Fairfax County Ecological Recovery Wheel

A holistic assessment of stream restoration

Department of Public Works and Environmental Services
Working for You!

A Fairfax County, VA, publication
July 20, 2021

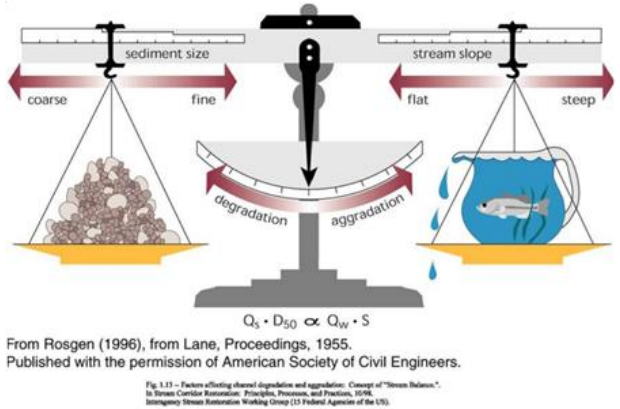
The Problem

"A stream which is level with surrounding ground looks better to people, but we should be looking at the park in **consideration** of the plants and wildlife which currently live there. How does a deeply cut stream rise to ground level? Is soil brought in from other areas? Is large equipment used? Such processes will damage, if not **destroy**, soil organisms, plants and animals in the area being restored. A stream at ground level will need more surrounding land for a flood plain during heavy rains, which are becoming more common with **climate change**. Not all erosion needs to be corrected; the Grand Canyon is an example.

…

A restored stream does not descend from the sky. A wide swath of land will be **damaged** during restoration, especially if heavy equipment is used. "

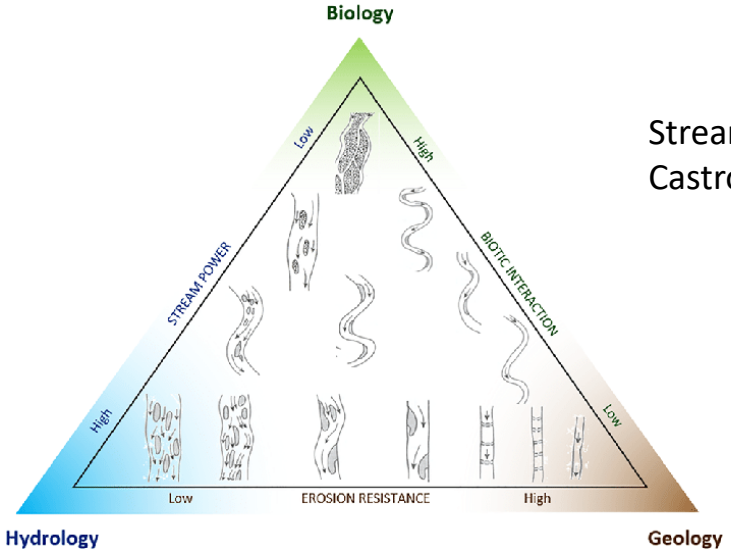
Stream restoration paradigms



From Rosgen (1996), from Lane, Proceedings, 1955.
Published with the permission of American Society of Civil Engineers.

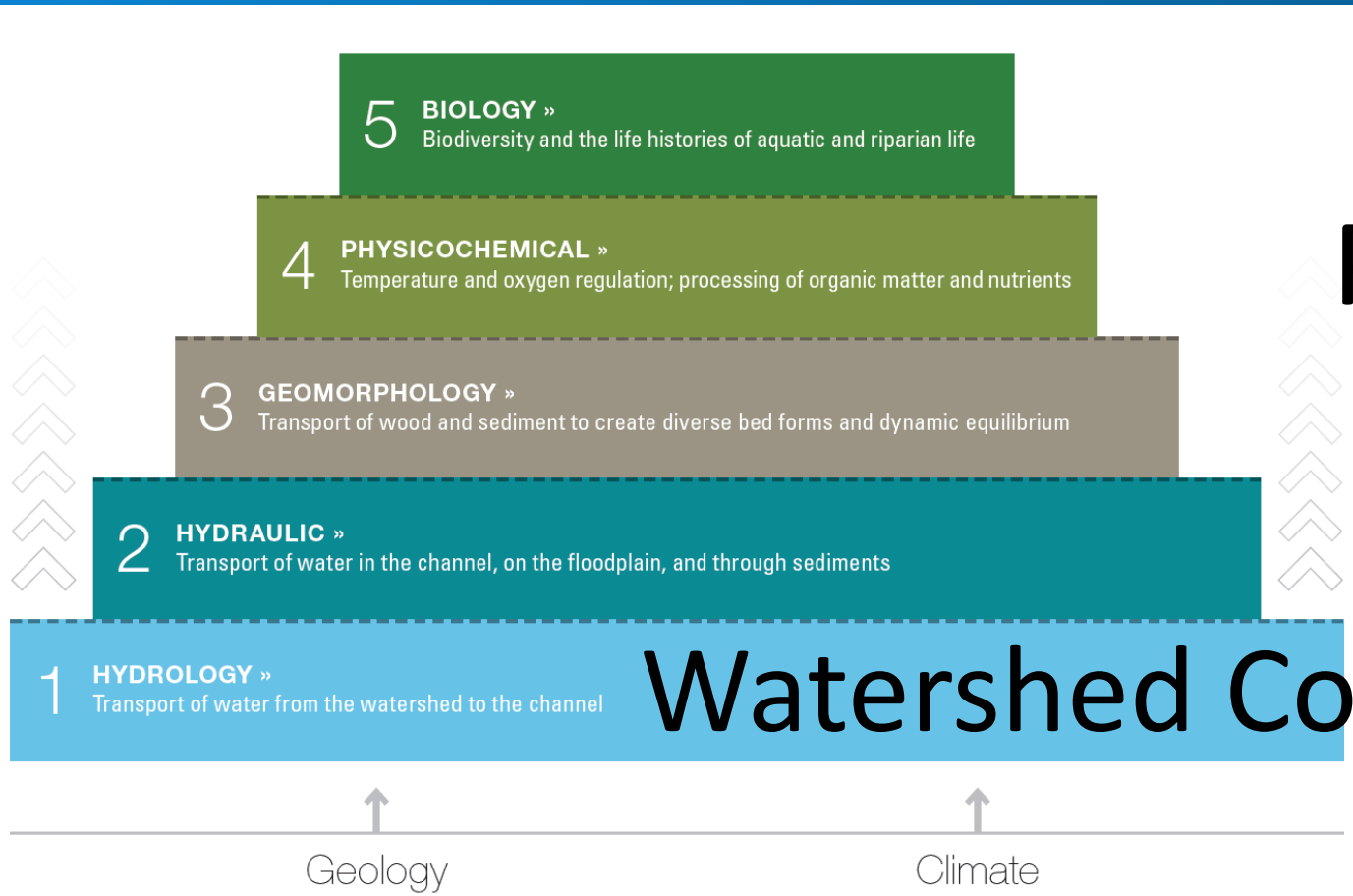
Lane's Balance diagram,
EW Lane 1955

Stream Function Pyramid,
Will Harmon 2012



Stream Evolution Triangle,
Castro & Thorne 2019

The Pyramid



Plants?

Watershed Condition

Socio-Cultural Values

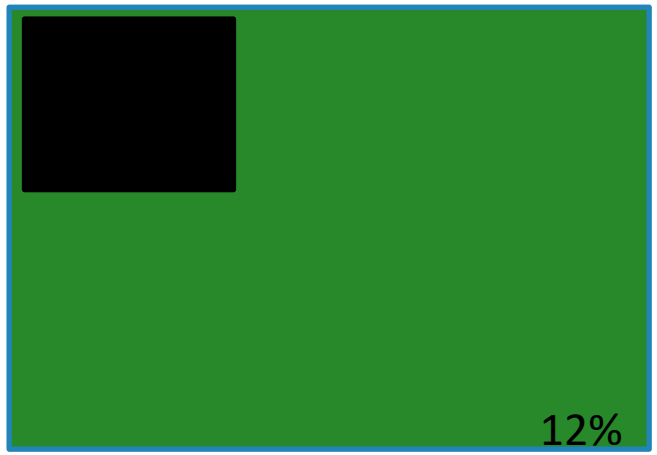
What does holistic mean?

