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Exit Here: Dealing with Ageing Dams and Reservoirs



Brief Backstory

- Managed Aquatic Systems Class
- Ageing Reservoirs & Management
- How can we be proactive in addressing these impending issues?
- System Relationships – the Dam and its Reservoir
- Ageing from a system wide perspective

Reservoir Rehabilitations: Seeking the Fountain of Youth

Aging of reservoirs alters the functions, and associated services, of these systems through time. The goal of habitat rehabilitation is often to alter the trajectory of the aging process such that the duration of the desired state is prolonged. There are two important characteristics in alteration of the trajectory—the amplitude relative to current state and the subsequent rate of change, or aging—that ultimately determine the duration of extension for the desired state. Rehabilitation processes largely fall into three main categories: fish community manipulation, water quality manipulation, and physical habitat manipulation. We can slow aging of reservoirs through carefully implemented management actions, perhaps even turning back the hands of time, but we cannot stop aging. We call for new, innovative perspectives that incorporate an understanding of aging processes in all steps of rehabilitation of reservoirs, especially in planning and assessing.

Fisheries

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Seeking the Fountain of Youth

Fish Passage in China

Indexing Reservoir Aging

ATF

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Oroville Dam: State official says new spillway already has cracks – Mercury News 11/28/2017

“State officials say emergency and subsequent repairs of the 770-foot dam have so far cost at least \$640 million but not all costs have been identified yet.”

“In February, authorities ordered nearly 200,000 people downstream of the dam to evacuate when both spillways suddenly began crumbling. ”



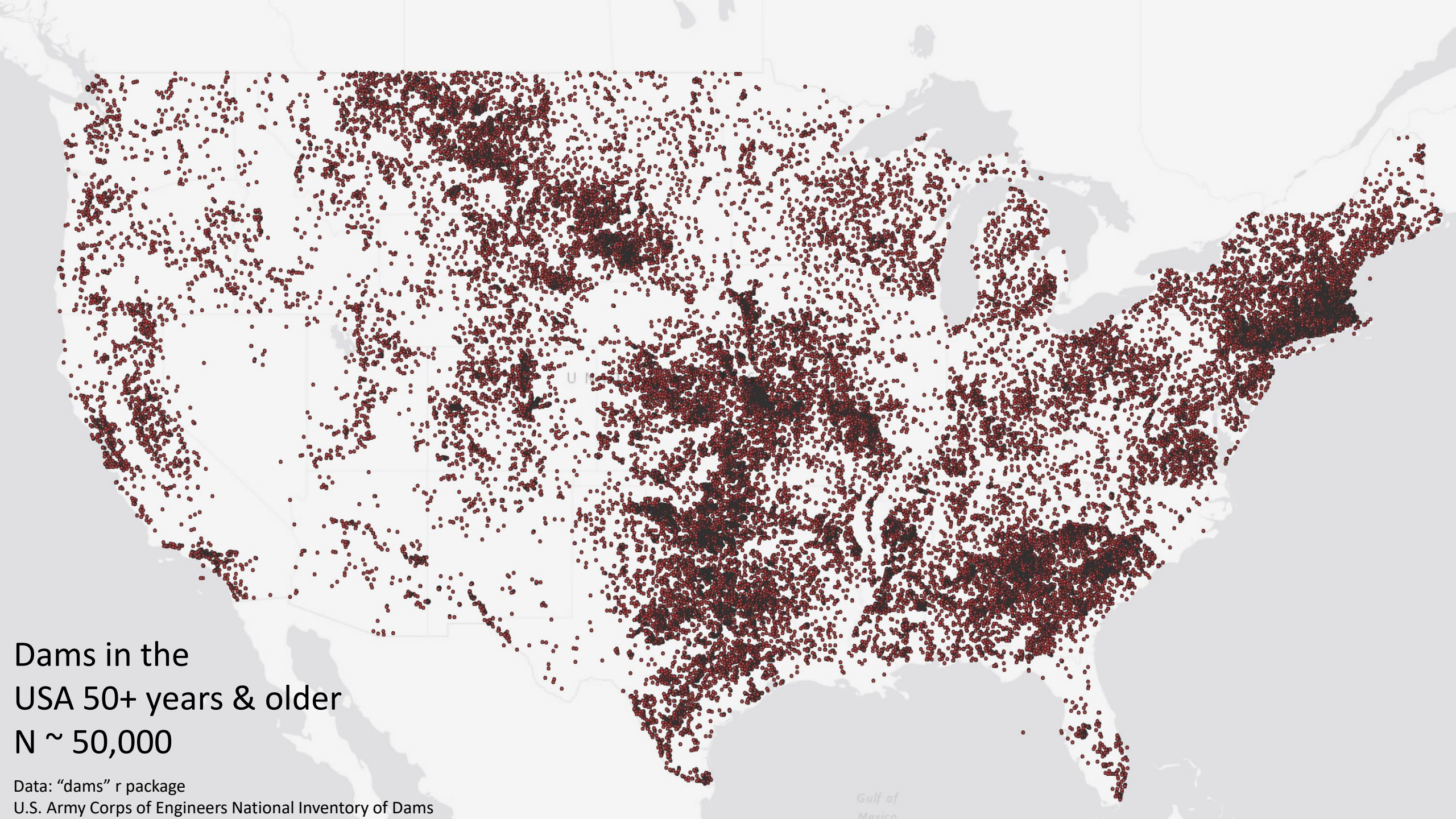
[City of Oroville sues over 2017 spillway emergency](#)

KCRA Sacramento - 9 hours ago

A small California city at the base of the tallest U.S. dam filed a lawsuit Wednesday against the state over an emergency that forced authorities to order 188,000 people to flee last year, arguing the crisis was caused by decades of mismanagement. The City of Oroville blames a culture of cronyism and a ...

[California City Sues State Over Oroville Dam Crisis in 2017](#)

