To Remove or Not to Remove: The Tree Removal Question

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Why are we talking about trees?

1. Trees are amazing!

2. Restoration can be invasive

3. Our forests are stressed

4. Feedback from general public

I thought our tree protection measures were working well

- Minimize impacts
- Apply tree and root protection practices
- Justify removals
- Replant

Stream restoration is the greater good. Right?

Table 1: An over-simplified comparison

| Benefits	Stream	Forest/Trees
Nutrient processing	✓	✓
Erosion control	✓	✓
Habitat	✓	✓
Birds	✓	✓
Fish	✓	✓
Chesapeake Bay	✓	✓
Society	✓	✓

Greater good at a landscape scale

How do we weigh our impacts and justify the greater good?

A conceptual model

Recovery debt is the "*interim reduction of biodiversity and biogeochemical functions occurring during ecosystem recovery*" (Moreno-Mateos, D. *et al.*, 2017)

Adapted from Moreno-Mateos, D. *et al.*, 2017
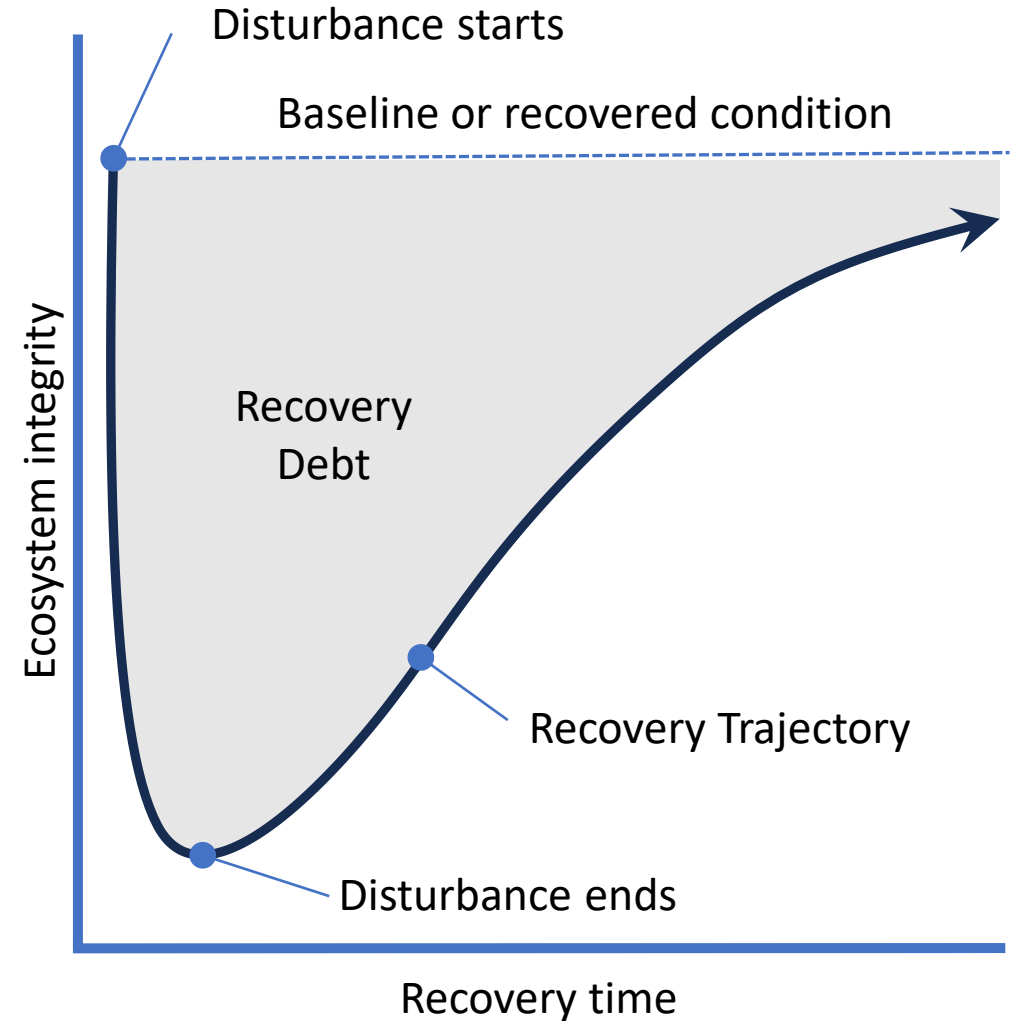
Simple example 1: More debt accrued to forest

