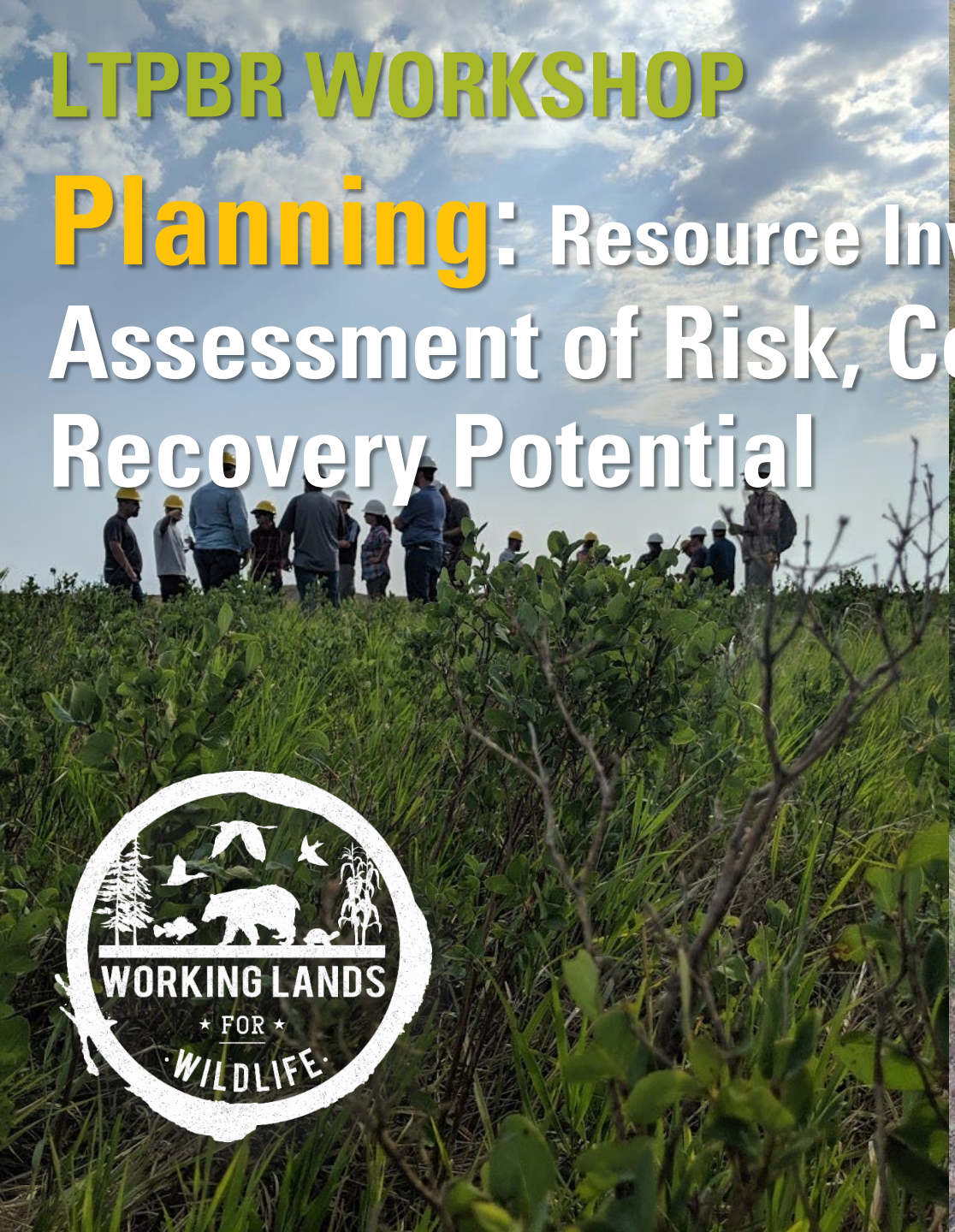
LTPBR WORKSHOP

Planning: Resource Inventory & Analysis

Assessment of Risk, Condition & Recovery Potential



Process Based Restoration LOW TECH

WORKING LANDS FOR WILDLIFE

CC BY

Utah State University
RESTORATION CONSORTIUM

PHASE 1 with Low-Tech

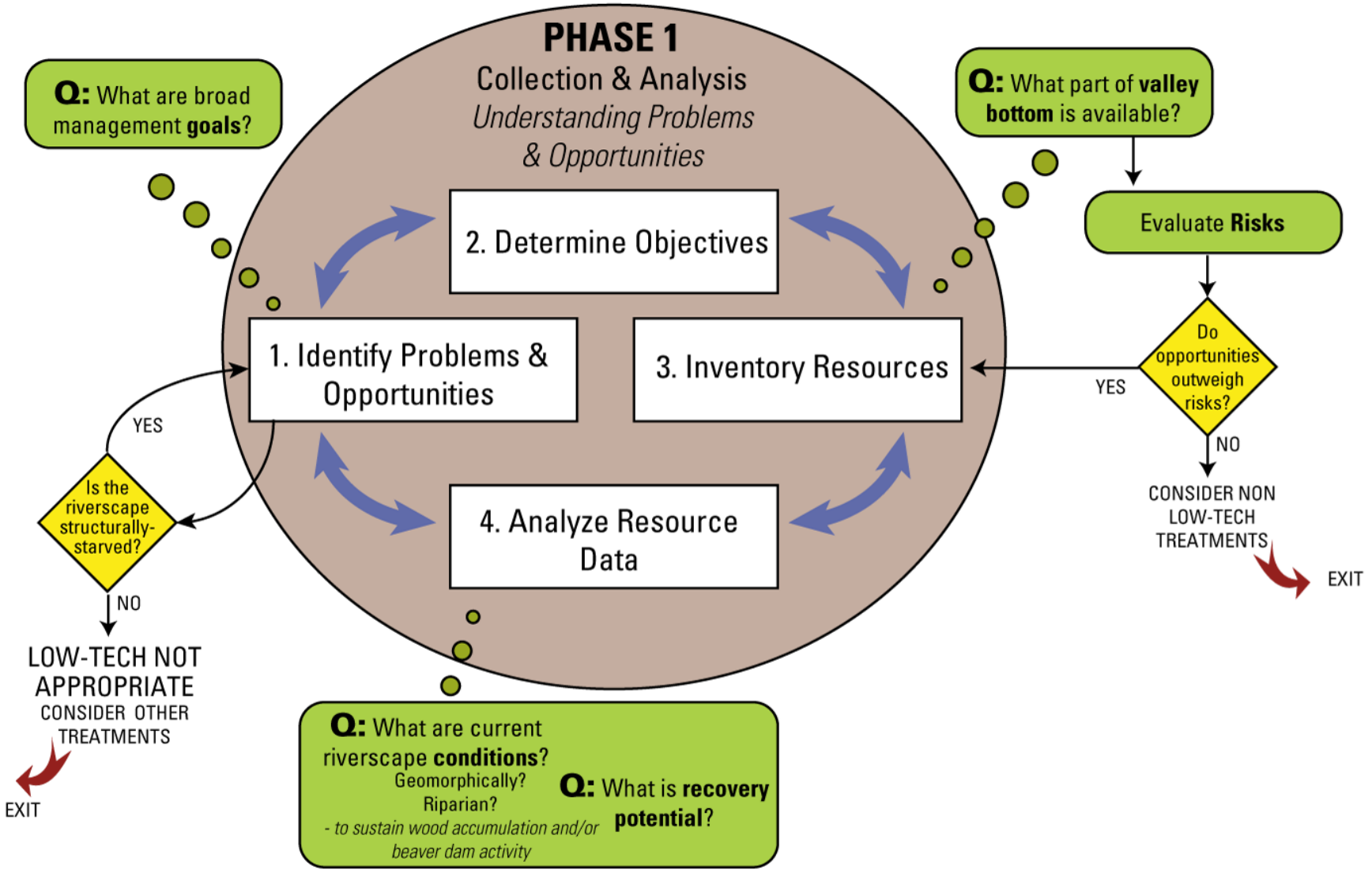


Figure 3.3 (p. 91) from Bennett et al. (2019) – Chapter 3 LTPBR Manual

DOI: 10.13140/RG.2.2.15815.75680

OUTLINE: Low-Tech Planning

I. Review

II. Conservation Planning Process

I. Phase 1 – **Planning**

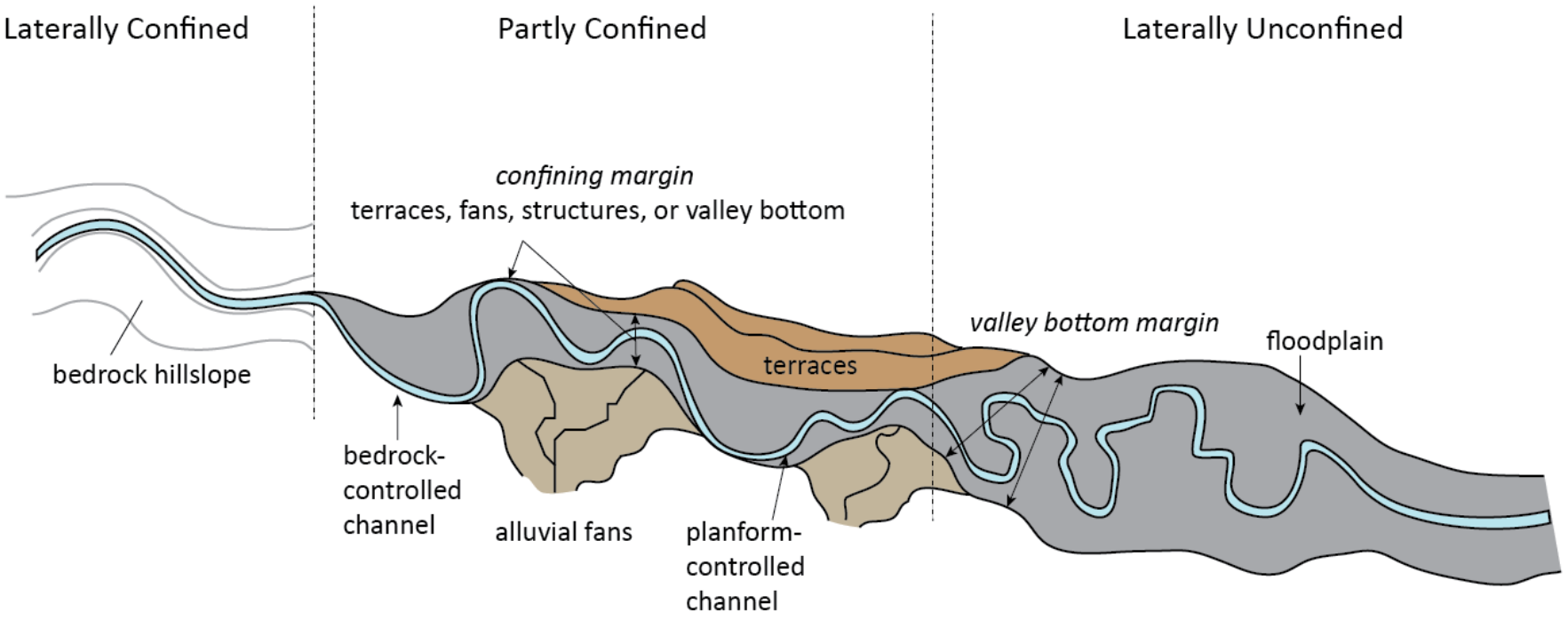
II. Phase 2 – Design

III. Phase 3 - Implementation

Where are we talking about?

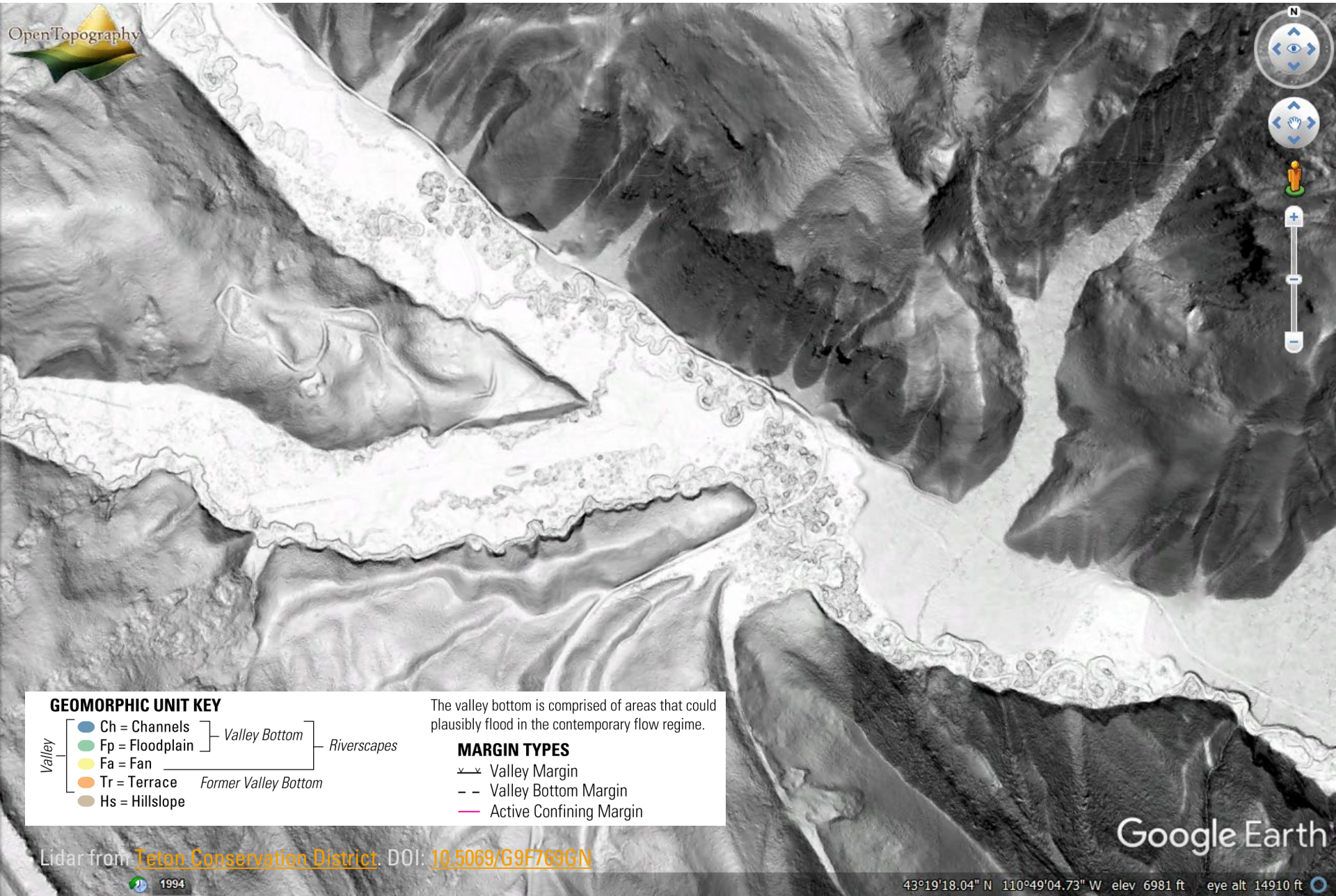
Q: What part of **valley bottom** is available?

What part of valley bottom is available for low-tech restoration?

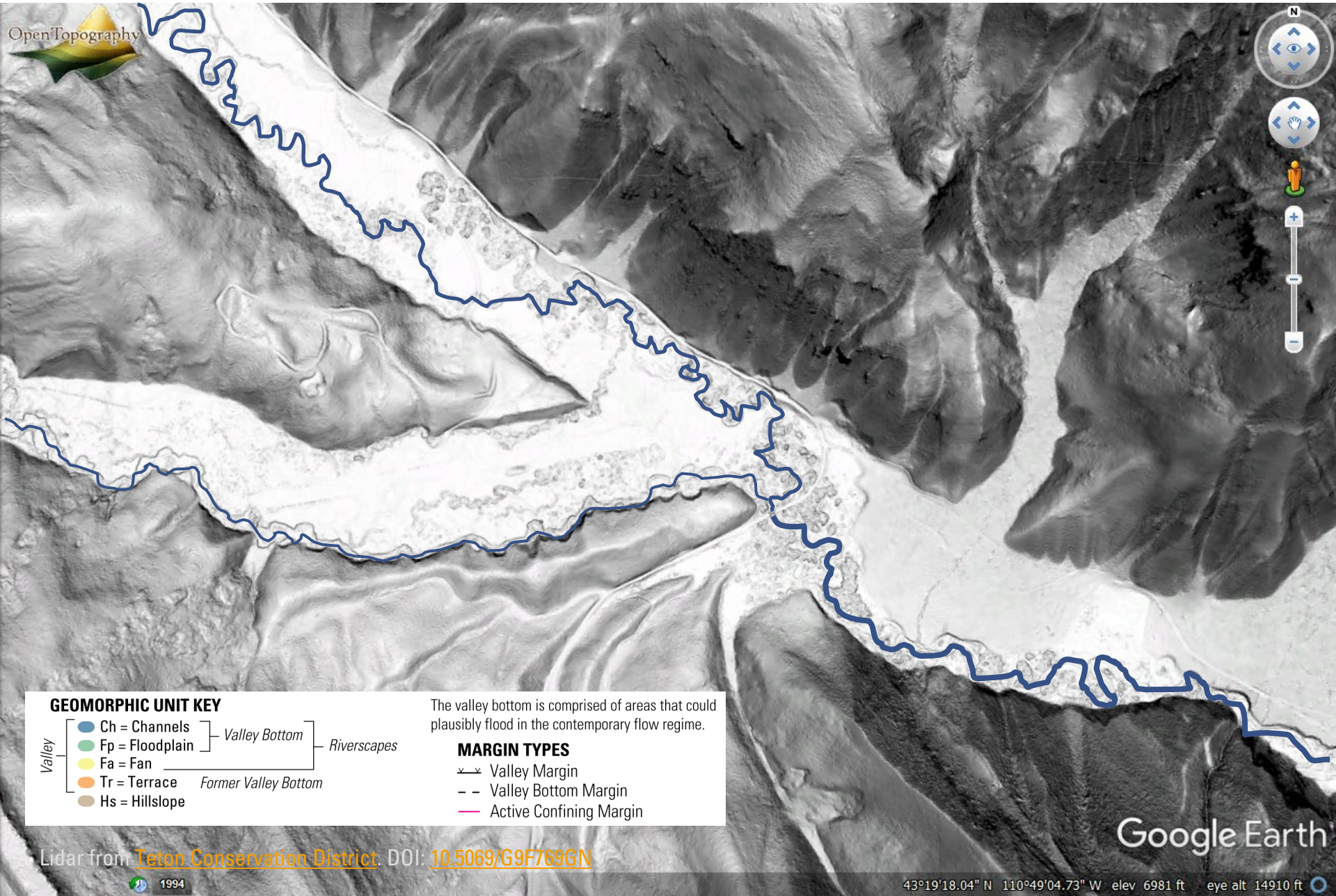


Remember This Place?

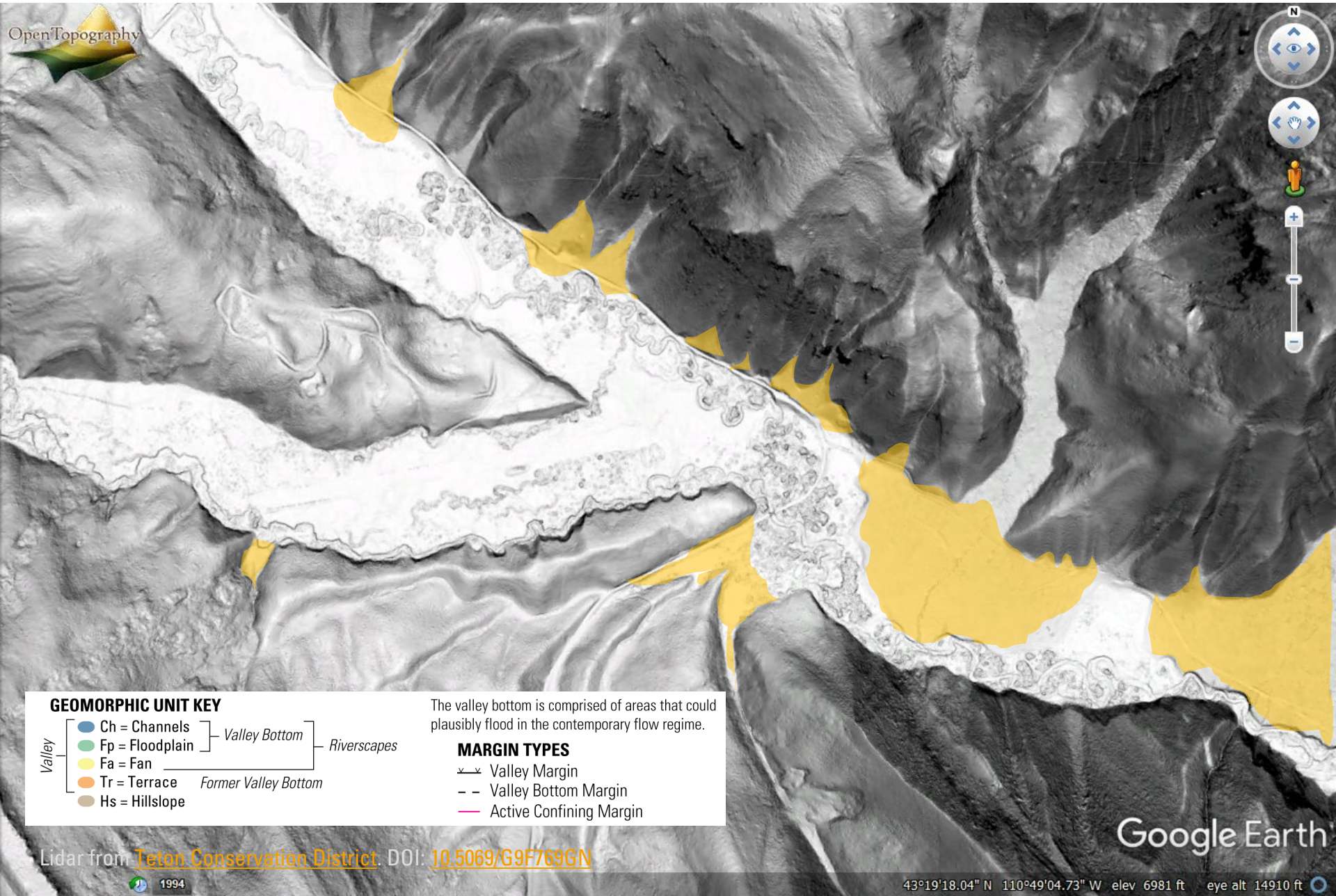
Map Your Perennial Valley Bottom & Channel(s)



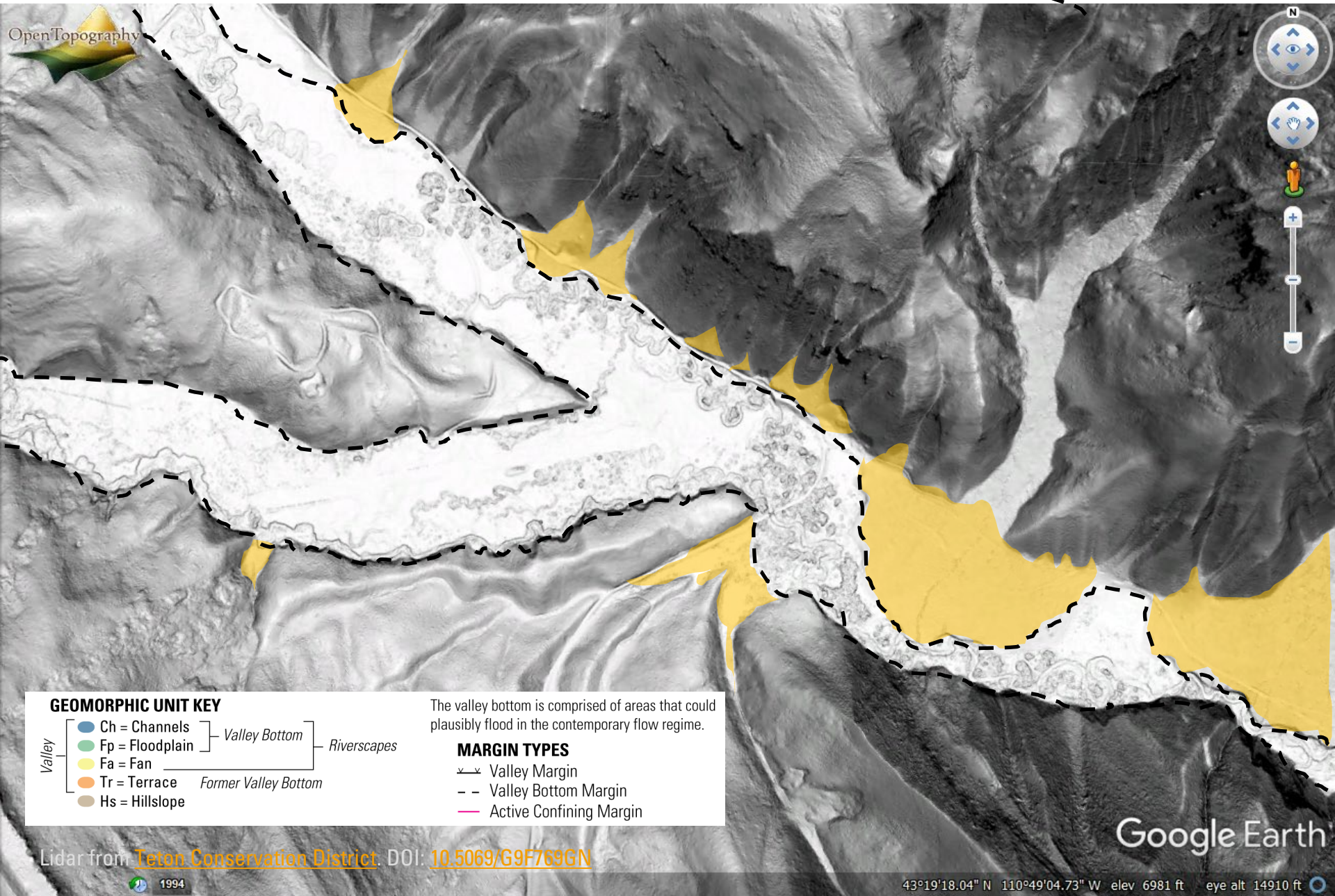
Start with those channels first!