- More than stream verification
- What types of functions does a stream restoration project effect?
  - Aquatic Structure
  - Species Composition
  - Riparian Structure
  - Physical Conditions
  - Physiochemical
  - External Exchanges (the people)

Impervious surface and benthic score – Aspects are outside our power

Benthic Score:
Good/Excellent

Median lot size 9,000 SF (2018), house footprint would be 720 SF



Benthic Score:
Fair/Good

House footprint would be 1,080 SF at 12% impervious

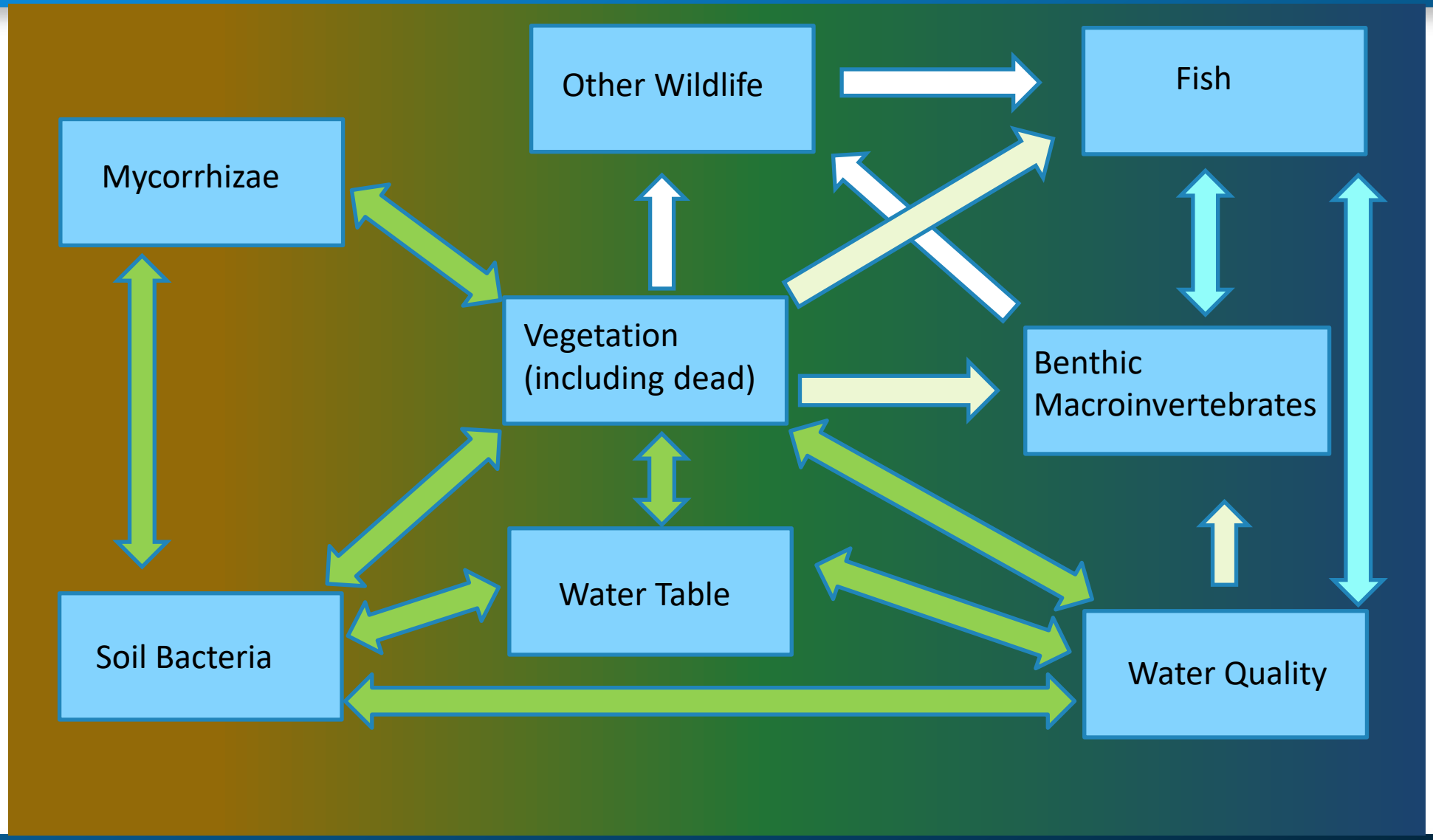
Benthic Score:
Very Poor/Poor

49% impervious surface in older, most, developed watersheds

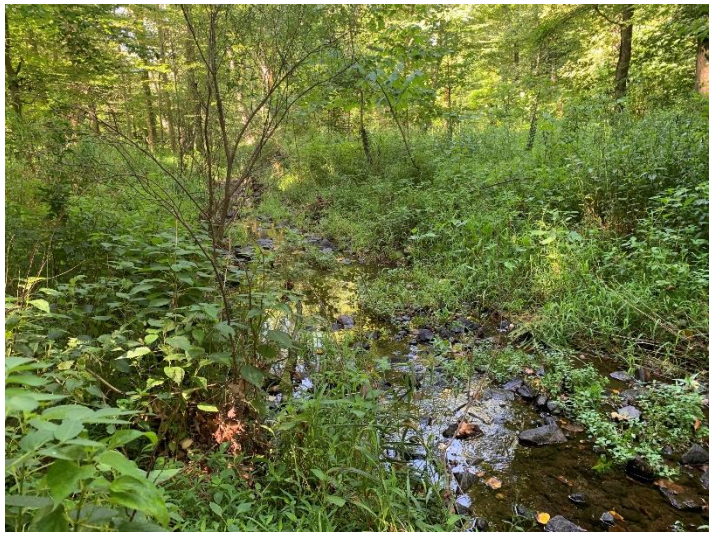
Benthic Score:
??

No additional development & an expected average rainfall increase of 22-27% over the next 100 years

Ecology of the riparian corridor/Immediate impacts of restoration practice



Three sites: Which one (or more) is functional? Site 1



The need for a communication tool

	Nice to Have	Should Have	Must Have
Simple			X
Visual			X
Adaptable		X	
Science-based/Defensible/Replicable		X	
Holistic/Engineering, Ecology, & Social		X	
Provides more understanding with a deeper dive	X		
Reflects changing priorities from starting point = move beyond stability, improve ecology, do no harm, affect change		X	
Our boss likes it	X	X	X

SER – Ecosystem Recovery Wheel

- [International Standards for the Practice of Ecological Restoration - Society for Ecological Restoration (ser.org)]

PRINCIPLE 6

SEEKS THE HIGHEST LEVEL OF ECOSYSTEM RECOVERY POSSIBLE

Ecological restoration aims for the highest practicable level of recovery appropriate to the circumstances.

Baseline *10 years later*

The **Ecological Recovery Wheel** *is part of the Standards' five-star system for designing and implementing restoration, and for assessing progress as compared to a reference model. See Principle 6.*