System	Functioning	Functioning at risk	Not functioning
Stream		✓	
Forest	✓		
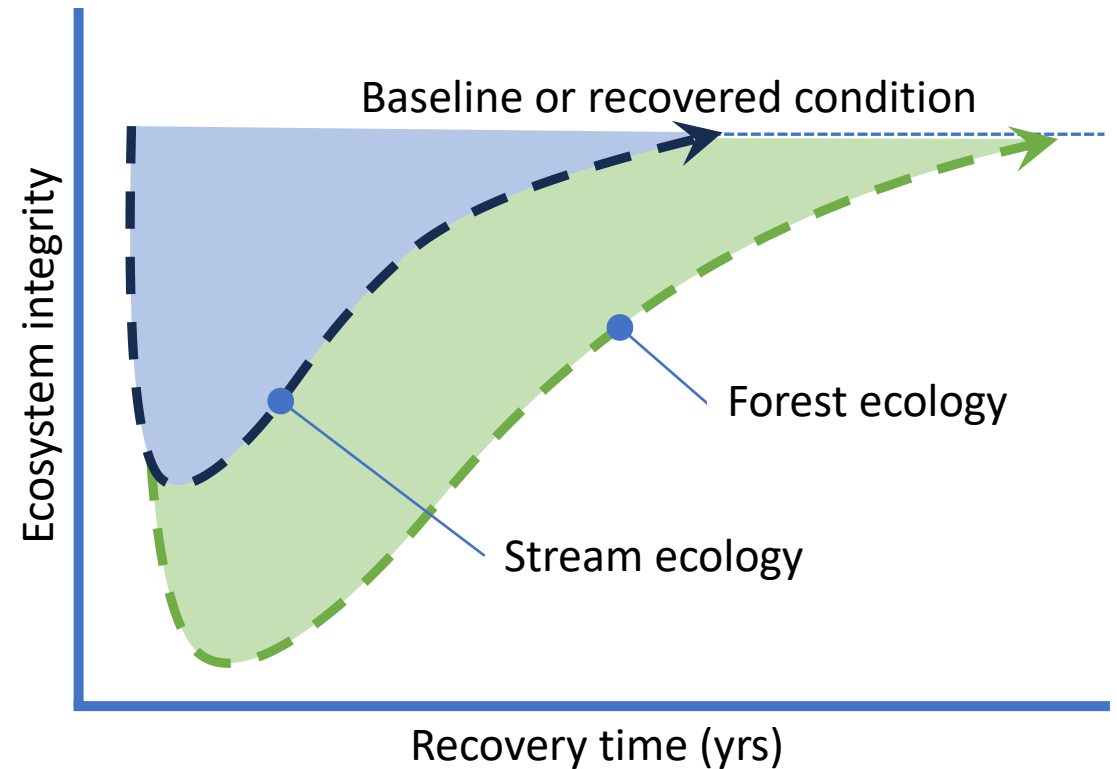
Simple example 2: More debt accrued to stream

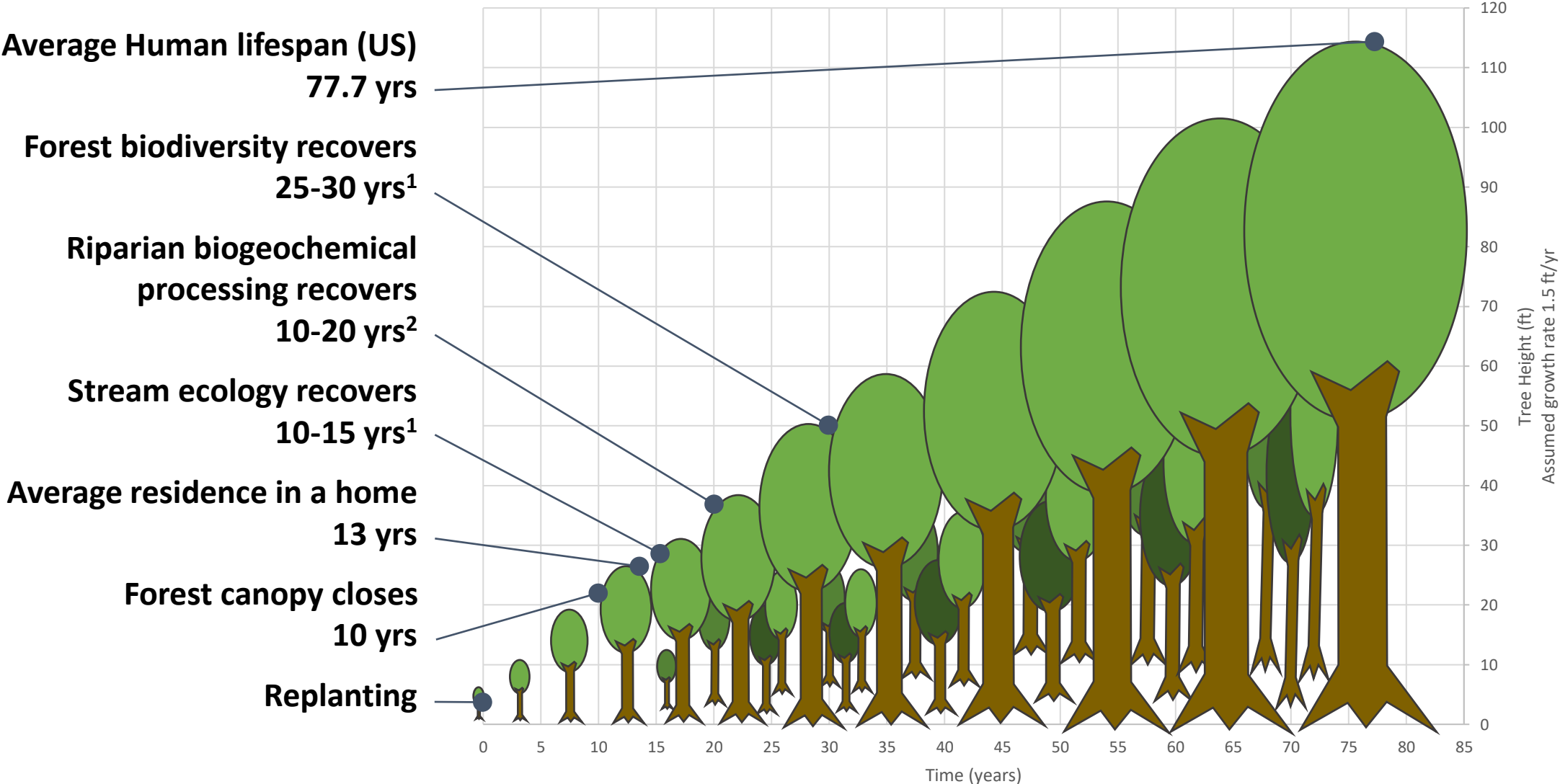| System	Functioning	Functioning at risk	Not functioning
Stream			✓
Forest		✓	

