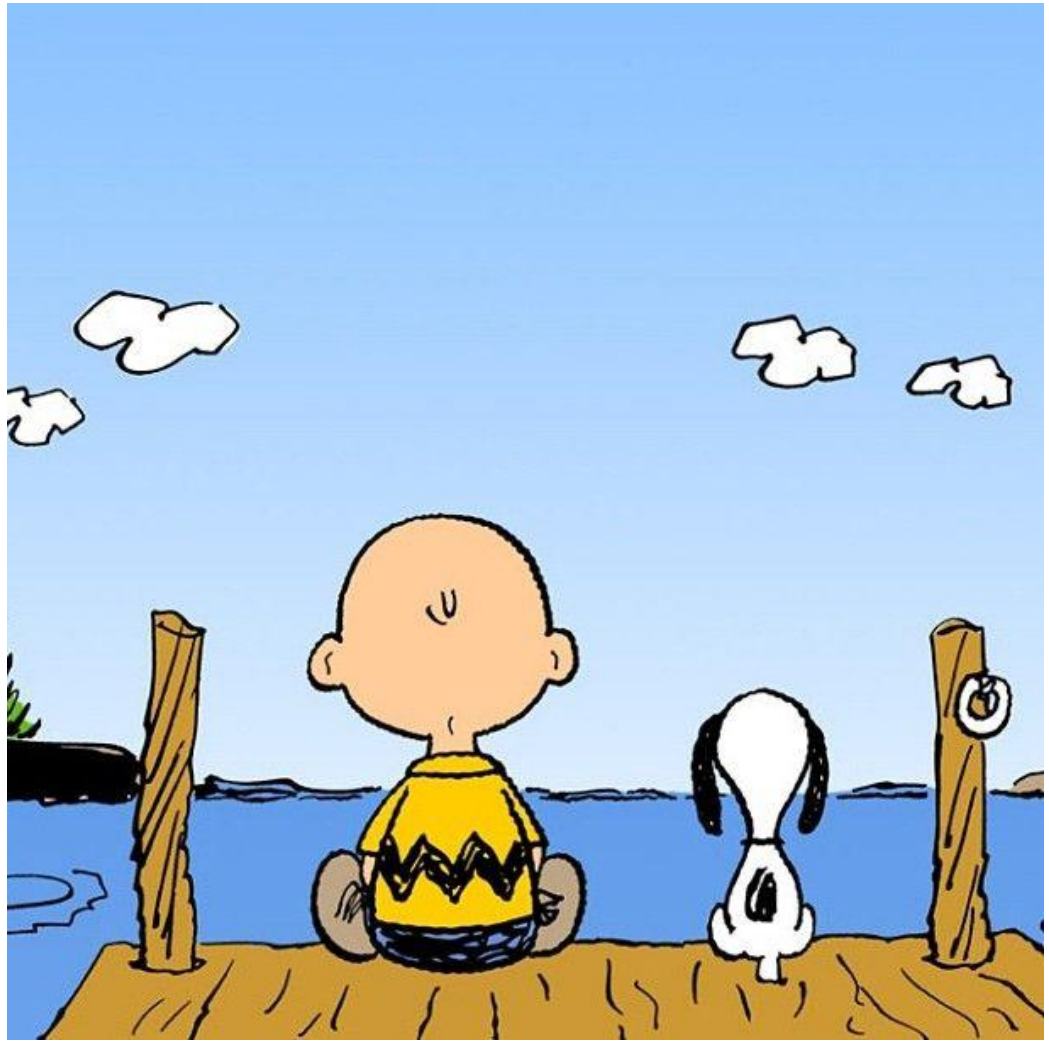
TERRA
Laboratory for sustainable land use and ecosystem services

Working with river networks, problems, challenges and solutions

Paulo Branco

pjbranco@isa.ulisboa.pt

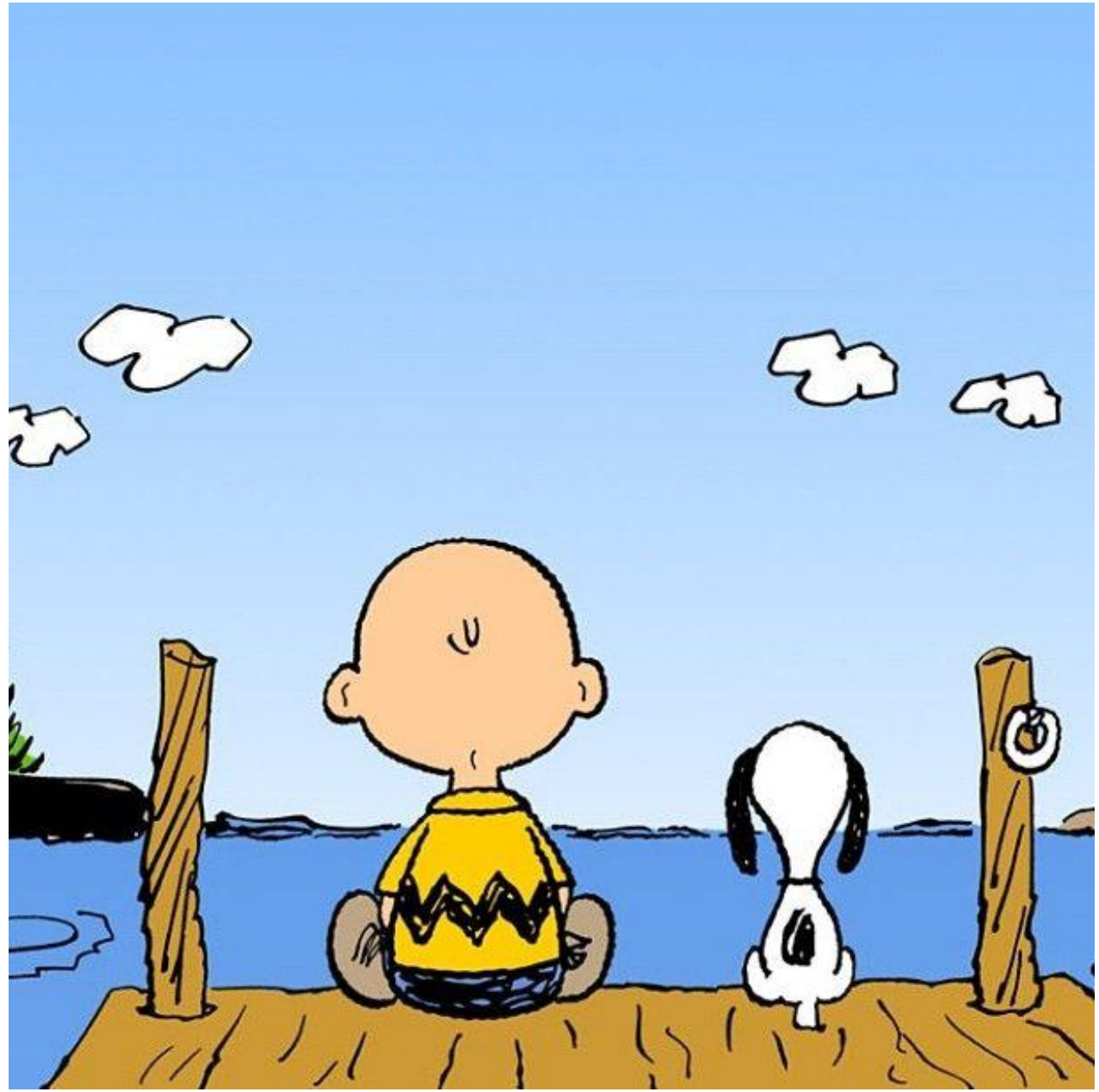


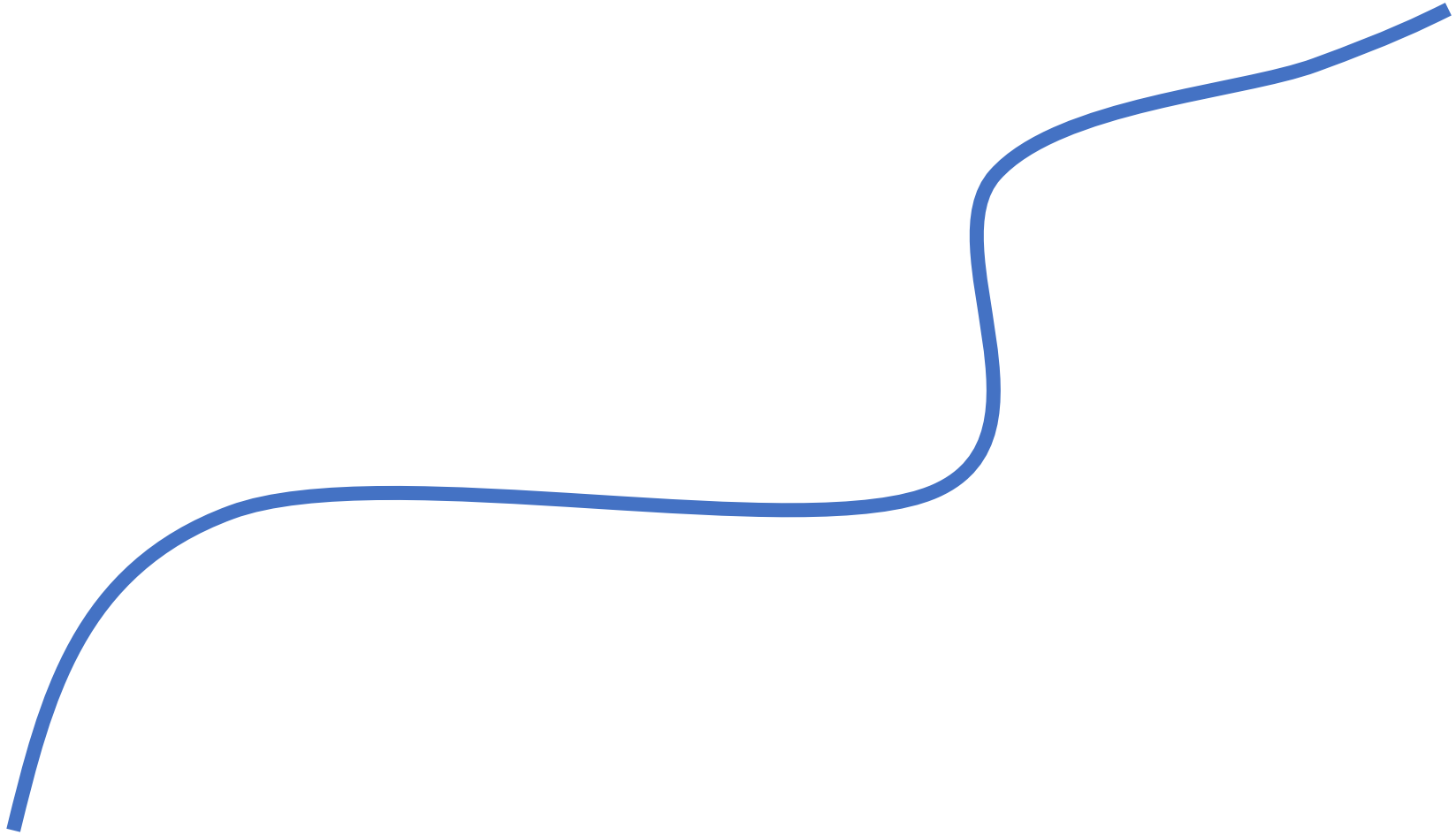
INSTITUTO SUPERIOR DE AGRONOMIA
Hinc Patriam Sustinet
Universidade de Lisboa