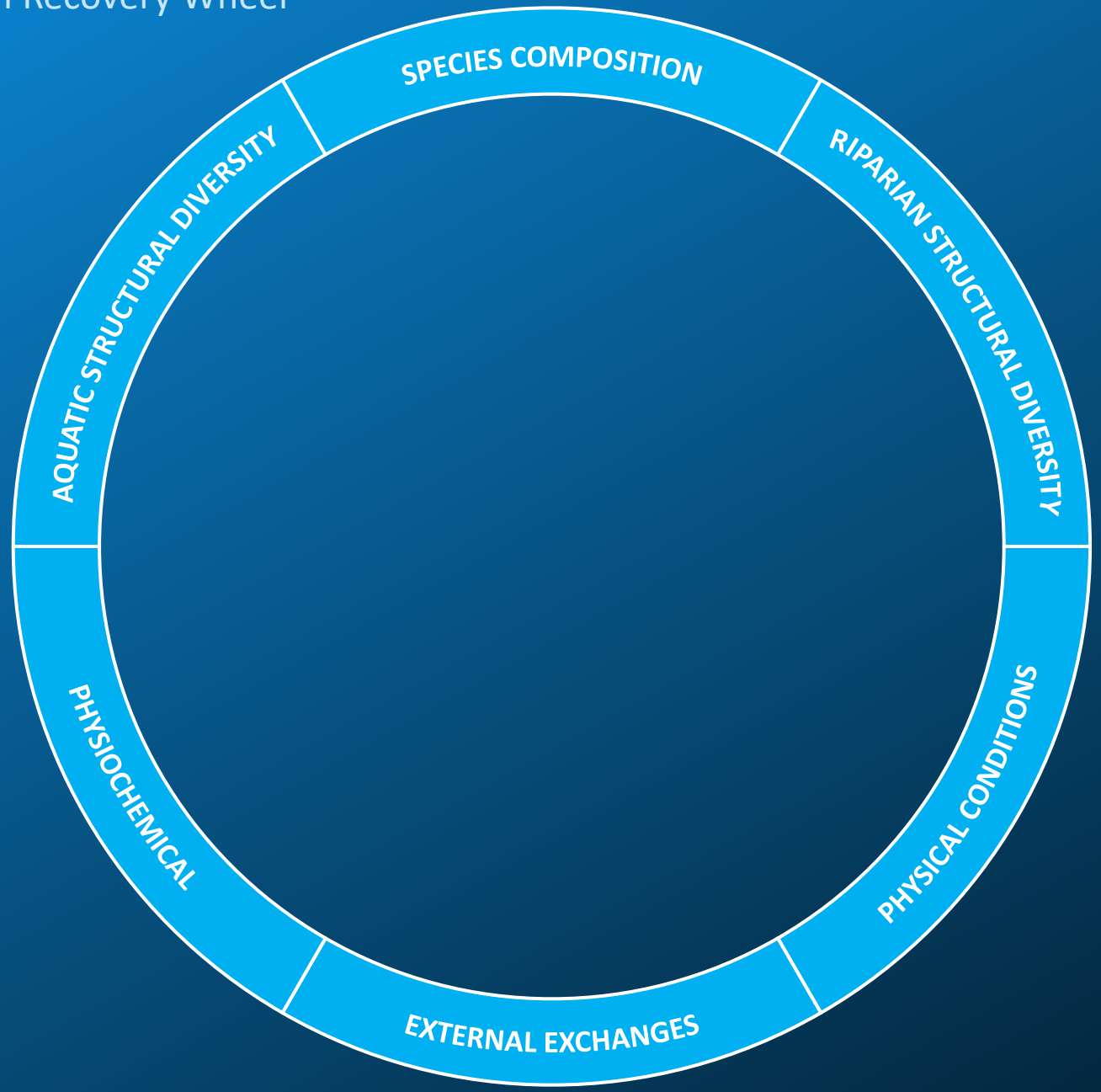
Developing the Fairfax Wheel

Values -> Metrics -> Targets -> Populate

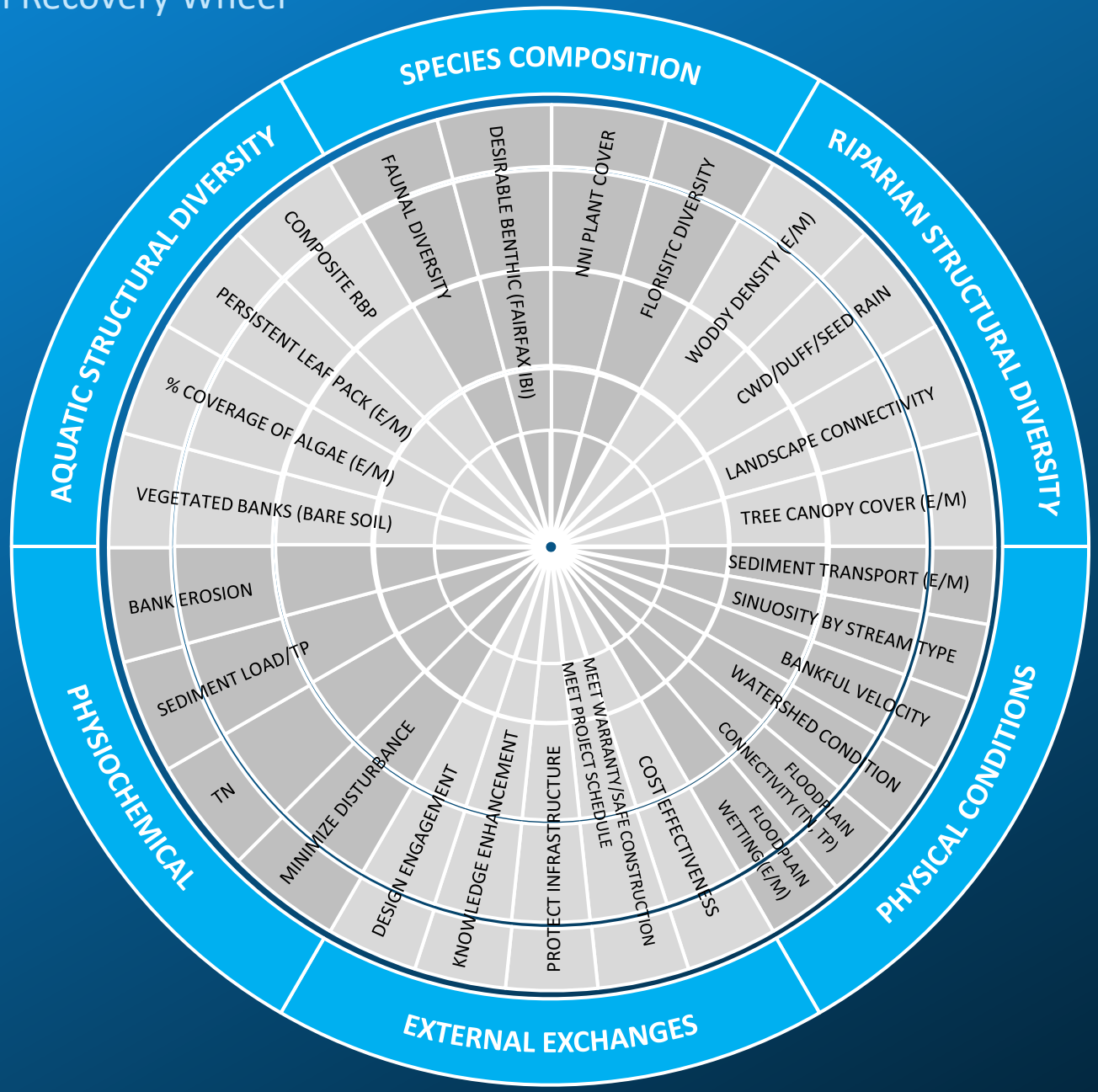
Fairfax Restoration Recovery Wheel

Aquatic Structural Diversity
Species Composition
Riparian Structural Diversity
Physical Conditions
Physiochemical
External Exchanges

