Identifying Where to Place Beavers and When to Use Beaver Mimicry for Low Tech Restoration

Beaver Restoration Webinar Series

UtahState University
DEPARTMENT OF WATERSHED SCIENCES

JOE WHEATON

ASSOCIATION OF STATE WETLAND MANAGERS

September 24, 2020

DOI: 10.13140/RG.2.2.31135.59045

RIVERSCAPES CONSORTIUM

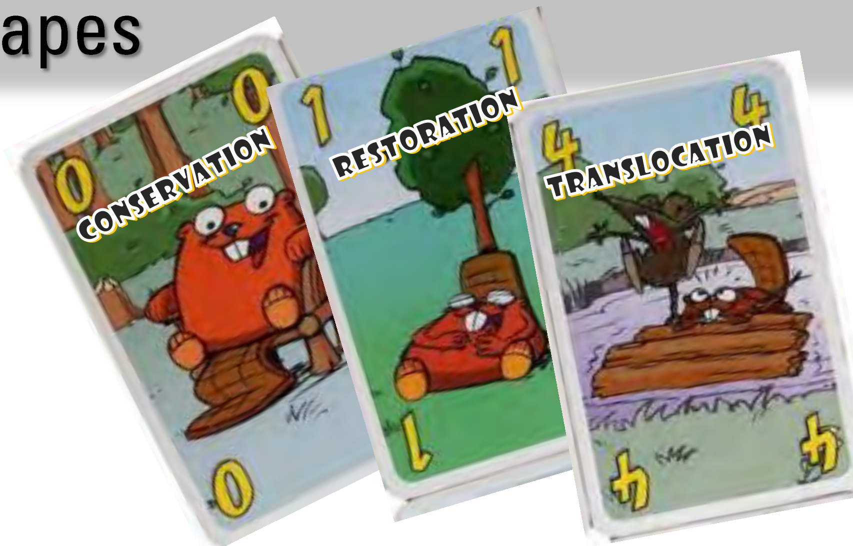
Logistics – Getting the most out of your webinar

- Look in GoTo Chat window for link to PDF of **Slides** on ResearchGate
- Look in GoTo Handouts for a BRAT cIS form (for **exercise**)… printr have
- We will take **questions** at three different points (queue them up in GoTo Questions window)
- Slides are littered with hyperlinks (clickable in PDF) to cited works, datastes, examples and other talks, resources, & training materials

DOI: 10.13140/RG.2.2.31135.59045

Purpose of Webinar

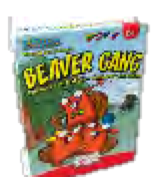
Expectation management around beaver as a restoration/conservation partner, vs. mitigating their impacts in riverscapes



Mimic → Promote → Sustain

When, where and how to play the beaver cards?

From [Beaver Gang](#) Card Game



From Goldfarb (2018) Science: http://science.sciencemag.org/content/360/6393/1058

OUTLINE

Identifying Where to Place Beavers and When to Use Beaver Mimicry for Low Tech Restoration

I. **Background & Other Resources**
II. Dam Building Focus – Expectations
III. Contextualizing Risk
IV. Prioritizing Opportunities
V. Partnering with Beaver… A people business

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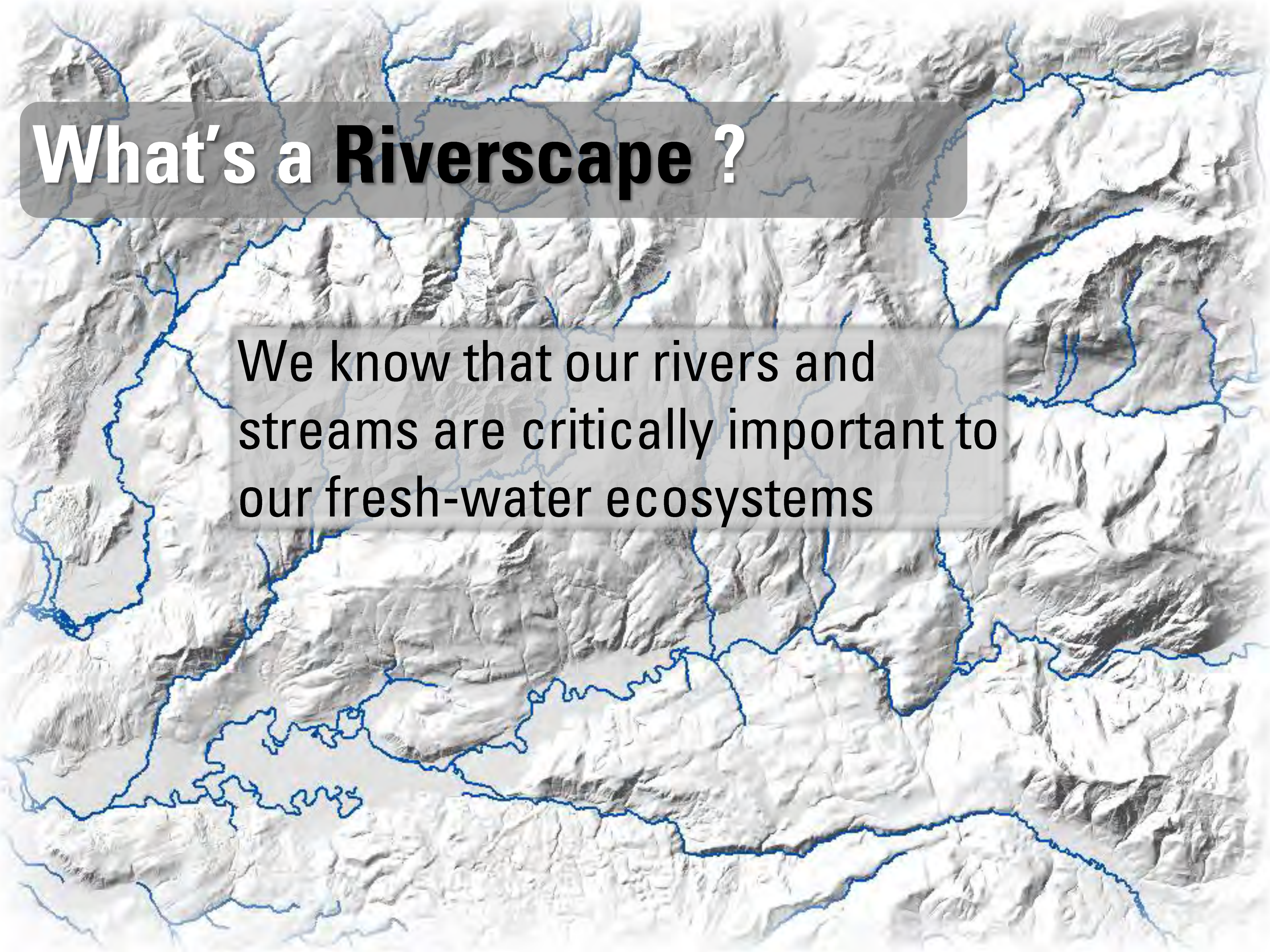
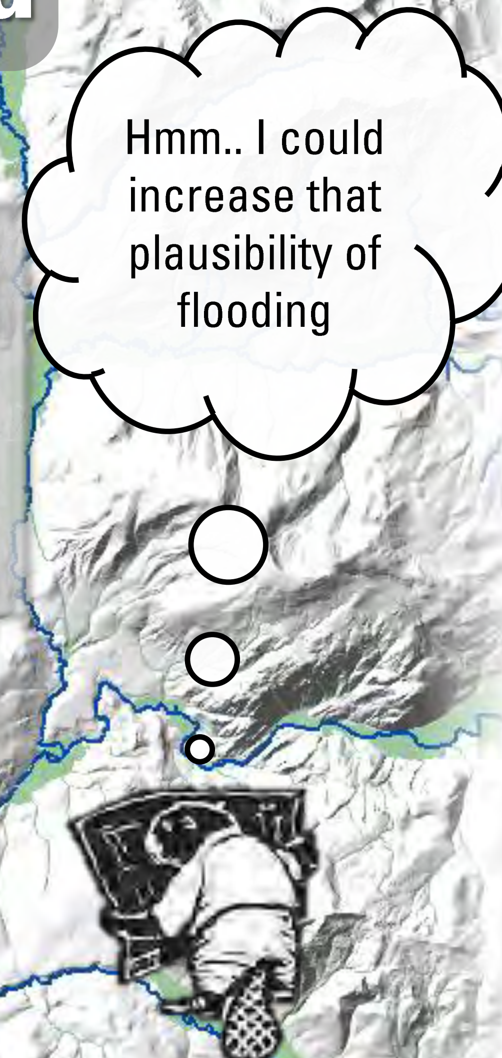
What's a **Riverscape** ?

We know that our rivers and streams are critically important to our fresh-water ecosystems

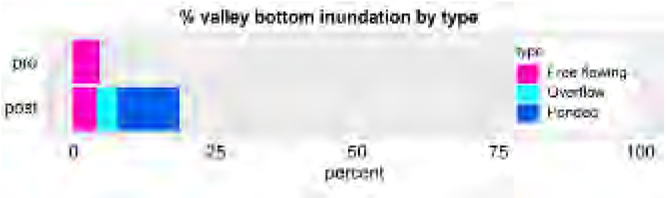


Riverscapes span the network across a watershed

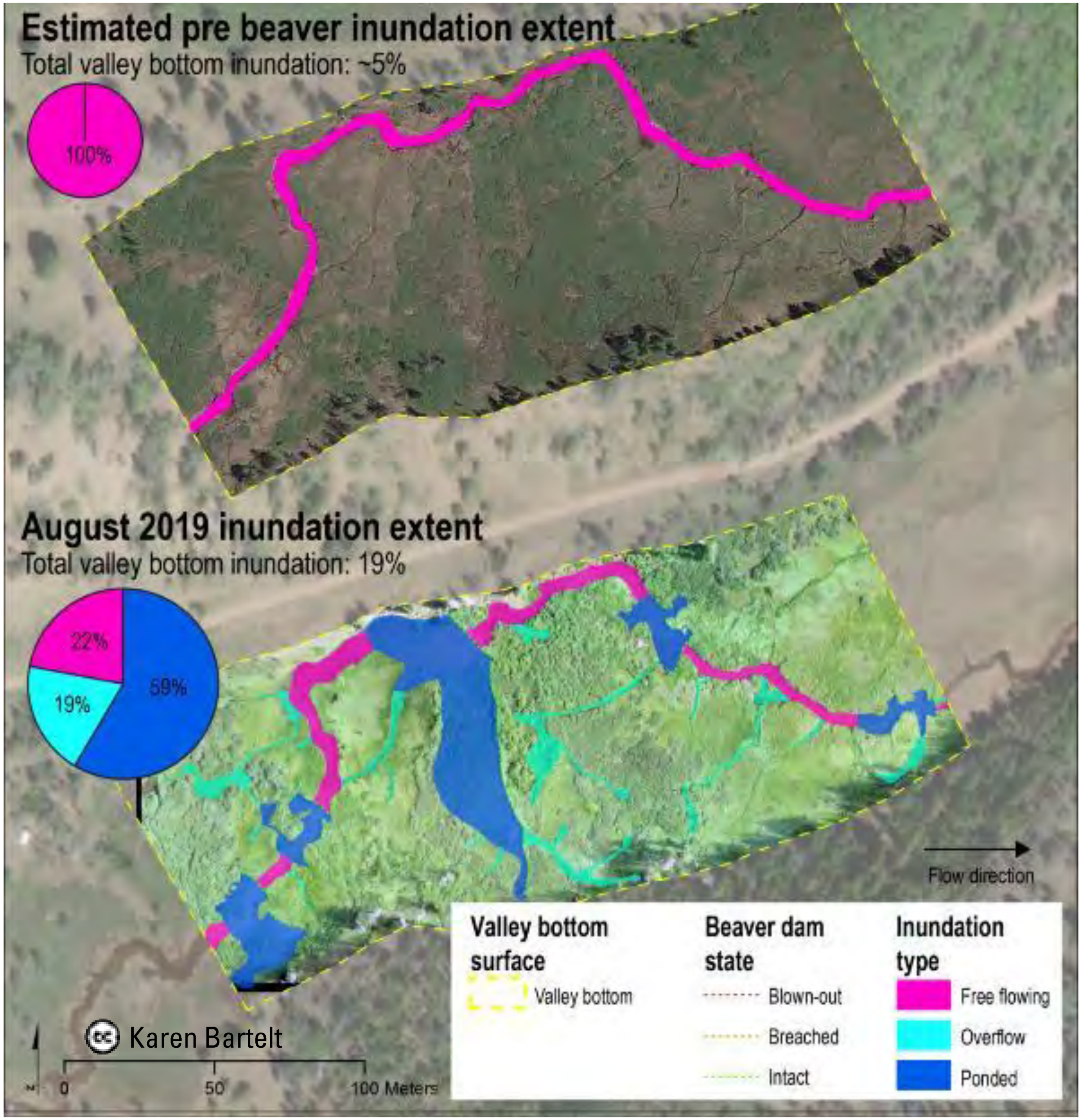
Riverscapes are the part of the landscape that could **plausibly** flood by their rivers & streams in the natural flow regime.



The Water Magic Trick – Beaver Induced Flooding



- Inundation types great proxy for residence time…



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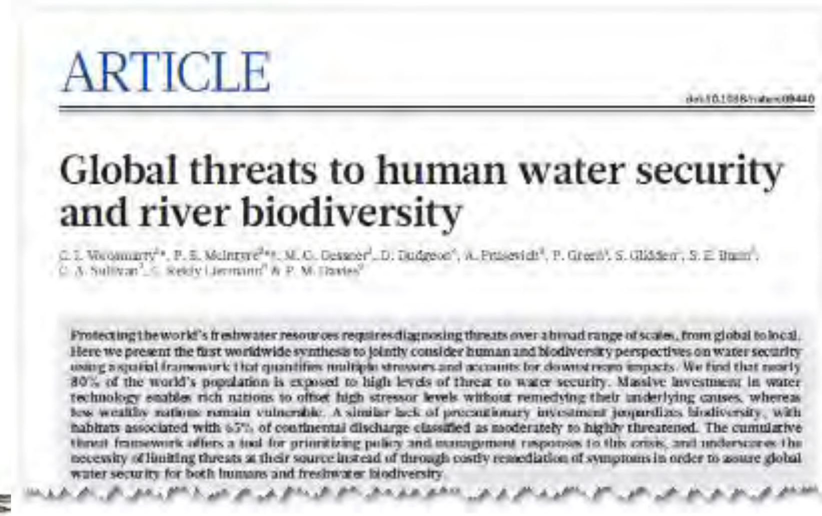
Global threat to river biodiversity


ARTICLE

Global threats to human water security and river biodiversity

Protecting the world's freshwater resources requires diagnosing threats over a broad range of scales, from global to local. Here we present the first worldwide synthesis to jointly consider human and biodiversity perspectives on water security using a spatial framework that quantifies multiple stressors and accounts for downstream impacts. We find that nearly 80% of the world's population is exposed to high levels of threat to water security. Massive investment in water technology enables rich nations to offset high stressor levels without remedying their underlying causes, whereas less wealthy nations remain vulnerable. A similar lack of precautionary investment jeopardizes biodiversity, with habitats associated with 65% of continental discharge classified as moderately to highly threatened. The cumulative threat framework offers a tool for prioritizing policy and management responses to this crisis, and underscores the necessity of limiting threats at their source instead of through costly remediation of symptoms in order to assure global water security for both humans and freshwater biodiversity.

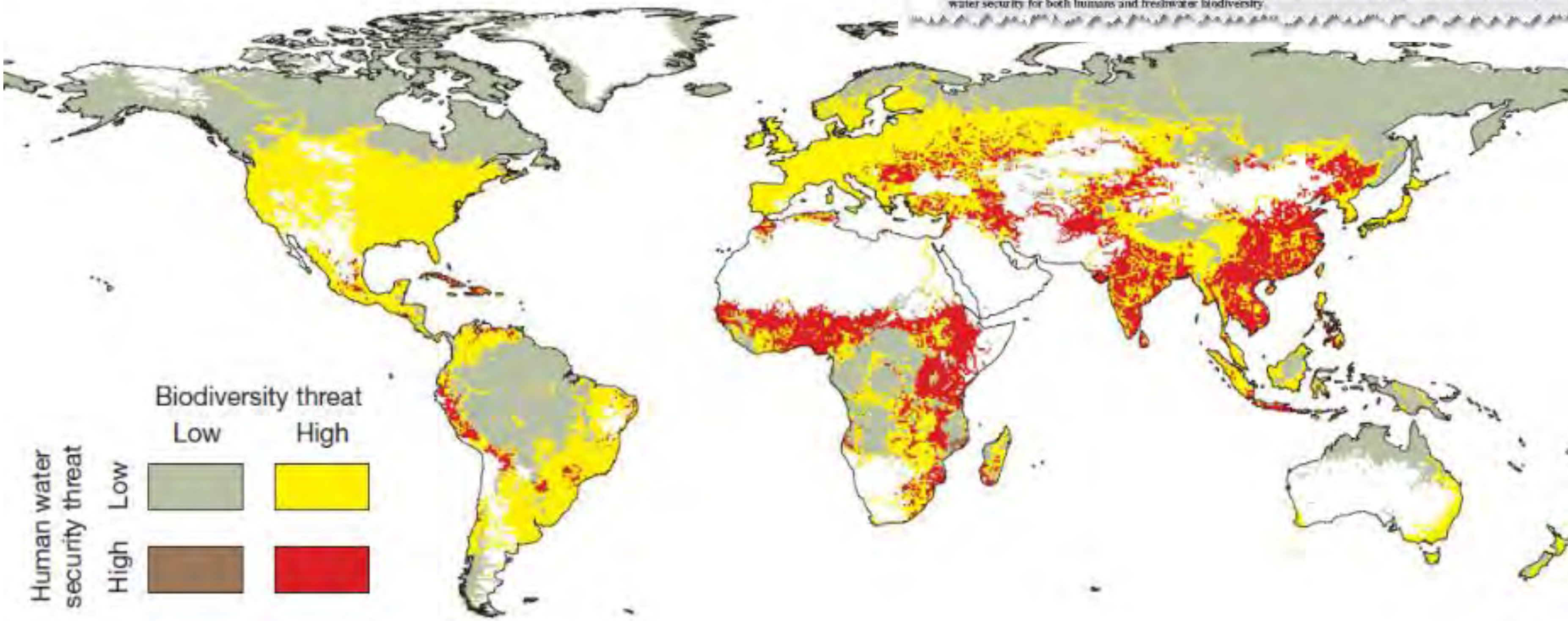


Figure 6 from Vörösmarty et al. (2010)

DOI: 10.1038/nature09440

Problem is Simple to State…

Scope of riverscape **degradation** is massive

- ~ Multi-Billions spent annually, but **barely scratching surface**
- We spend disproportionate $$$$ on **too few kilometers** of streams and rivers
- Leaving tens of millions of miles **neglected**…

Agricultural Stream Ecosystem (PDF)

Urban Stream Ecosystem (PDF)

USGS

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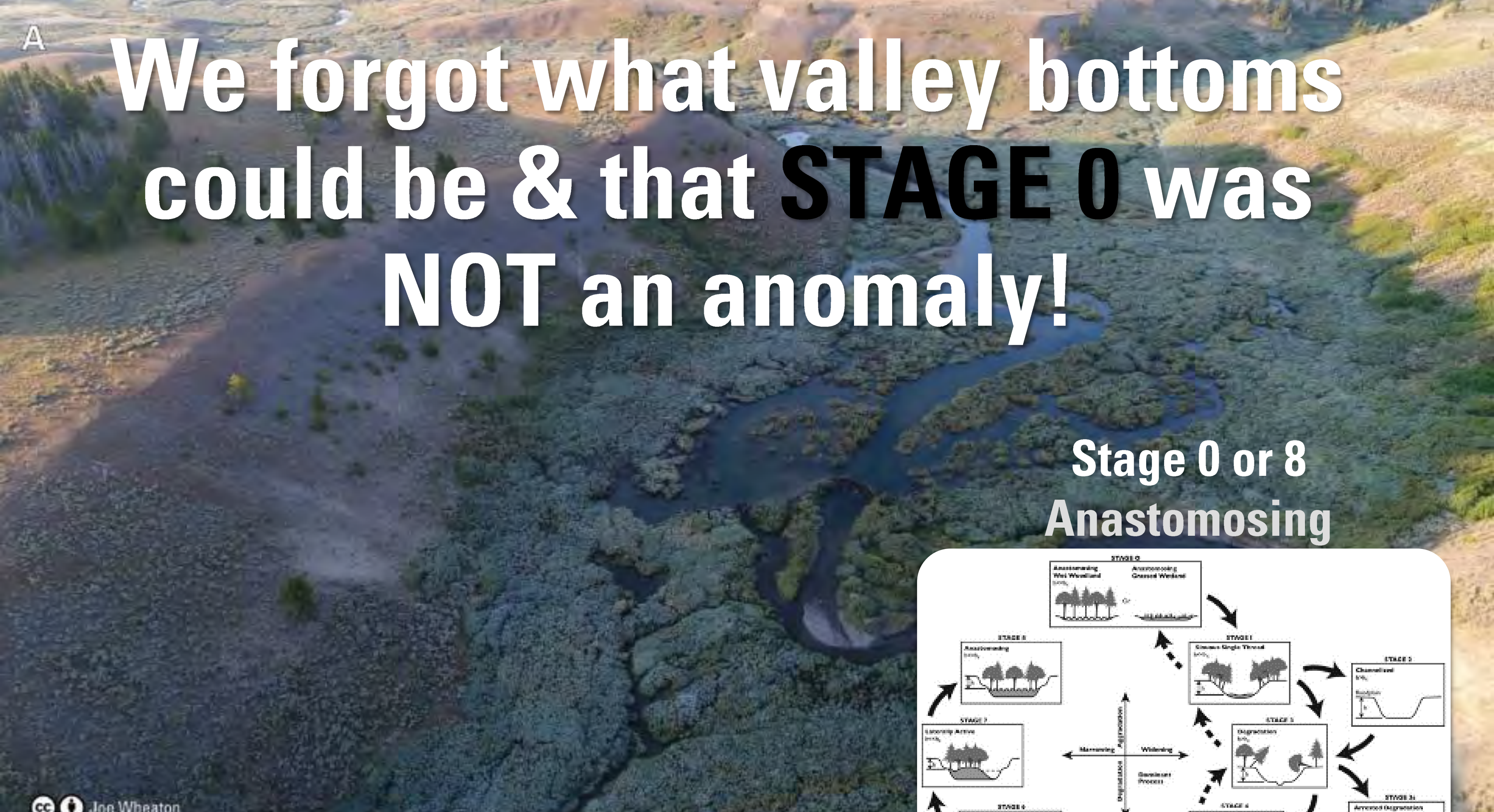
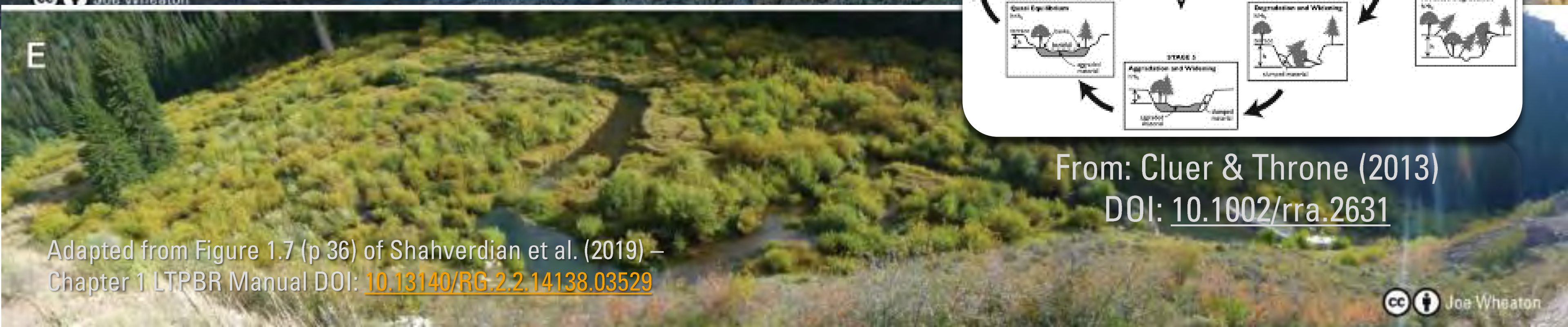
We forgot what valley bottoms could be & that **STAGE 0** was NOT an anomaly!



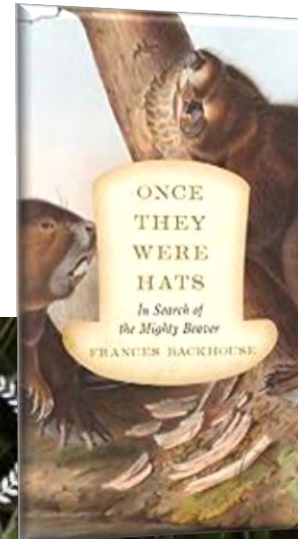


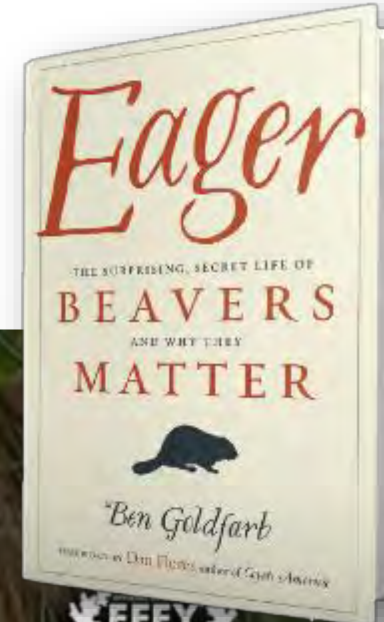
Stage 0 or 8
Anastomosing

From: Cluer & Throne (2013)
DOI: 10.1002/rra.2631

Adapted from Figure 1.7 (p 36) of Shahverdian et al. (2019) – Chapter 1 LTPBR Manual DOI: 10.13140/RG.2.2.14138.03529

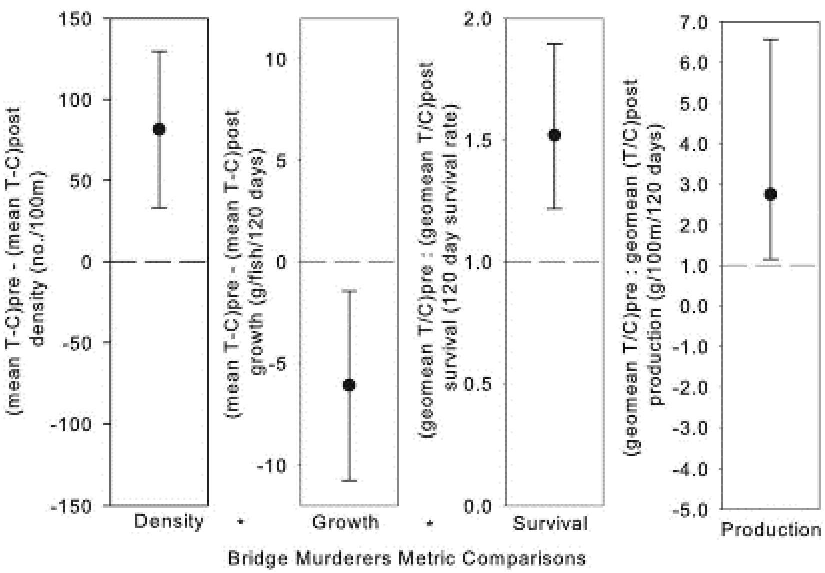
So many places to go…
For why beaver…

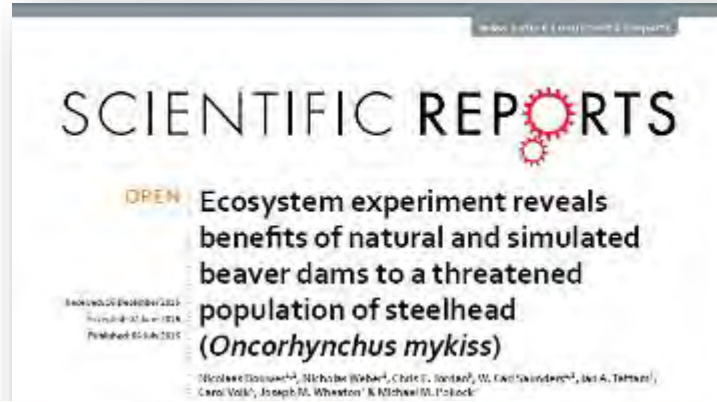




Beaver Dam Building can Benefit Endangered Species

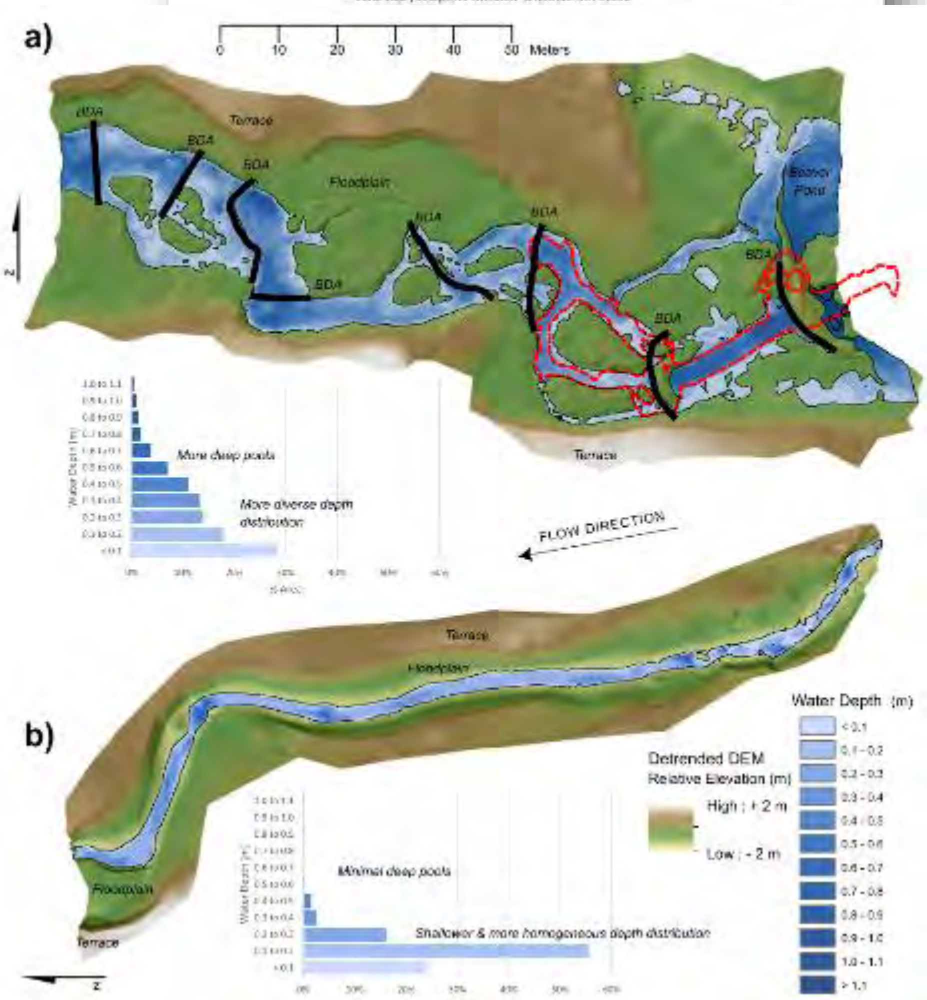
- Restoration using BDAs & beaver as restoration agent produced a population level increase in density, survival and production of ESA listed salmon




SCIENTIFIC REPORTS

OPEN

Ecosystem experiment reveals benefits of natural and simulated beaver dams to a threatened population of steelhead (*Oncorhynchus mykiss*)



From Bouwes et al. (2016)

DOI: 10.1038/srep28581

Two days Ago… As the American West burns…

5 MINUTE READ

BY BEN GOLDFARB

PUBLISHED SEPTEMBER 22, 2020

The American West is ablaze with fires fueled by climate change and a century of misguided fire suppression. In California, wildfire has blackened more than three million acres; in Oregon, a once-in-a-generation crisis has forced half a million people to flee their homes. All the while, one of our most valuable firefighting allies has remained overlooked: The beaver.

A new study concludes that, by building dams, forming ponds, and digging canals, beavers irrigate vast stream corridors and create fireproof refuges in which plants and animals can shelter. In some cases, the rodents' engineering can even stop fire in its tracks.

"It doesn't matter if there's a wildfire right next door," says study leader Emily Fairfax, an ecohydrologist at California State University Channel Islands. "Beaver-dammed areas are green and happy and healthy-looking."

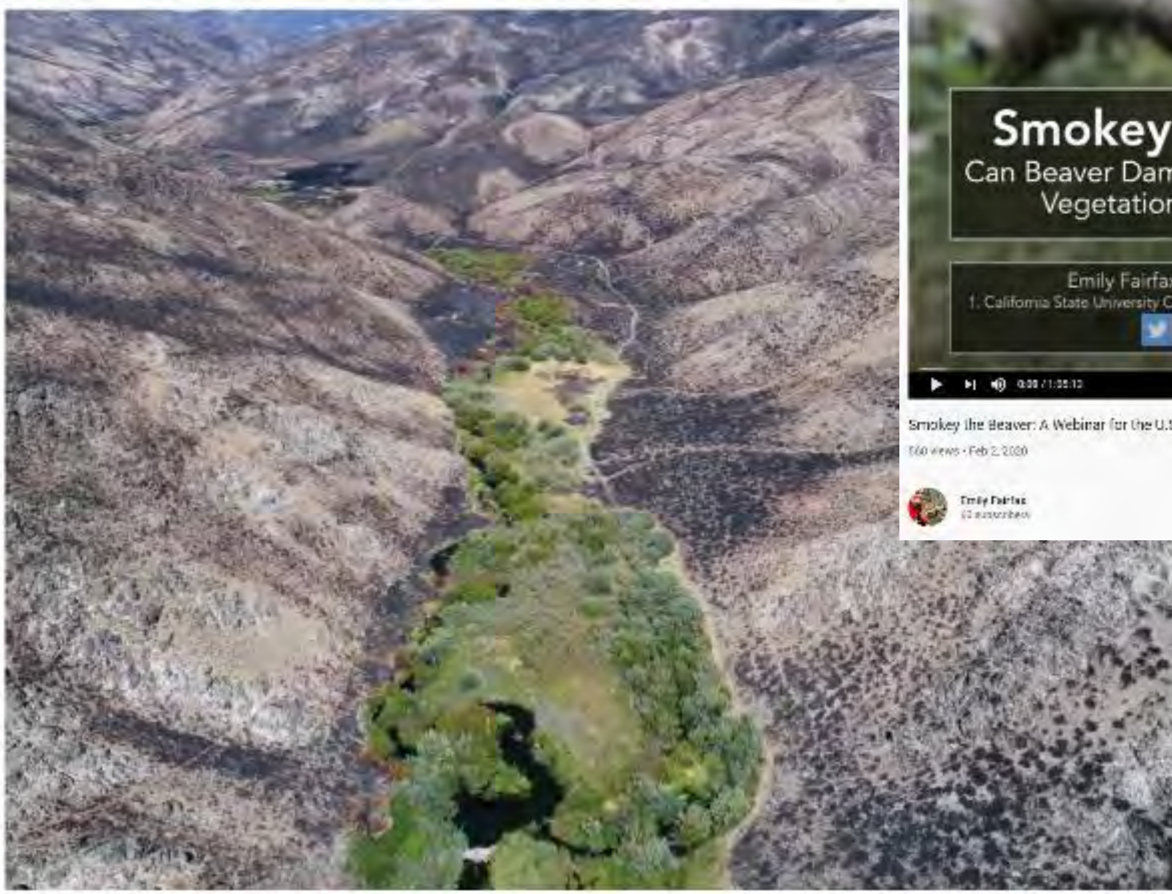
NATIONAL GEOGRAPHIC

ANIMALS

How beavers became North America's best firefighter

The rodent creates fireproof refuges for many species, suggesting wildlife managers should protect beaver habitat as the U.S. West burns.

Beaver increase riverscape resiliency to fire!



This beaver-dammed wetland in Baugh Creek, Idaho, is a so-called "emerald refuge" that can serve as a firebreak and refuge for other species during wildfires.

PHOTOGRAPH BY JOSEPH WHEATON

Fairfax & Whittle (2020) - Smokey the Beaver: beaver-dammed riparian corridors stay green during wildfire throughout the western USA. DOI: [10.1002/eap.2225](https://doi.org/10.1002/eap.2225)

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Beaver Management / Restoration Strategies

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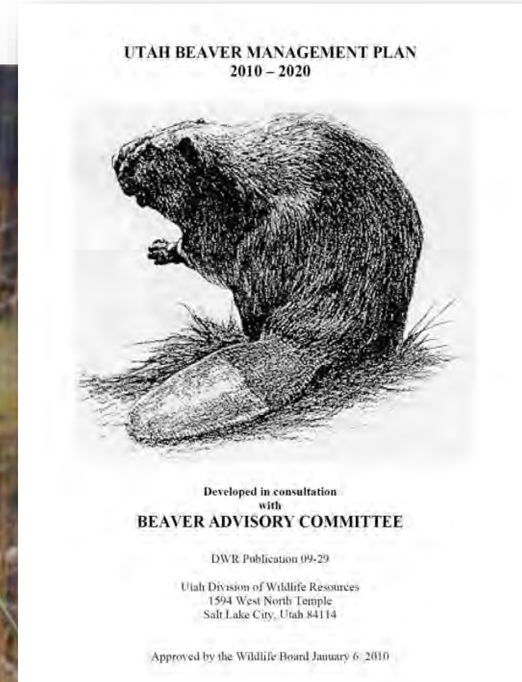
4. Restore riparian → Followed by Translocation
5. Help beaver out – **Beaver Dam Analogues** → *Facilitated dispersal of opportunistic species*
6. Mimic Beaver Dam Activity – *construction & maintenance (low-tech… NOT PBR)*

Conservation - Passive Beaver Strategies

Beaver protection- work with wildlife departments to get temporary or permeant closures for trapping in targeted areas



UTAH BEAVER MANAGEMENT PLAN
2010 – 2020

Developed in consultation
with
BEAVER ADVISORY COMMITTEE

DWR Publication 09-29

Utah Division of Wildlife Resources
1594 West North Temple
Salt Lake City, Utah 84114

Approved by the Wildlife Board January 6, 2010

Translocation – *or "Forced Dispersal"*

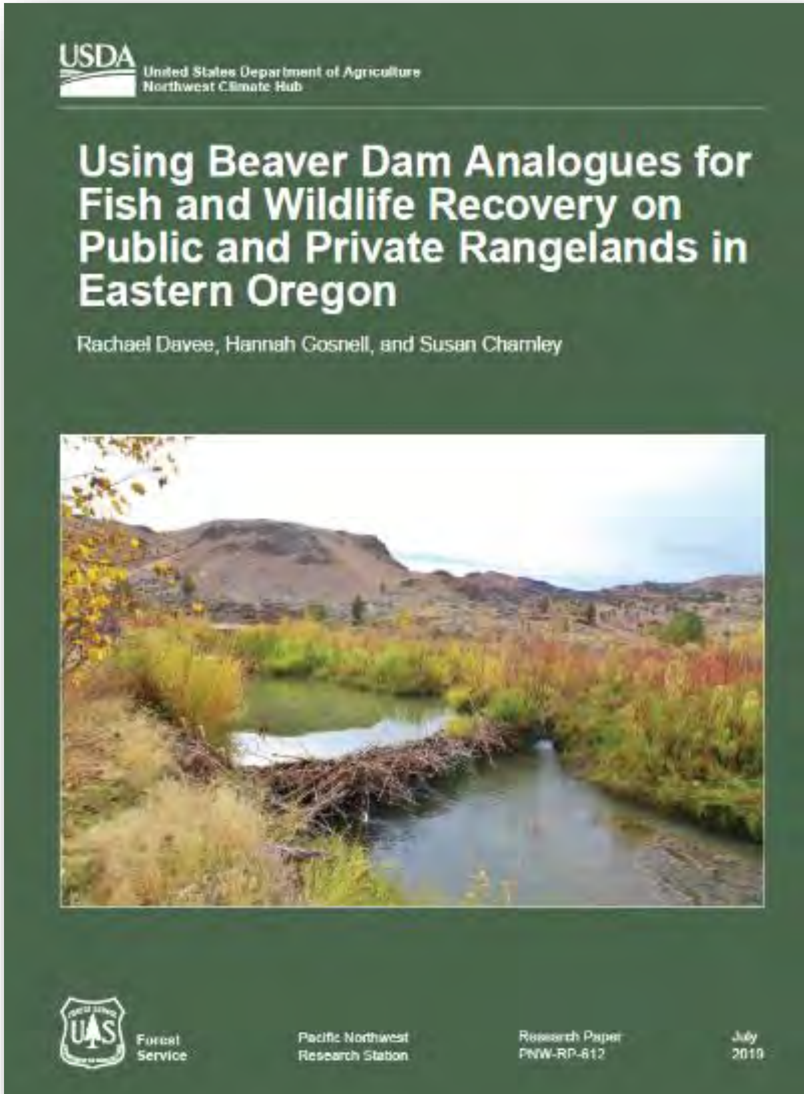
- Find a source population of nuisance beaver OR area with ample population…
- Relocate to areas with no or limited population & high capacity to support dam building activity

Nuisance beavers being translocated from Henry's Fork to High Unitas (Courtesy of Sorenson)

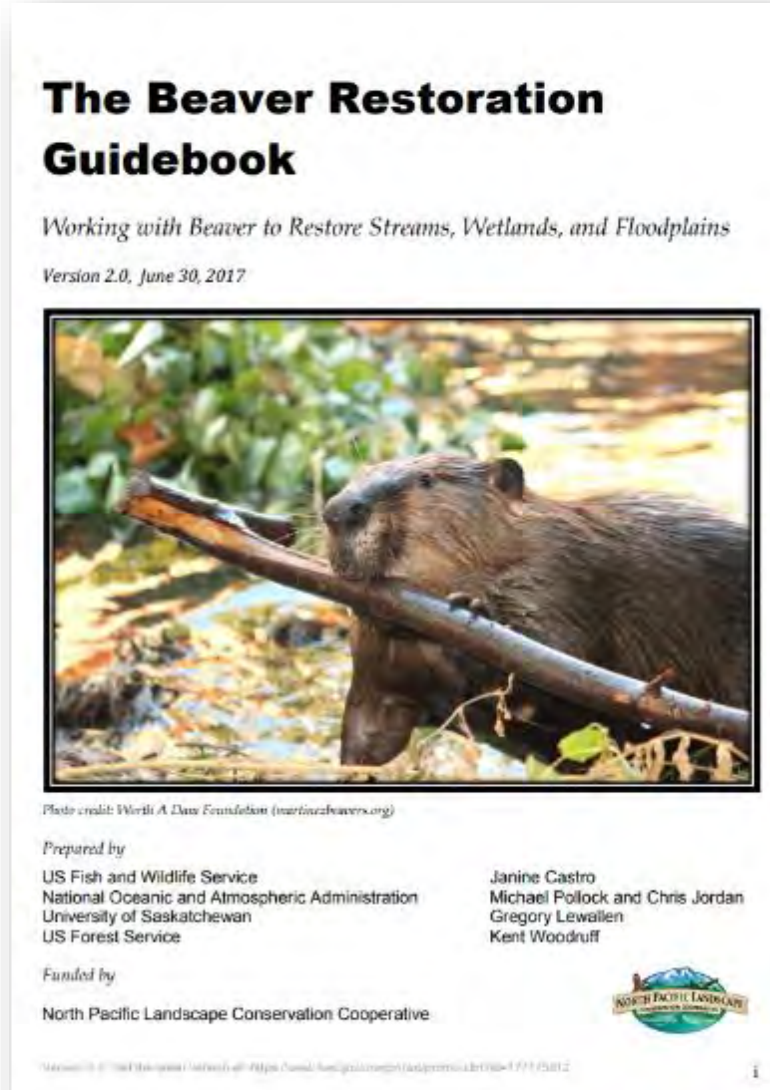
UTAH DNR WILDLIFE RESOURCES

See Kent & Amy's Webinar in this ASWM Series

Beaver Restoration Guidelines



Davee et al. (2019).