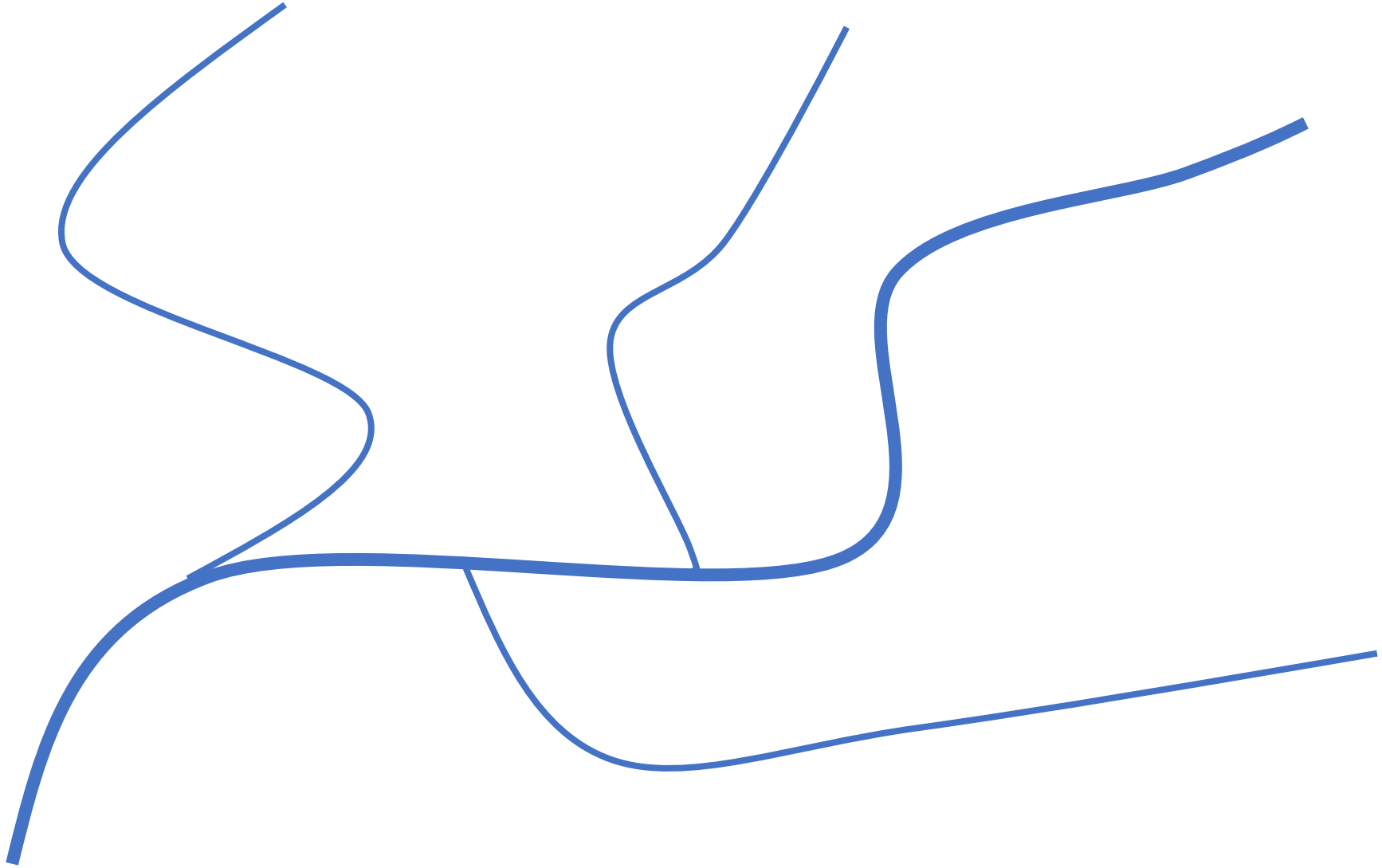
cef Centro de Estudos Florestais

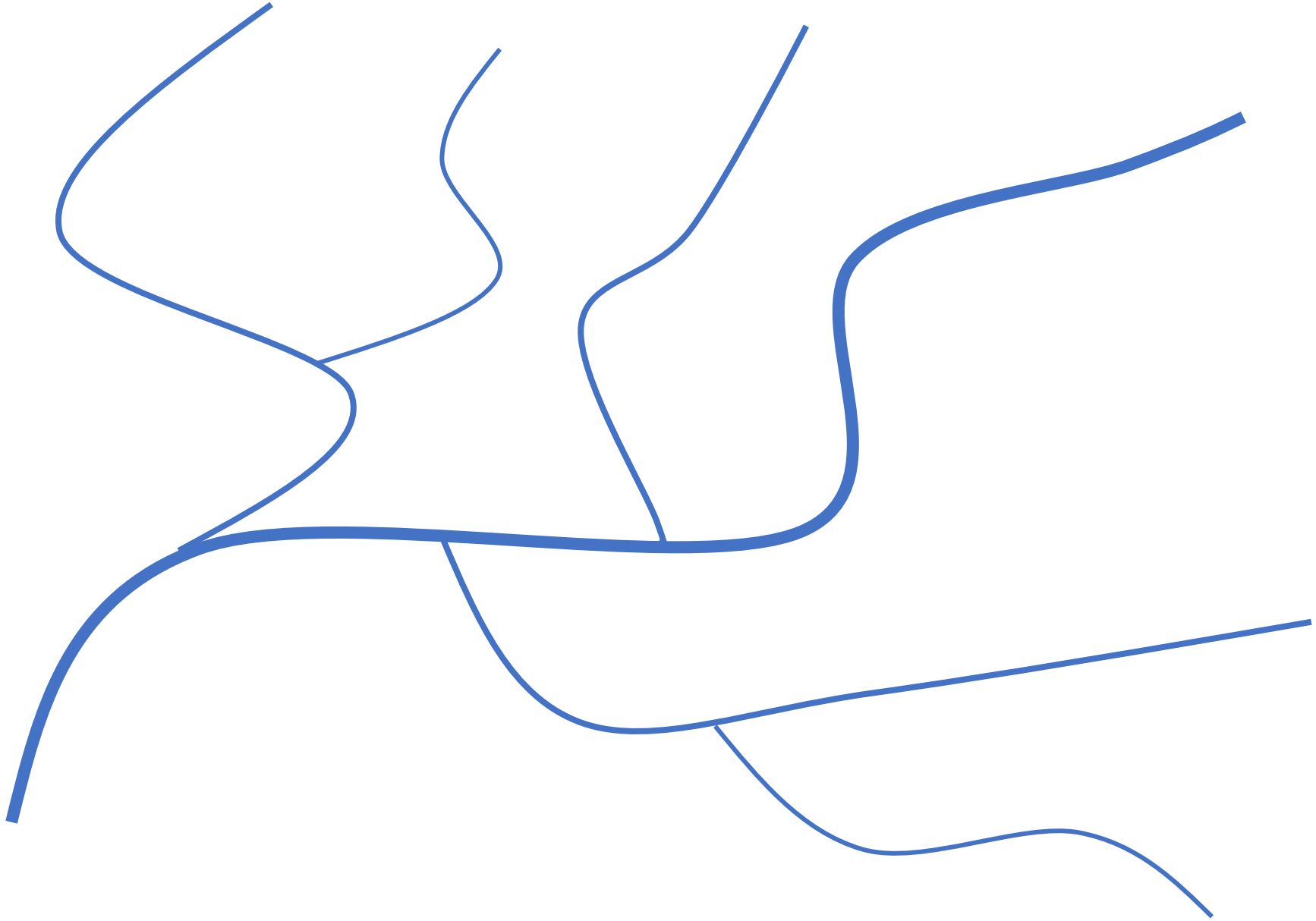
DammedFish

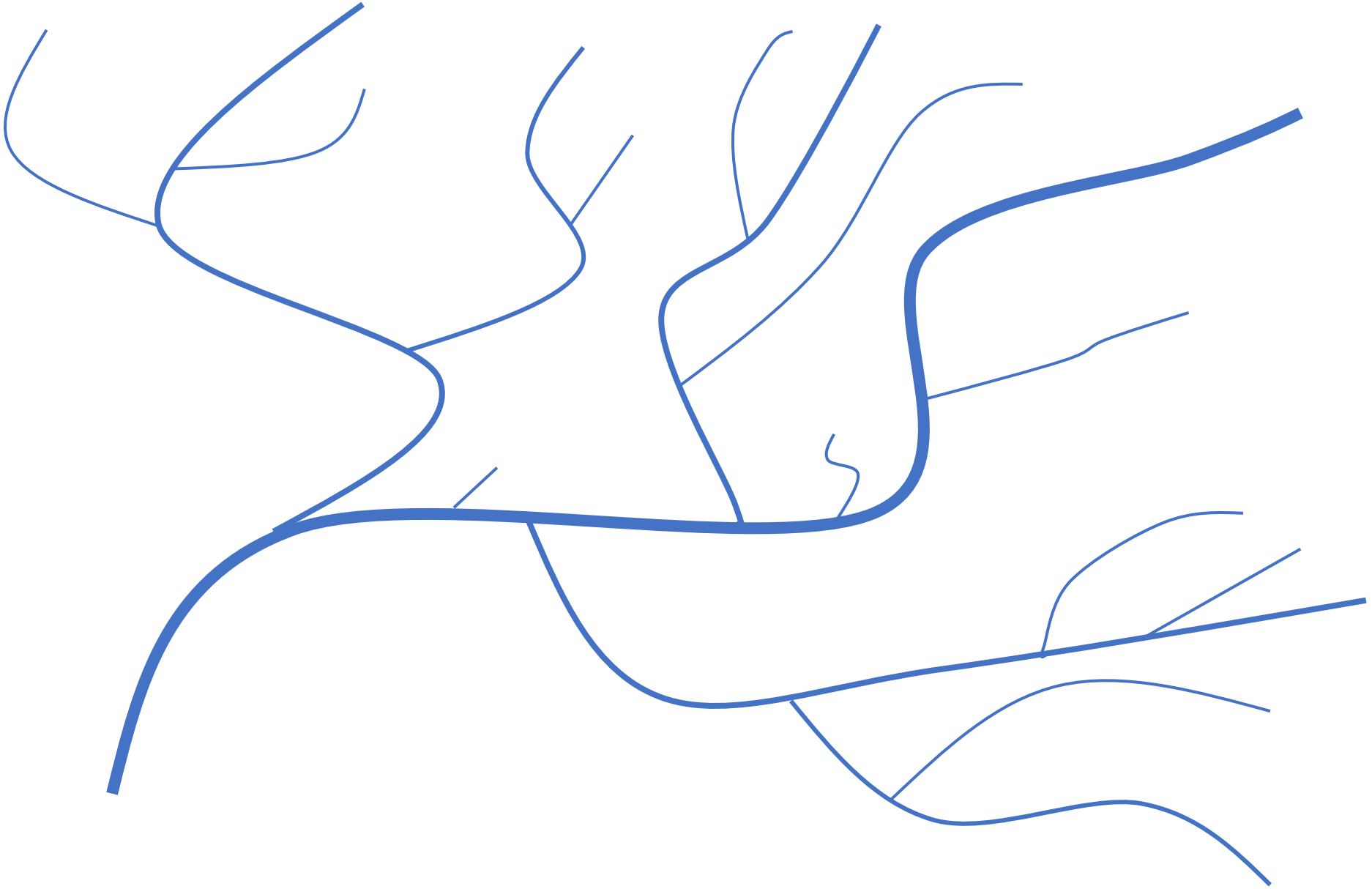
FCT
Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, INOVAÇÃO E DO ENSINO SUPERIOR