Recovery in context

Average Human lifespan (US)
77.7 yrs

Forest biodiversity recovers
25-30 yrs[1]

Riparian biogeochemical
processing recovers
10-20 yrs[2]

Stream ecology recovers
10-15 yrs[1]

Average residence in a home
13 yrs

Forest canopy closes
10 yrs
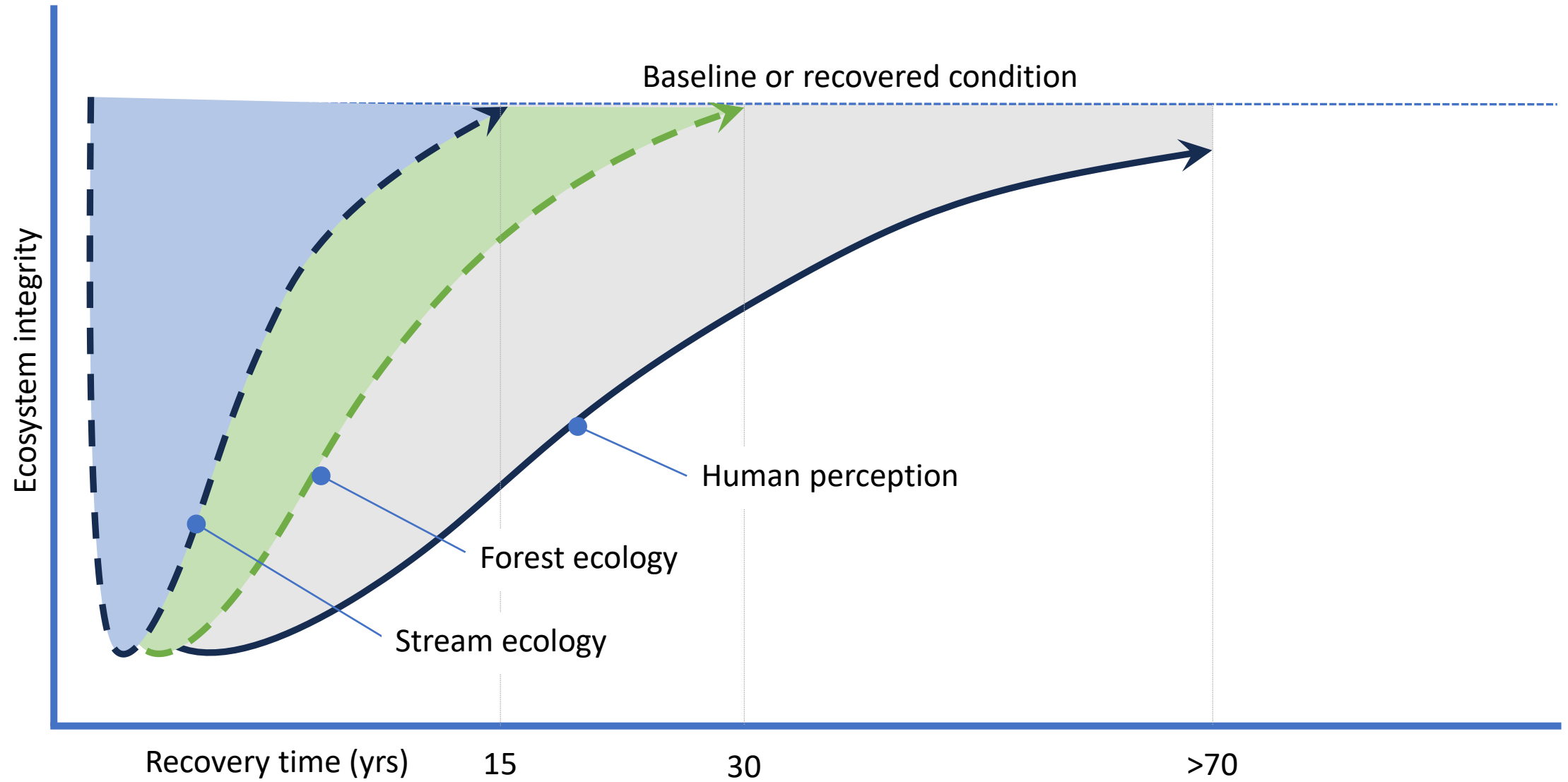
Replanting

Tree Height (ft)
Assumed growth rate 1.5 ft/yr

Time (years)
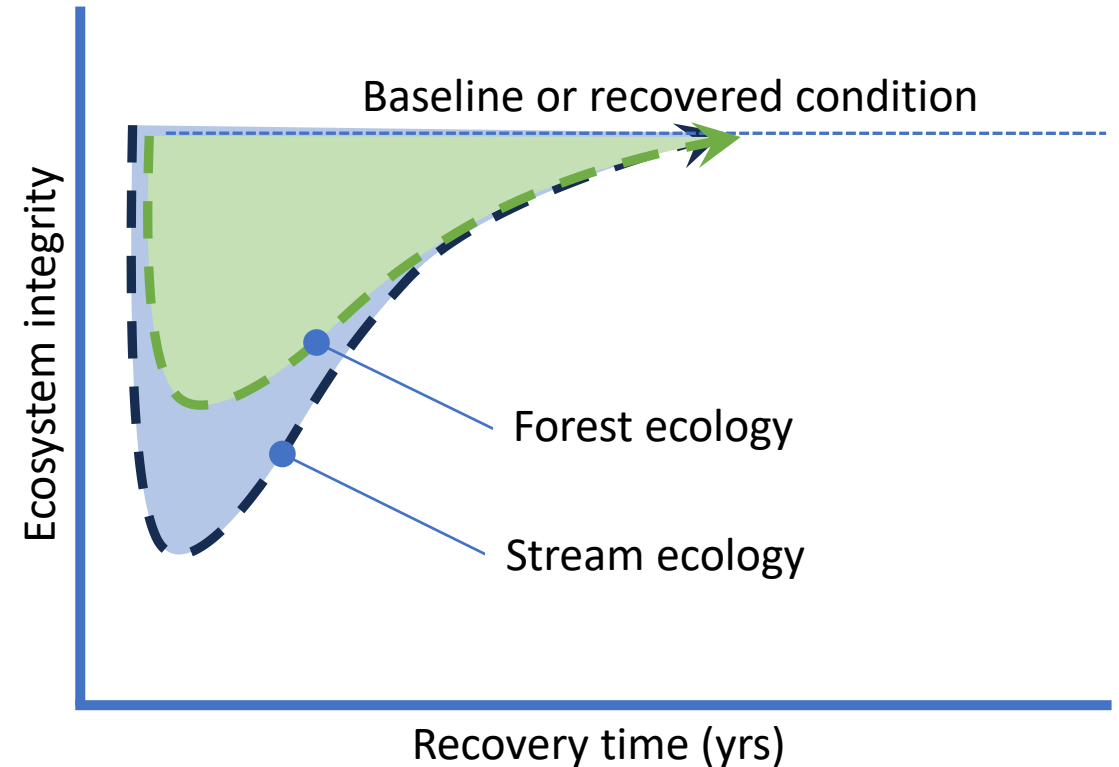
Note: Recovery times above are based on a limited literature review and are only intended for discussion purposes.