Fairfax Restoration Recovery Wheel

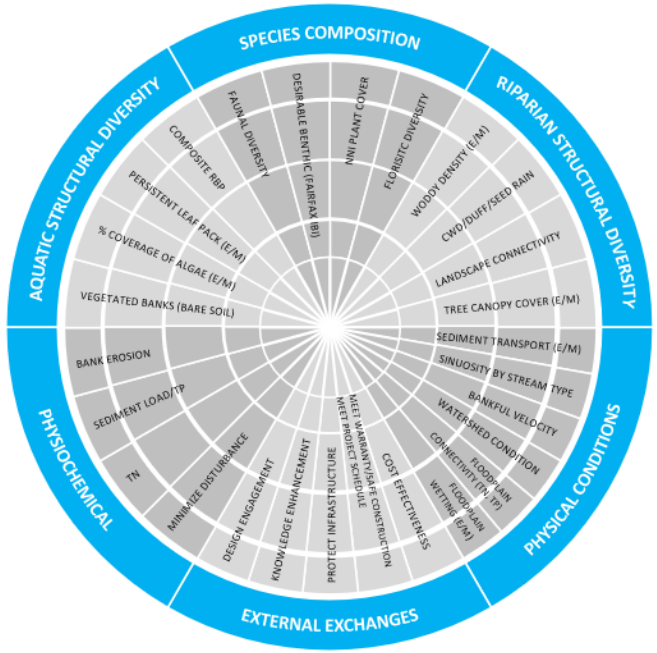


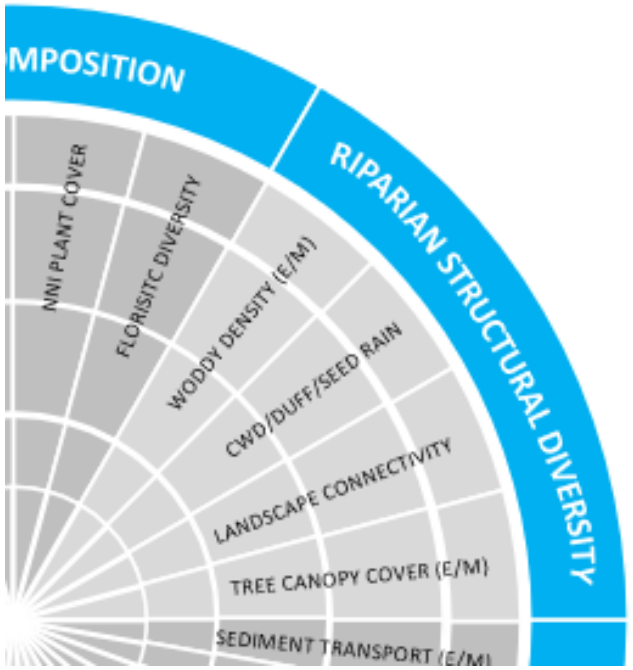
Fairfax Restoration Recovery Wheel



Note: E: estimated | M: measured

Ecological Recovery Wheel for Fairfax Riparian Systems





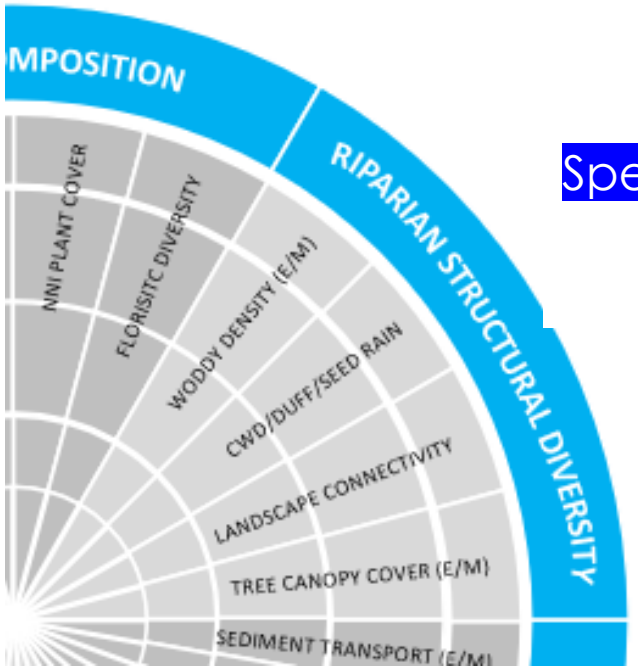
Species Composition

- NNI Plant Cover
- Floristic Diversity

Riparian Structural Diversity

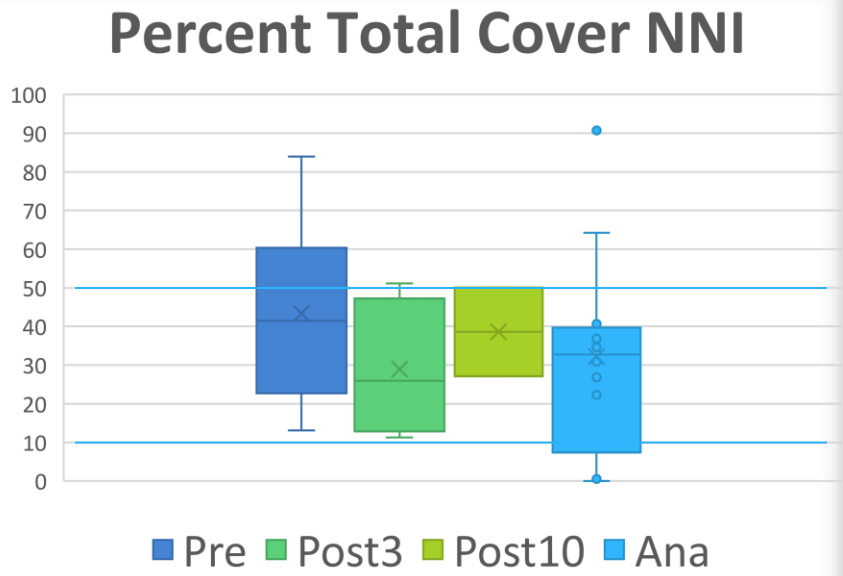
- Woody Stem Density
- Forest Floor (Duff, Woody Debris)
- Landscape Connectivity
- Tree Canopy Cover

Ecological Recovery Wheel for Fairfax Riparian Systems



NNI Plant Cover

1 - NNI (total) >50%
2 - NNI (total)>35%
3 - NNI (total)>30%
4 - NNI (total)>10%
5 - NNI<10%, HNNI=0%



Species Composition

NNI Plant Cover
Floristic Diversity

Bench marked with values and targets from the literature, Best Professional Judgment, and data

Metric targets should be scaled for each metric/level of monitoring effort

- Absolute
- Relative
- % of Reference/Analog
- others

A primer on choosing goals and indicators to evaluate ecological restoration success

Karel Prach ✉, Giselda Durigan, Siobhan Fennessy, Gerhard E. Overbeck, José Marcelo Torezan, Stephen D. Murphy

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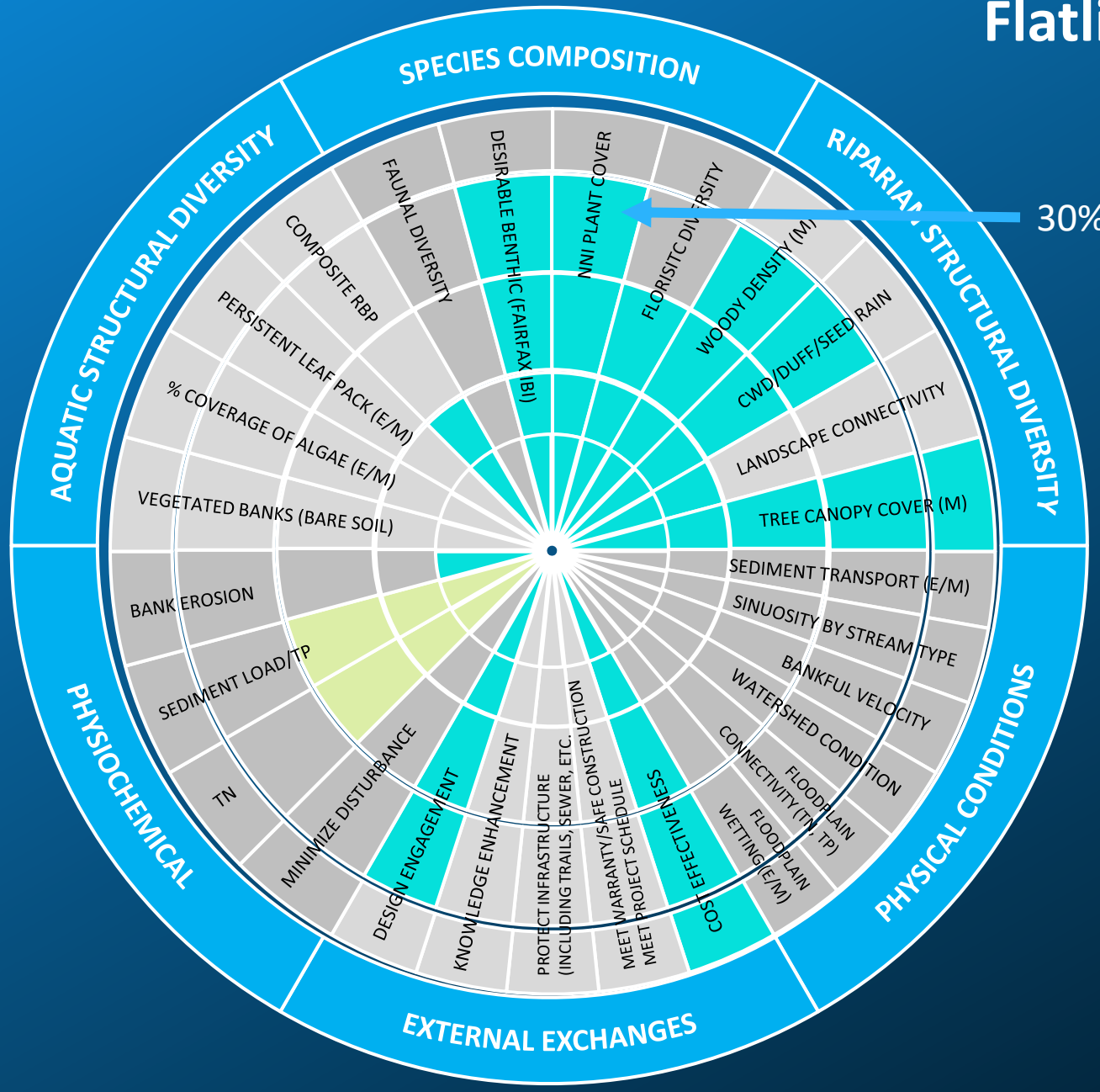
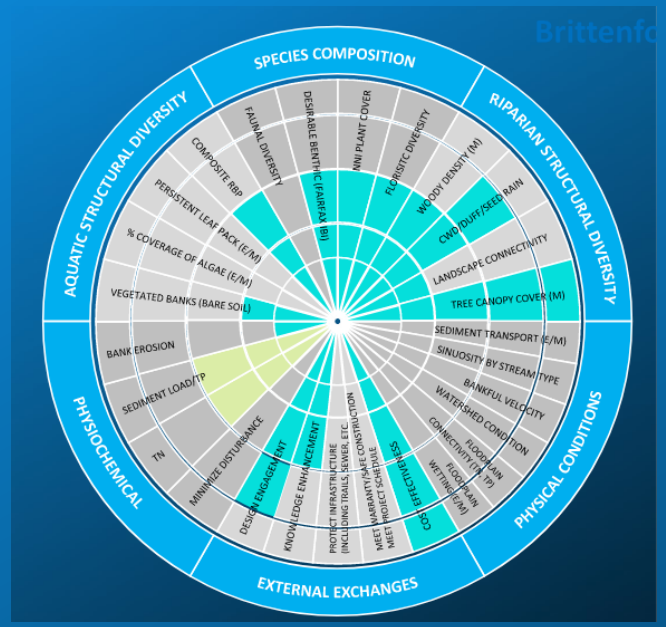
Author contributions: KP wrote the first version of the manuscript; then all authors wrote the manuscript interactively with more or less equal participation.
Coordinating Editor: Valter Amaral

Flatlick 2 (pre)