Pollock et al. (2017).

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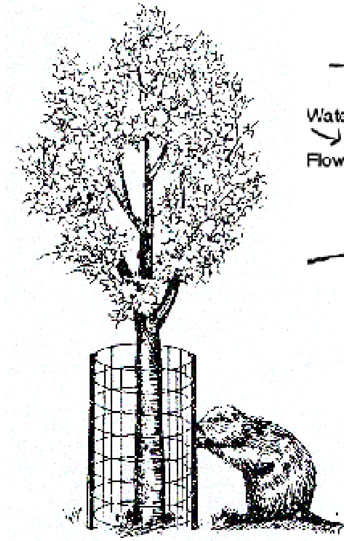
Recognizing beaver can cause damage, builds your credibility – empathize with the impacted

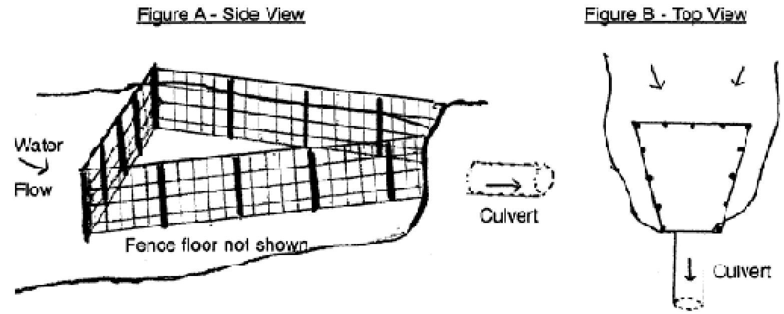
No denying, beaver can:

- cause flooding
- block culverts, which wash out roads
- chop down ornamental landscape trees
- impact irrigation diversions

Living With Beaver Strategies…

- Is problem real or perceived?
- If real:
  - ‘Beaver Deceivers’
  - ‘Pond Levelers’
  - ‘Caging’ or painting trees
  - All require maintenance
- If those don’t work, live trap and relocation





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Low-tech process-based restoration

noun

1. A practice of using simple, low unit-cost, structural additions (e.g., wood and beaver dams) to riverscapes to mimic functions and promote specific processes. Hallmarks of this approach include an explicit focus on the promoting geomorphic and fluvial processes, a conscious effort to use cost-effective, low-tech treatments (e.g., hand-built, natural materials, non-engineered, short-term design life-spans) because of the need to efficiently scale-up application, and '*Letting the system do the work*', which defers critical decision making to riverscapes and beaver.

Key Processes to DESIGN & SOLVE for!!!

PALS and BDAs

PALS

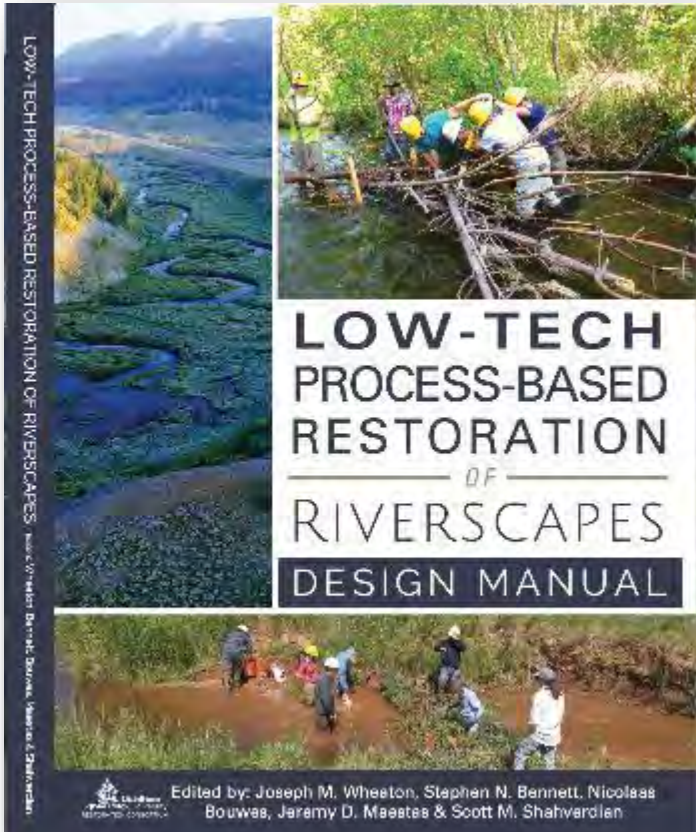
POST-ASSISTED LOG STRUCTURES

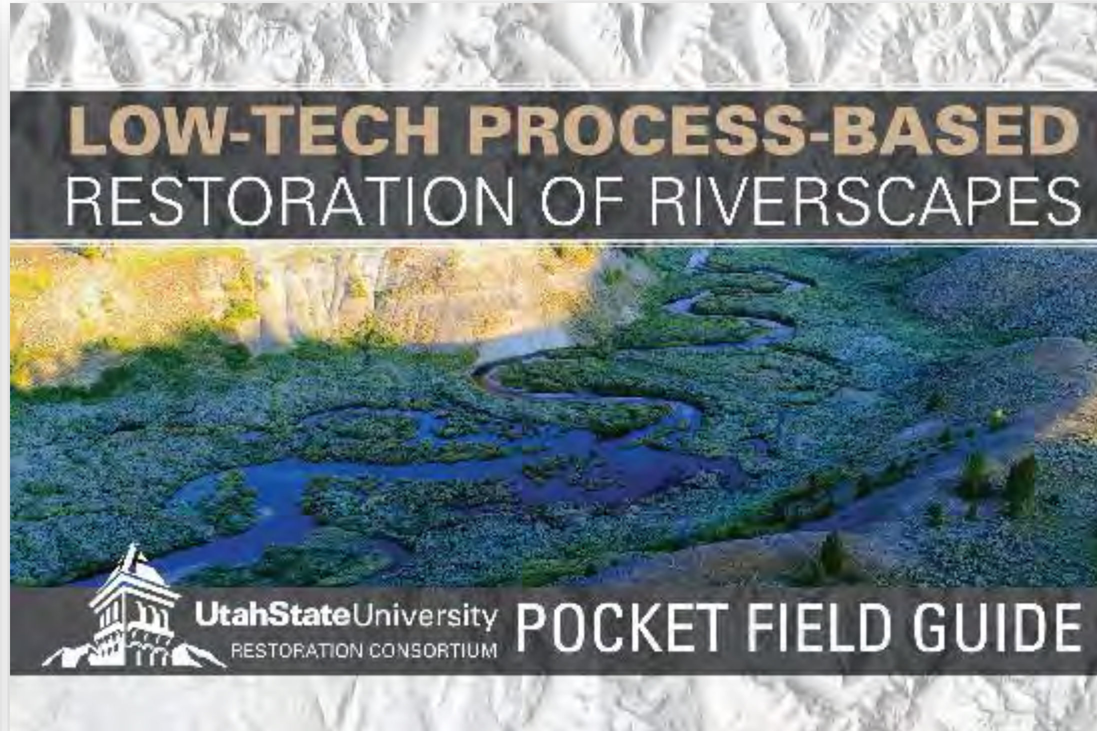
- PALS are handbuilt structures that mimic and promote the processes of **wood accumulation.**
- Woody material of various sizes pinned together with untreated wooden posts driven into the substrate.

BDAs

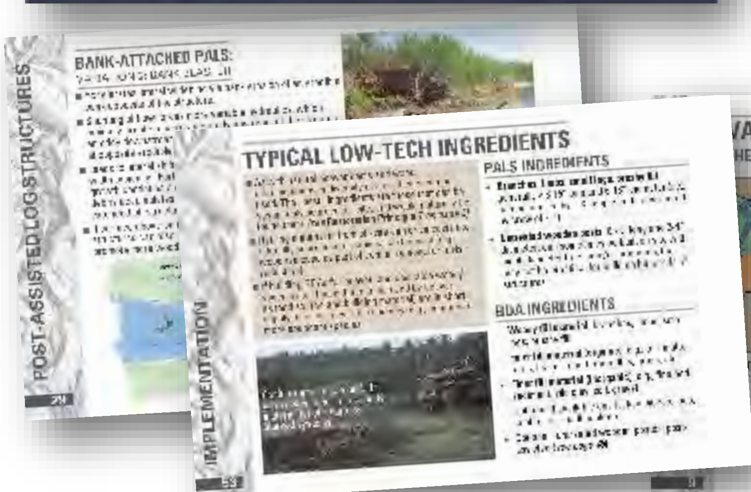
BEAVER DAM ANALOGUES

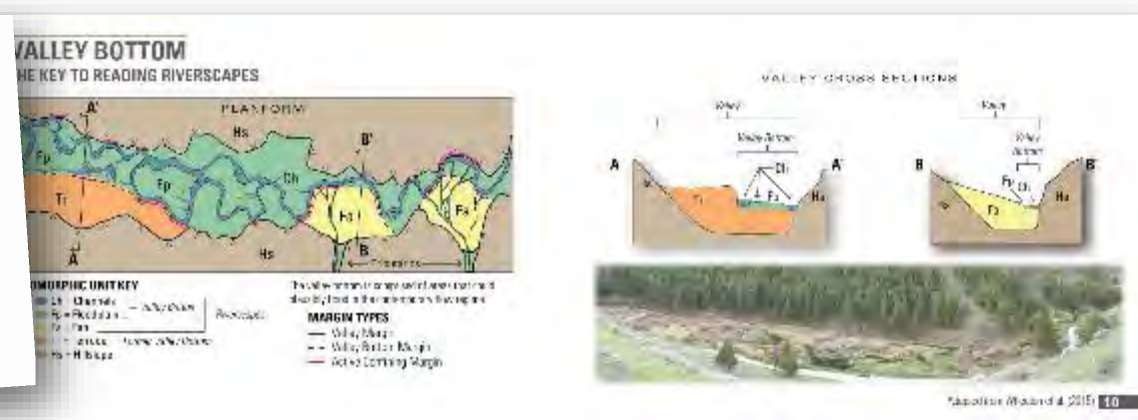
- BDAs are handbuilt structures that mimic and promote the processes of **beaver dam activity.**
- BDAs are a permeable, channel-spanning structure with a constant crest elevation, constructed with a mixture of woody debris and fill material to promote temporary ponding of water.





- Manual defines LTPBR Standard of Practice
- Print version now available for $60 on Amazon





Free Digitally @: http://lowtechpbr.restoration.usu.edu

THERE IS STRENGTH IN NUMBERS
RESTORATION PRINCIPLE 6.

Build the workforce!

We've taught over 20 LTPBR workshops

See Wheaton et al. (2019, p. 283)
Chapter 7 of LTPBR Manual
DOI: 10.13140/RG.2.2.18332.33922.

Free Self-Paced Workshop Modules

Modules on:

1. Intro to LTPBR
2. Science
3. Planning
4. Design
5. Implementation

http://lowtechpbr.restoration.usu.edu

A Lot of Amazing People are behind LTPBR:

An incomplete acknowledgement…

Working Lands for Wildlife

Sage Grouse Initiative

U.S. Fish & Wildlife Service – Department of the Interior

Pheasants Forever – The Habitat Organization

Trout Unlimited

The Nature Conservancy

Beaver Institute

Blue Forest Conservation – Financial Innovation for Sustainable Solutions

Worth A Dam

NOAA

USDA United States Department of Agriculture – Natural Resources Conservation Service

Grand Canyon Trust

Walton Family Foundation

Yakama Nation Fisheries

Snake River Salmon Recovery

Asotin County Conservation District – Assisting, protecting, and restoring Asotin County's natural resources.

Palouse Conservation District

National System of Public Lands – U.S. Department of the Interior – Bureau of Land Management

Upper Deschutes Watershed Council

Methow Beaver Project

California Republic

Watershed Artisans

Bonneville Power Administration

Utah's Watershed Restoration Initiative

Montana Fish, Wildlife & Parks

Colorado Parks & Wildlife

Swiftwater Design

Eco Logical Research

North Arrow Research

Watershed Solutions Inc

Forest Service – U.S. Department of Agriculture

Utah DNR Wildlife Resources

Oregon Watershed Enhancement Board – OWEB

Oregon Fish & Wildlife

Idaho Fish & Game

Nevada Department of Wildlife

Anabranch Solutions

Riverscapes Consortium

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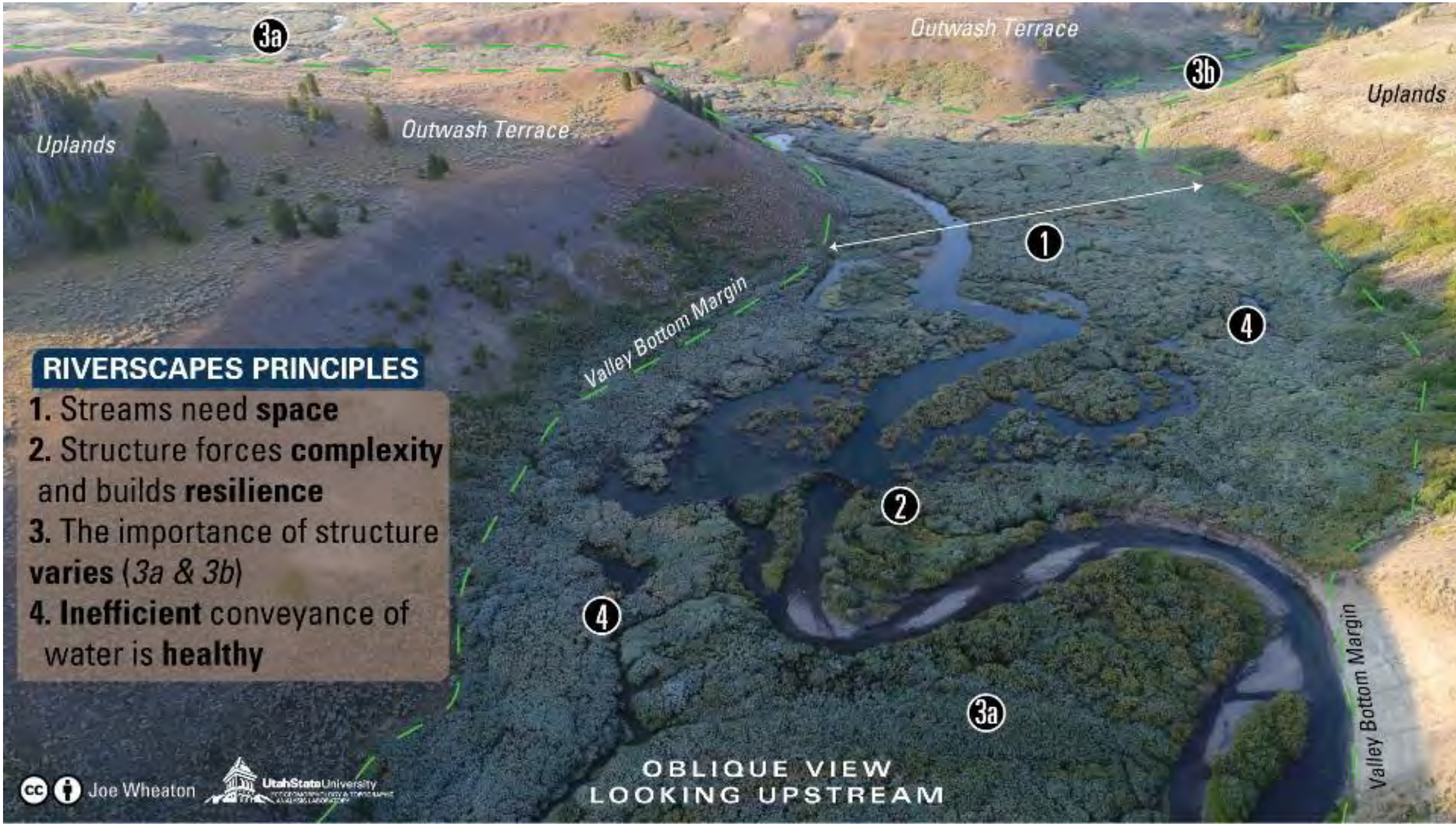
Really… Remember the Principles

Take some time to pause and focus on health, healing & hope

A whole day to say what we cover in 4 pages and a top 10 list…

Free Digitally @: http://lowtechpbr.restoration.usu.edu

What constitutes a healthy riverscape?



From pages 3-4 of Pocket Guide; Wheaton et al. (2019)

DOI: 10.13140/RG.2.2.28222.13123/1

Riverscapes Principles

See Wheaton et al. (2019, p 60): Chapter 2 LTPBR Manual for Principles

DOI: 10.13140/RG.2.2.34270.69447

Low-Tech Restoration Principles

RESTORATION PRINCIPLES

5. It's okay to be **messy**
6. There is strength in **numbers**
7. Use **natural** building materials
8. Let the system **do the work**
9. **Defer decision making** to the system
10. **Self-sustaining** systems are the solution

From pages 3-4 of Pocket Guide; Wheaton et al. (2019)

DOI: 10.13140/RG.2.2.28222.13123/1

See Wheaton et al. (2019, p 72)

Chapter 2 LTPBR Manual for Principles

DOI: 10.13140/RG.2.2.34270.69447

Beaver Like to Make Messes… So can you

- And it is precisely that messiness, that is so critical to ecosystem health
- So why not take a cue from the rodent?

9. Defer Decision Making to System

Pocket Guide; Wheaton et al. (2019, p. 3-4)
DOI: 10.13140/RG.2.2.28222.13123/1

See Wheaton et al. (2019, p 77)
Chapter 2 LTPBR Manual for Principles
DOI: 10.13140/RG.2.2.34270.69447

10. Self-Sustaining Systems are the Solution

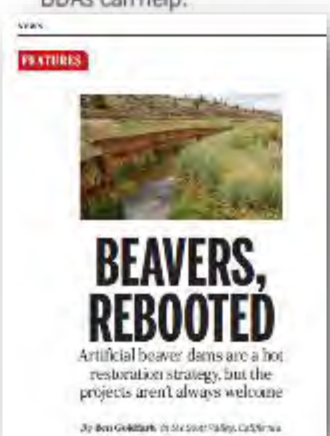
From Goldfarb (2018) Science:
http://science.sciencemag.org/content/360/6393/1058

Adding dams
Beaver trapping and overgrazing have caused countless creeks to cut deep trenches and water tables to drop, drying floodplains. Installing BDAs can help.

Widening the trench
BDAs divert flows, causing streams to cut into banks, widening the incised channel, and creating a supply of sediment that helps raise the stream bed.

Beavers return
As BDAs trap sediment, the stream bed rebuilds and forces water onto the floodplain, recharging groundwater. Slower flows allow beavers to recolonize.

A complex haven
Re-established beavers raise water tables, irrigate new stands of willow and alder, and create a maze of pools and side channels for fish and wildlife.


FEATURES

BEAVERS, REBOOTED

Artificial beaver dams are a hot restoration strategy, but the projects aren't always welcome

What's your exit strategy?

Mimic → Promote → Sustain

So back to the title and purpose?

Identifying Where to Place Beavers and When to Use Beaver Mimicry for Low Tech Restoration

Expectation management around beaver as a restoration/conservation partner, vs. mitigating their impacts in riverscapes

When, where and how to play the beaver cards?

From Goldfarb (2018) Science: http://science.sciencemag.org/content/360/6393/1058

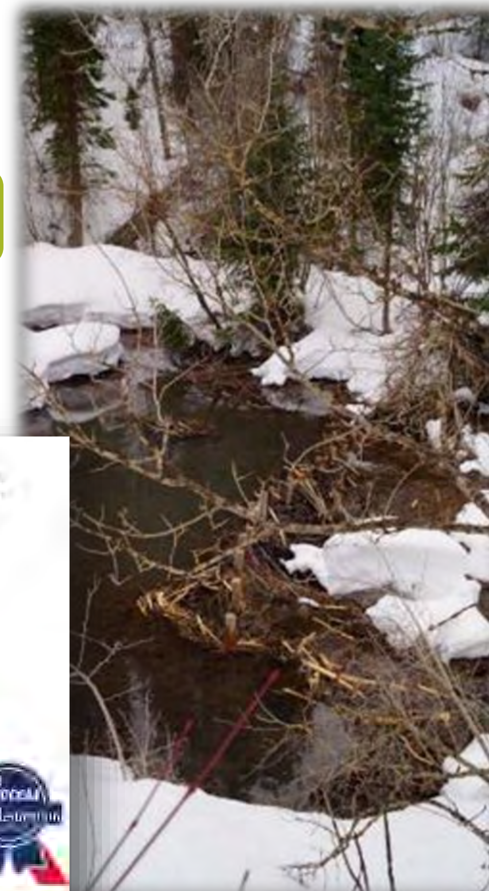
RIVERSCAPES CONSORTIUM

Meet the BRAT

Beaver **R**estoration **A**ssessment **T**ool

Build your understanding of BRAT for:

- conservation/restoration planning & prioritization
- risk/opportunity assessment
- expectation management



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6. Mimic Beaver Dam Activity – *construction & maintenance (low-tech… NOT PBR)*

Just a tool… we'll use it to organize our thoughts, but don't get obsessed with having the tool run

Acknowledging 'WE' from USU & NAR Development Team…

- **Wally Macfarlane (USU)**
- **Philip Bailey (NAR)**
- **Matt Reimer (NAR)**
- **Sara Bangen (USU)**
- **Jordan Gilbert (USU)**
- **Maggie Hallerud (USU)**
- **Tyler Hatch (USU)**
- Cashe Rasmussen (USU)
- Chalese Hafen (USU)
- Mic Albonico (USU)
- Braden Anderson (USU)
- Karen Bartelt (USU)
- Josh Gilbert (USU)
- Konrad Hafen (USU)
- Elijah Portugal (USU)
- Nick Bouwes (ELR/USU)
- Matt Meier (USU)
- Nick Weber (ELR/ Anabranch)
- Scott Shahveridan (USU/Anabranch)
- And many others… we are neglecting

BRAT

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE · NATIONAL PARK SERVICE · U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT · U.S. FISH & WILDLIFE SERVICE · IDAHO FISH & GAME · UTAH DNR WILDLIFE RESOURCES · The Nature Conservancy · EcoLogical Research, Inc. Science Driven Solutions · RIVERSCAPES CONSORTIUM

Conservation Planning Process

Phase 1 – Planning
Phase 2 – Design
Phase 3 – Implementation

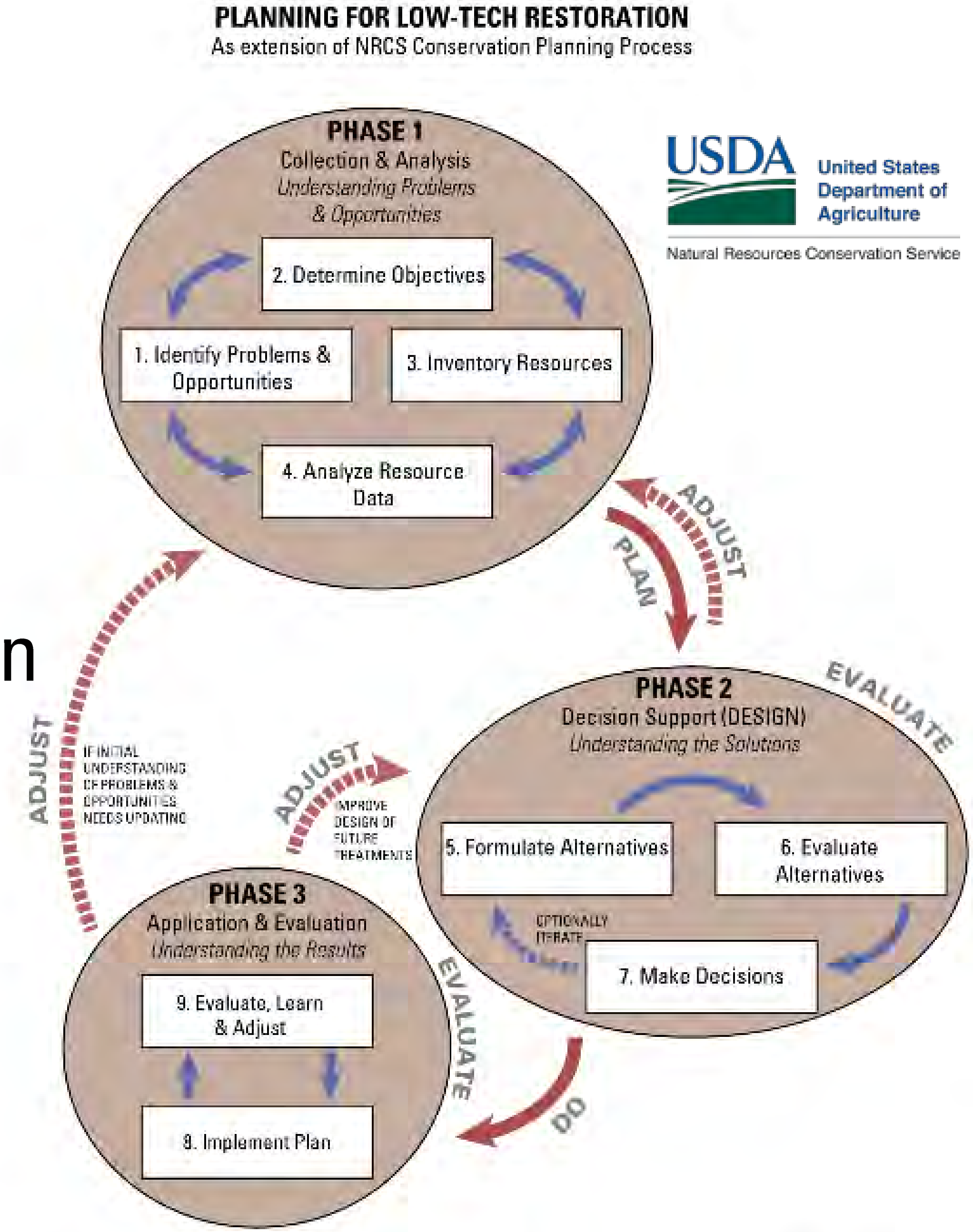


Figure 3.1 (p. 89) from Bennett et al. (2019)
Chapter 3 LTPBR Manual
DOI: [10.13140/RG.2.2.15815.75680]

Covered in Detail in Module 3

FOCUS on Key Questions related to Low-Tech Process-Based Restoration

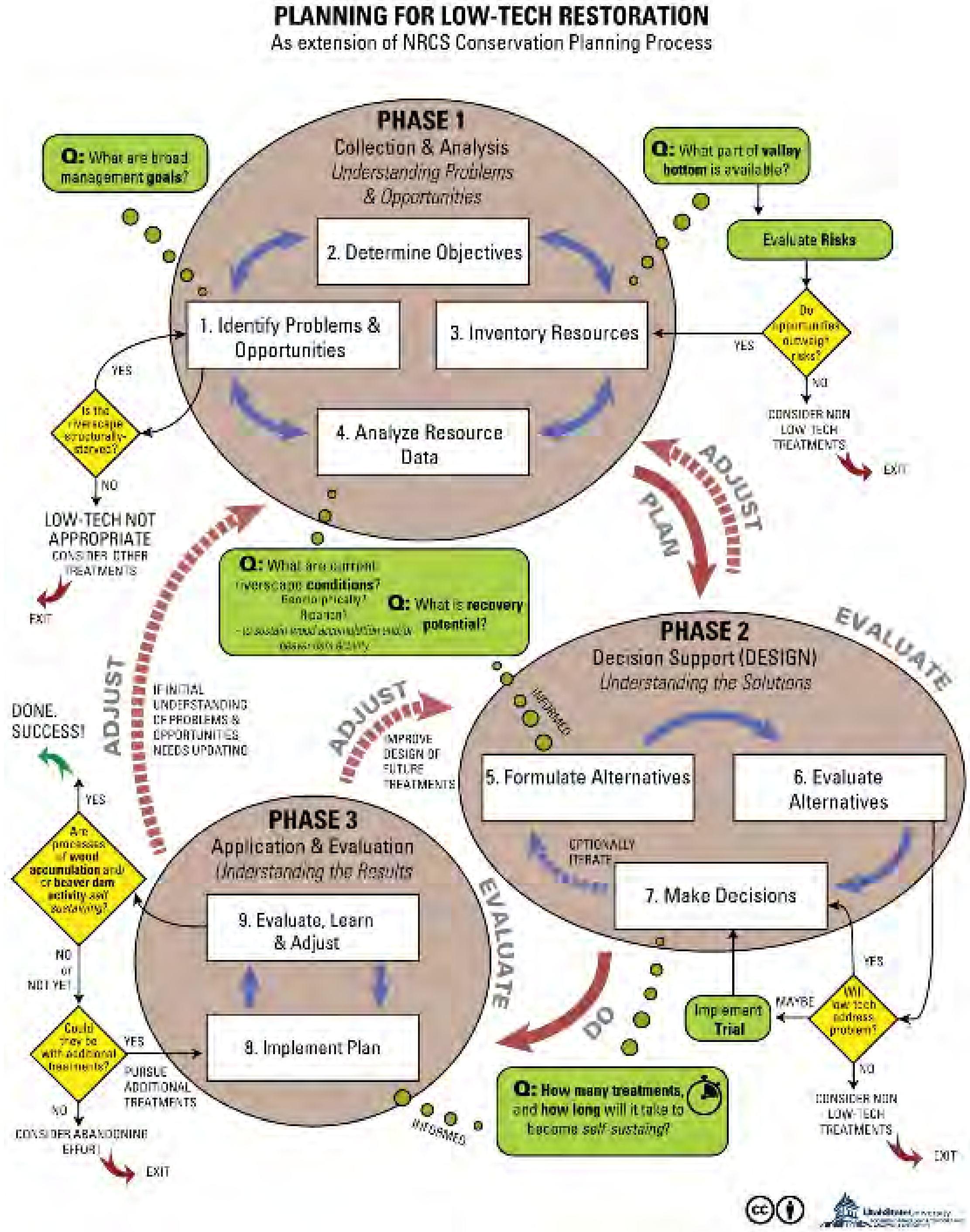


Figure 3.20 from Bennett et al. (2019, p 115)
Chapter 3 LTPBR Manual
DOI: 10.13140/RG.2.2.15815.75680

PHASE 1 with Low-Tech

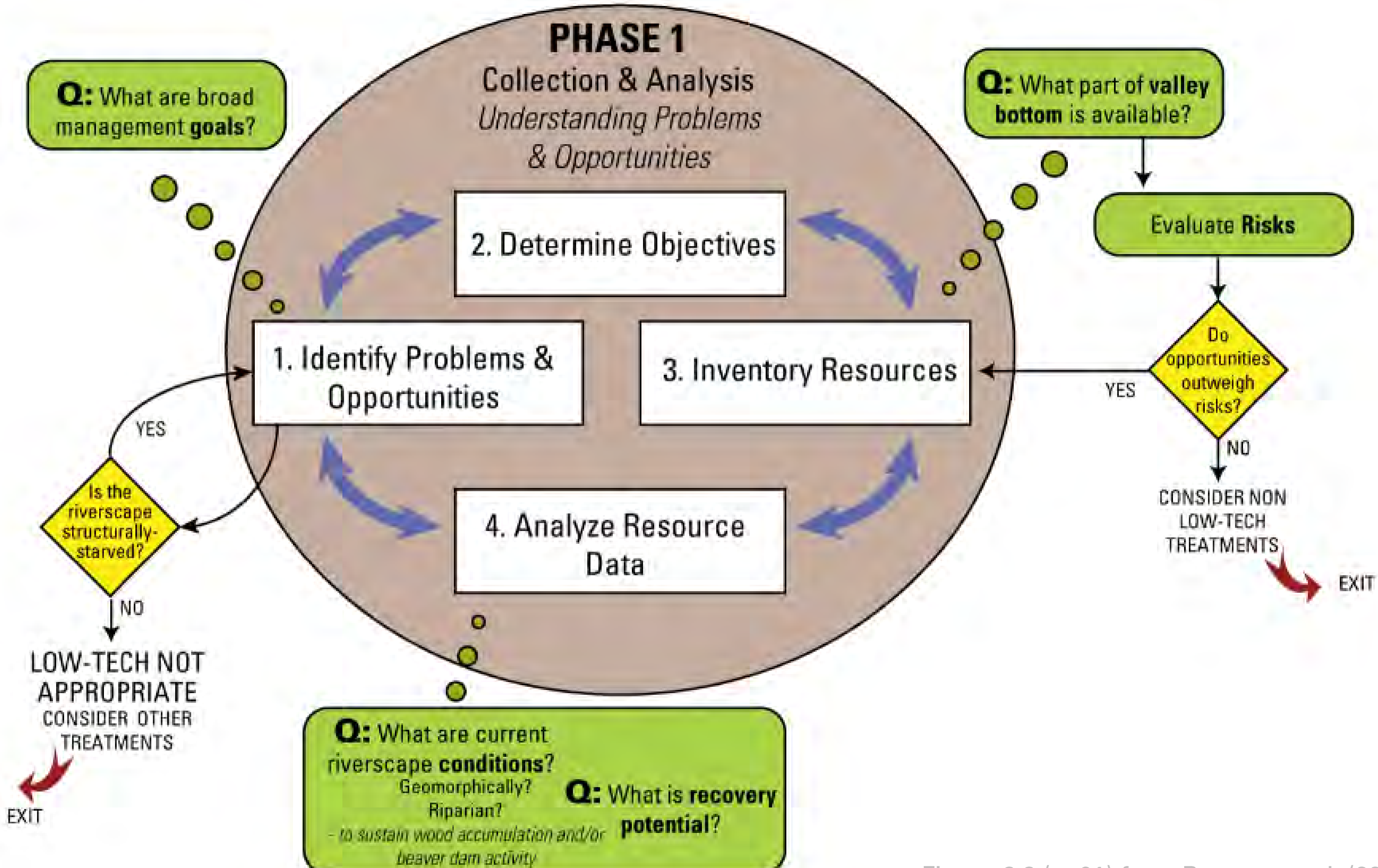


Figure 3.3 (p. 91) from Bennett et al. (2019) – Chapter 3 LTPBR Manual

DOI: 10.13140/RG.2.2.15815.75680

Take a Moment to Consider…

Q: What are current riverscape **conditions**?
Geomorphically?
Riparian?
- to sustain wood accumulation and/or beaver dam activity

Q: What is **recovery potential**?

Fall Creek
Couburn Creek
all Creek

1. Are the woody or vegetative resources present to support process of **wood accumulation**?
2. Could **beaver dam activity** be supported?

Could **beaver dam activity** be supported?

See Appendix 3F (p 127) in Bennett et al. (2019)

Chapter 3 LTPBR Manual

DOI: 10.13140/RG.2.2.15815.75680

BRAT

See: http://brat.riverscapes.xyz

- If beaver dams are present… apparently
- If so, to what degree?
- How much beaver dam activity?
- How much more?

Q: What are current riverscape **conditions**?
Geomorphically?
Riparian?
- to sustain wood accumulation and/or beaver dam activity

Q: What is **recovery potential**?

OUTLINE

Identifying Where to Place Beavers and When to Use Beaver Mimicry for Low Tech Restoration

I. Background & Other Resources

II. **Dam Building Focus – Expectations**

III. Contextualizing Risk

IV. Prioritizing Opportunities

V. Partnering with Beaver… A people business

Dam-Building Capacity Modeling

- **Beaver dams,** not beaver themselves, provide the desired impacts to habitat
- While beaver can survive in wide range of conditions, **where they build dams is more limited**
- Dam building activity varies dramatically according to availability of **dam building materials & flow regime**

Capacity Model In A Nutshell

Dam building beaver need water and wood…

- Type and extent of wood/vegetation matters most
- Flow regime act to potentially limit capacity

The Primary Questions We Ask

1. Is their *enough* **water** present to maintain a pond?
2. Are *enough* and the *right* type of **woody** resources present to support dam building?
3. Can they **build a dam** at *base flows?*
4. Are dams likely to withstand *typical floods*?