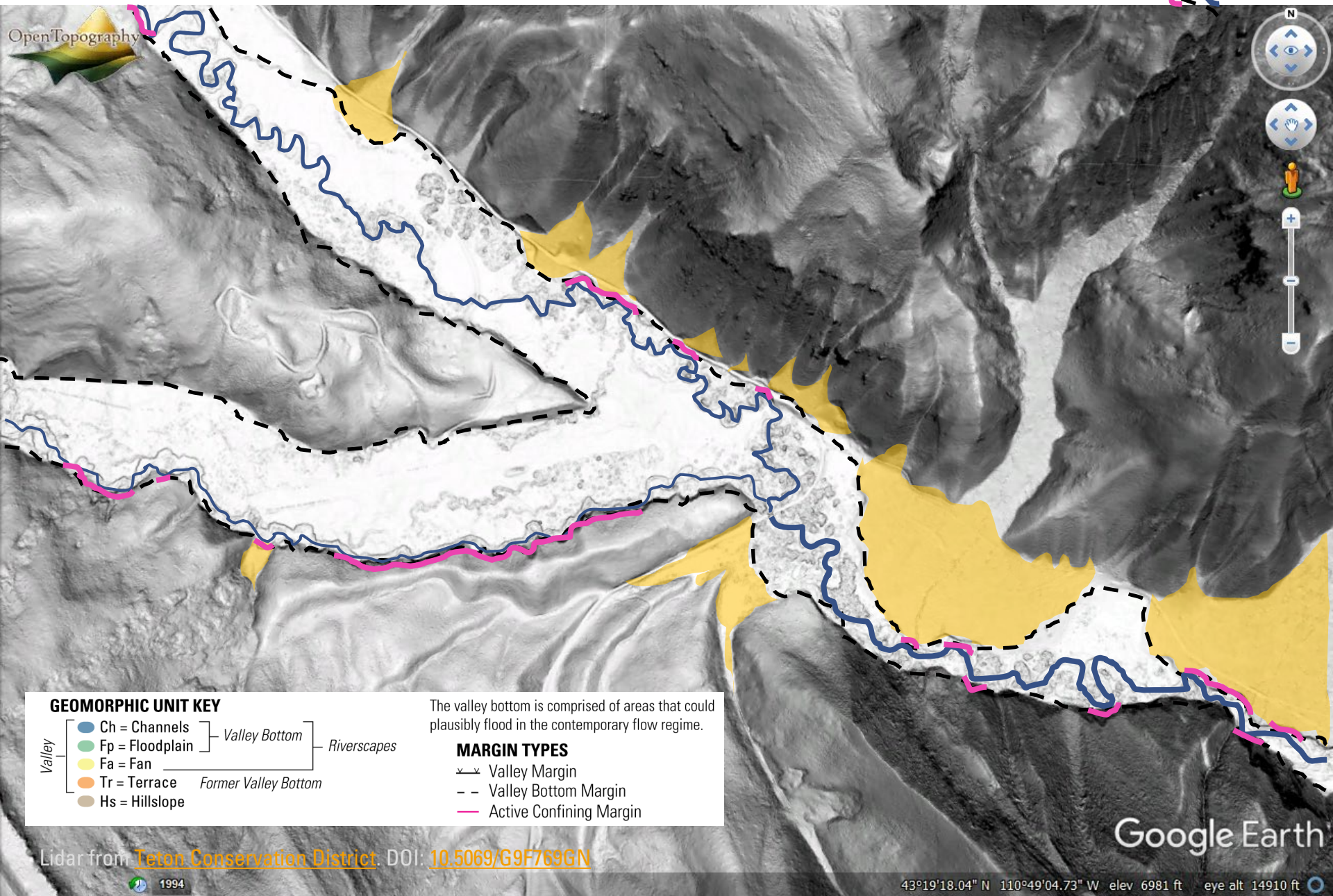
Next, map the fans (i.e. non valley bottom)



Next, trace the valley bottom margin

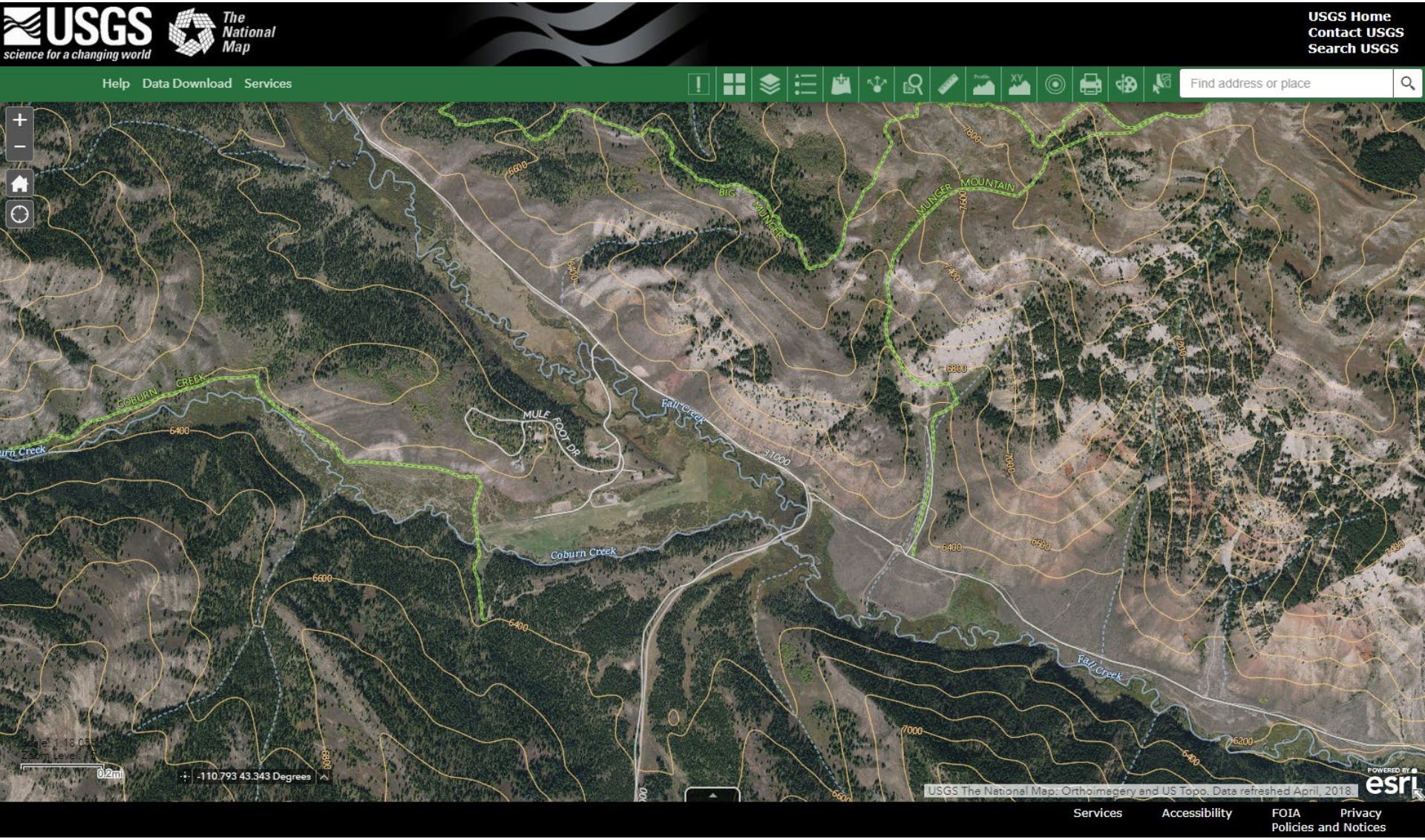


Finally, Identify Active Confining Margins



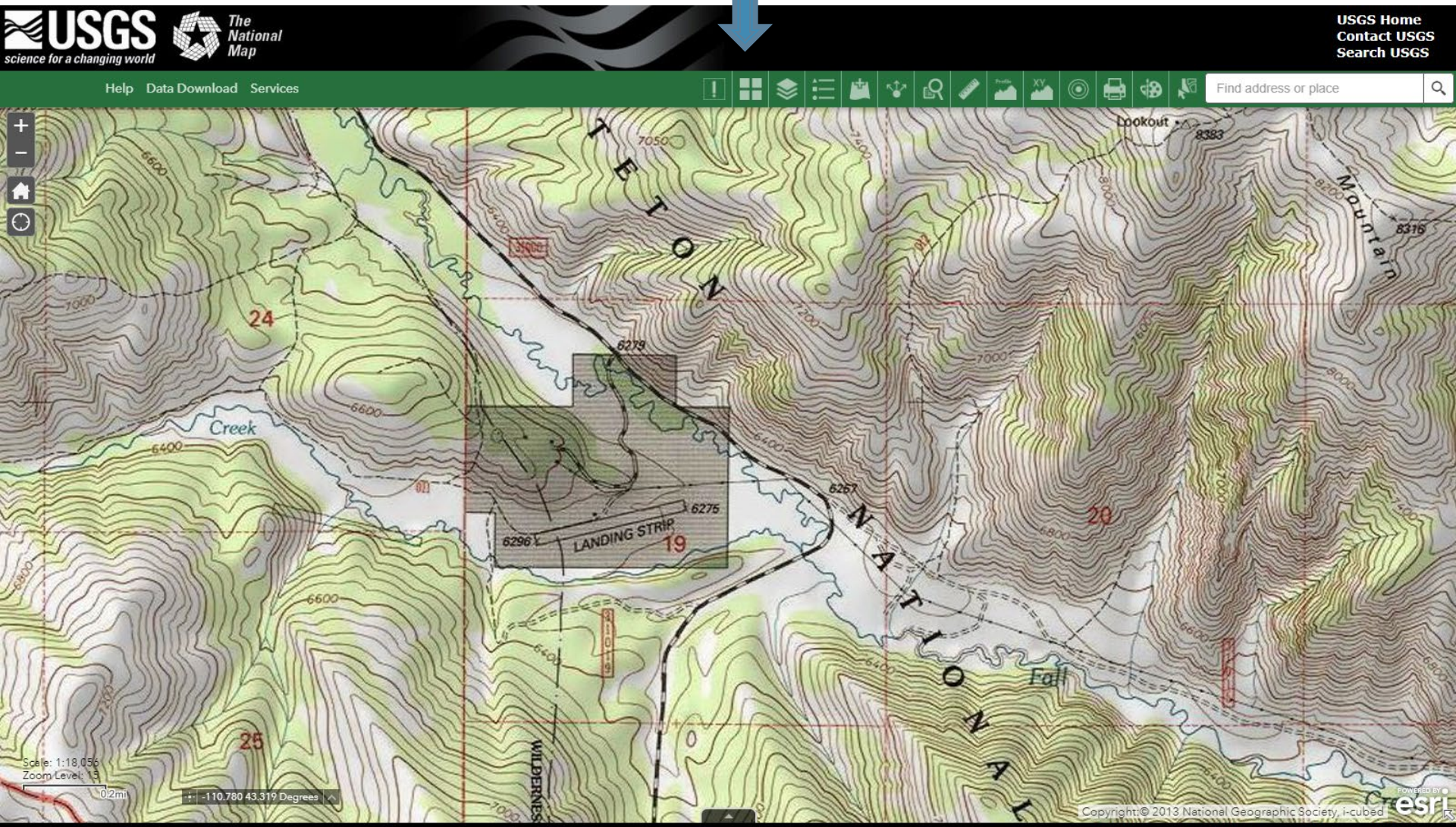
You Don't Need to be a GIS Whiz!

Visit USGS National Map: https://viewer.nationalmap.gov/advanced-viewer/



You can change Basemap to USGS 7.5 Quad!

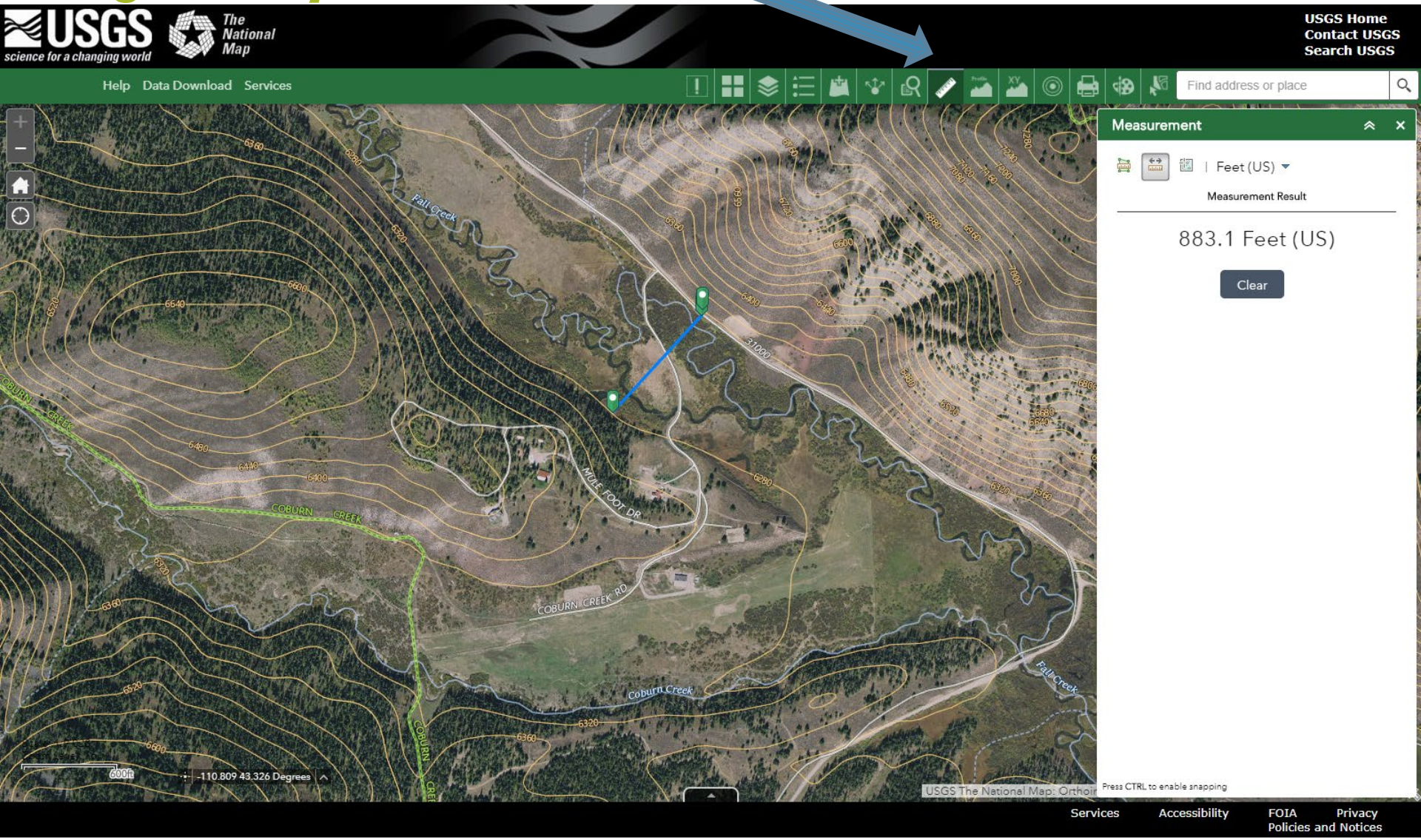
Use USA Topo Maps @ Zoom Level ≥14



U.S. Department of the Interior | U.S. Geological Survey
URL: https://viewer.nationalmap.gov/advanced-viewer/ Page Last Modified: 22-Oct-18
Page Contact Information: The National Map
USA.gov

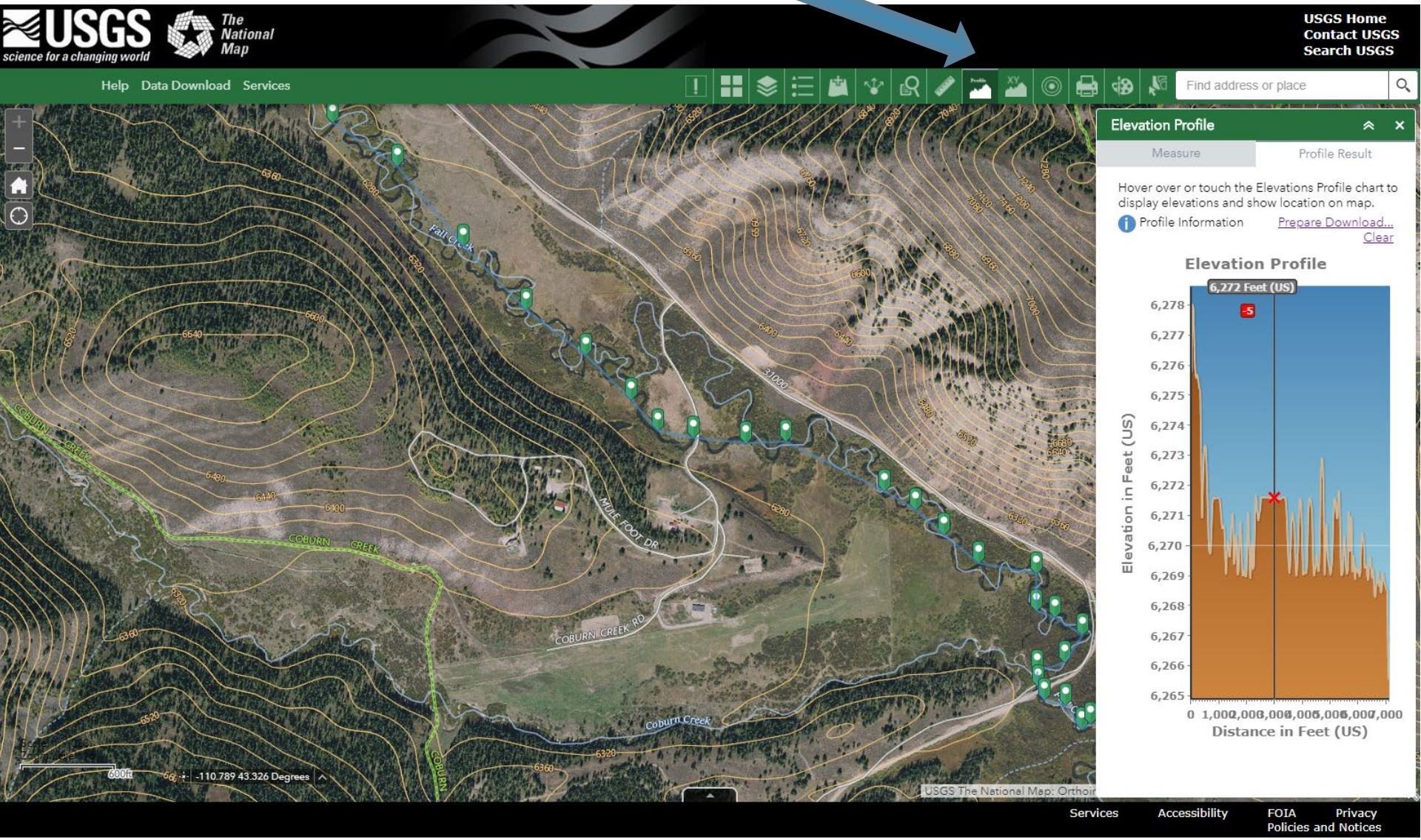
Make Basic Measurements

e.g. Valley Bottom Width



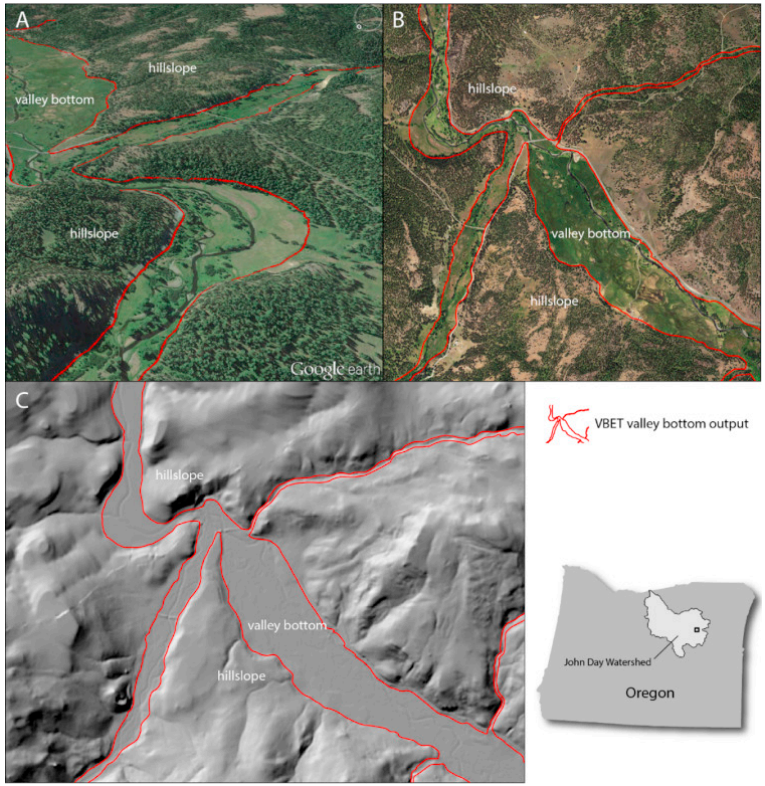
Pull Rough Sections or Profiles

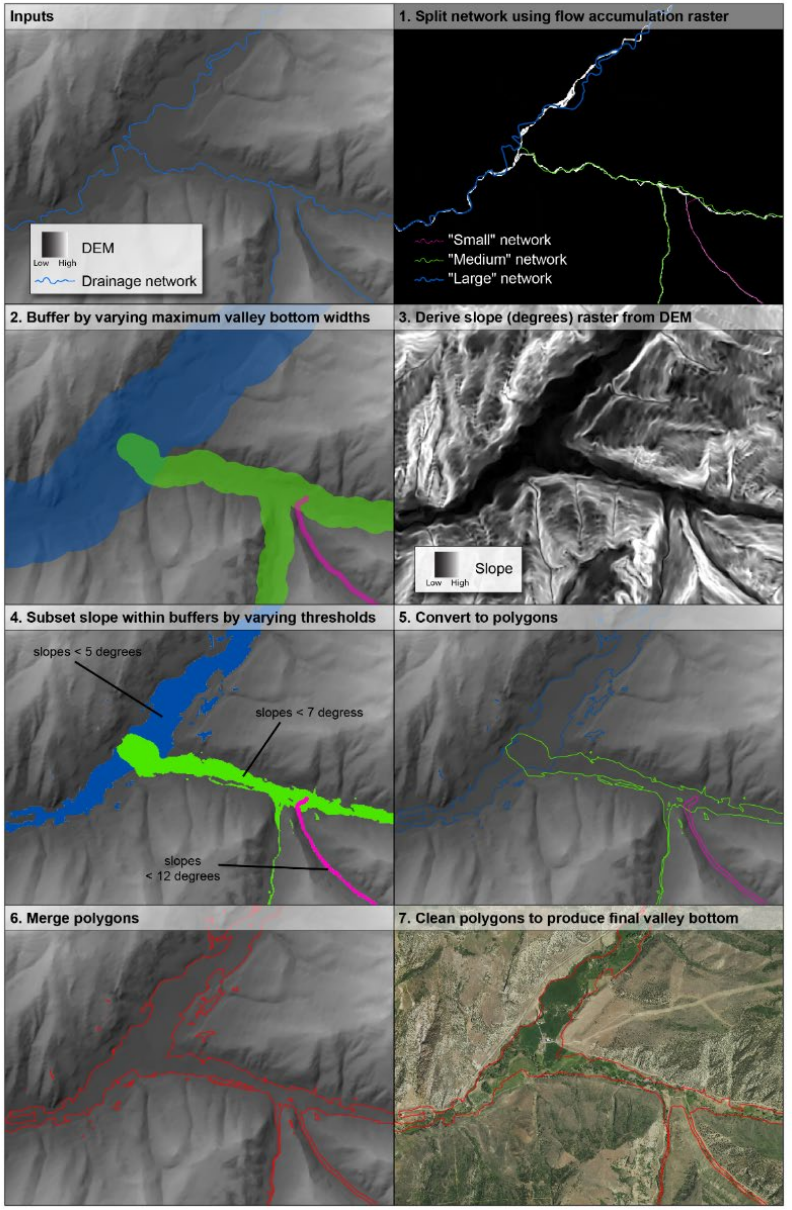
i.e. From 10 m NED DEM



V-BET: VALLEY BOTTOM EXTRACTION TOOL

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

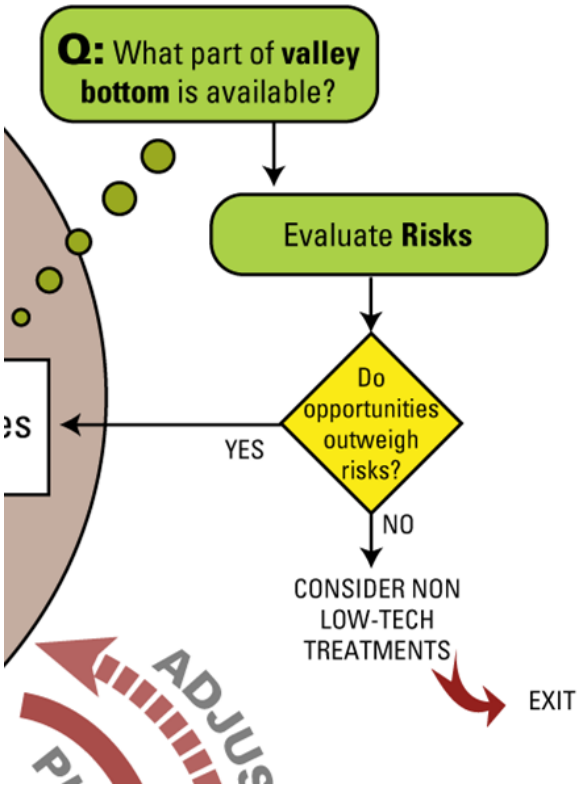




From: Gilbert et al. (2016) – Computers & Geosciences ;
DOI: 10.1016/j.cageo.2016.07.014
http://rcat.riverscapes.xyz