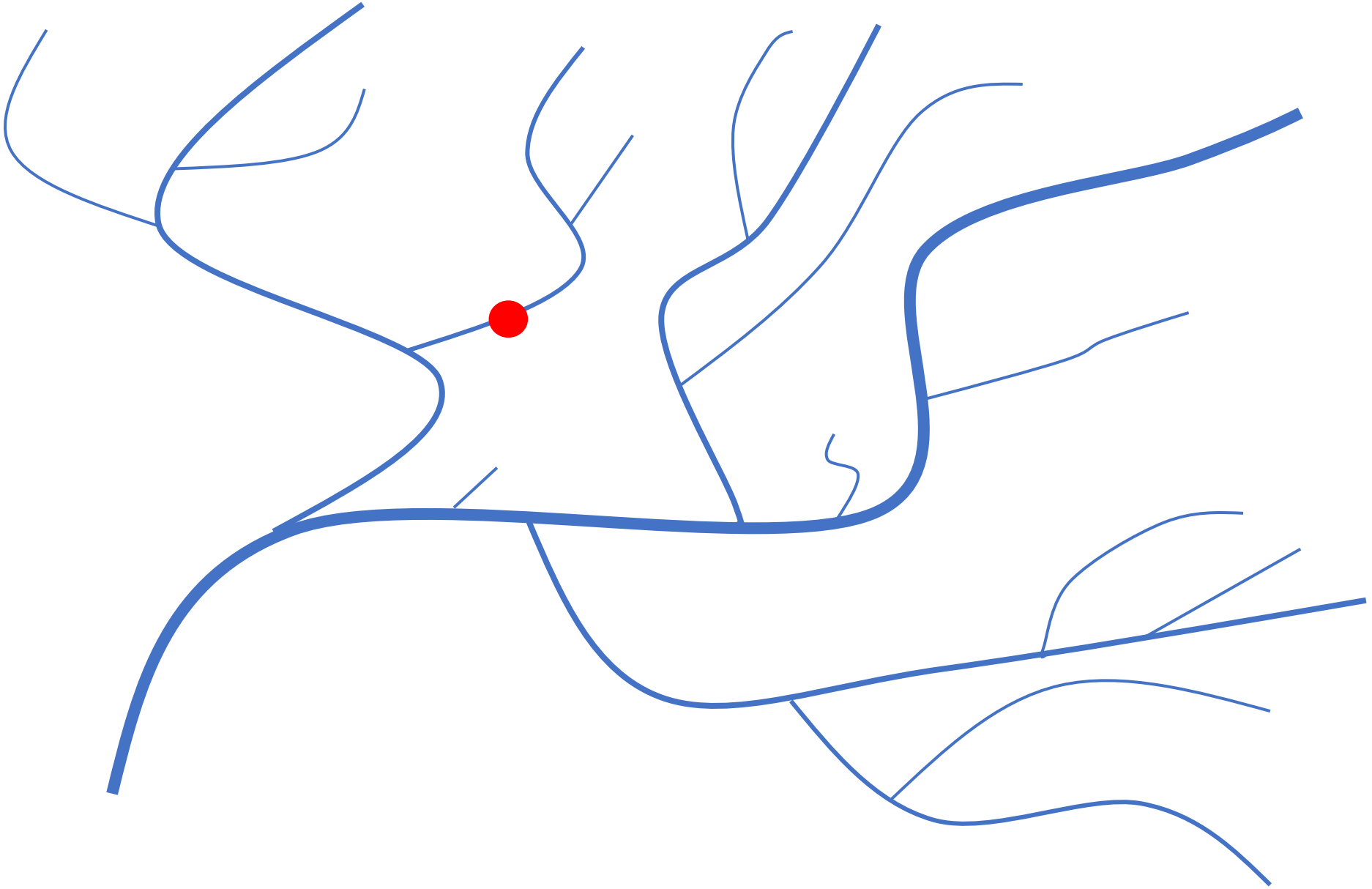


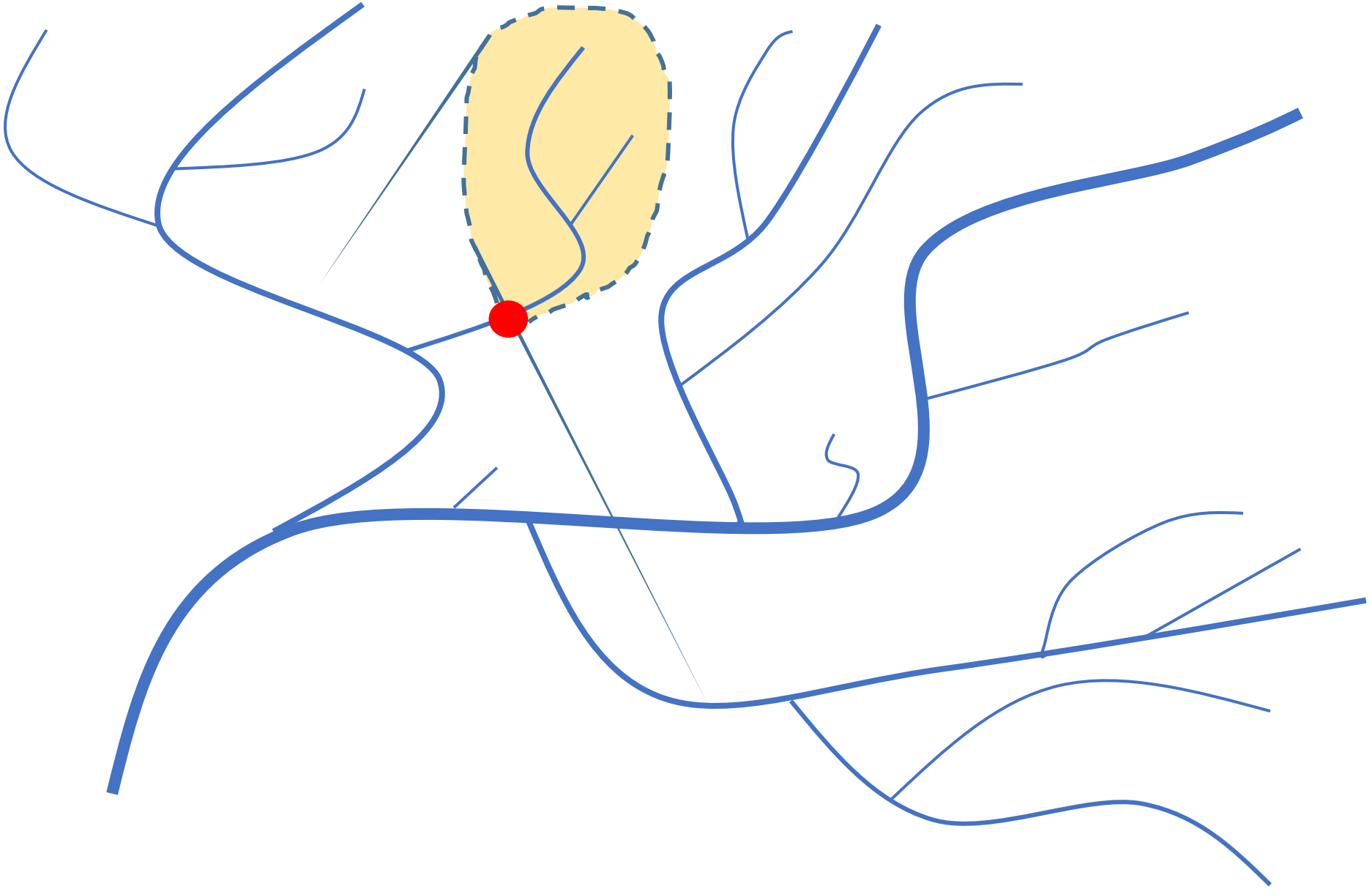


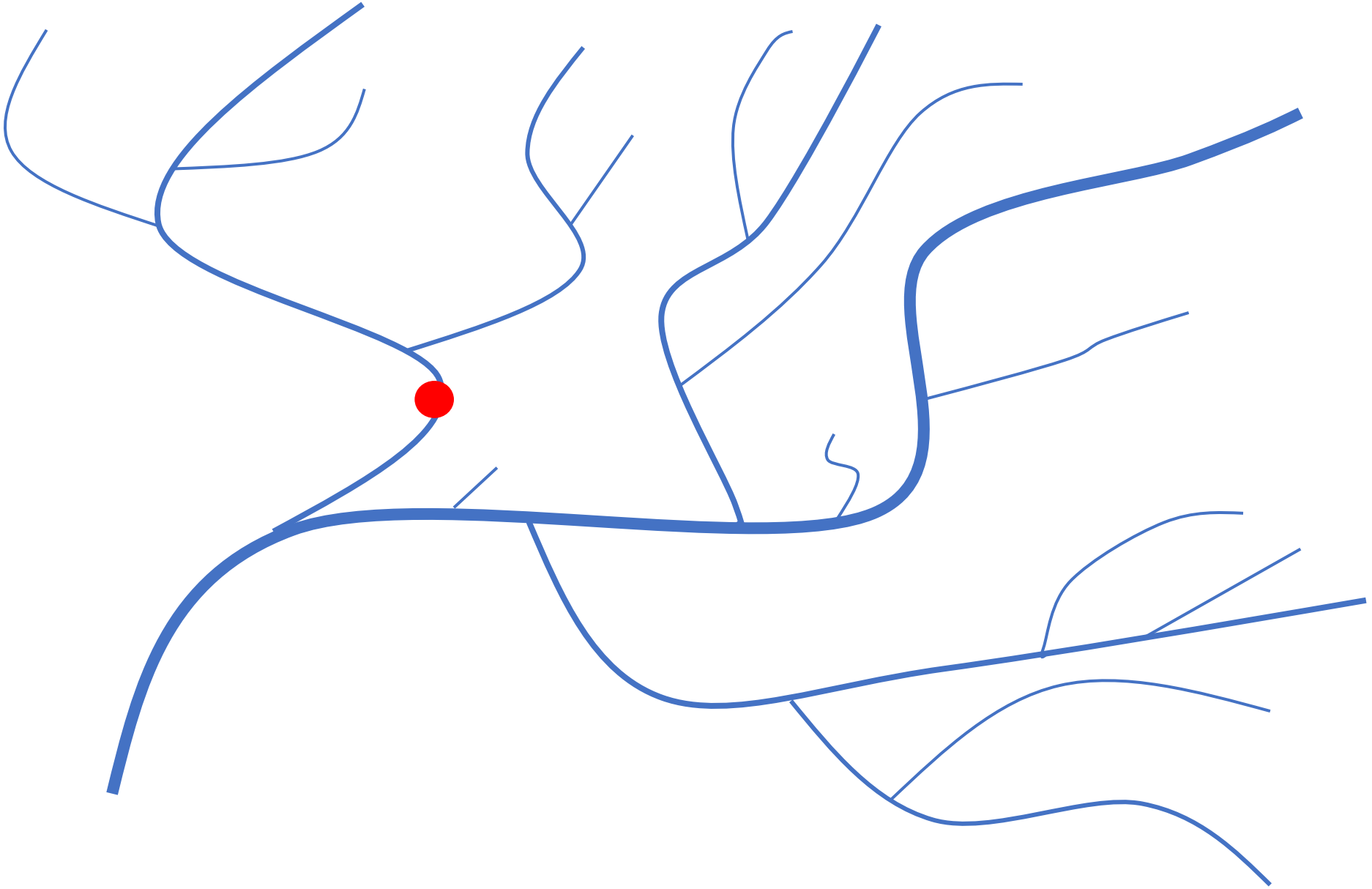


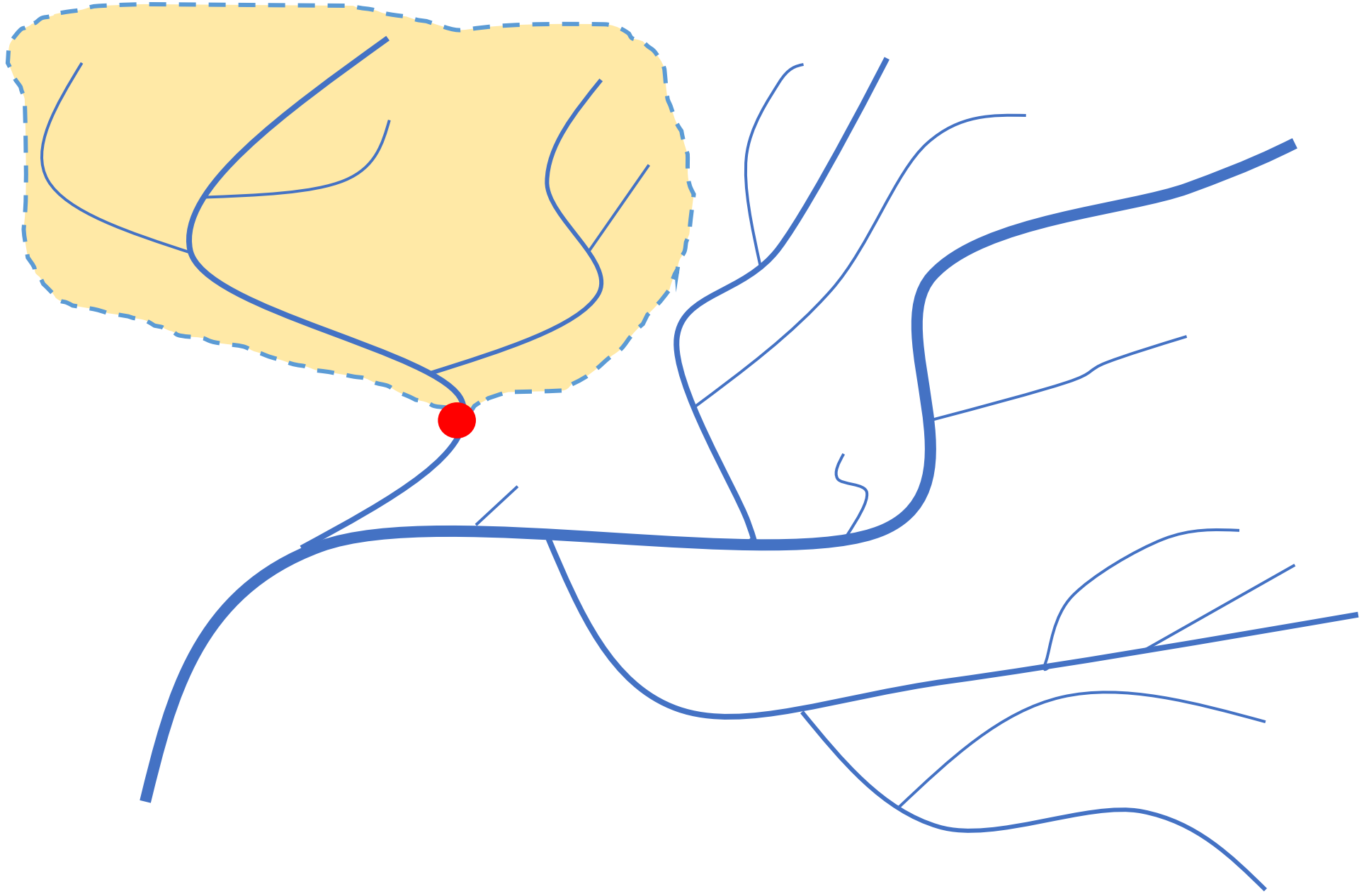


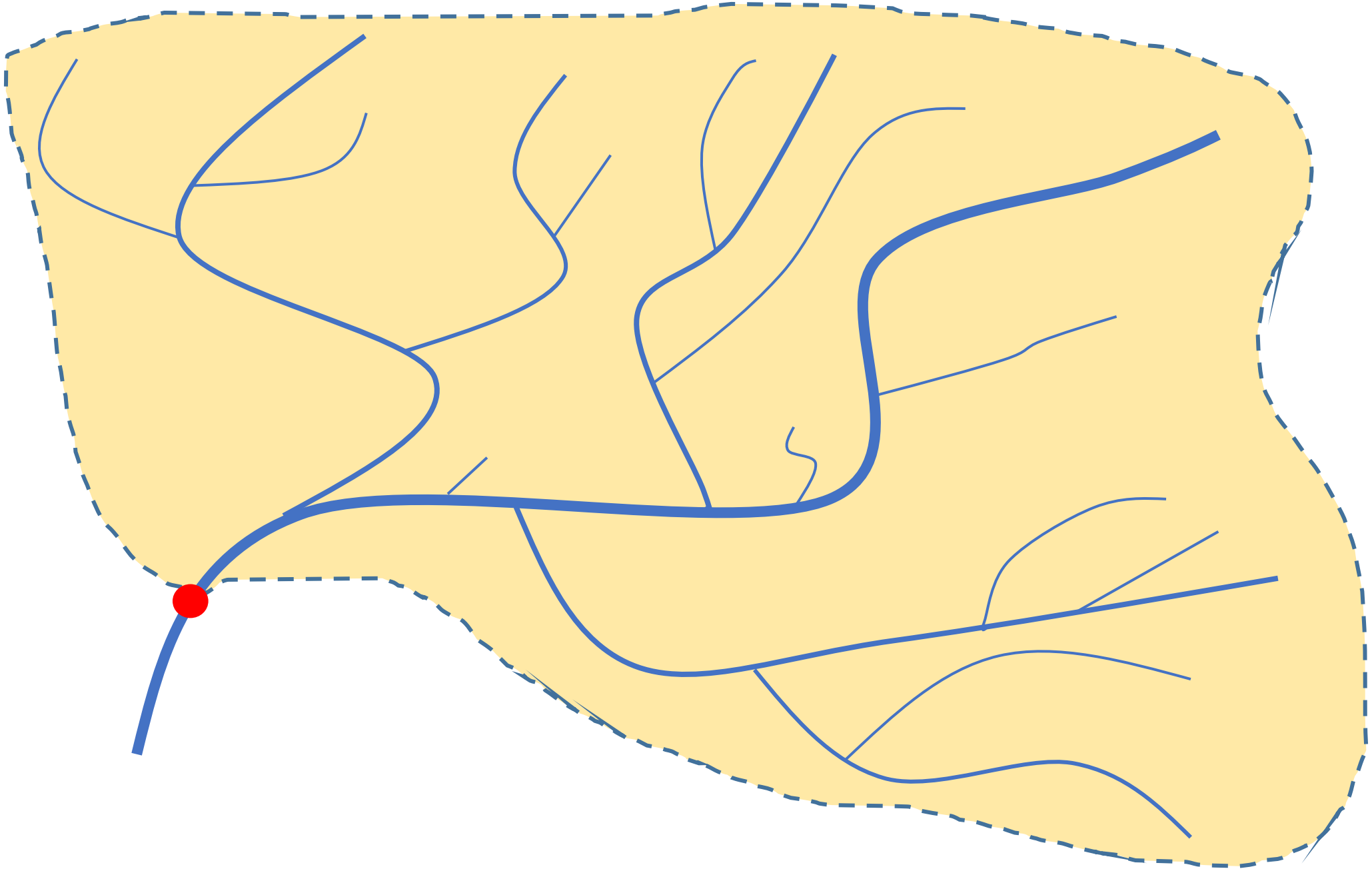












RVTool

RivTool

Takes full **advantage of river network databases** like the CCM

Straightforward linkage between environmental and river network data

User-friendly & straightforward implementation

No topological restrictions as it is database driven

Dynamic outputs over time

Fast performance even with large datasets

Universal applicability

Works with **segment or sub-basin** as a basic **analysis unit**

A set of **ready-to-use libraries**

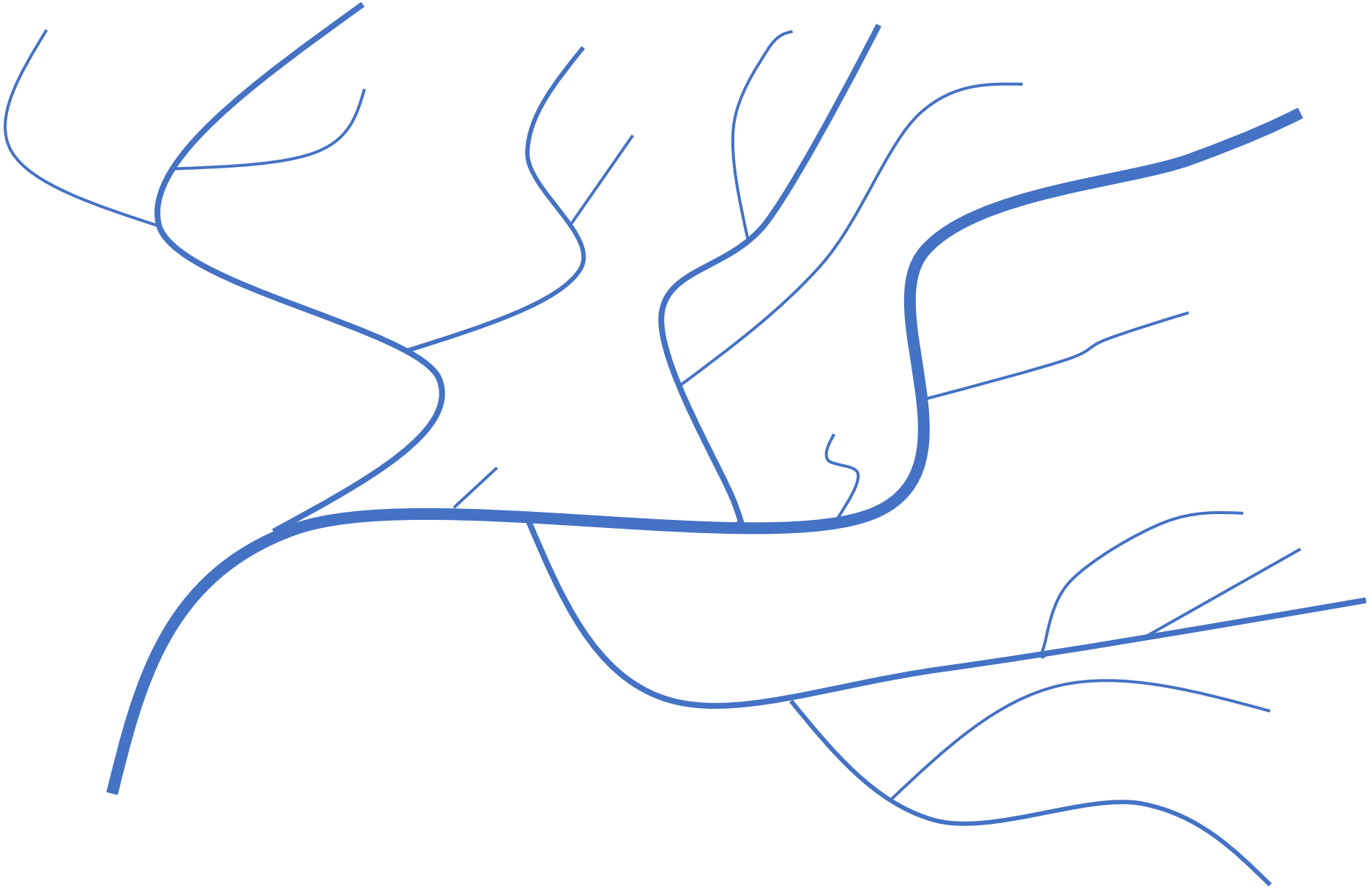
Duarte, G., Segurado, P., Oliveira, T., Haidvogl, G., Pont, D., Ferreira, M. T., & Branco, P. (2019). The river network toolkit–RivTool. *Ecography*, *42*(3), 549-557.