Macfarlane et al. (2016) DOI: 10.1016/j.geomorph.2015.11.019

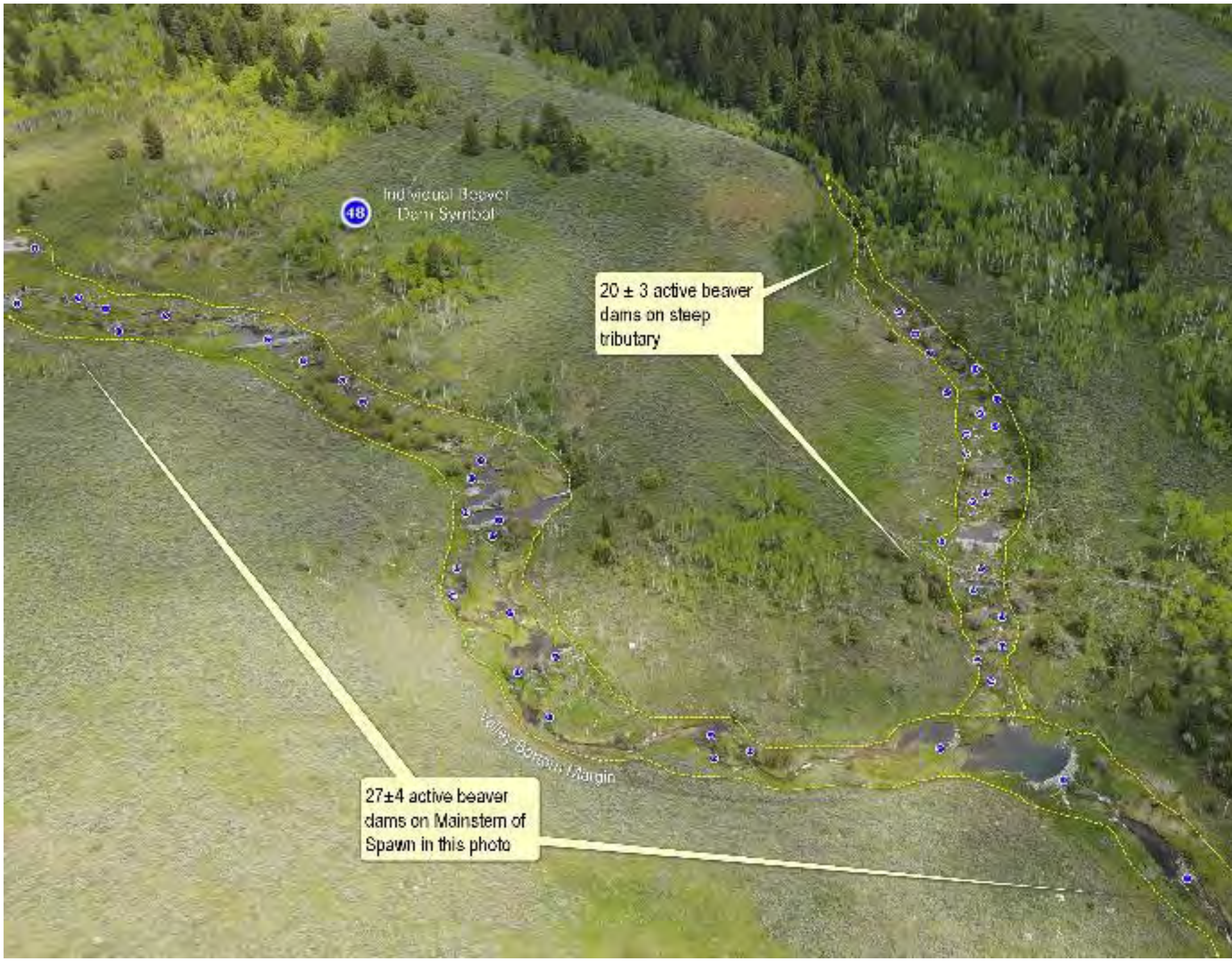
Some nationally-available lines of evidence to address questions:

- NHD – perennial streams (1:24K)
- LANDFIRE - vegetation type (EVT)
- USGS Regional Curves for
  - *Baseflow statistics*
  - Q_2
- USGS NED 10 m DEM – derive reach slope and estimate stream power

BRAT Dam Capacity Model

- Resolves **where** and at **what level** (within a drainage network) **beaver dams** can be built and sustained.

How many Dams? Capacity is upper limit?



Joe Wheaton @flu... · May 31

How many beaver dams do you think you see in Spawn Creek and that tributary (you're looking at 0.5 mile of trib up center of photo and about ~ 1 mile flowing from left to right)?

There aren't any dams!	4.2%
5-10 beaver dams	16.7%
10-50 beaver dams	**62.5%**
> 50	16.7%

24 votes · Final results

1 3

Joe Wheaton
@fluvialwheaton

Thanks to those of you that weighed in. Either 10-50 or > 50 are good answers. All the blue dots are what I counted... ~ 47. There are a lot more both upstream and downstream (left and right) out out of view.

11:12 AM · Jun 3, 2020 · Twitter Web App

How Many & Where?

- Existing capacity: 356,294 dams
- 8.3 dams/km

Table 4
Summary of existing beaver dam gross modeled capacity estimates by capacity categories.

Category	Stream length (km)	% of stream network	Estimated dam capacity
Pervasive	6219	15%	147,644
Frequent	18,162	45%	186,184
Occasional	8234	20%	21,544
Rare	3307	8%	922
None	4639	12%	
Total	40,561		356,294

- Note: Utah is second driest state in US

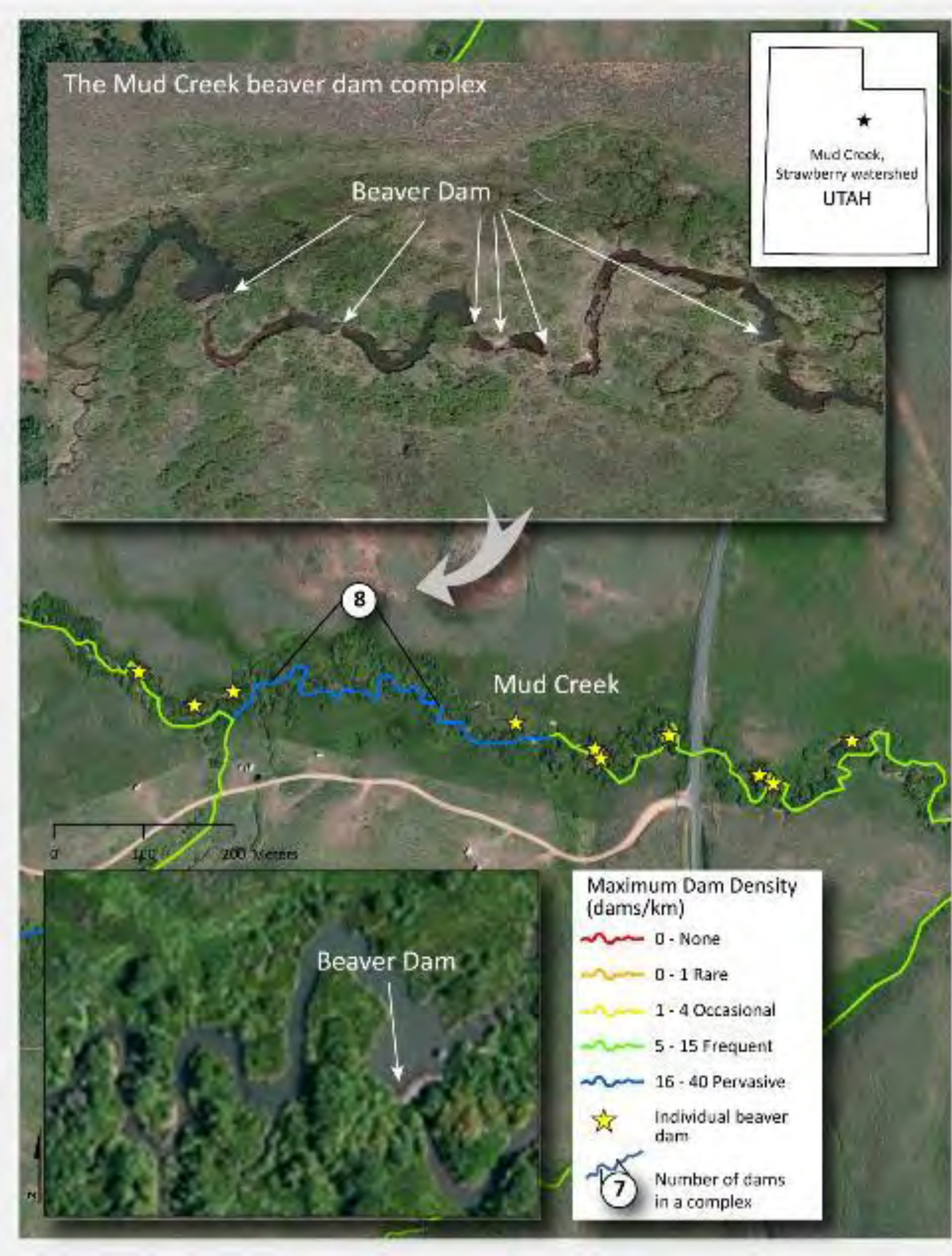
Maximum Dam Density
(Beaver Dams / km)

- 0 : None
- 0 -1 : Rare
- 1 - 4: Occasional
- 5 - 15 : Frequent
- 15 - 40 : Pervasive

From Macfarlane et al. (2016) DOI: 10.1016/j.geomorph.2015.11.019

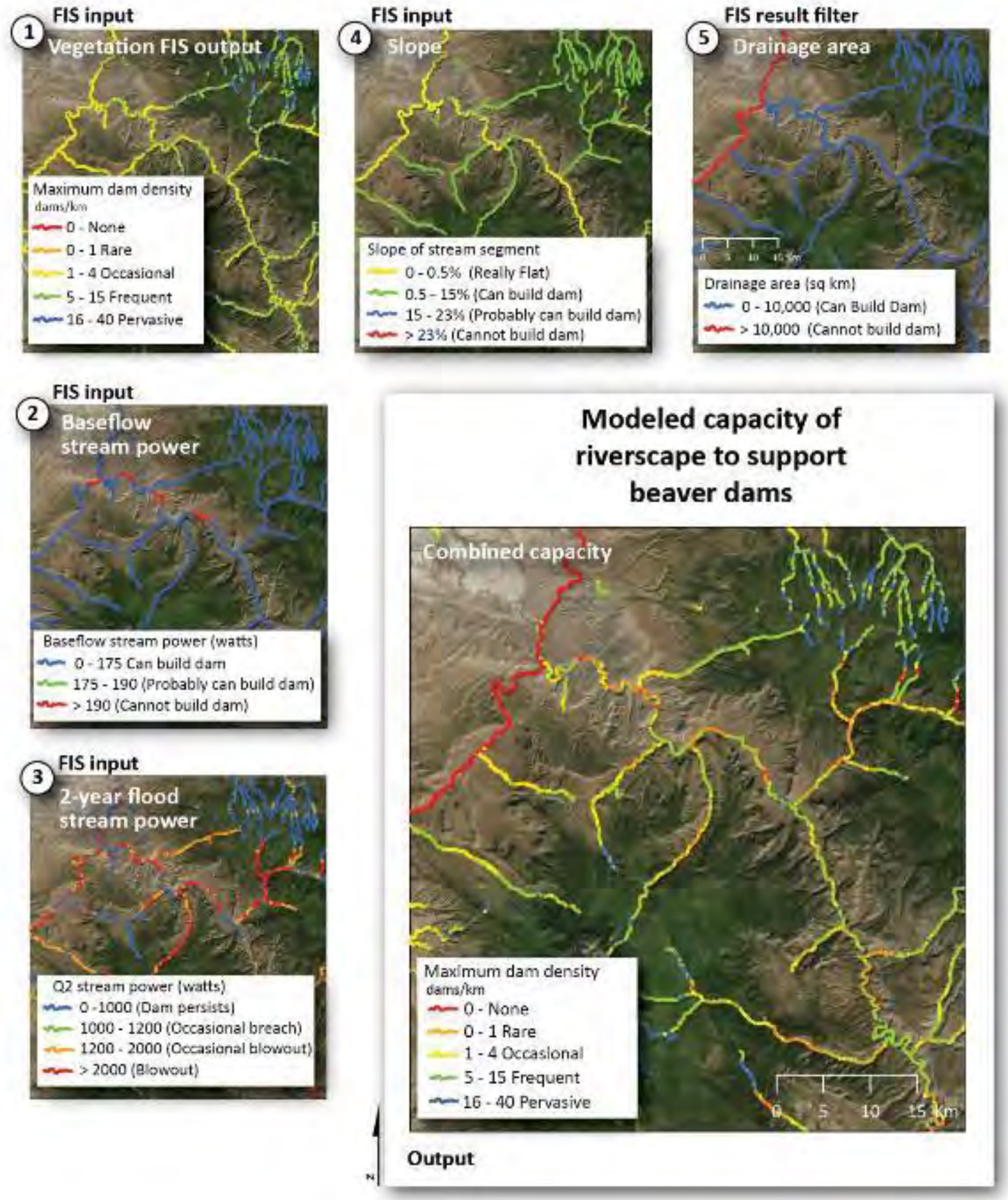
Resolution of BRAT

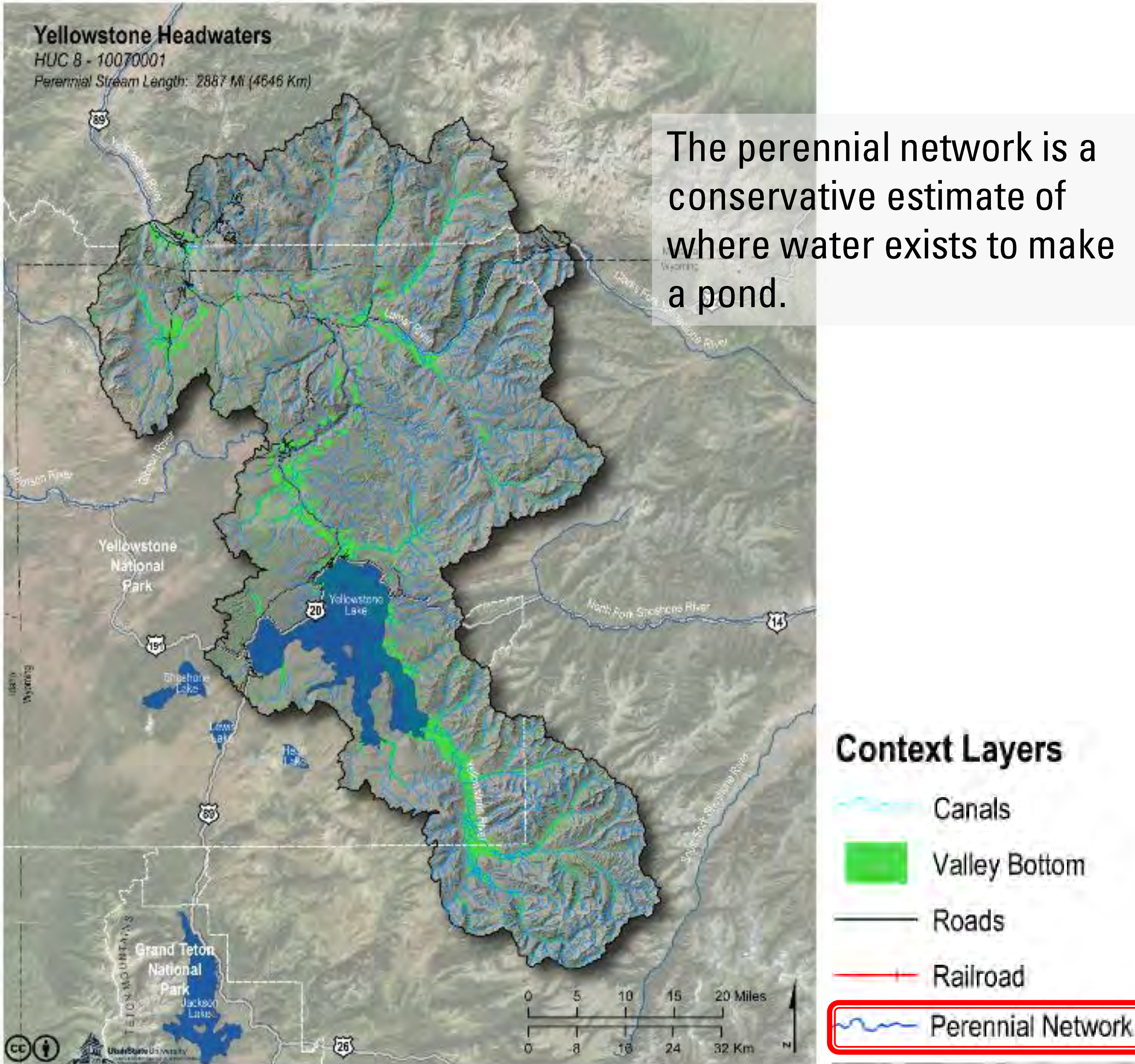
- At a scale that is still meaningful on the ground (250 m reaches)
- Just because BRAT predicts high capacity, does not mean it will be realized… but it does define a plausible upper limit
- In many places, at some point in time this upper limit is reached… just never all at once



The Questions

1. Is their *enough* **water** present to maintain a pond?
2. Are *enough* and the *right* type of **woody** resources present to support dam building?
3. Can they **build a dam** at *base flows?*
4. Are dams likely to withstand *typical floods*?

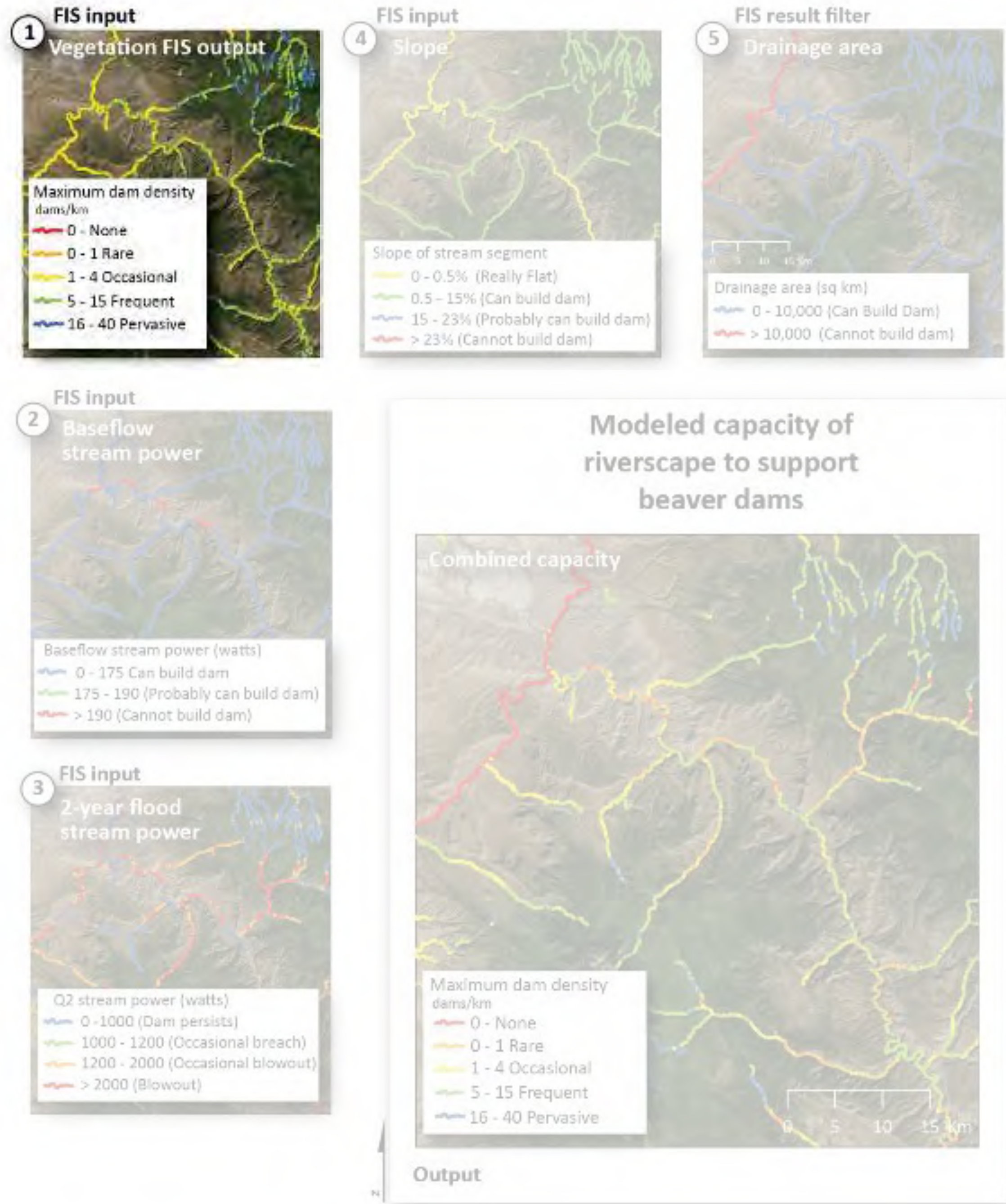




The perennial network is a conservative estimate of where water exists to make a pond.

THE QUESTIONS

1. Is their *enough* **water** present to maintain a pond?
2. Are enough and the right type of woody resources present to support dam building?
3. Can they **build a dam** at *base flows?*
4. Are dams likely to withstand *typical floods*?



After perennial… proceed with veg

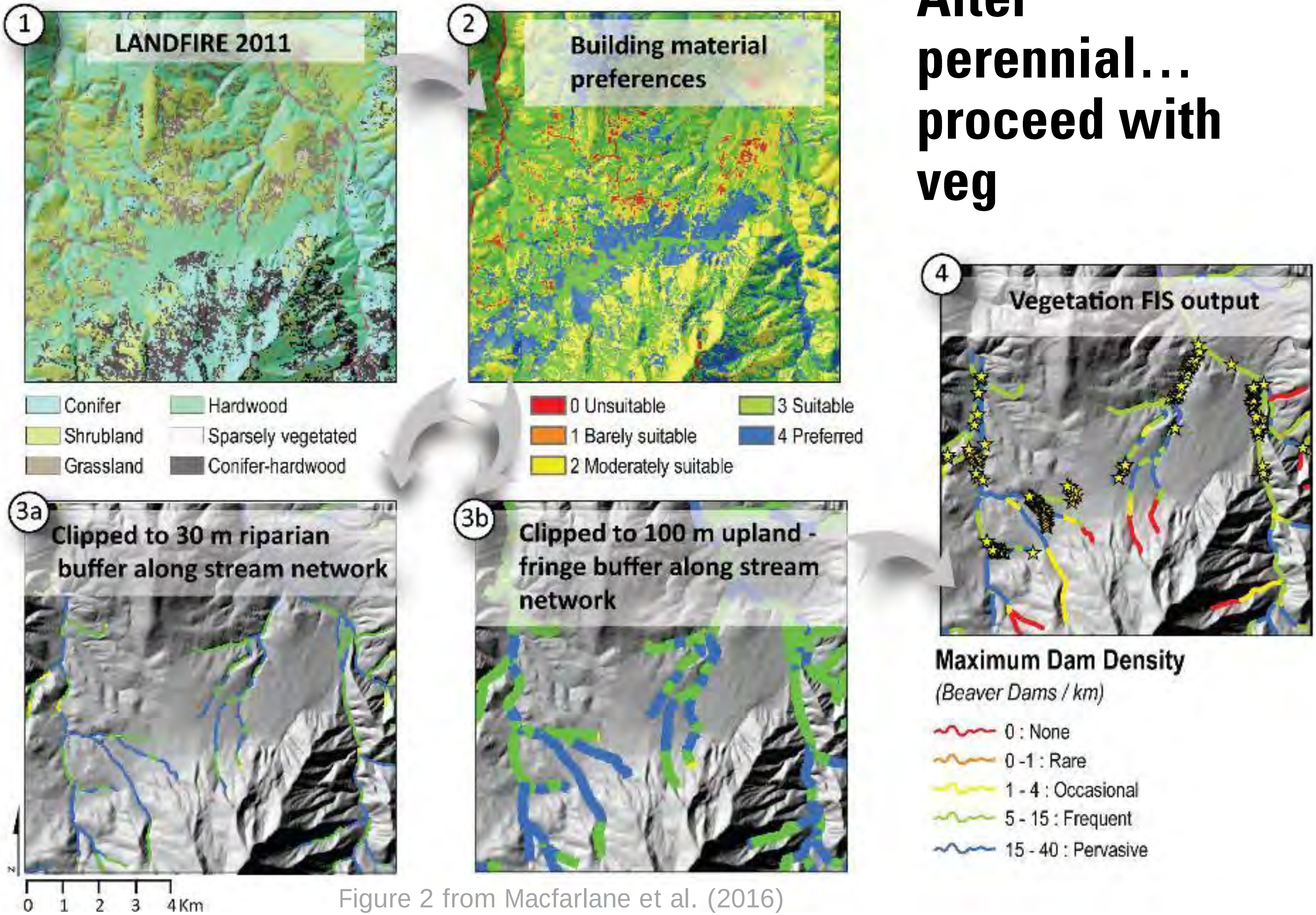
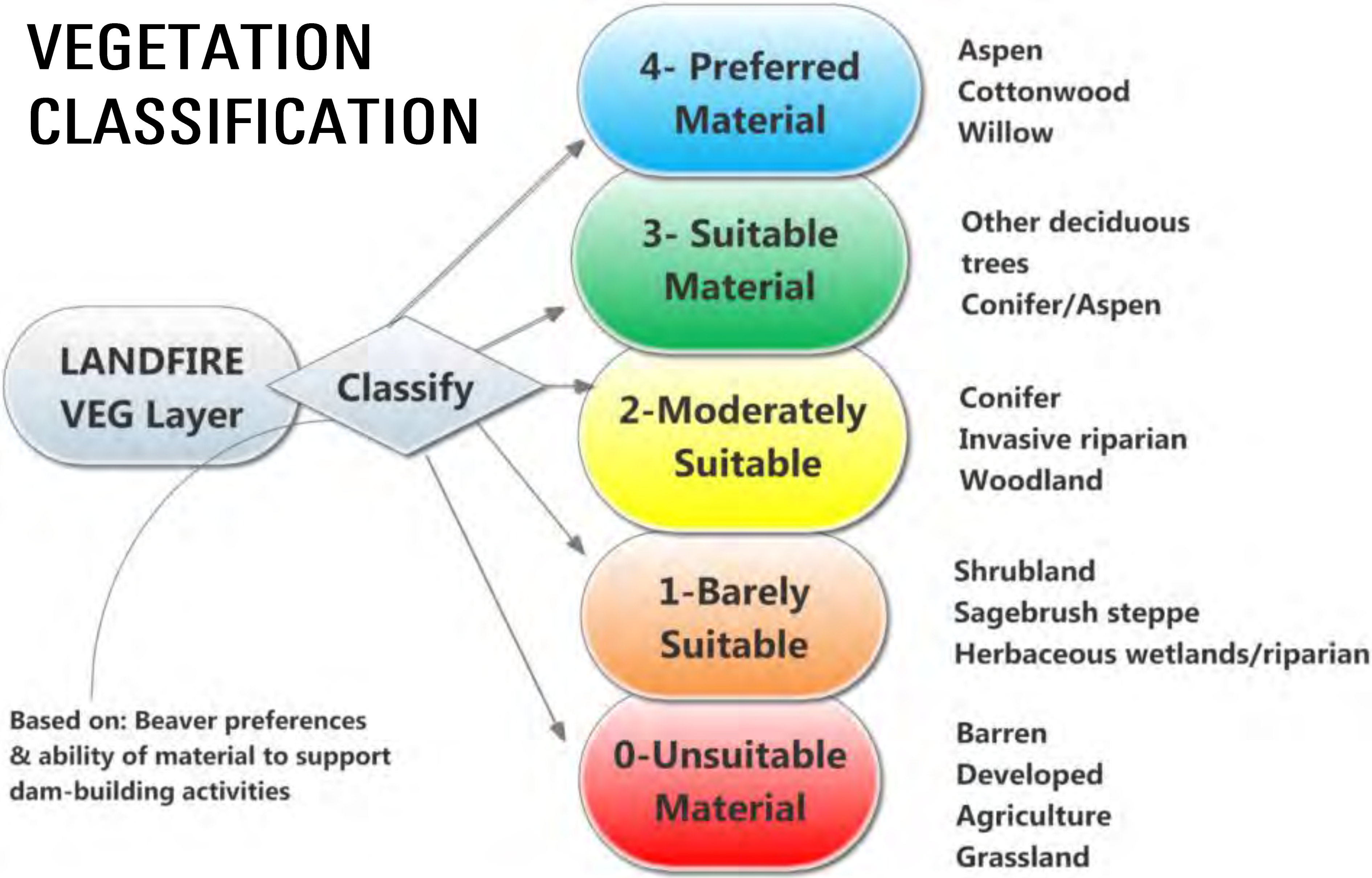


Figure 2 from Macfarlane et al. (2016)

DOI: 10.1016/j.geomorph.2015.11.019

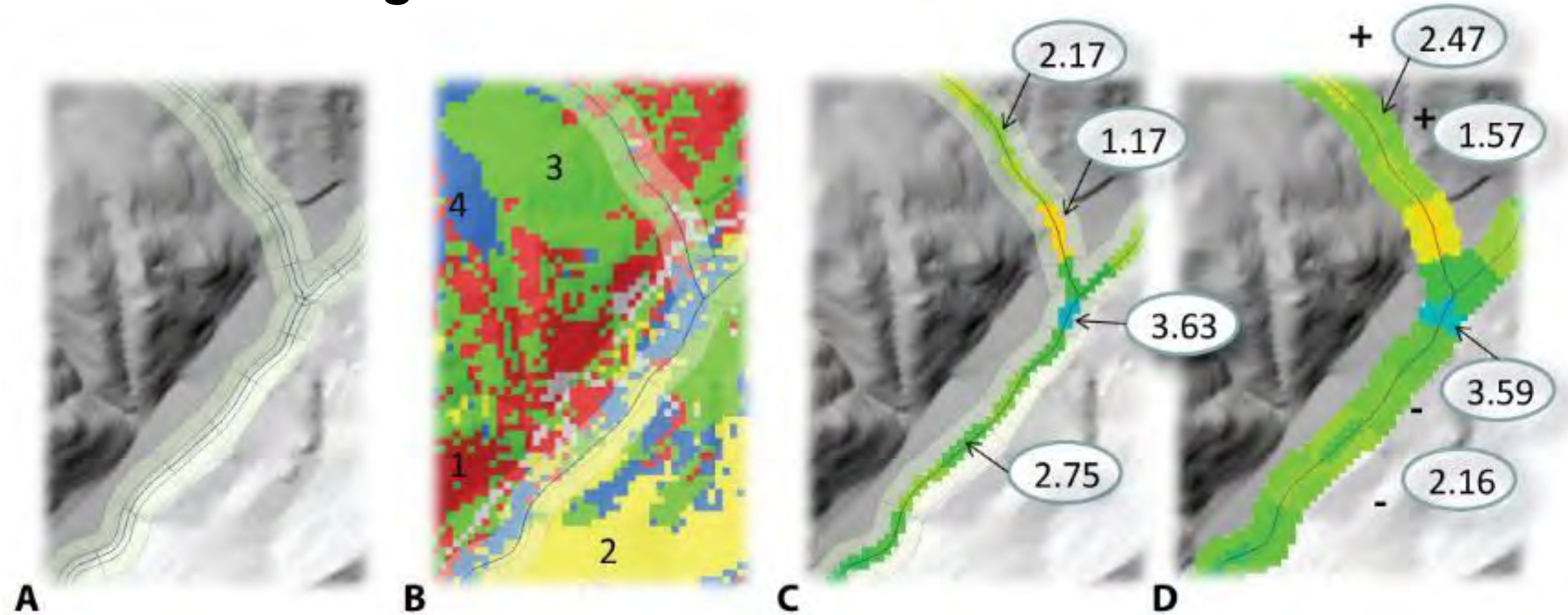

100 m
30 m

VEGETATION CLASSIFICATION



Appropriate Spatial Sampling

Converts Categorical Pixels To Continuous Measure



A. 30 vs. 100 m stream network buffer (300 m reaches)
B. Classified LANDFIRE raster-- shows dam building suitability from 0 (unsuitable) to 4 (optimal)
C. Averaged values for the 30 m buffer (300 m reaches)
D. Averaged values for the 100 m buffer (300 m reaches)

Figure 3 from Macfarlane et al. (2016)
DOI: 10.1016/j.geomorph.2015.11.019

Inference System – (Simple Rules)

	IF	INPUTS: Suitability of Streamside Vegetation		INPUTS: Suitability of Riparian/Upland Vegetation		OUTPUT: Dam Density Capacity
RULES	12	Barely Suitable	&	Moderately Suitable	, then	Occasional
	13	Moderately Suitable	&	Moderately Suitable	, then	Frequent
	14	Suitable	&	Moderately Suitable	, then	Frequent
	15	Preferred	&	Moderately Suitable	, then	Frequent
	16	Unsuitable	&	Suitable	, then	Occasional
	17	Barely Suitable	&	Suitable	, then	Occasional
	18	Moderately Suitable	&	Suitable	, then	Frequent
	19	Suitable	&	Suitable	, then	Frequent
	20	Preferred	&	Suitable	, then	Frequent
	21	Unsuitable	&	Preferred	, then	Occasional
	22	Barely Suitable	&	Preferred	, then	Frequent
	23	Moderately Suitable	&	Preferred	, then	Frequent
	24	Suitable	&	Preferred	, then	Pervasive
	25	Preferred	&	Preferred	, then	Pervasive

MADE FIS – BY FUZZY MEMBERSHIP FUNCITONS

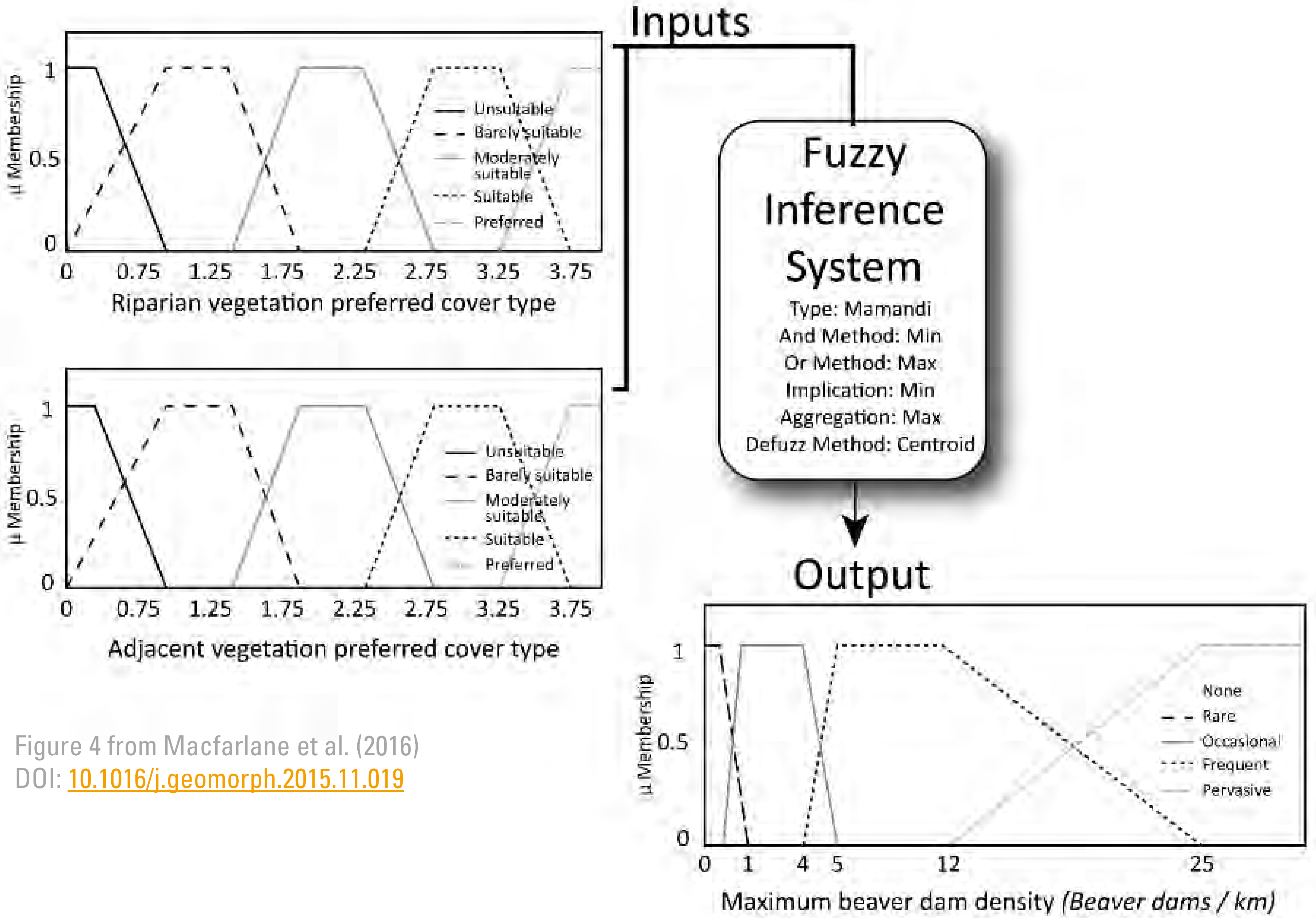


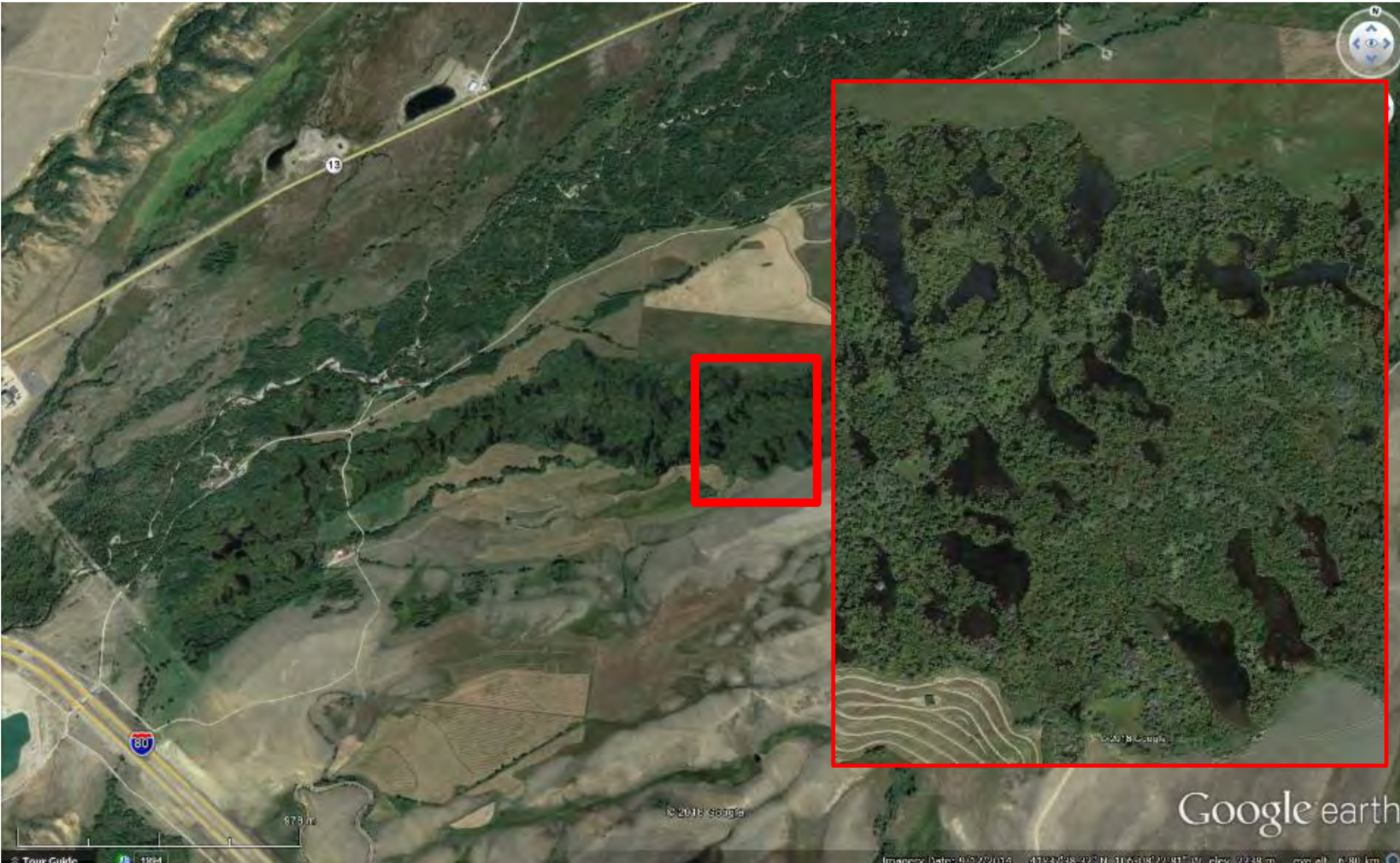
Figure 4 from Macfarlane et al. (2016)
DOI: 10.1016/j.geomorph.2015.11.019

Dam Density Output Categories:

- **None** – **0 dams**: *segments deemed **not capable** of supporting dam building activity*
- **Rare** – **1 dam/km**: *segments **barely capable** of supporting dam building activity; likely used by dispersing beaver*
- **Occasional** – **2-4 dams/km**: *segments that are **not ideal**, but can support an occasional dam or even a small colony*
- **Frequent** – **5-15 dams/km**: *segments that can support multiple colonies and dam complexes, but may be **slightly resource limited***
- **Pervasive** – **16-40 dams/km**: *segments that can support **extensive dam complexes** and many colonies*