Recovery in context

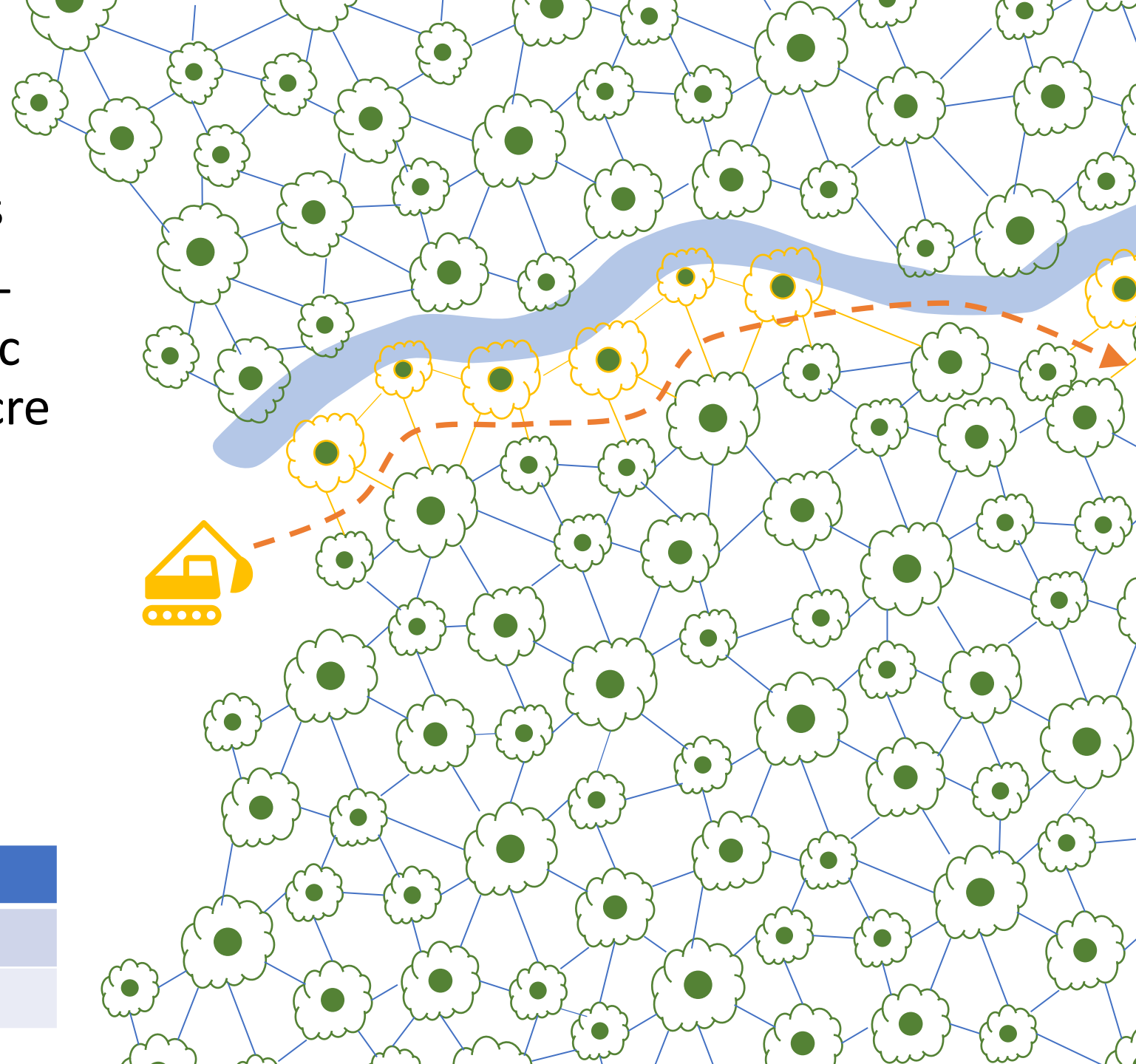Can we get better at using stream credit to pay down our forest debt?

Impact scenario 1:

- On alignment spot repairs

- Focus on pockets of small-scale disturbance to mimic natural process: +/- 0.1 acre patches