30%>21.76%>10%

Note: E: estimated | M: measured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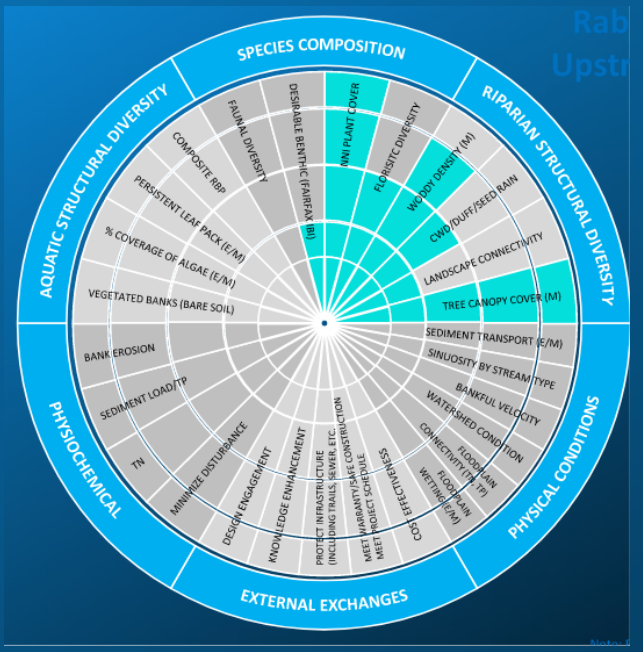
COMPOSITE RBP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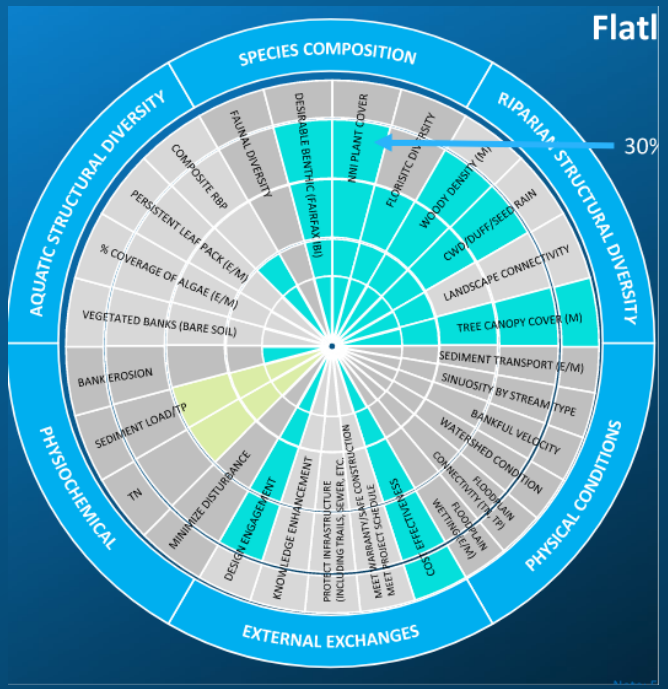
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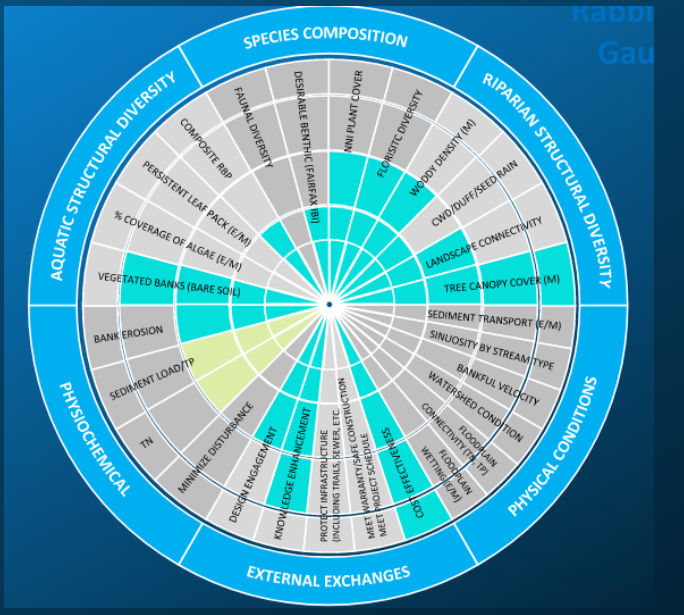
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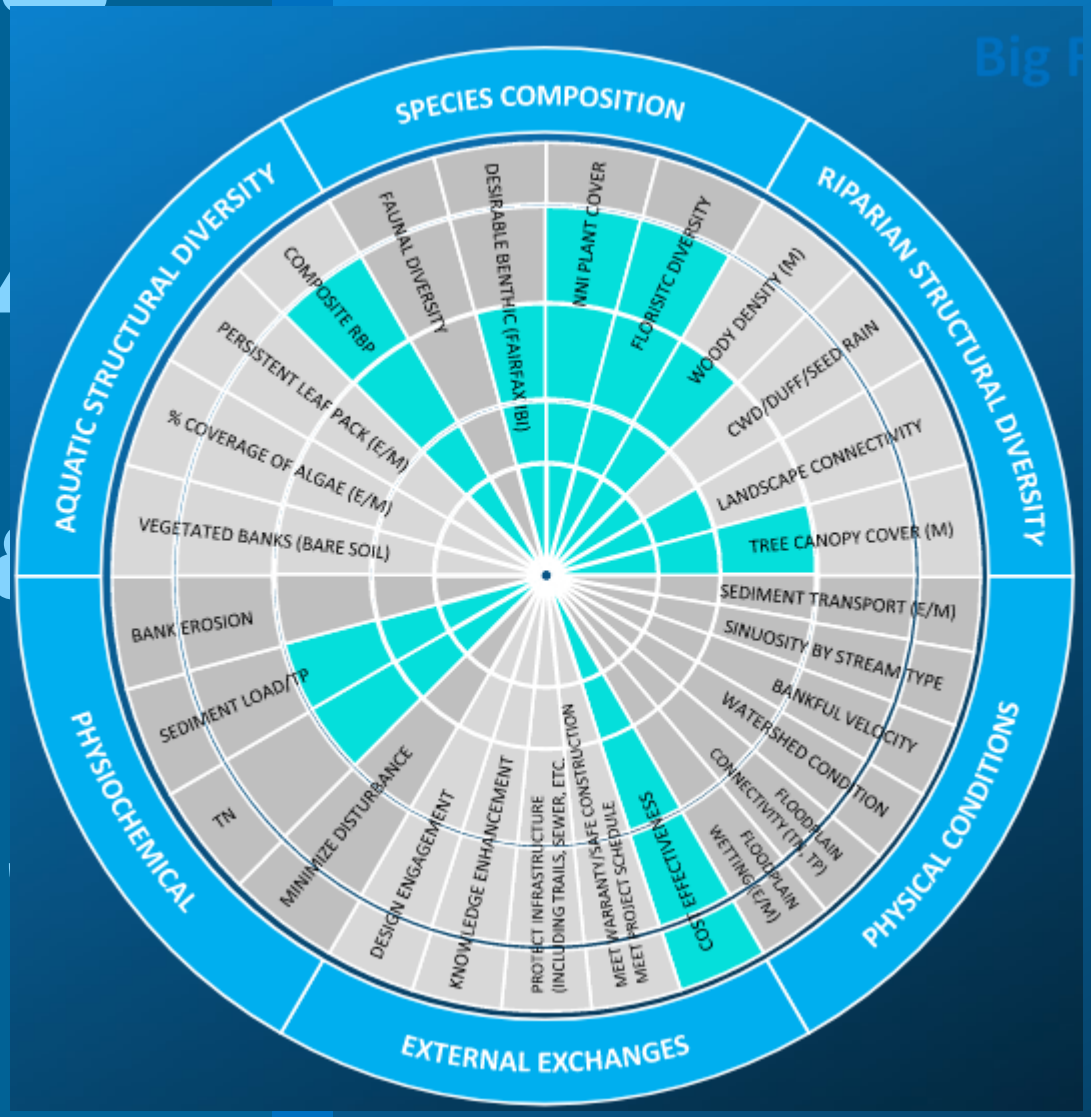
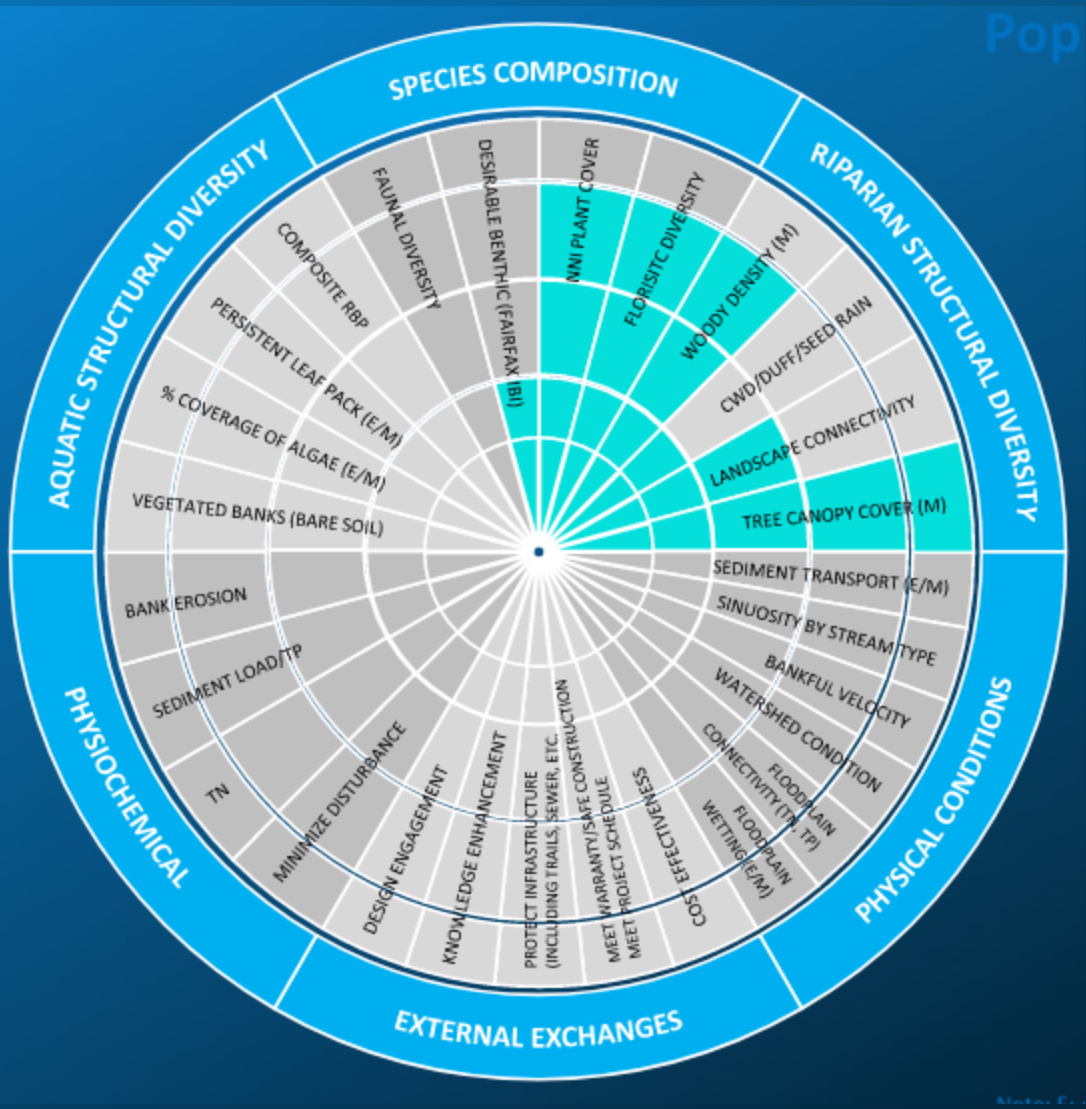
Post 3



