire Mill Dam

Randle et al. 2015

Site Access

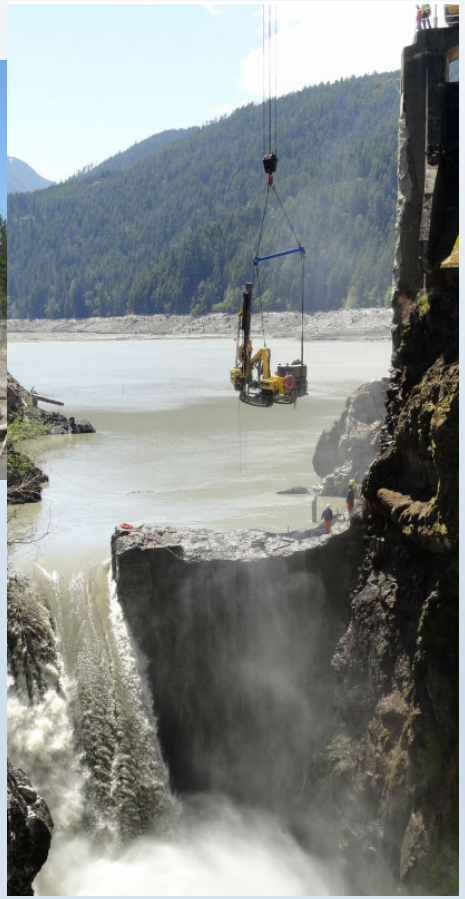
- Existing roads
  - may require improvement
- New access roads
- Barge
- Crane
- Helicopter

Glines Canyon Dam, WA

Photograph courtesy of Tim Randle, Bureau of Reclamation

Photograph Courtesy of Barnard Construction

Photograph courtesy of National Park Service, January 14, 2012



http://www.ussdams.org/wp-content/uploads/2016/09/Barnard-Elwha-Glines-Nomination.pdf

Sediment Management Alternatives

- Natural Erosion
  - Allow river to transport sediments downstream
  - Least costly
  - May be unacceptable due to water quality concerns
- Mechanical removal
  - Prevent downstream transport by removing sediments from the reservoir
- Sediment Stabilization
  - Reduce downstream transport by stabilizing sediments in place

See
Part 2 of Webinar Series:
Sediment Management
Nov 3

Pilot Channel

- Used to help guide final stream location

Prior to excavation of pilot channel and vegetation removal

Photograph courtesy of Tom Roorda, Northwestern Territories, Inc.

Pilot channel through Lake Mills delta in preparation for removal of Glines Canyon Dam

Photograph courtesy of Bureau of Reclamation, December 2010).

With pilot channel

Photograph courtesy of Dick Bauman, Bureau of Reclamation

Mechanical Removal of Sediment

- Reduce long term risk by removing sediments before they can erode
- Can significantly increase $
- Methods
  - Conventional excavation equipment
  - Mechanical dredging
  - Hydraulic dredging
- Disposal locations
  - Gravel pits or quarries
  - Landfills
  - Borrow sites
- Conveyance
  - Truck
  - Conveyor belt
  - Slurry pipeline

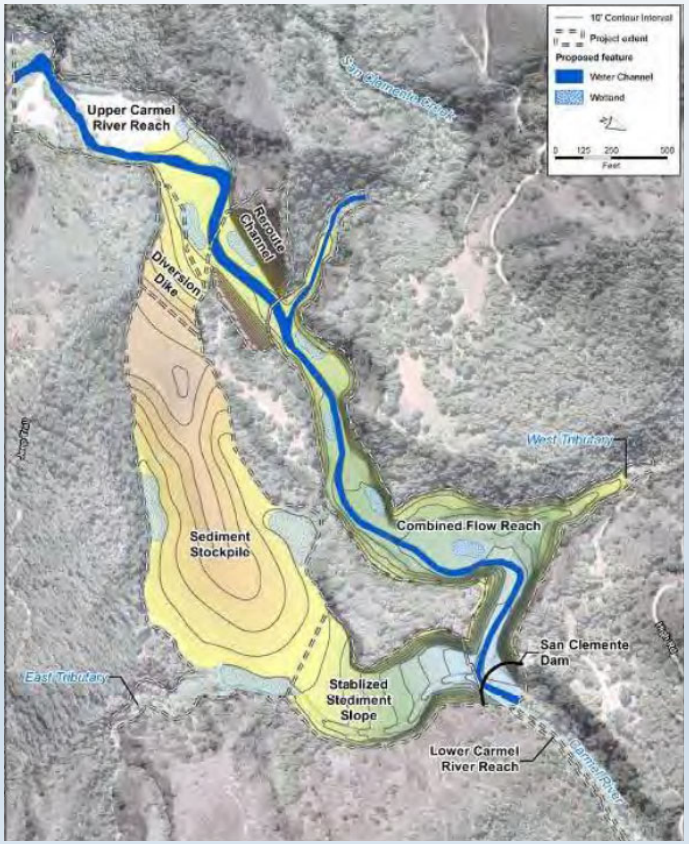
Dredge operating on Strontia Springs Reservoir near Denver, Colorado