- Some trees can become isolated and stressed

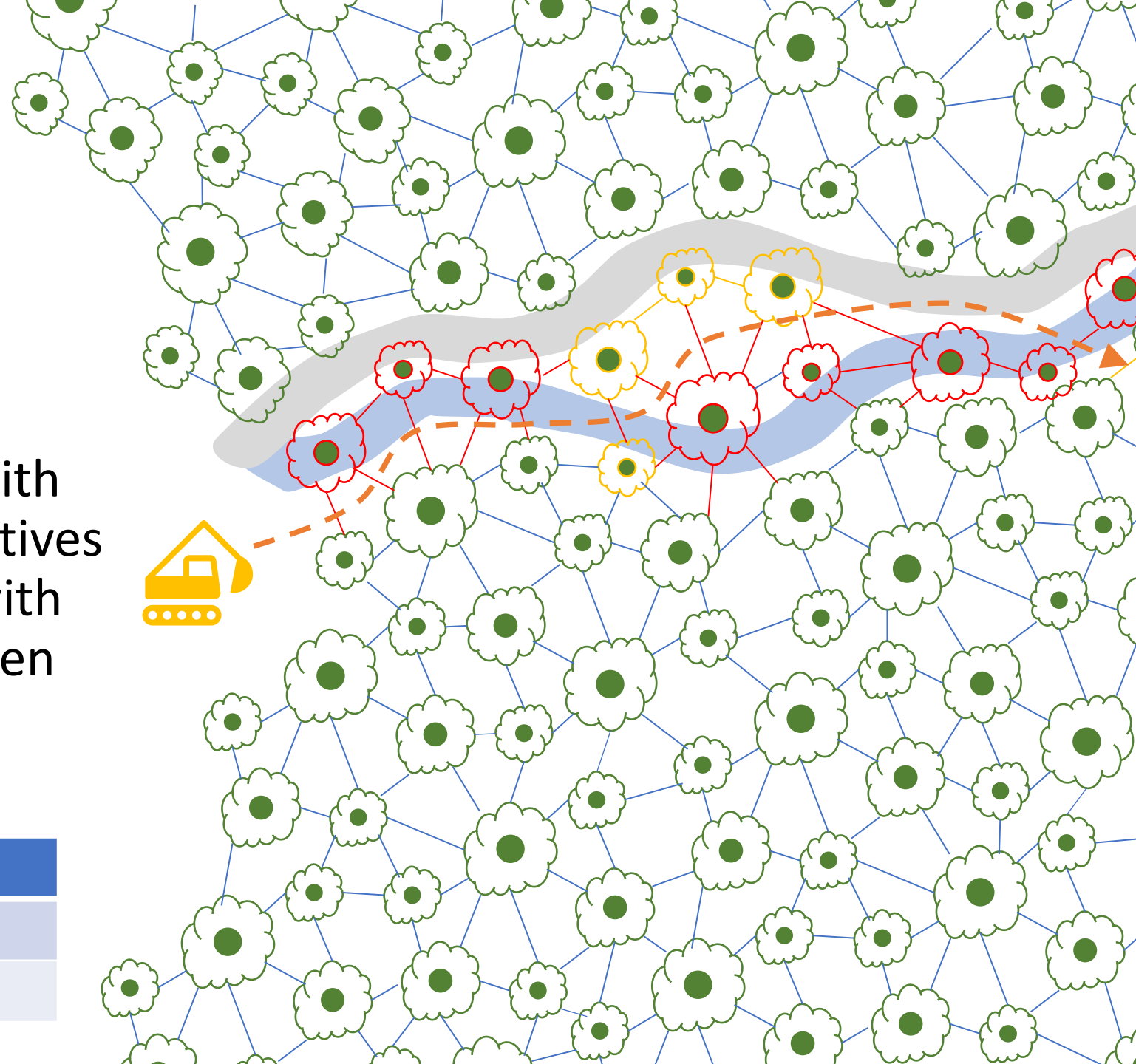- Lowest recovery debt

- Quickest recovery

System	Func.	FAR	NF
Stream		✓	✓
Forest	✓	✓	✓

Impact scenario 2:

- Realignments and minor floodplain grading