RCAT

Evaluate Risks



Risk Considerations Checklist for Low-Tech Stream and Meadow Restoration

Instructions

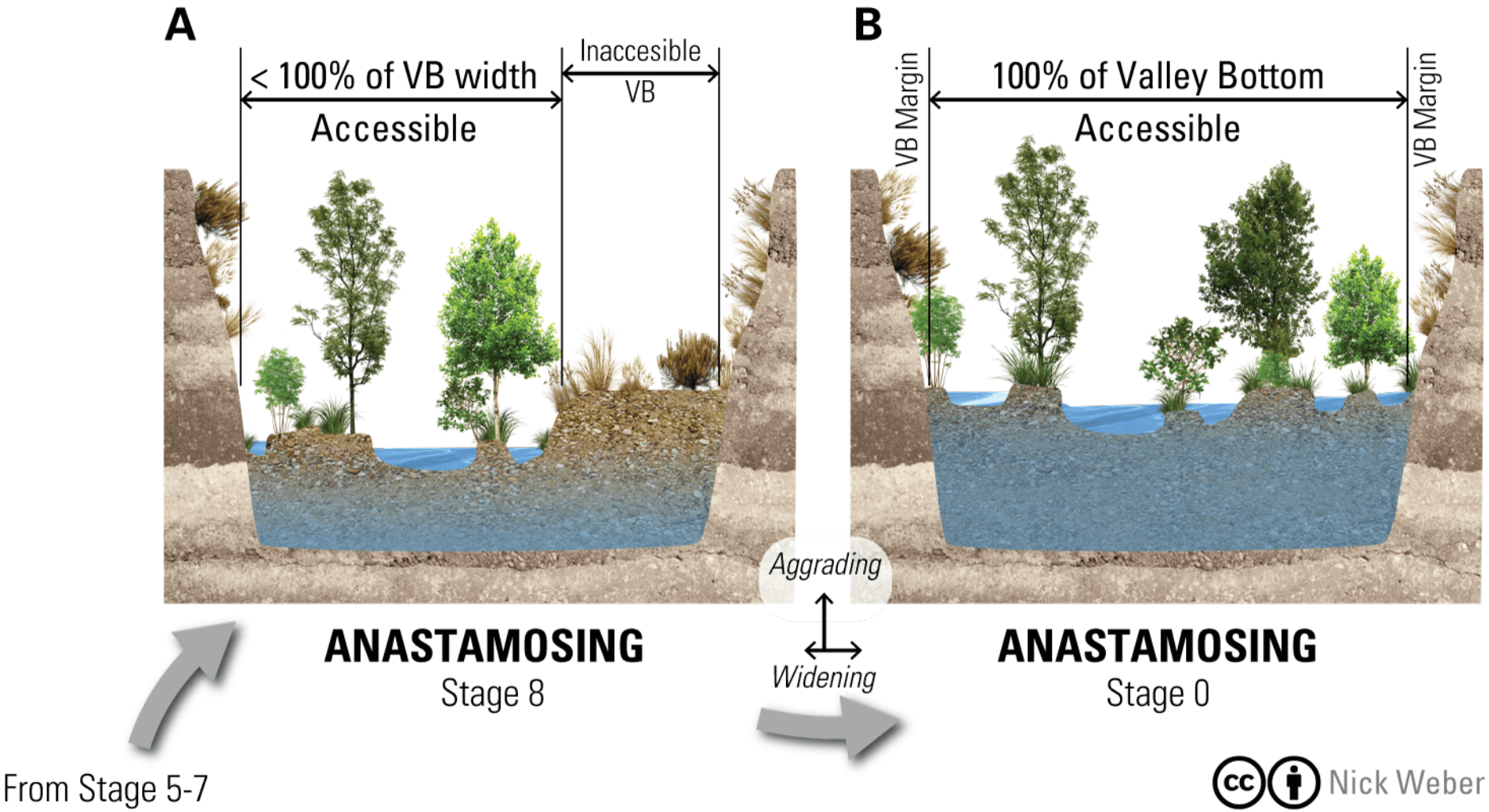
For each factor, select the characteristic that best describes the project site. If answers vary within project area, consider breaking site into multiple reaches and assessing each separately. This is not a comprehensive list, but rather, represents some basic considerations related to assessing potential risks to property, infrastructure, and public safety to discuss with the landowner/manager and stakeholders (green = lower risk, yellow = moderate risk, red = higher risk). For factors rating yellow or red, project planners may need to engage other technical specialists for additional review and analysis. Alternatives to mitigate or lower risks to acceptable levels should be evaluated in the planning process. In the notes, describe the situation and how risks are being reduced. In some cases, low-tech restoration approaches may not be appropriate based on constraints and risks.

Areas Adjacent to Riverscape Land Use
Areas adjacent are in an undeveloped range or forest land setting
Areas adjacent are in a crop, pasture, or hay land setting
Areas adjacent are in a developed setting
Valley Bottom Land Use (e.g., roads, bridges, culverts, buildings, diversions)
Valley bottom and adjacent area (up and downstream) does not contain infrastructure of concern
Valley bottom or adjacent area (up and downstream) contains some infrastructure, but would not be negatively impacted by processes of wood accumulation or beaver dam activity, or consequences of impact would be low
Valley bottom or adjacent area (up and downstream) contains infrastructure that may be negatively impacted by low-tech structure failure and consequences would be unacceptable
Stream Order & wadeability
1st through 3nd order wadeable stream
3rd – 5th order wadeable stream
5th order non-wadeable stream or greater
Channel Change and Floodplain Reconnection
Landowner/manager willing/able to give the stream space to adjust in the valley bottom and understands this may include lateral erosion, deposition, change of stream channel position, and inundation
Landowner/manager willing/able to give the stream space to adjust in some portions of the valley bottom but not all of it
Landowner/manager unwilling/unable to give the stream space to adjust in the valley bottom
Willingness to allow processes of wood accumulation and/or beaver dam activity
Landowner/manager willing/able to allow dynamic processes & no concerns with nearby landowner/managers.
Landowner/manager willing/able to allow some processes (but maybe not all) and/or concerns of or with nearby landowner/managers
Landowner/manager unwilling/unable to allow processes of wood accumulation and/or beaver dam activity
Adaptive Management
Landowner/manager understands multiple treatments through time may be needed and is committed to follow-up monitoring, maintenance, and adaptive management
Landowner/manager understands multiple treatments through time may be needed but resources to do follow-up may limit the ability to adjust or correct problems
Landowner/manager wants a single intervention; no monitoring, maintenance, or adaptive management will occur
Notes:

Appendix 3D (pp. 121-122) from Bennett et al. (2019) Chapter 3 LTPBR Manual

DOI: 10.13140/RG.2.2.15815.75680

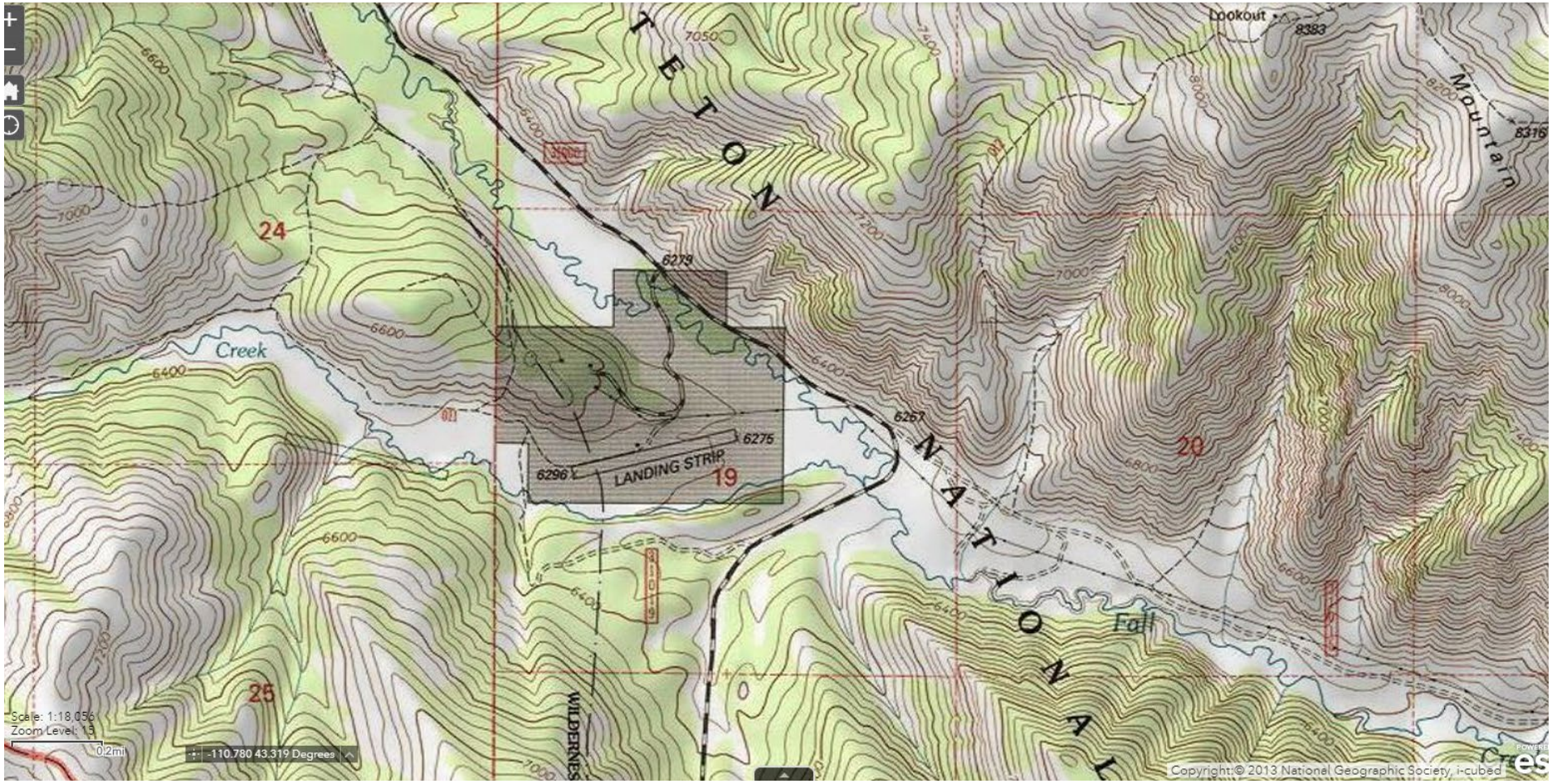
How Much of Valley Bottom?



From Shahverdian et al. (2019) – Chapter 1 LTPBR Manual
DOI: 10.13140/RG.2.2.14138.03529

Next we will map anthropogenic Constraints…

With some limited photographic & map-based evidence



Map Infrastructure Risks within and adjacent to Valley Bottom

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Valley bottom or adjacent area (up and downstream) contains infrastructure that may be negatively impacted by low-tech structure failure and consequences would be unacceptable	

Refer to Chapter 3 Appendix 3D (pp 121-123)

Just as a reminder…

Buildings

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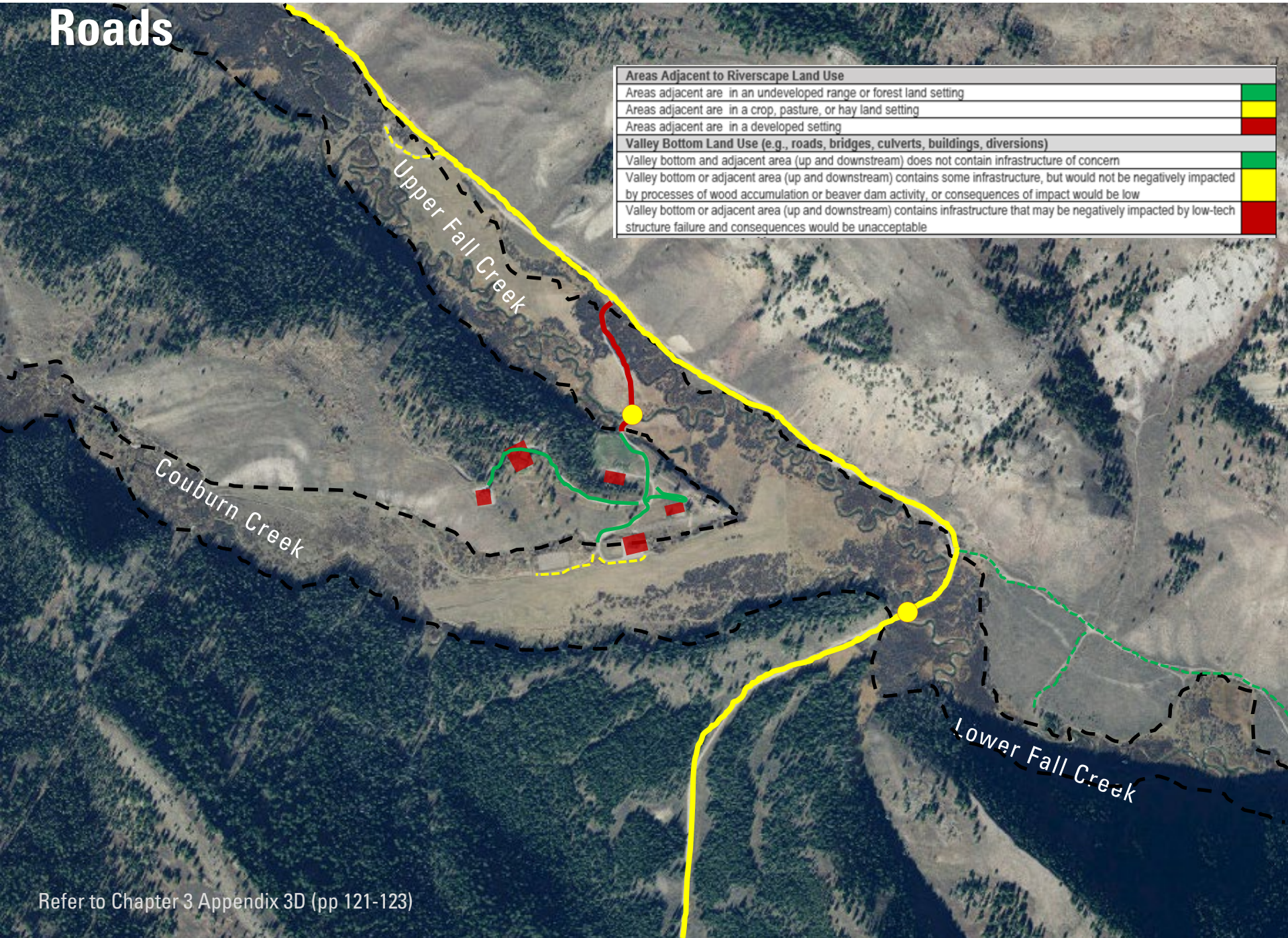
Refer to Chapter 3 Appendix 3D (pp 121-123)

Roads



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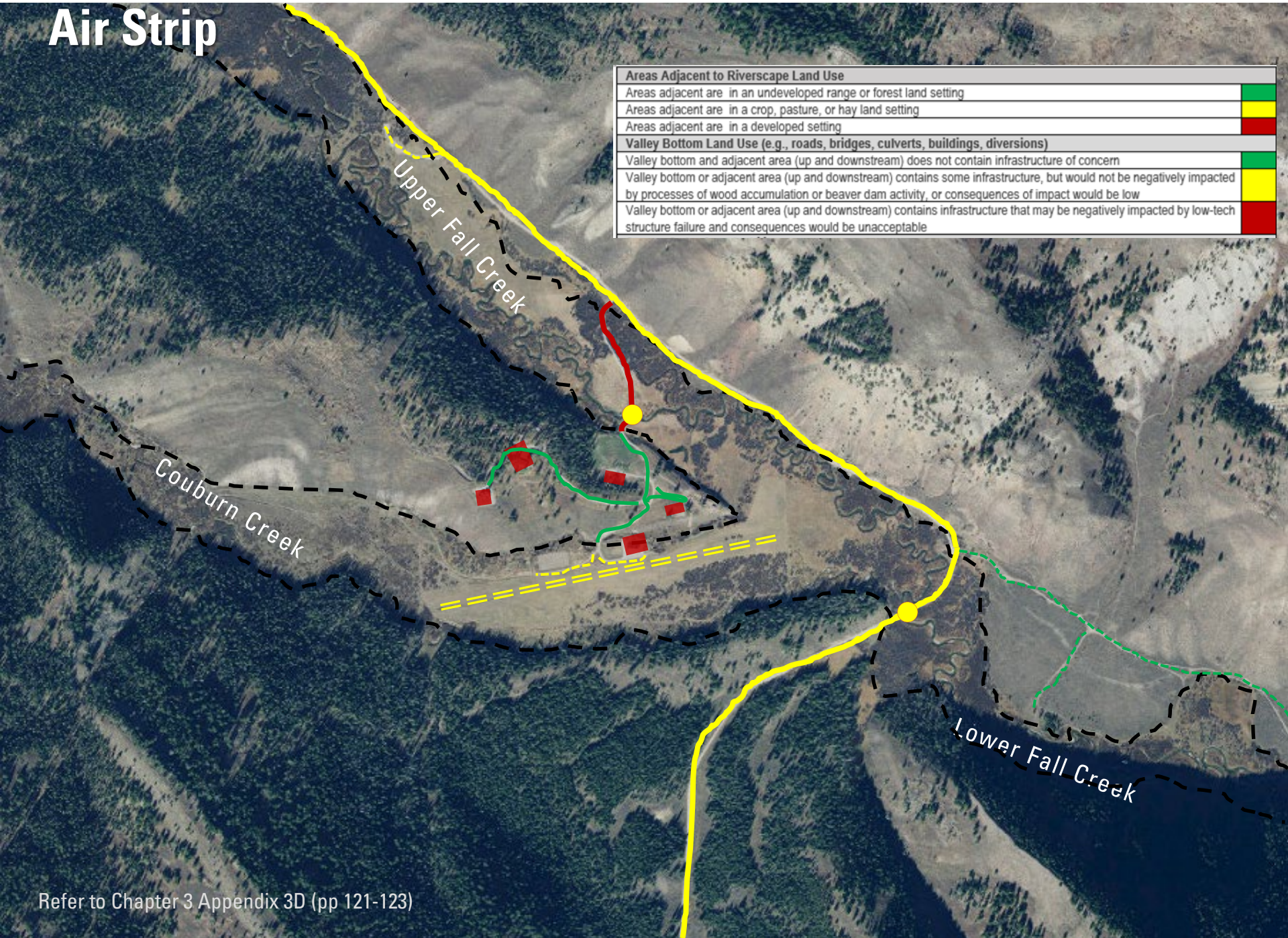
Refer to Chapter 3 Appendix 3D (pp 121-123)

Air Strip



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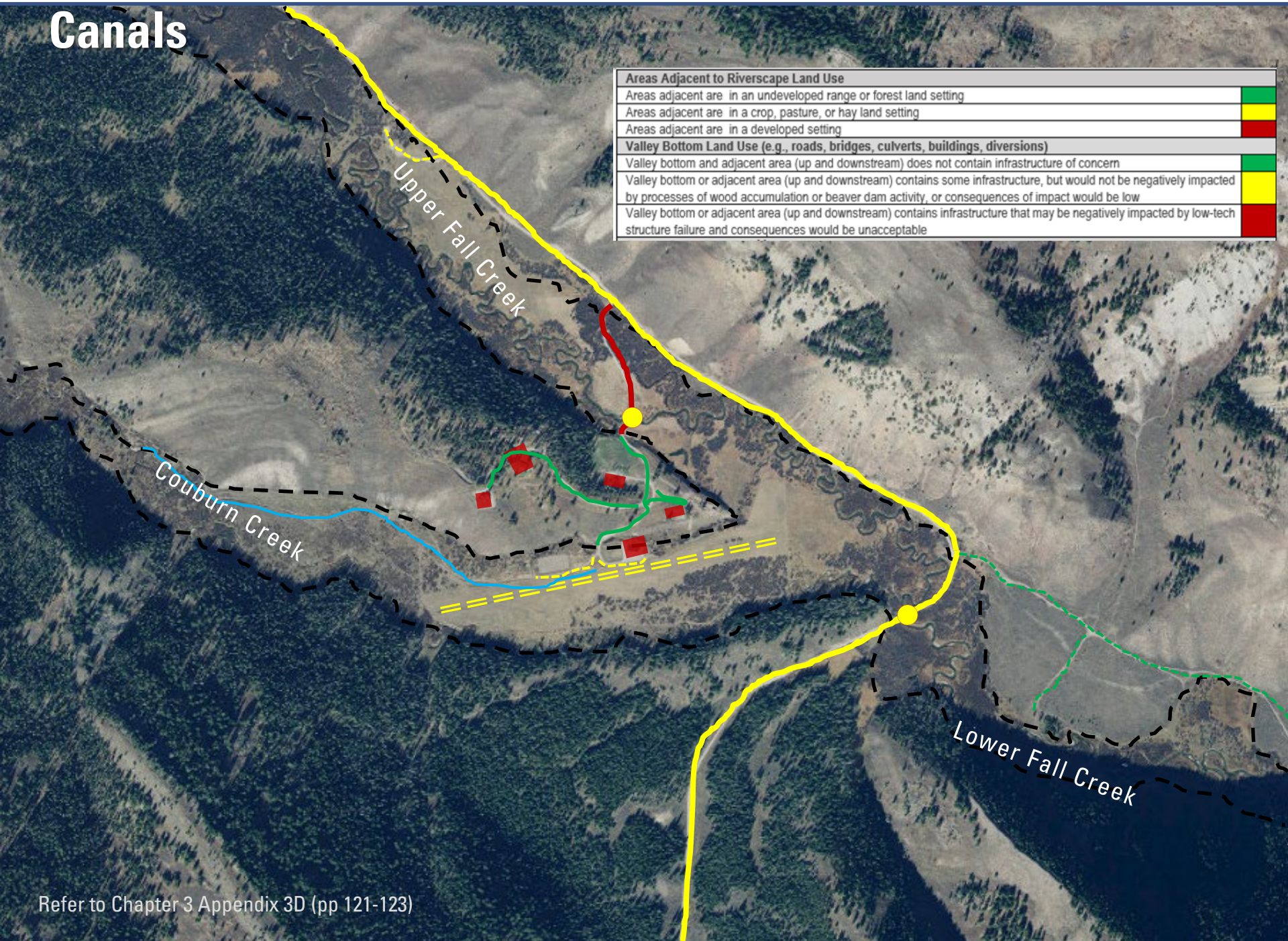
Refer to Chapter 3 Appendix 3D (pp 121-123)

Canals



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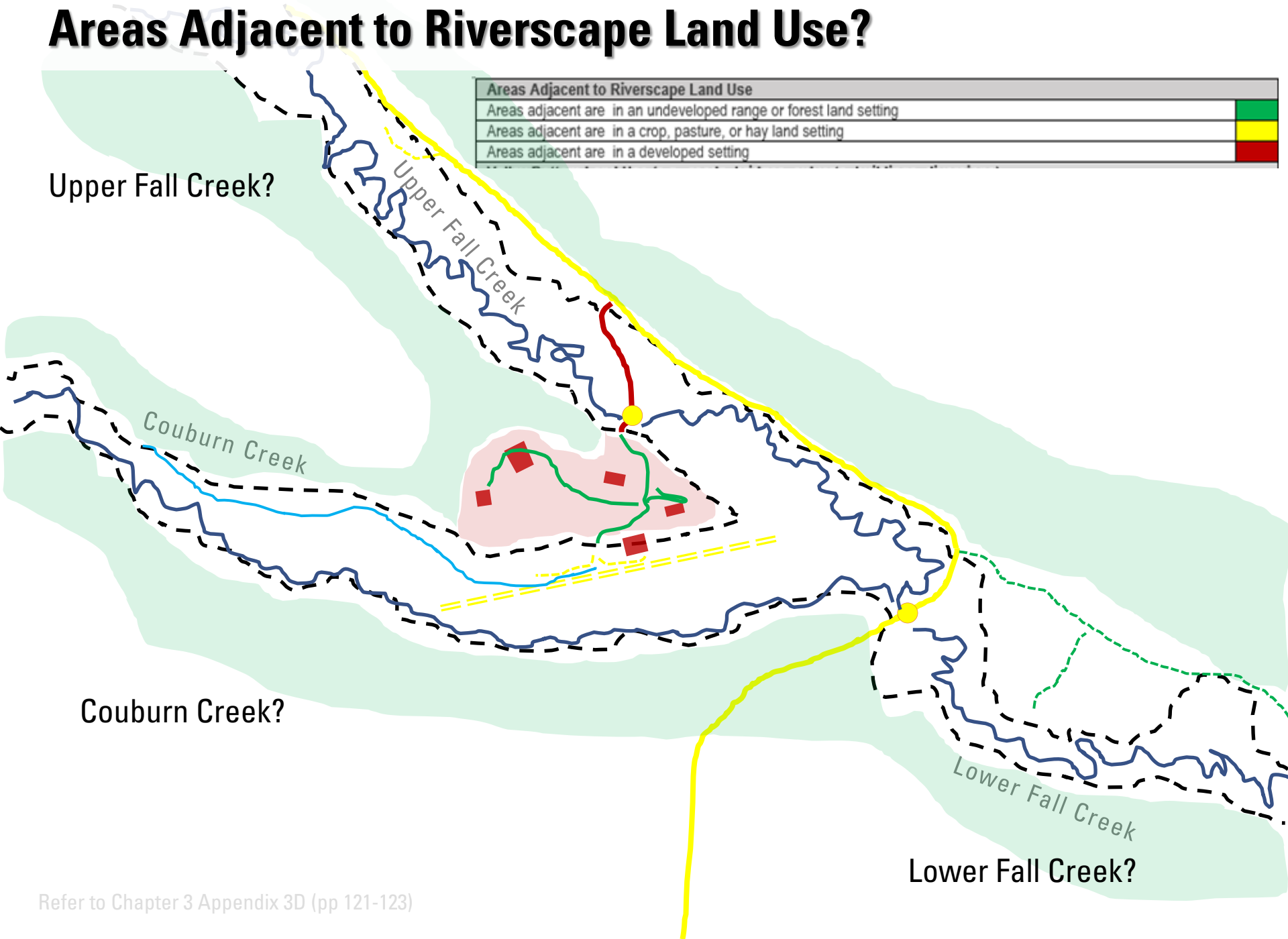
Refer to Chapter 3 Appendix 3D (pp 121-123)

Areas Adjacent to Riverscape Land Use?