Photo from: William Croyle, California Department of Water Resources



Dams in the
USA 50+ years & older
N ~ 50,000

Data: "dams" r package
U.S. Army Corps of Engineers National Inventory of Dams



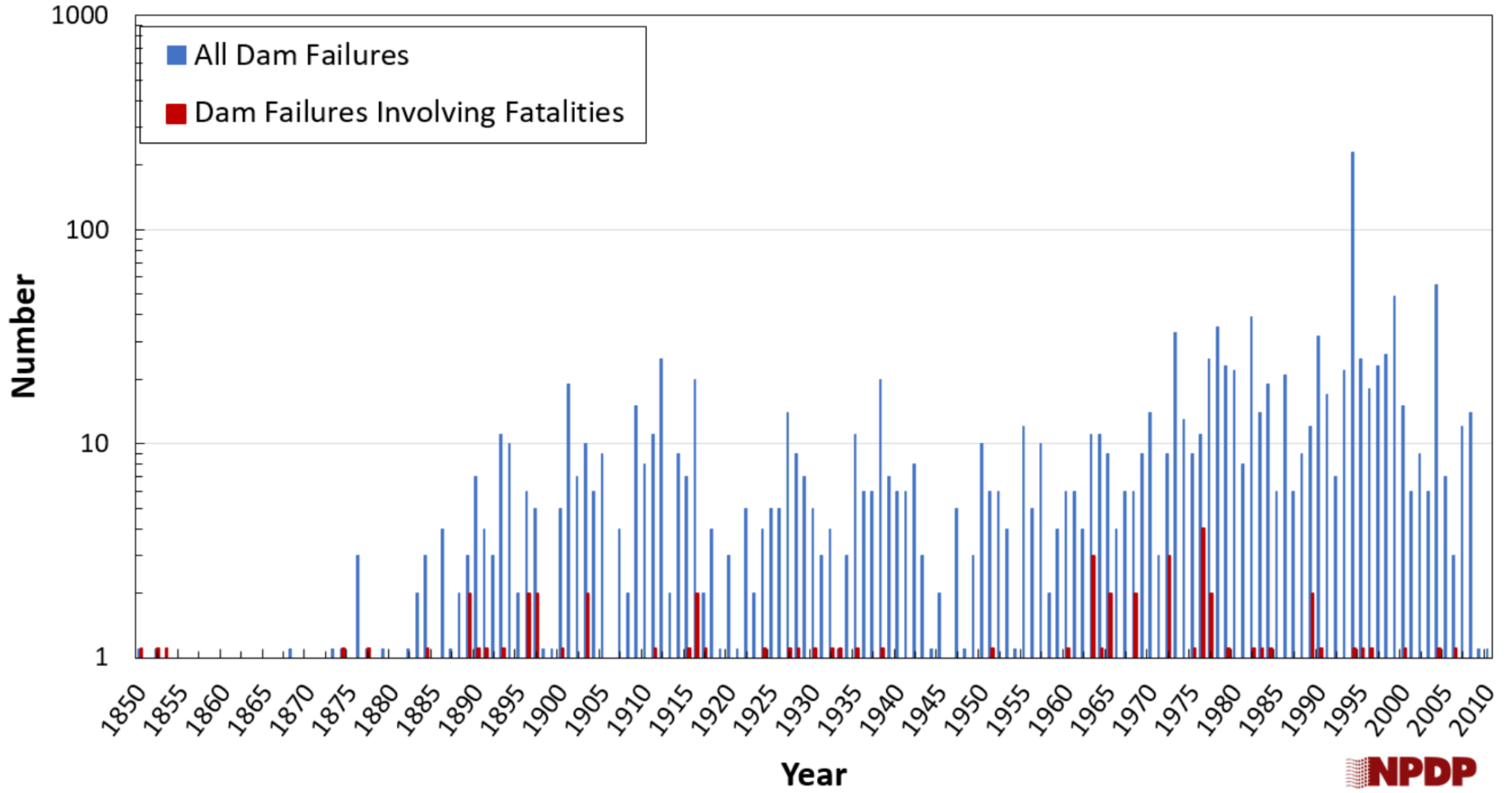
2017

INFRASTRUCTURE
REPORT CARD
ASCE



Dams

15,498 (17%) dams identified
as high-hazard potential



Toxic algae blooms becoming more common across US

By Associated Press

June 22, 2018









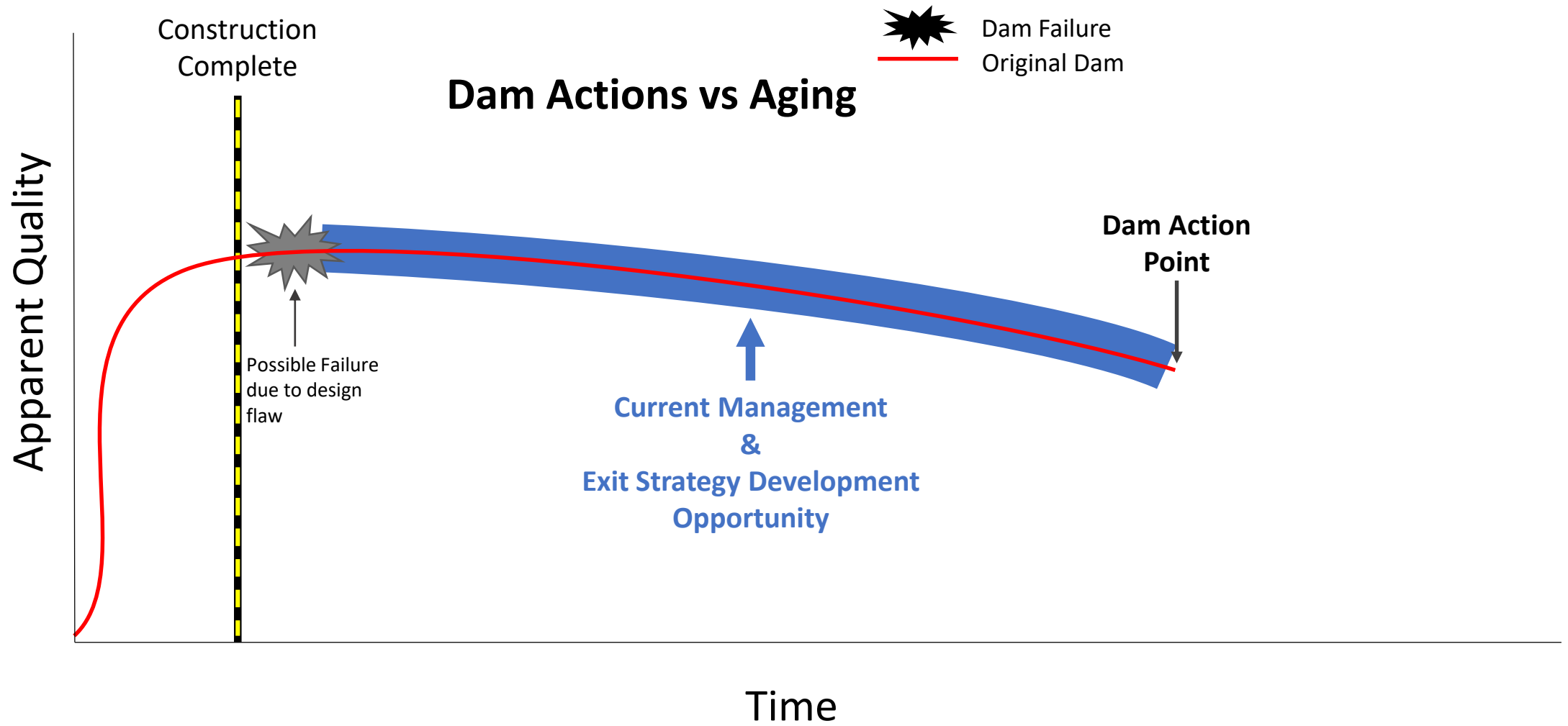


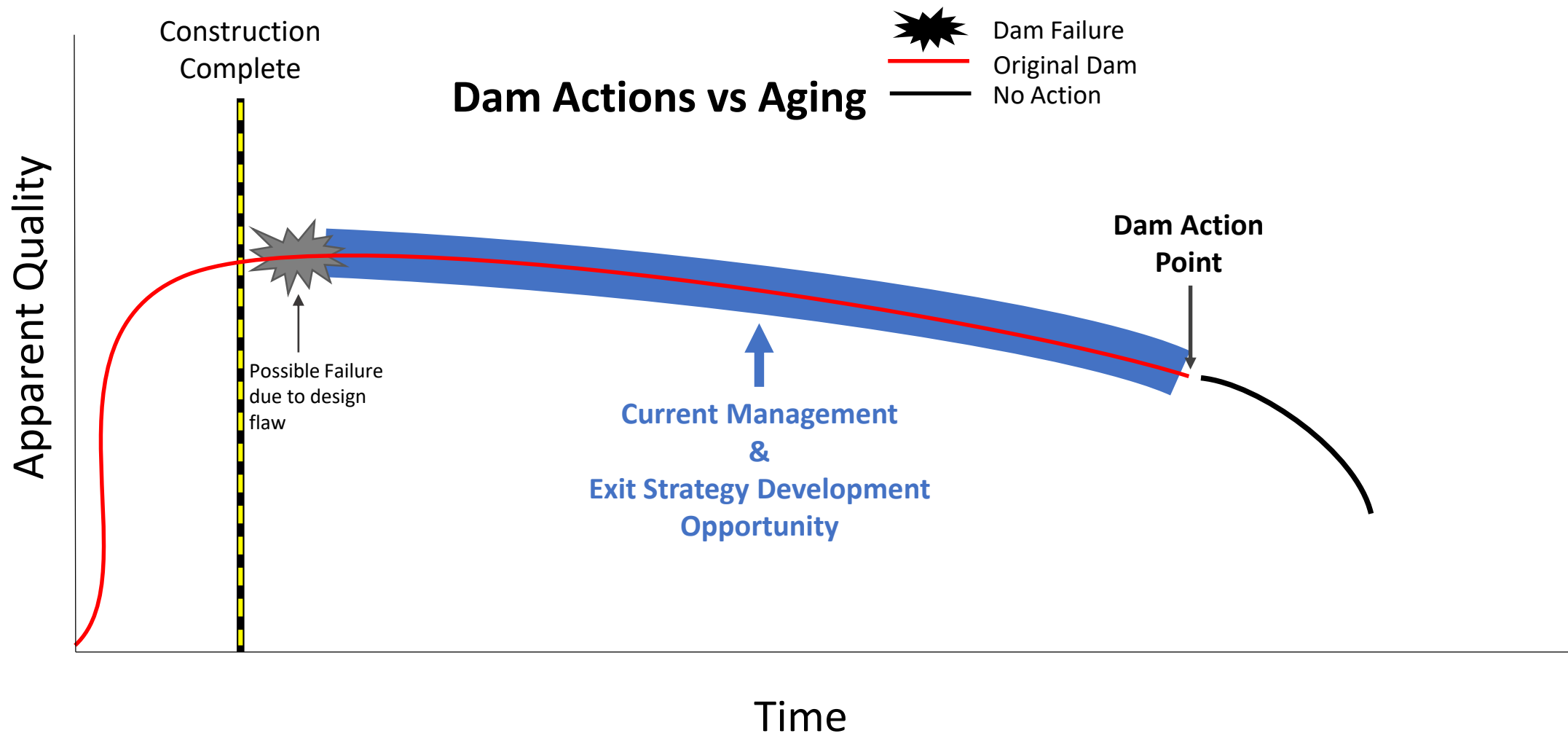


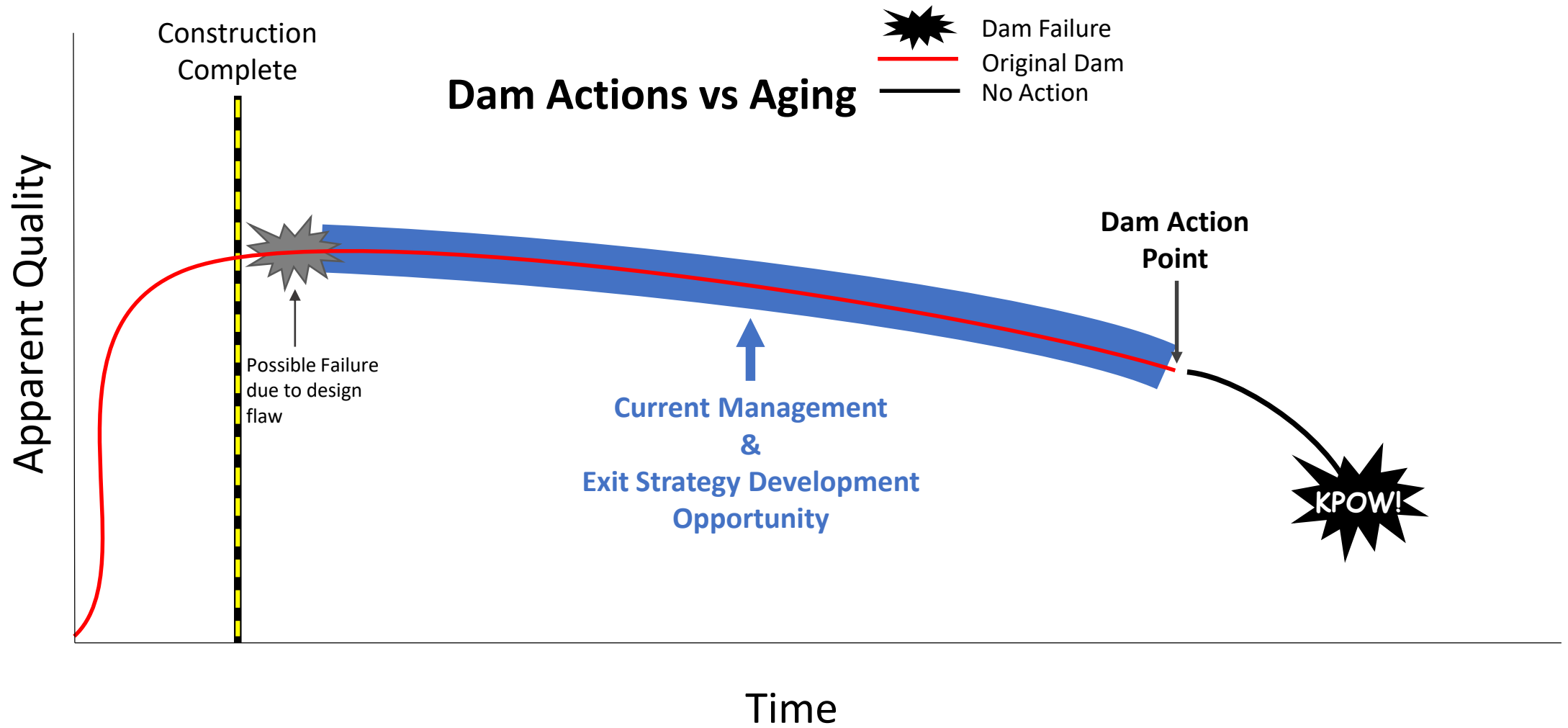
Changing the Status Quo

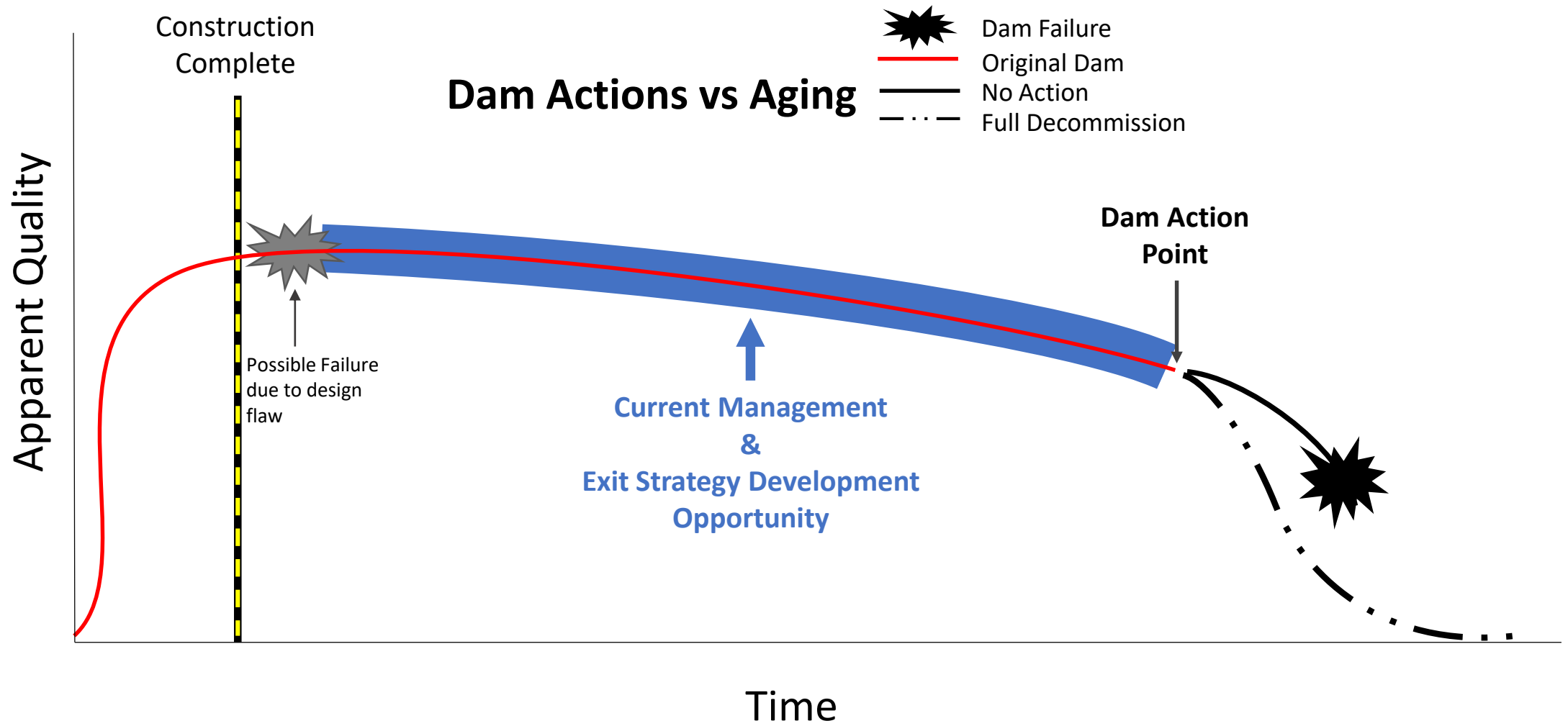
- Ideal outcomes from change
 - Controlled transitions for infrastructure & socio-ecological systems
- Needs for change
 - Understanding slowing vs ending the ageing process
 - A proactive approach
 - There is no silver bullet action
- Our solution – a conceptual exit strategy framework