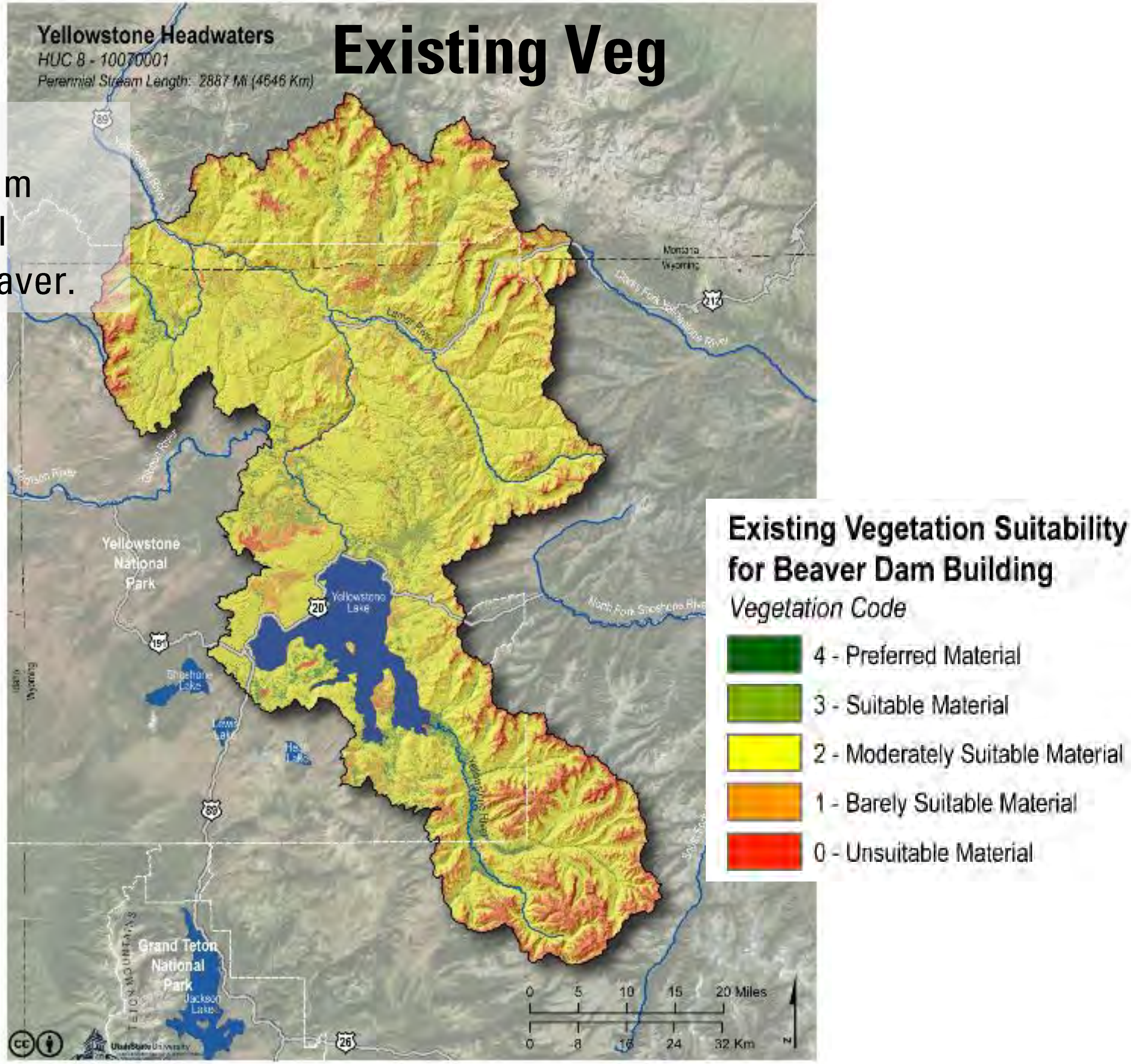
If you don't believe me on dam density

> 100 dams/km … but closer to 40 dams/km/thread (i.e. 1 dam every 25 m)



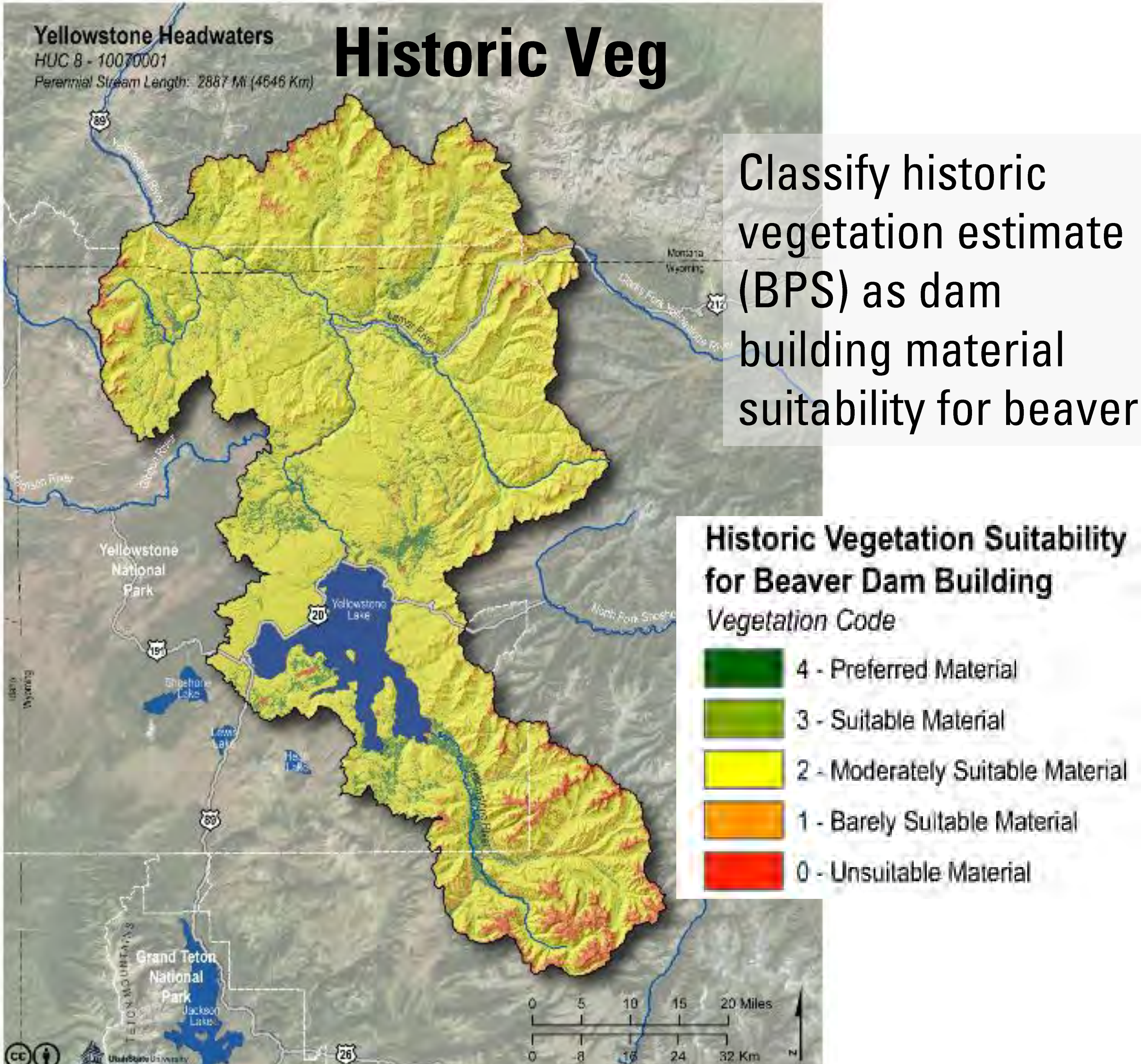
Existing Veg

Classify existing vegetation as dam building material suitability for beaver.



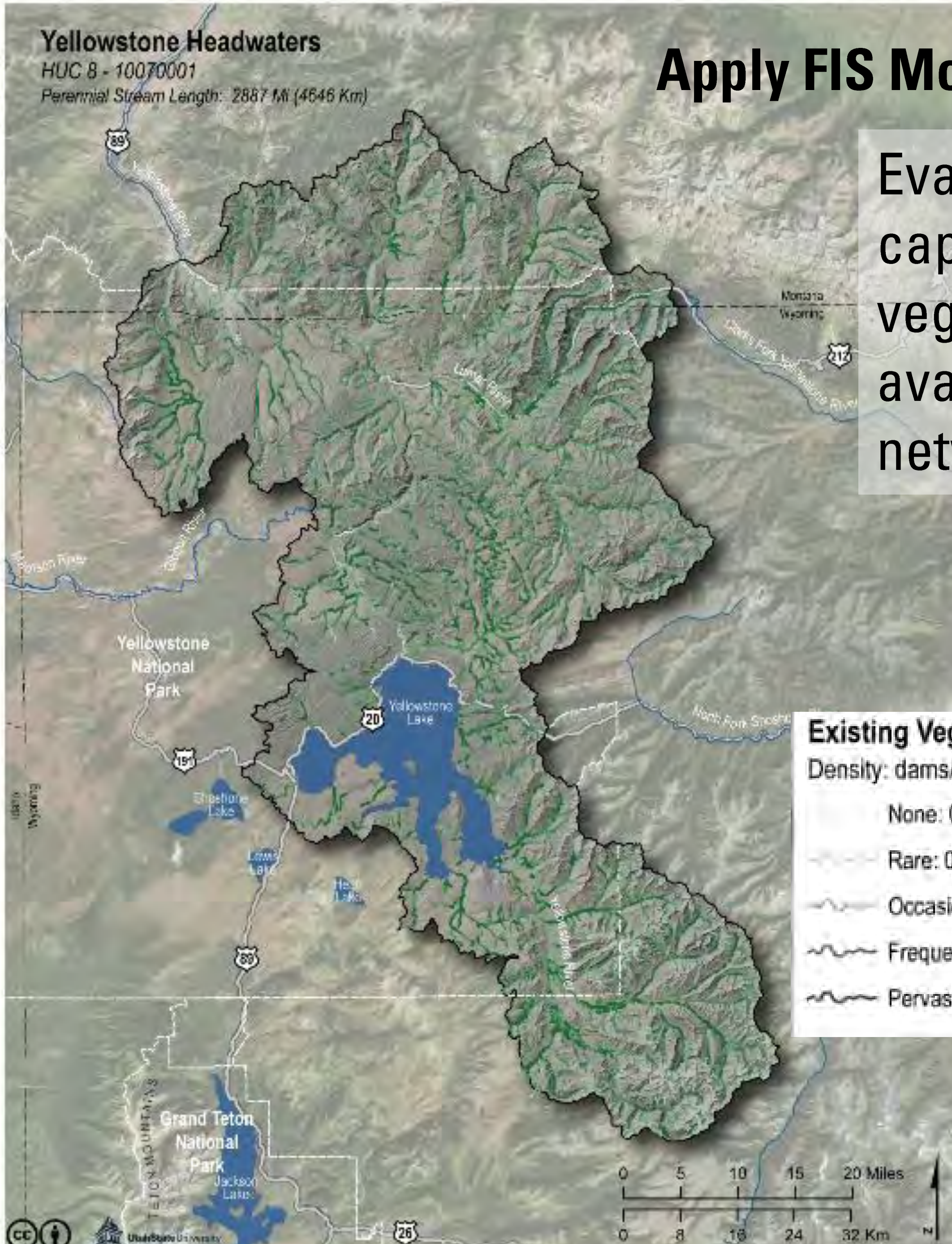
Historic Veg

Classify historic vegetation estimate (BPS) as dam building material suitability for beaver.



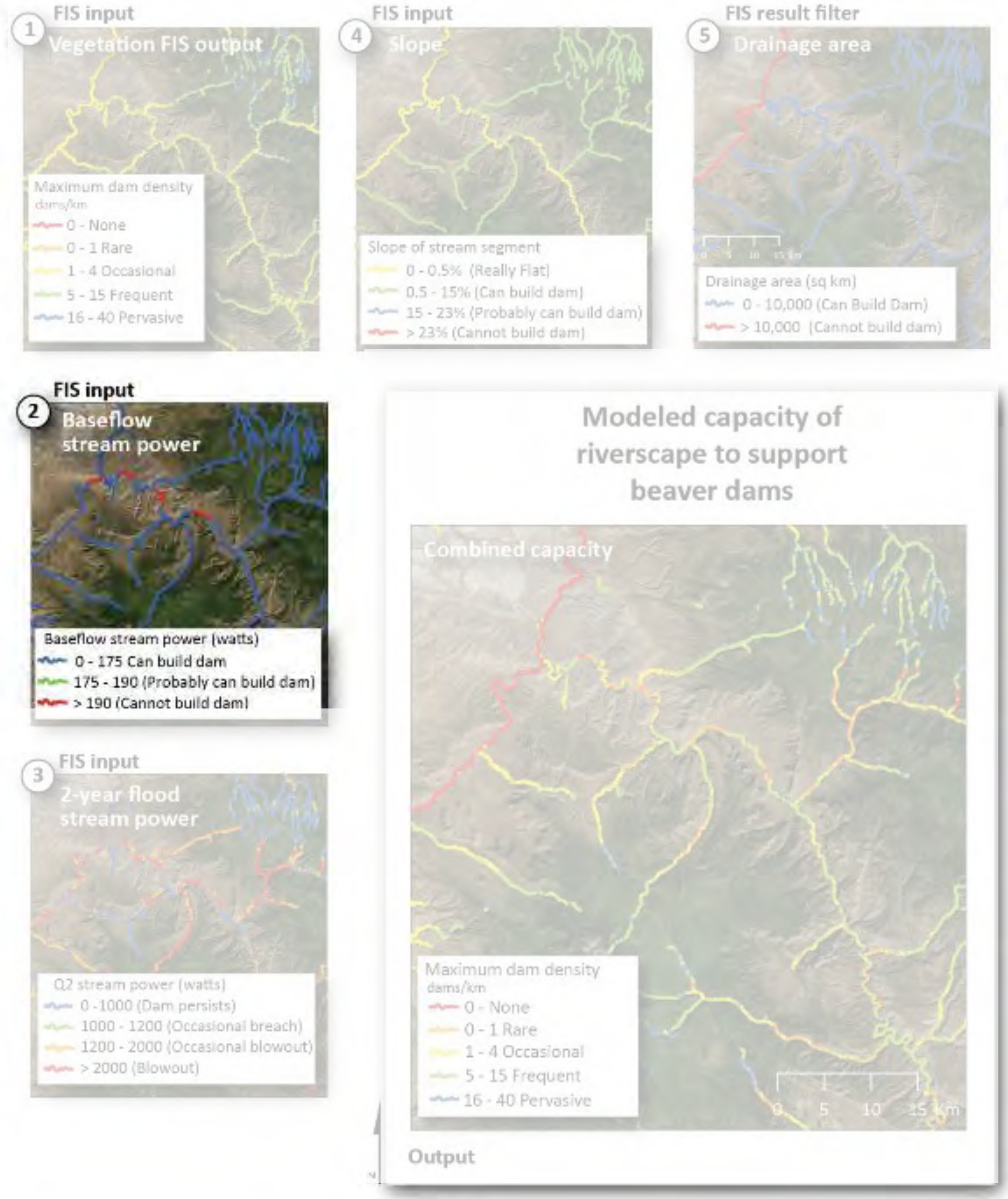
Apply FIS Model → Network

Evaluate **existing** capacity strictly on vegetation availability along network.



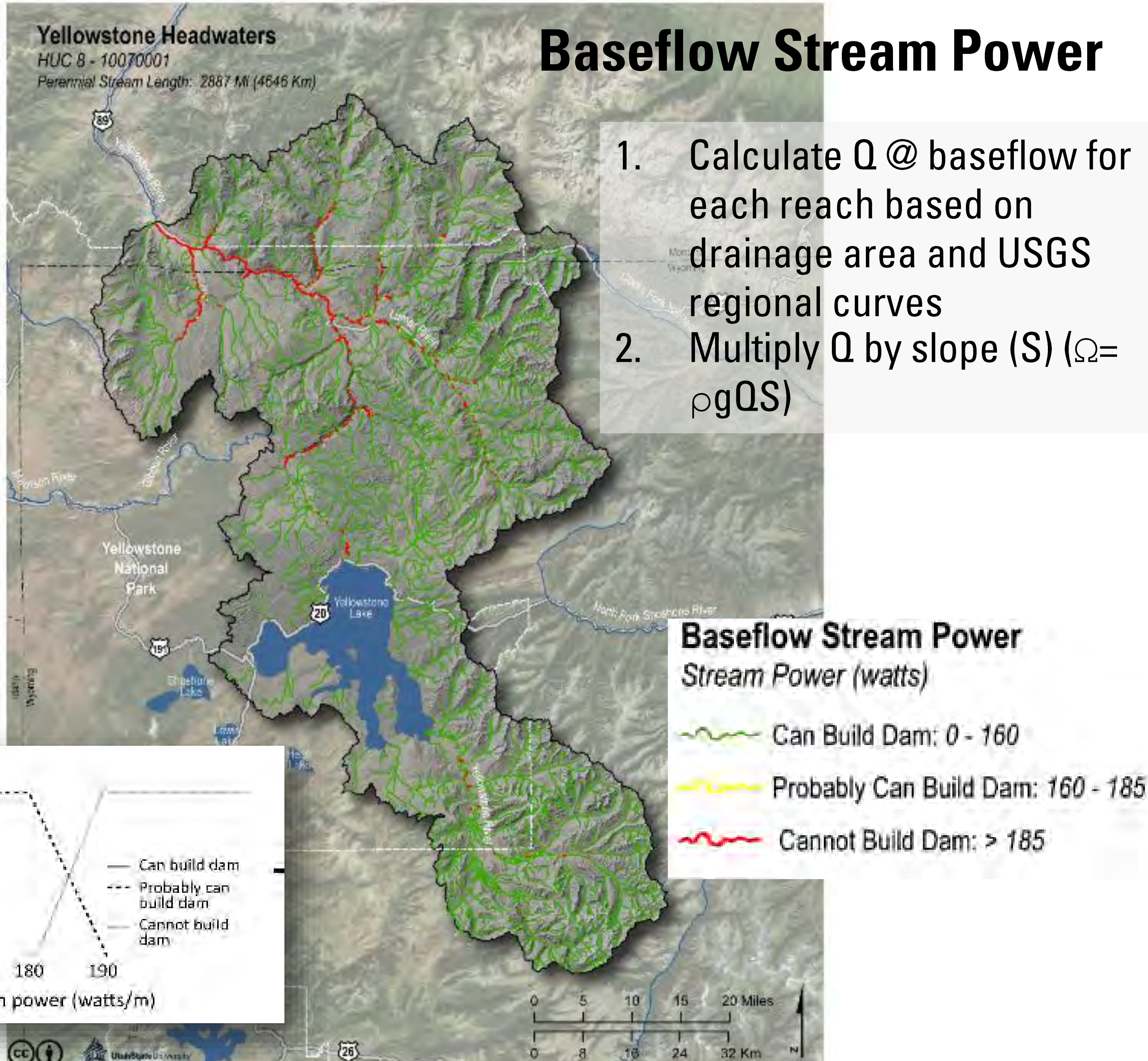
THE QUESTIONS

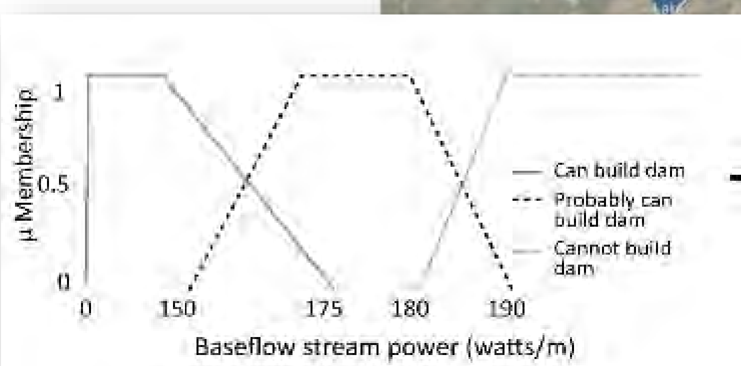
1. Is their *enough* **water** present to maintain a pond?
2. Are enough and the right type of woody resources present to support dam building?
3. Can they **build a dam** at *base flows?*
4. Are dams likely to withstand *typical floods*?



Baseflow Stream Power

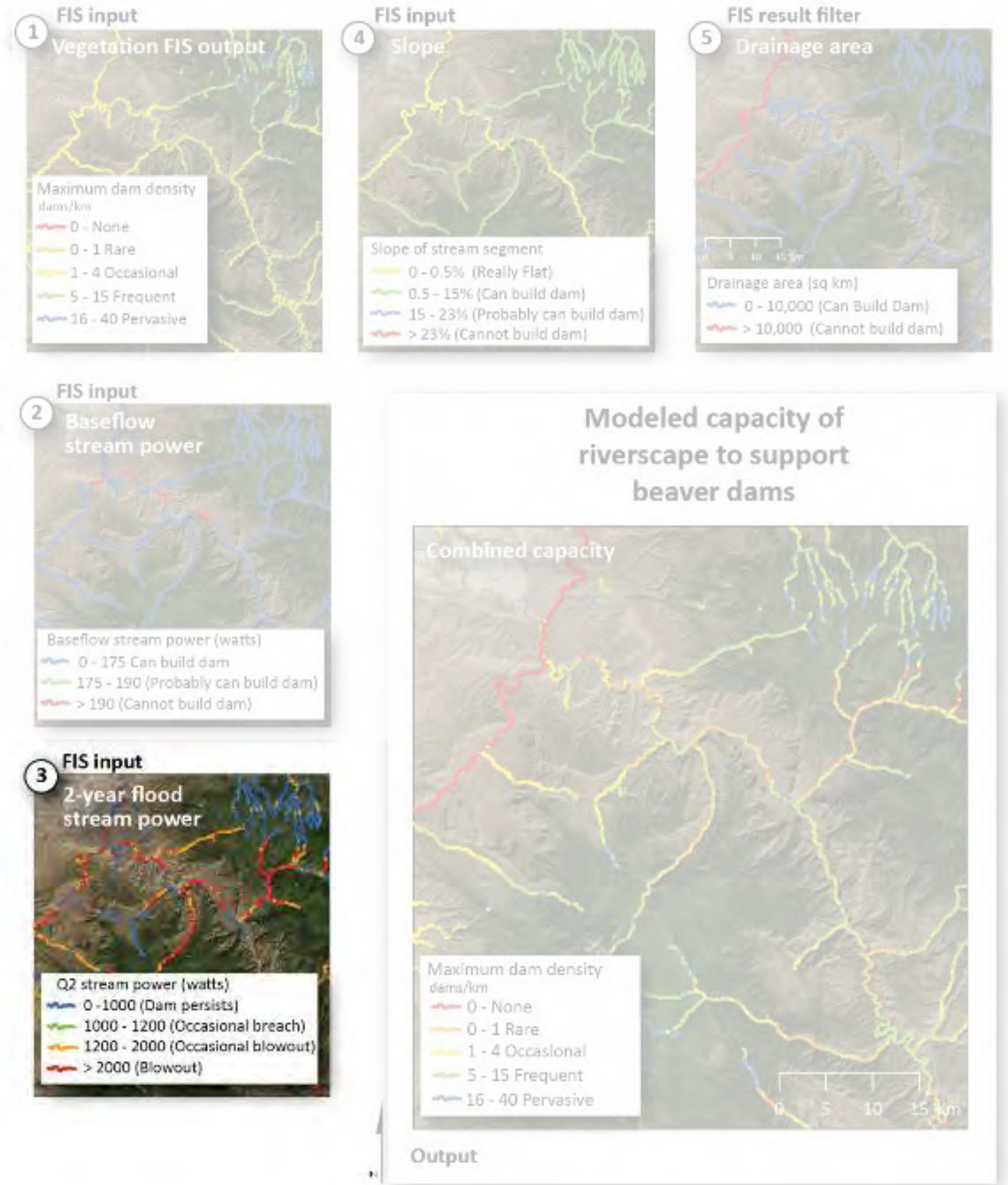
1. Calculate Q @ baseflow for each reach based on drainage area and USGS regional curves
2. Multiply Q by slope (S) ($\Omega = \rho g Q S$)





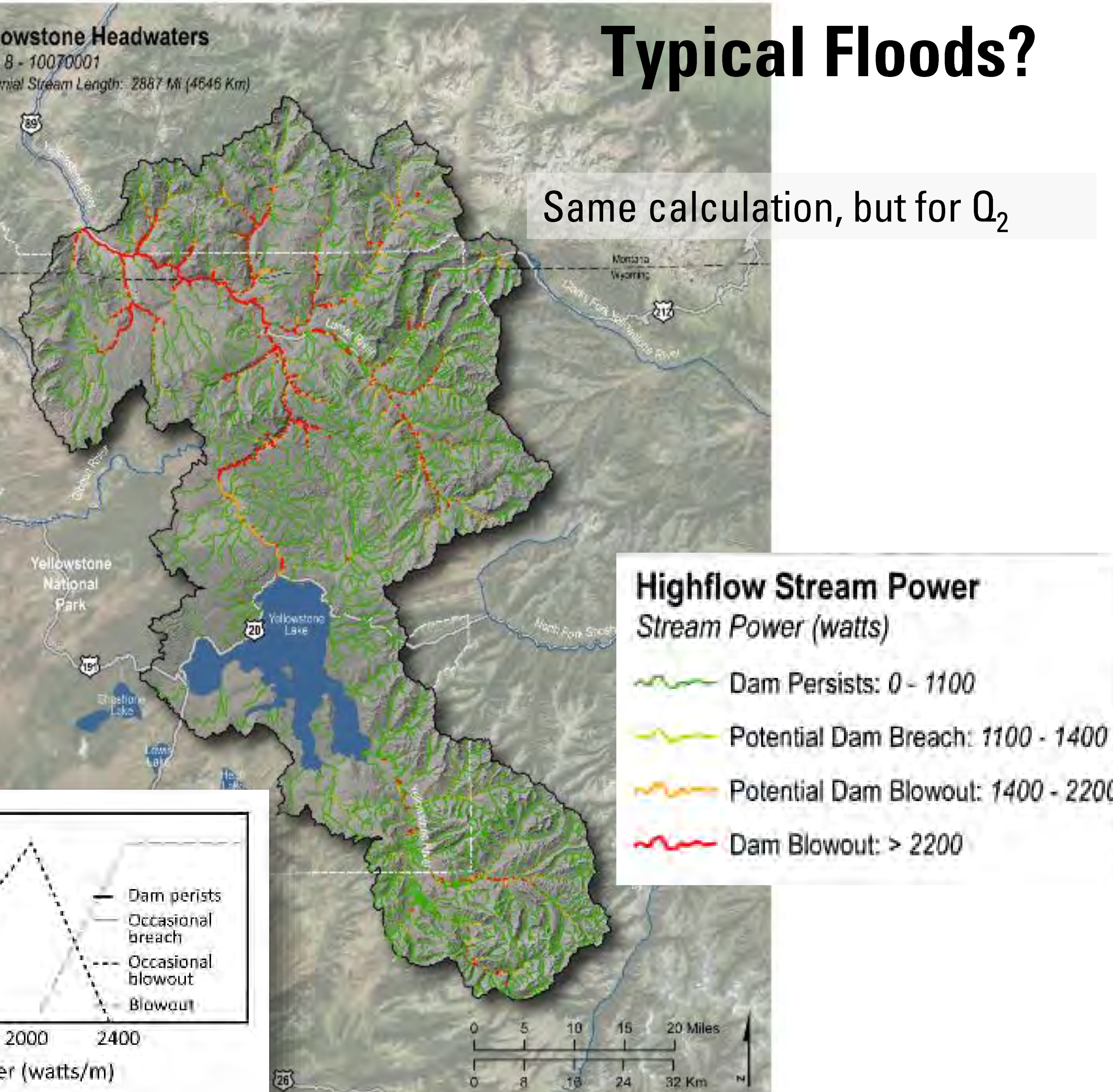
THE QUESTIONS

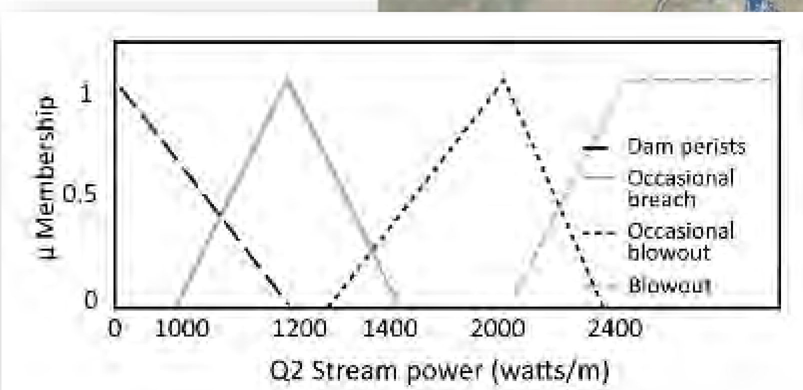
1. Is their *enough* **water** present to maintain a pond?
2. Are enough and the right type of woody resources present to support dam building?
3. Can they **build a dam** at *base flows?*
4. Are dams likely to withstand *typical floods*?



Typical Floods?

Same calculation, but for Q_2





Put the other inputs together

1. Is their *enough* **water** present to maintain a pond?
2. Are *enough* and the *right* type of **woody** resources present to support dam building?
3. Can they **build a dam** at *base flows?*
4. Are dams likely to **withstand** *typical floods*?

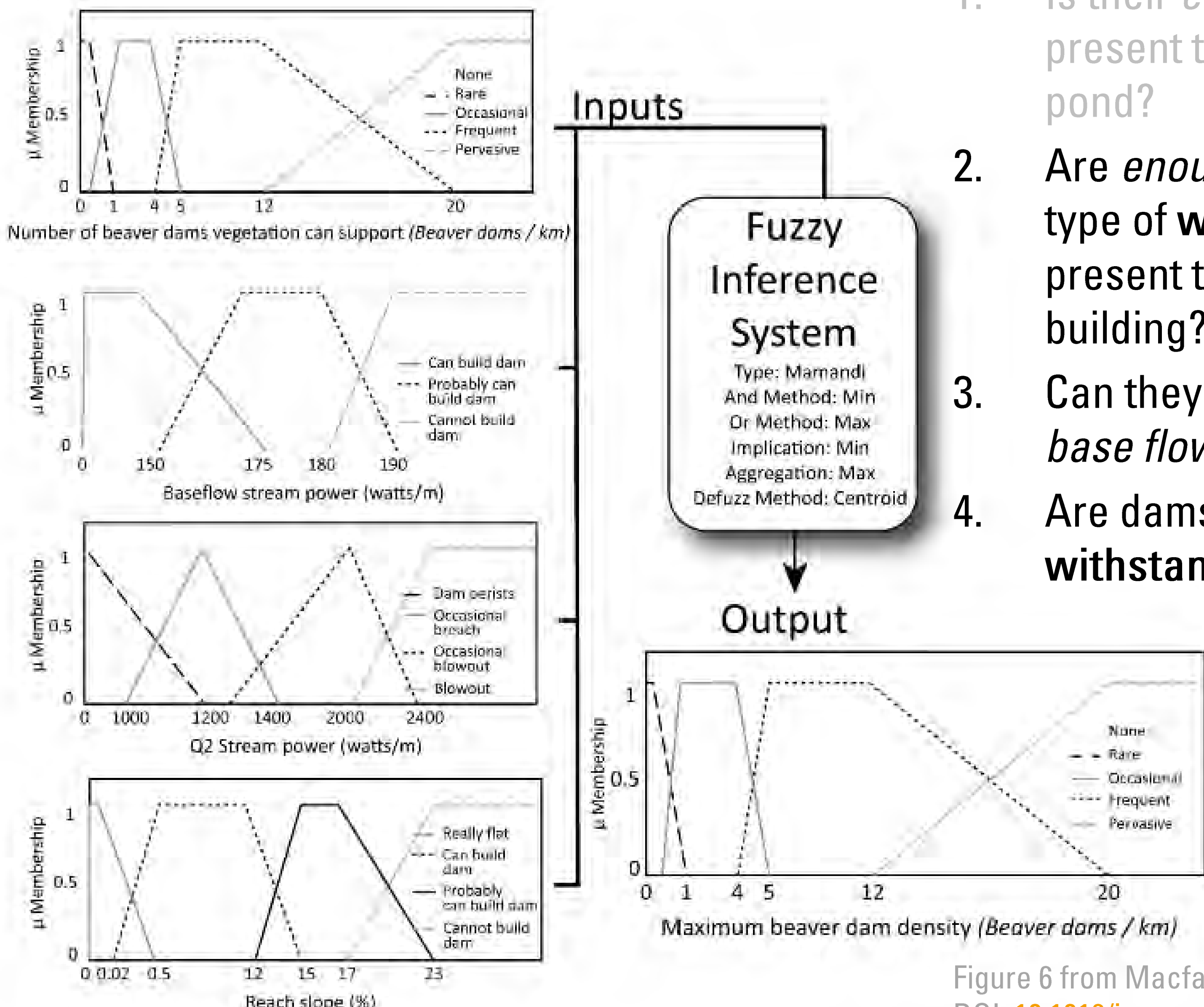
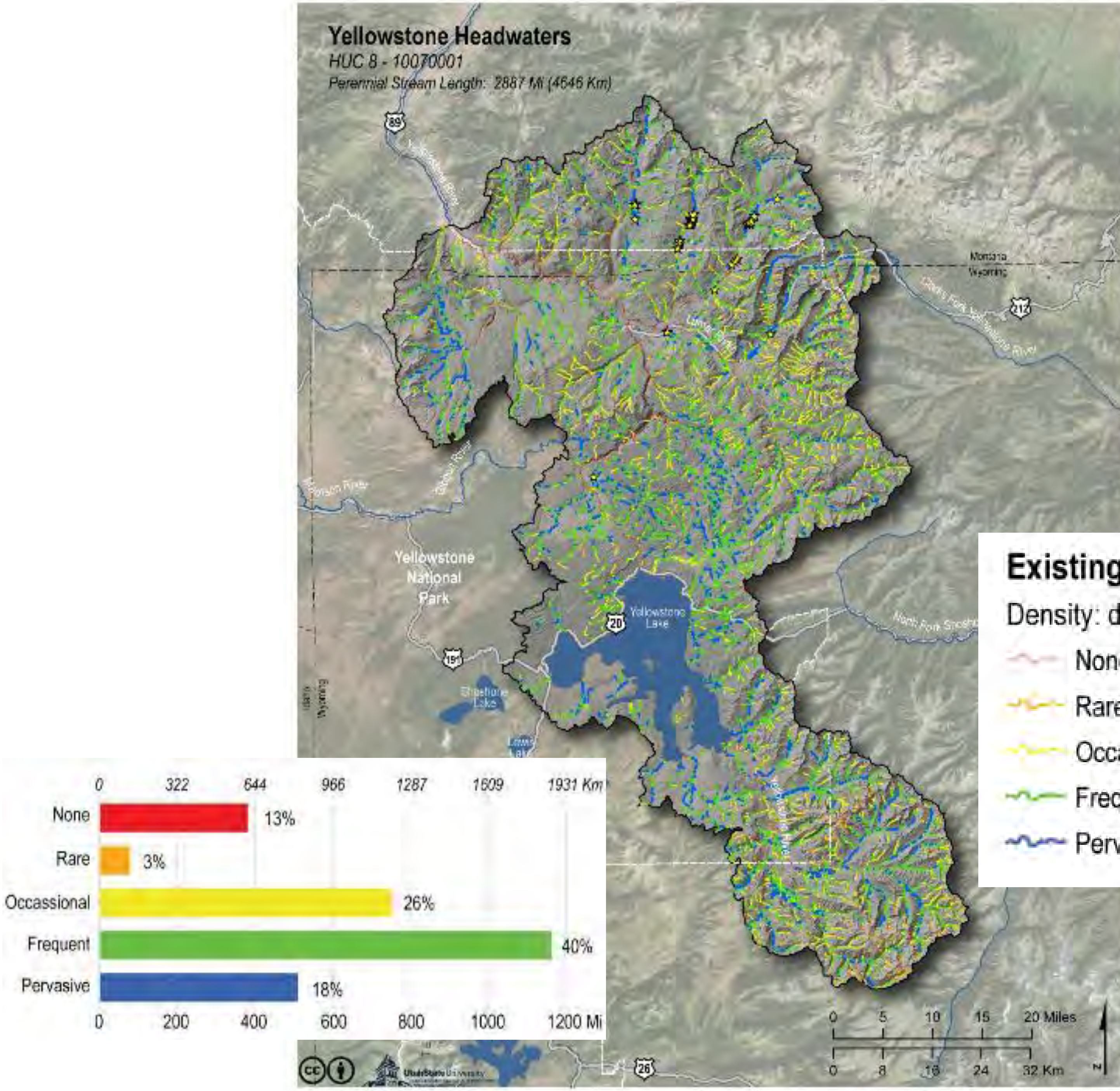


Figure 6 from Macfarlane et al. (2016)

DOI: 10.1016/j.geomorph.2015.11.019

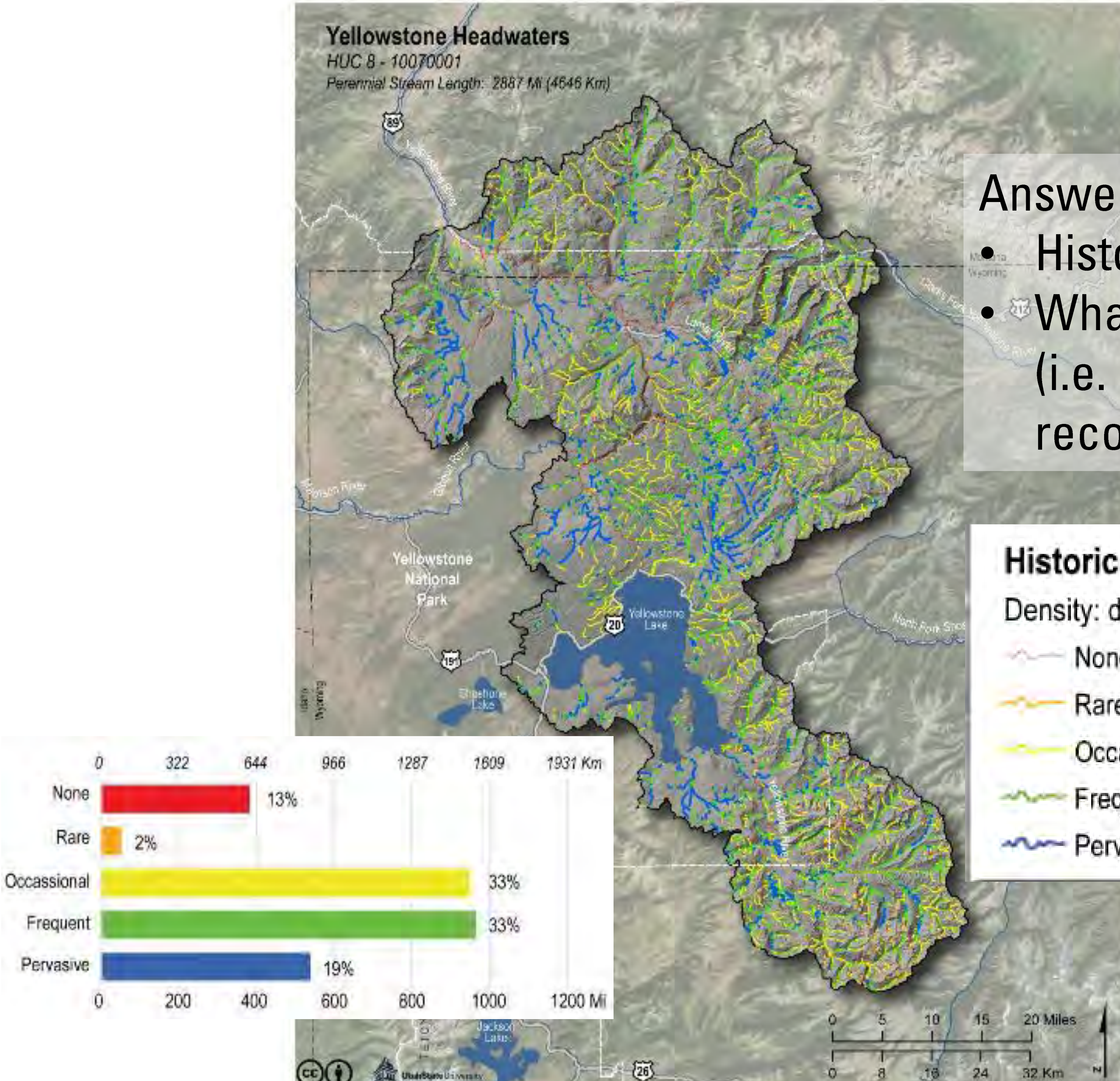
Existing Capacity

Where can beaver build dams now & what extent?