Refer to Chapter 3 Appendix 3D (pp 121-123)

Valley Bottom Land Use?

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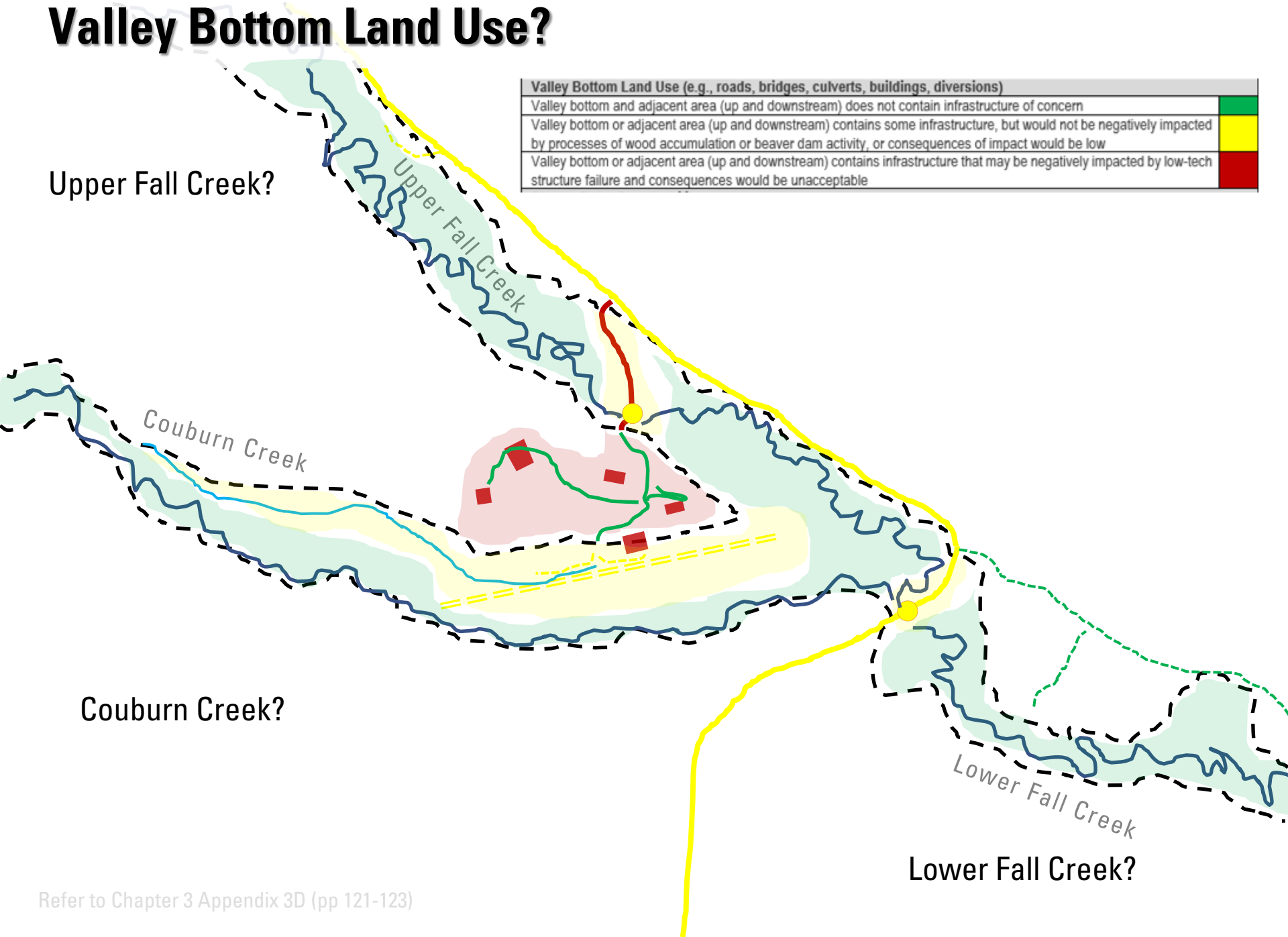
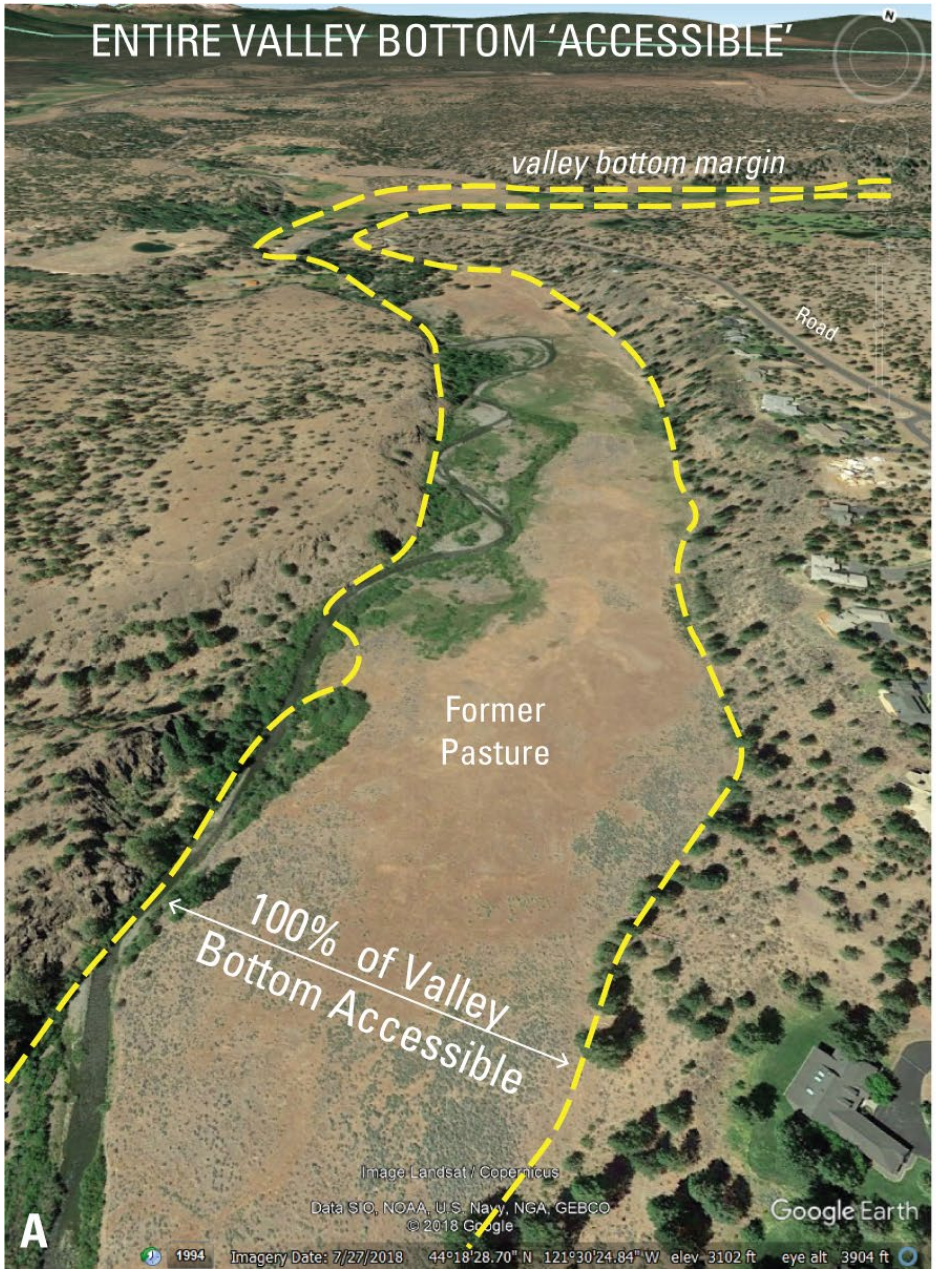


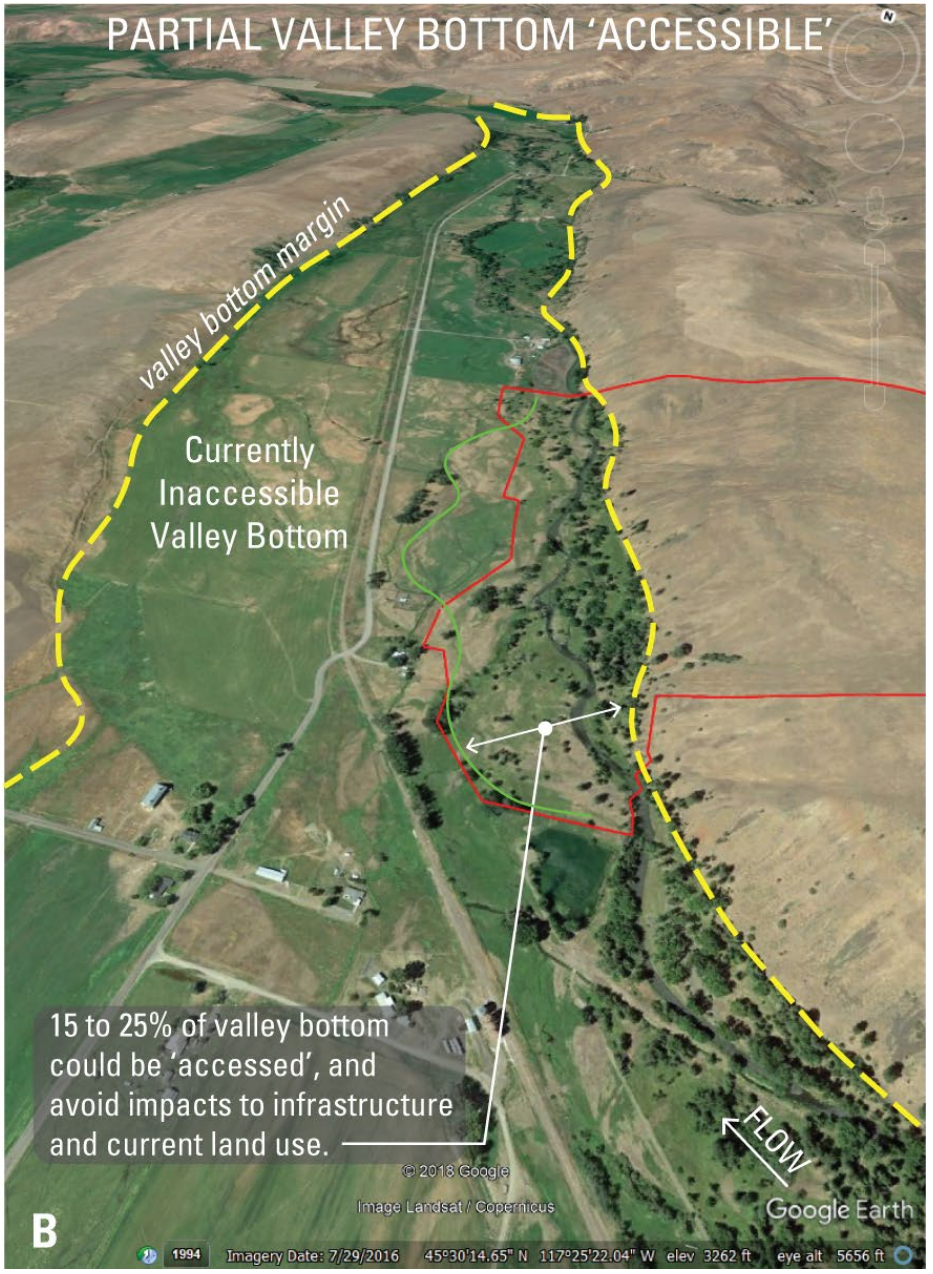
Upper Fall Creek?

Couburn Creek?

Lower Fall Creek?

Refer to Chapter 3 Appendix 3D (pp 121-123)

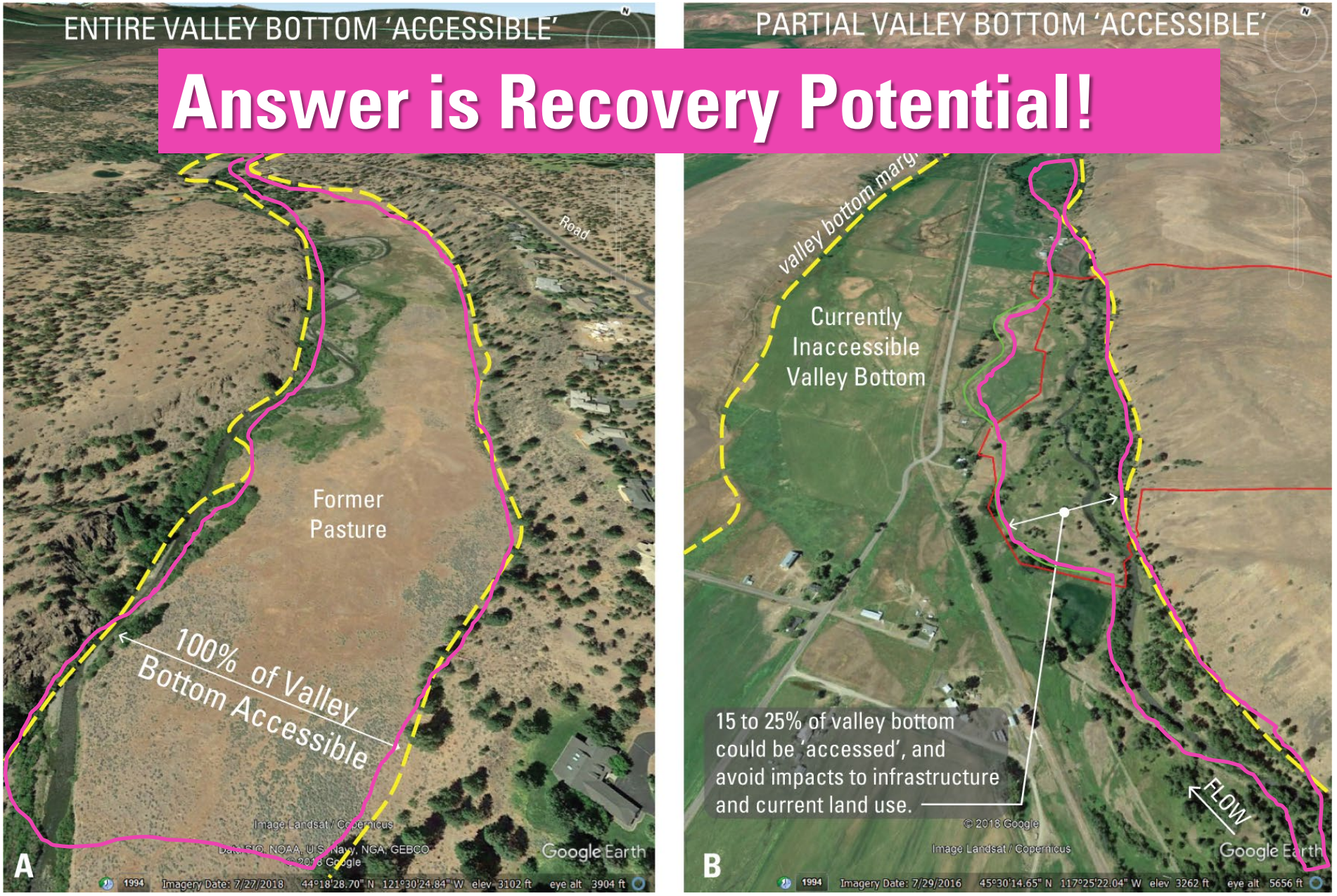




From page 14 of Pocket Guide; Wheaton et al. (2019)

DOI: 10.13140/RG.2.2.28222.13123/1

How much is in play for restoration?

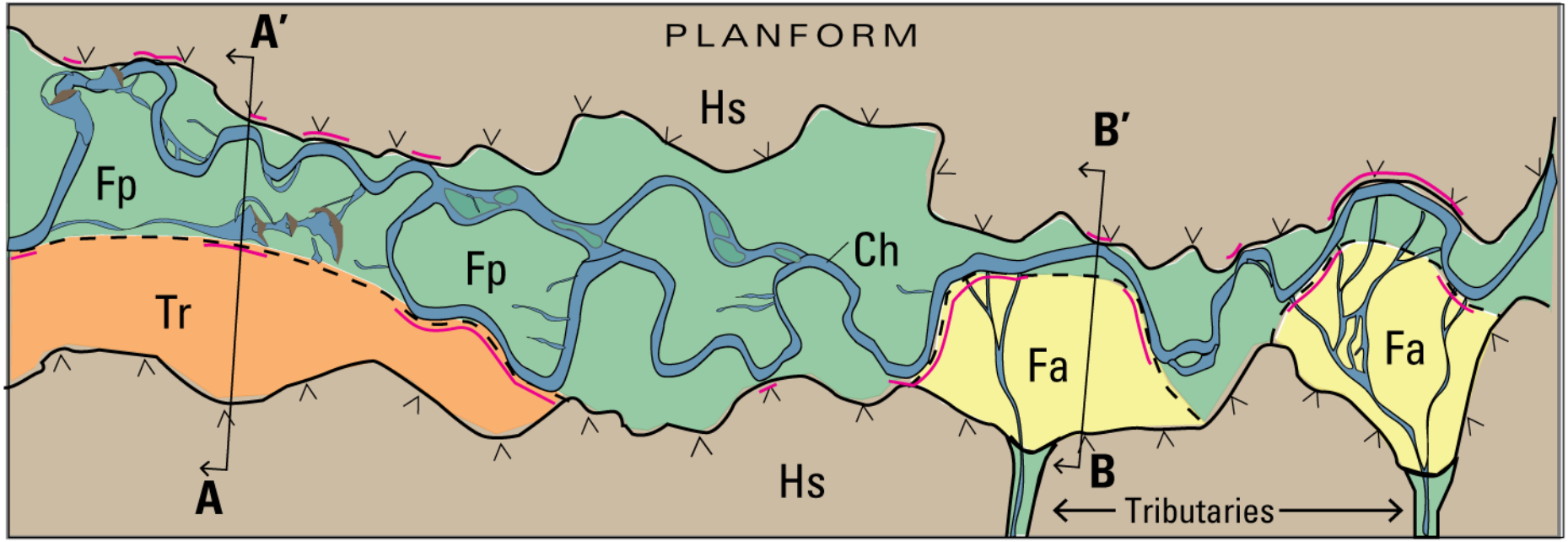


From page 14 of Pocket Guide; Wheaton et al. (2019)

DOI: 10.13140/RG.2.2.28222.13123/1

How much is in play for restoration?

Remember how we said valley bottoms have two components (at Tier 1)?



GEOMORPHIC UNIT KEY

Valley
- Ch = Channels
- Fp = Floodplain
- Fa = Fan
- Tr = Terrace
- Hs = Hillslope

Ch, Fp → *Valley Bottom*

Fa → *Former Valley Bottom*

Valley Bottom, Former Valley Bottom → *Riverscapes*

The valley bottom is comprised of areas that could plausibly flood in the contemporary flow regime.

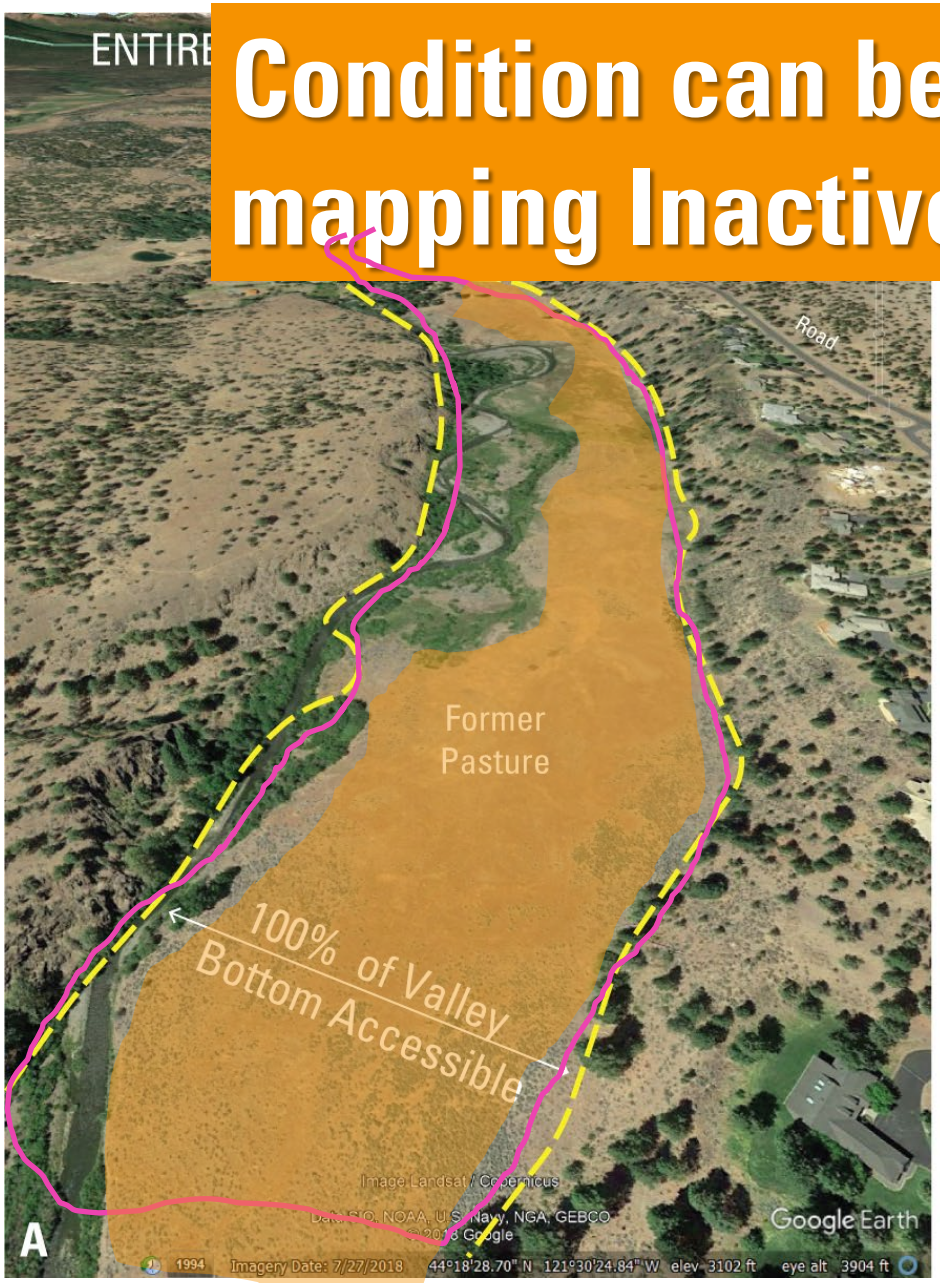
MARGIN TYPES

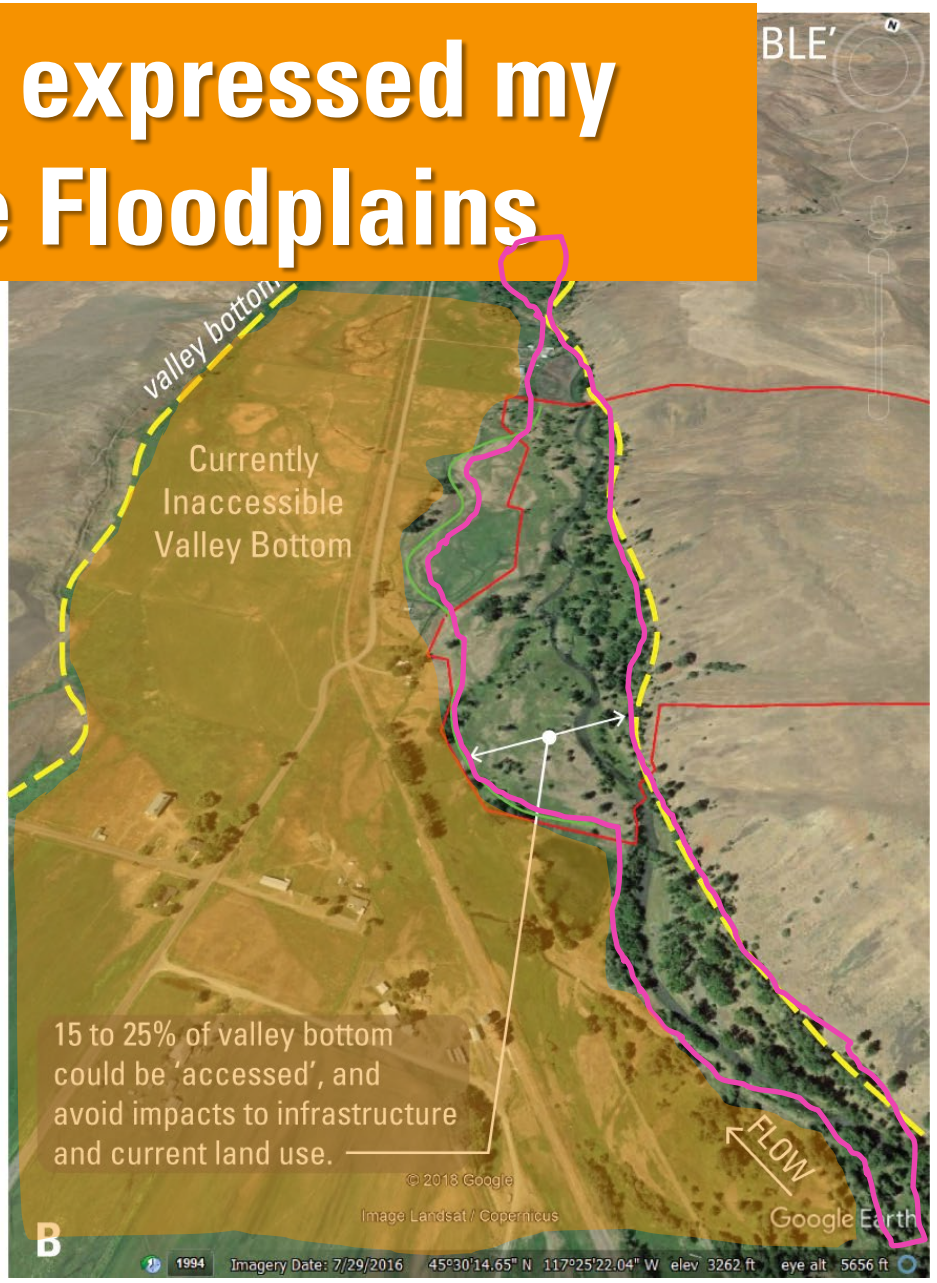
- Valley Margin
- Valley Bottom Margin
- Active Confining Margin