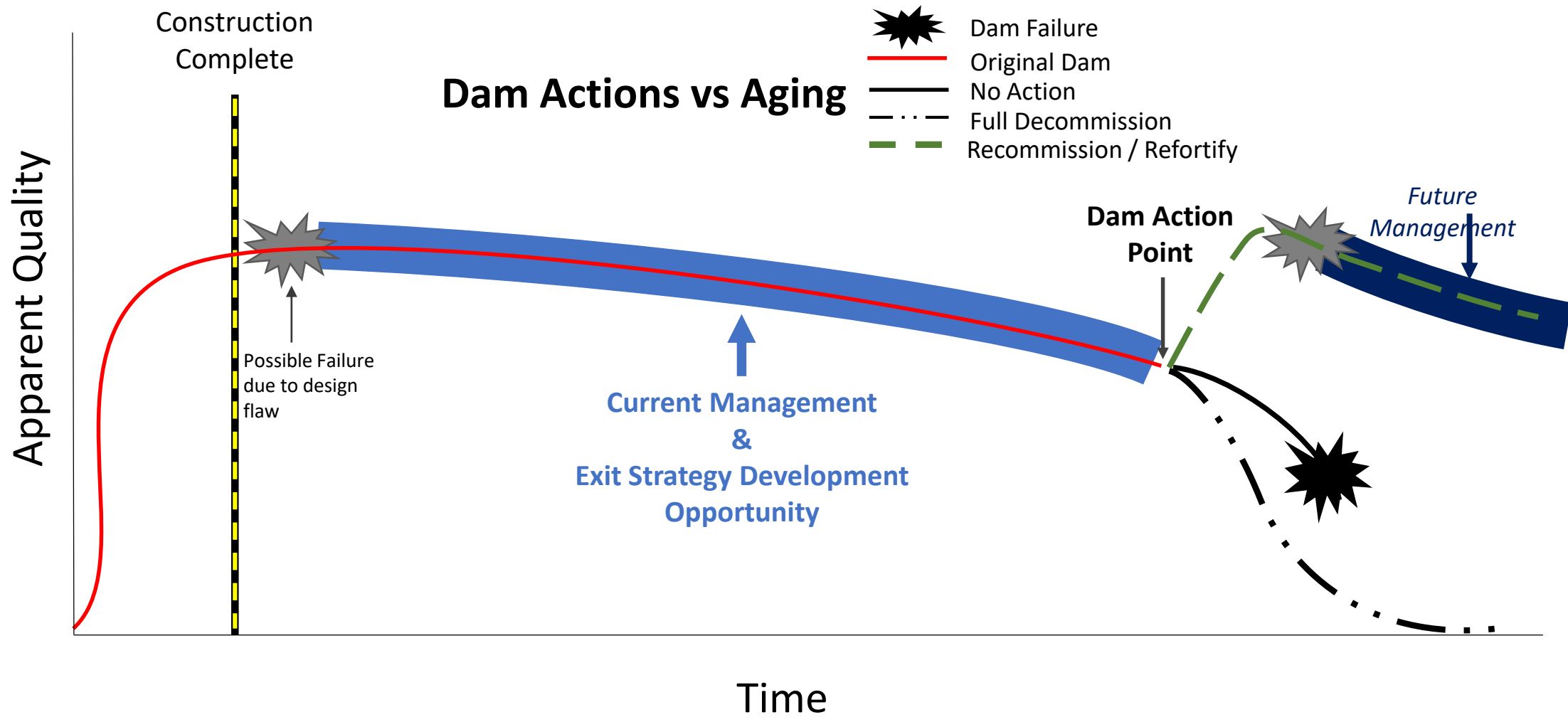


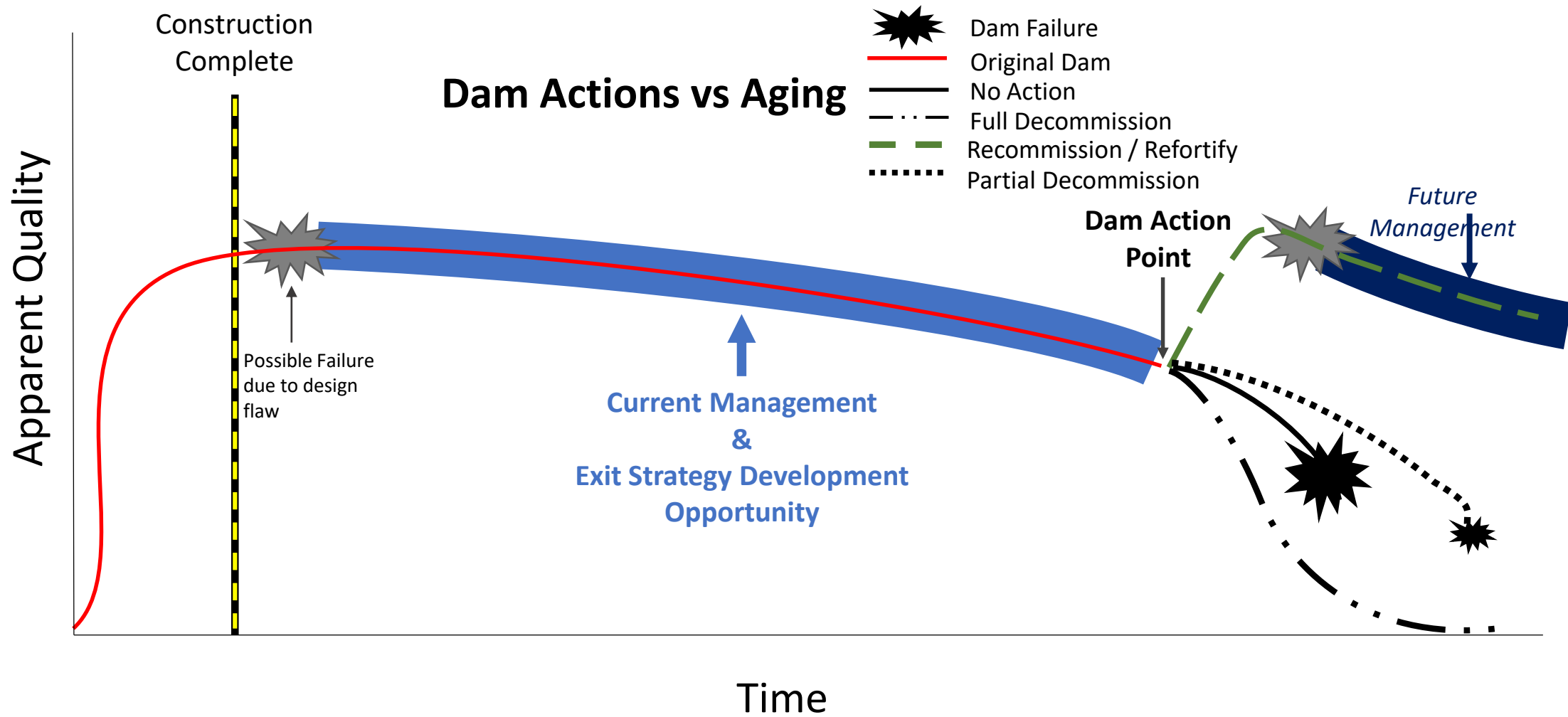




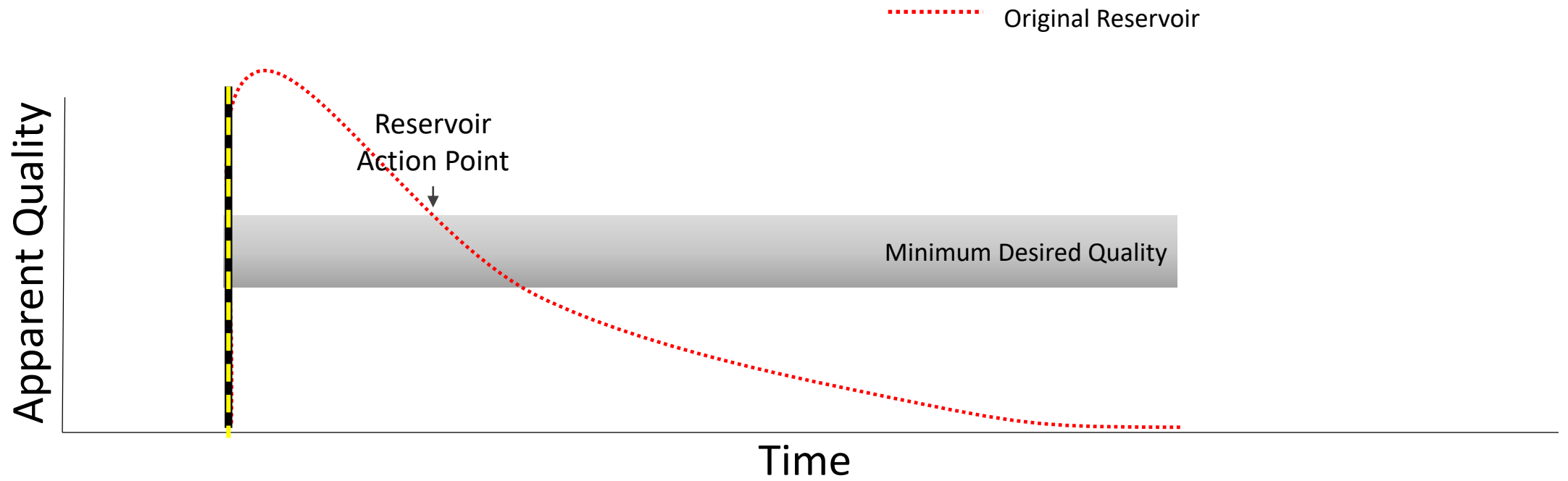




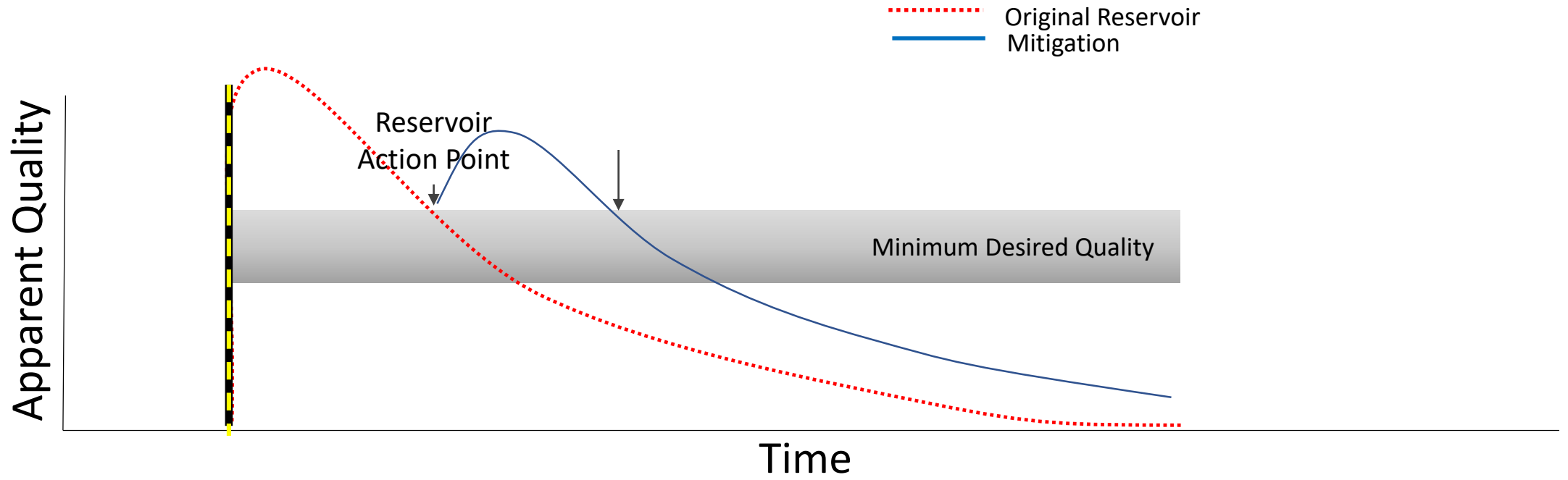




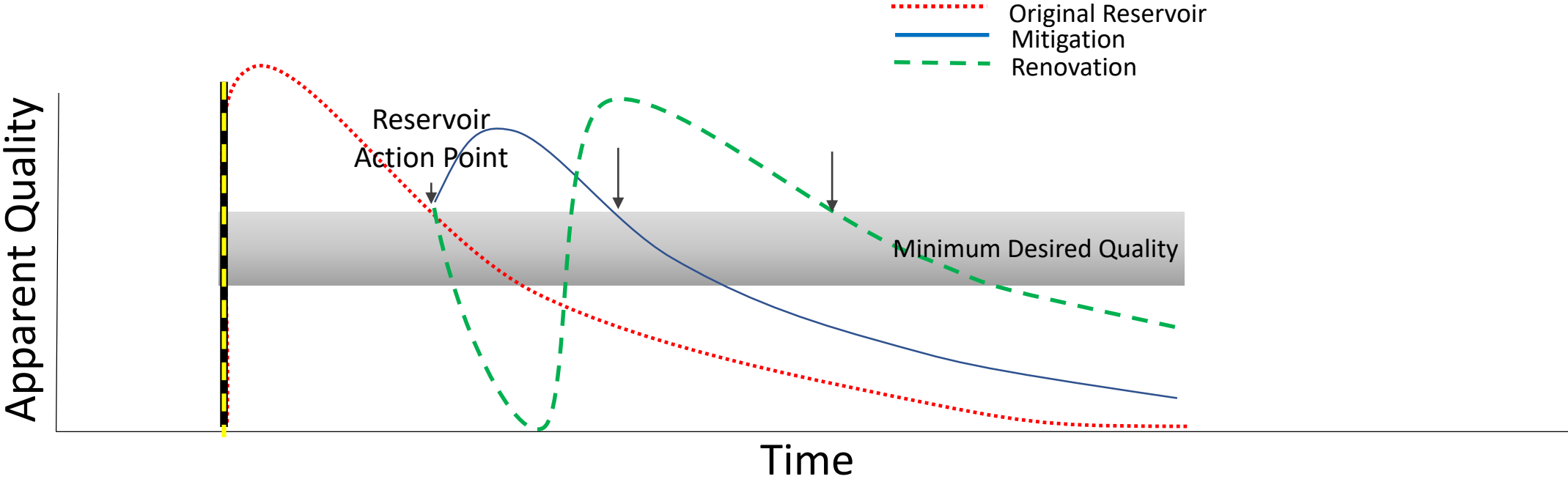
Reservoir Actions vs Aging



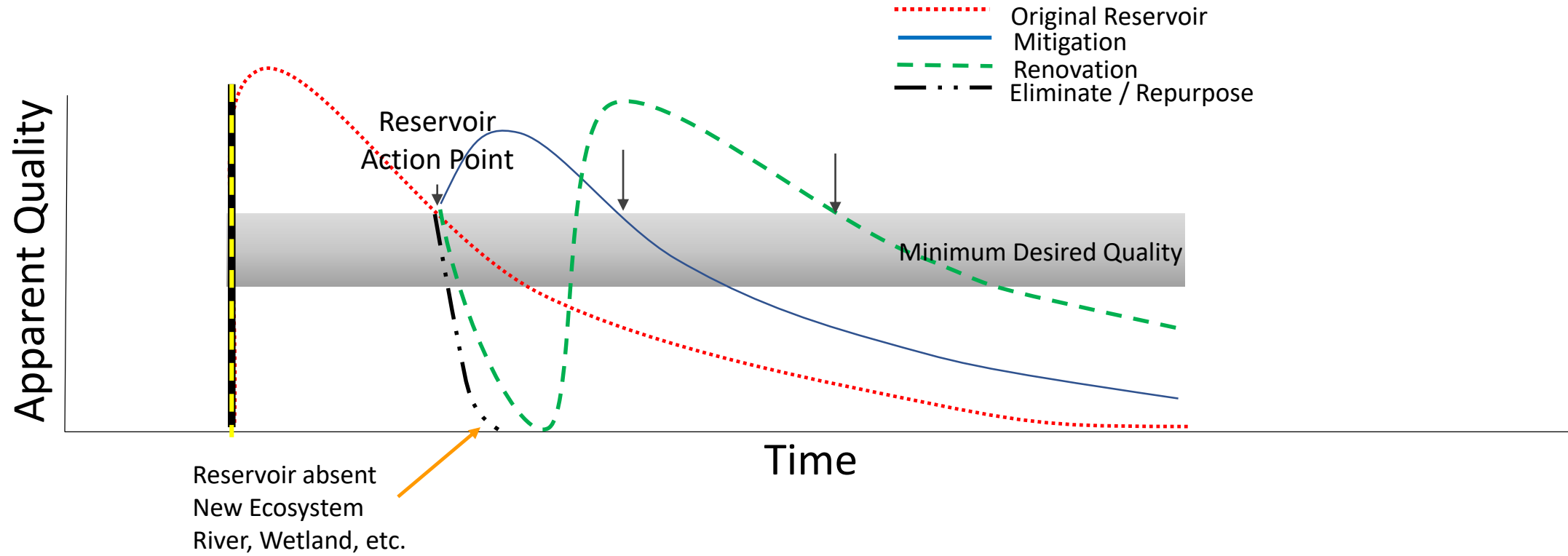
Reservoir Actions vs Aging

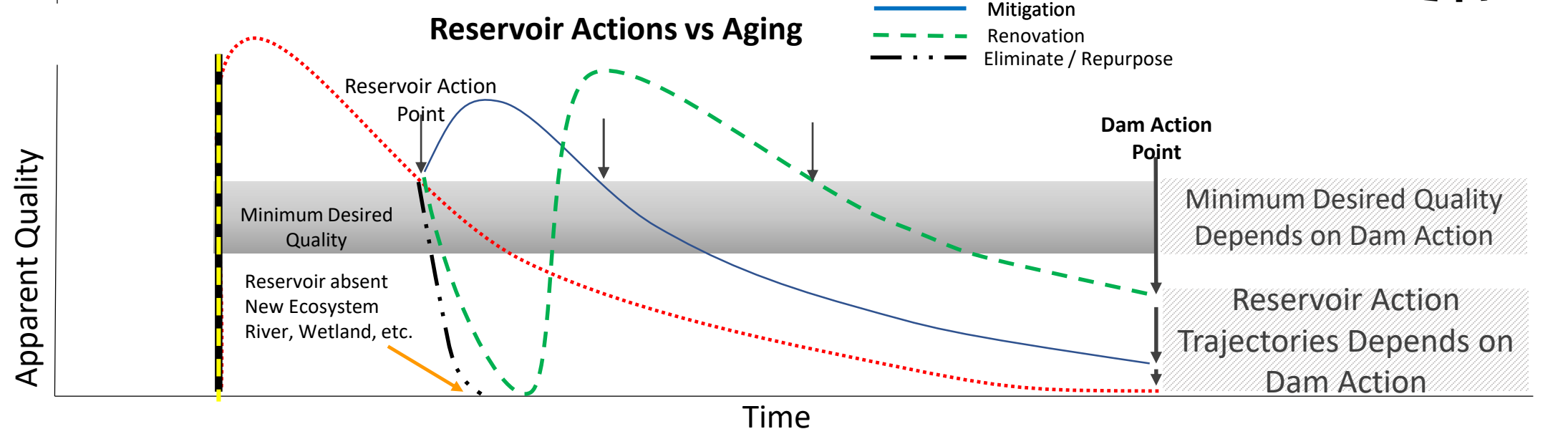
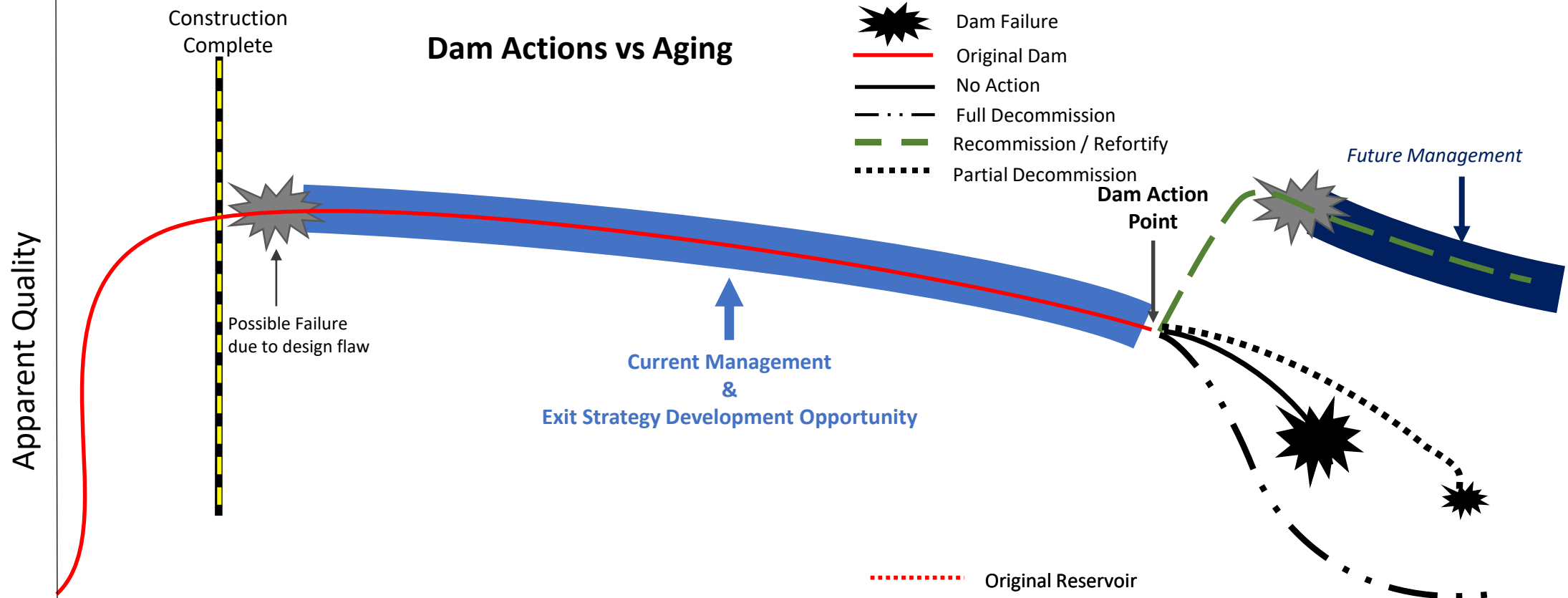



Reservoir Actions vs Aging




Reservoir Actions vs Aging





Reservoir Action Severity 

Dam Action Severity 

	Mitigate	Renovate	Repurpose	Eliminate
Full Decommission				✓
Partial Decommission			✓	✓
Recommission	✓	✓	✓	✓
Refortify	✓	✓	✓	✓
Reactive Management	✓	✓	✓	✓
No Action	✓	✓	✓	✓











Reservoir Action Severity →

Dam Action Severity ↑

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Reactive Management	✓	✓	✓	✓
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Feasibility