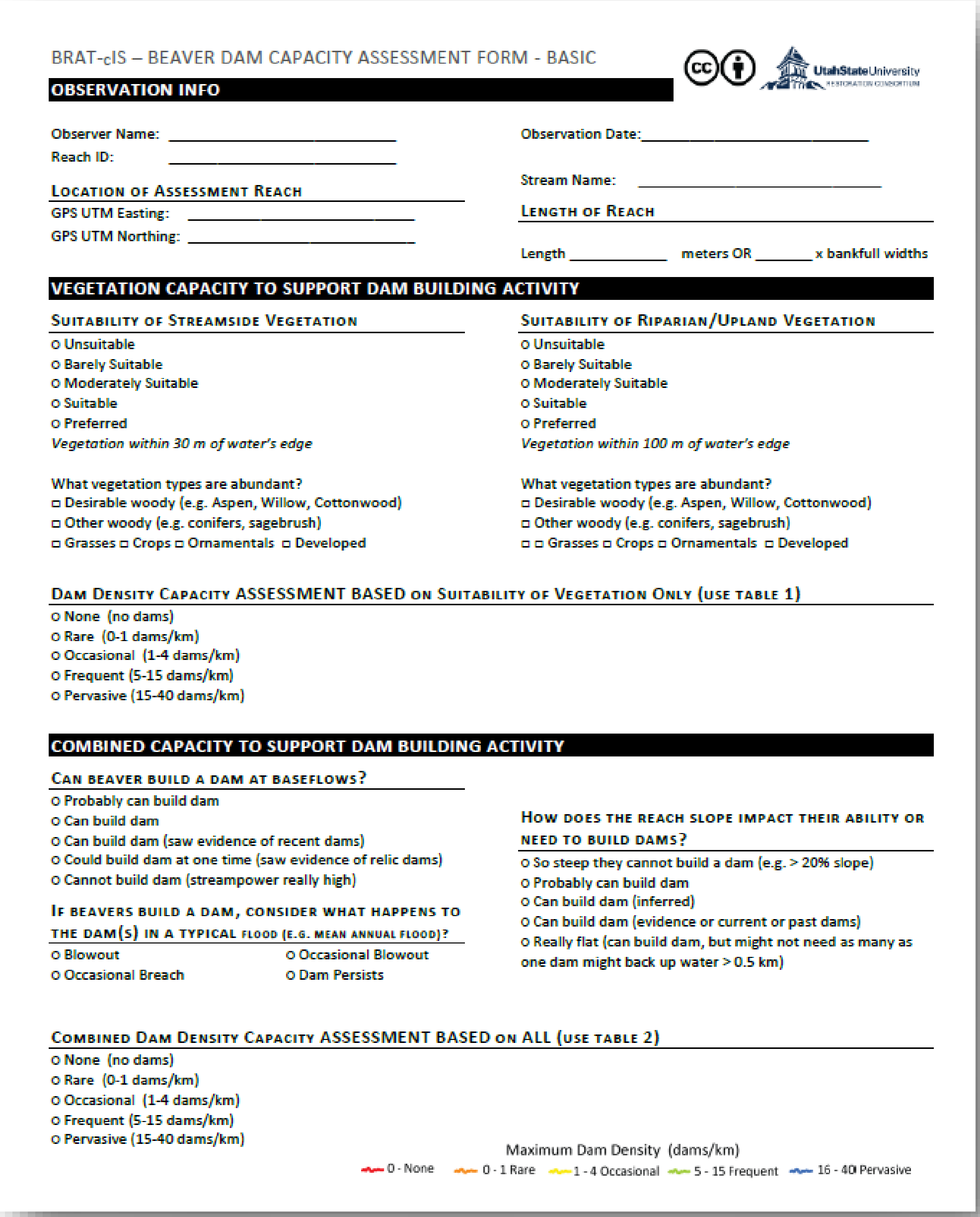
Historic Capacity

Answer questions for:
- Historic conditions
- What is possible (i.e. upper limit of recovery potential)



Capacity… Max Number Of Dams

- You can do this..
- You will answer those basic questions… and the inference system
- With the actual model, we approximate quantitative answers to those with GIS data



BRAT-cIS – BEAVER DAM CAPACITY ASSESSMENT FORM - BASIC

UtahStateUniversity RESTORATION CONSORTIUM

OBSERVATION INFO

Observer Name: ____________________ Observation Date: ____________________
Reach ID: ____________________

Stream Name: ____________________

LOCATION OF ASSESSMENT REACH
GPS UTM Easting: ____________________
GPS UTM Northing: ____________________

LENGTH OF REACH
Length __________ meters OR ______ x bankfull widths

VEGETATION CAPACITY TO SUPPORT DAM BUILDING ACTIVITY

SUITABILITY OF STREAMSIDE VEGETATION
o Unsuitable
o Barely Suitable
o Moderately Suitable
o Suitable
o Preferred
Vegetation within 30 m of water's edge

What vegetation types are abundant?
□ Desirable woody (e.g. Aspen, Willow, Cottonwood)
□ Other woody (e.g. conifers, sagebrush)
□ Grasses □ Crops □ Ornamentals □ Developed

SUITABILITY OF RIPARIAN/UPLAND VEGETATION
o Unsuitable
o Barely Suitable
o Moderately Suitable
o Suitable
o Preferred
Vegetation within 100 m of water's edge

What vegetation types are abundant?
□ Desirable woody (e.g. Aspen, Willow, Cottonwood)
□ Other woody (e.g. conifers, sagebrush)
□ □ Grasses □ Crops □ Ornamentals □ Developed

DAM DENSITY CAPACITY ASSESSMENT BASED ON SUITABILITY OF VEGETATION ONLY (USE TABLE 1)
o None (no dams)
o Rare (0-1 dams/km)
o Occasional (1-4 dams/km)
o Frequent (5-15 dams/km)
o Pervasive (15-40 dams/km)

COMBINED CAPACITY TO SUPPORT DAM BUILDING ACTIVITY

CAN BEAVER BUILD A DAM AT BASEFLOWS?
o Probably can build dam
o Can build dam
o Can build dam (saw evidence of recent dams)
o Could build dam at one time (saw evidence of relic dams)
o Cannot build dam (streampower really high)

IF BEAVERS BUILD A DAM, CONSIDER WHAT HAPPENS TO THE DAM(S) IN A TYPICAL FLOOD (E.G. MEAN ANNUAL FLOOD)?
o Blowout
o Occasional Blowout
o Occasional Breach
o Dam Persists

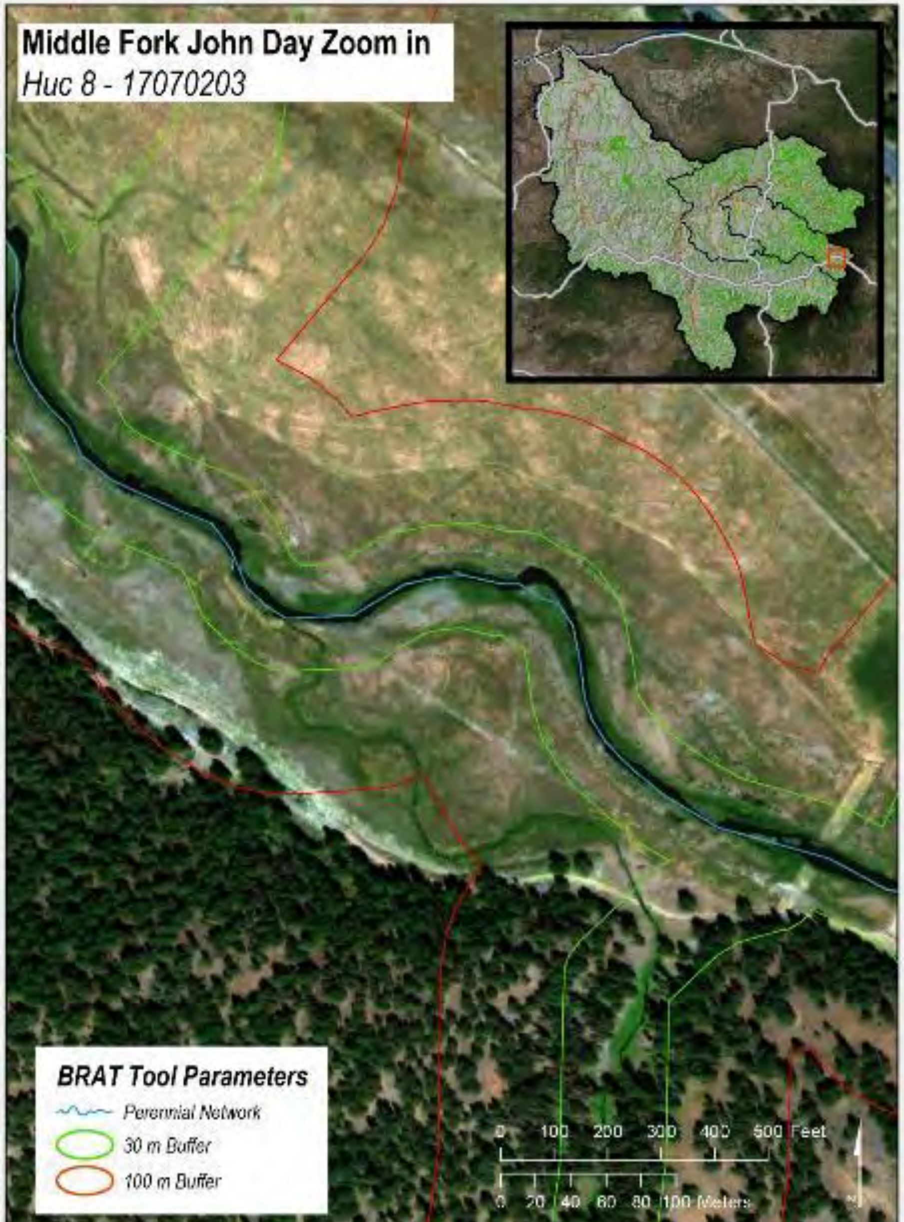
HOW DOES THE REACH SLOPE IMPACT THEIR ABILITY OR NEED TO BUILD DAMS?
o So steep they cannot build a dam (e.g. > 20% slope)
o Probably can build dam
o Can build dam (inferred)
o Can build dam (evidence or current or past dams)
o Really flat (can build dam, but might not need as many as one dam might back up water > 0.5 km)

COMBINED DAM DENSITY CAPACITY ASSESSMENT BASED ON ALL (USE TABLE 2)
o None (no dams)
o Rare (0-1 dams/km)
o Occasional (1-4 dams/km)
o Frequent (5-15 dams/km)
o Pervasive (15-40 dams/km)

Maximum Dam Density (dams/km)
0 - None | 0 - 1 Rare | 1 - 4 Occasional | 5 - 15 Frequent | 16 - 40 Pervasive

https://tinyurl.com/y4osd5wu

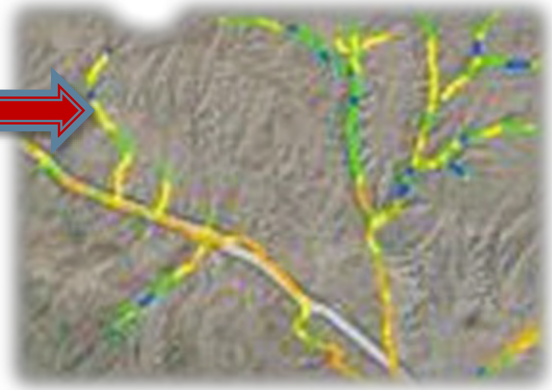
Desktop – BRAT cIS Evaluation

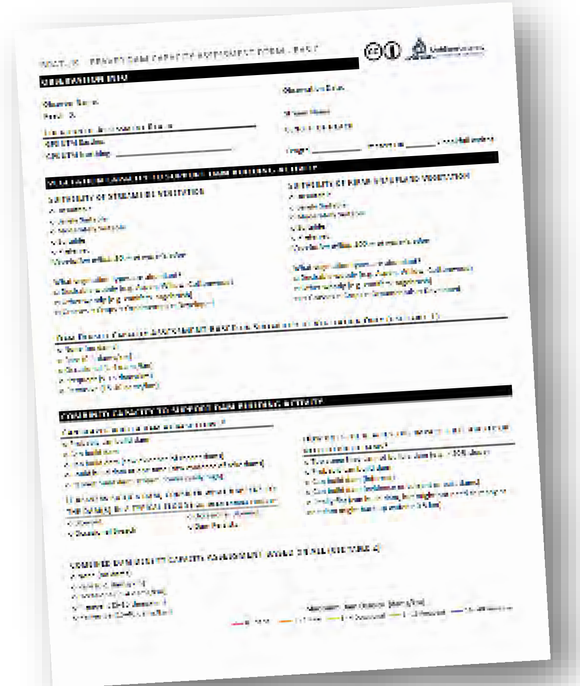


- You will evaluate how many beaver dams (max) could this reach support

BRAT - $_{c}$IS

Who?
Where?
When?





BRAT-$_{c}$IS – BEAVER DAM CAPACITY ASSESSMENT FORM - BASIC

OBSERVATION INFO

Observer Name: ______________________

Reach ID: ______________________

Observation Date: ______________________

Stream Name: ______________________

Location of Assessment Reach

GPS UTM Easting: ______________________

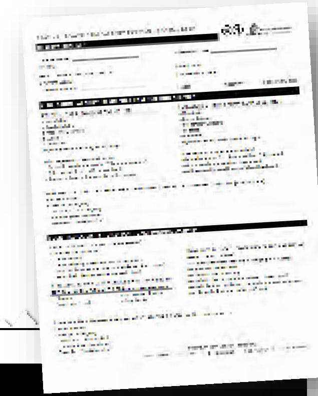
GPS UTM Northing: ______________________

Length of Reach

Length __________ meters OR ______ x bankfull widths

BRAT - $_c$IS

The veg questions… - dam building materials



VEGETATION CAPACITY TO SUPPORT DAM BUILDING ACTIVITY

Suitability of Streamside Vegetation

- o Unsuitable
- o Barely Suitable
- o Moderately Suitable
- o Suitable
- o Preferred

Vegetation within 30 m of water's edge

What vegetation types are abundant?

☐ Desirable woody (e.g. Aspen, Willow, Cottonwood)

☐ Other woody (e.g. conifers, sagebrush)

☐ Grasses ☐ Crops ☐ Ornamentals ☐ Developed

Suitability of Riparian/Upland Vegetation

- o Unsuitable
- o Barely Suitable
- o Moderately Suitable
- o Suitable
- o Preferred

Vegetation within 100 m of water's edge

What vegetation types are abundant?

☐ Desirable woody (e.g. Aspen, Willow, Cottonwood)

☐ Other woody (e.g. conifers, sagebrush)

☐ ☐ Grasses ☐ Crops ☐ Ornamentals ☐ Developed

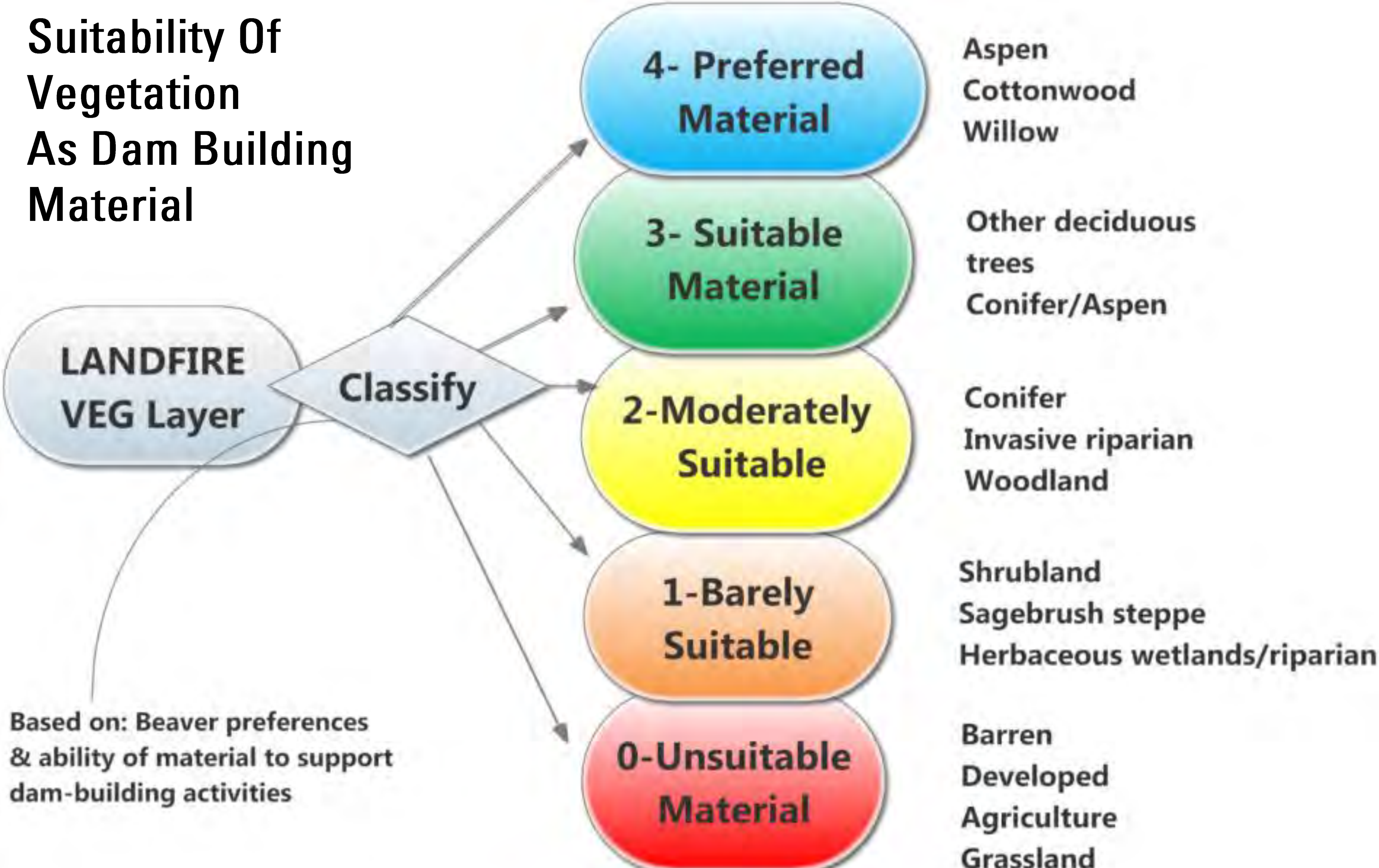
Dam Density Capacity ASSESSMENT BASED on Suitability of Vegetation Only (use table 1)

- o None (no dams)
- o Rare (0-1 dams/km)
- o Occasional (1-4 dams/km)
- o Frequent (5-15 dams/km)
- o Pervasive (15-40 dams/km)

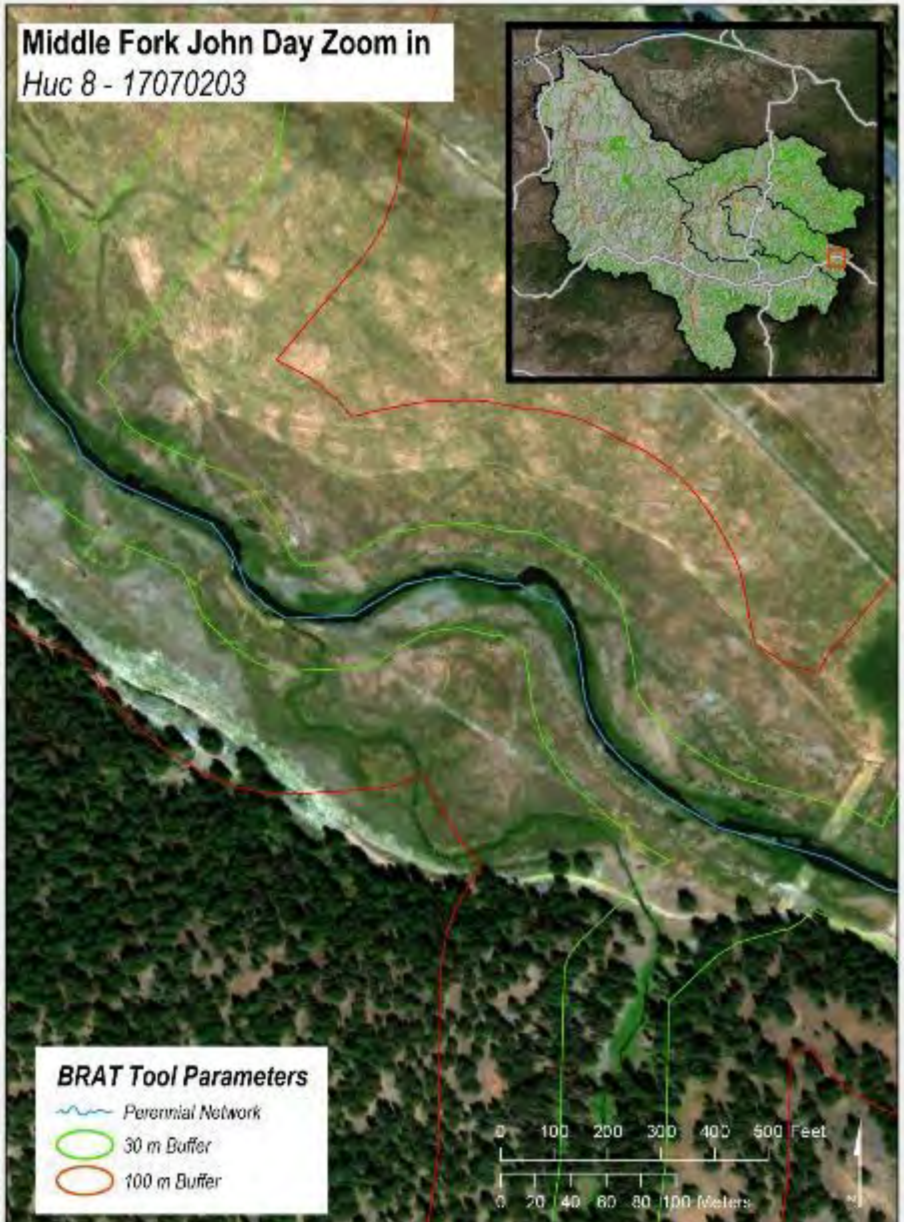
COMBINED CAPACITY TO SUPPORT DAM BUILDING ACTIVITY

Can beaver build a dam at base flows?

Suitability Of Vegetation As Dam Building Material



Desktop – BRAT cIS Evaluation



- For vegetation question, answer separately within 30 m vs. 100 m buffer:
  - Proportion of building material
    - Unsuitable (0)
    - Barely Suitable (1)
    - Moderately Suitable (2)
    - Suitable (3)
    - Preferred (4)
  - And estimate an area weighted average (between 0 & 4), then choose closest category

BRAT - $_{c}$IS

The inference system… look up table!

VEGETATION CAPACITY TO SUPPORT DAM BUILDING ACTIVITY

Suitability of Streamside Vegetation

- o Unsuitable
- o Barely Suitable
- o Moderately Suitable
- ◉ Suitable
- o Preferred

Vegetation within 30 m of water's edge

What vegetation types are abundant?
□ Desirable woody (e.g. Aspen, Willow, Cottonwoo
□ Other woody (e.g. conifers, sagebrush)
□ Grasses □ Crops □ Ornamentals □ Developed

Suitability of Riparian/Upland Vegetation

- ◉ Unsuitable

Dam Density Capacity Assessment Base

- o None (no dams)
- o Rare (0-1 dams/km)
- o Occasional (1-4 dams/km)
- o Frequent (5-15 dams/km)
- o Pervasive (15-40 dams/km)

INFERENCE SYSTEM OF CAPACITY BASED ON VEGETATION ONLY:

Table 1. Rule table for two input inference system that models the capacity of the reach to support dam building activity (in dam density) using the suitability of streamside vegetation and suitability of riparian/upland vegetation as inputs.

Rules		Inputs: Suitability of streamside vegetation	& Suitability of riparian/upland vegetation		Output: Dam density capacity
1	if	Unsuitable	& Unsuitable	, then	None
2	if	Unsuitable	& Barely suitable	, then	Rare
3	if	Unsuitable	& Moderately suitable	, then	Rare
4	if	Unsuitable	& Suitable	, then	Occasional
5	if	Unsuitable	& Preferred	, then	Occasional
6	if	Barely suitable	& Unsuitable	, then	Rare
7	if	Barely suitable	& Barely suitable	, then	Rare
8	if	Barely suitable	& Moderately suitable	, then	Occasional
9	if	Barely suitable	& Suitable	, then	Occasional
10	if	Barely suitable	& Preferred	, then	Occasional
11	if	Moderately suitable	& Unsuitable	, then	Rare
12	if	Moderately suitable	& Barely suitable	, then	Occasional
13	if	Moderately suitable	& Moderately suitable	, then	Occasional
14	if	Moderately suitable	& Suitable	, then	Frequent
15	if	Moderately suitable	& Preferred	, then	Frequent
16	if	Suitable	& Unsuitable	, then	Occasional
17	if	Suitable	& Barely suitable	, then	Occasional
18	if	Suitable	& Moderately suitable	, then	Frequent
19	if	Suitable	& Suitable	, then	Frequent
20	if	Suitable	& Preferred	, then	Pervasive
21	if	Preferred	& Unsuitable	, then	Occasional
22	if	Preferred	& Barely suitable	, then	Frequent
23	if	Preferred	& Moderately suitable	, then	Pervasive
24	if	Preferred	& Suitable	, then	Pervasive
25	if	Preferred	& Preferred	, then	Pervasive

COMBINED CAPACITY TO SUPPORT DAM

Can beaver build a dam at base flows?

BRAT - $_{c}$IS

Does hydrology (manifested as local hydraulics and approximated with stream power) limit this capacity?

COMBINED CAPACITY TO SUPPORT DAM BUILDING ACTIVITY

Can beaver build a dam at base flows?

- Probably can build dam
- Can build dam
- Can build dam (saw evidence of recent dams)
- Could build dam at one time (saw evidence of relic dams)
- Cannot build dam (stream power really high)

If beavers build a dam, consider what happens to the dam(s) in a typical flood (e.g. mean annual flood)?

- Blowout
- Occasional Blowout
- Occasional Breach
- Dam Persists

How does the reach slope impact their ability or need to build dams?

- Too steep they cannot build a dam (e.g. > 20% slope)
- Probably can build dam
- Can build dam (inferred)
- Can build dam (evidence or current or past dams)
- Really flat (can build dam, but might not need as many as one dam might back up water > 0.5 km)

Combined Dam Density Capacity ASSESSMENT BASED on ALL (use table 2)

- None (no dams)
- Rare (0-1 dams/km)
- Occasional (1-4 dams/km)
- Frequent (5-15 dams/km)
- Pervasive (15-40 dams/km)

Maximum Dam Density (dams/km)

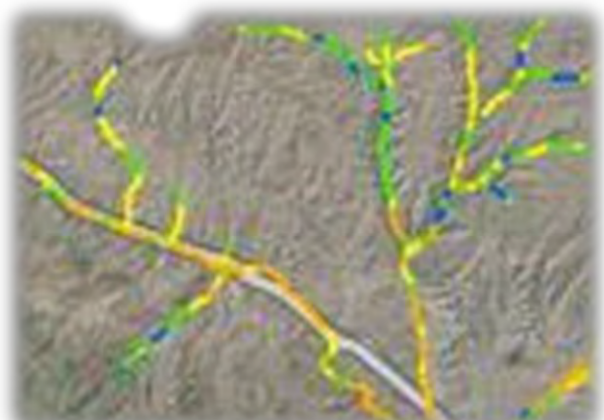
0 - None | 0 - 1 Rare | 1 - 4 Occasional | 5 - 15 Frequent | 16 - 40 Pervasive

BRAT - $_{C}$IS

COMBINED INFERENCE SYSTEM:

Uglier table… but simple to apply

Rules		Inputs: Vegetation dam density capacity	&	2-year flood stream power	&	Baseflow stream power	&	Reach slope		Output: Dam density capacity
1	*If*	None	&	-	&		&	-	*, then*	None
2	*If*	-	&	-	&	Cannot build dam	&	-	*, then*	None
3	*If*	-	&	-	&	-	&	Cannot build dam	*, then*	None
4	*If*	Rare	&	Dam persists	&	Can build dam	&	NOT Cannot build dam	*, then*	Rare
5	*If*	Rare	&	Dam persists	&	Probably can build dam	&	NOT Cannot build dam	*, then*	Rare

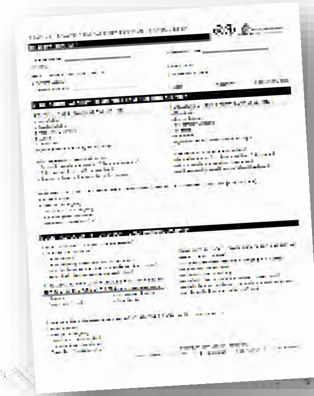


BRAT - $_{c}$IS

Answer is?

Still occasional

But if blowout drops to rare



COMBINED CAPACITY TO SUPPORT DAM BUILDING ACTIVITY

CAN BEAVER BUILD A DAM AT BASE FLOWS?

- o Probably can build dam
- o Can build dam
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IF BEAVERS BUILD A DAM, CONSIDER WHAT HAPPENS TO THE DAM(S) IN A TYPICAL FLOOD (E.G. MEAN ANNUAL FLOOD)?

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COMBINED DAM DENSITY CAPACITY ASSESSMENT BASED ON ALL (USE TABLE 2)

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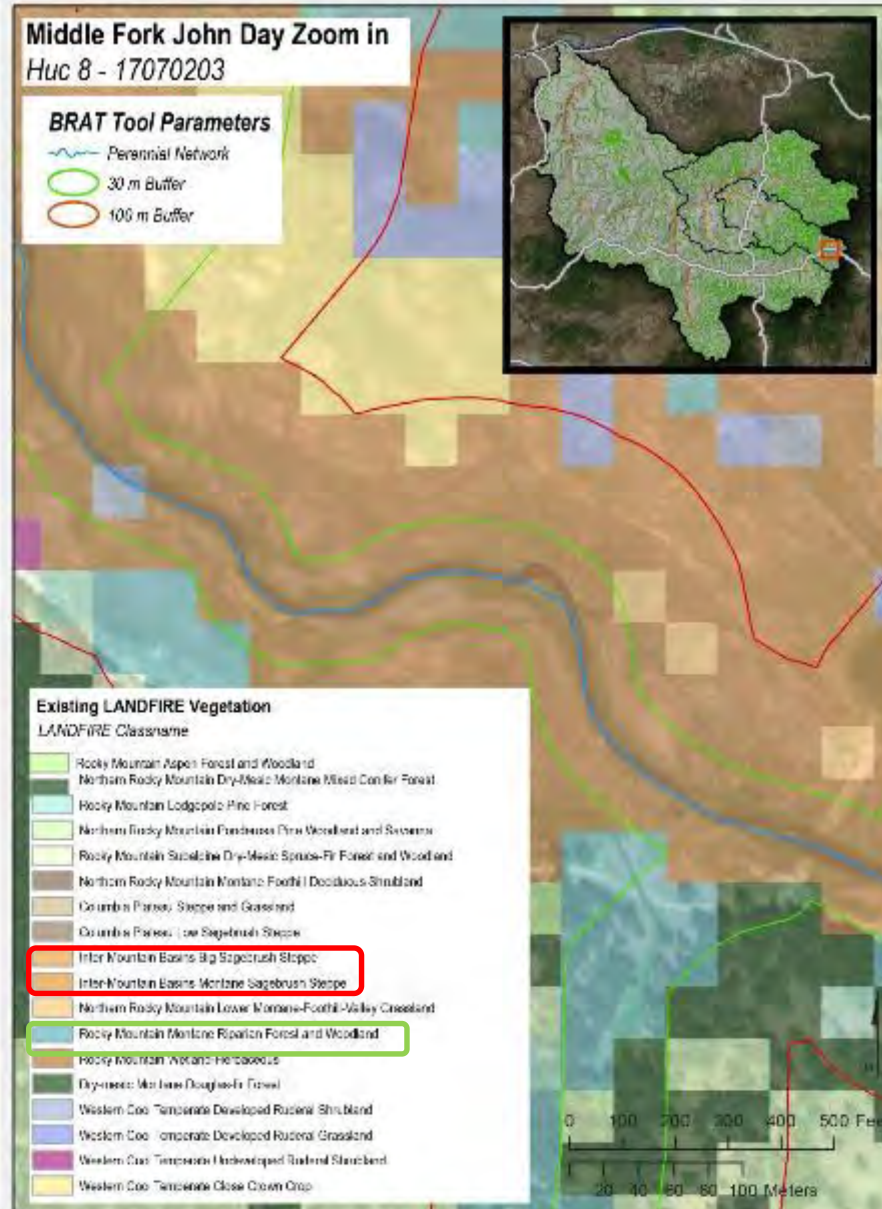
- o Pervasive (15-40 dams/km)

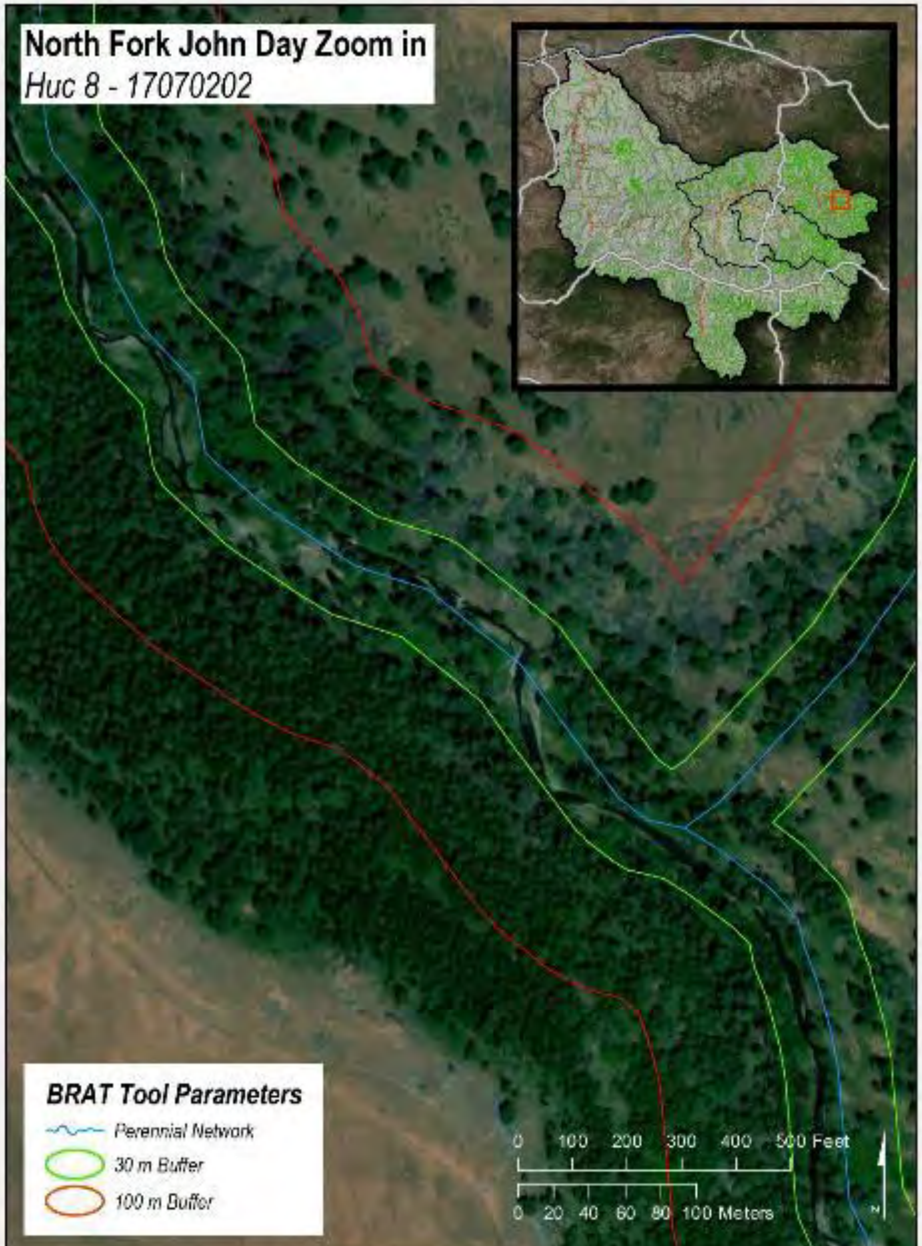
Maximum Dam Density (dams/km)

0 - None | 0 - 1 Rare | 1 - 4 Occasional | 5 - 15 Frequent | 16 - 40 Pervasive

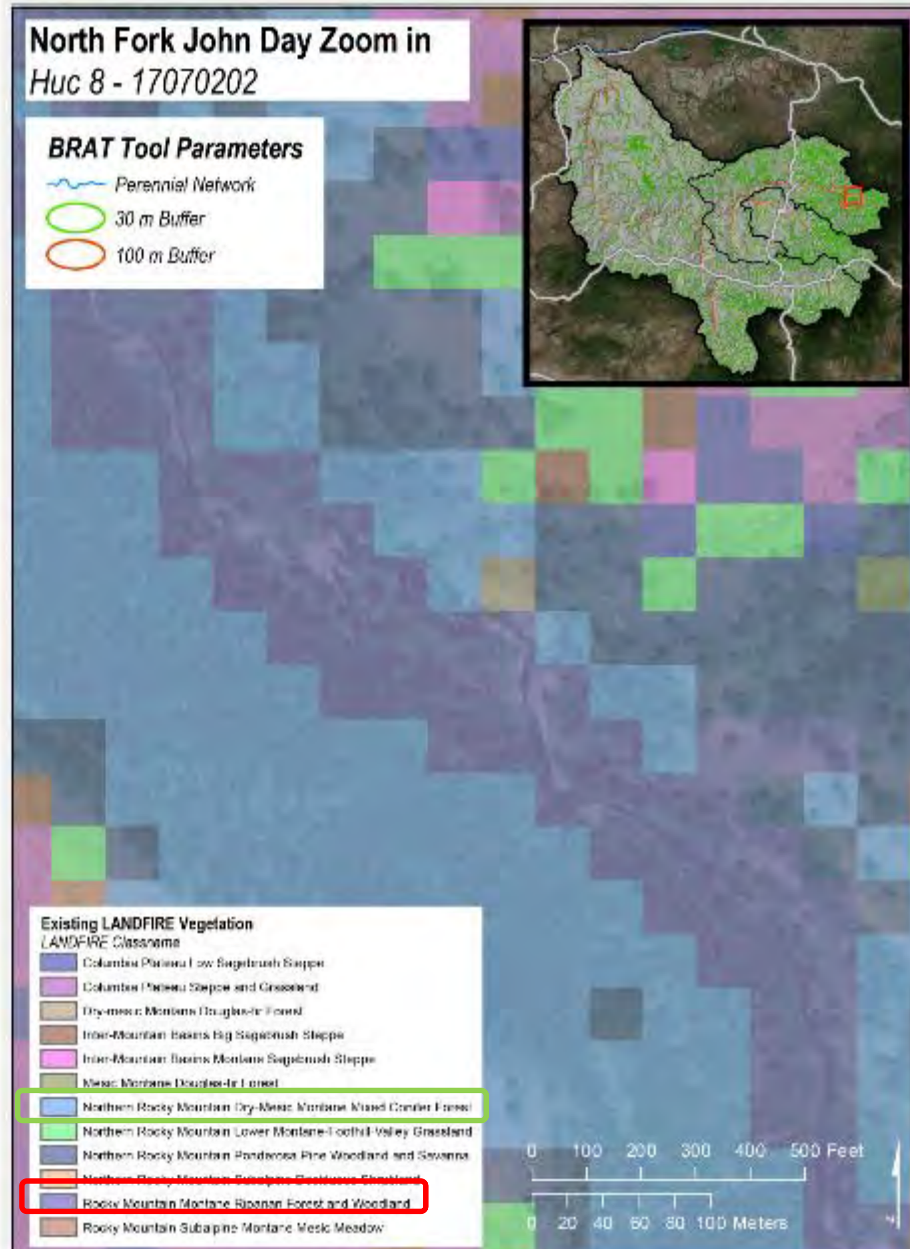
AP Evidence Vs. LANDFIRE Evidence



ANOTHER…

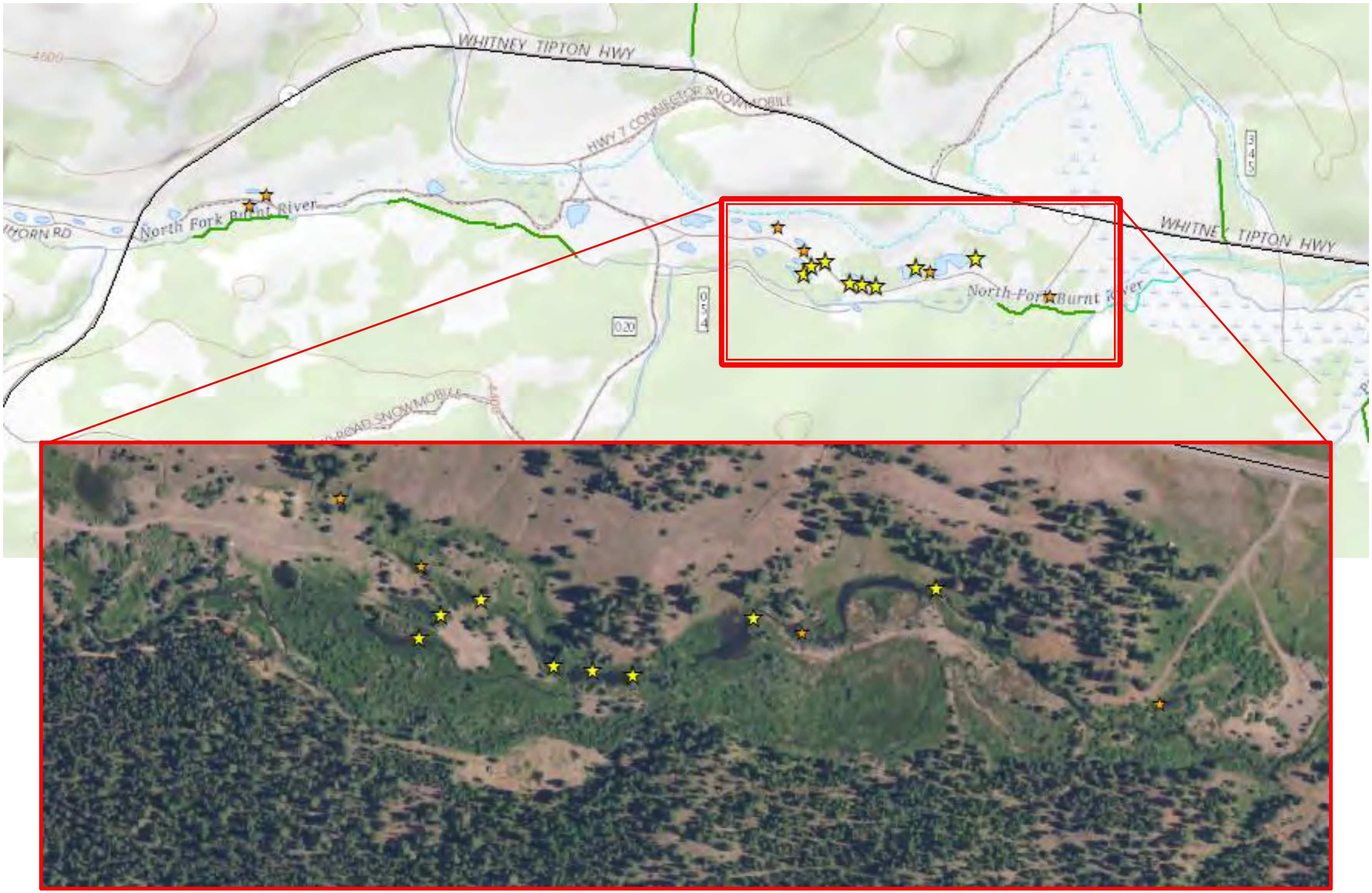


North Fork John Day Zoom in
Huc 8 - 17070202
BRAT Tool Parameters
Perennial Network
30 m Buffer
100 m Buffer
0 100 200 300 400 500 Feet
0 20 40 60 80 100 Meters