- Results in a corridor of disturbance (less natural)

- Coordinate disturbance with forest management objectives 0.1- to 0.5-acre pockets with narrower corridors between
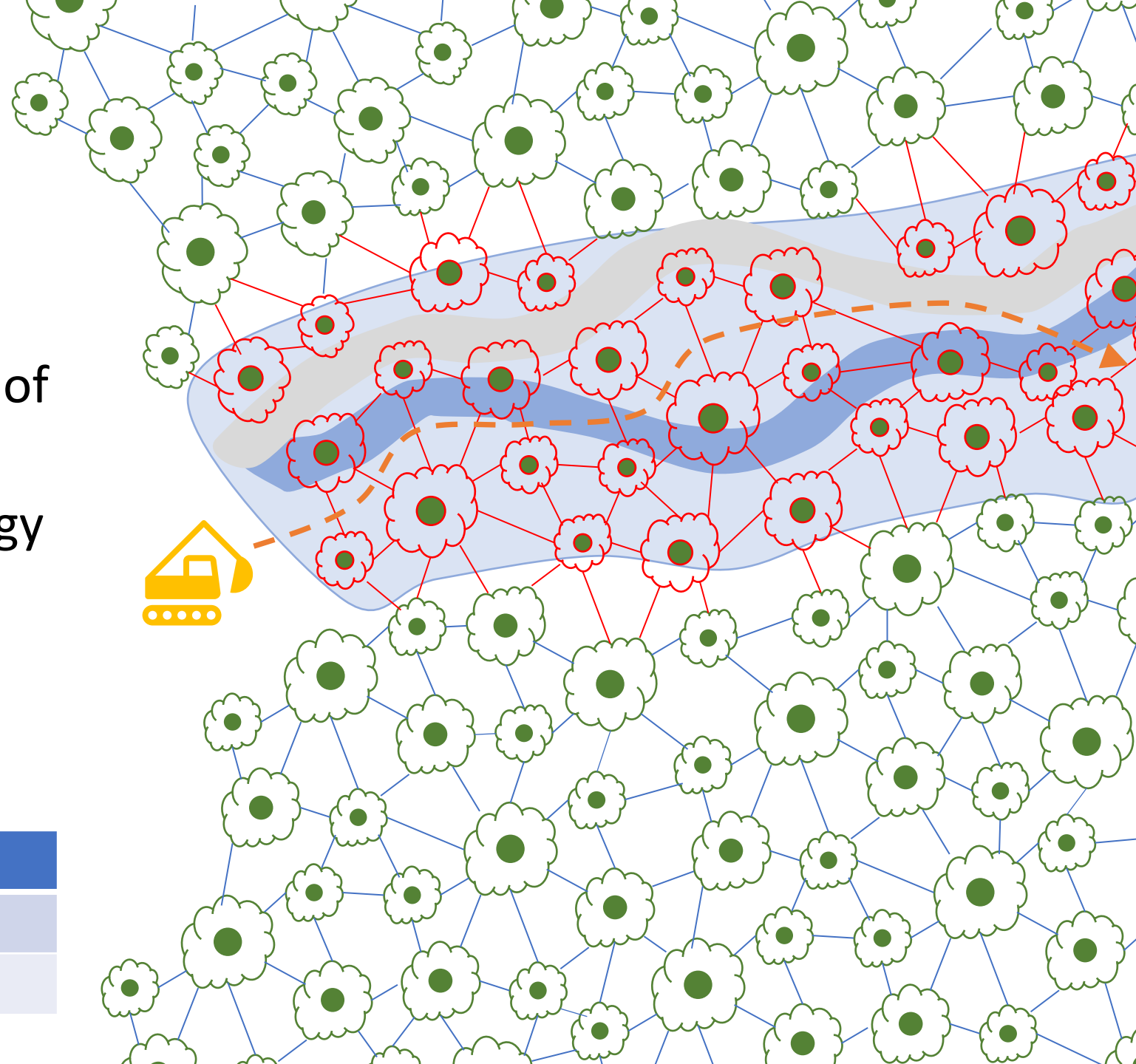
- Moderate recovery debt