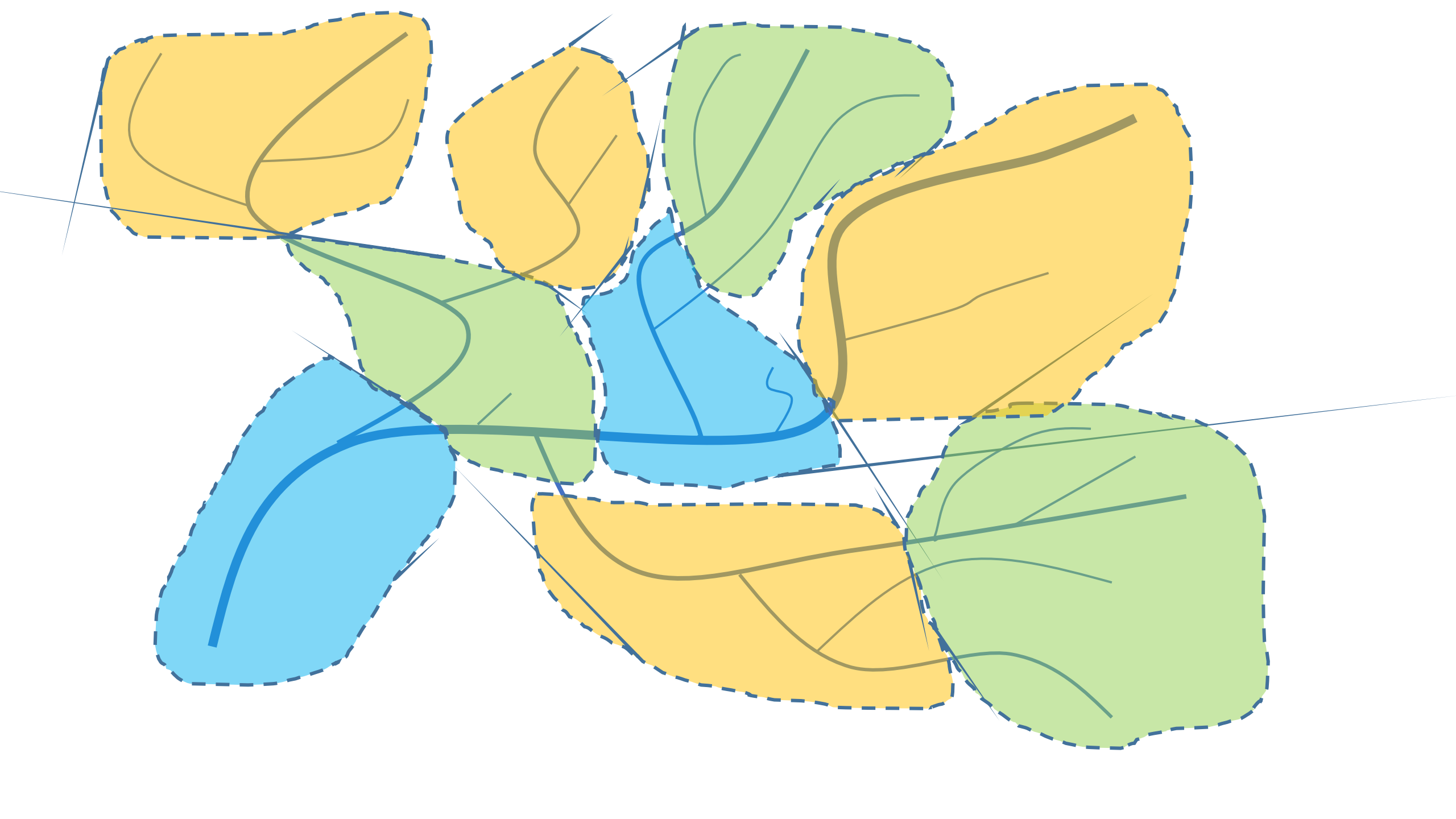
MERLiN

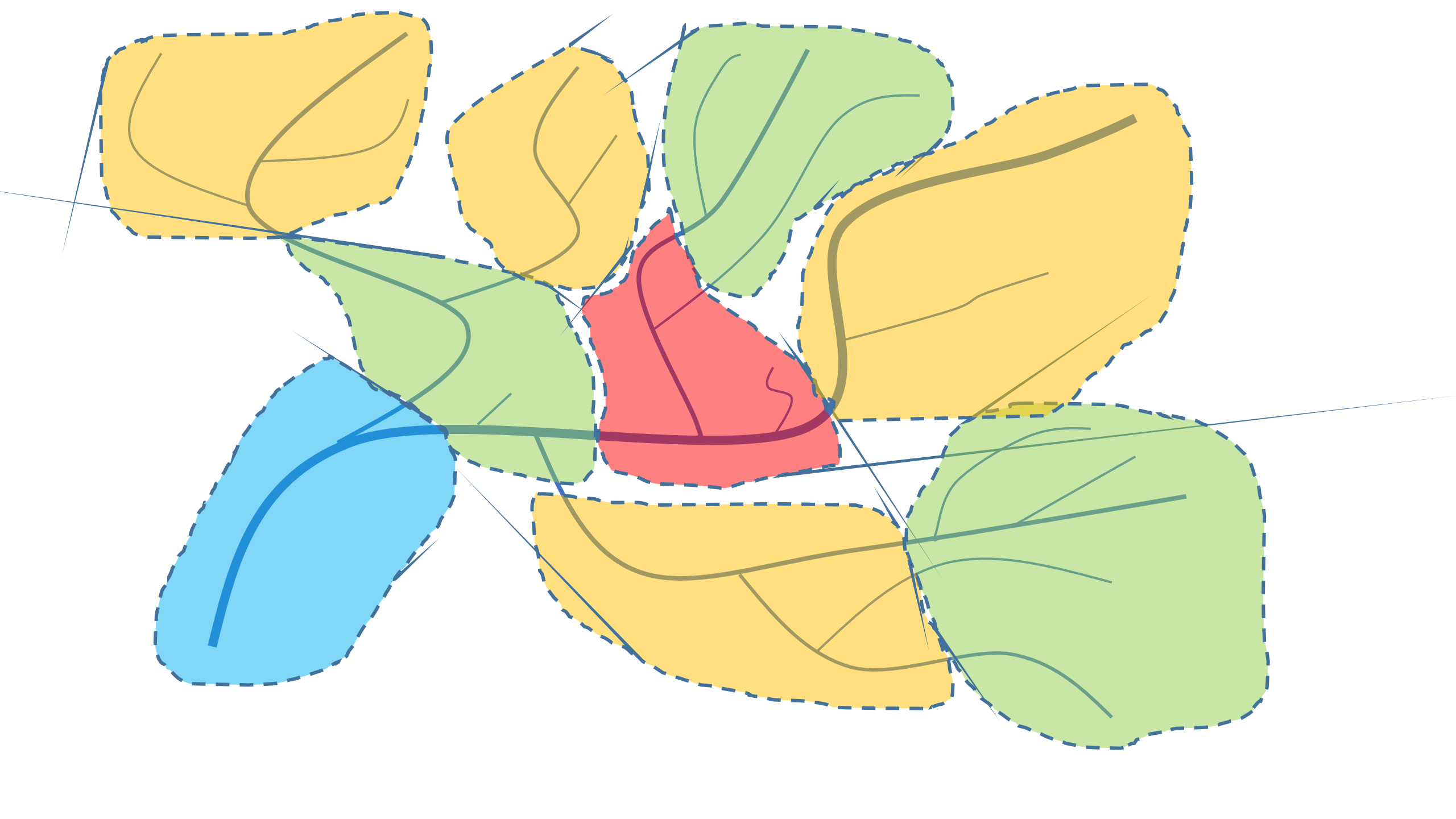
MERLiN

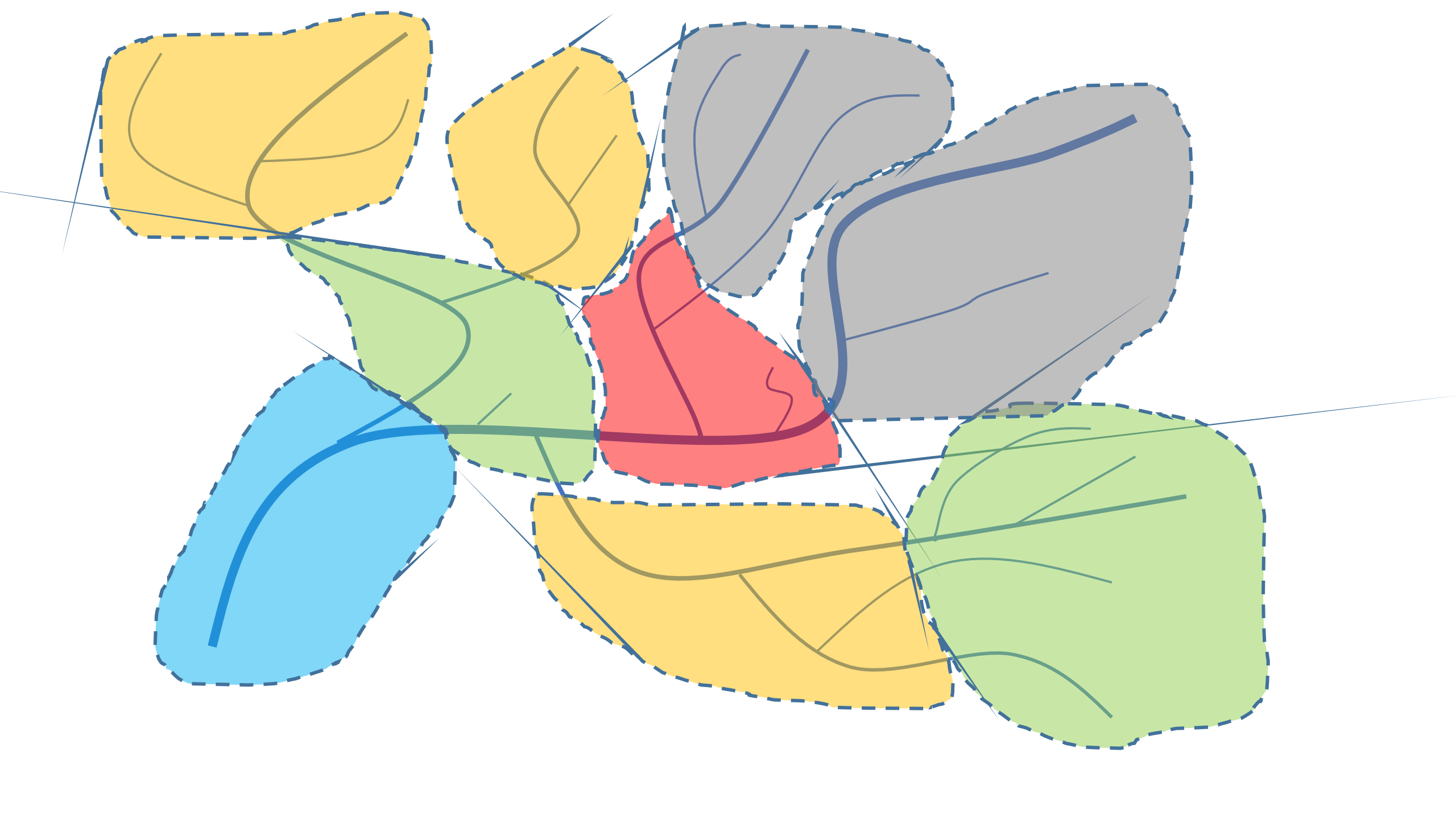
Restoration needs

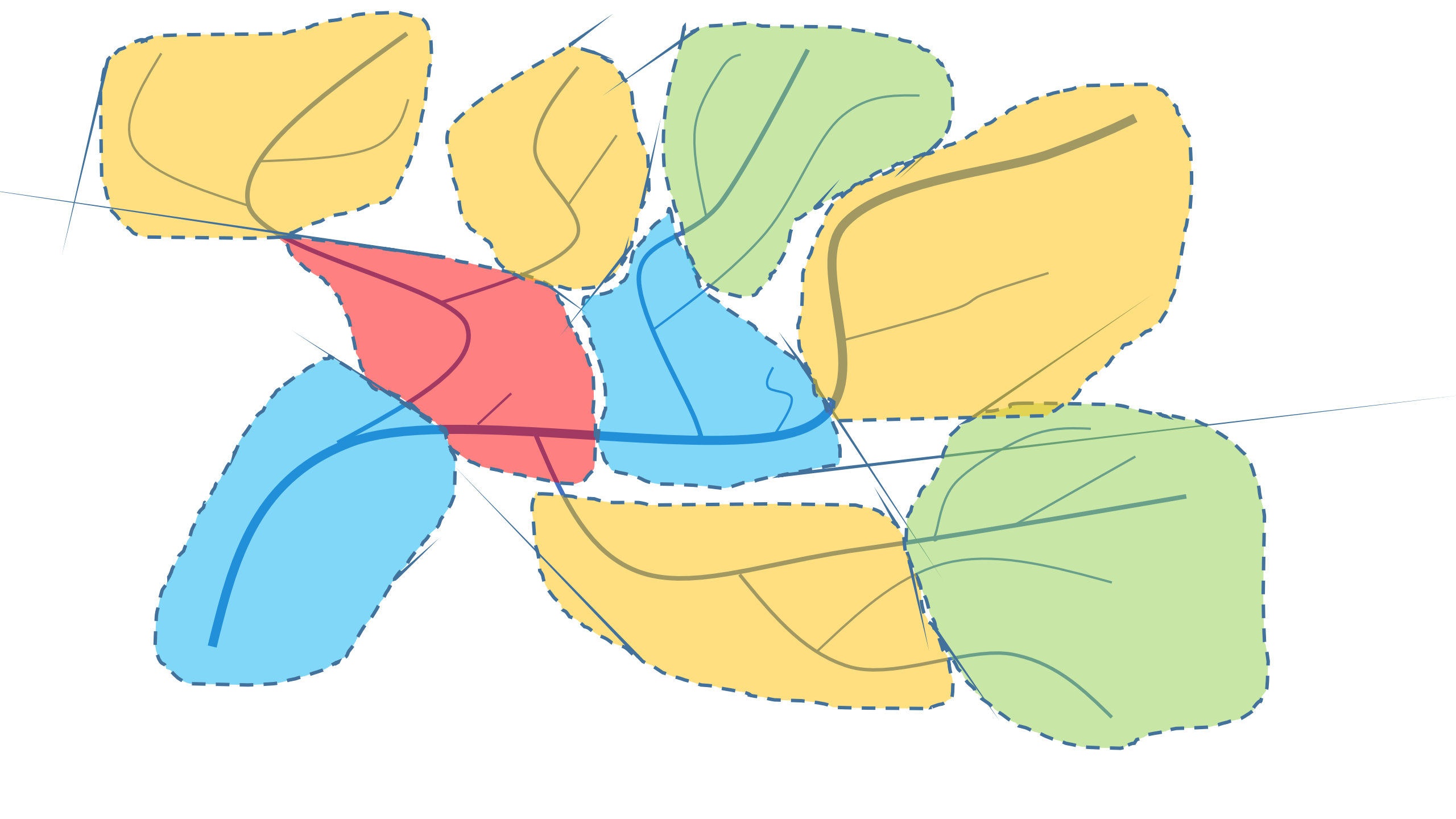
Restoration potentials

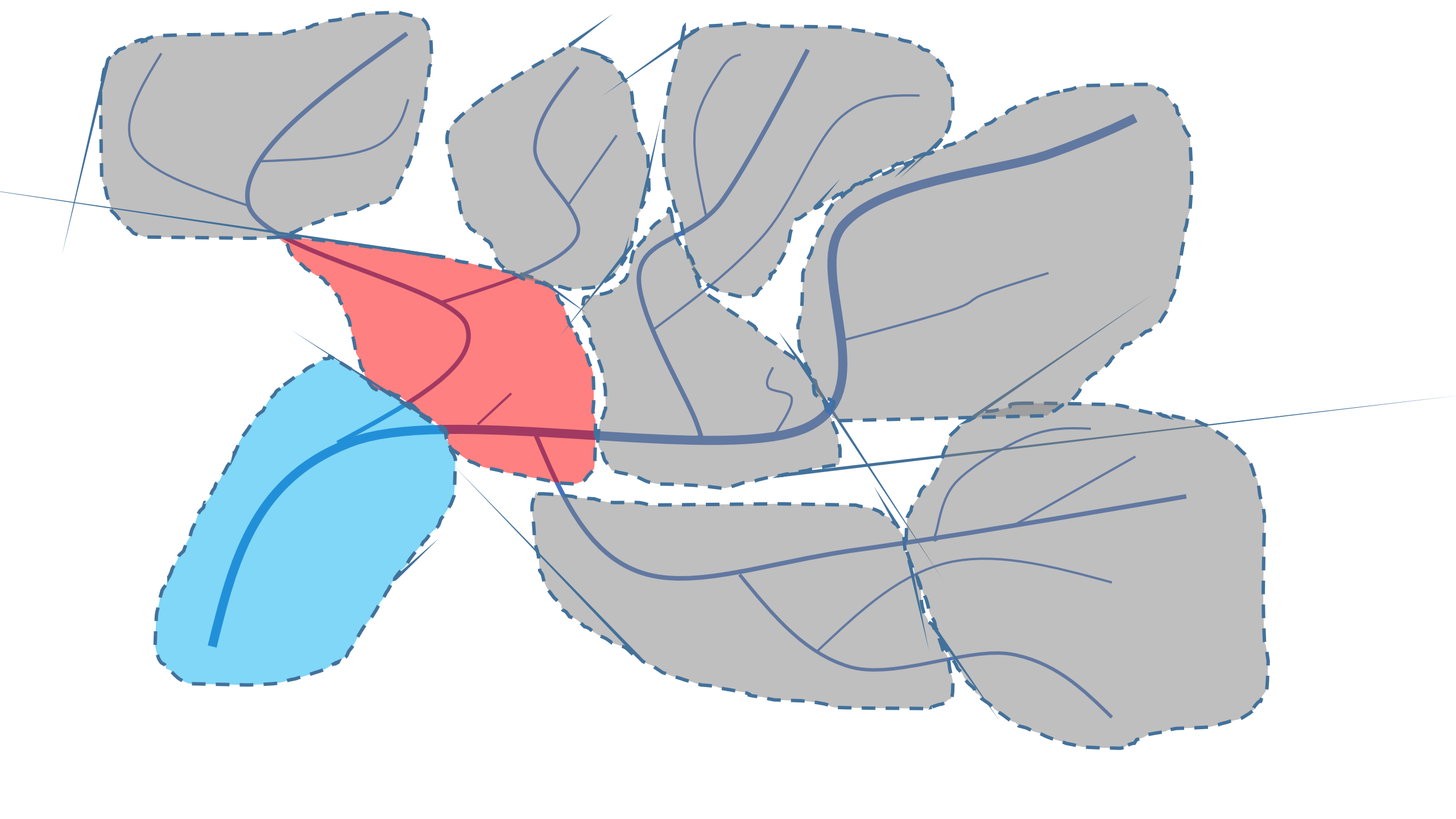


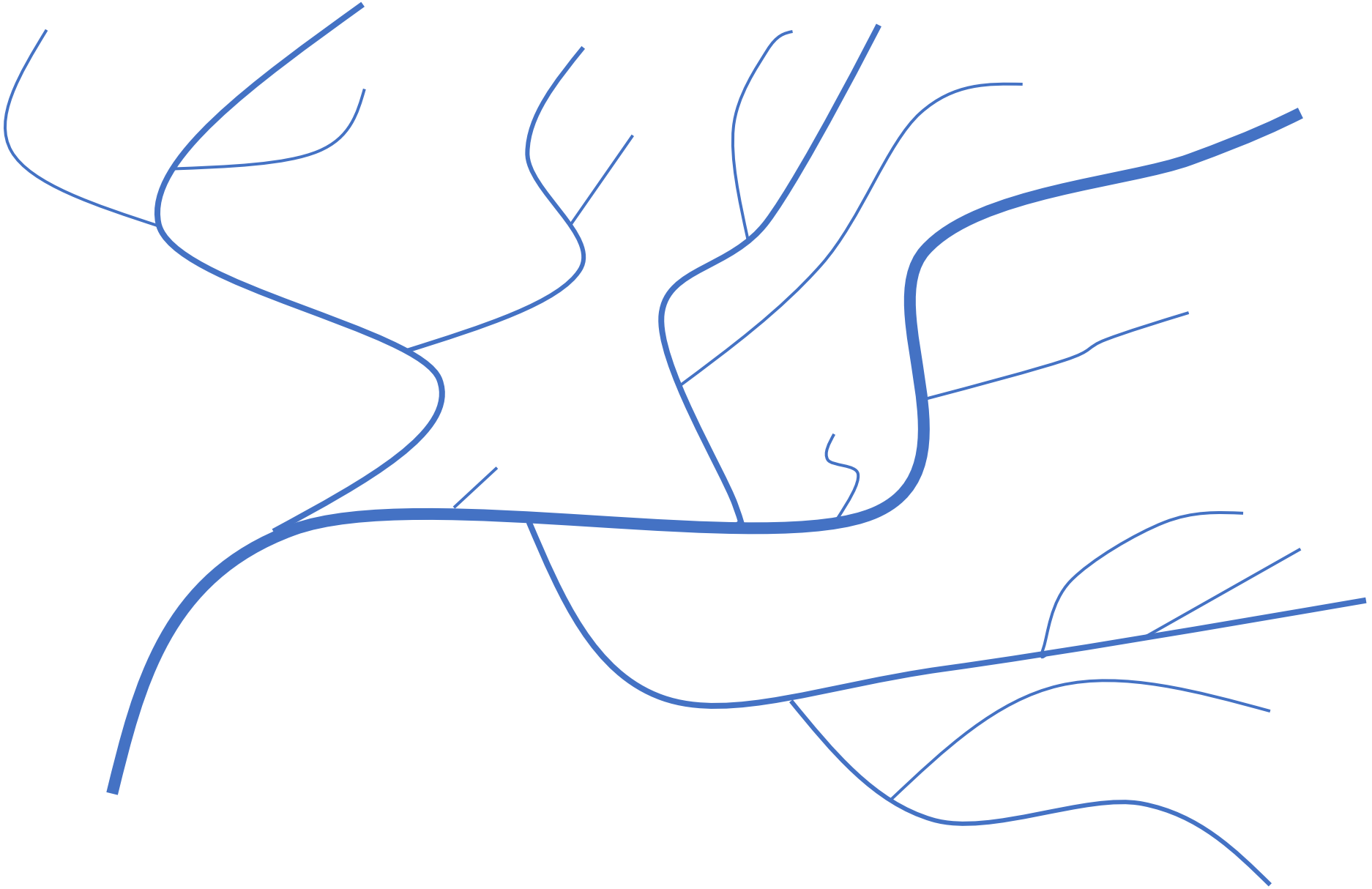