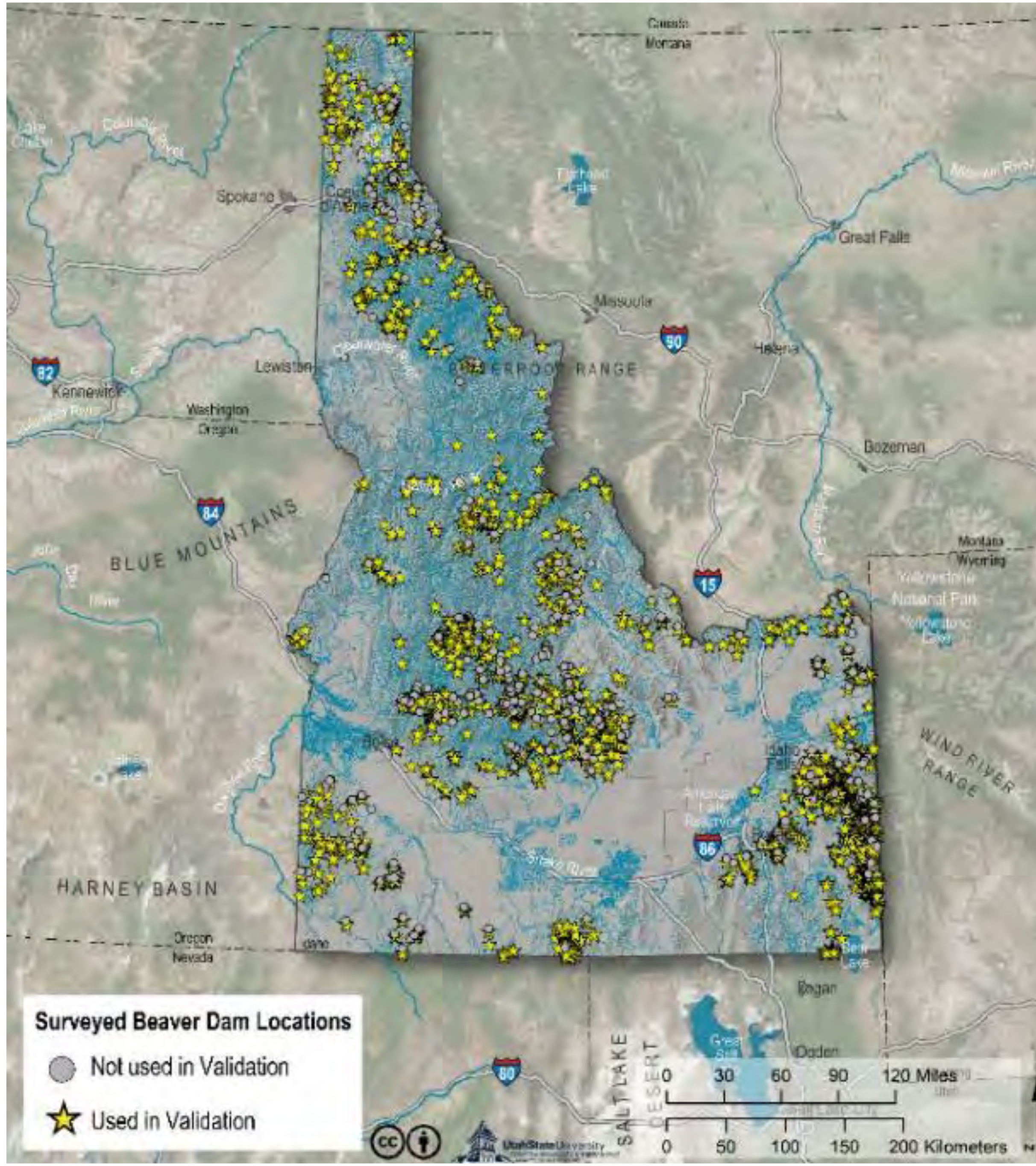
North Fork John Day Zoom in
Huc 8 - 17070202
BRAT Tool Parameters
Perennial Network
30 m Buffer
100 m Buffer
Existing LANDFIRE Vegetation
LANDFIRE Classname
Columbia Plateau Low Sagebrush Steppe
Columbia Plateau Steppe and Grassland
Dry-mesic Montane Douglas-fir Forest
Inter-Mountain Basins Big Sagebrush Steppe
Inter-Mountain Basins Montane Sagebrush Steppe
Mesic Montane Douglas-fir Forest
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest
Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland
Northern Rocky Mountain Ponderosa Pine Woodland and Savanna
Rocky Mountain Montane Riparian Forest and Woodland
Rocky Mountain Subalpine Montane Mesic Meadow
0 100 200 300 400 500 Feet
0 20 40 60 80 100 Meters

Surveying Dams… Gives you data in same currency of density (dams/km)



Can be done at broader scales…

- 9048 dams from desktop census
- Statewide current capacity is 994,299 (i.e. < 1%) or 8 dams/km
- Historic was 1.7 million



Dam Surveys in Field

- Simple…

BEAVER DAM MONITORING FORM - BASIC

UtahStateUniversity
RESTORATION CONSORTIUM

OBSERVATION INFO

Observer Name: ______________________

Site ID: ______________________

Observation Date: ______________________

BEAVER BUILT DAM?

- o Beaver Dam
- o Beaver Dam Analogue (manmade)

DAM TYPE:

- o Primary (has lodge… typically larger)
- o Secondary (typically smaller – part of complex)

STATUS

- o Active
- o Abandon
- o Historic/Relic

CONFIDENCE IN STATUS

- o Certain - Documented Evidence
- o Probable - Strong Evidence
- o Possible - Anecdotal or Inconclusive Evidence
- o Unsure - Just a guess

POSITIONAL ATTRIBUTES

GPS UTM Easting: ______________________

GPS UTM Northing: ______________________

Stream Name: ______________________

NOTES &/OR SKETCH

Monitoring Complexes in Field Is Quicker

BEAVER **DAM COMPLEX** MONITORING FORM - BASIC

UtahStateUniversity
RESTORATION CONSORTIUM

OBSERVATION INFO

Observer Name: ______________________________

Site ID: ______________________________

Observation Date: ______________________________

BEAVER BUILT DAMS?

- o Beaver-only Built Dams
- o Beaver Dam Analogue (manmade)
- o Mix of beaver-built and manmade

COMPLEX TYPE:

- o Single Dam only
- o Primary + One or More Secondary
- o Multiple Possible Primaries + One or More Secondary

STATUS

- o Active
- o Abandon
- o Historic/Relic

CONFIDENCE IN STATUS

- o Certain - Documented Evidence
- o Probable - Strong Evidence
- o Possible - Anecdotal or Inconclusive Evidence
- o Unsure - Just a guess

POSITIONAL ATTRIBUTES

LOCATION OF PRIMARY DAM

GPS UTM Easting: ______________________________

GPS UTM Northing: ______________________________

COMPLEX SIZE

Number of Primary Dams: ______________________

Number of Secondary Dams: ______________________

POSITION OF DAMS

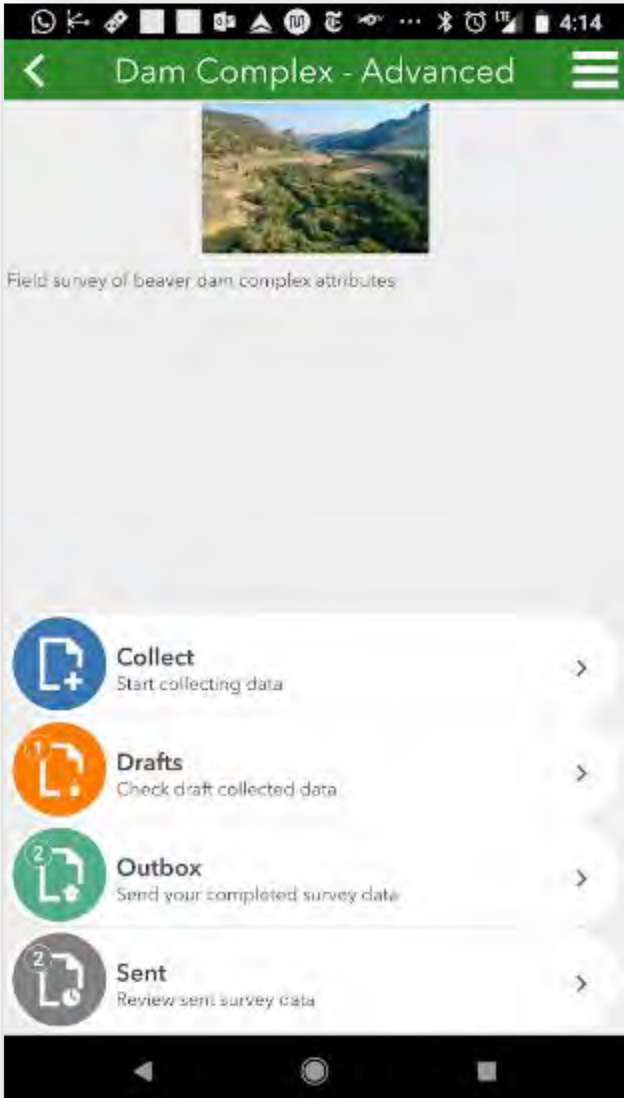
Primary Dam Location: □ Top □ Bottom □ In-between

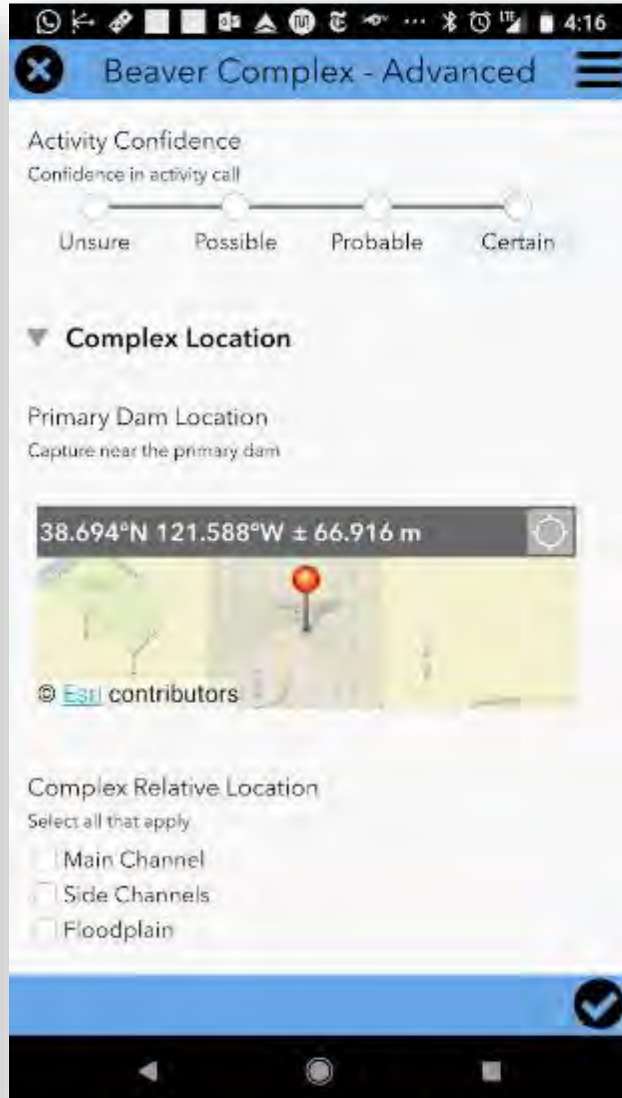
Number of Secondary Dams Upstream of Primary: ________

Number of Secondary Dams Downstream of Primary: ________

NOTES & / OR SKETCH

Same Thing but as Survey 123 App





No substitute for thinking…

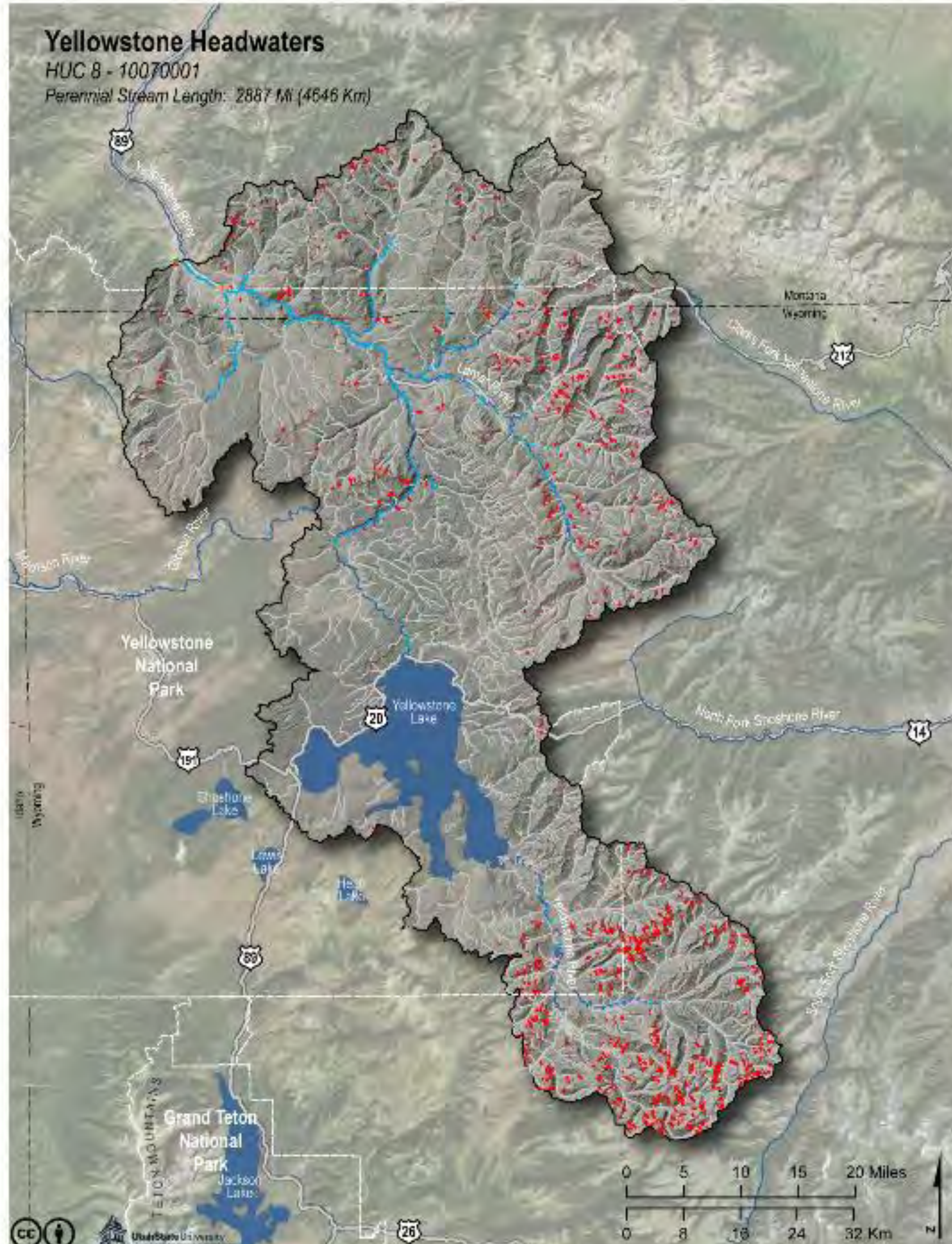
What's Limiting?

Where beaver cannot build dams and why?

Unsuitable/Limited Dam Building Opportunities

- Anthropogenically Limited
- Stream Power Limited
- Slope Limited
- Naturally Vegetation Limited
- Stream Size Limited
- Dam Building Possible

* "Dam Building Possible" values excluded from chart. Percent perennial stream length for this category is 87%

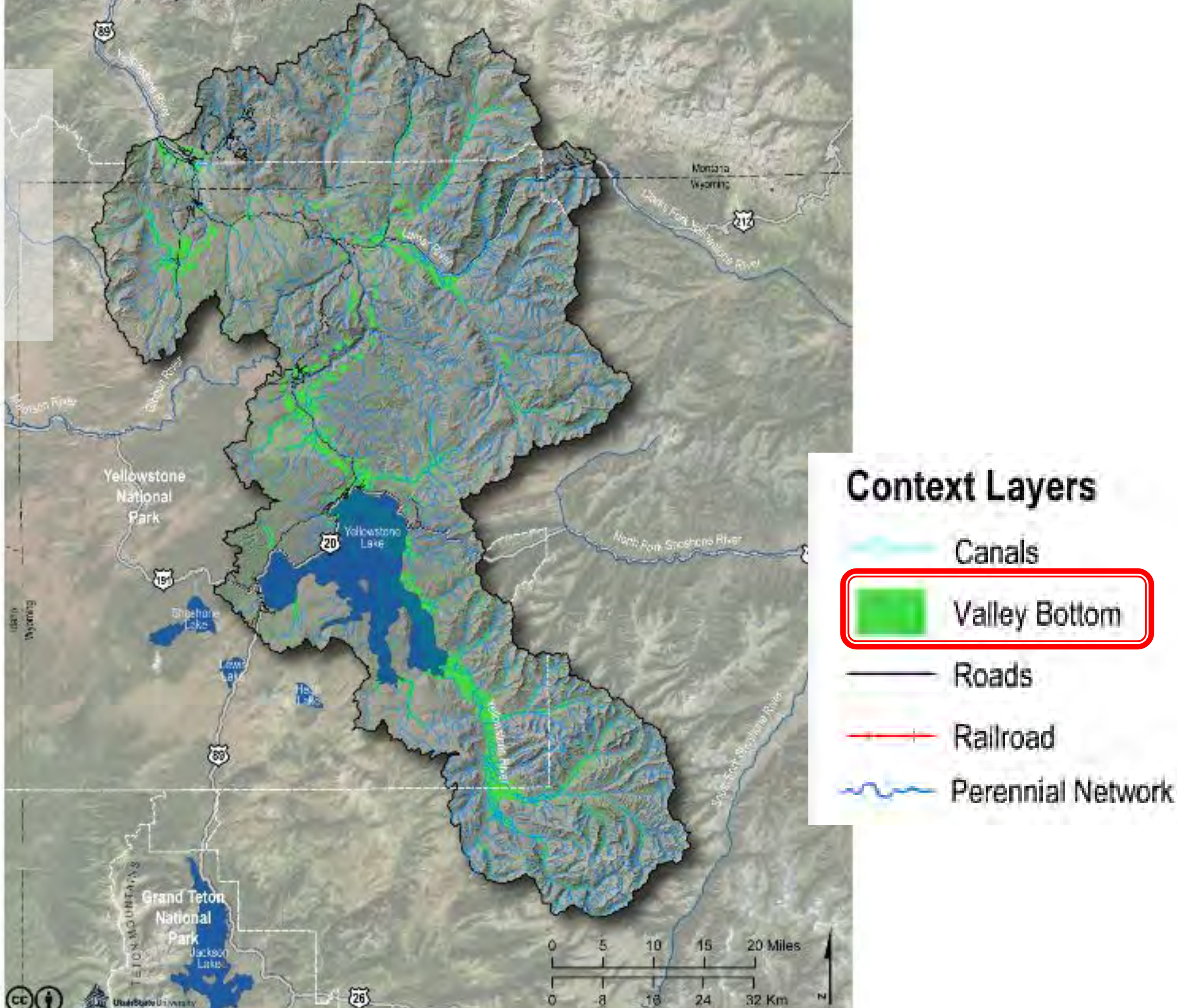


OUTLINE

Identifying Where to Place Beavers and When to Use Beaver Mimicry for Low Tech Restoration

Valley Bottoms

Let's start with the areas beavers could impact: **Valley bottoms**



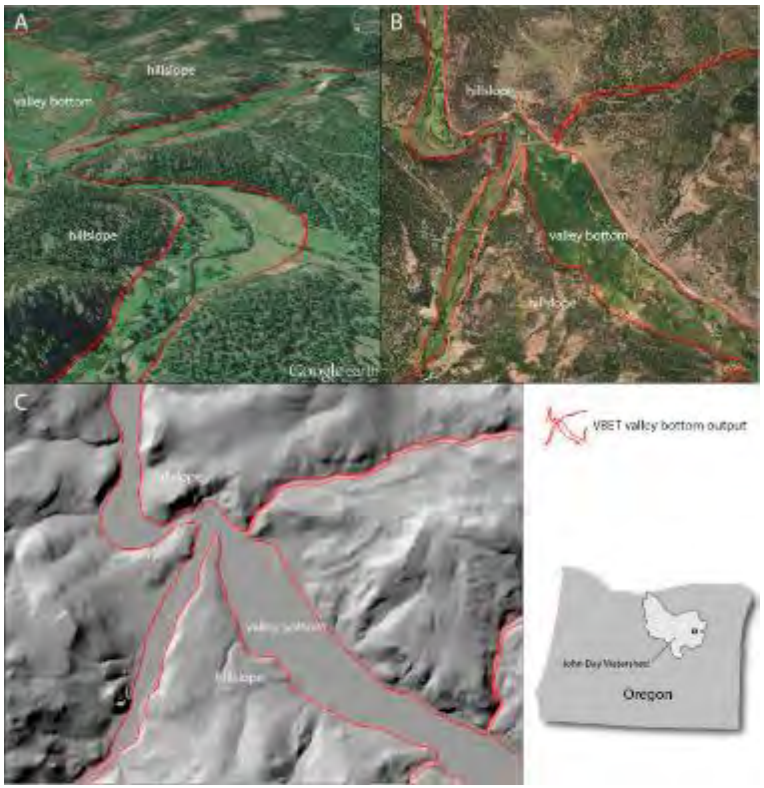
RECALL, Streams need space (i.e. their valley bottoms)

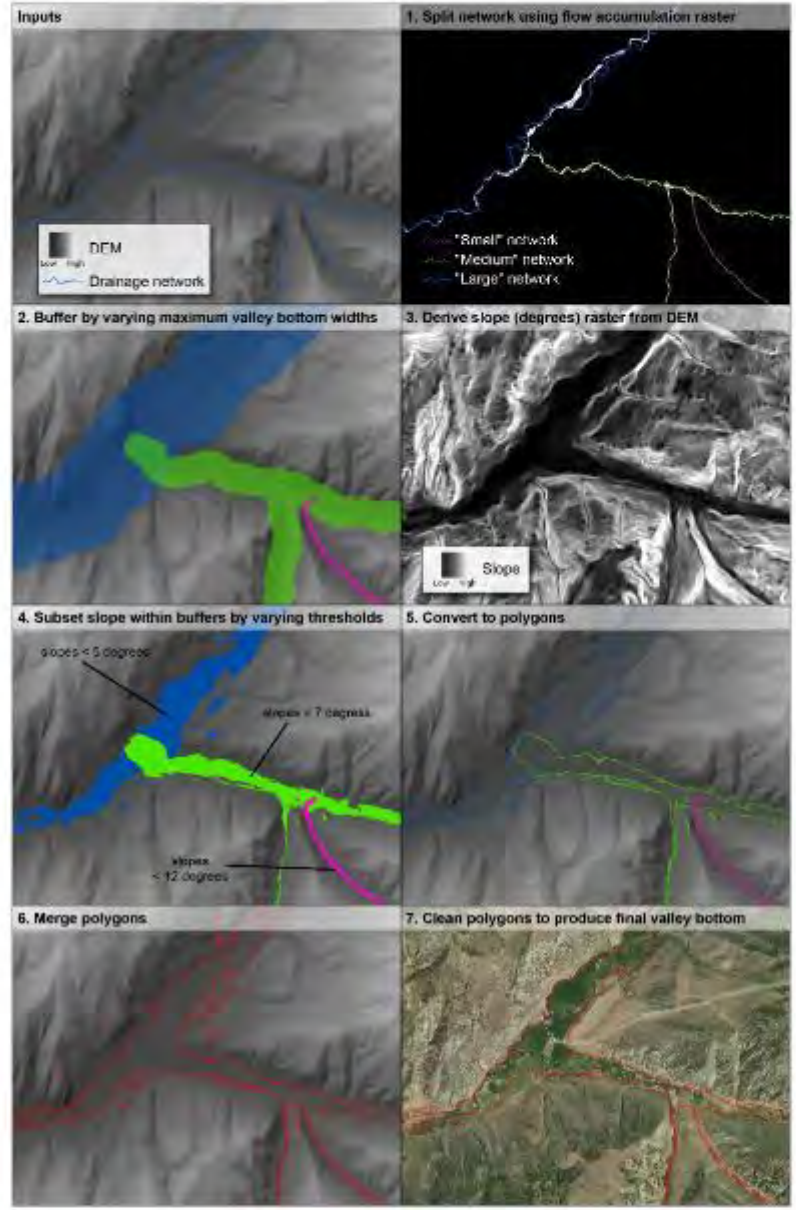
From Wheaton et al. (2019) – LTPBR Manual

DOI: 10.13140/RG.2.2.19590.63049/1

V-BET: VALLEY BOTTOM EXTRACTION TOOL

- From topography (e.g. USGS 10 m NED or LiDAR) & V-BET





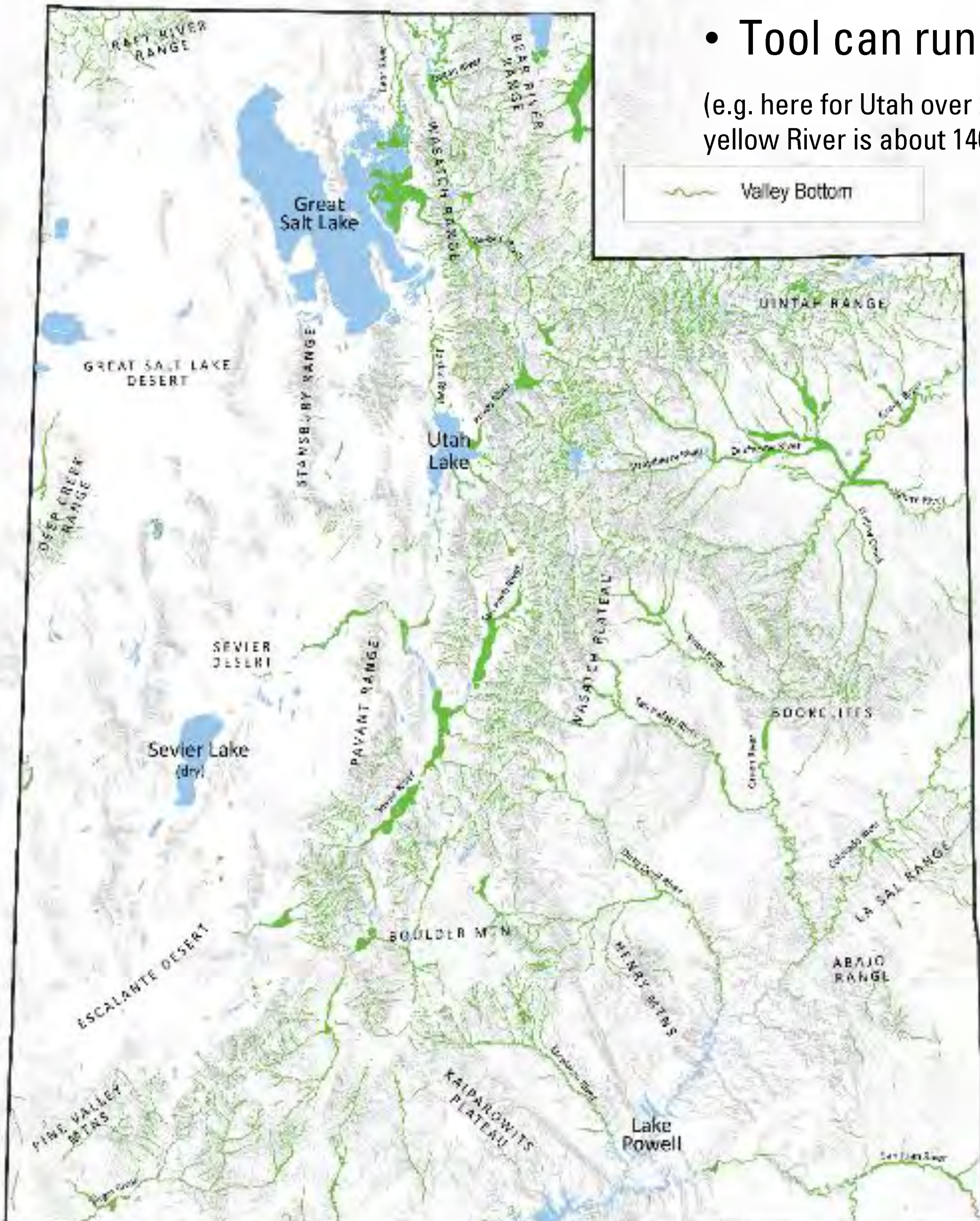
From: Gilbert et al. (2016) – Computers & Geosciences ;
DOI: 10.1016/j.cageo.2016.07.014
http://rcat.riverscapes.xyz

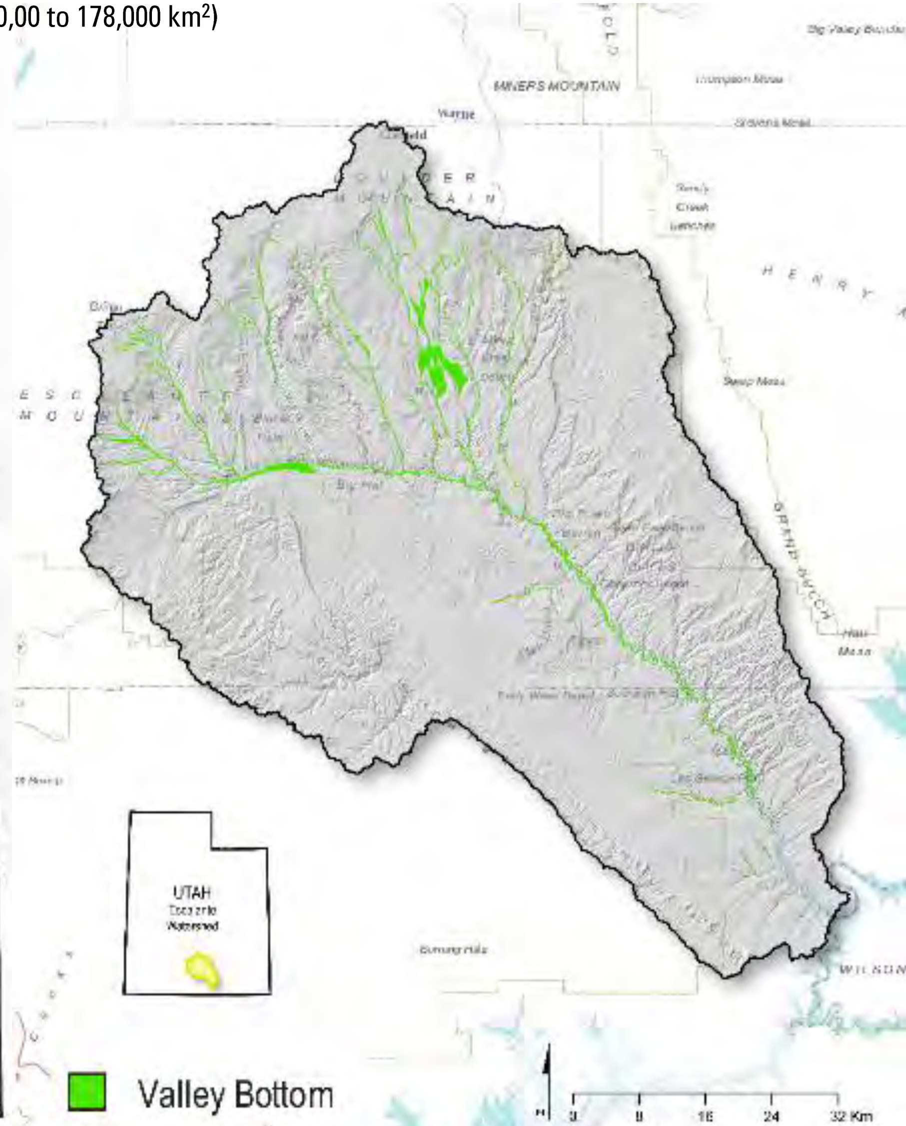
RCAT

State-Wide or Watershed Wide: VALLEY BOTTOMS

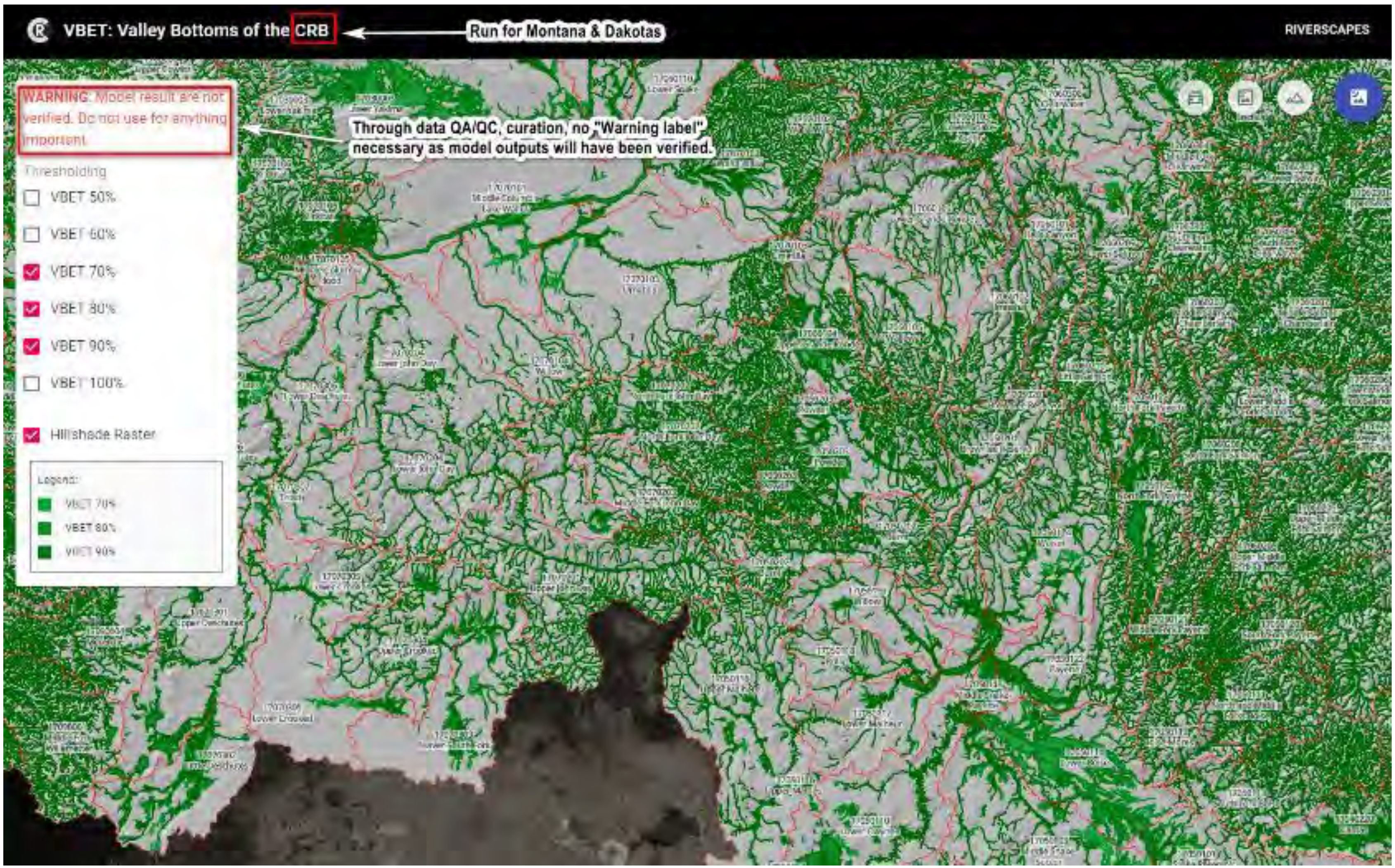
- Tool can run @ broad spatial scales from DEM

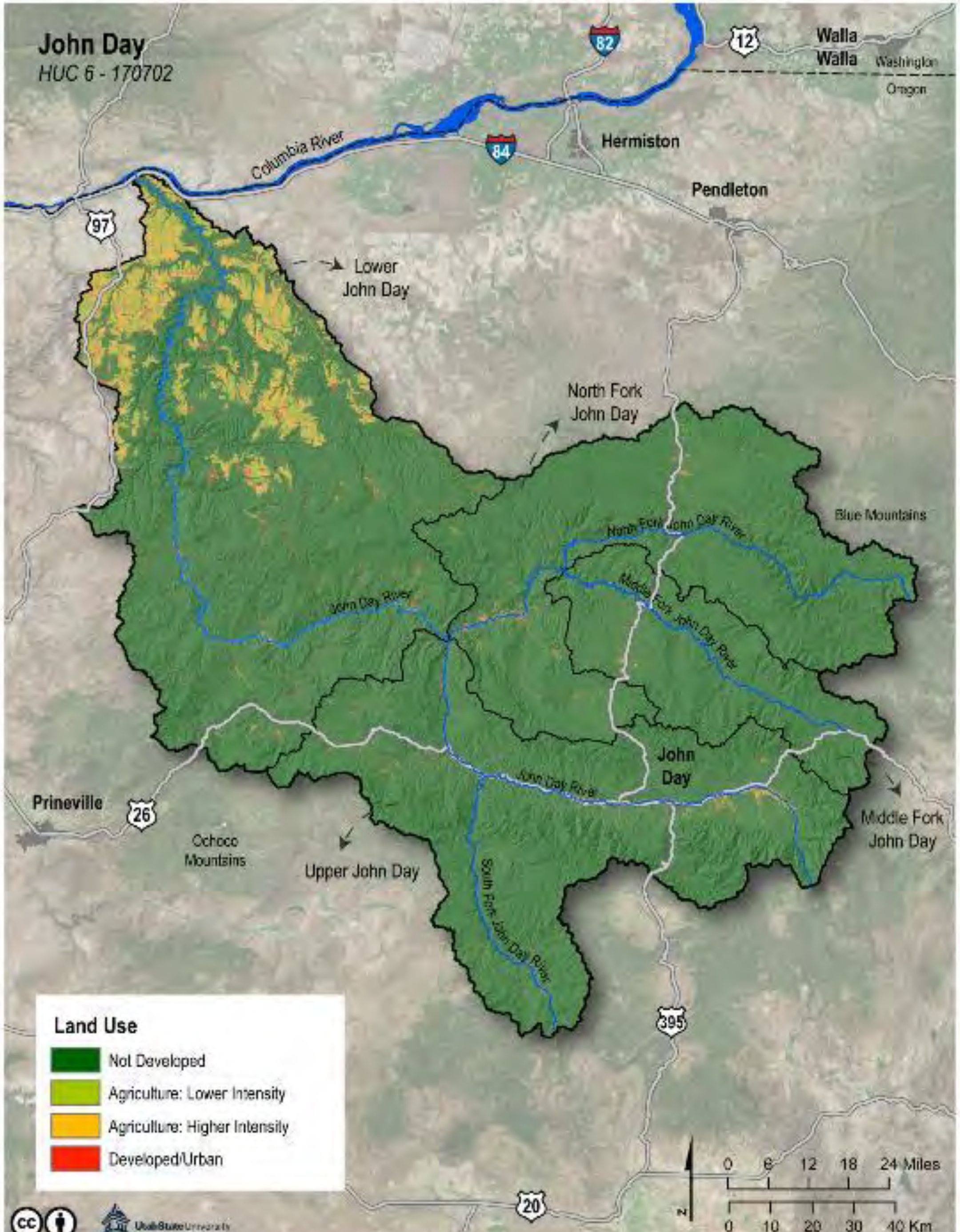
(e.g. here for Utah over 25,000 km of riverscape in a region ~ 220,000 km^2 ; by comparison Upper yellow River is about 140,00 to 178,000 km^2)