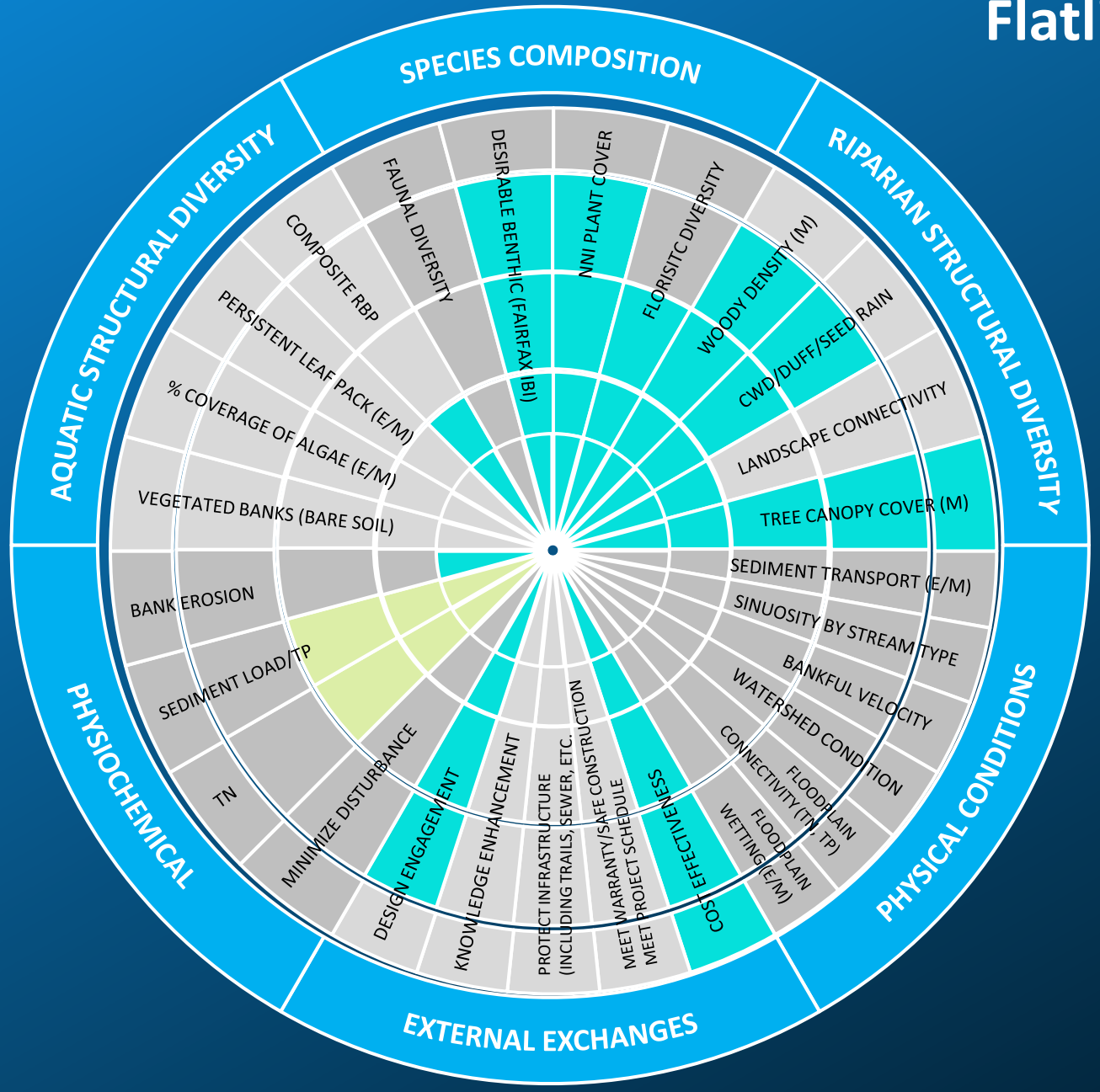
Post 10



Pre-existing condition

Post condition

Flatlick 2 (pre)