Photograph courtesy of Tim Randle, Bureau of Reclamation, October 2011

Sediment Stabilization

- Stabilize reservoir sediment to prevent erosion and downstream transport
- Less $ than removal
- Channel and floodplain reconstruction
  - Through reservoir sediment
  - Around reservoir sediment
- Channel design to ensure stability
- Stabilize in place sediment by
  - Slowly draining impoundment
  - Revegetation
  - Bank protection
  - Other structures – grade control

Reroute of Carmel River for removal of San Clemente Dam



Randle et al. 2015

Revegetation

- Provides
  - Erosion control
  - Bank stabilization
  - Water quality
  - Wildlife habitat & biodiversity
- Natural revegetation
  - Depends on climate, soil type, seed bank
  - Inexpensive
- Active revegetation
  - May help prevent invasive species
  - May improve bank stability and limit erosion
- Monitoring may be required

Lake Aldwell

May 12, 2012 after draining

More than two years after removal of Elwha Dam (August 18, 2014)

Randle et al. 2015

Grade Control Installation

- Prevents migration of upstream headcut
- May be needed when:
  - Downstream severely degraded
  - Better control in populated areas
  - Protection of infrastructure

Photo from Tetra Tech. https://www.djc.com/news/co/cis.html?id=12134796

Goldsborough Creek Dam removal, WA

Photo from Brian Graber.

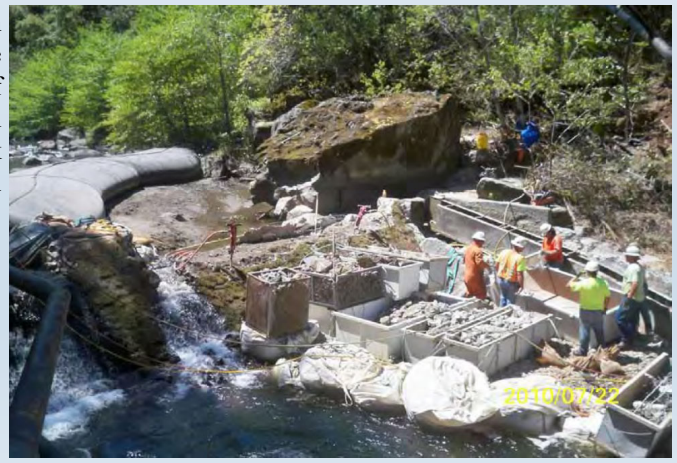
Upstream Water Management

- Reservoir drawdown
  - Rate
  - Through outlet works, or breaching
- Streamflow diversion
  - Bypass channels or pipelines
  - Coffer dams

Lined bypass channel for removal of Saeltzer Dam and contaminated sediments from Clear Creek in California

Photograph courtesy of Tom Hepler, Bureau of Reclamation

Temporary cofferdam and diversion pipeline to isolate left end of Wildcat Dam on North Fork of Battle Creek CA



Photograph courtesy of Mid-Pacific Region, Bureau of Reclamation

Photograph courtesy of Rick Benik, Bureau of Reclamation

Sheet pile and geotextile-lined cofferdam designed to isolate right end of Savage Rapids Dam in OR

Questions so far…

Type your questions in the chat box.

http://archive.vcstar.com/news/matilija-dam-others-across-nation-featured-in-new-film-ep-459265401-351467581.html

(Part B - Posted Separately)

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Part 1B:
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