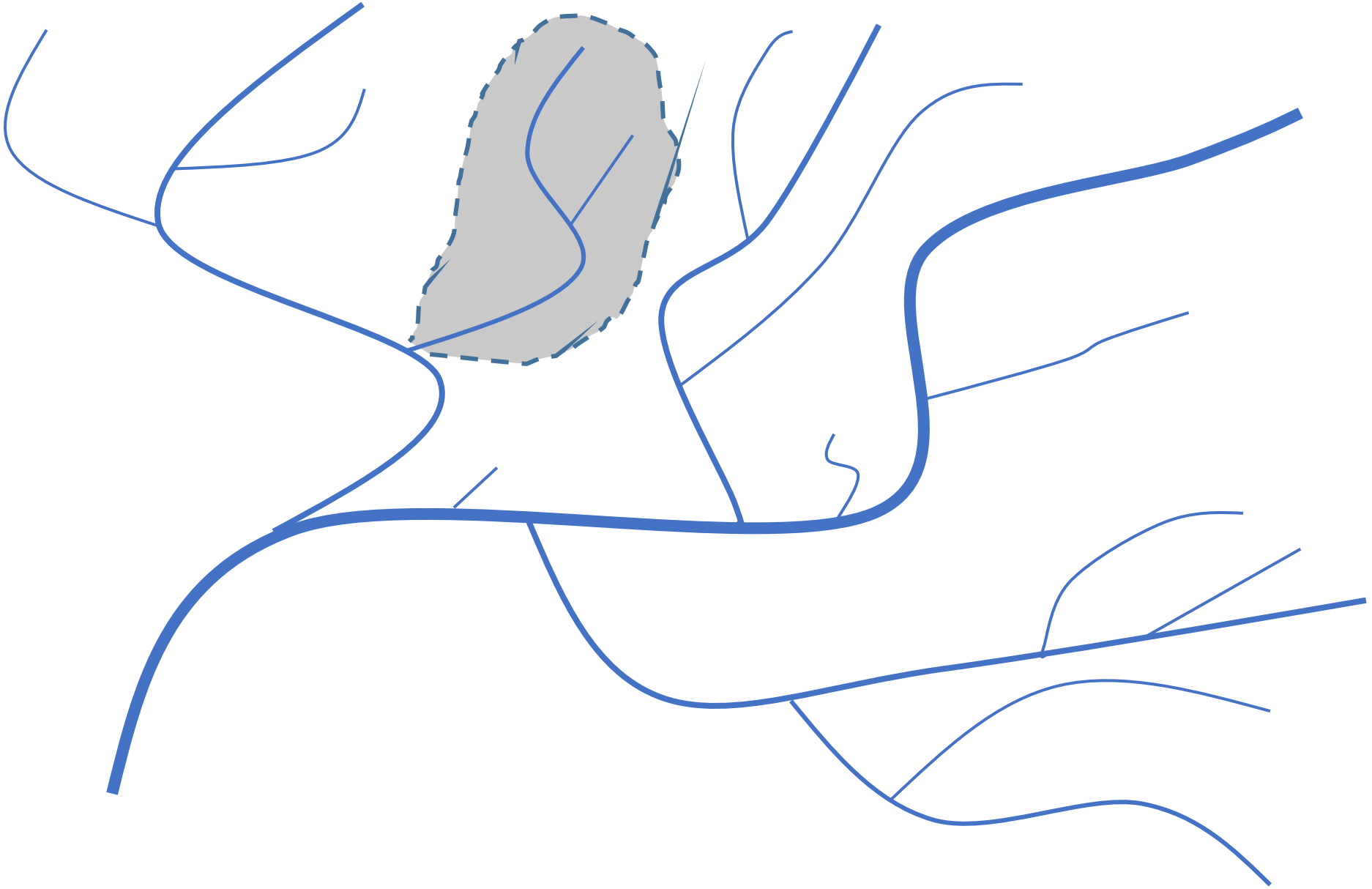


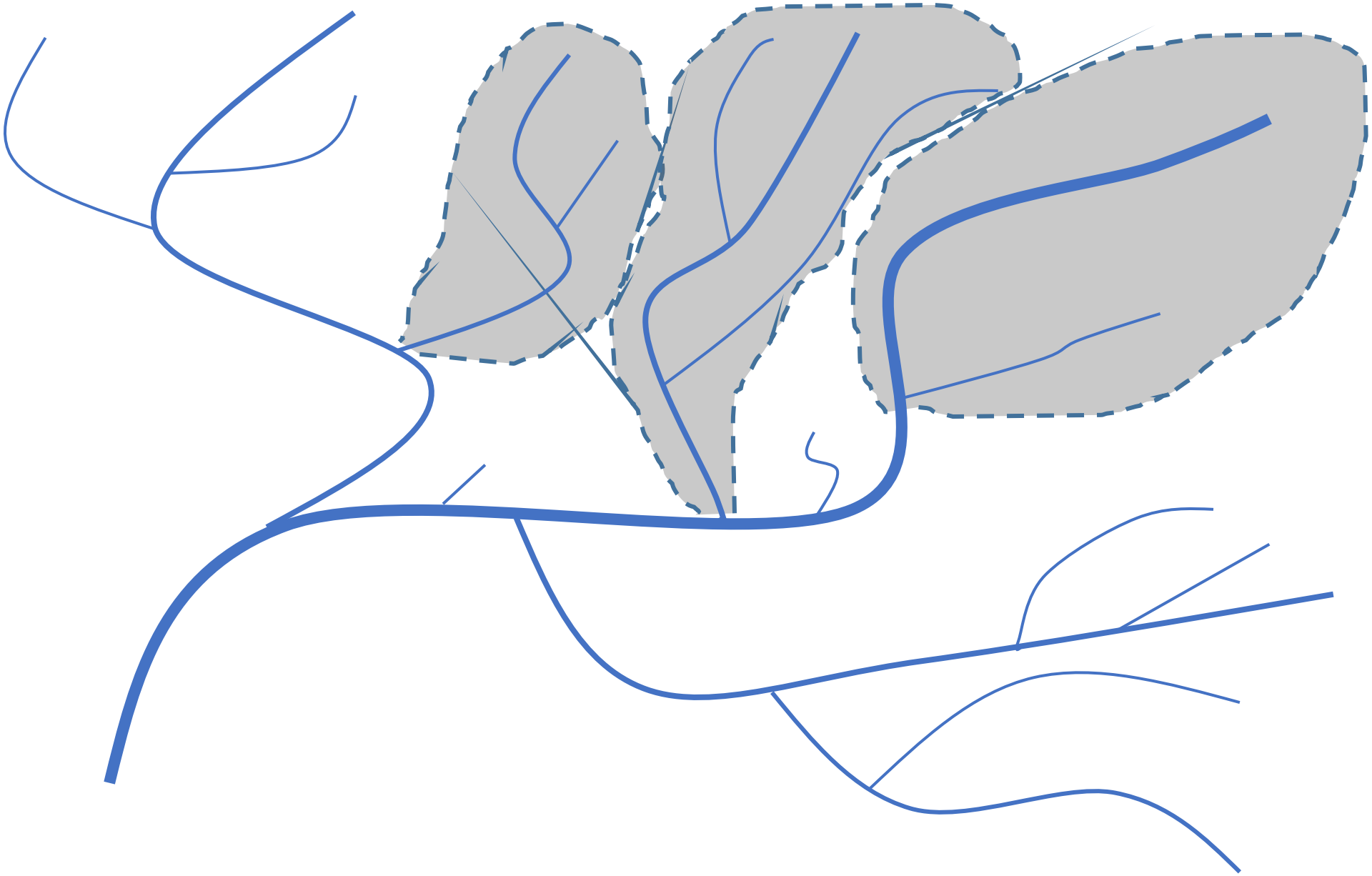


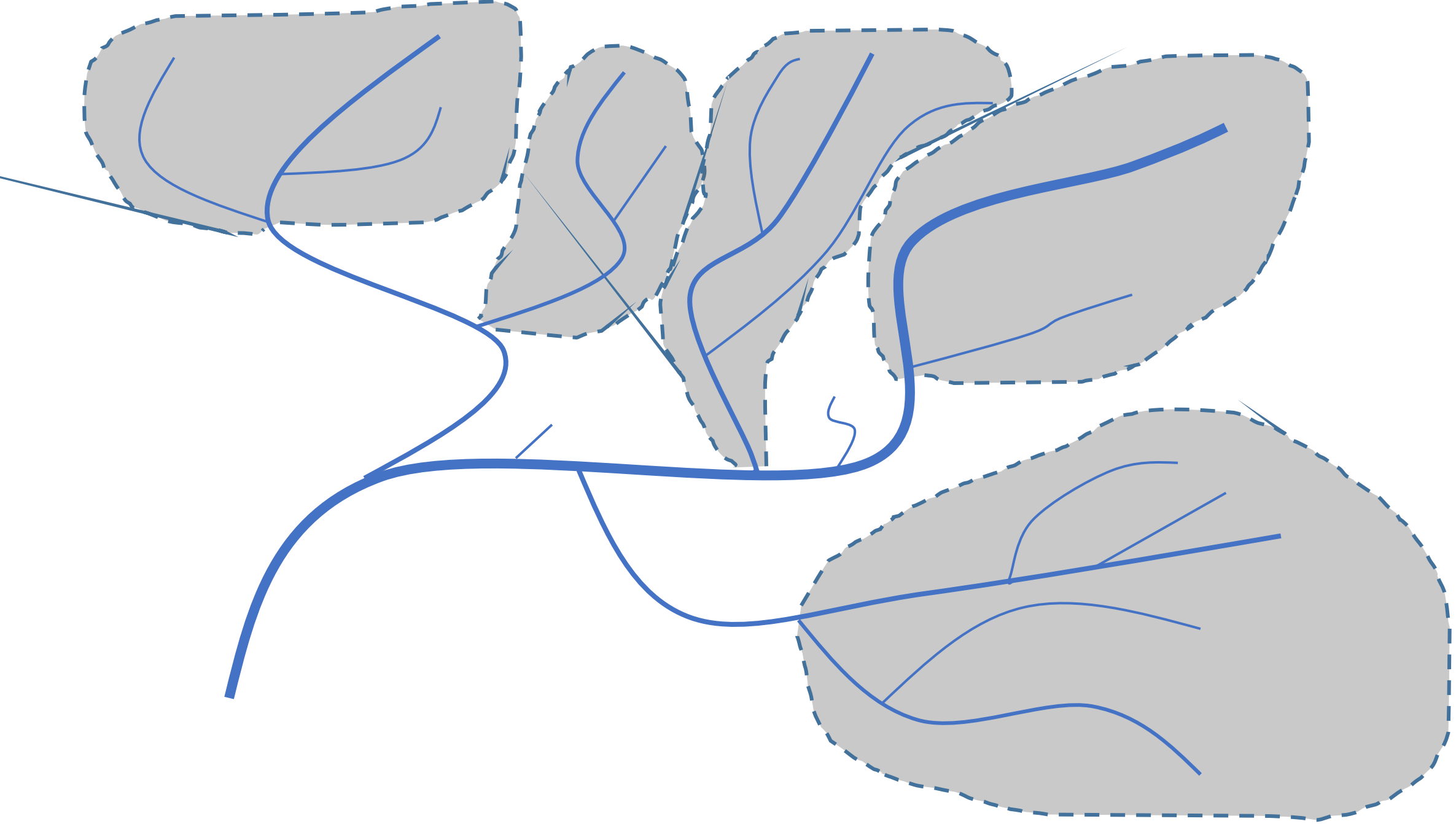


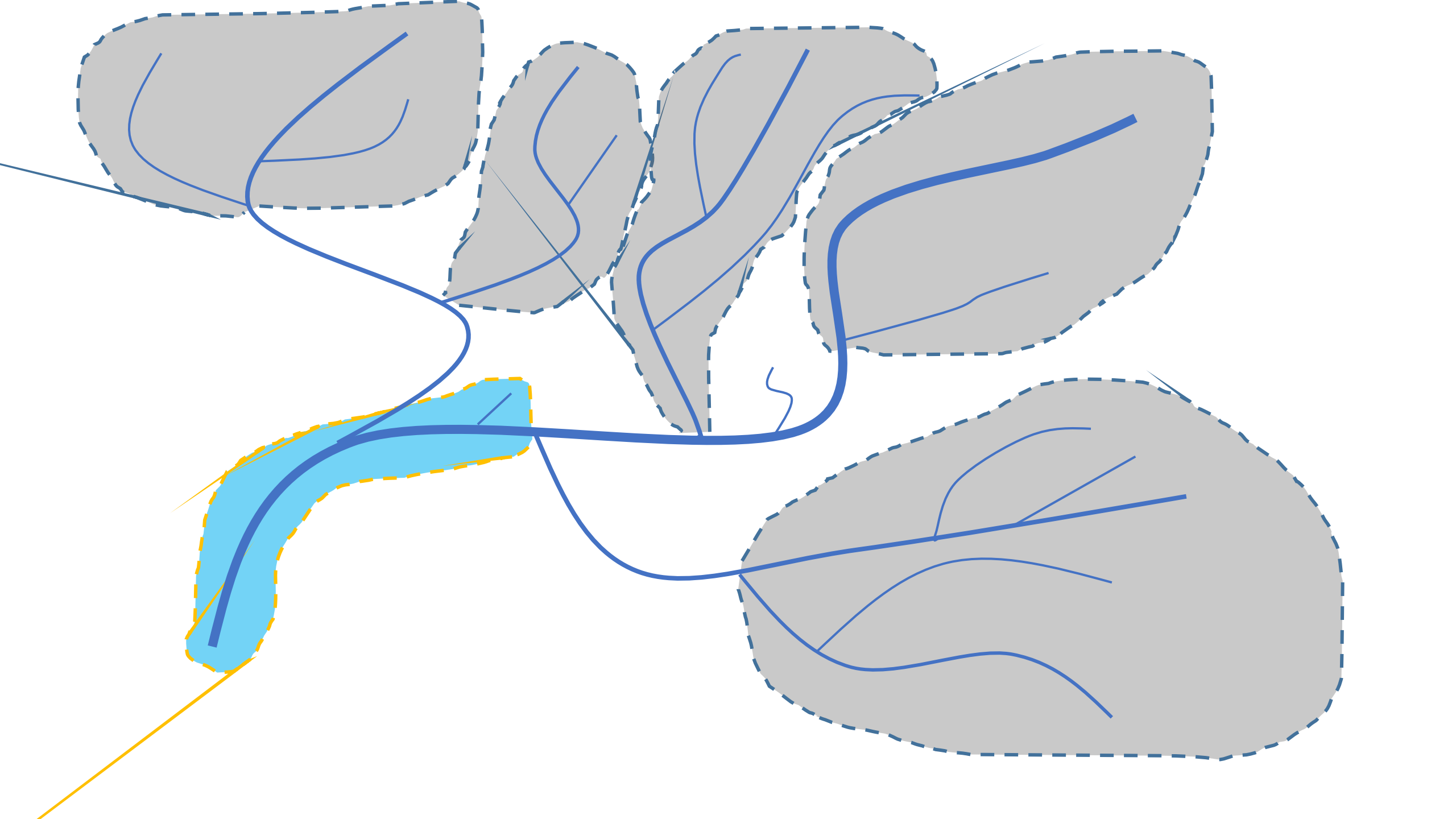


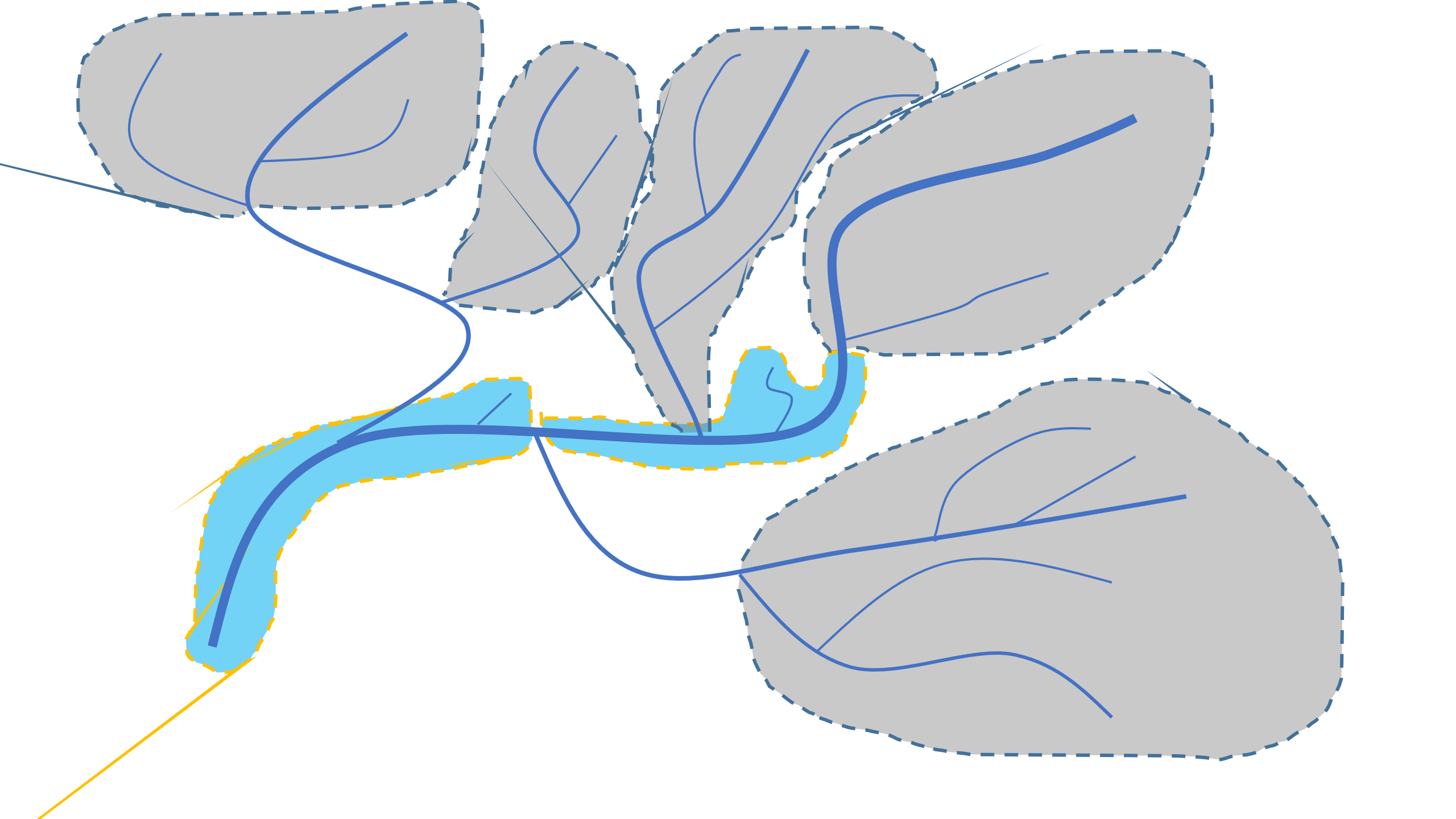


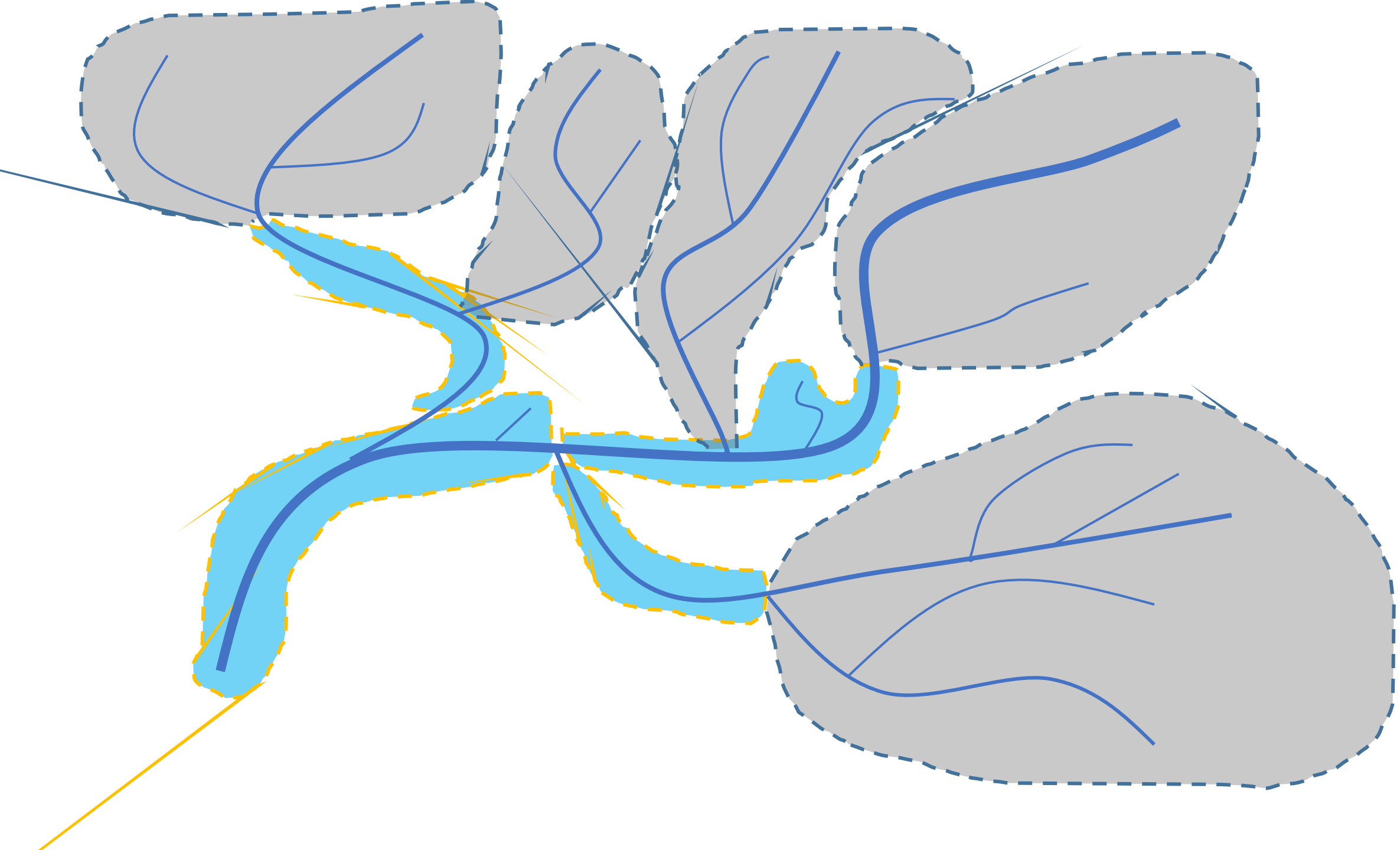




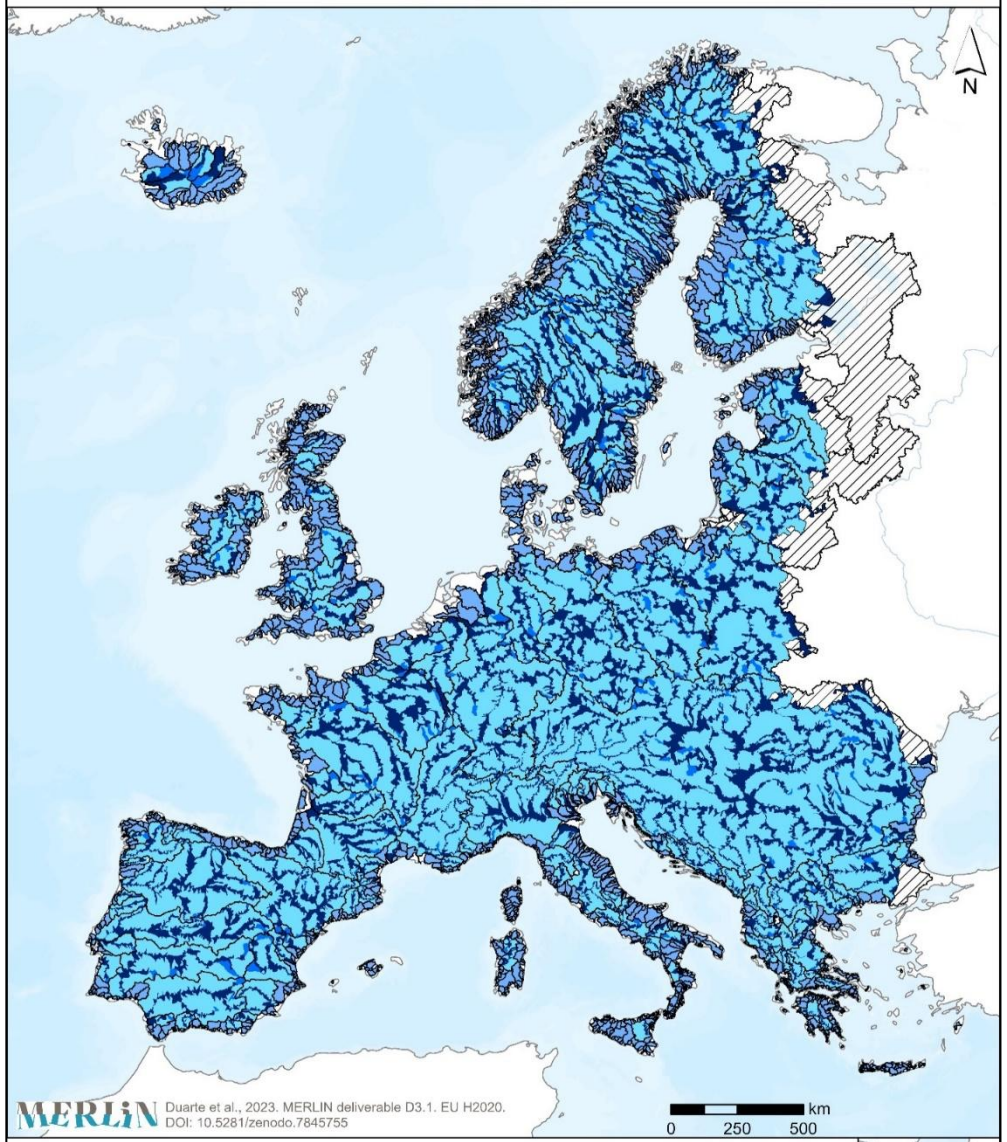




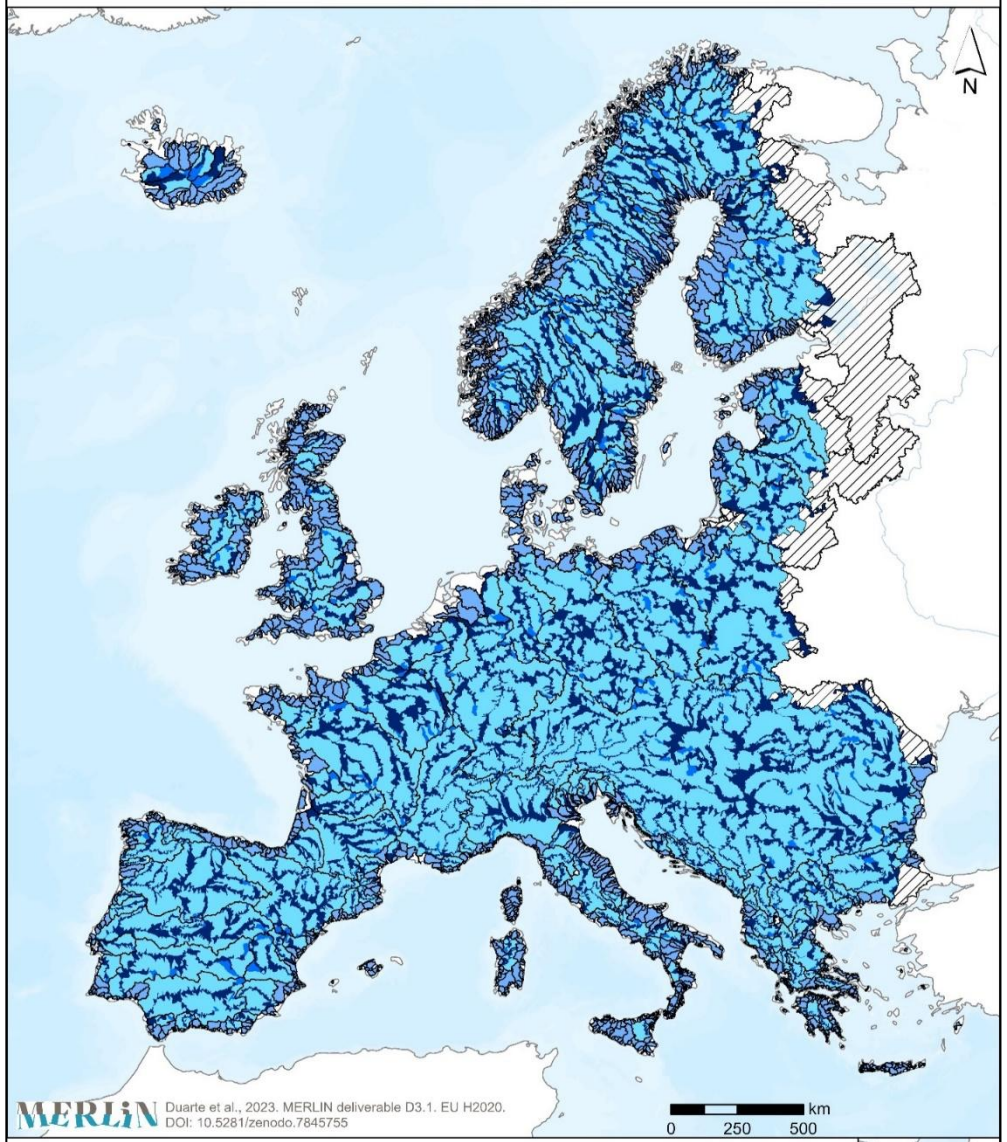