Scale

Engineering

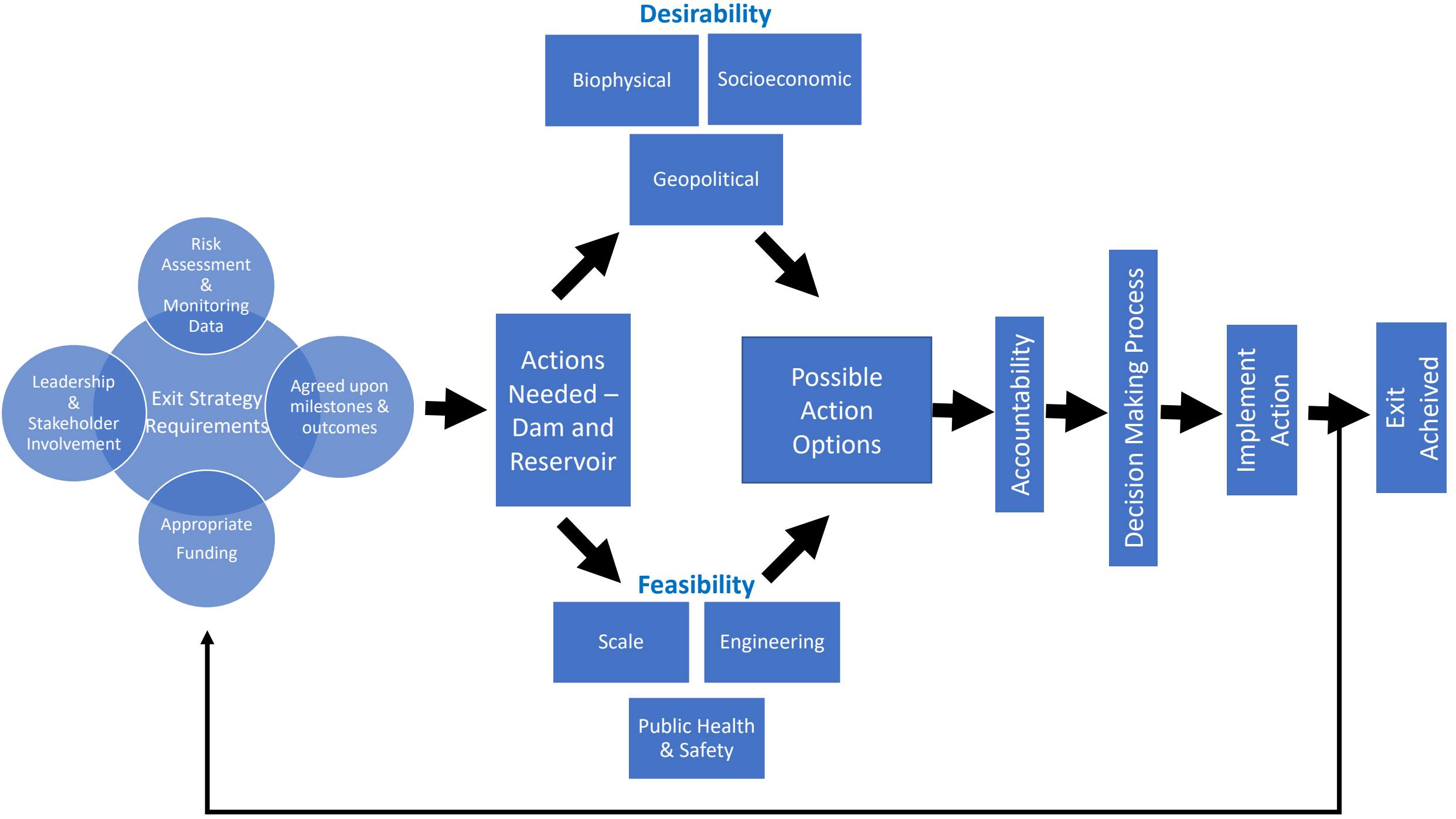
Public Health
& Safety

Desirability

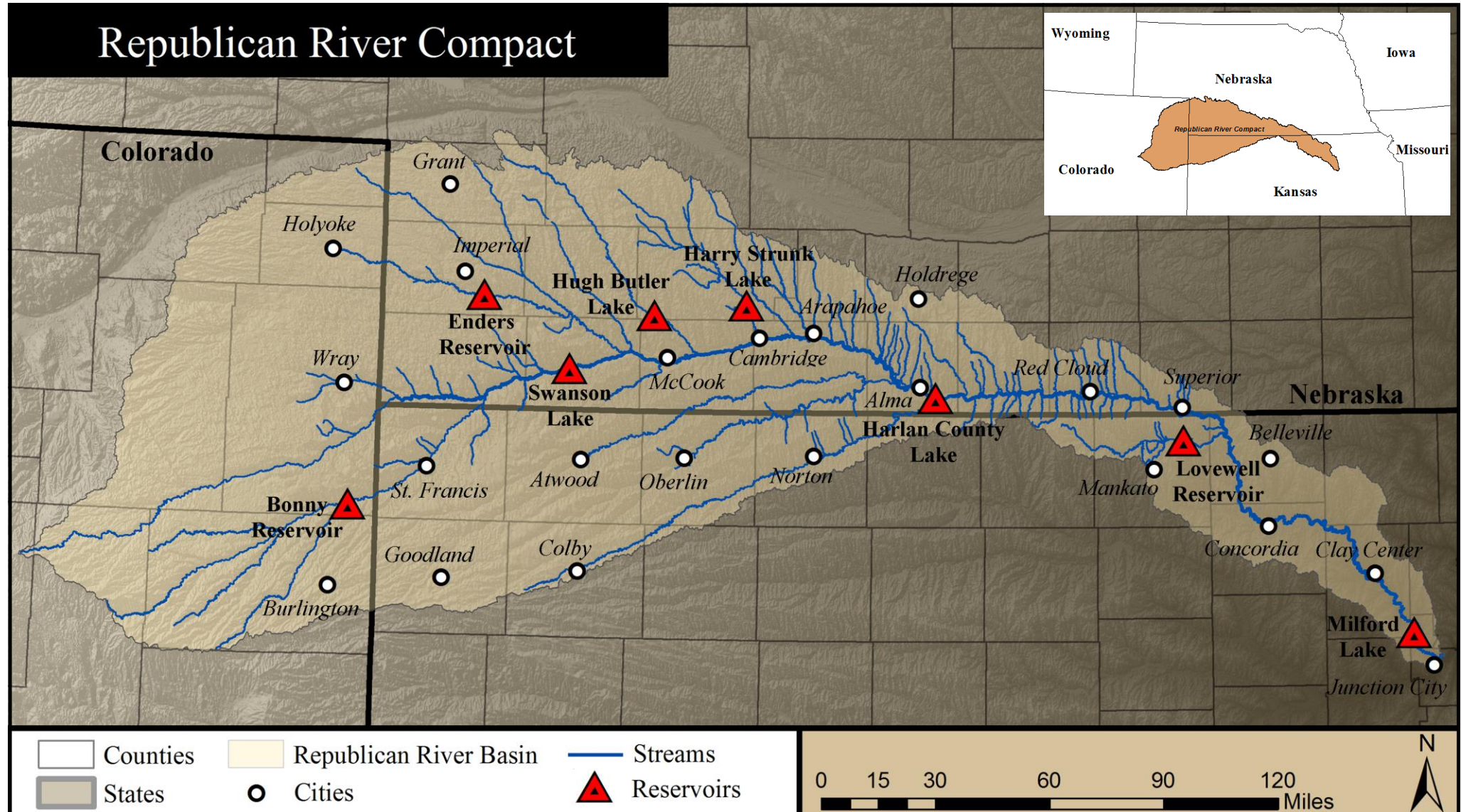
Biophysical

Socioeconomic

Geopolitical

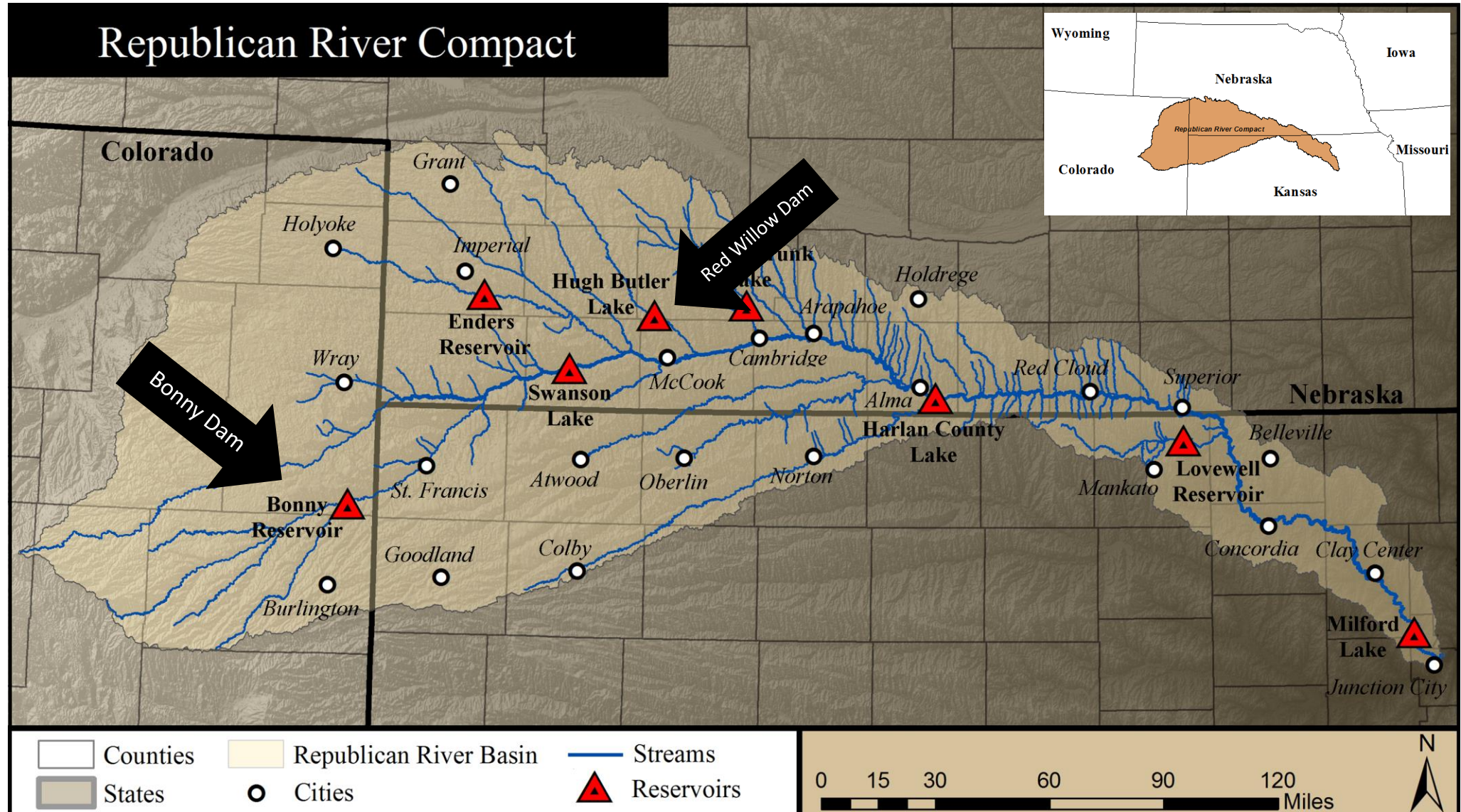


A tale of two dams



Map by: Nebraska DNR

A tale of two dams

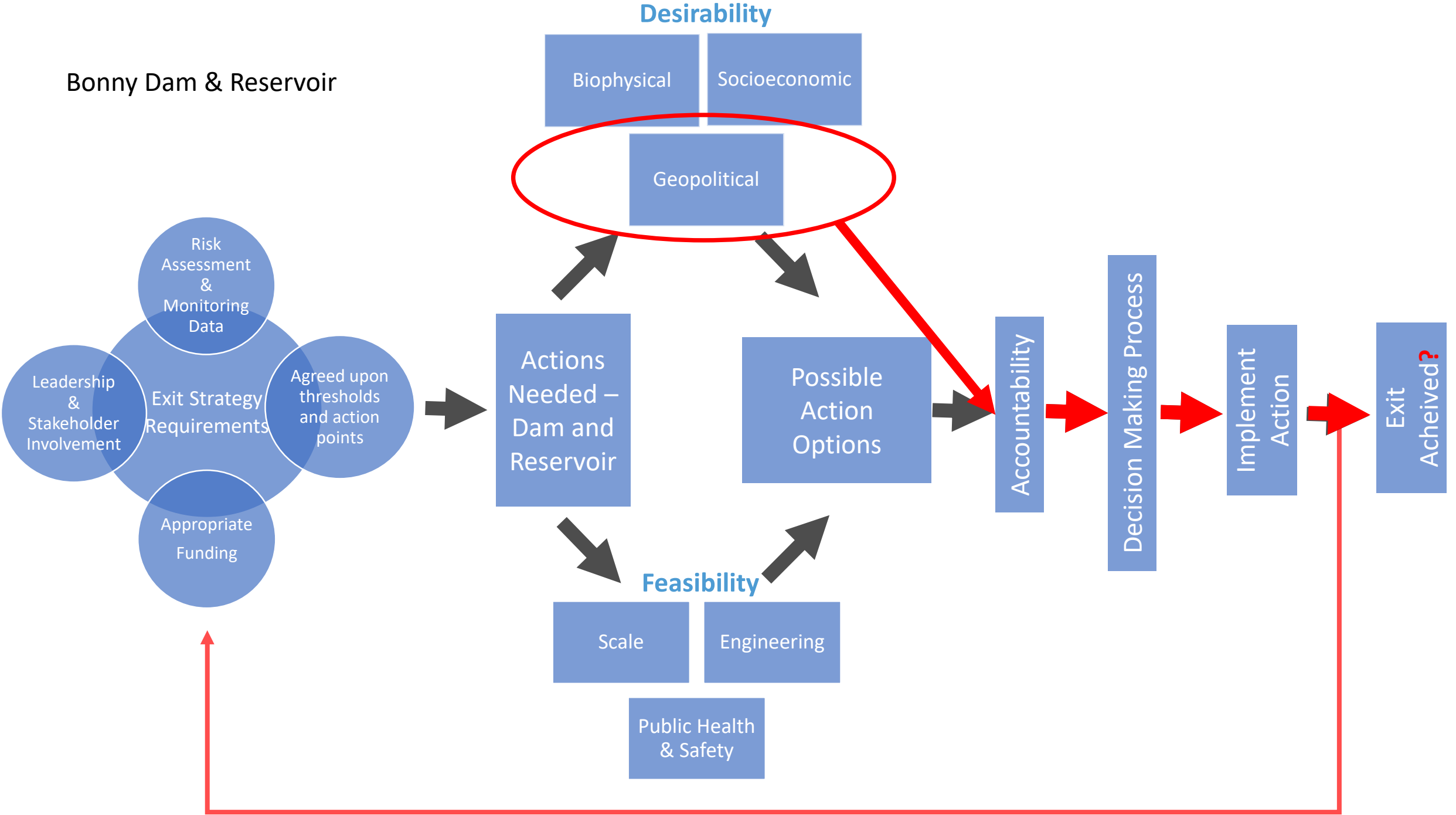


Bonny Dam

Constructed in 1951