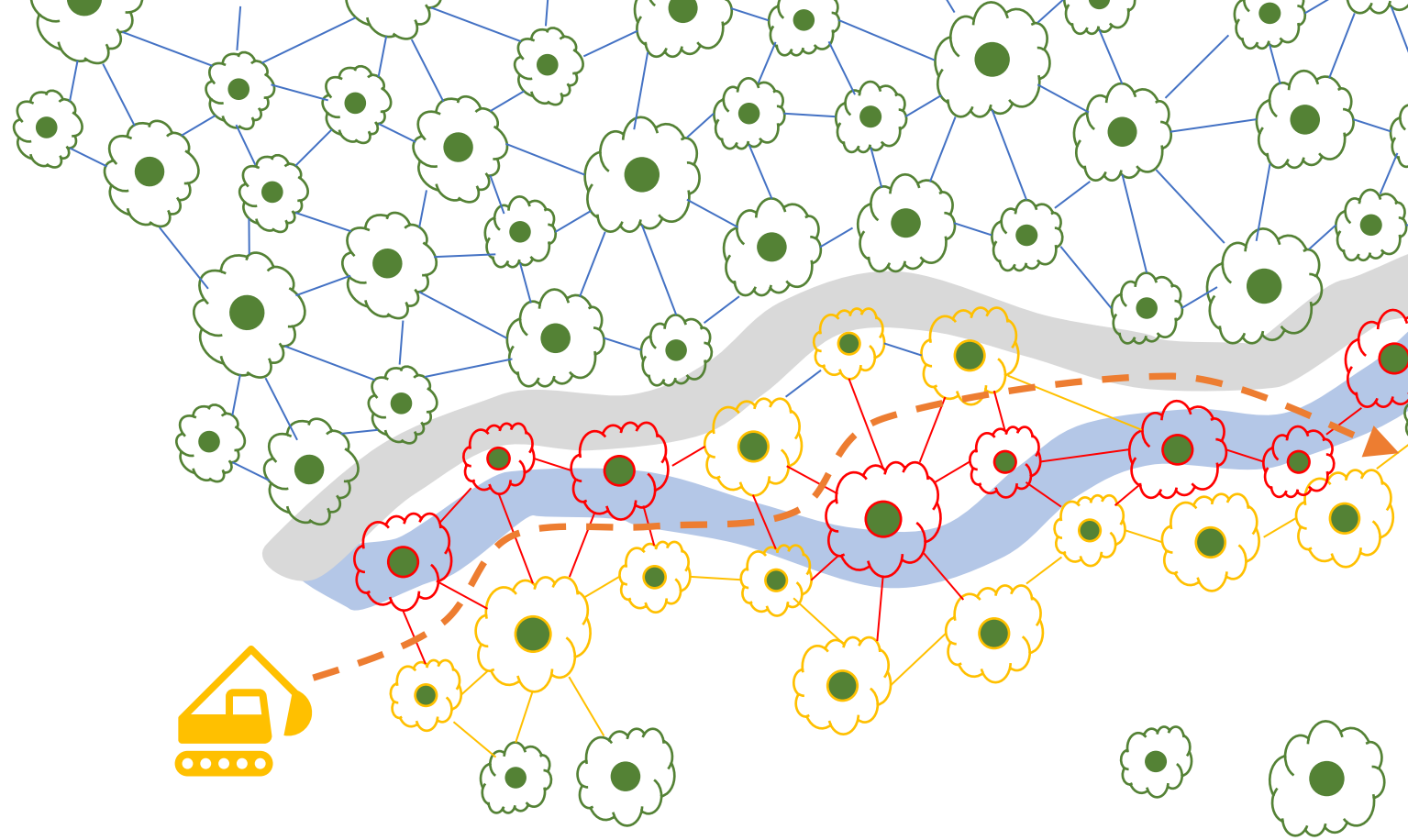| System	Func.	FAR	NF
Stream		✓	✓
Forest		✓	✓