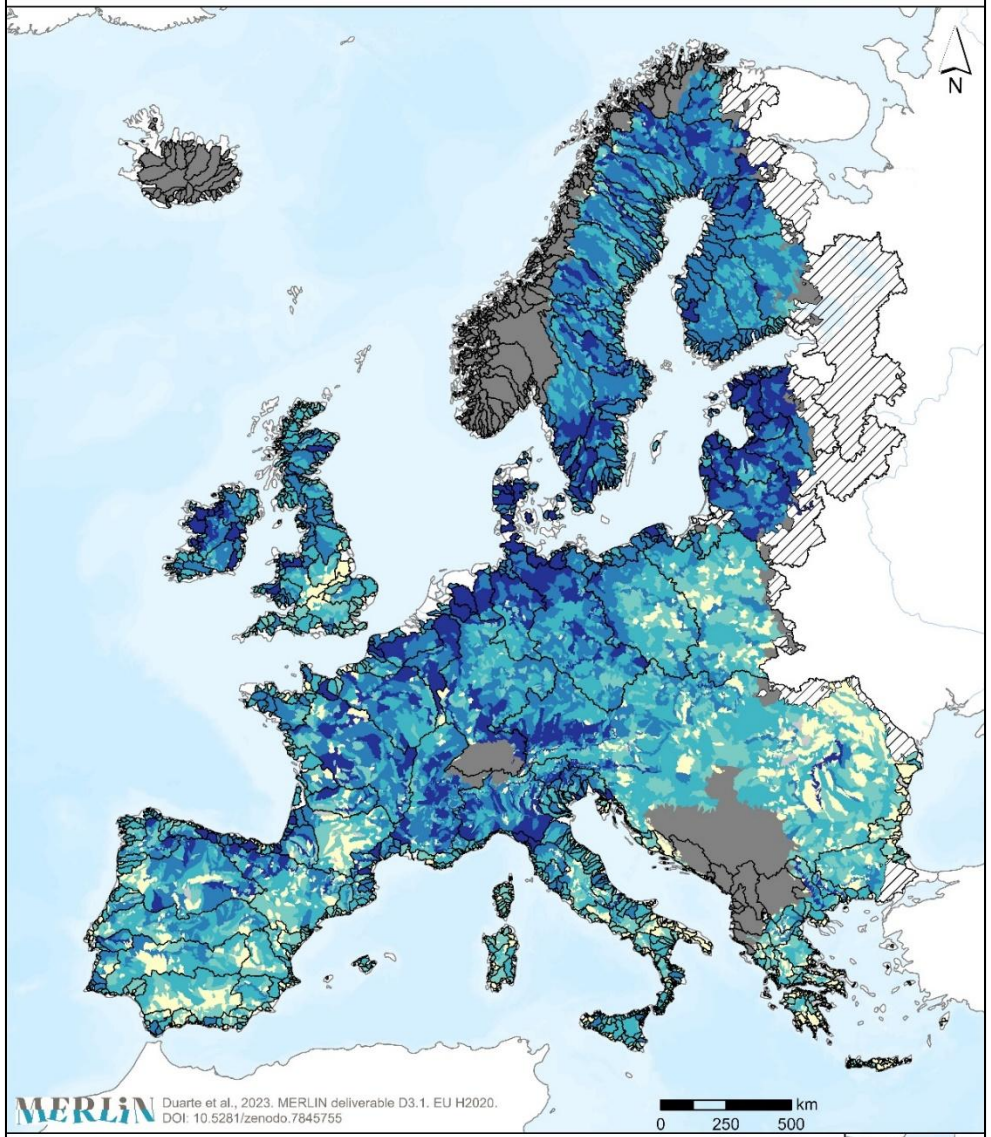
Typology of River Restoration Units



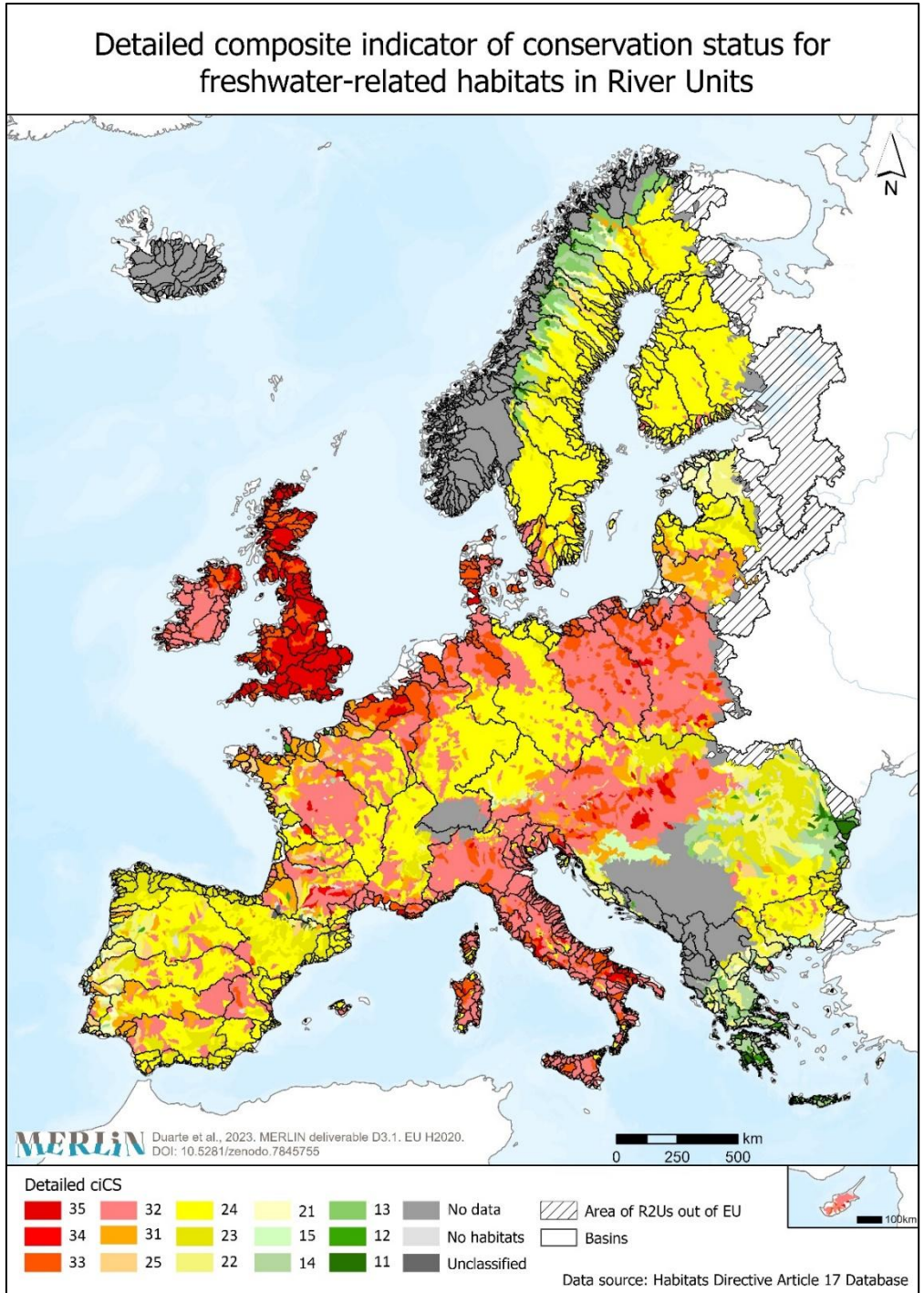
Typology of River Restoration Units



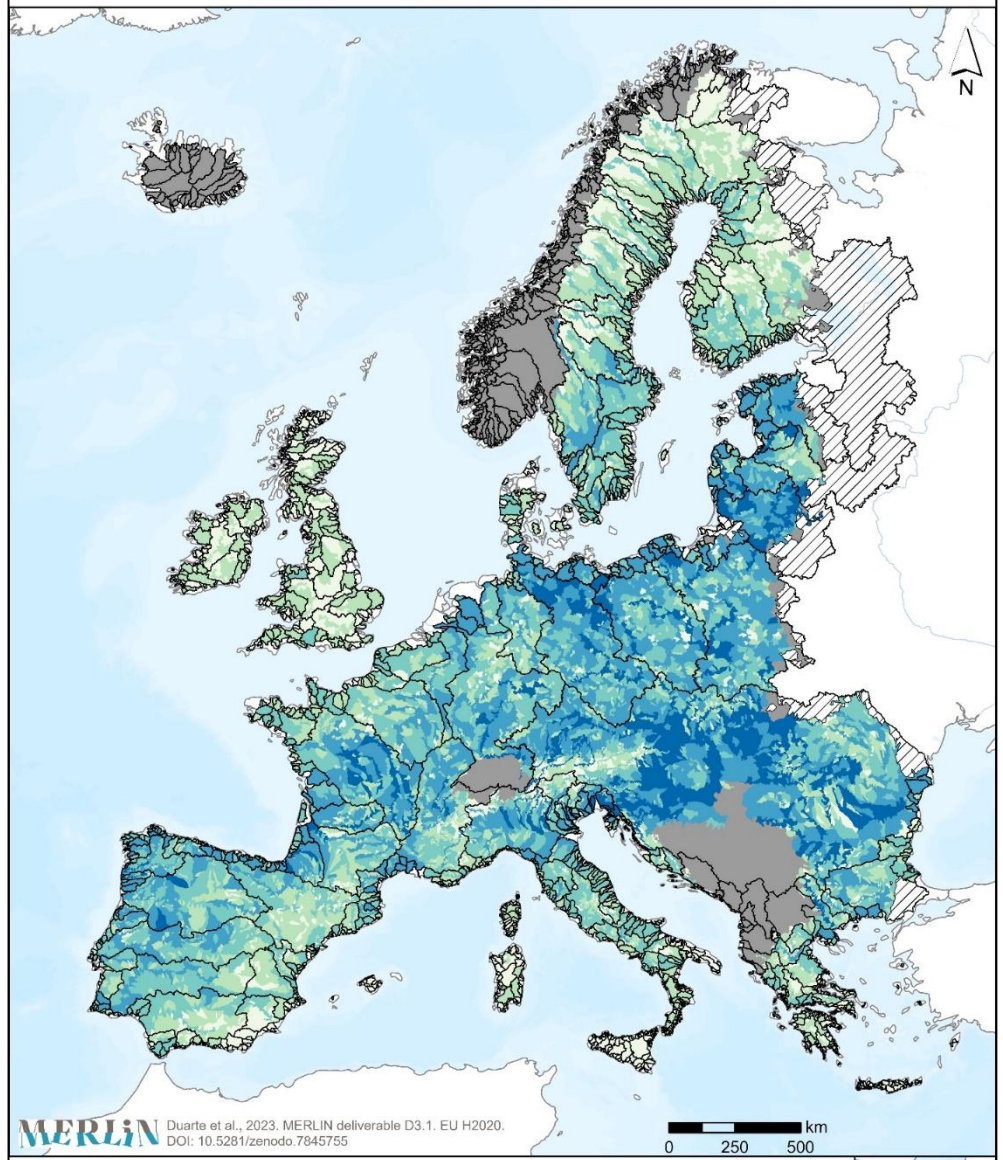
Number of freshwater-related protected habitats under the Habitats Directive in River Units