I sort of lied… that is true for intact systems in good condition

From page 9 of Pocket Guide; Wheaton et al. (2019)
DOI: 10.13140/RG.2.2.28222.13123/1

Condition can be expressed my mapping Inactive Floodplains

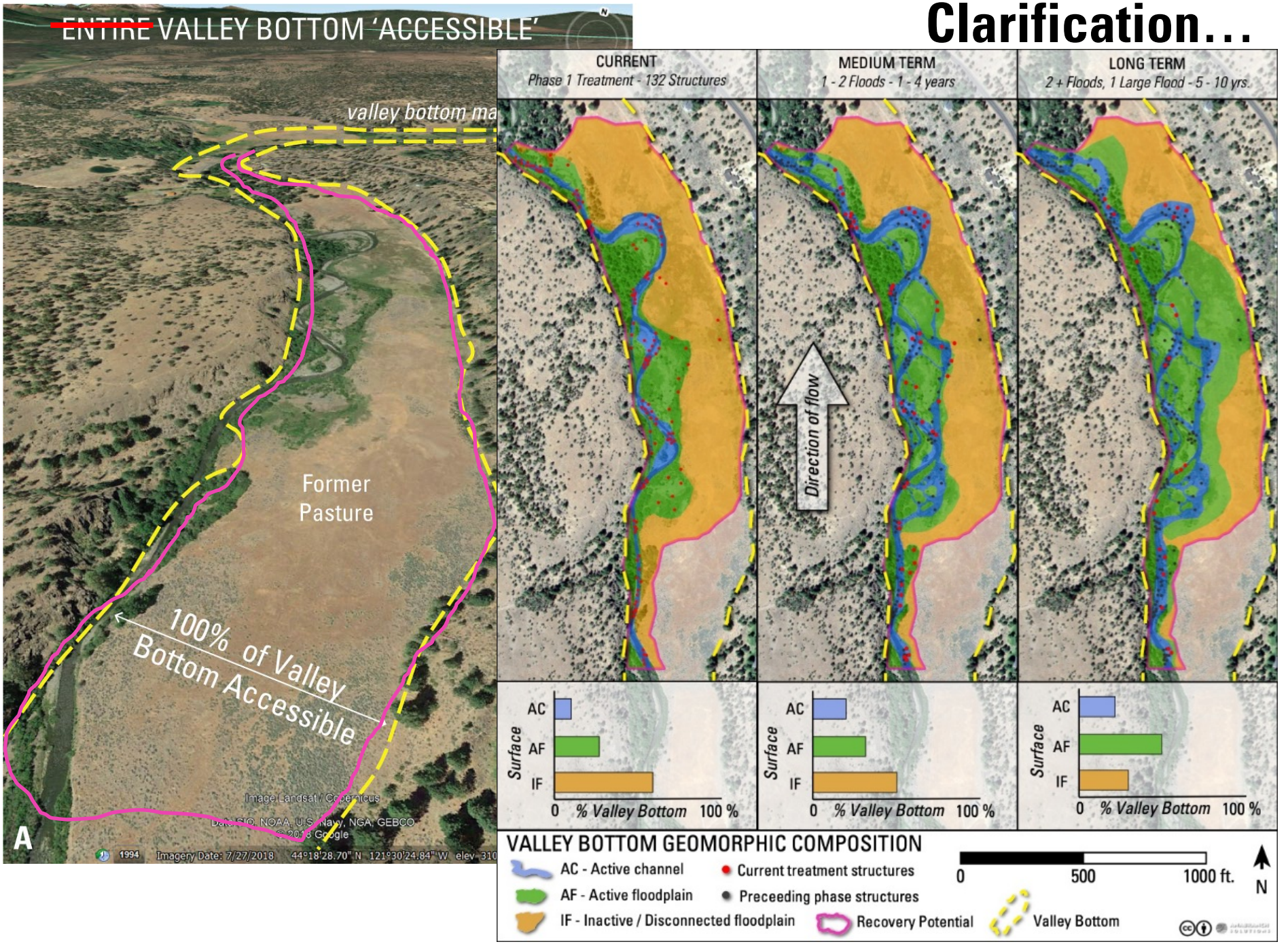




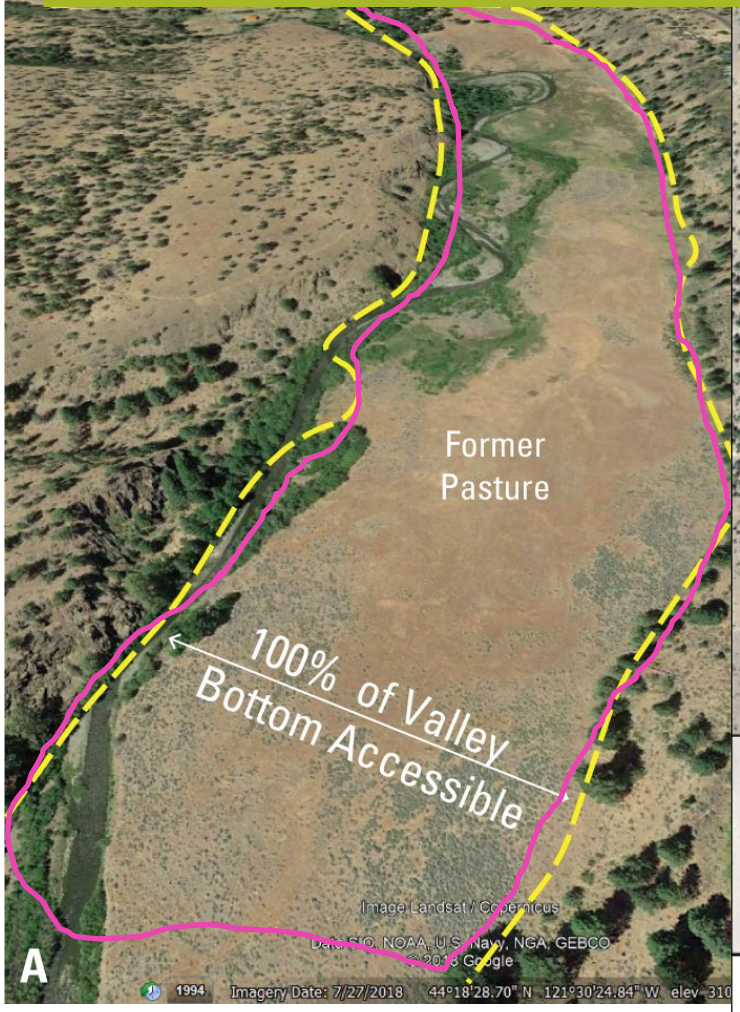
From page 14 of Pocket Guide; Wheaton et al. (2019)
DOI: 10.13140/RG.2.2.28222.13123/1

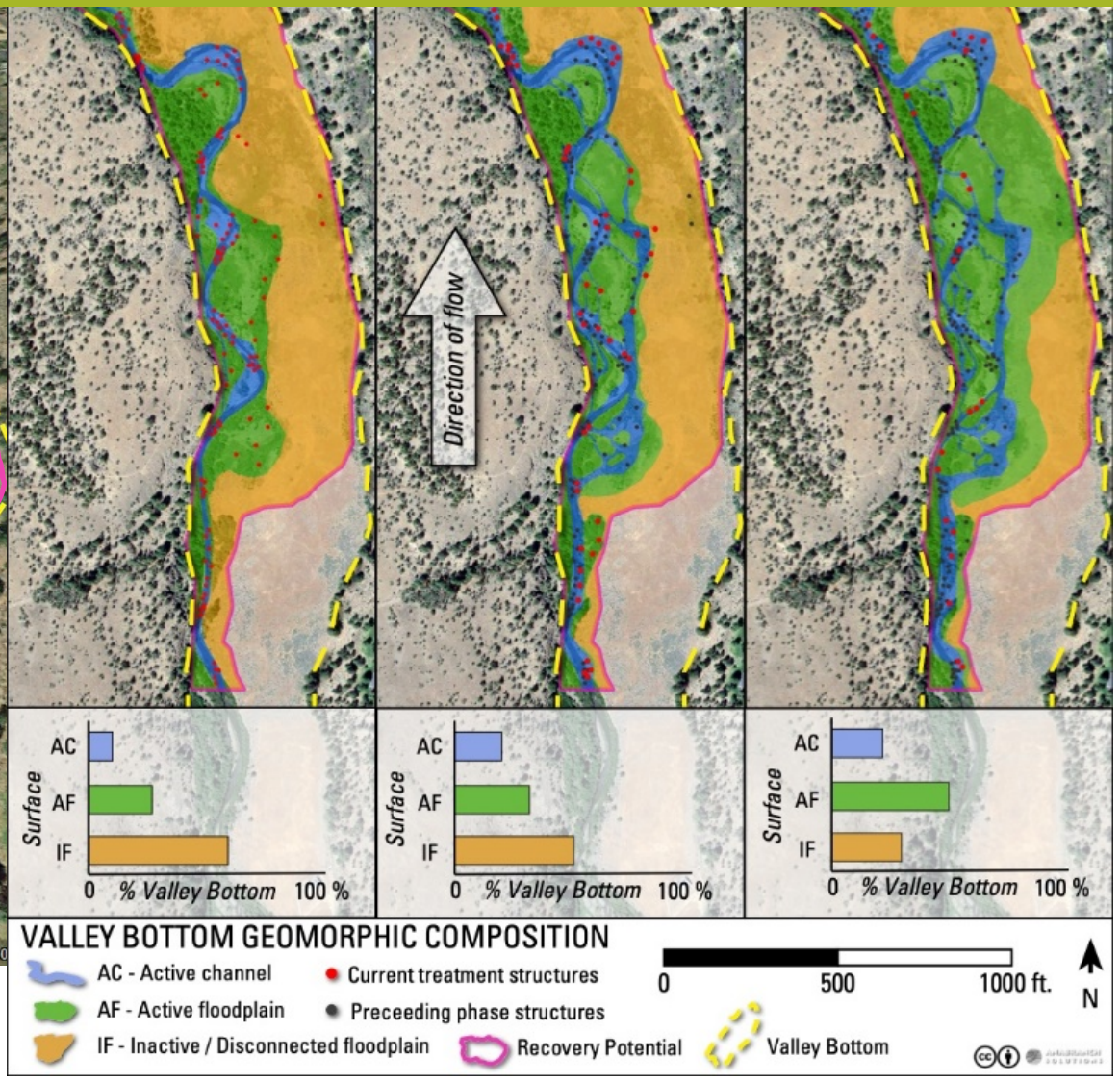
How much is in play for restoration?

Clarification…



Opportunity is defined by gap between Condition & Recovery Potential

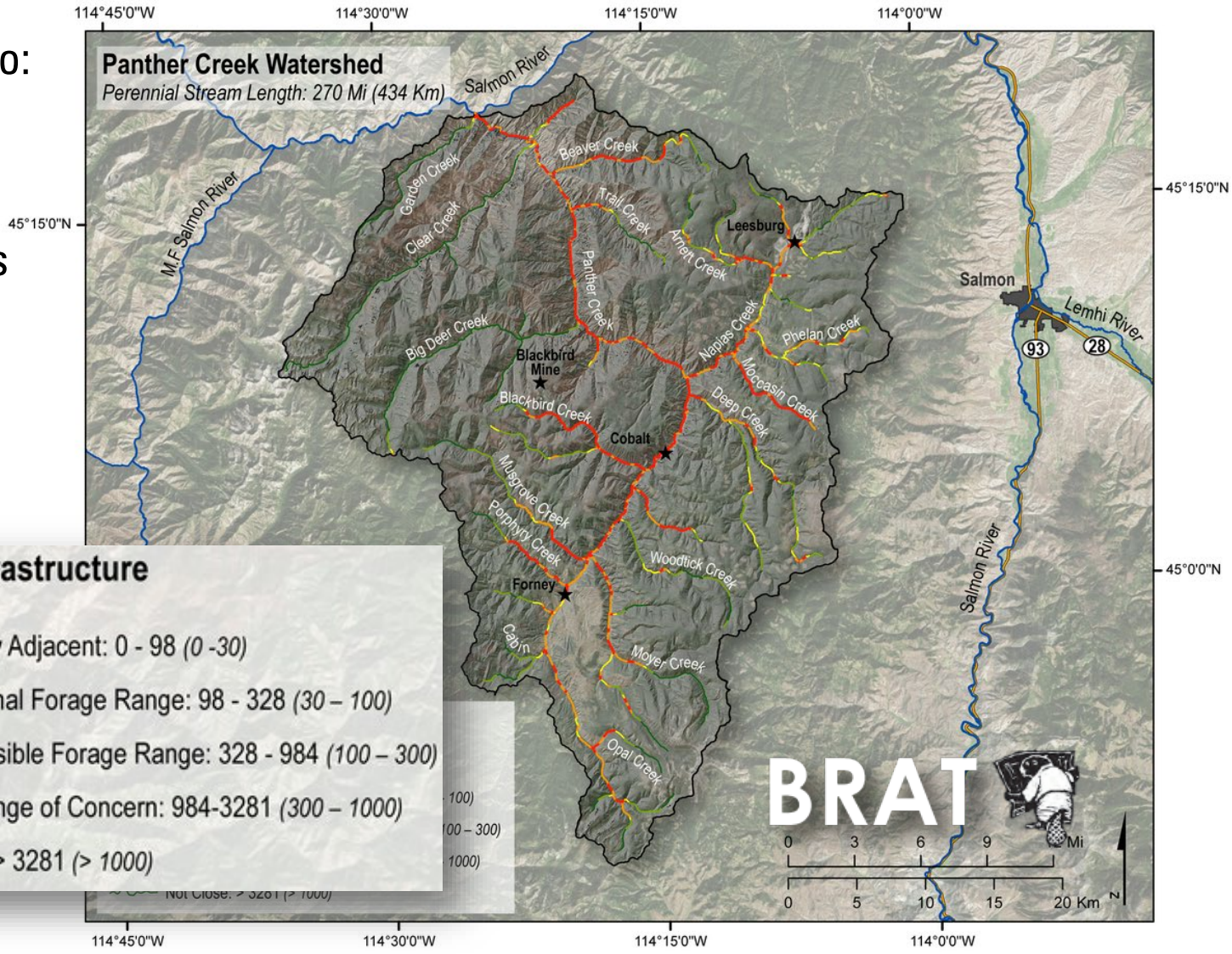




Approximations from Freely Available Data

Closest distance to:

- Railroads
- Roads
- Bridges/Culverts
- Diversions
- Canals
- Intensive Land Uses



See Appendix 3D of Bennett et al. (2019, p 121-123) Chapter 3 LTPBR Manual

See: http://brat.riverscapes.xyz

DOI: 10.13140/RG.2.2.15815.75680

Contextualizing Risk (e.g. with Beaver)

Closet distance to:

- Railroads
- Roads
- Bridges/Culverts
- Diversions
- Canals
- Intensive Land Uses

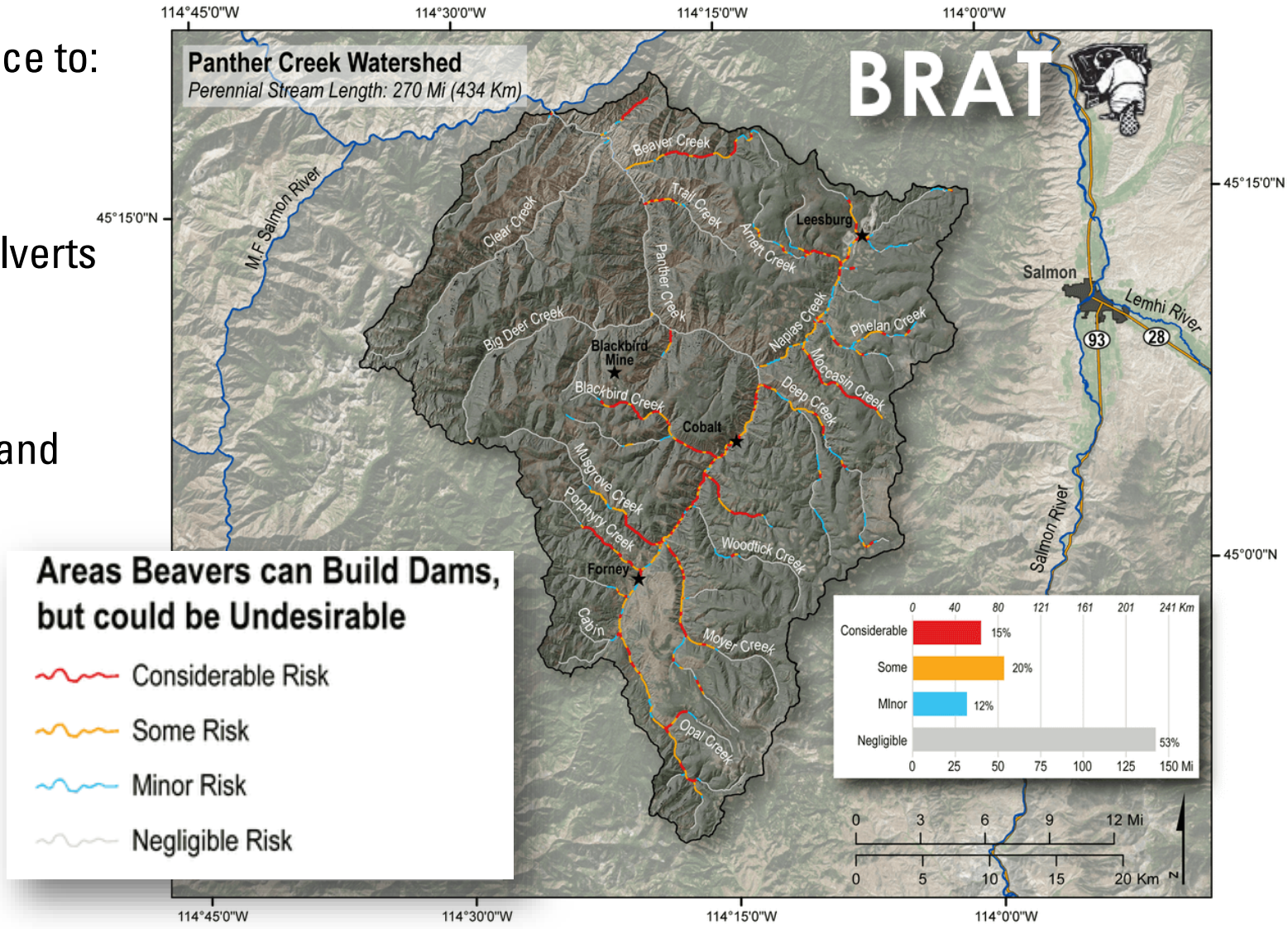


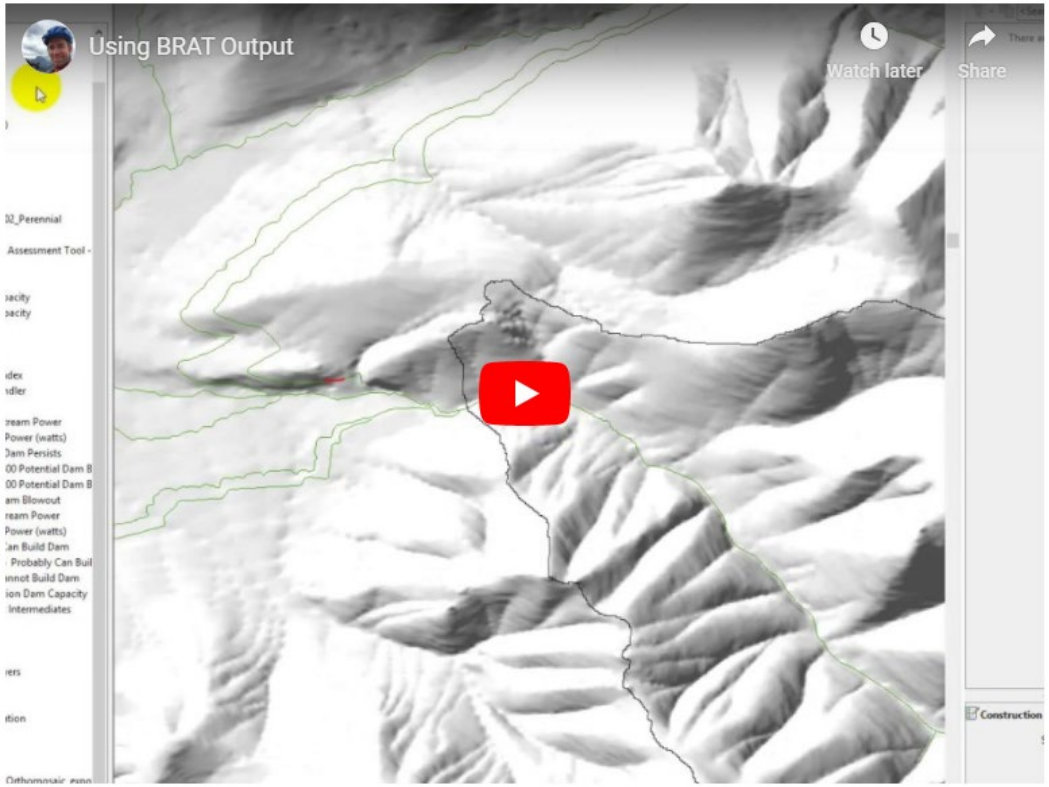
Figure 3.24 from Bennett et al. (2019, p. 123) Chapter 3 LTPBR Manual

See: http://brat.riverscapes.xyz

DOI: 10.13140/RG.2.2.15815.75680

More Detail…

Expected Beaver Dam Capacity



Riparian Condition Capacity to support Process of Beaver Dam Activity

BRAT

Allowing beaver dispersing from upstream to move down in and maintain water in this reach could be adventagoues. Where beaver dam activity is an immediate, or long-term goal, the question to ask is whther or not beaver dam actiivty could be sustained and if so to what level? From BRAT, you can at least get:

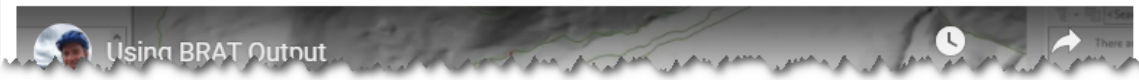
- Nubmer of Dams in a reach that can be supported currently (e.g. count of capacity)
- Comparison to what might have been supported their historically (i.e. count of upper plausible extent of capacity)

: of recovery potential is possible in terms of a capacity bump. Note that the city if the area within 100 m of the channel is not likely to increase is n building activity. Finally, you can:

ial capacity (uplift potential)
could cause unintended harm that may need to be mitigated and/or

Resource Link	Notes or Alternative Resource
entire BRAT Project BRAT.zip-	You can make this assessment by asking the questions that BRAT does in the field or at the desktop with the BRAT cIS
the BRAT Project you need 01.zip - 1100 MB!	Above file includes a preliminary run you do not need
the layer package output of the eed	This is what's used in video below and smaller if you're having problems downloading
Just `*.lpk` for `BatchRun01`	BRAT_MiddleBear_16010202_Perrenial.lpk- 450 MB!	

This video shows how to download and use the primary outputs of BRAT:



Analyze Resource Data – Consider Conditions!