Bonny Dam & Reservoir




Bonny Reservoir After Draining



Lori Potter – Kearney Hub –
https://www.kearneyhub.com/news/local/water-tour-series-draining-bonny-reservoir-one-part-of-colorado/article_c0150ae6-d192-5c10-a709-9f16c541ab78.html

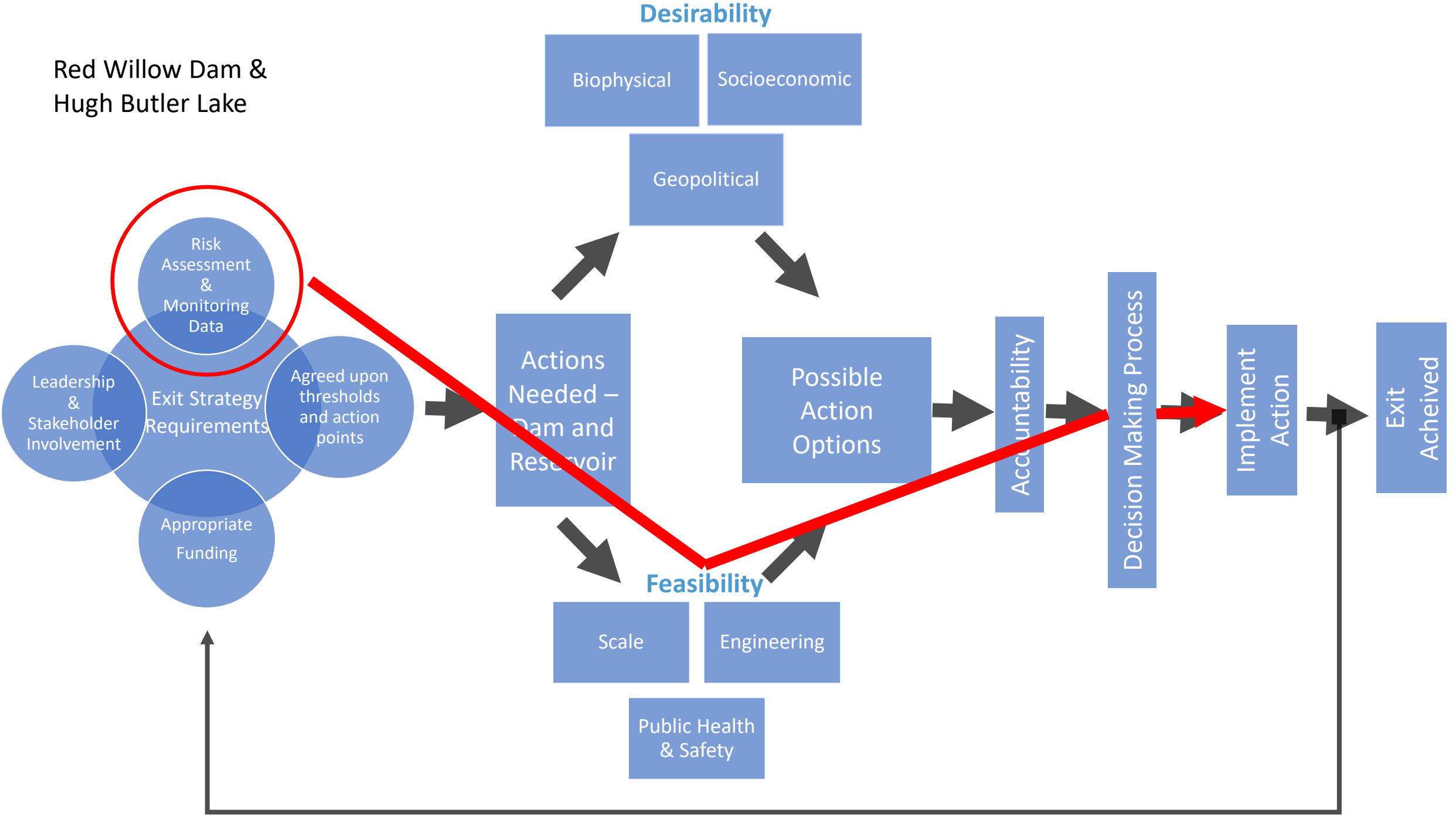


https://en.wikipedia.org/wiki/Bonny_Dam#/media/File:Bonny_Reservoir_-_Spring_2014.JPG