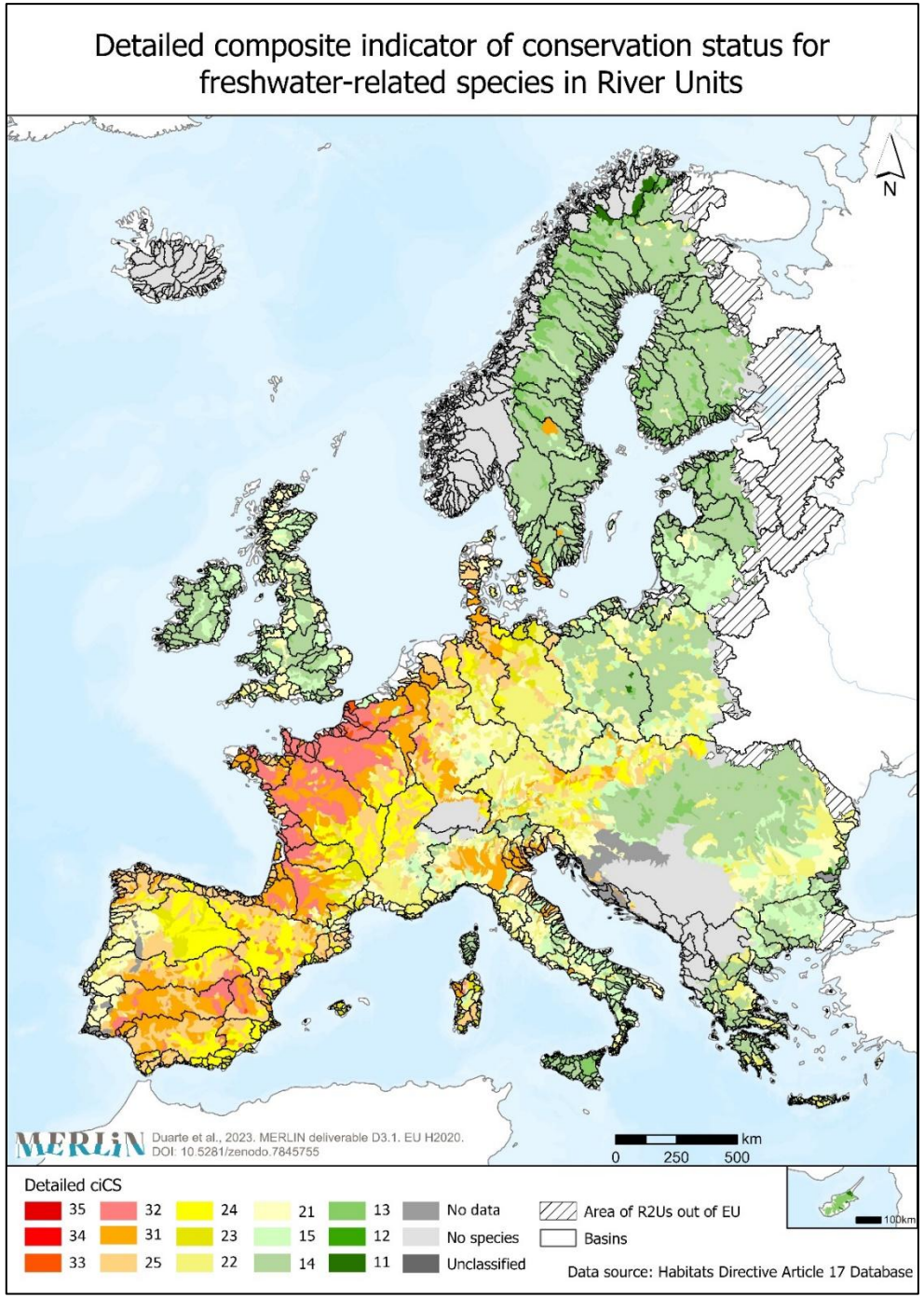
Habitat related needs



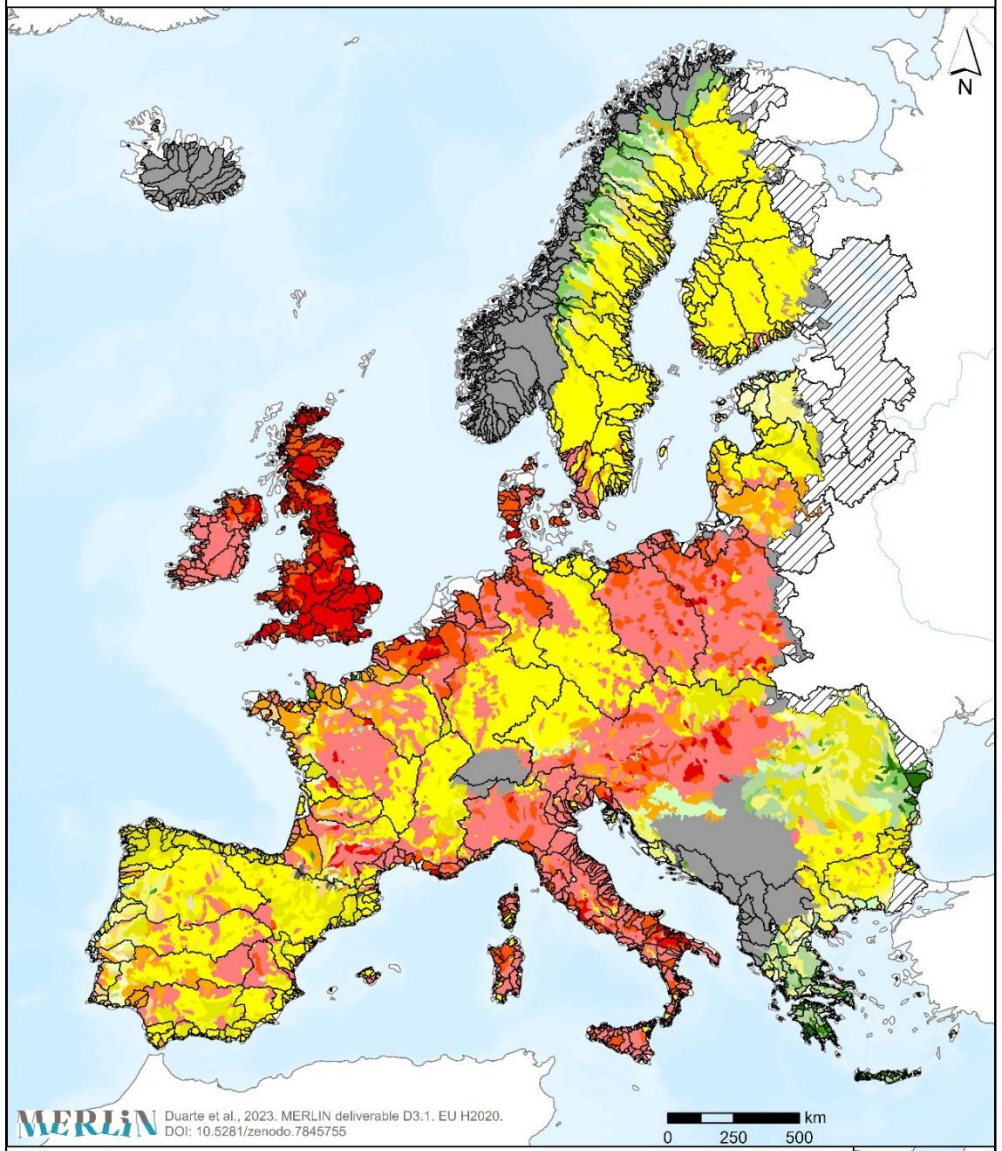
Number of freshwater-related protected species under the Habitats Directive in River Units



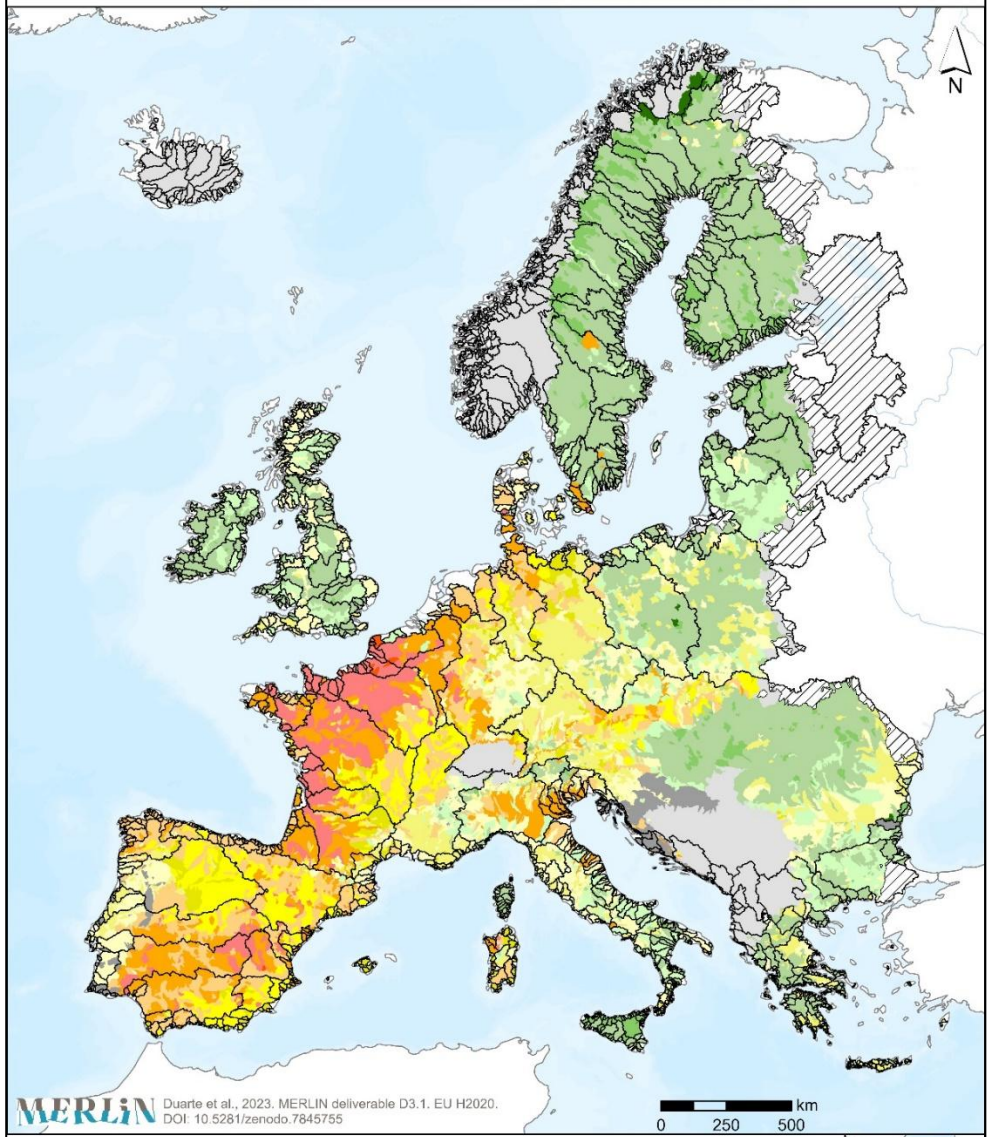
Species related needs

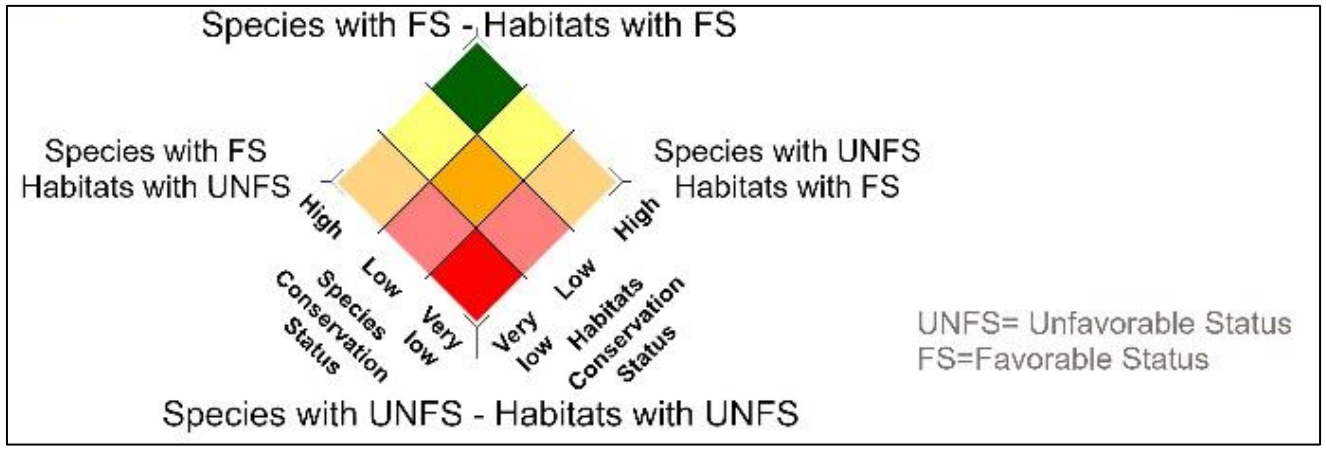


Detailed composite indicator of conservation status for freshwater-related habitats in River Units

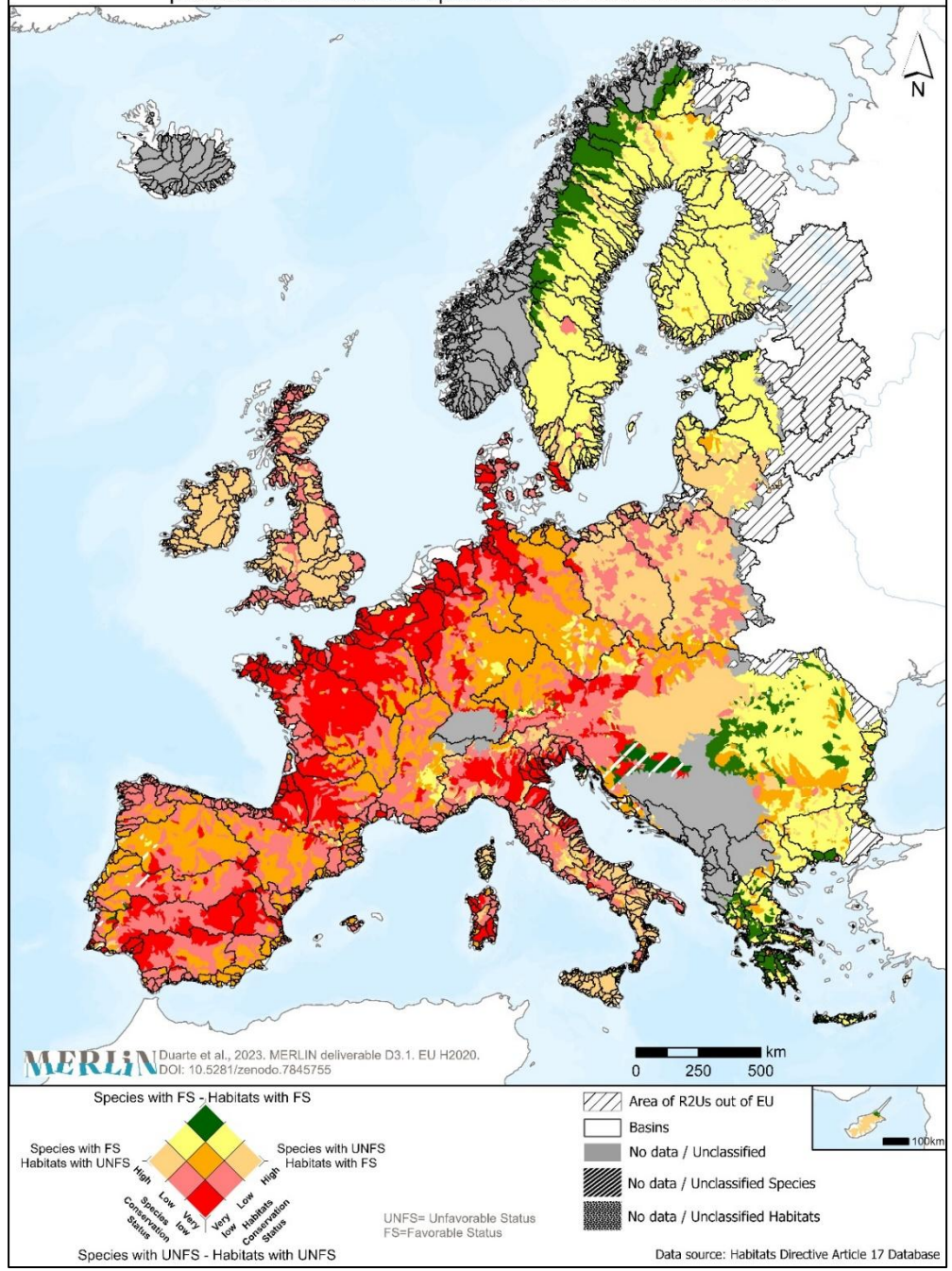


Detailed composite indicator of conservation status for freshwater-related species in River Units

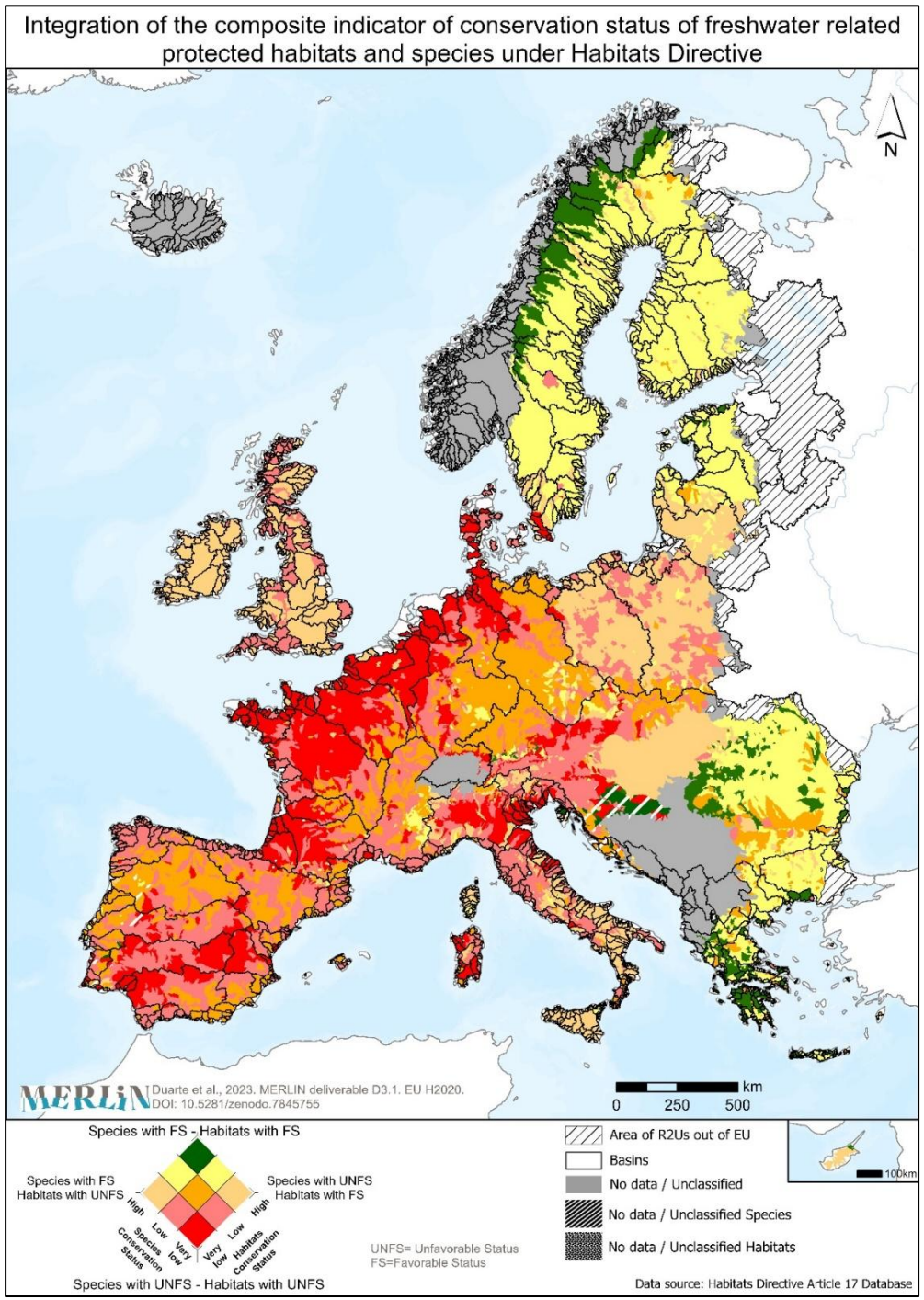




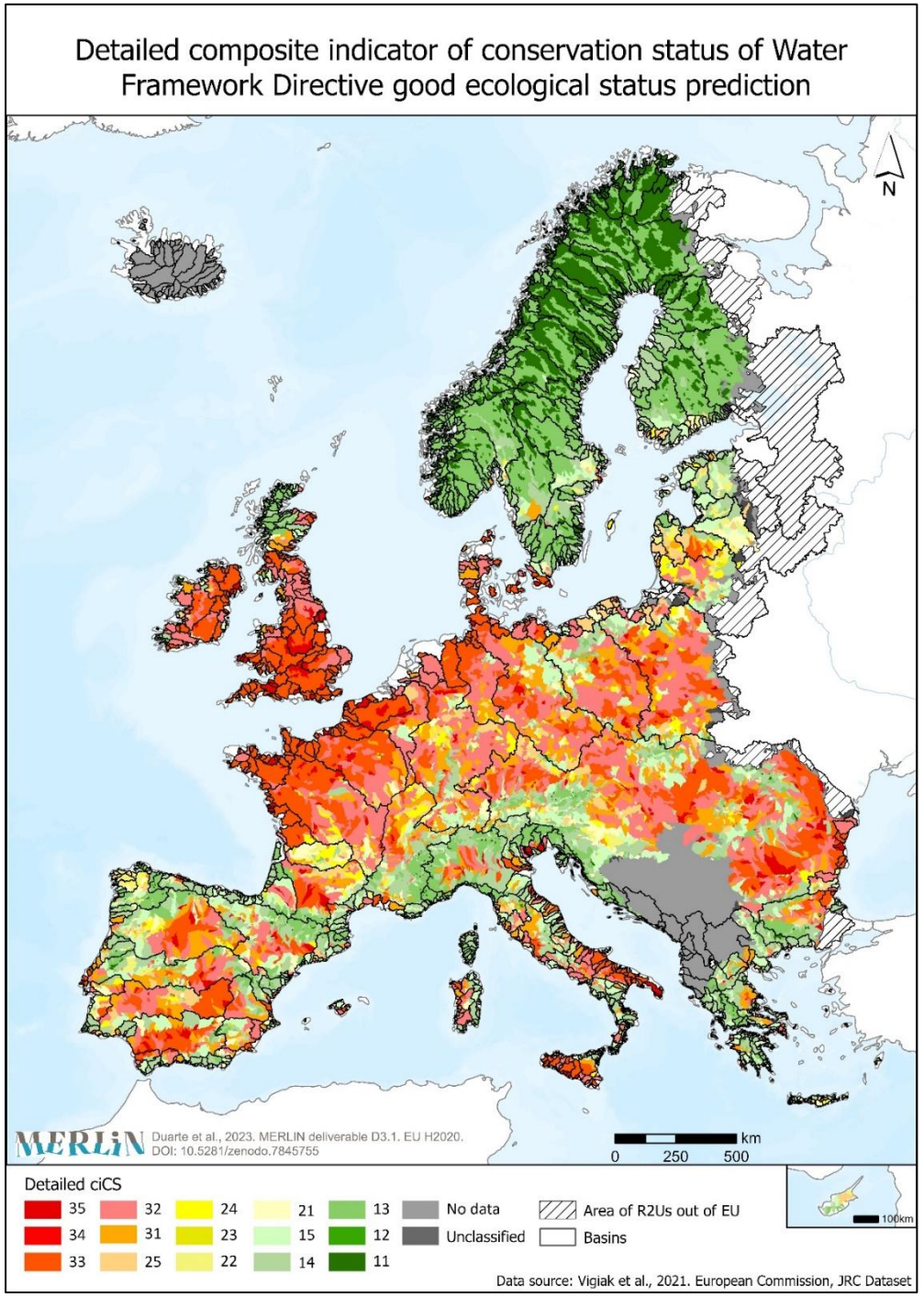
Integration of the composite indicator of conservation status of freshwater related protected habitats and species under Habitats Directive