Making Investment

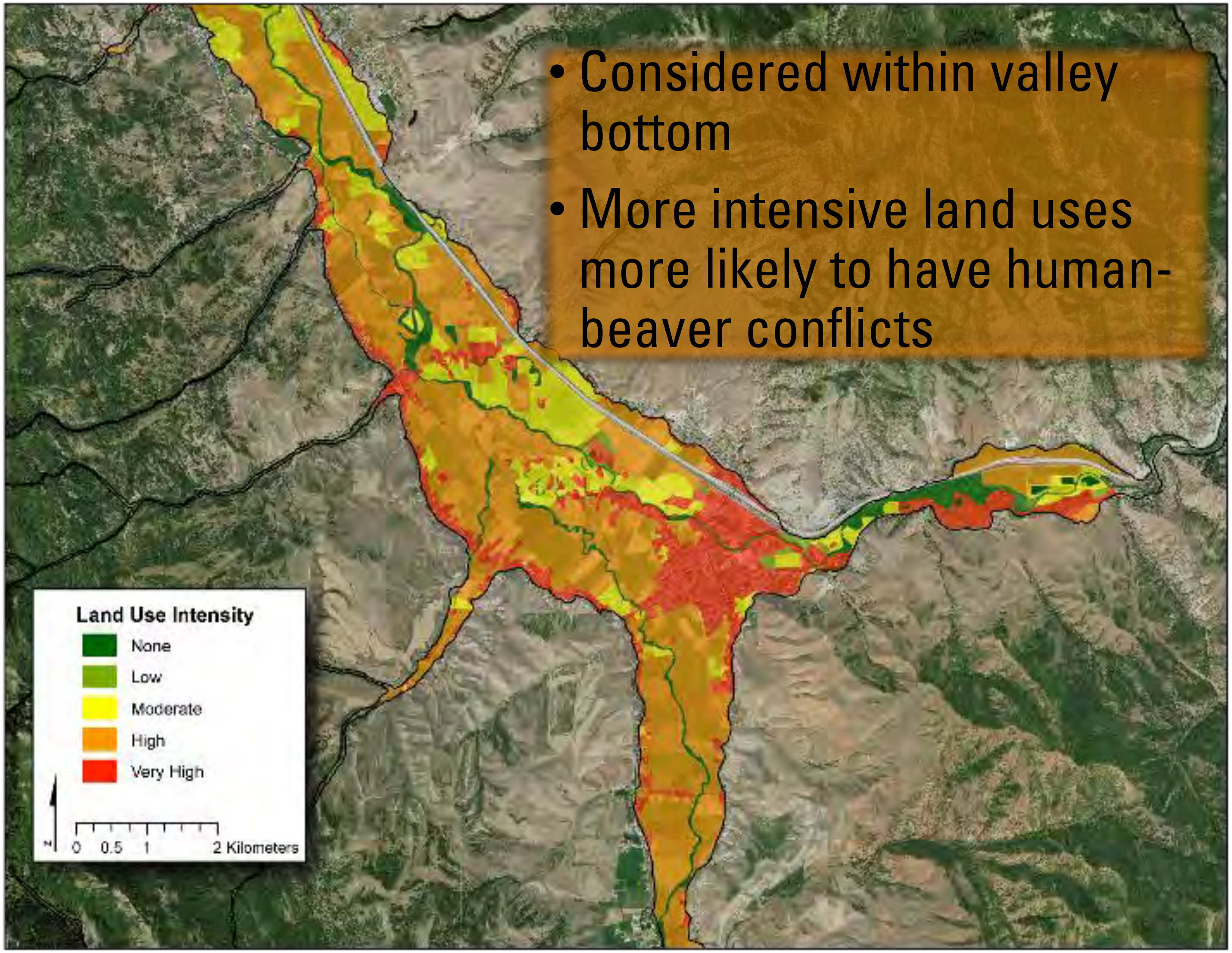




Land Use Intensity

- Land use intensity is easily derived from LANDFIRE

Within Valley Bottom: Land Use Intensity

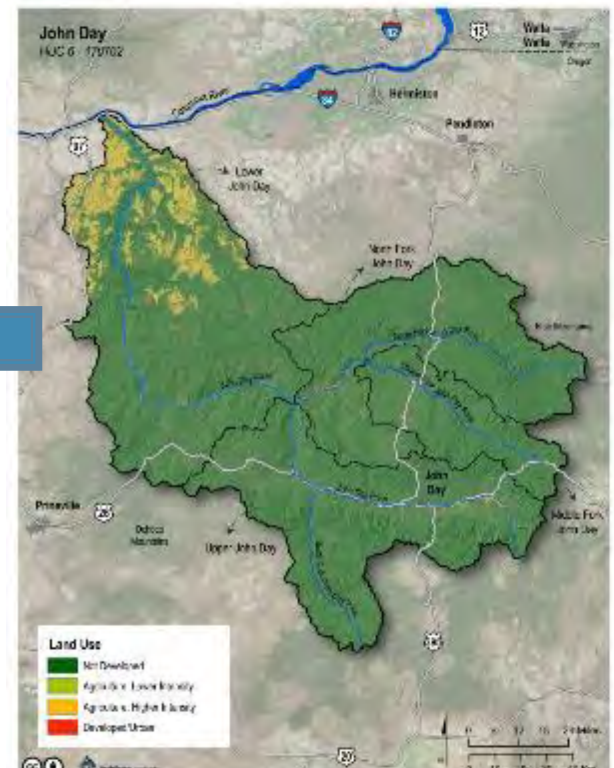


- Considered within valley bottom
- More intensive land uses more likely to have human-beaver conflicts

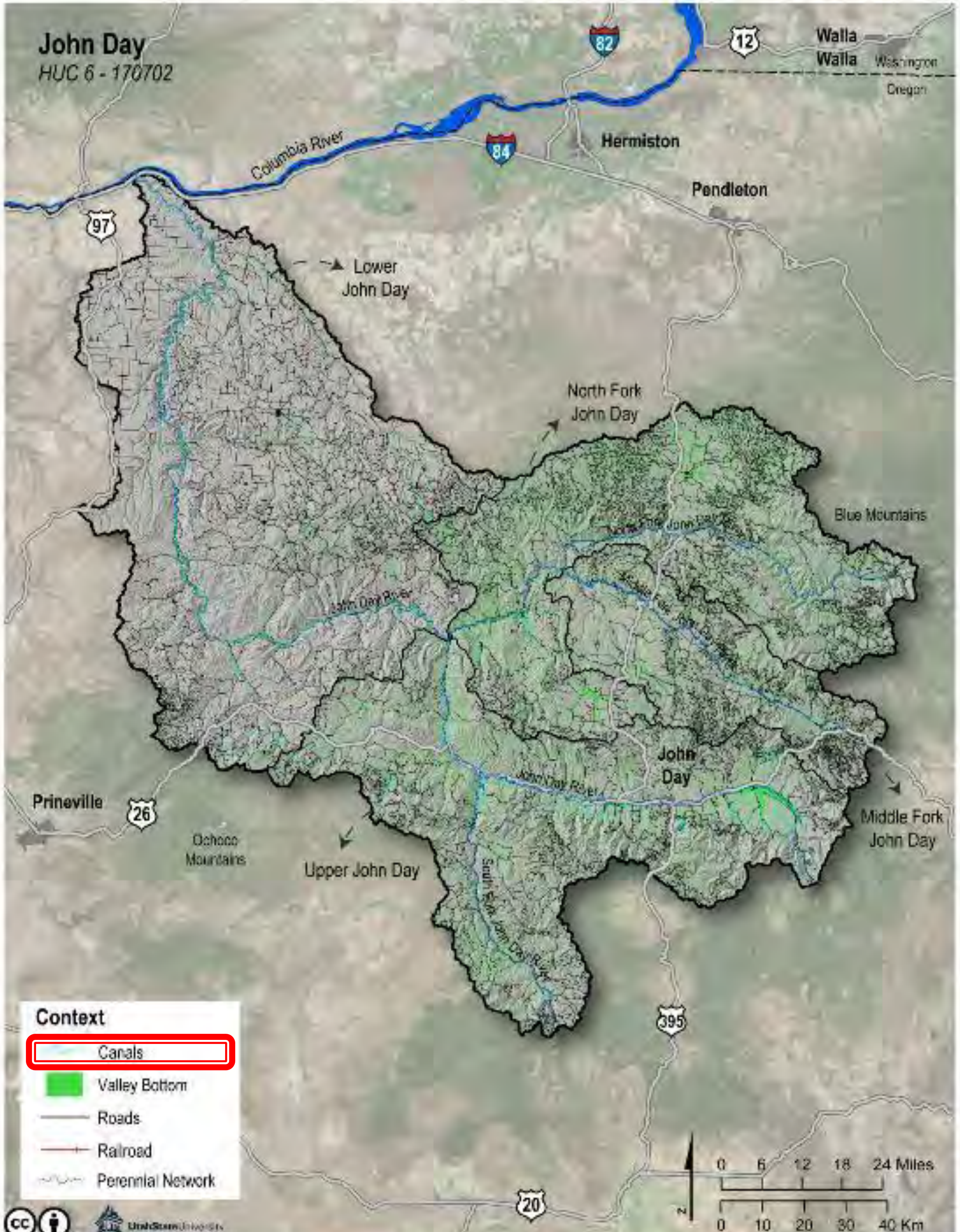
Macfarlane et al. (2018) Journal of Environmental Management: DOI: [10.1007/s00267-018-1061-2](https://doi.org/10.1007/s00267-018-1061-2).
http://rcat.riverscapes.xyz

Land use intensity on network

An average land use intensity within the valley bottom of each reach can be easily calculated

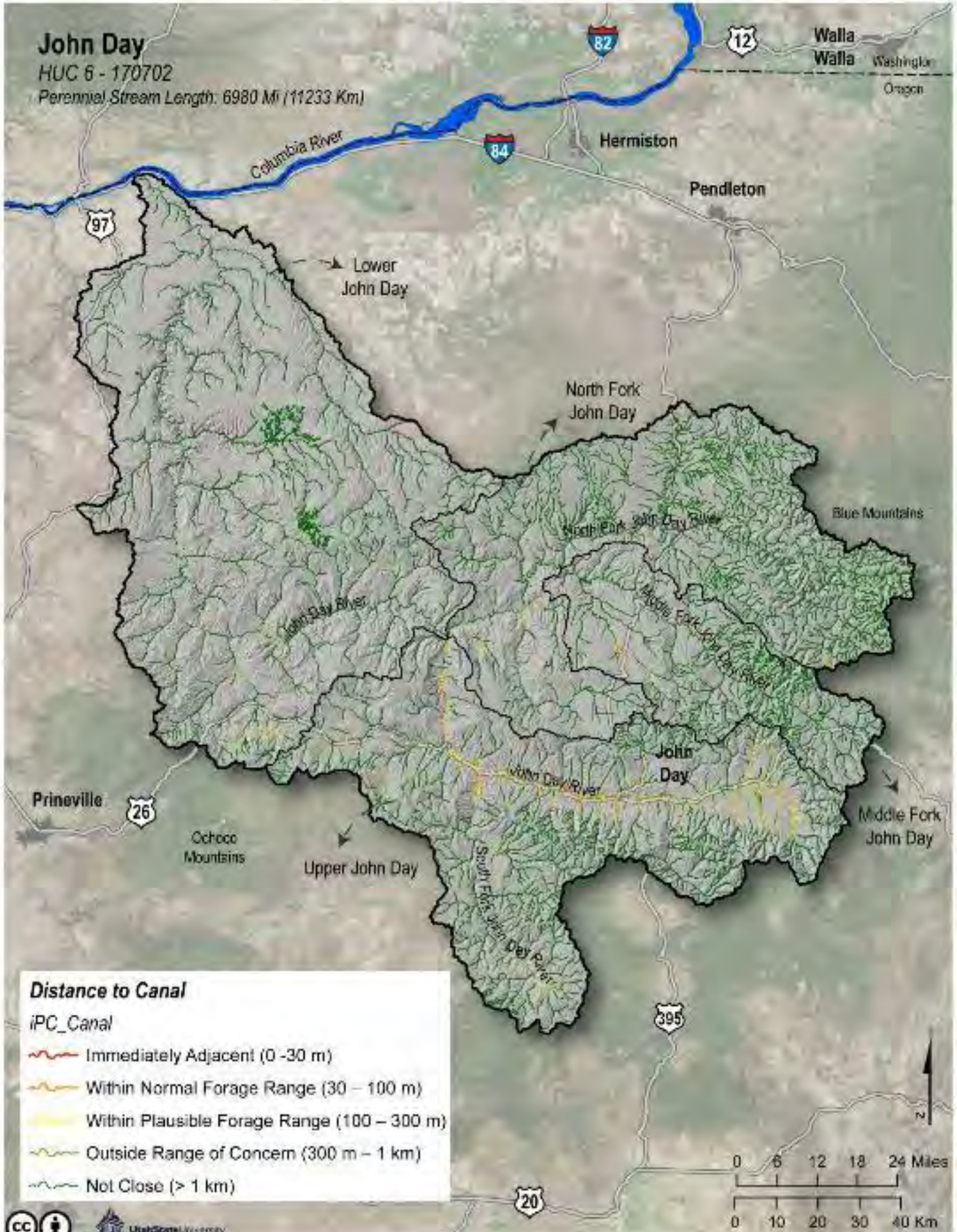


Infrastructure



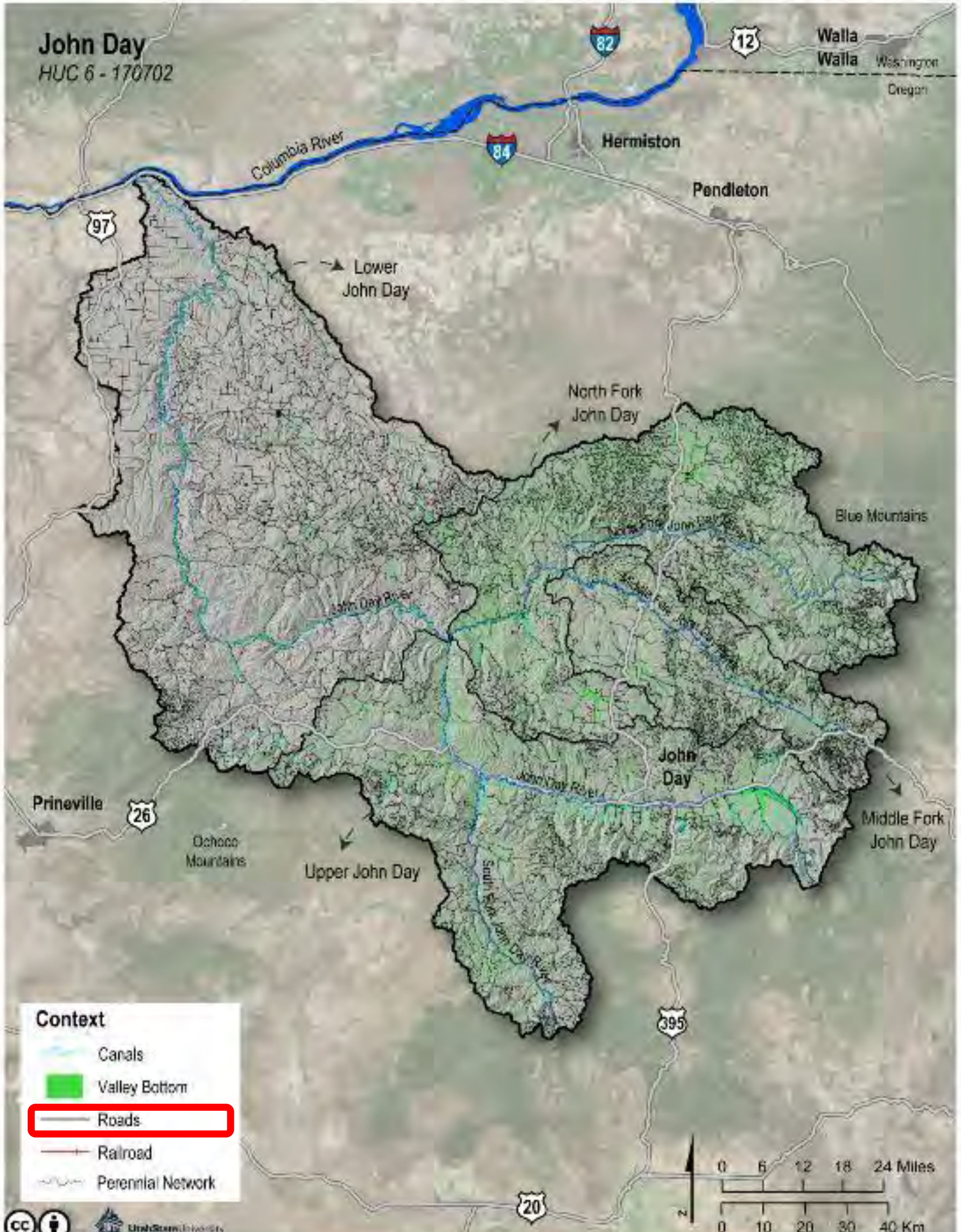
Next, we can look at how close we are to infrastructure beaver could flood or damage: roads, railroads, canals

Canals



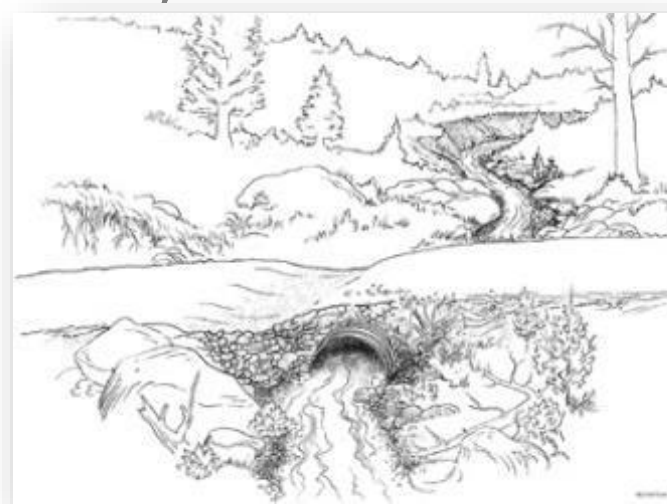
Generally, beaver are not welcome or useful additions to irrigation canals

There are a lot of irrigation ditches… evaluating distance from canals can be cast in terms of 'beaver distances'



Roads?

The black lines are roads
(note the extremely high density in headwaters)



A RISK WITH ROADS… CROSSINGS

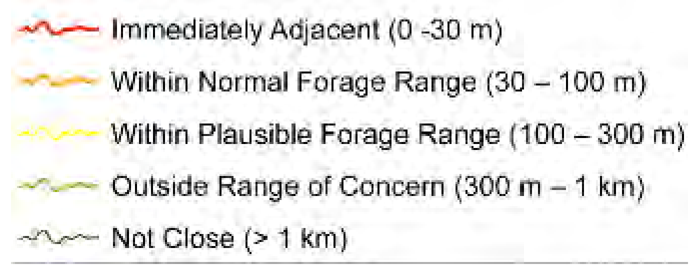
- Simply looking at road crossings and distance from that can help evaluate potential 'clogging' locations
- A large bridge with plenty of clearance is not necessarily a problem…
- A small culvert might be

Distance to road vs. Road in valley bottom

While roads can also be looked at in terms of distance from the channel, if we're interested in road flooding problem, we just care about **roads in the valley bottom**.

Bringing All These Together

- Proximity to 'floodable' or 'clogable' infrastructure:
  - Roads
  - Road Crossings
  - Canals
  - Railroads
- How far to closest threat?

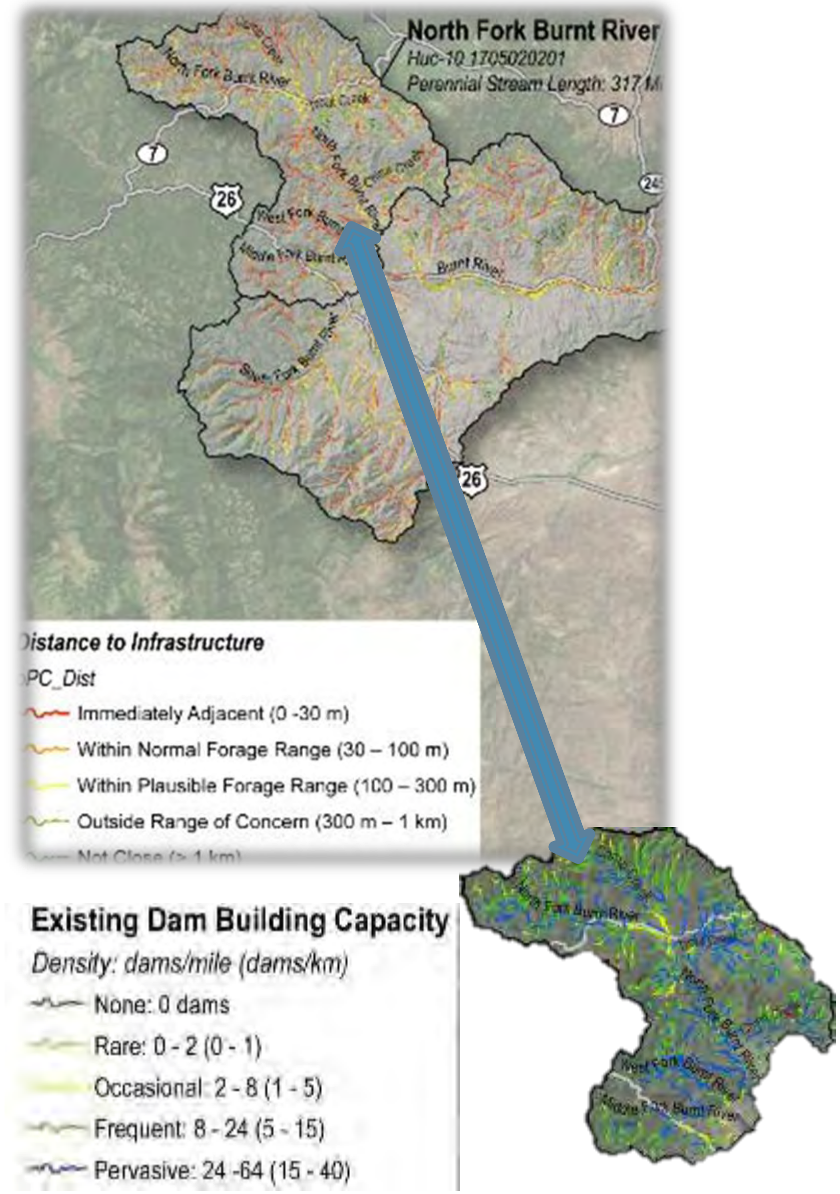


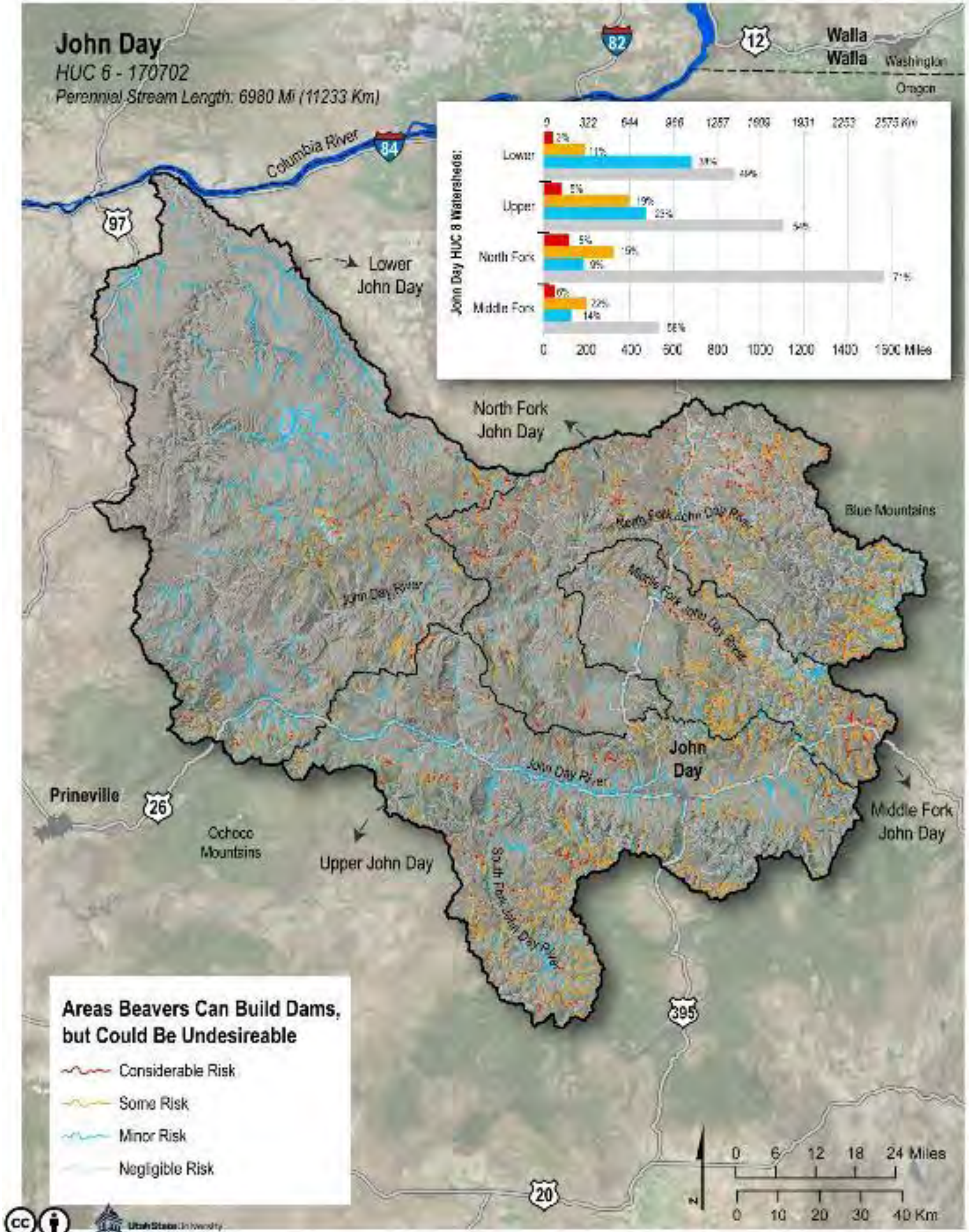
Nearest Infrastructure

We can synthesize all these by calculating the distance to **closest infrastructure** (i.e. road in valley bottom, road crossing, railroad, or canal)

But, this is unrealistically pessimistic

- This is just how close is the stream to these things!
- NOT how close will beaver be
- Setting aside undesirable harvest of vegetation/trees, main impact of beavers is damming
- So just look at where proximity is higher, and where beaver are likely to build dams





More Focused Look @ "Risk"

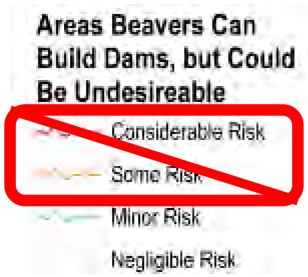
Where could there be some risks of human-beaver conflict?

- Assuming that beaver are present in that reach & they decide to build dam & it actually causes impact… (i.e. very conservative over-prediction)

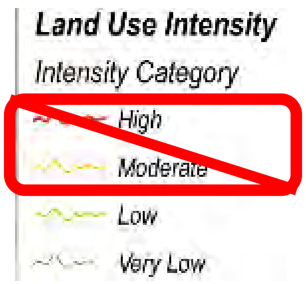

OUTLINE
Identifying Where to Place Beavers and When to Use Beaver Mimicry for Low Tech Restoration
I. Background & Other Resources
II. Dam Building Focus – Expectations
III. Contextualizing Risk
IV. Prioritizing Opportunities
V. Partnering with Beaver… A people business

With risks considered, where are the restoration & conservation opportunities?

- Be conservative:
  - Only look in areas of:
    - Minor risk
    - Negligible risk



  - Avoid high intensity land use:
    - Low
    - Very low



Restoration & Conservation Opportunities

- Areas with limited 'risk' of human-beaver conflict & some ex. capacity.
  - **Low Hanging Fruit** has capacity, just needs some beaver!

Frequent: 8 - 24 (5 - 15)
Pervasive: 24 -64 (15 - 40)

  - **Quick Return** is currently *Occasional* but historically higher

Occasional: 2 - 8 (1 - 5)

  - **Strategic** is currently hammered but historically was high

Rare: 0 - 2 (0 - 1)

Possible Beaver Dam Conservation/Restoration Opportunities

Easiest - Low-Hanging Fruit
Straight Forward - Quick Return
Strategic - Long-Term Investment
Other

Existing Dam Building Capacity

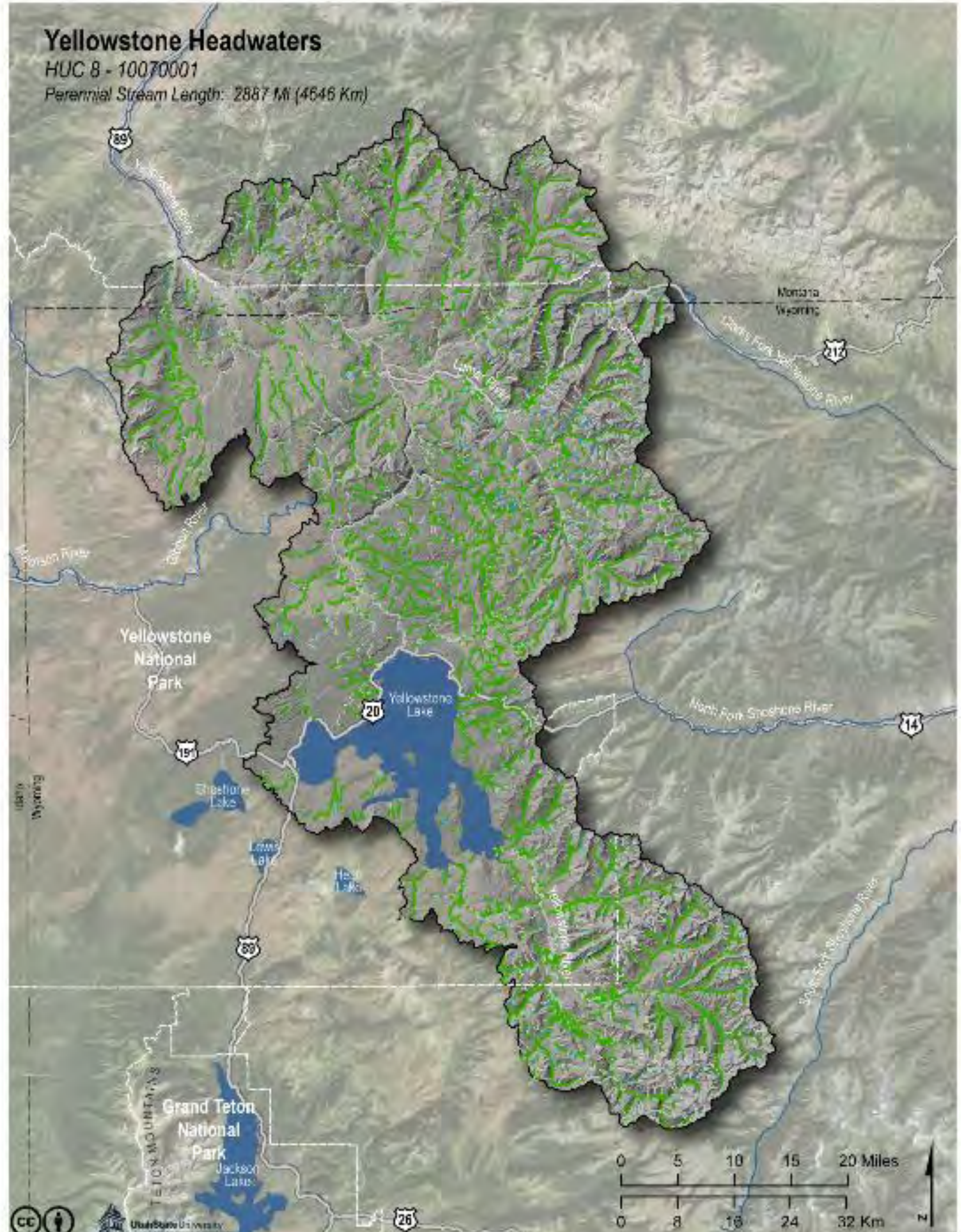
Density: dams/mile (dams/km)

None: 0 dams
Rare: 0 - 2 (0 - 1)
Occasional: 2 - 8 (1 - 5)
Frequent: 8 - 24 (5 - 15)
Pervasive: 24 -64 (15 - 40)

These areas typically need long-term riparian recovery first (e.g. grazing management)

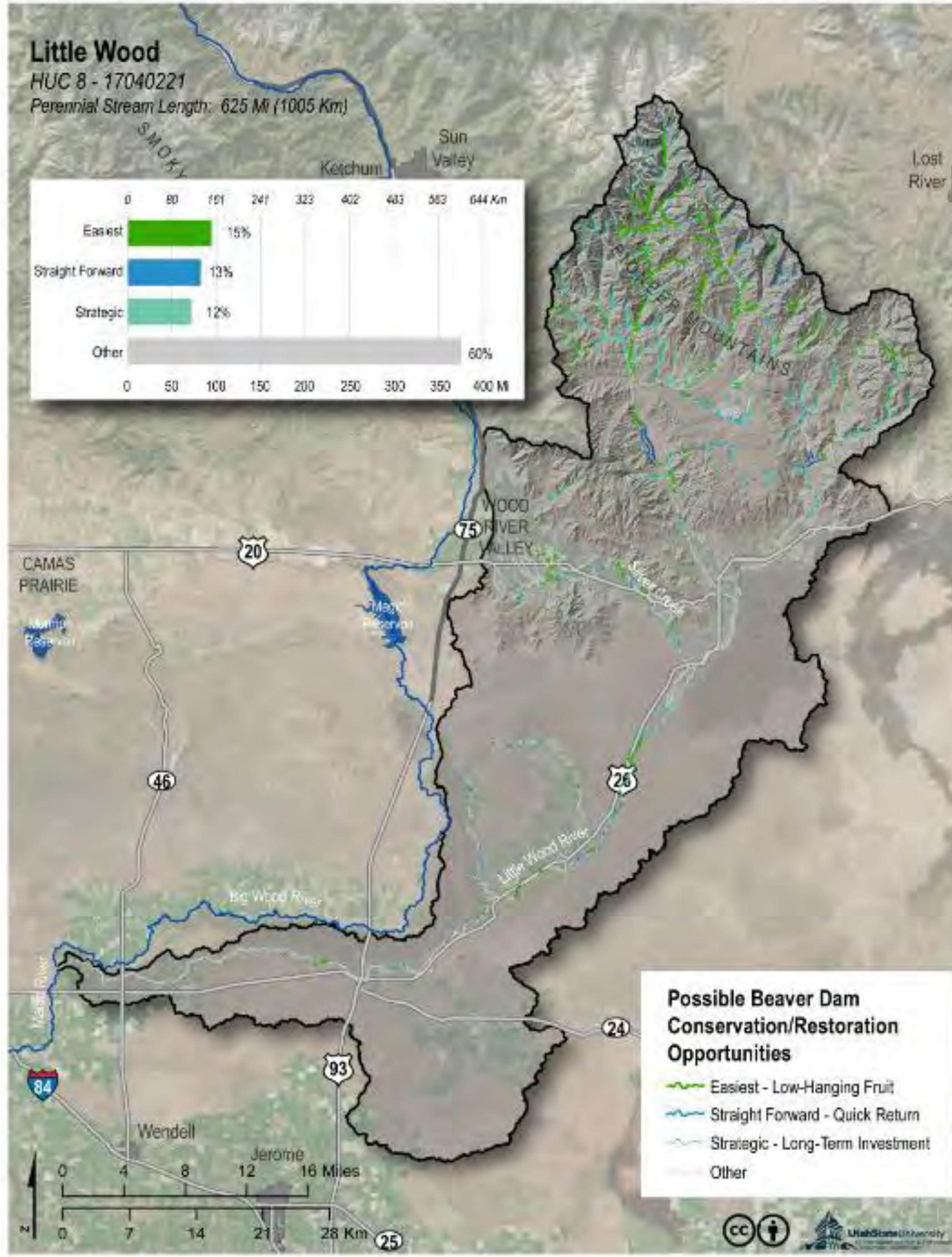
Restoration & Conservation Opportunities

Where are low-risk beaver restoration & conservation opportunities located?



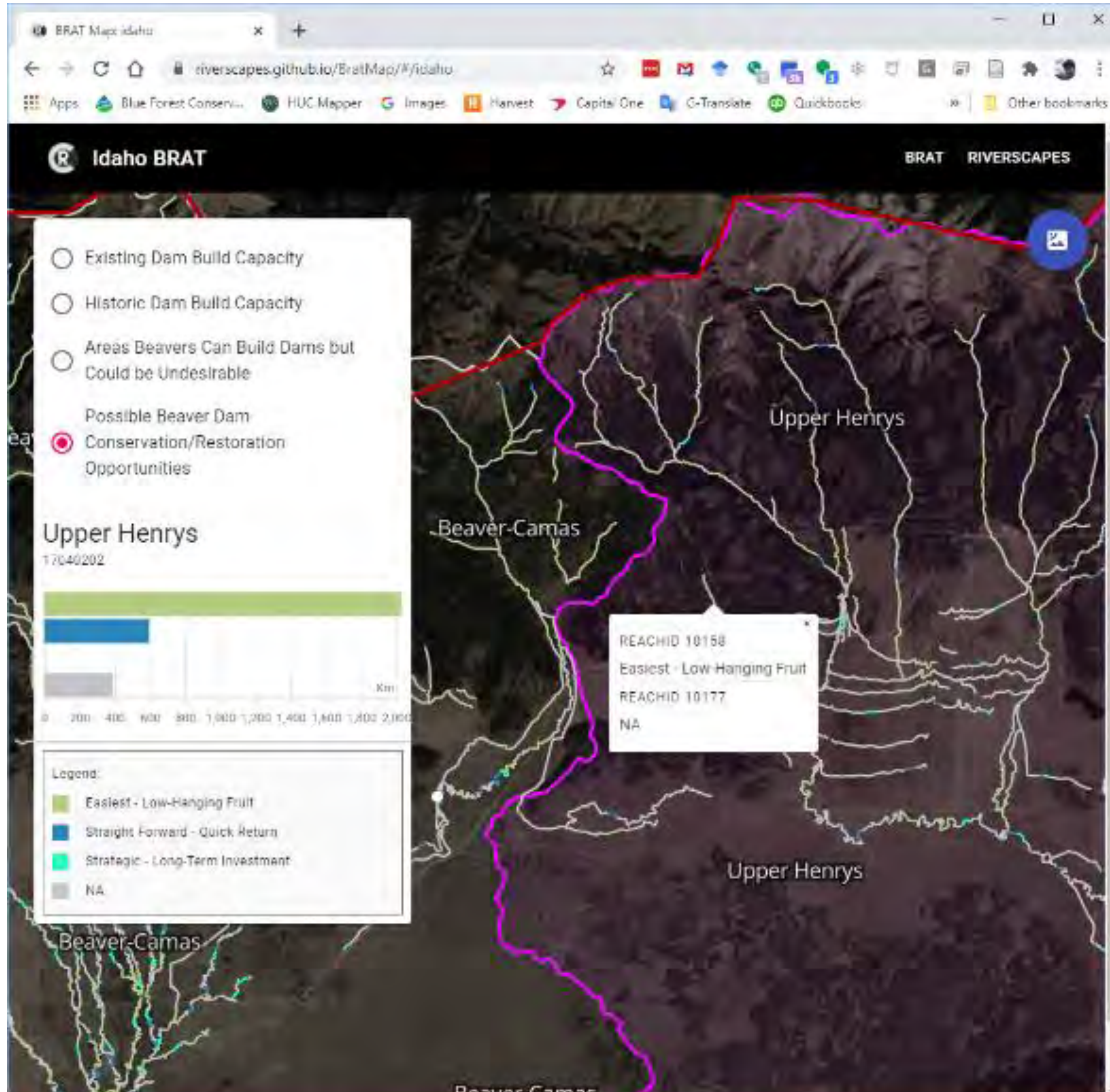
Restoration & Conservation Opportunities

Little Wood watershed has more interesting results



So where should you work?