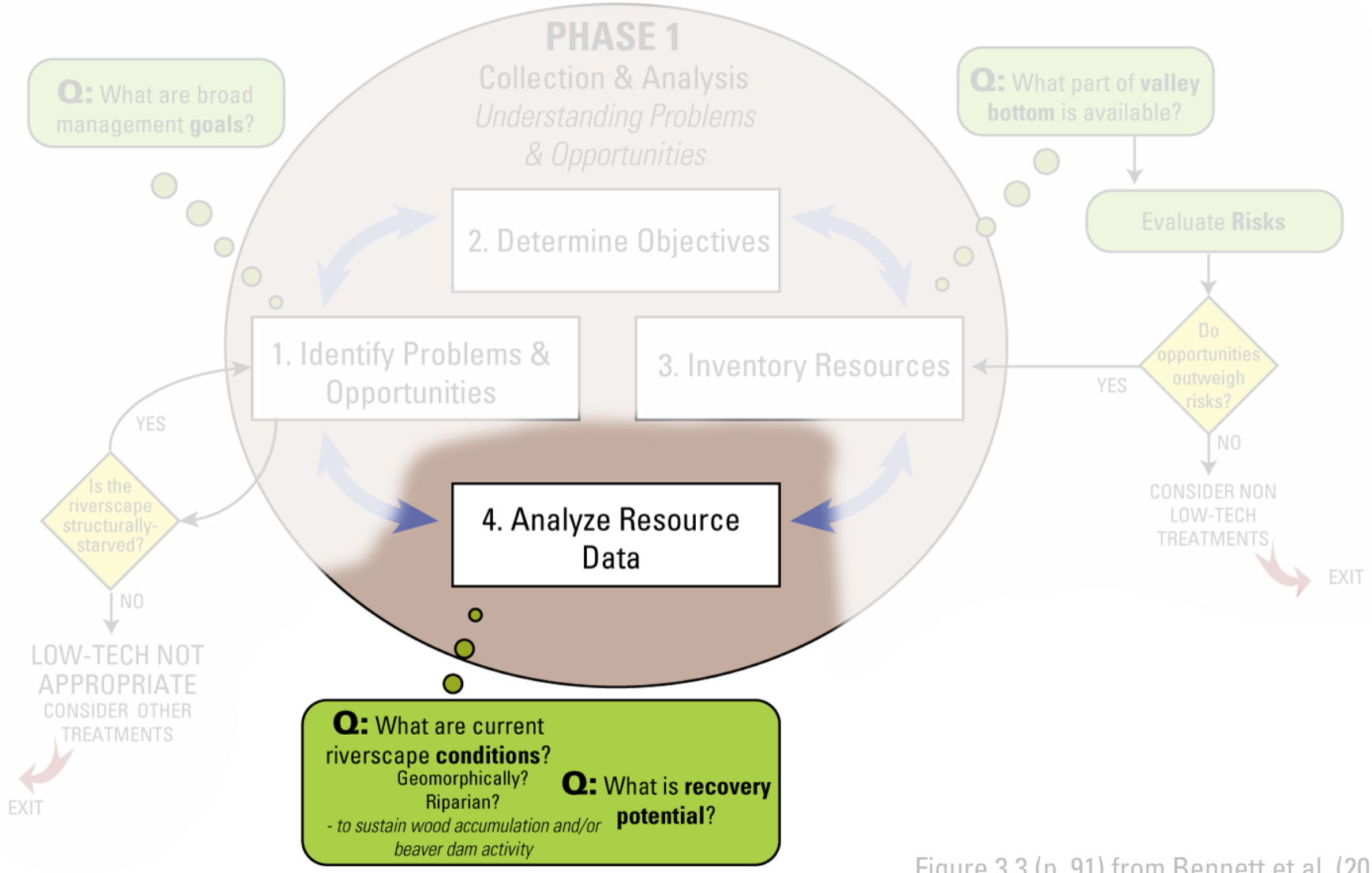
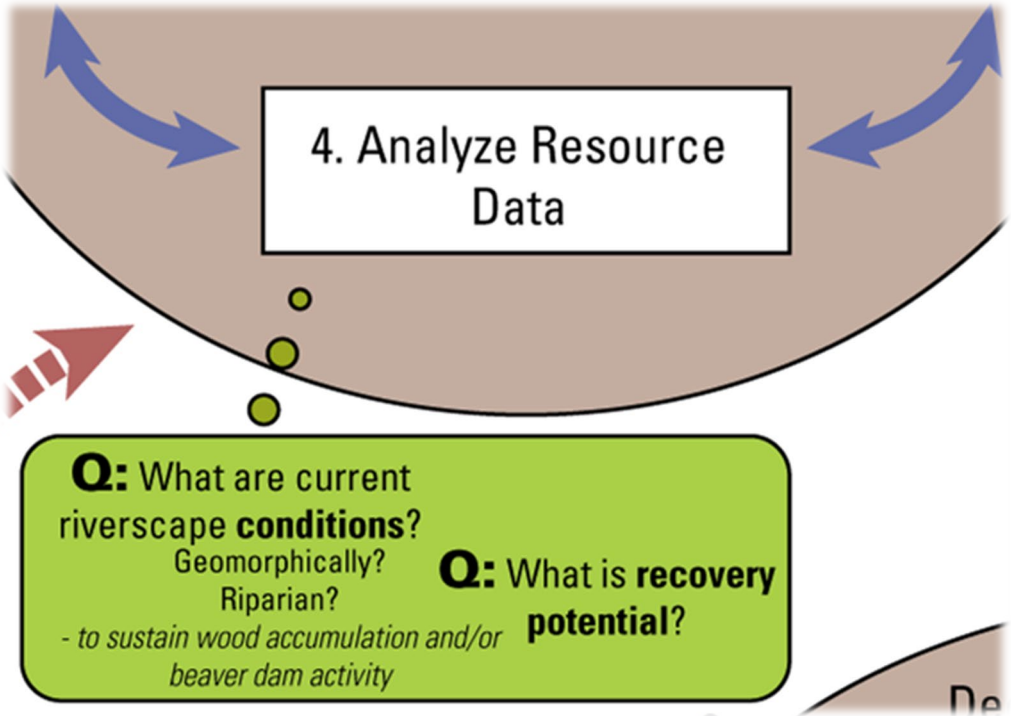


Figure 3.3 (p. 91) from Bennett et al. (2019) – Chapter 3 LTPBR Manual

DOI: 10.13140/RG.2.2.15815.75680

Current & Potential Conditions



Therein, we focus on processes that can sustain wood accumulation and/or beaver dam activity

Key LTPBR Questions – Step 4

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

Q: What is **recovery potential**?

Key Low-Tech Questions and Considerations

There are two key questions, with regards to analysis of resources, for low-tech restoration we consider from two perspectives (Figure 3). Those key questions are:

- What are the current riverscape conditions?
- What is the recovery potential of the riverscape?

Now

& What could be…

Since the primary strategy with low-tech process-based restoration of riverscapes is mimicking, promoting and eventually sustaining processes of wood accumulation and/or beaver dam activity, we must consider the above questions about current and potential conditions from the perspective of geomorphic conditions and riparian conditions. Therefore, we can cast these key questions from both a geomorphic and riparian perspective as:

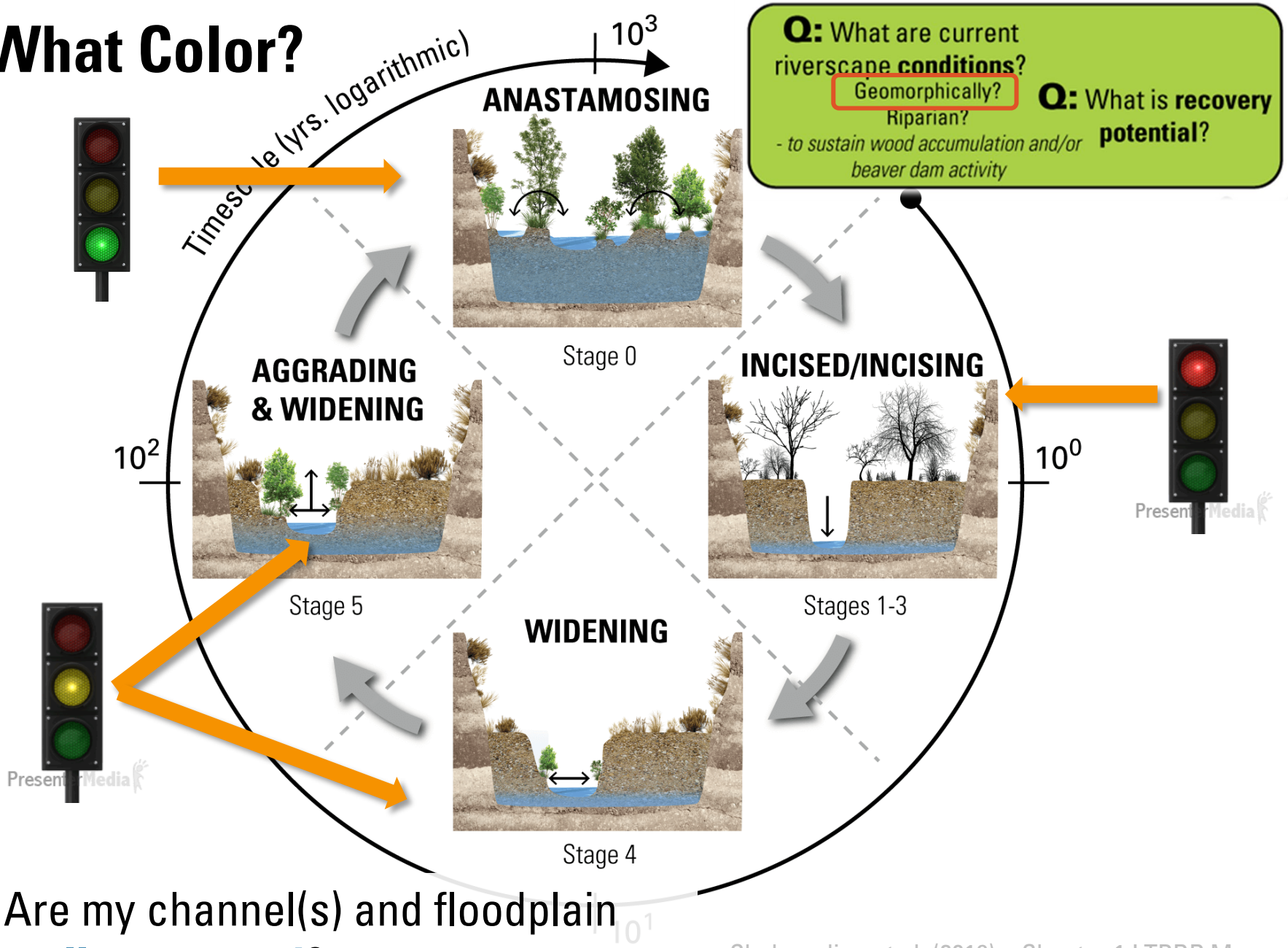
1. Are my channel(s) and floodplain well-connected (geomorphology/hydrology)?
2. Is it likely that a self-sustaining source of woody structure can be restored (riparian and beaver ecology)?

1. Are my channel(s) and floodplain well-connected (geomorphology/hydrology)?
2. Is it likely that a self-sustaining source of woody structure can be restored (riparian & beaver ecology)?

p. 100 from Bennett et al. (2019) – Chapter 3 LTPBR Manual

DOI: 10.13140/RG.2.2.15815.75680

What Color?



1. Are my channel(s) and floodplain **well-connected**?

Shahverdian et al. (2019) – Chapter 1 LTPBR Manual
DOI: 10.13140/RG.2.2.14138.03529

Current Geomorphic Conditions

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

Q: What is **recovery potential**?

CONDITION MAPS

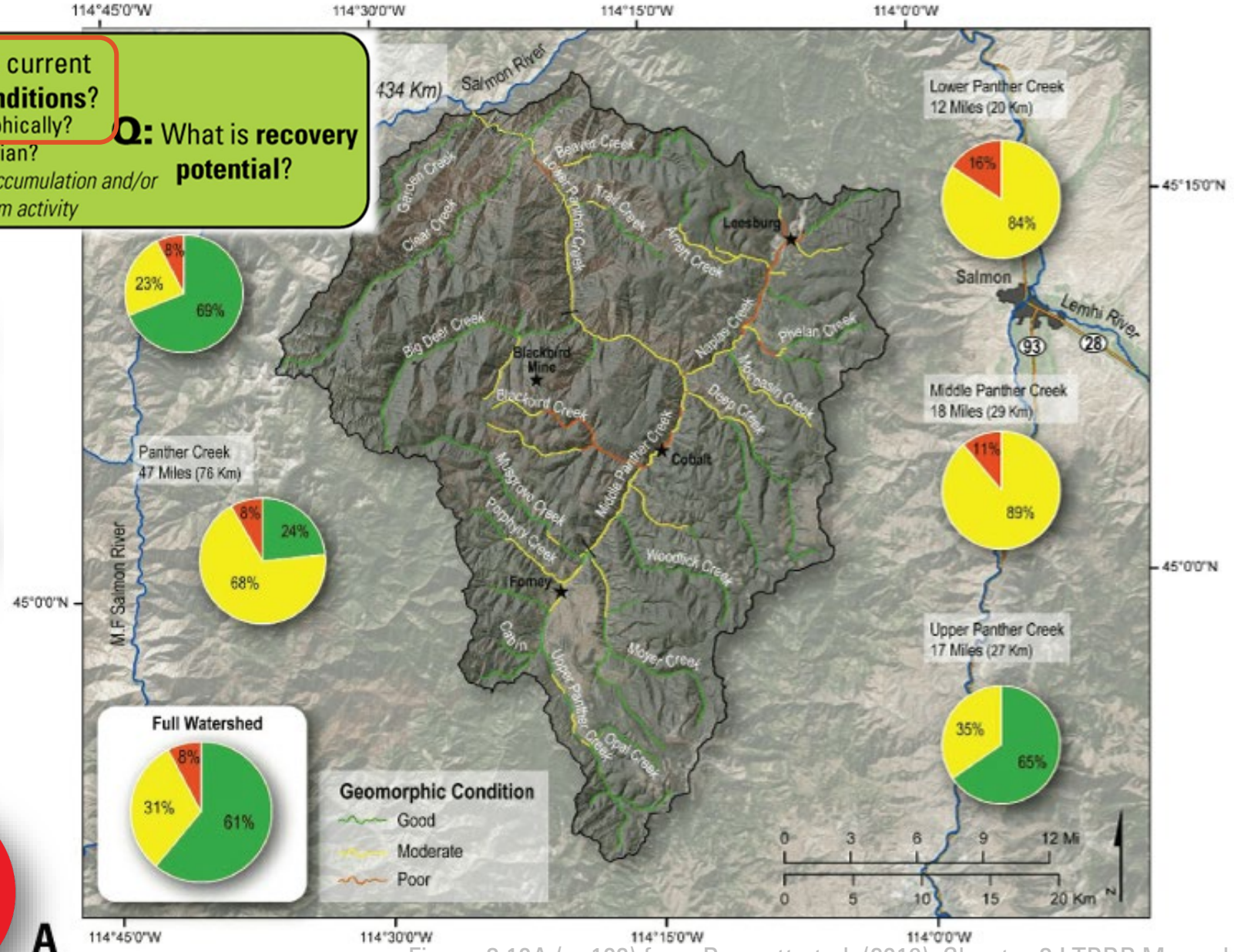


Figure 3.10A (p. 102) from Bennett et al. (2019), Chapter 3 LTPBR Manual

DOI: 10.13140/RG.2.2.15815.75680

Potential Geomorphic Conditions (i.e. recovery potential)

Q: What are current riverscape **conditions**?

Geomorphically?

Riparian?

- to sustain wood accumulation and/or beaver dam activity

Q: What is **recovery potential**?

RECOVERY POTENTIAL MAPS

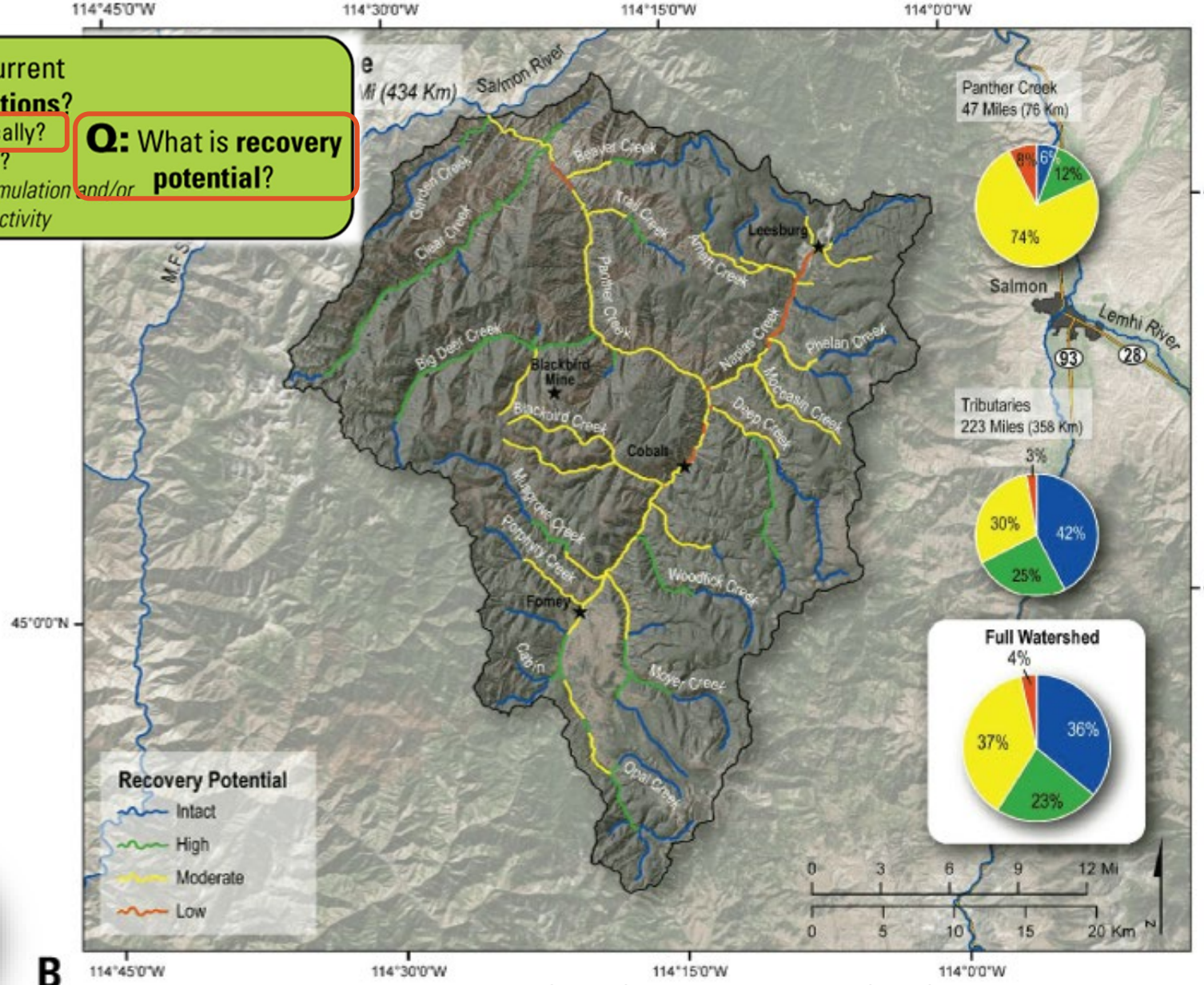


Figure 3.10B (p. 102) from Bennett et al. (2019), Chapter 3 LTPBR Manual

DOI: 10.13140/RG.2.2.15815.75680

More Detail…

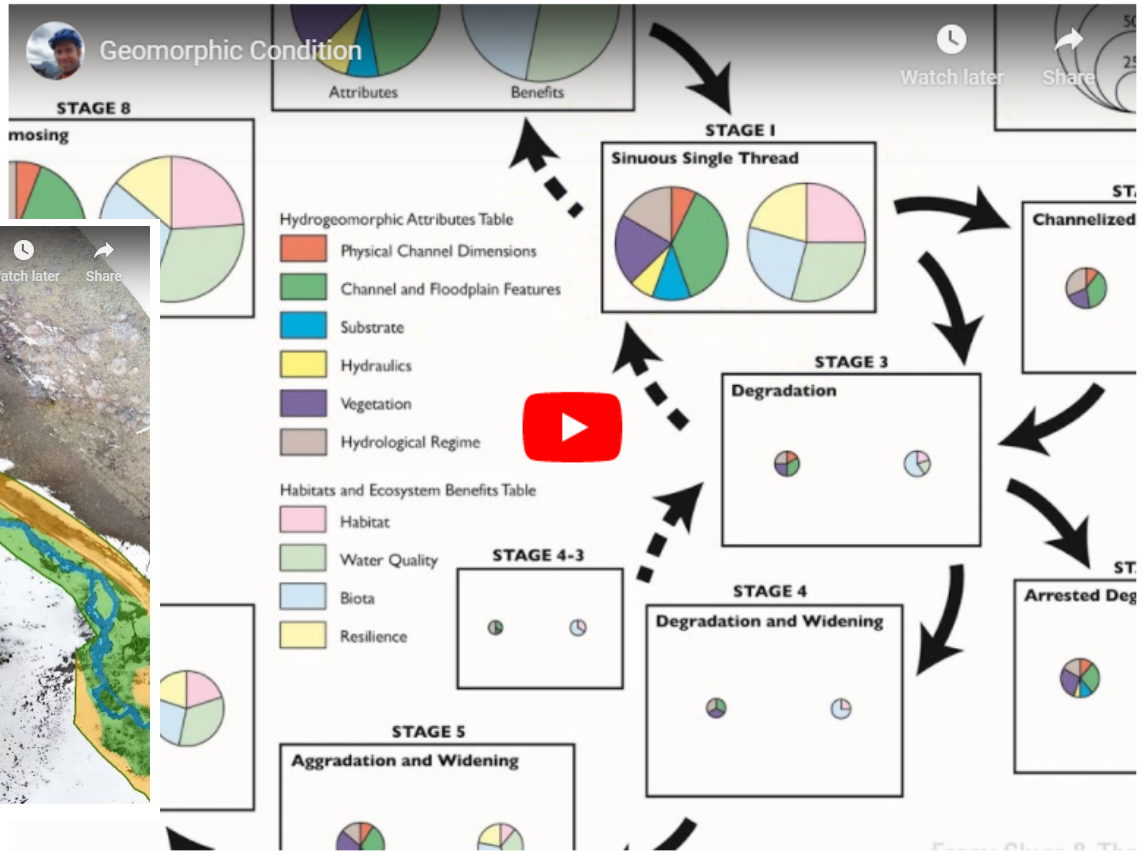
Geomorphic Condition

4. Resource Analysis

Assessment of Current Conditions and Recovery Potential

Geomorphic Condition

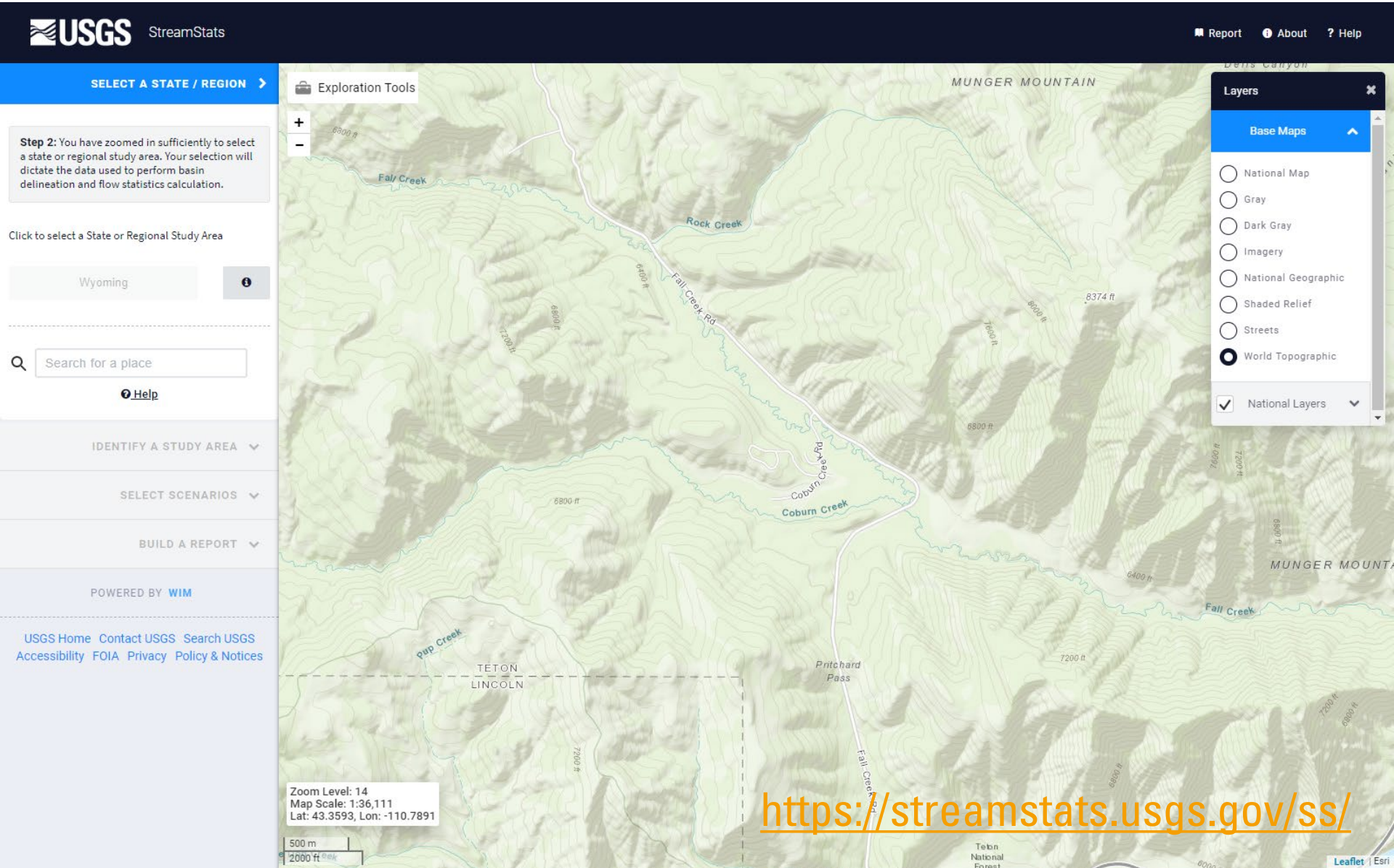
This video below goes through some generic background on assessing geomorphic condition, primarily by using the Cluer & Thorne (2013) riverscape evolution model.



Applying this to Birch Creek requires a visit in the field and broader training than we have provided you in fluvial geomorphology then this class. As such, I provide the GIS files below in the geomorphic resources that I have done for you and explain to you in the video below how I obtained them.