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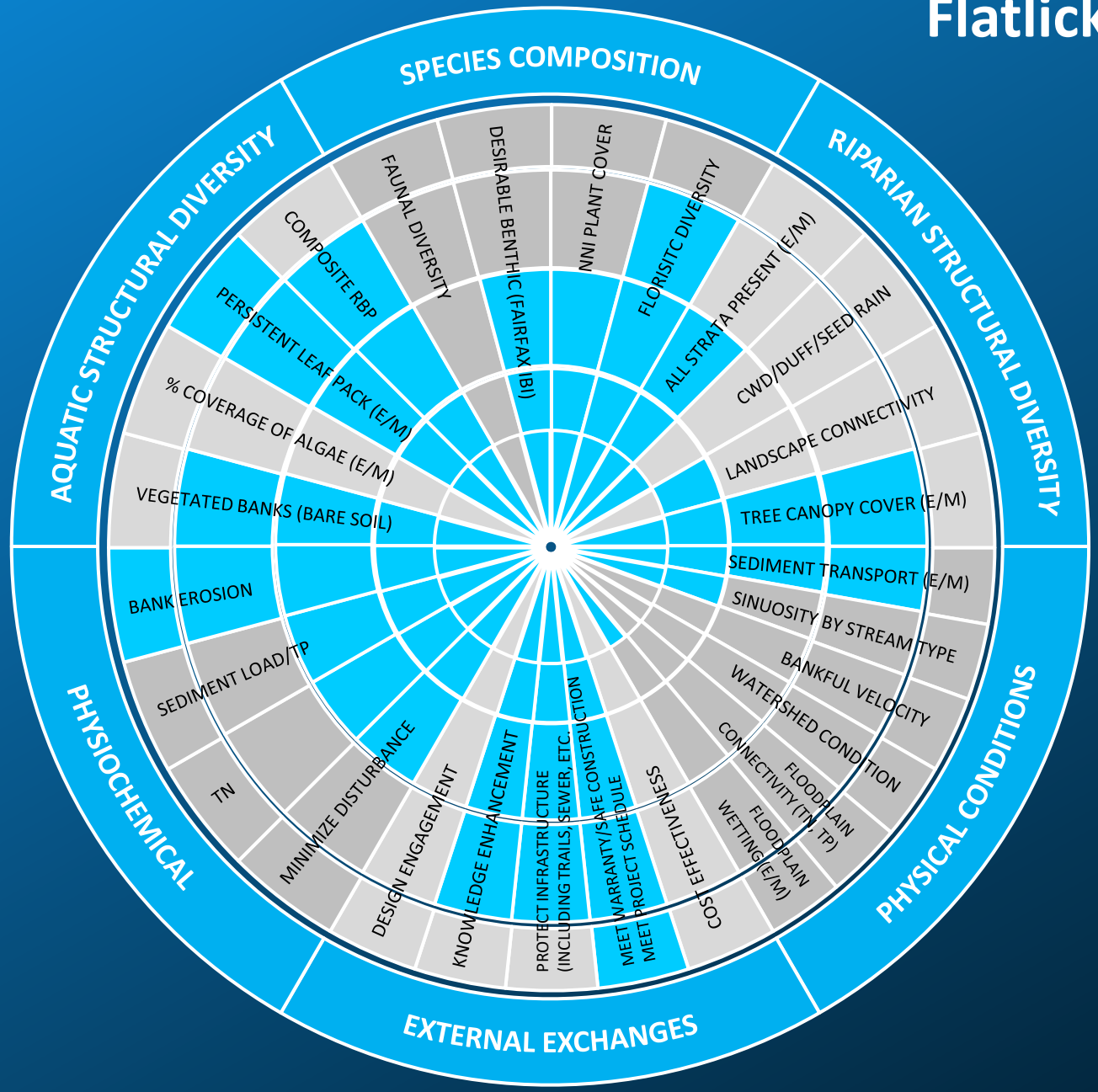

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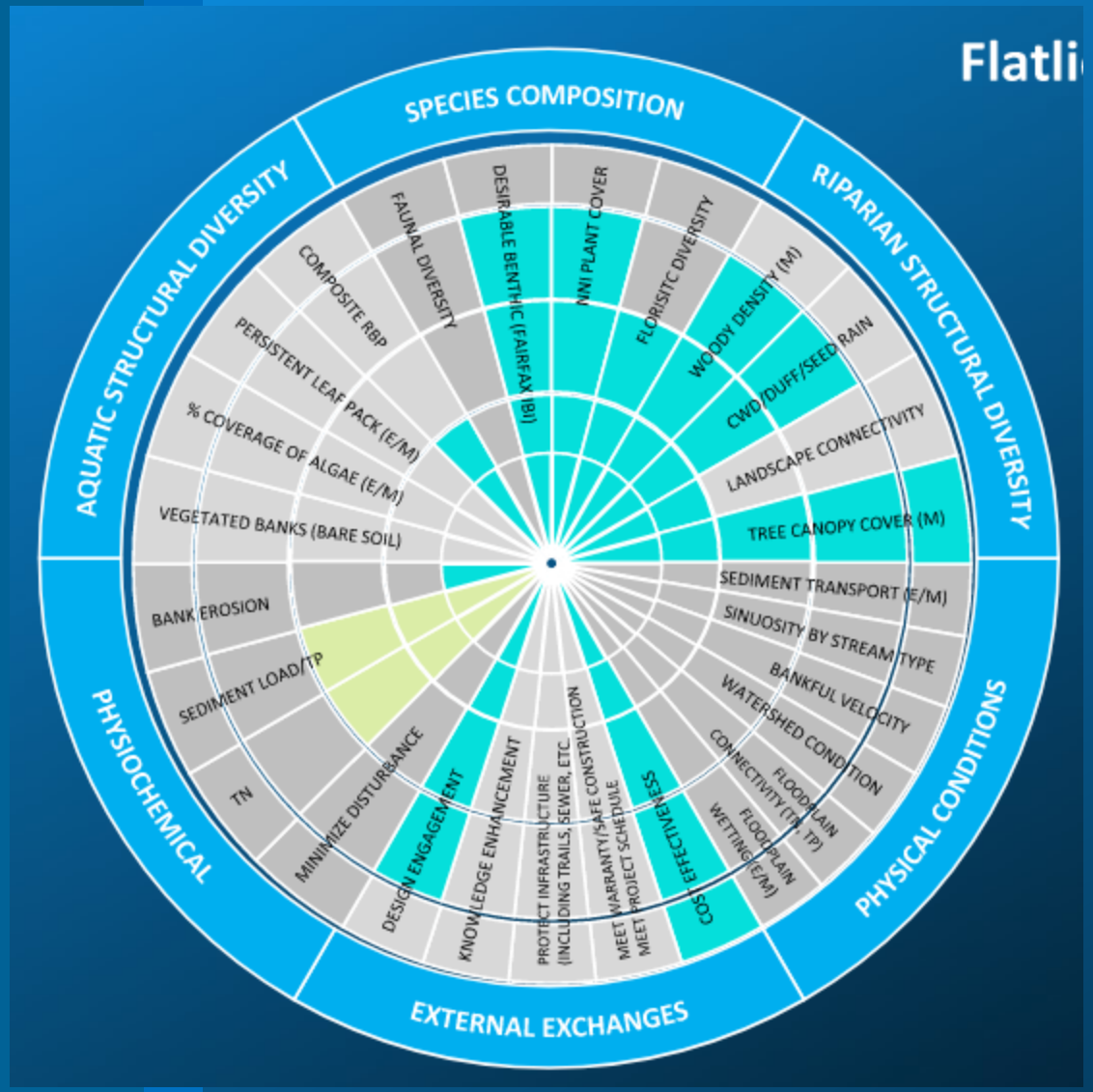
Pre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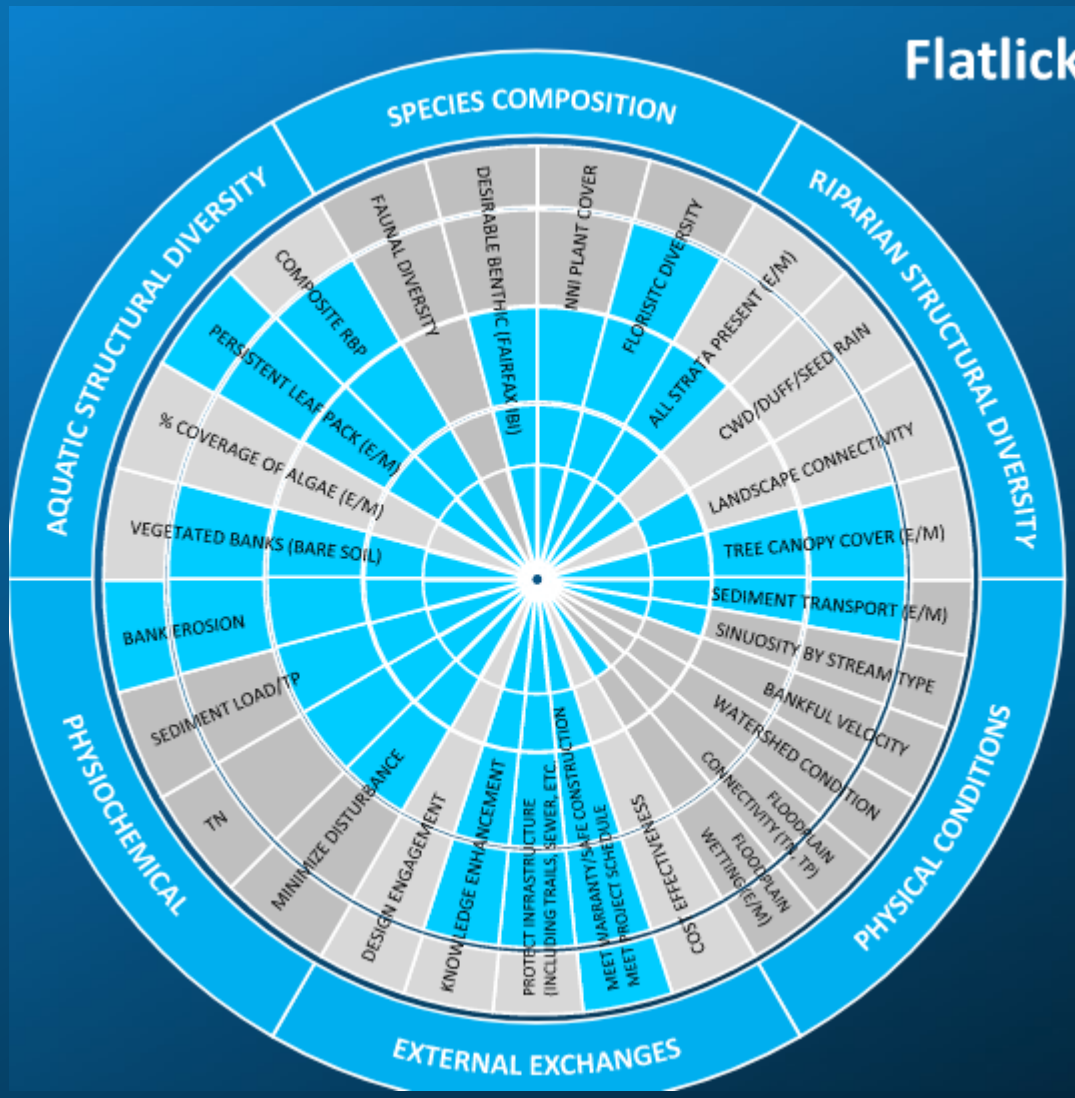
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The Metrics