- What are you trying to do?
- What impairments are you trying to address?
- What species are you trying to benefit?
- What uplift or improvement (e.g. in quantity of mesic habitat) are you trying to get?
- What risks should you be aware of, mitigate and/or avoid?



Difference between conservation & restoration

- Compare realized dam counts to existing capacity
- In reaches @ or near capacity & in 'low hanging fruit'
  - Flag as conservation (e.g. trapping closure)
- In reaches with no realized-capacity or under-utilized-capacity:
  - Target for restoration and/or translocation
  - Maybe use BDAs to promote beaver to stick
- In quick-return areas, use low-tech PBR & better land management to improve conditions and try to get beaver to help
- If 'long-term' areas are important, strategically invest to improve riparian conditions

OUTLINE

Identifying Where to Place Beavers and When to Use Beaver Mimicry for Low Tech Restoration

I. Background & Other Resources

II. Dam Building Focus – Expectations

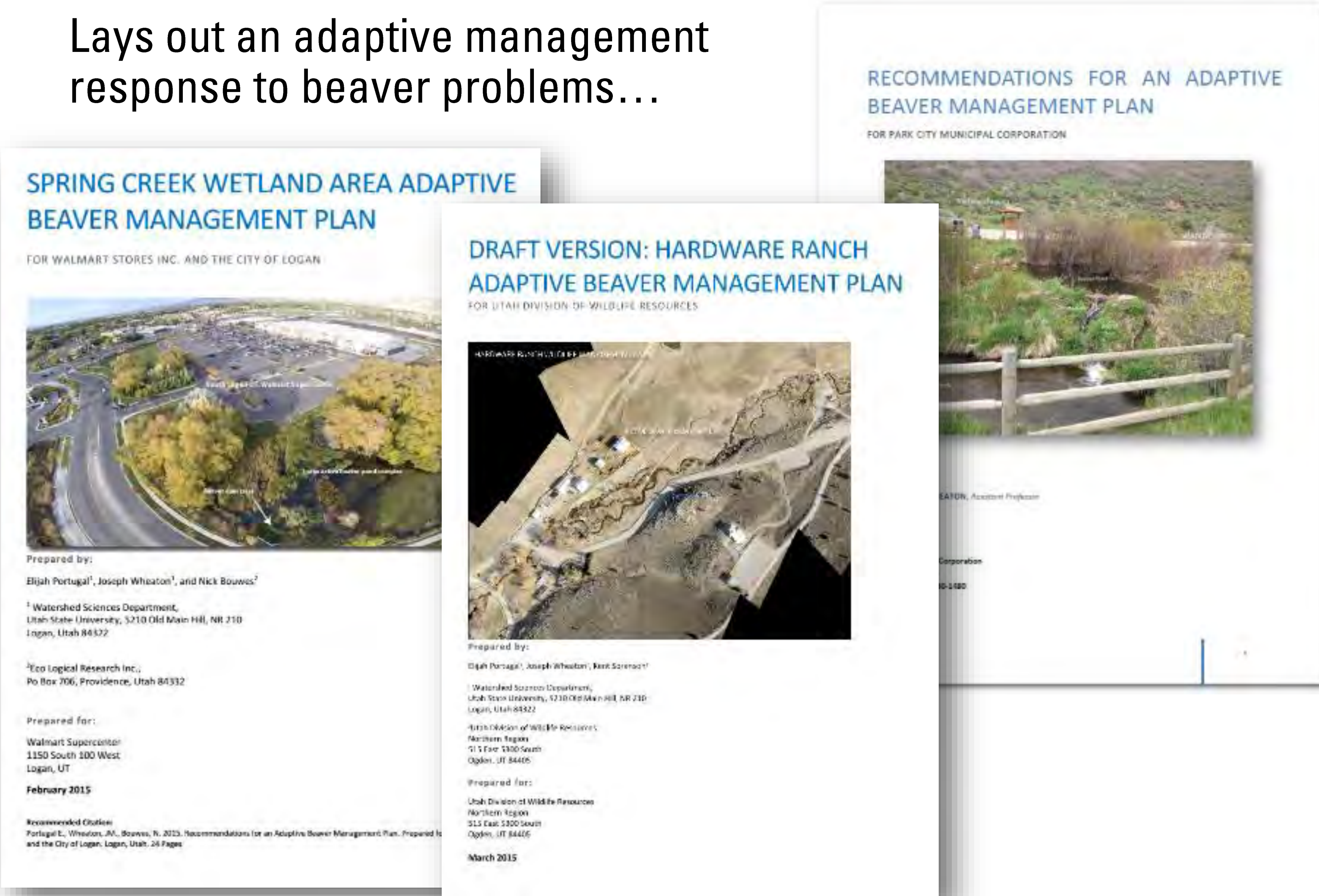
III. Contextualizing Risk

IV. Prioritizing Opportunities

V. **Partnering with Beaver… A people business** http://lowtechpbr.restoration.usu.edu/resources/adaptivemgt.html

Examples of how to do AM…

Lays out an adaptive management response to beaver problems…



SPRING CREEK WETLAND AREA ADAPTIVE BEAVER MANAGEMENT PLAN

FOR WALMART STORES INC. AND THE CITY OF LOGAN

Prepared by:

Elijah Portugal[1], Joseph Wheaton[1], and Nick Bouwes[2]

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Logan, UT

February 2015

DRAFT VERSION: HARDWARE RANCH ADAPTIVE BEAVER MANAGEMENT PLAN

FOR UTAH DIVISION OF WILDLIFE RESOURCES

Prepared by:

Prepared for:

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Northern Region
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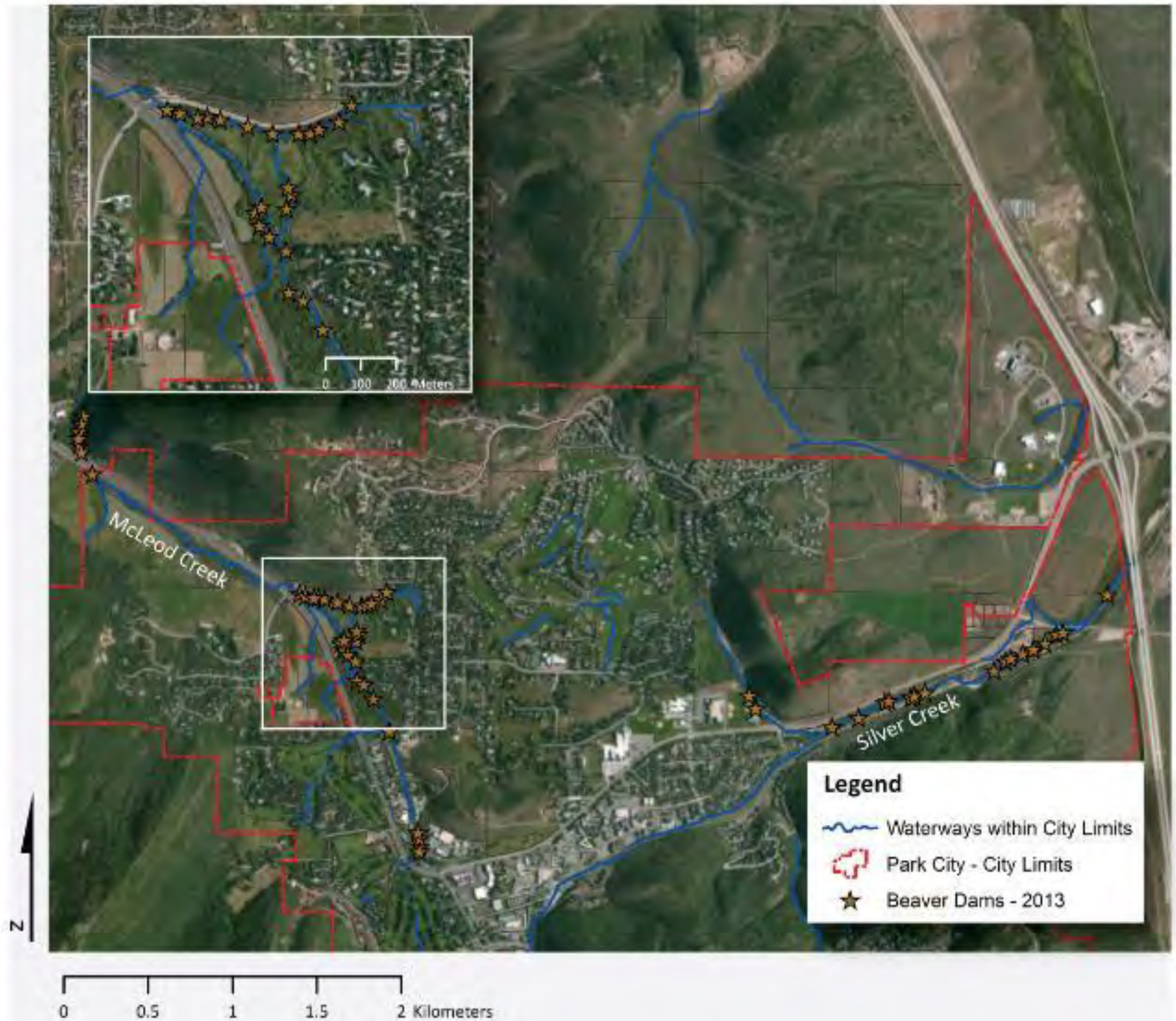
March 2015

RECOMMENDATIONS FOR AN ADAPTIVE BEAVER MANAGEMENT PLAN

FOR PARK CITY MUNICIPAL CORPORATION

Park City Story

- Good old days of traditional, undocumented beaver management
- Change of mgmt…
- Beaver come back
- Beaver cause flooding problems
- City removes (traditional mgmt.)
- But people liked the beaver… and complained
- CONFLICT!

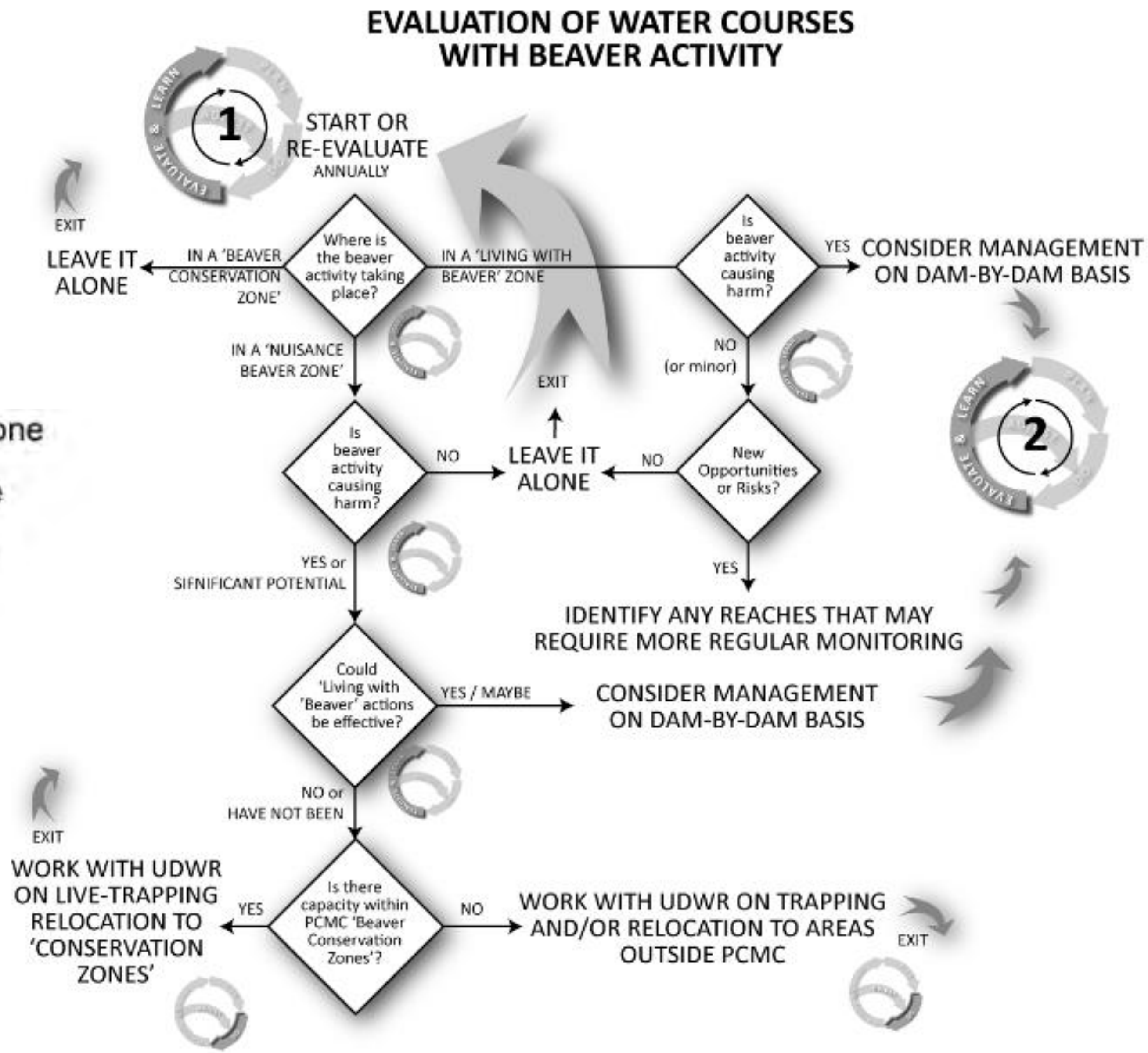


Wheaton (2013)

DOI: 10.6084/m9.figshare.903648.

Simple Decision Points – By Water Course

- Cheaper and more effective then just lethal treatment everywhere…

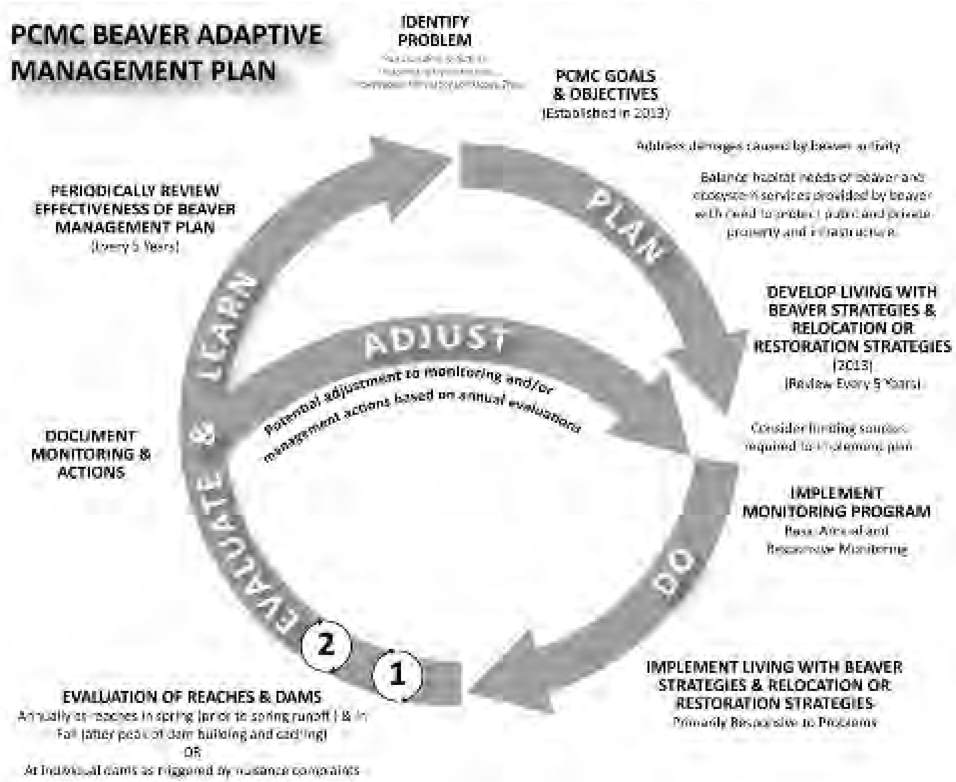


Wheaton (2013)

DOI: 10.6084/m9.figshare.903648.

Adaptive Beaver Management Plan

- Beaver Conservation Zone
- Living with Beaver Zone
- Nuisance Beaver Zone
- Non-Beaver Bearing
- Culvert or Bridge



Genuine Partnerships

Jay Wilde's story of restoring perennial flow to his creek using beaver…

LOW-TECH PROCESS-BASED RESTORATION OF RIVERSCAPES
DESIGN MANUAL, RESOURCES, WORKSHOPS

Utah State University RESTORATION CONSORTIUM

LOW-TECH PBR VIRTUAL FIELD TRIP

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Subscribe to the Low-Tech PBR mailing list

Email Address

First Name

Virtual Field Trip to Birch Creek

Normally, in our in-person workshops, we like to take participants in the field to see an actual low-tech process-based restoration (LTPBR) project on the ground. This helps you see first-hand a real riverscape subjected to "structural starvation", and for which a LTPBR project was successfully completed.

There is no substitute for meeting Jay Wilde in person and seeing what the beaver have done to Birch Creek, Idaho because of his efforts. Tromping around in the water and mud and experiencing this for yourself, really helps the concepts and the scope of what is possible sink in. This page attempts to reproduce as much of that experience as we can virtually for you in Birch Creek.

Guided Virtual Tour

In this 90 minute video, you are invited to a series of stops up and down Birch Creek. The conversation between Jay Wilde and Joe Wheaton is similar to the conversation we have when we take a whole class out. Unlike the real field trip, where when you've had enough you can just hang back and wander around on your own, with this one you can fast forward if you get bored.

So where has pyBRAT 3.0 been run?
Is the tool the GIS tool or the outputs? Or the thought process?

http://brat.riverscapes.xyz/BRATData/

Everything Is Open-source… But

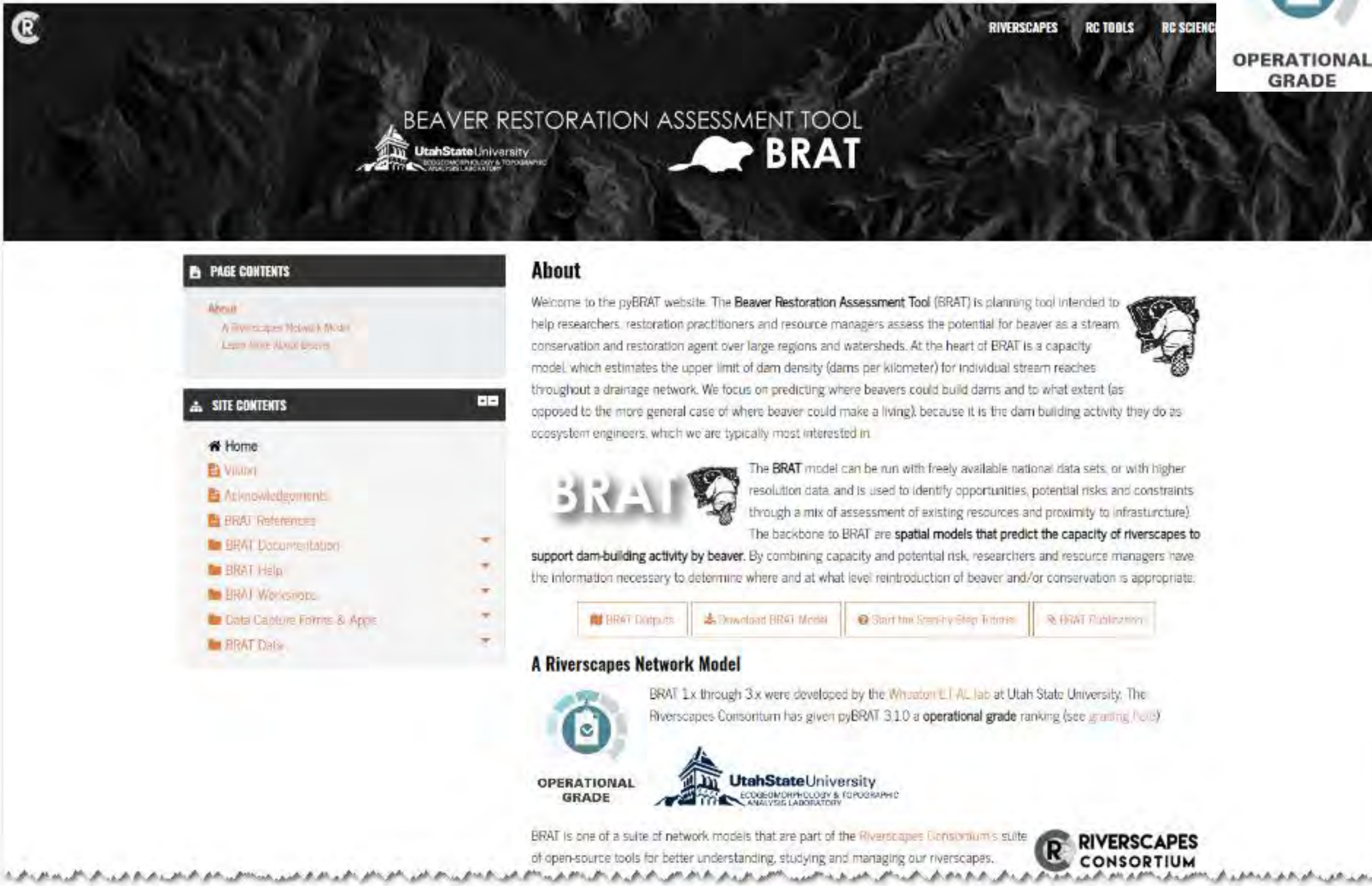
RIVERSCAPES CONSORTIUM

http://riverscapes.xyz

https://github.com/Riverscapes

pyBRAT is just Operational Grade Tool

OPERATIONAL GRADE



RIVERSCAPES RC TOOLS RC SCIENC

BEAVER RESTORATION ASSESSMENT TOOL

UtahStateUniversity ECOGEOMORPHOLOGY & TOPOGRAPHIC ANALYSIS LABORATORY

BRAT

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- BRAT Workshops
- Data Capture Forms & Apps
- BRAT Data

About

Welcome to the pyBRAT website. The **Beaver Restoration Assessment Tool** (BRAT) is planning tool intended to help researchers, restoration practitioners and resource managers assess the potential for beaver as a stream conservation and restoration agent over large regions and watersheds. At the heart of BRAT is a capacity model which estimates the upper limit of dam density (dams per kilometer) for individual stream reaches throughout a drainage network. We focus on predicting where beavers could build dams and to what extent (as opposed to the more general case of where beaver could make a living), because it is the dam building activity they do as ecosystem engineers, which we are typically most interested in.

BRAT

The **BRAT** model can be run with freely available national data sets, or with higher resolution data, and is used to identify opportunities, potential risks and constraints through a mix of assessment of existing resources and proximity to infrastructure). The backbone to BRAT are **spatial models that predict the capacity of riverscapes to support dam-building activity by beaver.** By combining capacity and potential risk, researchers and resource managers have the information necessary to determine where and at what level reintroduction of beaver and/or conservation is appropriate.

BRAT Outputs | Download BRAT Model | Start the Step-by-Step Tutorial | BRAT Publications

A Riverscapes Network Model

BRAT 1.x through 3.x were developed by the Wheaton ET AL lab at Utah State University. The Riverscapes Consortium has given pyBRAT 3.1.0 a **operational grade** ranking (see grading here)

OPERATIONAL GRADE

UtahStateUniversity ECOGEOMORPHOLOGY & TOPOGRAPHIC ANALYSIS LABORATORY

BRAT is one of a suite of network models that are part of the Riverscapes Consortium's suite of open-source tools for better understanding, studying and managing our riverscapes.

RIVERSCAPES CONSORTIUM

http://brat.riverscapes.xyz

BRAT

RIVERSCAPES REPORT CARD

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BRAT is one of several tools developed by the Riverscapes Consortium. This report card communicates BRAT's compliance with the Riverscape Consortium's published tool standards.

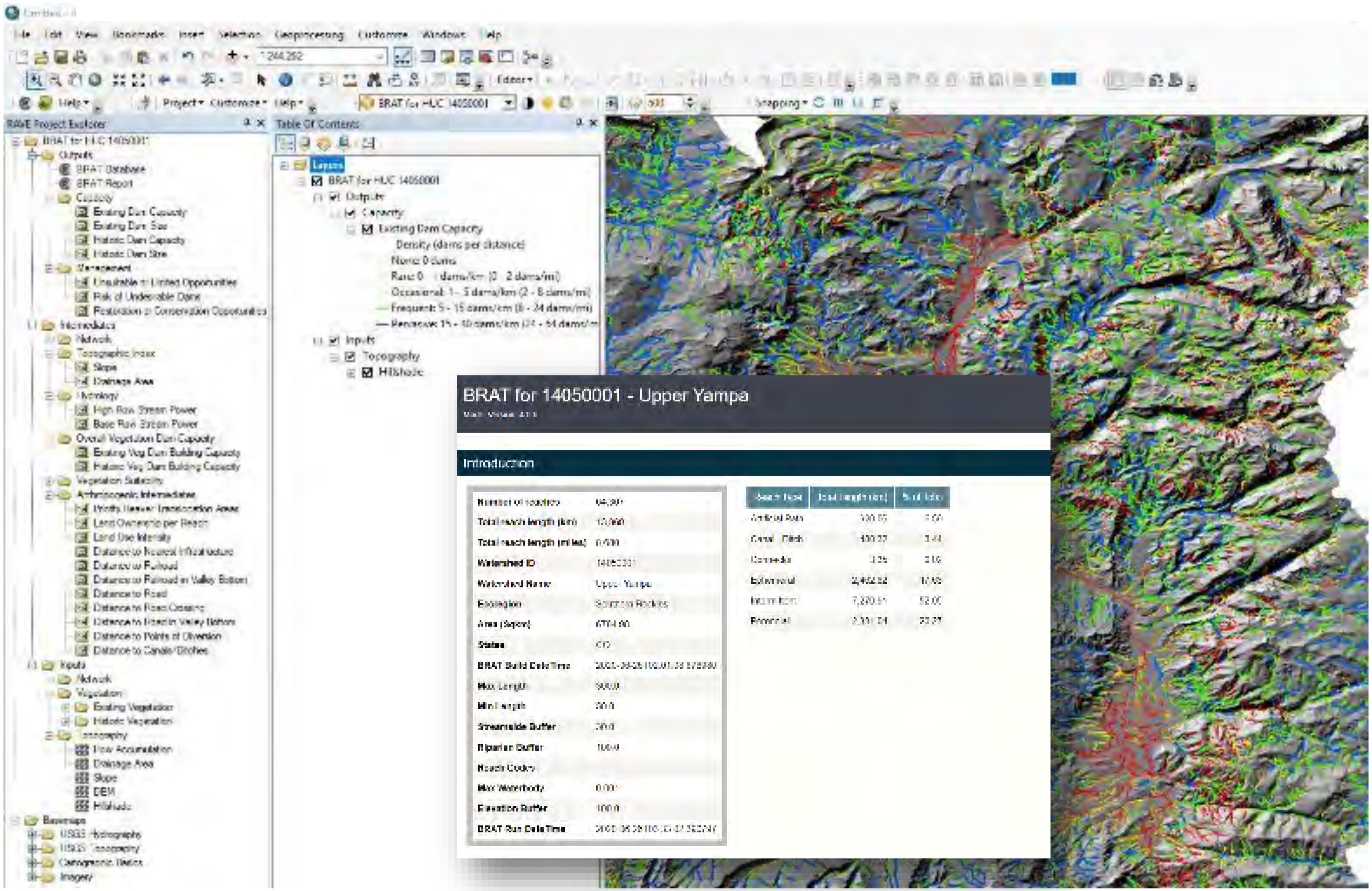
Report Card Summary

Tool	BRAT - Beaver Restoration Assessment Tool
Version	3.1.00
Date	2020-03-18
Assessment Team	Bailey & Wheaton
Current Assessment	Operational Grade
Target Status	Commercial Grade
Riverscapes Compliance	Pending
Assessment Rationale	BRAT has been applied extensively throughout the Western US and in the UK. It has been used extensively to inform policy and planning and state-wide, regional and watershed extents, but also to inform restoration planning and design at the reach-scale. Others have applied the model, but for the most part it has been implemented by the USU ETAL team. It is well deserving of an Operational Grade.

View in RAVE – Riverscapes Analysis Viewer Explorer

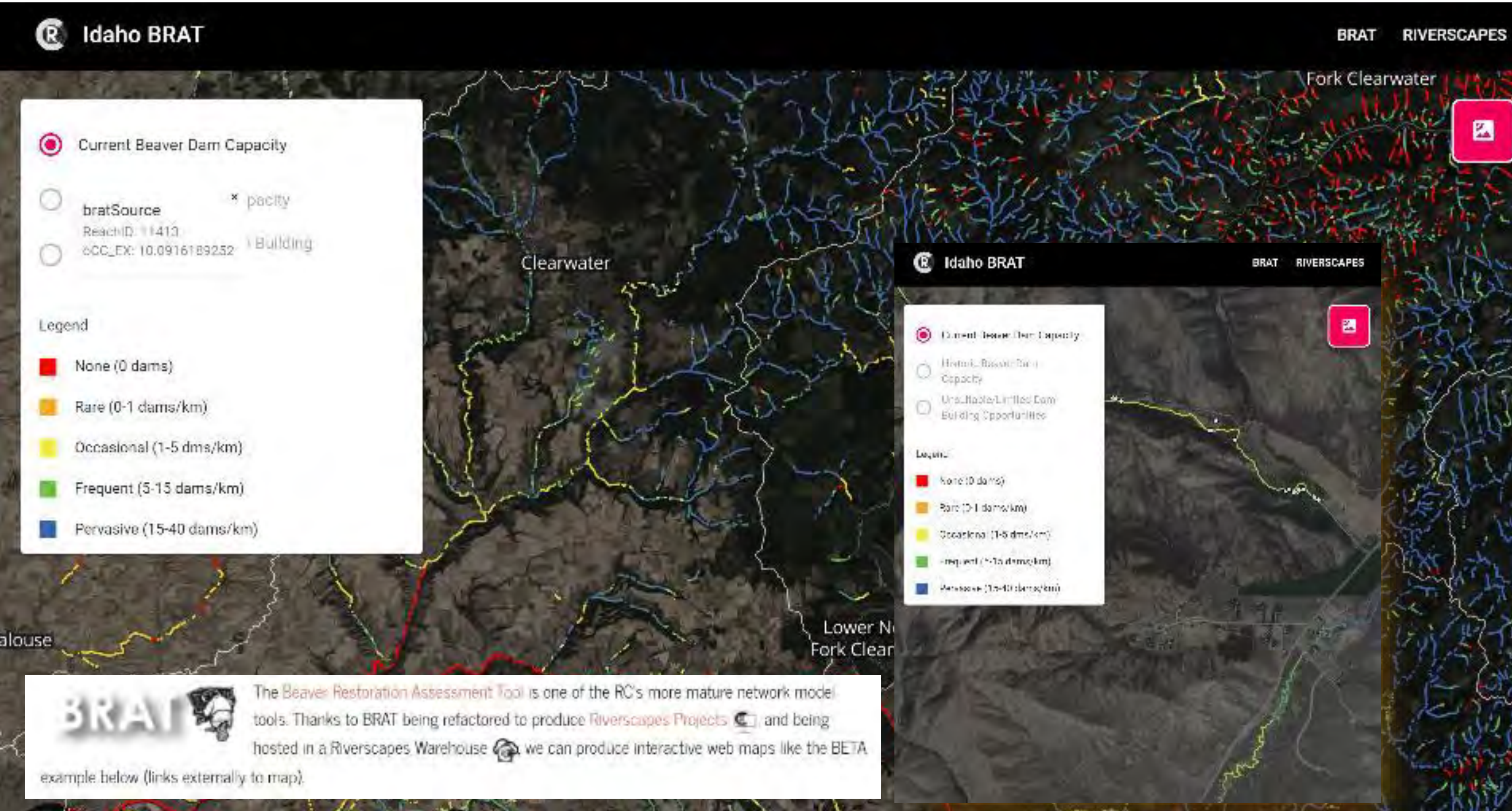
Glorified Housekeeping?

Yes, but who has time for it? Going to the effort of making your tool riverscapes-compliant turns the process of file management and metadata production and curation automatic for every analysis and write operation in your tools.



http://rave.riverscapes.xyz

Map Example – Network Going to sqlBRAT 4.0 – Don't need to be a GIS user



Will be available *next year (thank you BLM)* at: https://maps.riverscapes.xyz

RIVERSCAPES CONSORTIUM

If there isn't a run in my area…

1. Struggle through teaching yourself ArcPy and running GIS yourself
2. Just manually assess using cIS
3. Pay someone to run it for you

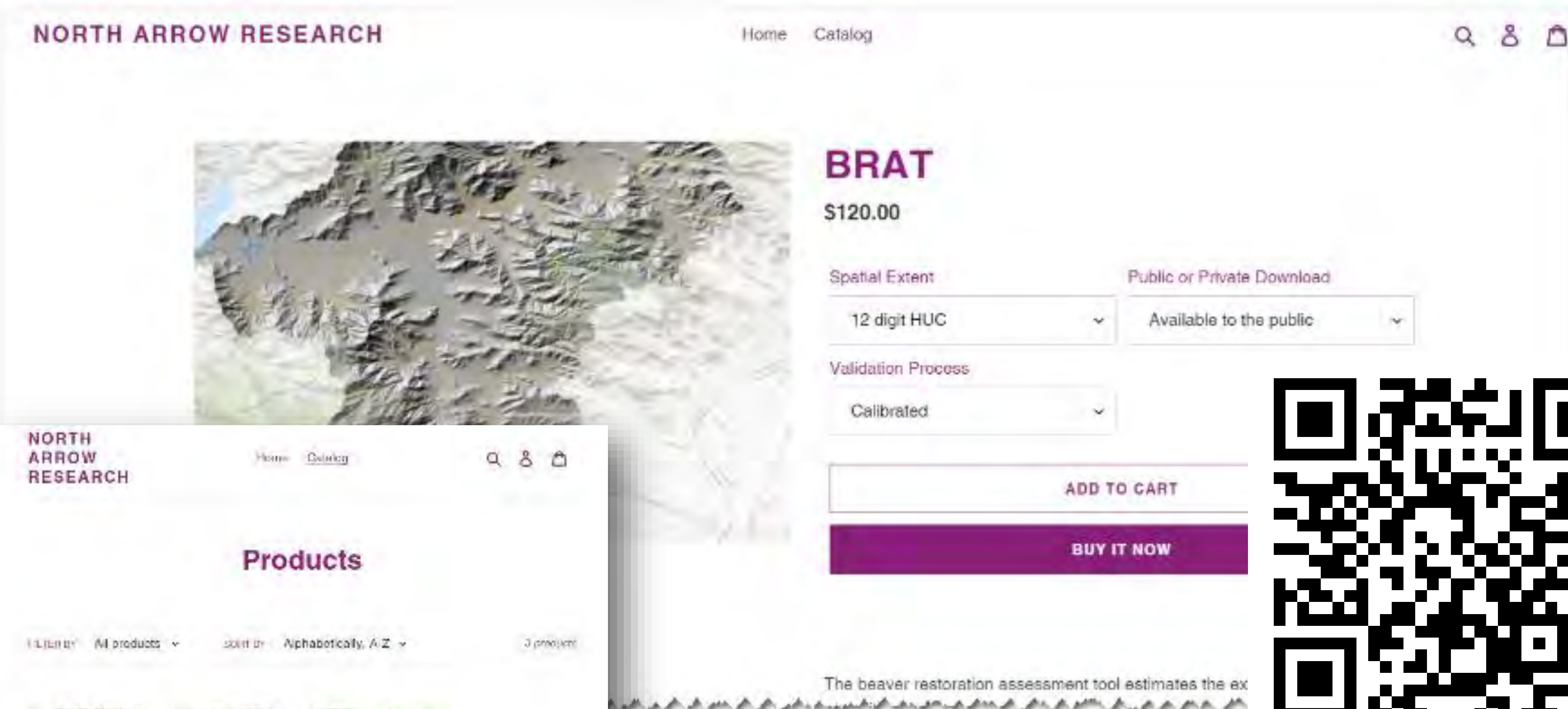
TODAY

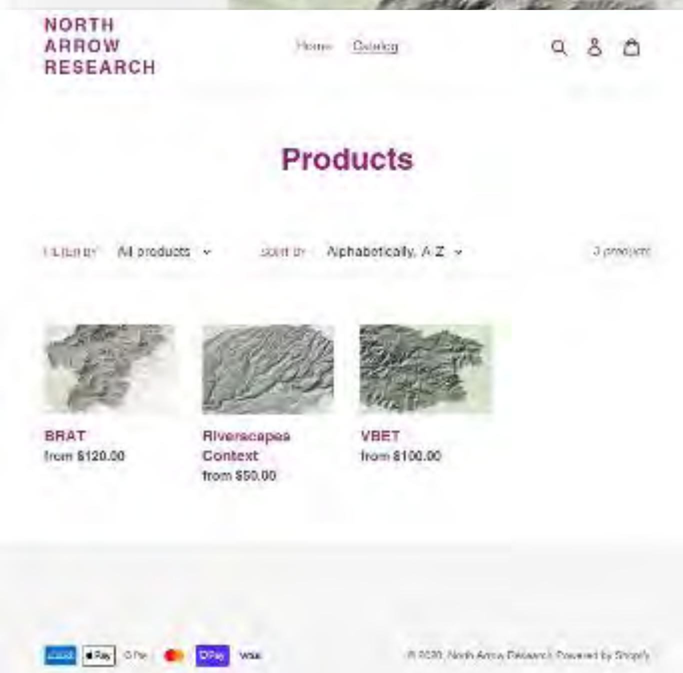
*validated

Cost for	CONCEPT	BRAT cIS PROOF OF CONCEPT	BRAT 2.x RESEARCH GRADE	PyBRAT 3.x OPERATIONAL GRADE	*Skipped* PROFESSIONAL GRADE	SqlBRAT 4.x PRODUCTION GRADE	pgBRAT 5.x COMMERCIAL GRADE
Site Visit Reach		$ 250 to $1000	NA	NA	NA	NA	NA
Dekstop Visit Reach (you)		*Free*	NA	NA	NA	NA	*Free*
HUC 12		$30K	NA	~$8K	NA	$120 to $350*	*Free*
HUC 10		NA	NA	~$10K	NA	$250 to $550*	*Free*
HUC 8		NA	$30K	~$15K	NA	$600 to $1300*	*Free*
State		NA	$75K to $150K	$50K to $100K	NA	Contact Us $25K to $40K	*Free*
Investment R&D		$30K	$150K	$110K	NA	$150K	$350K to $500K

While we wait for Commercial Grade, YOU can help crowd source this & GET BRAT for your AREA

PRODUCTION GRADE





- As little as $120 for a HUC 12 if you let us make it publicly available

https://north-arrow-research.myshopify.com/

Conclusions

RIVERSCAPES CONSORTIUM

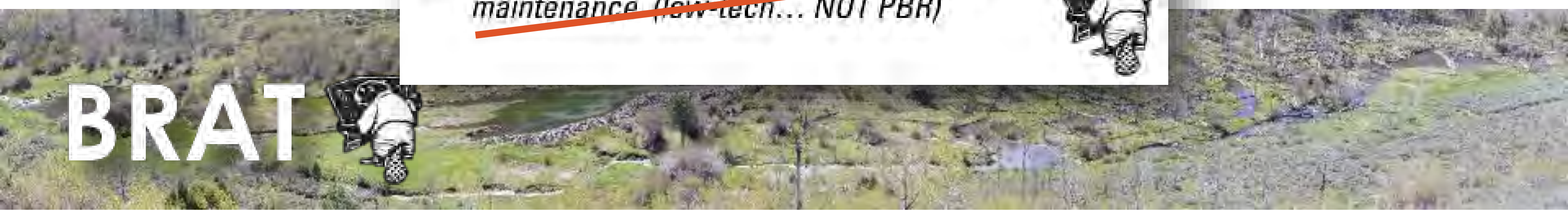
Beaver **R**estoration **A**ssessment **T**ool

Build your understanding of BRAT for:

- conservation/restoration planning & prioritization
- risk/opportunity assessment
- expectation management

Beaver Management / Restoration Strategies

1. **Conservation** / Promotion (leave them alone or protect)
2. **Living with beaver**
3. **Translocation** to areas with suitable capacity → BDAs for release
4. Restore riparian → Followed by Translocation
5. Help beaver out – **Beaver Dam Analogues** → *Facilitated dispersal of opportunistic species*
6. Mimic Beaver Dam Activity – *construction & maintenance (low-tech… NOT PBR)*



Questions?

1913 vs. 2018

- BRAT: http://brat.riverscapes.xyz/
- Crowd Source it: https://north-arrow-research.myshopify.com/
- Low-Tech Process-Based Restoration: http://lowtechpbr.restoration.usu.edu

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