Resource Type	Suggested Resource Link	Notes or Alternative Resource
Active Valley		This is a template worksheet for populating active channel,

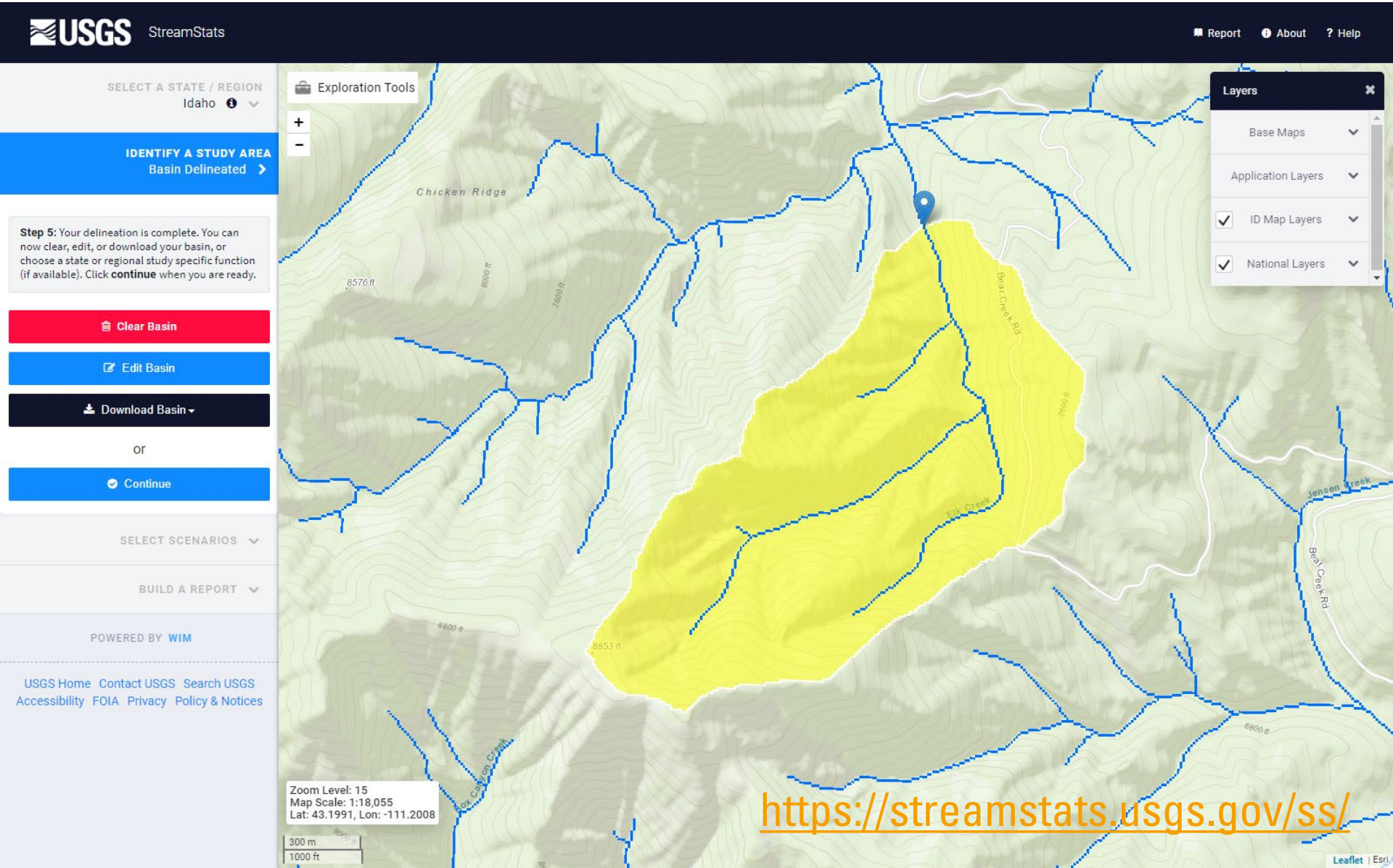
Is flow regime present to “Do the Work”?



https://streamstats.usgs.gov/ss/

Where StreamStats is present…

Delineates Watershed



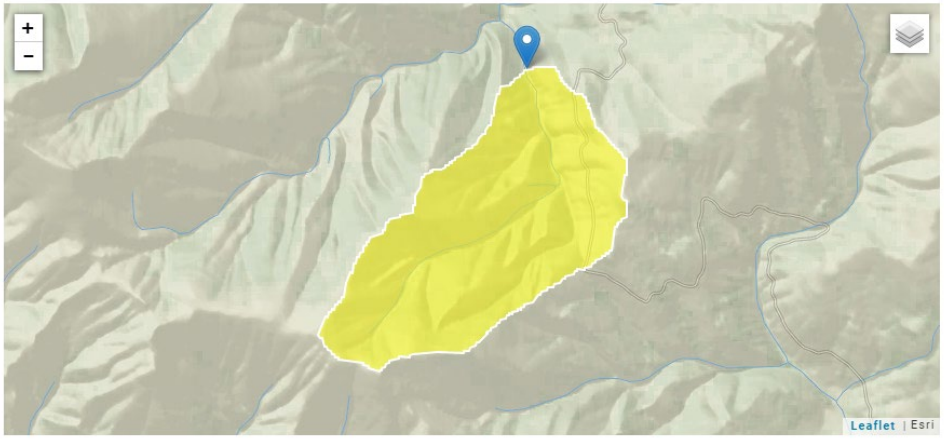
https://streamstats.usgs.gov/ss/

Where StreamStats is present…

Provides flow statistics based on regional curves

StreamStats Report

Region ID: ID
Workspace ID: ID20190729050512812000
Clicked Point (Latitude, Longitude): 43.22144, -111.21683
Time: 2019-07-28 23:06:04 -0600



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.79	square miles
PRECPRIS10	Basin average mean annual precipitation for 1981 to 2010 from PRISM	29.7	inches
BSLDEM30M	Mean basin slope computed from 30 m DEM	49.8	percent

Peak-Flow Statistics Parameters [Peak Flow Region 6 and 8 2016 5083]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.79	square miles	2.77	3740
PRECPRIS10	Mean Annual Precip PRISM 1981 2010	29.7	inches	18.9	54.6

Peak-Flow Statistics Disclaimers [Peak Flow Region 6 and 8 2016 5083]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Flow Region 6 and 8 2016 5083]

Statistic	Value	Unit
1.25 Year Peak Flood	7.39	ft^3/s
1.5 Year Peak Flood	9.77	ft^3/s
2 Year Peak Flood	13	ft^3/s
2 33 Year Peak Flood	14.8	ft^3/s
5 Year Peak Flood	22	ft^3/s
10 Year Peak Flood	29.3	ft^3/s
25 Year Peak Flood	39.1	ft^3/s
50 Year Peak Flood	46.9	ft^3/s
100 Year Peak Flood	56.8	ft^3/s
200 Year Peak Flood	65.5	ft^3/s
500 Year Peak Flood	80.6	ft^3/s

Peak-Flow Statistics Citations

Wood, M.S., Fosness, R.L., Skinner, K.D., and Veilleux, A.G.,2016, Estimating peak-flow frequency statistics for selected gaged and ungaged sites in naturally flowing streams and rivers in Idaho: U.S. Geological Survey Scientific Investigations Report 2016–5083, 56 p.

Low-Flow Statistics Parameters [Low Flow Region 8 2006 5053]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit

https://streamstats.usgs.gov/ss/

More Detail…

Flow Regime to do the Work

Flow Regimes ability to "Do the Work" of Restoration

Assessment of Flow Regime to do "geomorphic work" necessary to follow desired recovery trajectory.

Birch Creek Flow Resources

Resource Type	Suggested Resource Link	Notes or Alternative Resource
Flow Regime Assessment	StreamStats	Typical peak-flow statistics (e.g. Q2 and Q100) are easy to estimate using StreamSTats. You can download flow gague data and do your own regional curves, but this is a reasonable approximation in under 10 minutes.
Stream Power Assessment	BRAT Estimates (see below)	For a given segment of reach, you could also take any flow estimate, measurement, or flow statistic (e.g. from StreamStats) and multiply it by reach slope, gravity and density of water and do what BRAT attempts to do for you.

In this video, I review how you can use StreamStats to address the flow regime's ability to "do the work" by simply getting you some discharge estimates.

Flow Regime to "Do the Work"?

- Stream power is an expression of flow strength and the erosive capacity of streams. calculated as:

- $\Omega = \rho g Q S$

- Where Ω is the stream power (in Watts), ρ is the density of water (1000 kg/m3), g is acceleration due to gravity (9.8 m/s2), Q is discharge (m3/s), and S is the channel slope.

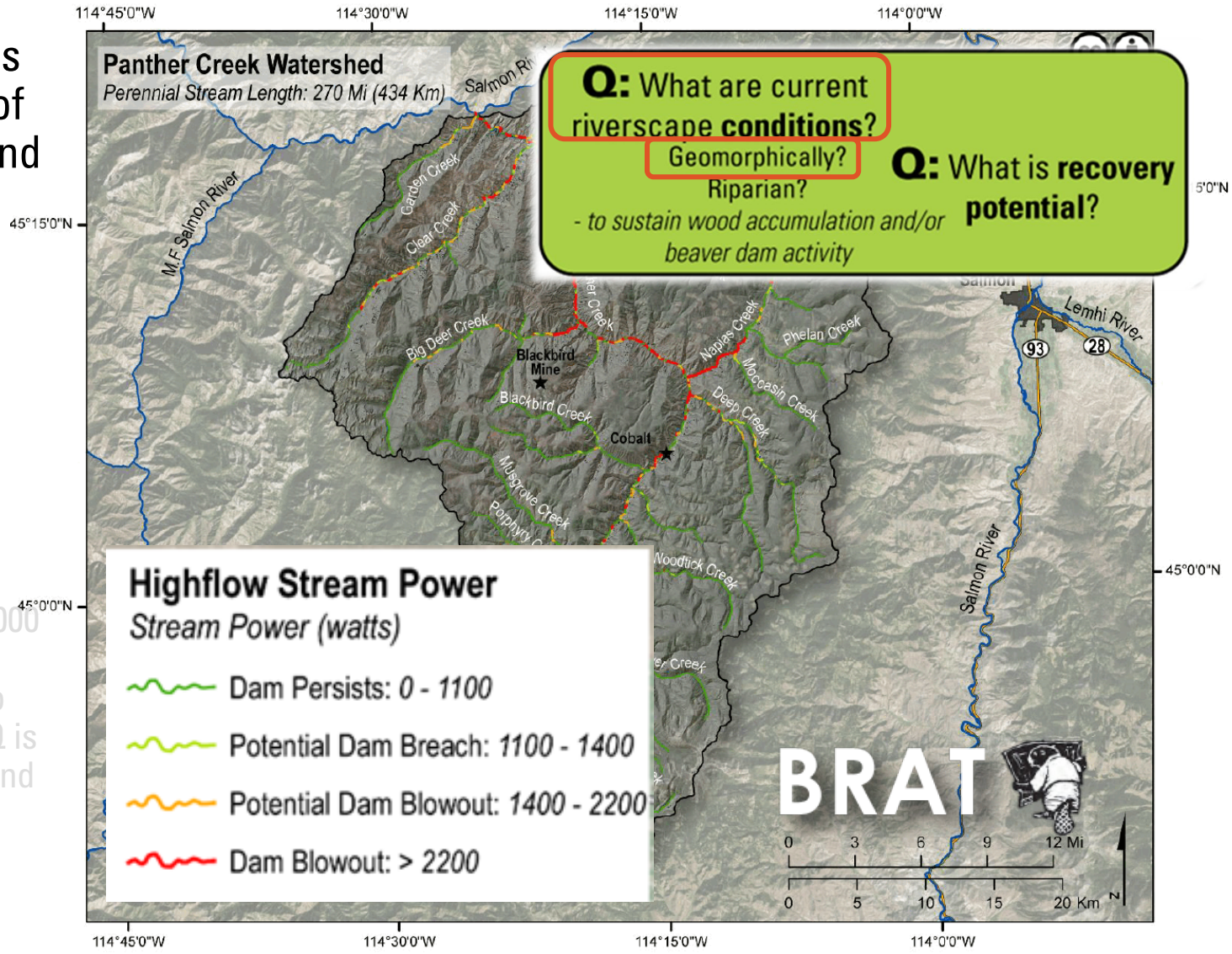


Figure 3.9 (p. 101) from Bennett et al. (2019) Chapter 3 LTPBR Manual

See: http://brat.riverscapes.xyz

DOI: 10.13140/RG.2.2.15815.75680

Take a Moment to Consider…

Q: What are current riverscape **conditions**?

Geomorphically?

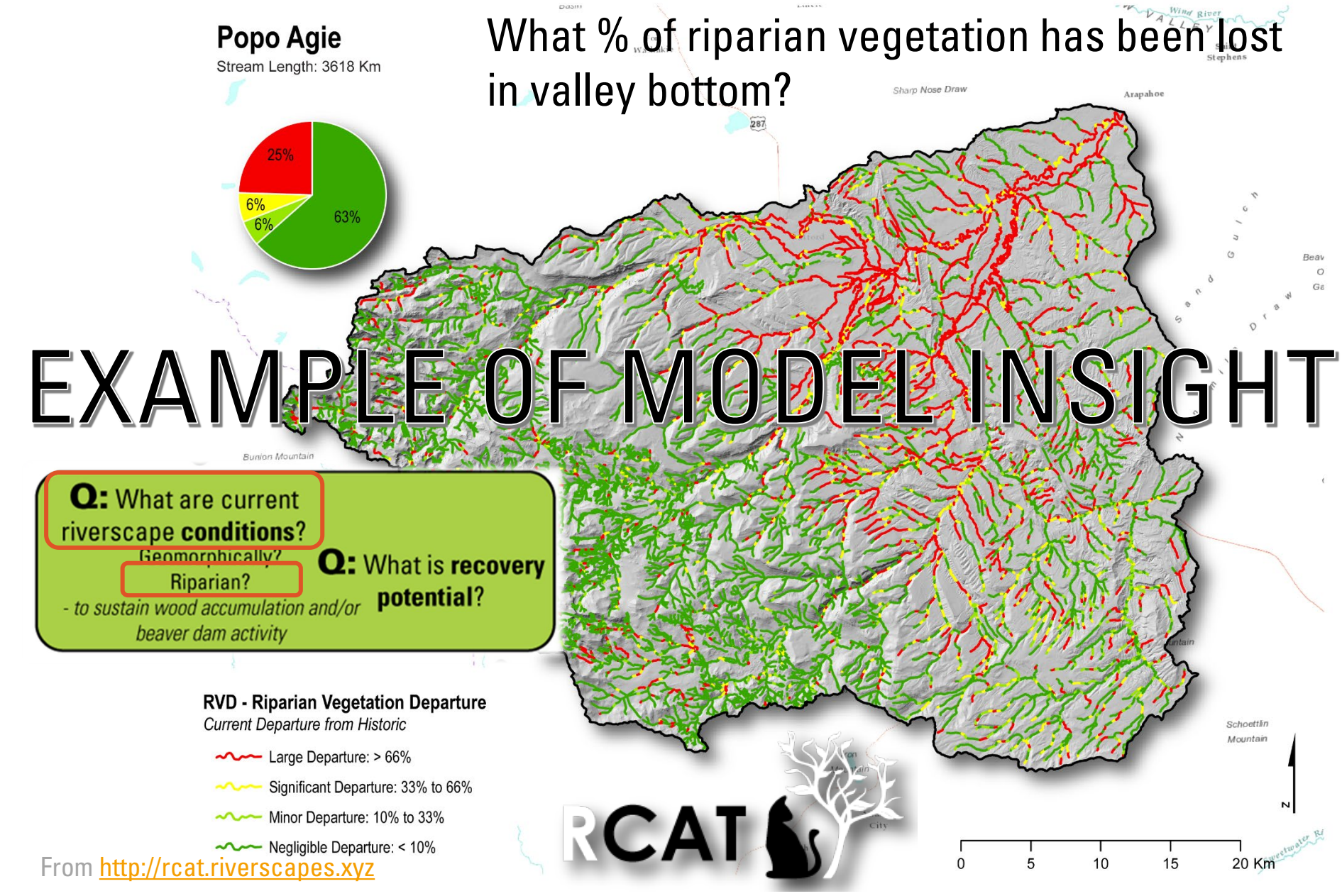
Riparian?

- to sustain wood accumulation and/or beaver dam activity

Q: What is **recovery potential**?

1. Are the woody or vegetative resources present to support process of **wood accumulation**?

Riparian Vegetation Departure (RVD)



From http://rcat.riverscapes.xyz

Existing

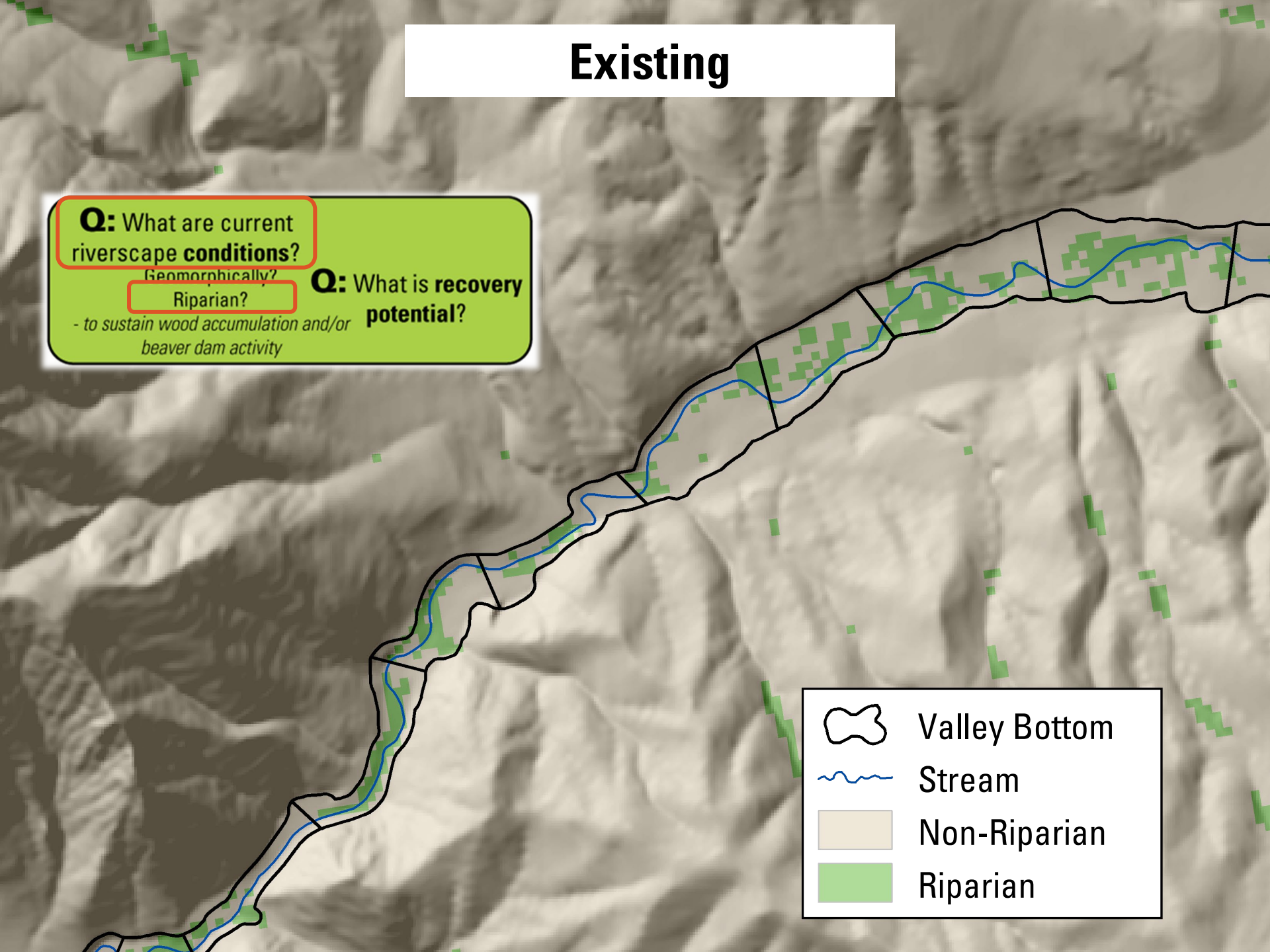
Q: What are current riverscape **conditions**?

Geomorphically?

Riparian?

- to sustain wood accumulation and/or beaver dam activity

Q: What is **recovery potential**?



Historic Estimate

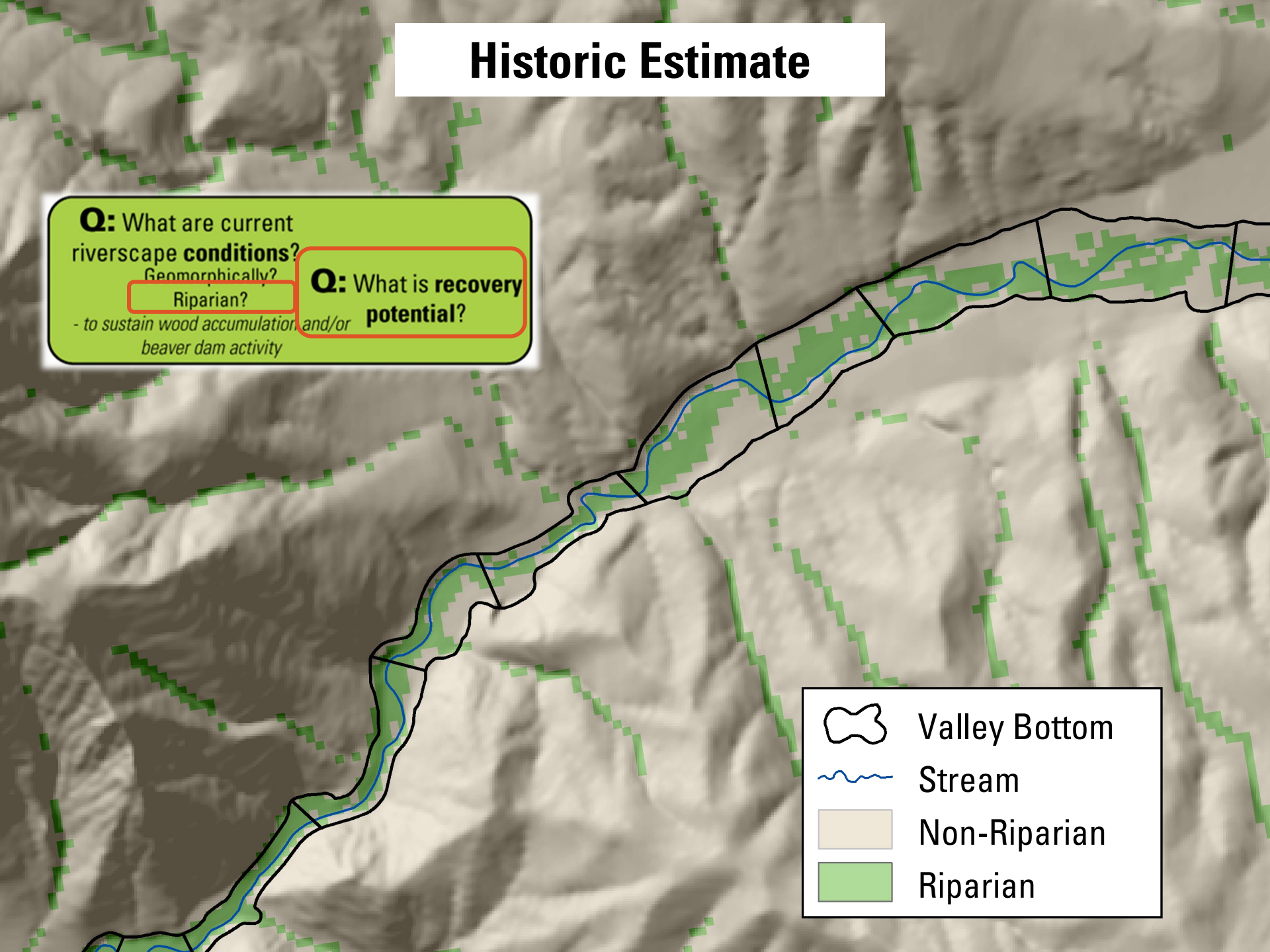
Q: What are current riverscape **conditions**?

Geomorphically?

Riparian?

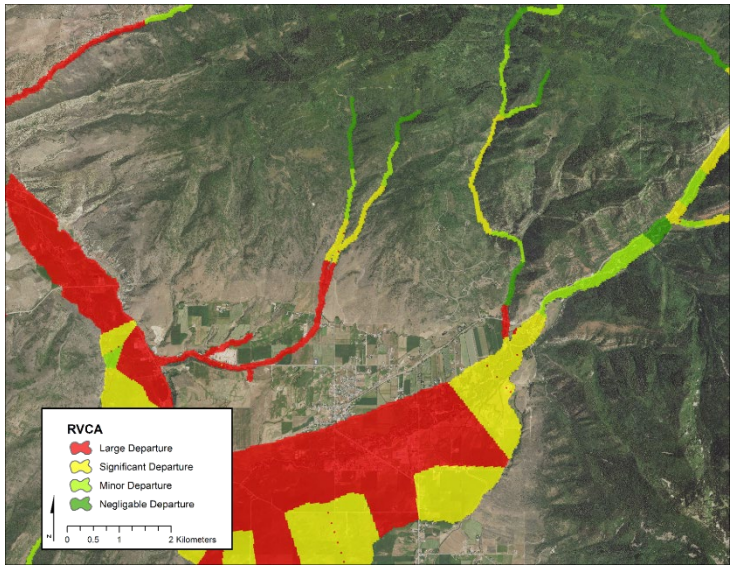
- to sustain wood accumulation and/or beaver dam activity

Q: What is **recovery potential**?