		1	2	3	4	5
Physical Conditions						
	Sediment Transport (E/M)	visible signs of significant agradation or degradation	visible signs of aggradation or degradation	conveyance - unhealthy	efficient conveyance - healthy	
		very poor	ppoor	fair	good	excellent
	Sinuosity by stream type	straight channels, major reductions =<0.8	misses the target >0.8 to = 1.1	replicates pre-restoration condition, minimum 1.1	adds 0.1 to pre-restoration condition or exceeds 1.2	adds 0.2 to pre-restoration condition or exceeds 1.3
	Floodplain Connectivity (TN, TP)	>1.63	>1.45 to =<1.63	<1.45 to >1.1	>0.95 to =<1.1	=< 0.95
	Floodplain wetting (E/M)	less after restoration	no change pre/post	<50% more of available area to be connected	50-75% more of area available to be connected	> 75% of available area to be connected
Physiochemical						
	Bank Erosion	<5	6-9	10-13	14-17	>18
	Sediment Load /TP	more after restoration	no change pre/post	50% reduction	80% reduction	a lot of tonnage for the size of the stream
	TN	more after restoration	no change pre/post	50% reduction	80% reduction	a lot of tonnage for the size of the stream
	Minimize Disturbance			follow BMP's	SPR or other effort	Restoration minimizes land disturbance, removes <25% of 12" dbh trees 200 feet from the stream edge.

The Metrics

		1	2	3	4	5
External Exchanges						
	Design Engagement	Stakeholders identified and made aware of project and its rationale. Ongoing communication strategy prepared.	Key stakeholders supportive and involved in project planning phase. Discussion for post-restoration begun.	Number of stakeholders, support, and involvement increasing through to design completion. Plan in place for post-construction involvement (e.g. remove encroachments, monitoring or maintenance).	Number of stakeholders, support, and involvement post-construction.	Number of stakeholders, support and involvement optimal and self-managed post-construction.
	Knowledge Enrichment	Relevant sources of existing knowledge identified and mechanisms for generating new knowledge selected	Relevant sources of existing knowledge (and potential for new knowledge) informing project planning and monitoring design.	Implementation phase making use of relevant knowledge, stakeholder feedback, and early project results.	Implementation enriched by relevant knowledge as well as field corrections as needed. Project well documented.	Implementation enriched by relevant knowledge and results from the project disseminated widely.
	Protect Infrastructure (including trails, sewer, etc.)	Does not protect infrastructure	Hard protection, without ecological potential	Hard protection with ecological protection or no further ecological degradation.	Soft protection, e.g. riffles over wastewater lines.	Soft protection with ecological potential.
	Project Logistics	Any safety violations not minor	Safety incidents minor, no injury	Met Structure Warranty/Safe Construction	Met Structure Warranty/Safe Construction/Project Schedule	Meet Warranty/Safe Construction/Meet Project Schedule

The Metrics

		1	2	3	4	5
Riparian Structural Diversity						
	Tree Canopy Cover (E/M)	<40%	40-60%	60-80%	80-90%	90-100%
	Woody Density (E/M)	<440 woody stems per acre	>440 woody stems per acre	up to 2200 shrub & 3400 tree - any size	600 -1200 shrub > 1/2" caliper /200 tree > 2" dbh	over 1200 shrub > 1/2" crown /200 tree > 2" dbh
		herb	tree	herb/shrub	shrub/tree; herb/tree	all three
	Forest floor	metrics at or below pre- condition	metrics at 75% of reference	metrics at 90% of reference	metrics at or near reference condition	metrics exceed reference condition
	Landscape Connectivity	1	2	3	4	5
Aquatic Structural Diversity						
	Composite RBP	very poor	poor	fair	good	excellent
		very poor	poor	fair	good	excellent
	% coverage of algae (E/M)	very poor	poor	fair	good	excellent
		>50% coverage	40-50%	30-40%	20-30%	<20%
	Persistent leaf pack (E/M)	<10% or greater than 80%	10-20% or 70-80%	20-30% or 60-70%	30-40% or 50-60%	50%
	Vegetated Banks (bare soil)	>20% bare soil on restored segments	no more than 20% bare soil, 80% is bank armoring, NNI, just roots no greenery	no more than 20% bare soil, 50% is bank armoring, just roots no greenery, adding in canopy tree roots	no more than 20% bare soil, tree roots, fine roots and <30% native woody veg	>30% woody, majority native; no more than 20% bare soil
Species Composition						
	Desirable benthic (Fairfax IBI)	very poor	poor	fair	good	excellent
	Faunal Diversity					
	Floristic Diversity	FQI < 11	FQI 11-18.9	FQI 19-21.9	FQI 22-24.9	FQI>25
	NNI Plant Cover	NNI (total) >50%	NNI (total)>35%	NNI (total)>30%	NNI (total)>10%	NNI<10%, HNNI=0%

The Problem has created the Solution

"A stream which is level with surrounding ground looks better to people, but we should be looking at the park in **consideration** of the plants and wildlife which currently live there. How does a deeply cut stream rise to ground level? Is soil brought in from c processes will damage, if not **destroy**, soil organisms, plants and anir round level will need more surrounding land for a flood pla ore common with **climate change**. Not all erosion needs mple.

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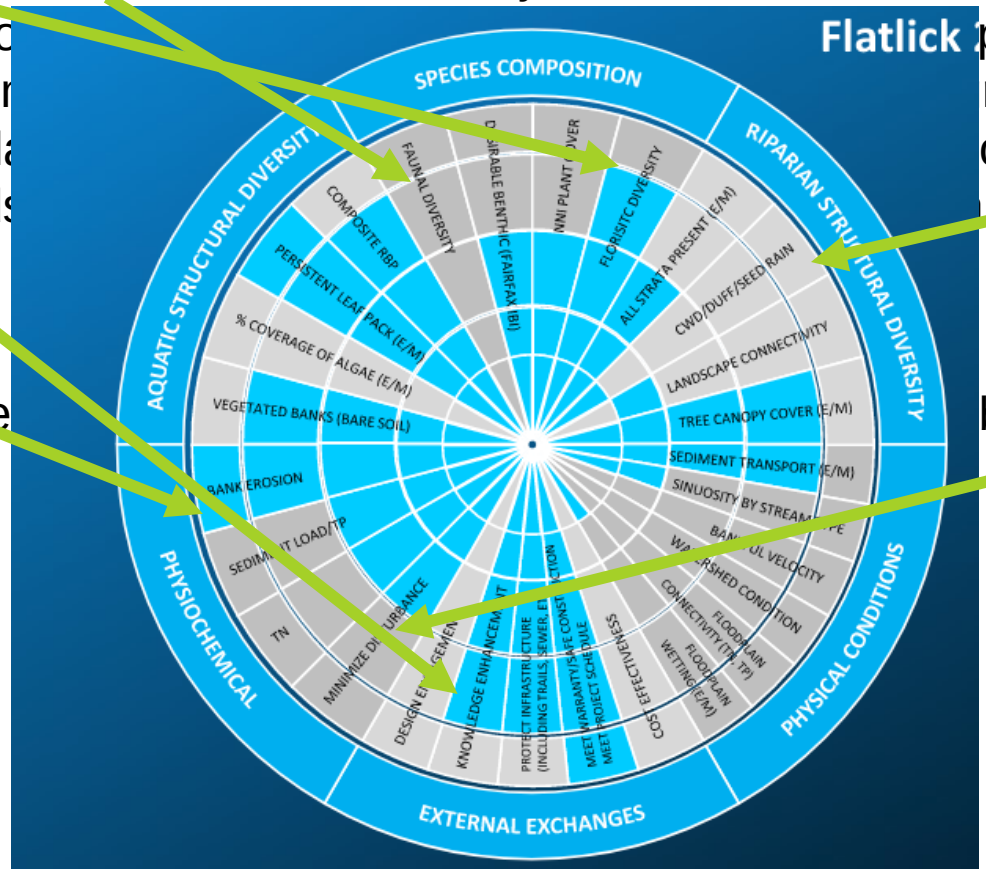

Additional Information

For additional information, please contact

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