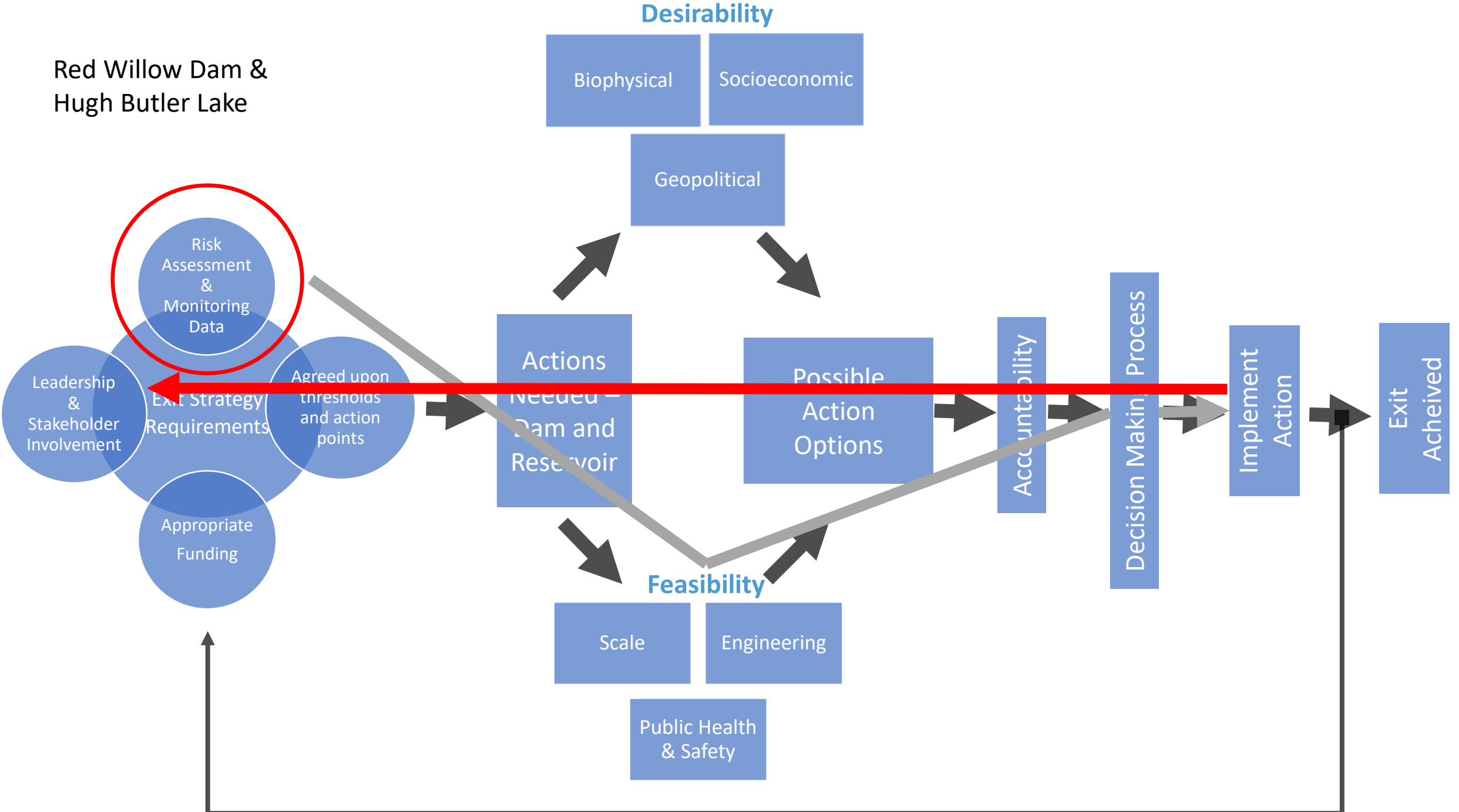
An aerial photograph of the Red Willow Dam, a long concrete structure extending from the right side of the frame towards the center. The dam is surrounded by a large reservoir of water. The surrounding landscape is green and hilly, with several winding roads and some small structures visible. The sky is clear and blue.