Impact scenario 3:

- Major realignment and floodplain excavation

- Results in a wide corridor of disturbance (un-natural)

- Invest in replanting strategy to expedite recovery

- High recovery debt

| System	Func.	FAR	NF
Stream		✓	✓
Forest		✓	✓

Impact scenario 4:

- Activities on forest edge
- Can isolate pockets of trees and expand edge effect
- Focus on preserving core forest
- Moderate recovery debt

System	Func.	FAR	NF
Stream		✓	✓
Forest	✓	✓	✓

The bottom line

- Mind the project footprint
- Mimic scales of natural disturbance
- Landscape context matters
- Settle your debts

Scenario 1

Scenario 2

Scenario 3

Scenario 4
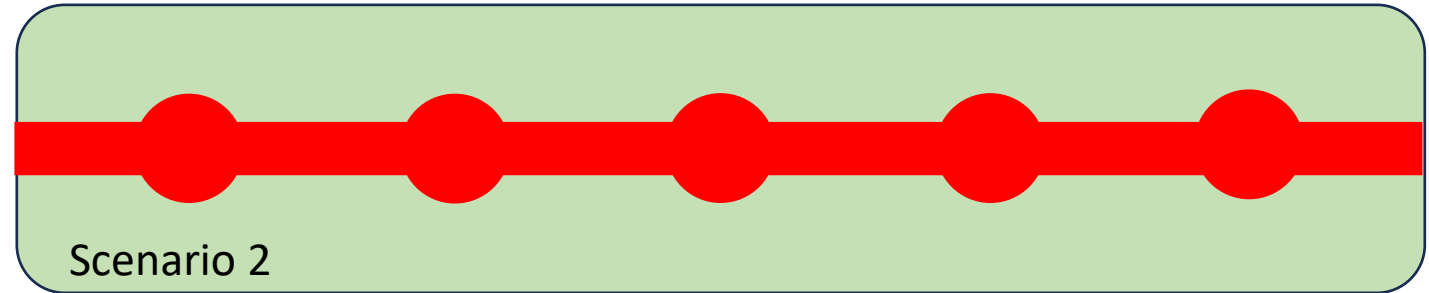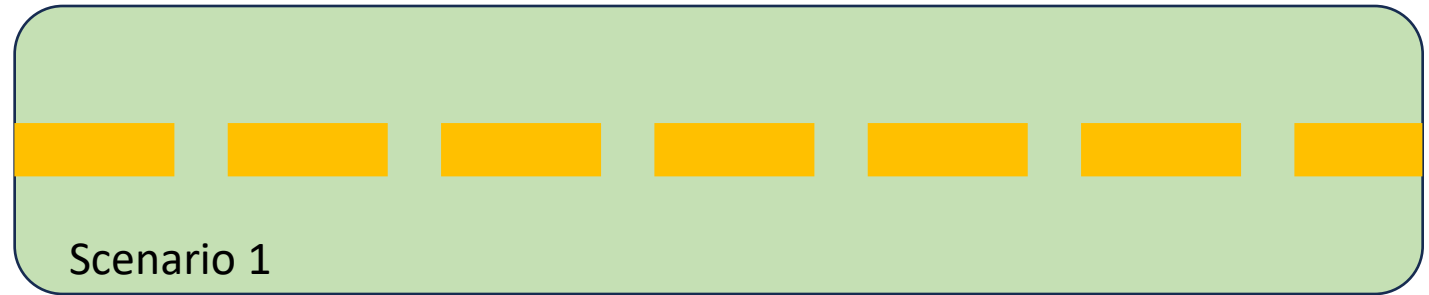
Questions?

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References

1. Moreno-Mateos, D. *et al*. Anthropogenic ecosystem disturbance and the recovery debt. *Nat. Commun*. **8**, 14163 doi: 10.1038/ncomms14163 (2017).

2. Wood, K. *et. al*. Tree Trade-Offs in Stream Restoration: Impacts on Riparian Groundwater Quality. *Urban Ecosyst*. 25(3): 773–795. doi:10.1007/s11252-021-01182-8 (2022).