The ‘local’ reach by reach example…

- Riparian vegetation departure calculated for every 30 m pixel within valley bottom
- Then.. summed up by reaches… for display at broader scales…

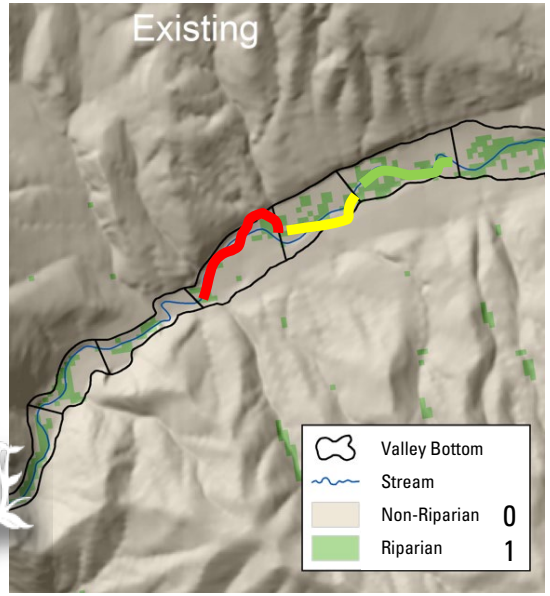


Large Departure: > 66%

Significant Departure: 33% to 66%

Minor Departure: 10% to 33%

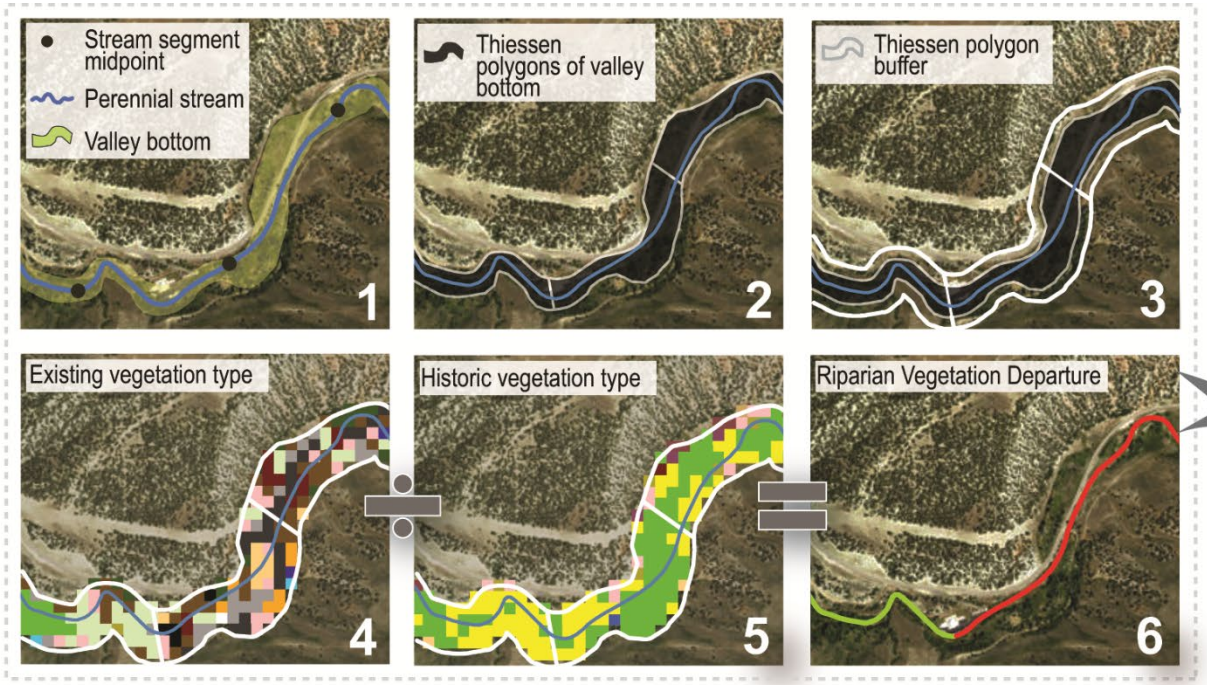
Negligable Departure: < 10%



RCAT

See Appendix 3E in Bennett et al. (2009, pp 124-126)
From http://rcat.riverscapes.xyz

Riparian Vegetation Departure (RVD)



Existing vegetation

Riparian

- Open Water
- Cottonwood-Willow
- Bigtooth Maple
- Introduced Upland Vegetation
- Tall Forb
- Sparsely Vegetated
- Developed
- Curlleaf Mountain-Mahogany
- Mountain Big Sagebrush
- Wyoming Big Sagebrush
- Juniper-Pinyon Pine Woodland
- Gambel oak
- Saltbush-Greasewood
- Chokecherry-Serviceberry Rose
- No Dominant Lifeform

Historic vegetation

Riparian

- Open Water
- Black Cottonwood-Narrowleaf Willow
- Gambel Oak-Serviceberry
- Wyoming Big Sage-Wheatgrass
- Wyoming Big Sage-Rubber Rabbitbrush
- Mountain Sagebrush-Bluebunch Wheatgrass - Idaho Fescue
- Greasewood-Shadscale

RVD - Riparian Vegetation Departure

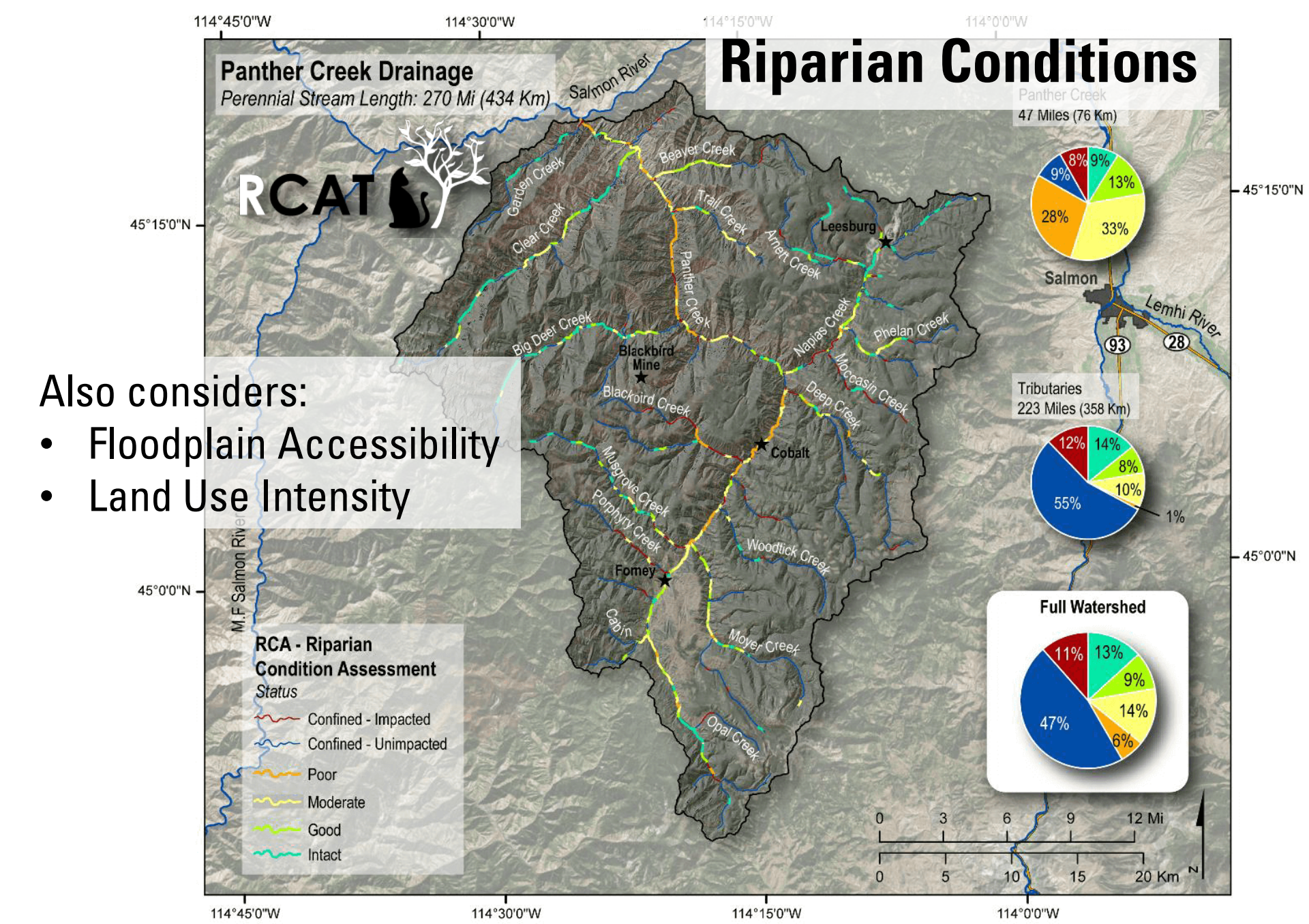
Current Departure from Historic

- Large: > 66%
- Significant: 33% - 66%
- Minor: 10% - 33%
- Negligible: < 10%

Macfarlane et al. (2016) DOI: 10.1016/j.jenvman.2016.10.054

RIVERSCAPES CONSORTIUM

RCAT



Also considers:

- Floodplain Accessibility
- Land Use Intensity

Figure 3.9 (p. 101) from Bennett et al. (2019) Chapter 3 LTPBR Manual

DOI: 10.13140/RG.2.2.15815.75680

More Detail…
Riparian Condition

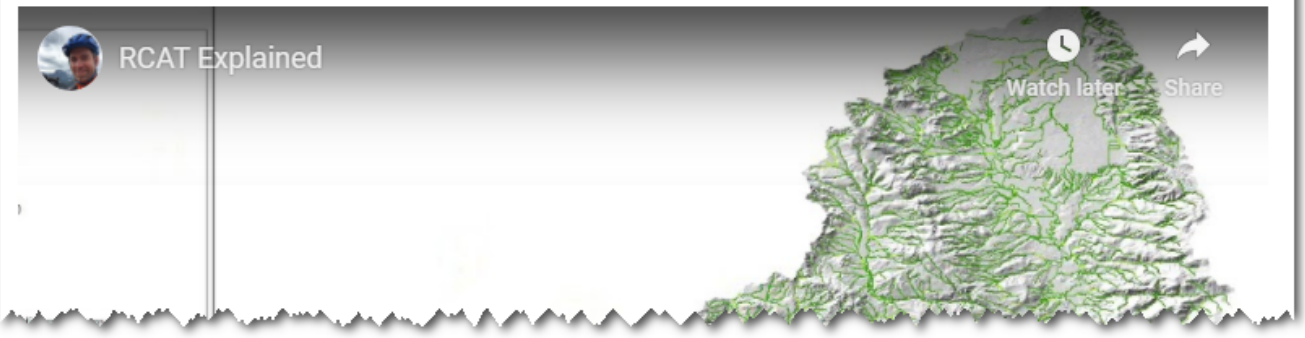
Riparian Condition to support Process of Wood Accumulation

Think about what you can do map existing and potential woody resources (riparian and upland) for processes of wood recruitment, wood transport and wood accumulation). The Ripairan Condition Assessment Tool gets at some of these lines of evidence, others you will need to make an interpretation and your own assessment of. From page 19 of Chapter 3 of the LTPBR Manual, we look at riparian conditions to address the key question of "**is it likely that a self-sustaining source of woody structure can be restored**?"

We can ask:

- What is existing riparian vegetation in the valley bottom relative to historic conditions? *with RCAT*
- Can the riverscape and adjacent uplands support provide a source of woody debris and is natural wood recruitment possible?
- How accessible is the floodplain for flooding and riparian vegetation recruitment (infrastructure / like levees; this is the *active channel plus active floodplain* you did above?
- What land uses are taking place in the valley bottom and are they compatible with maintaining a self-sustaining source of structure?
- How many woody debris jams are currently present? How many could be given the current wood supply? How many could be given the potential wood supply?

As with geomorphic condition, these questions can often be answered simply by walking a site and assessing wood resources and recruitment potential. You can count jams off the imagery and report them as quantities or linear densities (i.e. jams per mile) for more consistent intercomparison across sites. Below we show what can be gleaned from RCAT as a line of evidence:



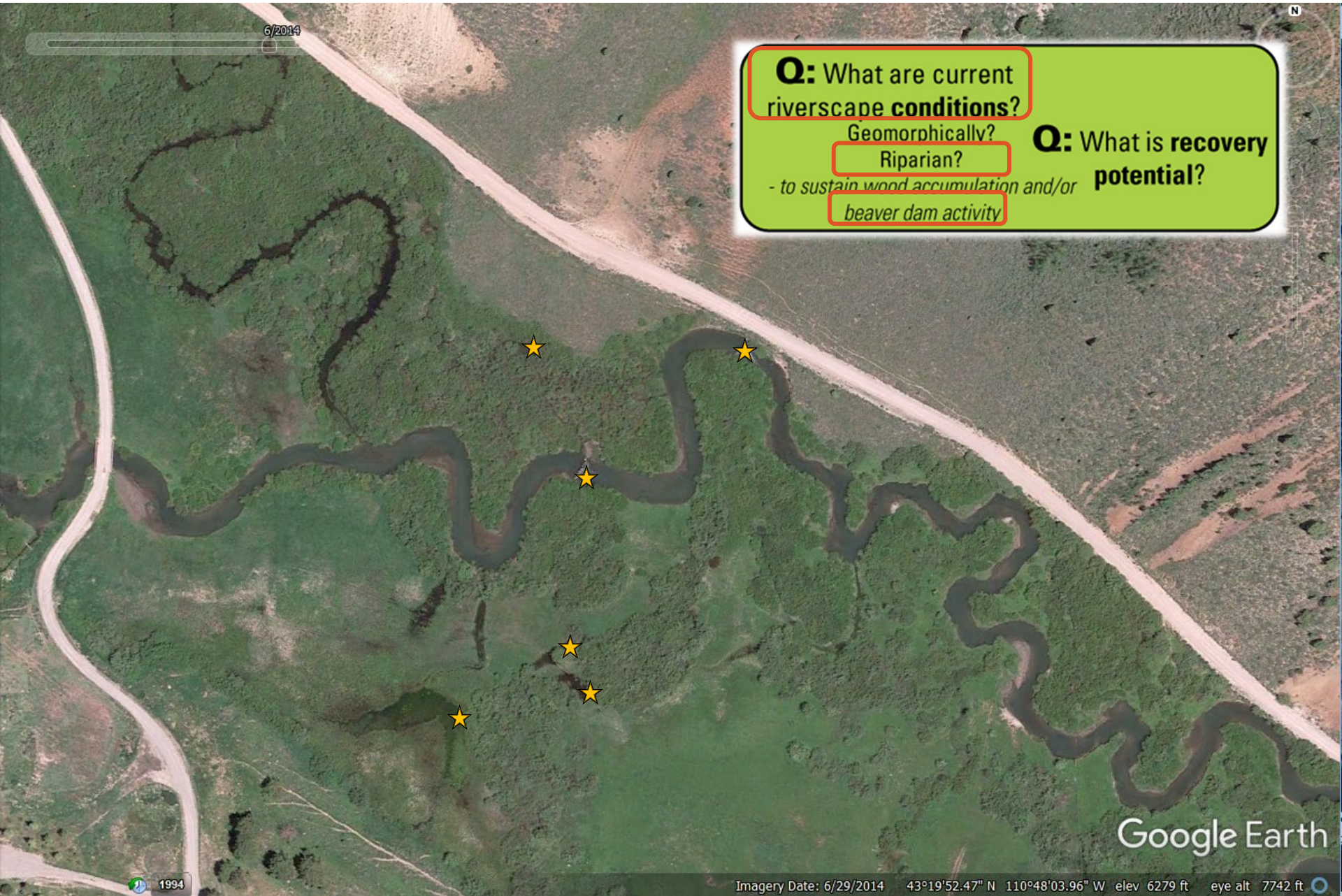
Take a Moment to Consider…

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

Q: What is **recovery potential**?

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?



Could **beaver dam activity** be supported?

Could **beaver dam activity** be supported? – **Census it!**

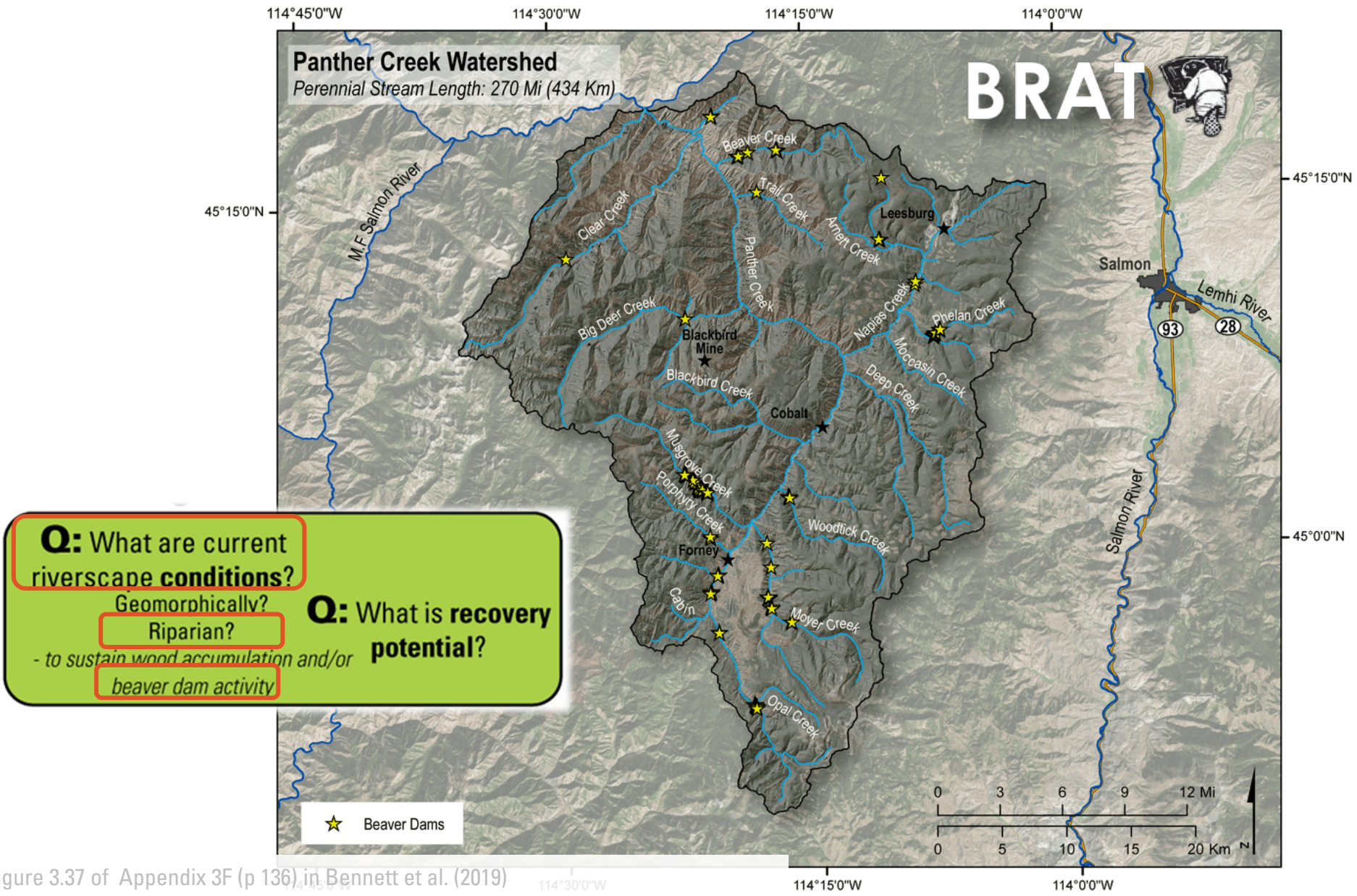


Figure 3.37 of Appendix 3F (p 136) in Bennett et al. (2019)

DOI: 10.13140/RG.2.2.15815.75680

Should beaver dam activity be supported? – **Census it!**

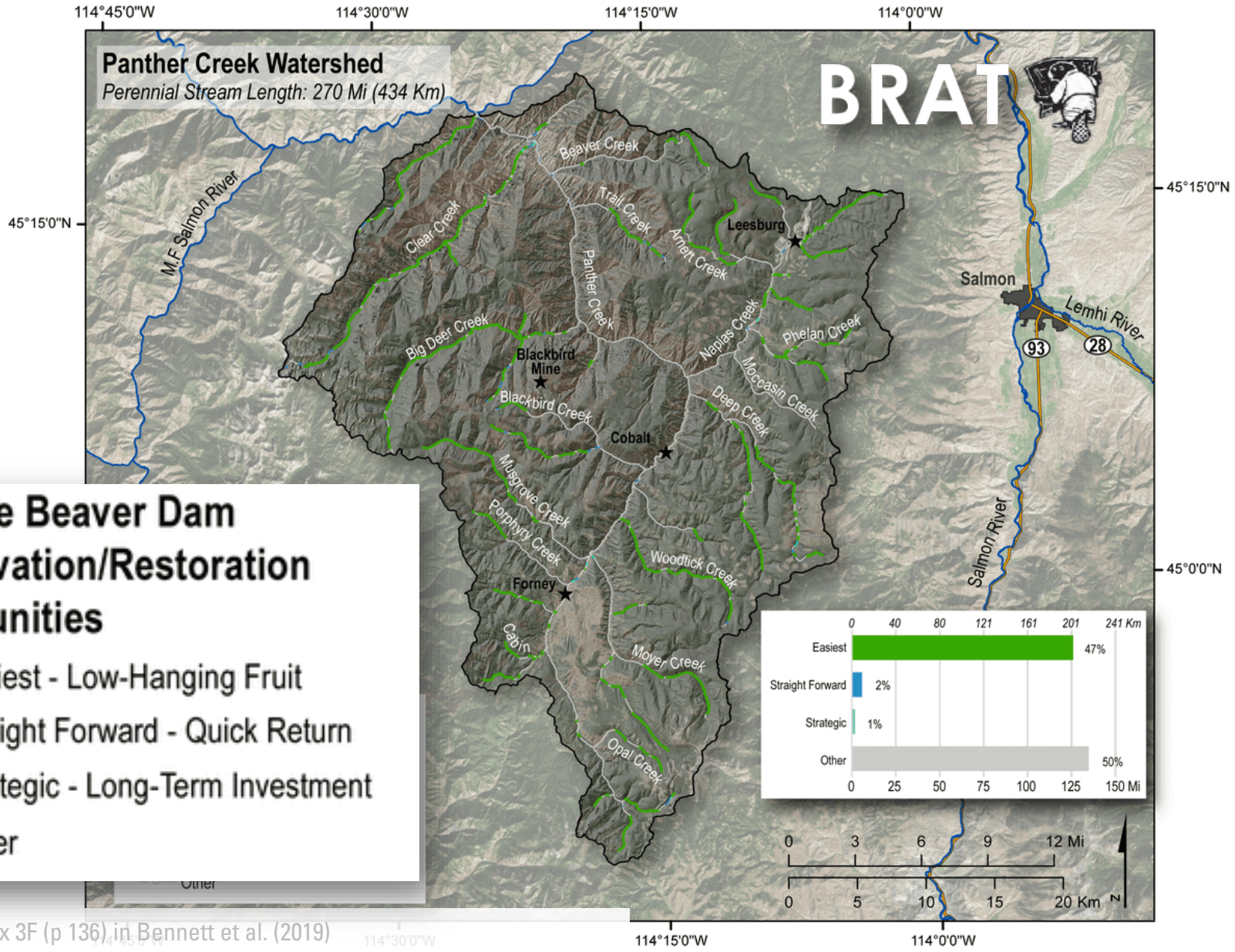


Figure 3.37 of Appendix 3F (p 136) in Bennett et al. (2019)

DOI: 10.13140/RG.2.2.15815.75680

More Detail…

Mapping Risks & Using BRAT Intermediates

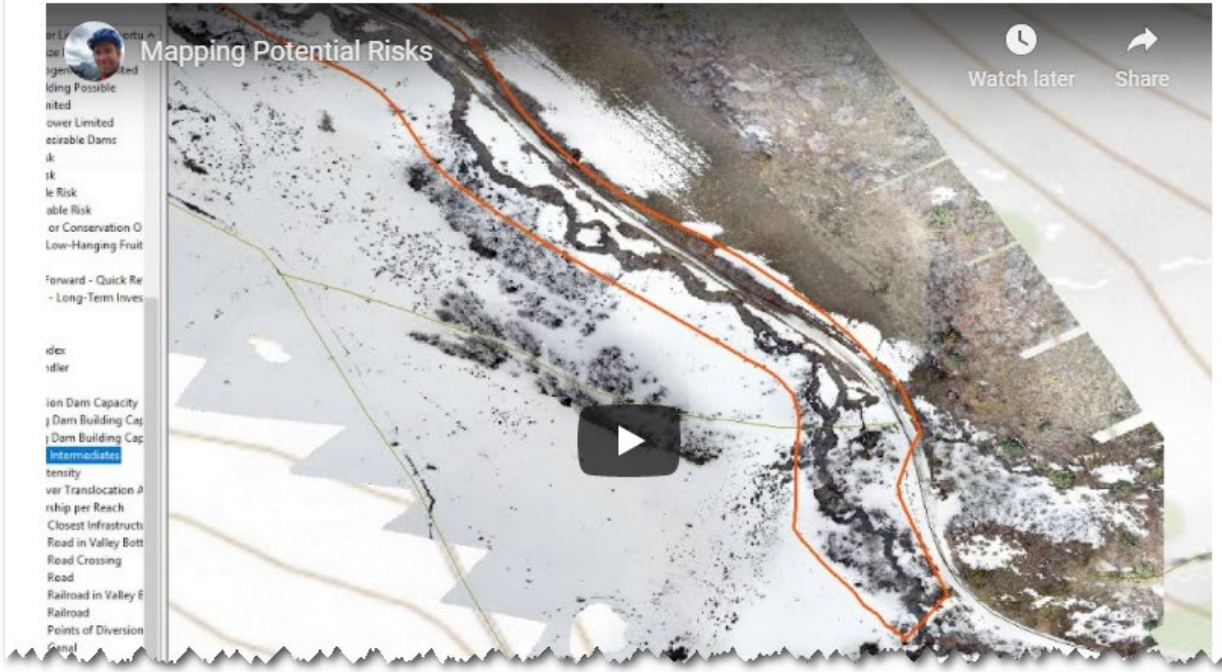
Identified Risks within & Adjacent to Riverscape

Once you have a valley bottom mapped (even if over-estimted), you have a reasonable zone within which and adjacent to which you can assess potential risks associated with flooding and your proposed low-tech restoration. You should map all known infrastructure and land use within and adjacent to riverscape, as well as immediately downstream; use the NRCS risk matrix to evaluate (see Appendix 3D, pages 36-37 of Chapter 3 of LTPBR Design Manual).

Birch Creek Landuse & Infrastructure Resources

Resource Type	Suggested Resource Link	Notes or Alternative Resource
Beaver Restoration Assessment Tool	This is the entire BRAT Project BRAT.zip- 1700 MB!	BRAT includes a bunch of layers that give insights into land use and infrastructure resources

Scroll down to the BRAT download and video, to get the BRAT dataset. Once you have it, this video focuses in on how to use that information that BRAT harvest from freely available national datasets (like NHD, Census Tiger Data for Roads, Land Use Layers, Land Ownership, etc.) to map and make an informed assessment of risk to infrastructure resources and landuse within the riverscape. You job is to take a look at this free data, and decide if it captures what you know to be going on out on site, and if it captures concerns from the land owner (Jay) and/or stakeholders (e.g. USFS, road users and irrigators downstream).



CONCLUSIONS

- Low-tech restoration just follows Conservation Planning Process
- Highlighted specific considerations for low-tech
- Provided clear exit points
- Integrates with principles