Red Willow Dam
Constructed in 1962

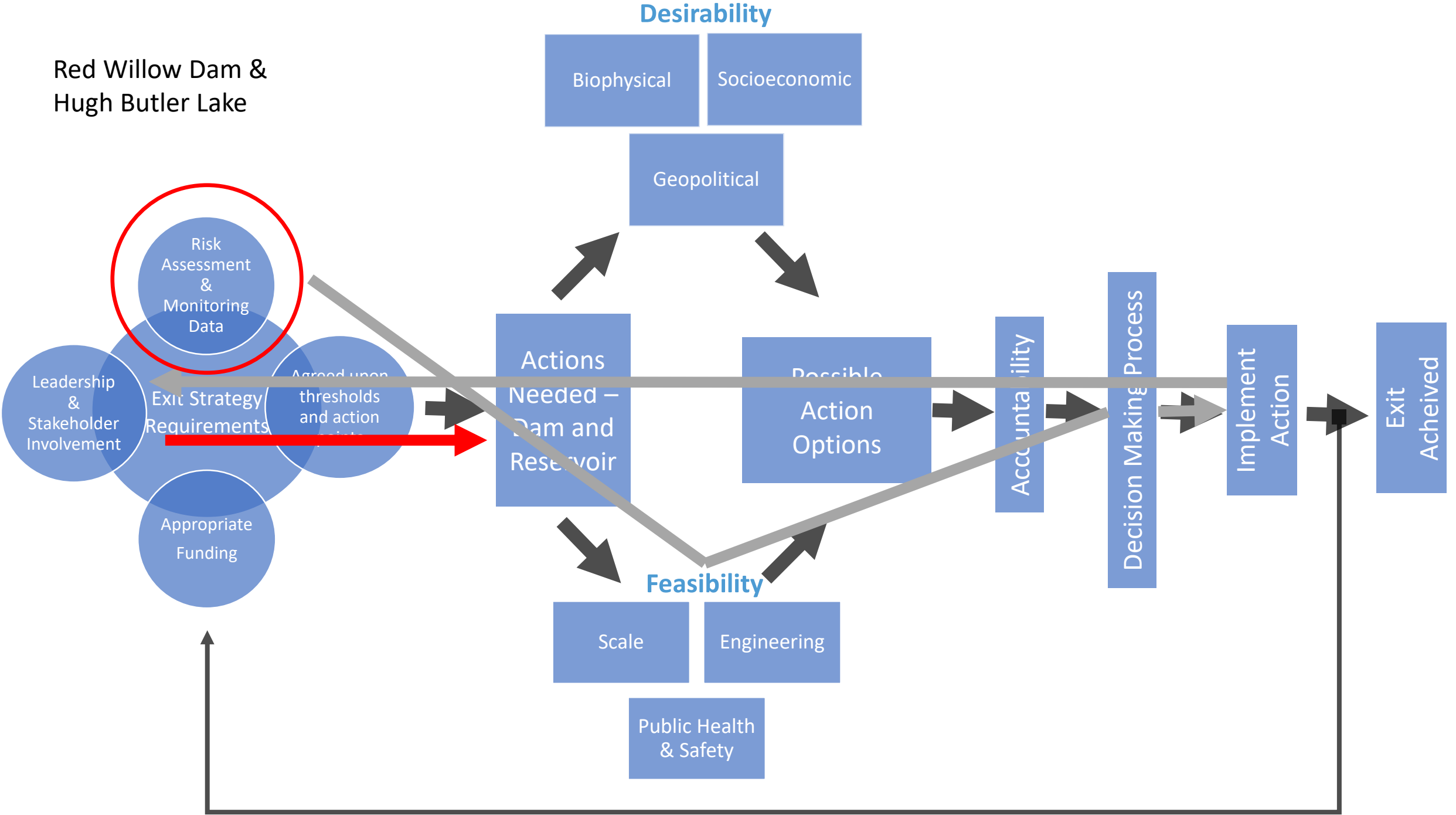
Red Willow Dam & Hugh Butler Lake



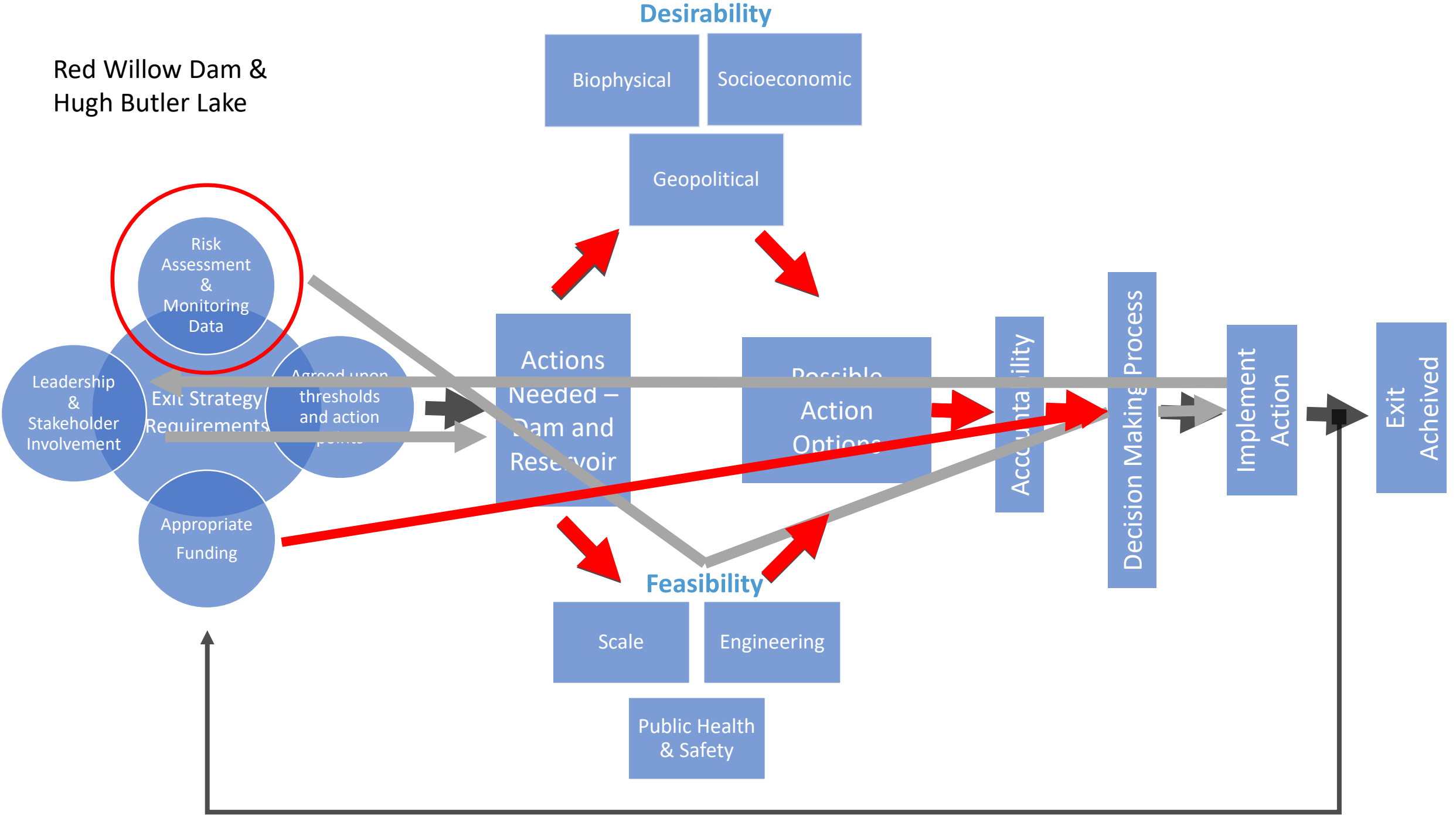
Red Willow Dam & Hugh Butler Lake



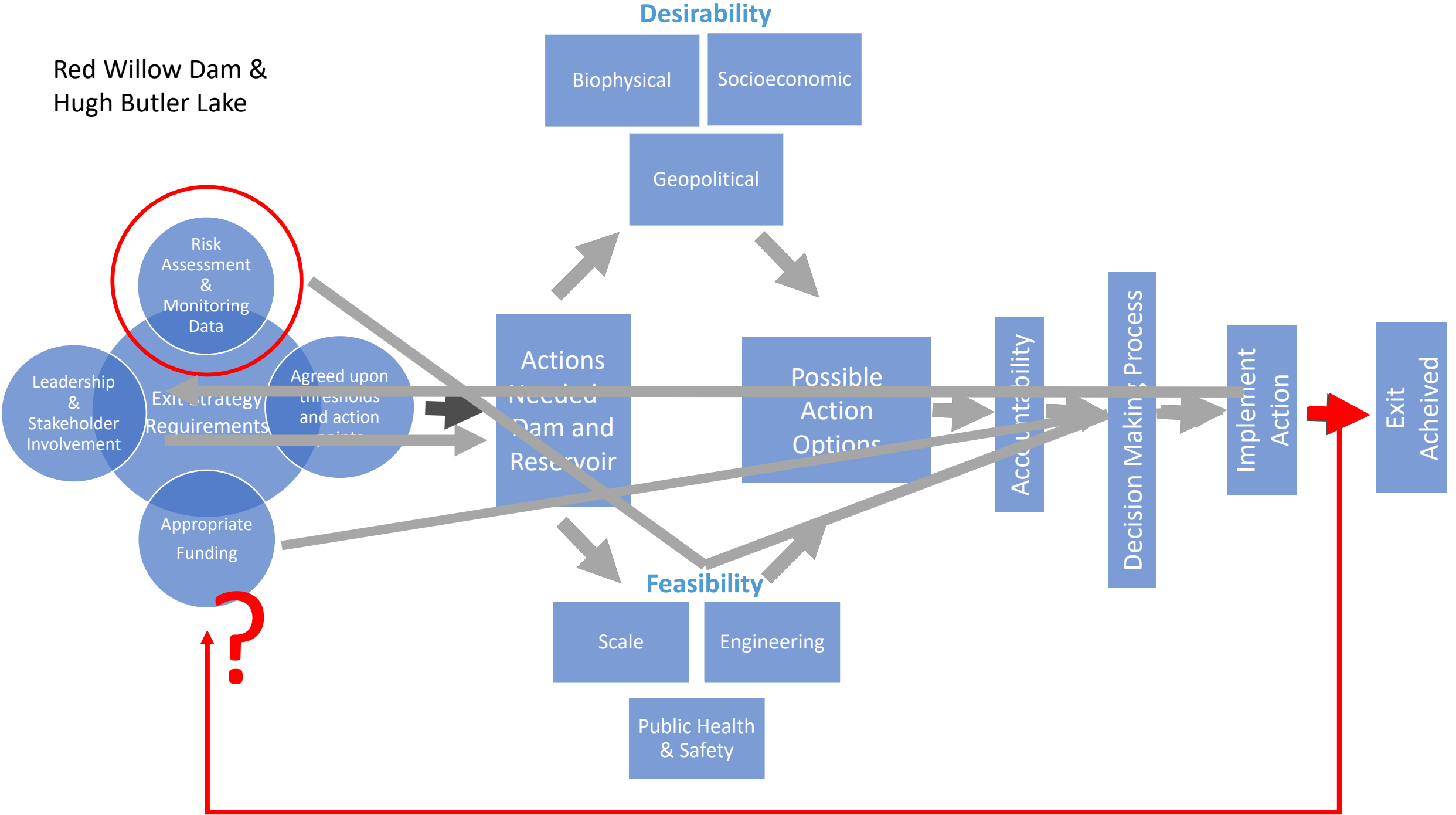
Red Willow Dam & Hugh Butler Lake



Red Willow Dam & Hugh Butler Lake



Red Willow Dam & Hugh Butler Lake



Red Willow Dam – Embankment Repair



<https://www.mccookgazette.com/gallery/11134>

Red Willow Dam – Embankment Repair



Red Willow Dam – Embankment Repair



https://www.usbr.gov/gp/images/red_willow_modification2_large.jpg

Red Willow Dam & Hugh Butler Lake

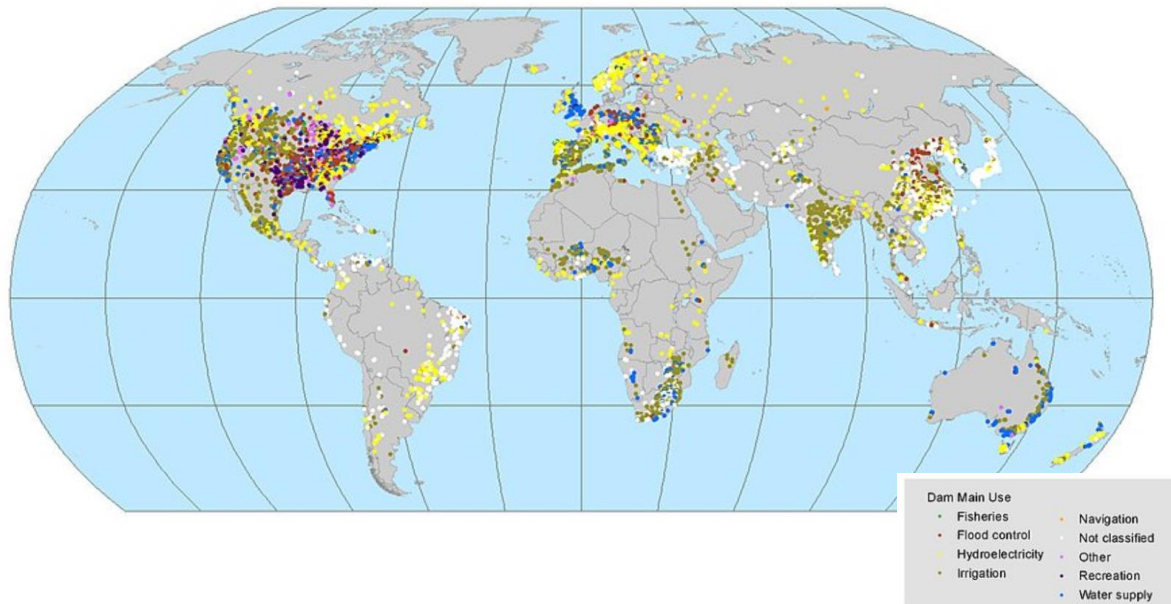


<http://outdoornebraska.gov/redwillow/>

Call to Action

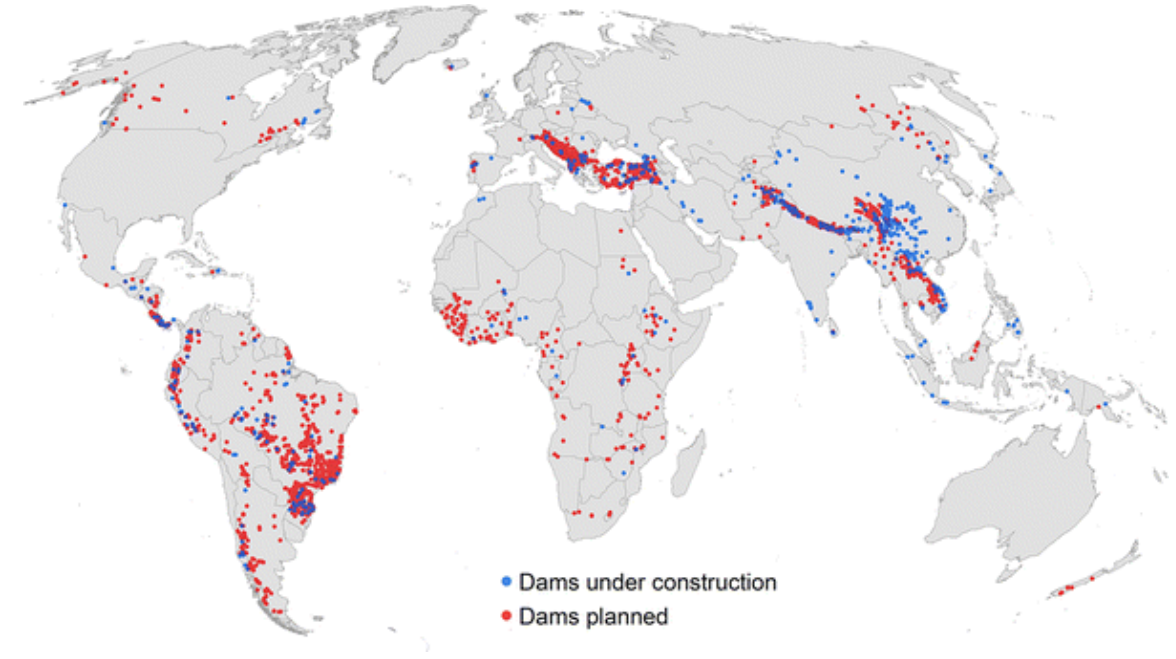
Present Day Dams and Reservoirs

Global Reservoir and Dam Database, Version 1 (GRanDv1), Revision 01



Lehner et al. 2011 *Frontiers in Ecology and the Environment*

Future Dams* and Reservoirs



*Map of Hydropower Dam Development
Zarfl et al. 2015 *Aquatic Sciences*