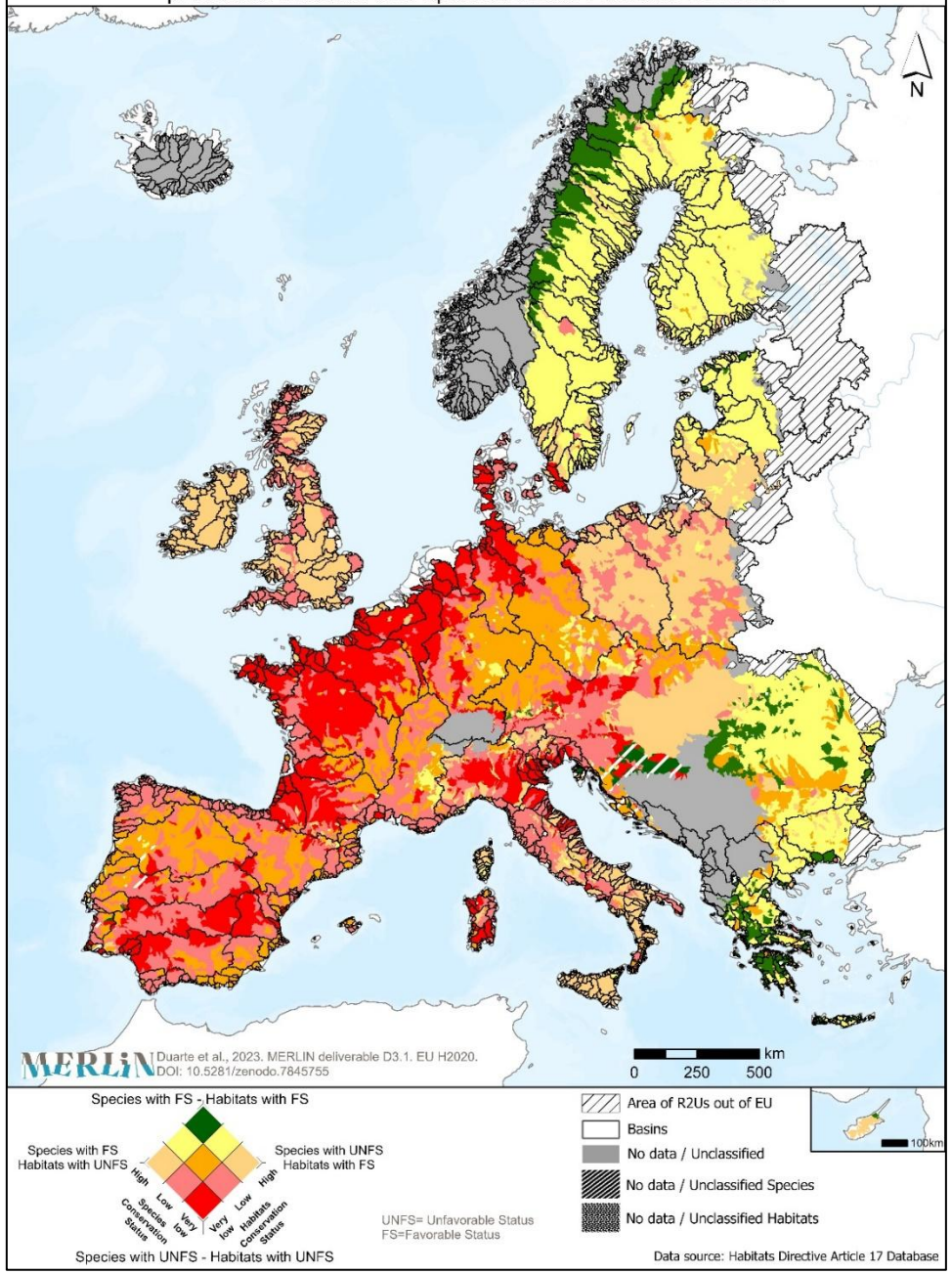
Habitats Directive needs



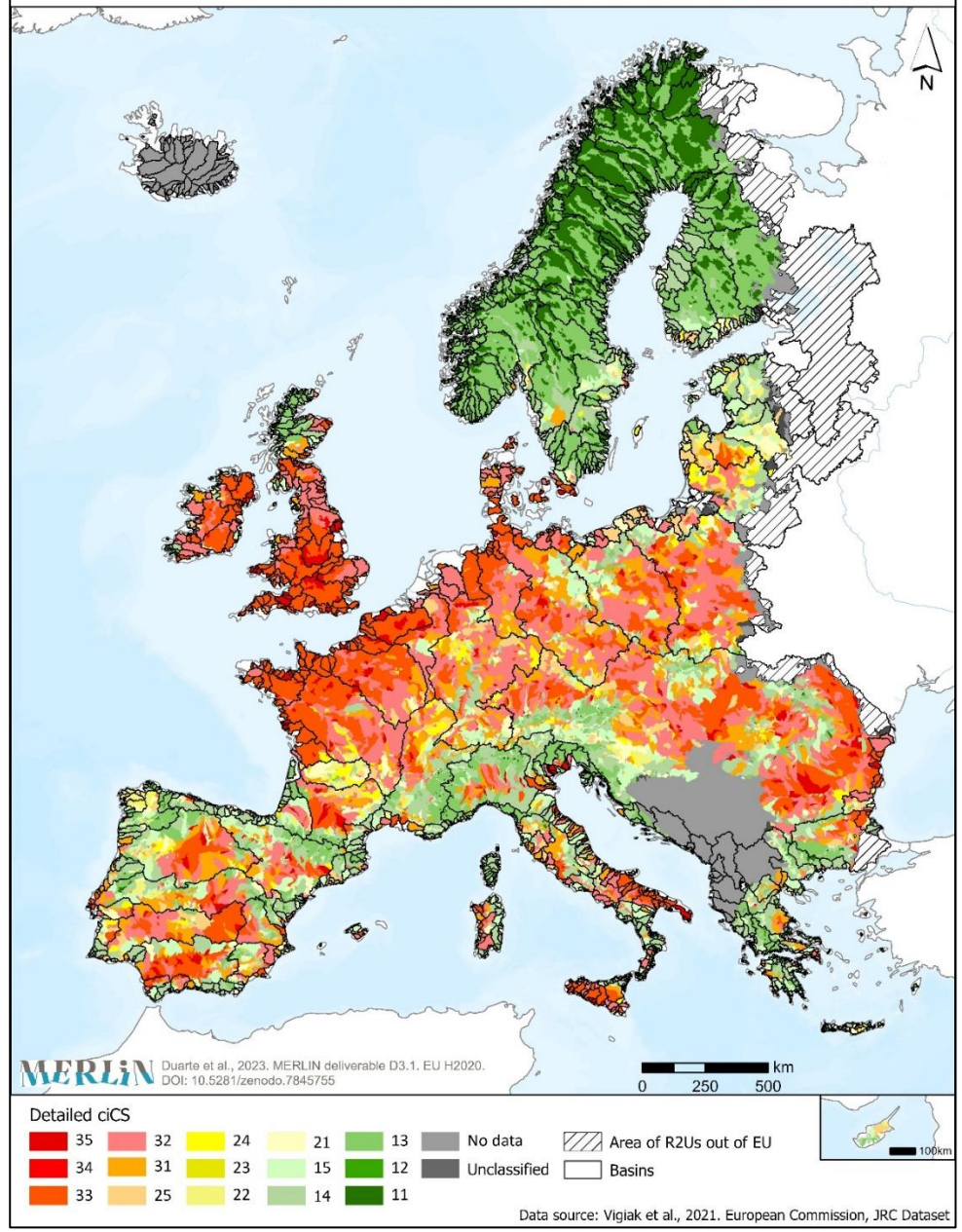
WFD needs

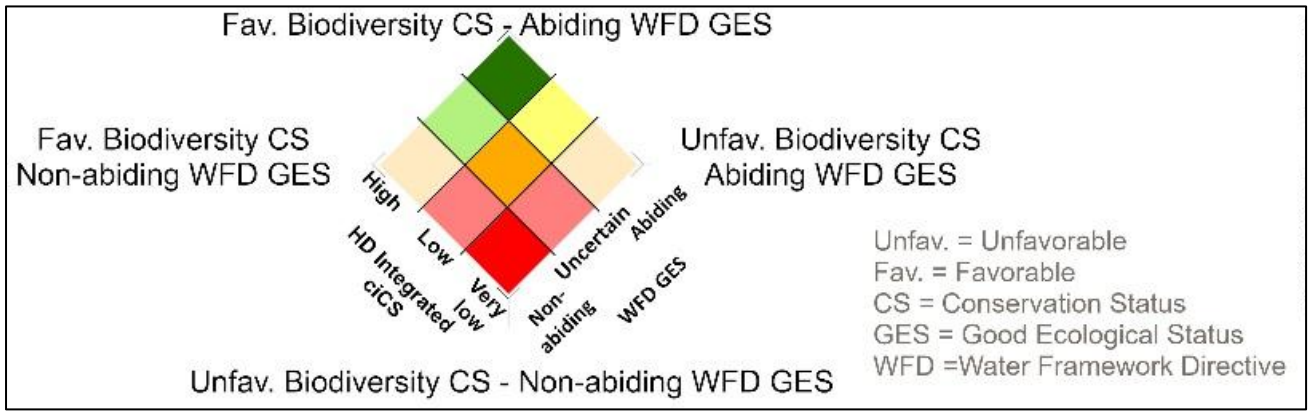

Detailed composite indicator of conservation status of Water Framework Directive good ecological status prediction
N
MERLIN
Duarte et al., 2023. MERLIN deliverable D3.1. EU H2020.
DOI: 10.5281/zenodo.7845755
km
0 250 500
Detailed ciCS
35 32 24 21 13 No data Area of R2Us out of EU
34 31 23 15 12 Unclassified Basins
33 25 22 14 11
100km
Data source: Vigiak et al., 2021. European Commission, JRC Dataset

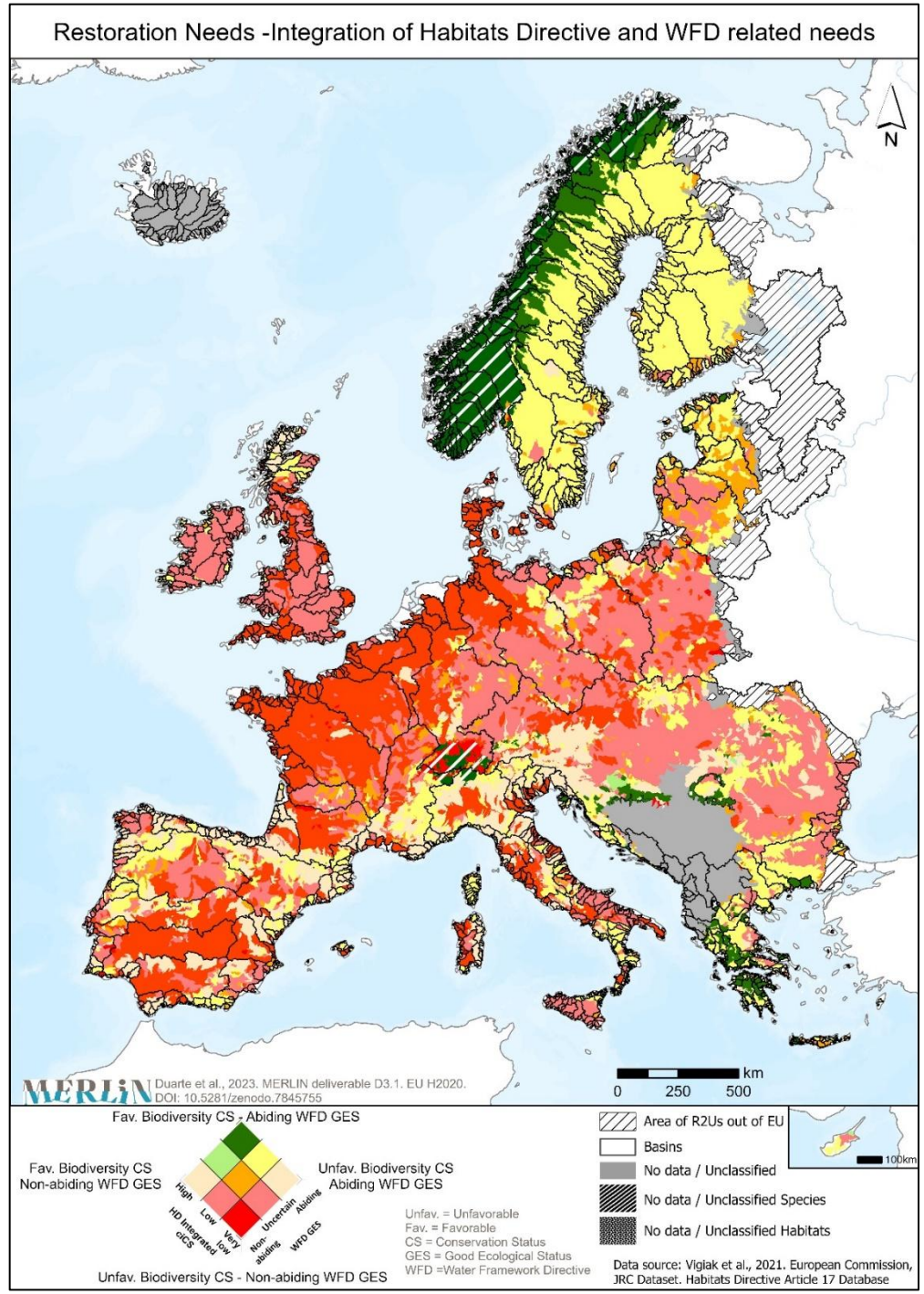
Integration of the composite indicator of conservation status of freshwater related protected habitats and species under Habitats Directive



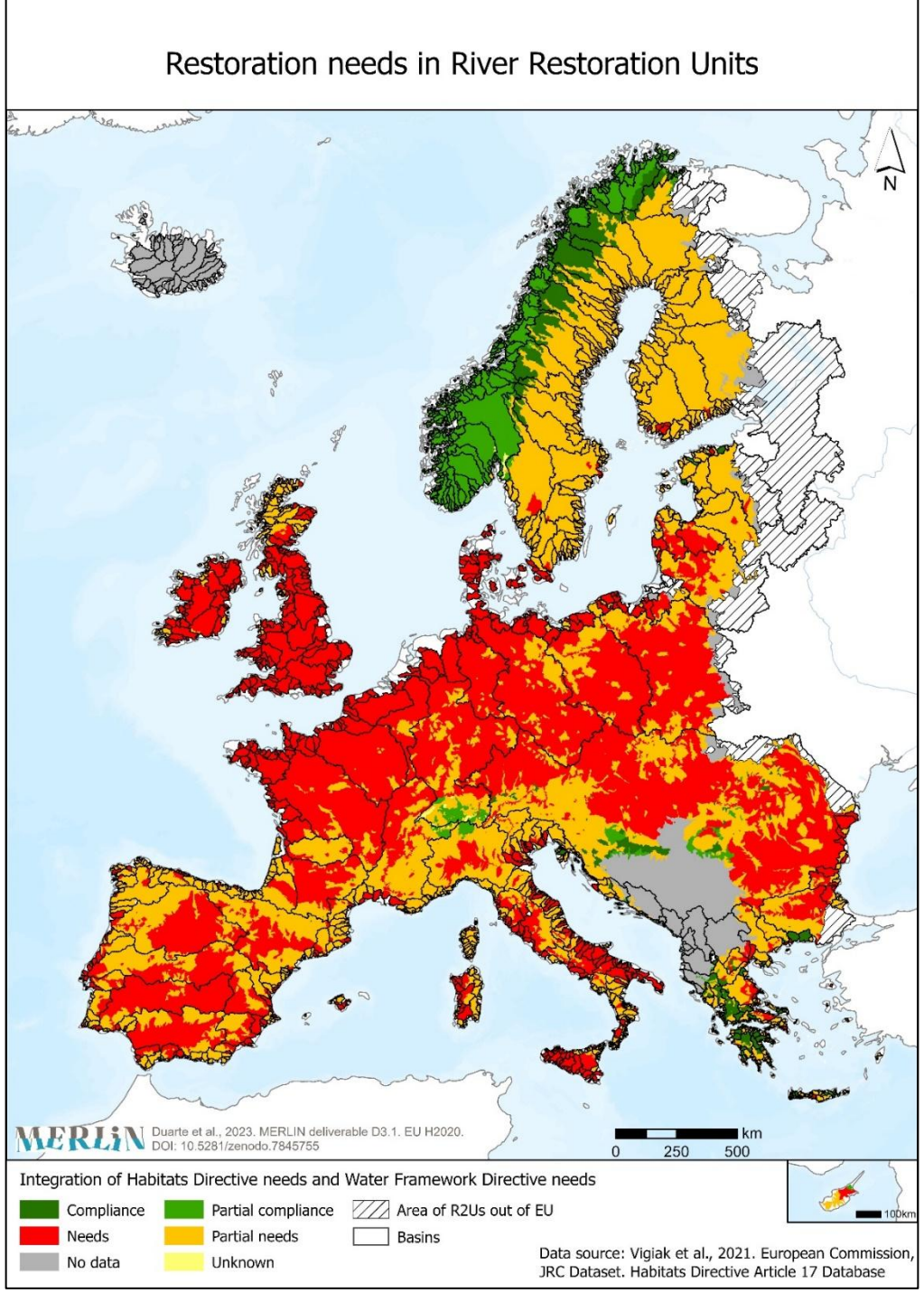
Detailed composite indicator of conservation status of Water Framework Directive good ecological status prediction




Fav. Biodiversity CS - Abiding WFD GES
Fav. Biodiversity CS
Non-abiding WFD GES
Unfav. Biodiversity CS
Abiding WFD GES
High
Low
Uncertain
Abiding
HD Integrated
ciCS
Very
low
Non-
abiding
WFD GES
Unfav. Biodiversity CS - Non-abiding WFD GES
Unfav. = Unfavorable
Fav. = Favorable
CS = Conservation Status
GES = Good Ecological Status
WFD =Water Framework Directive

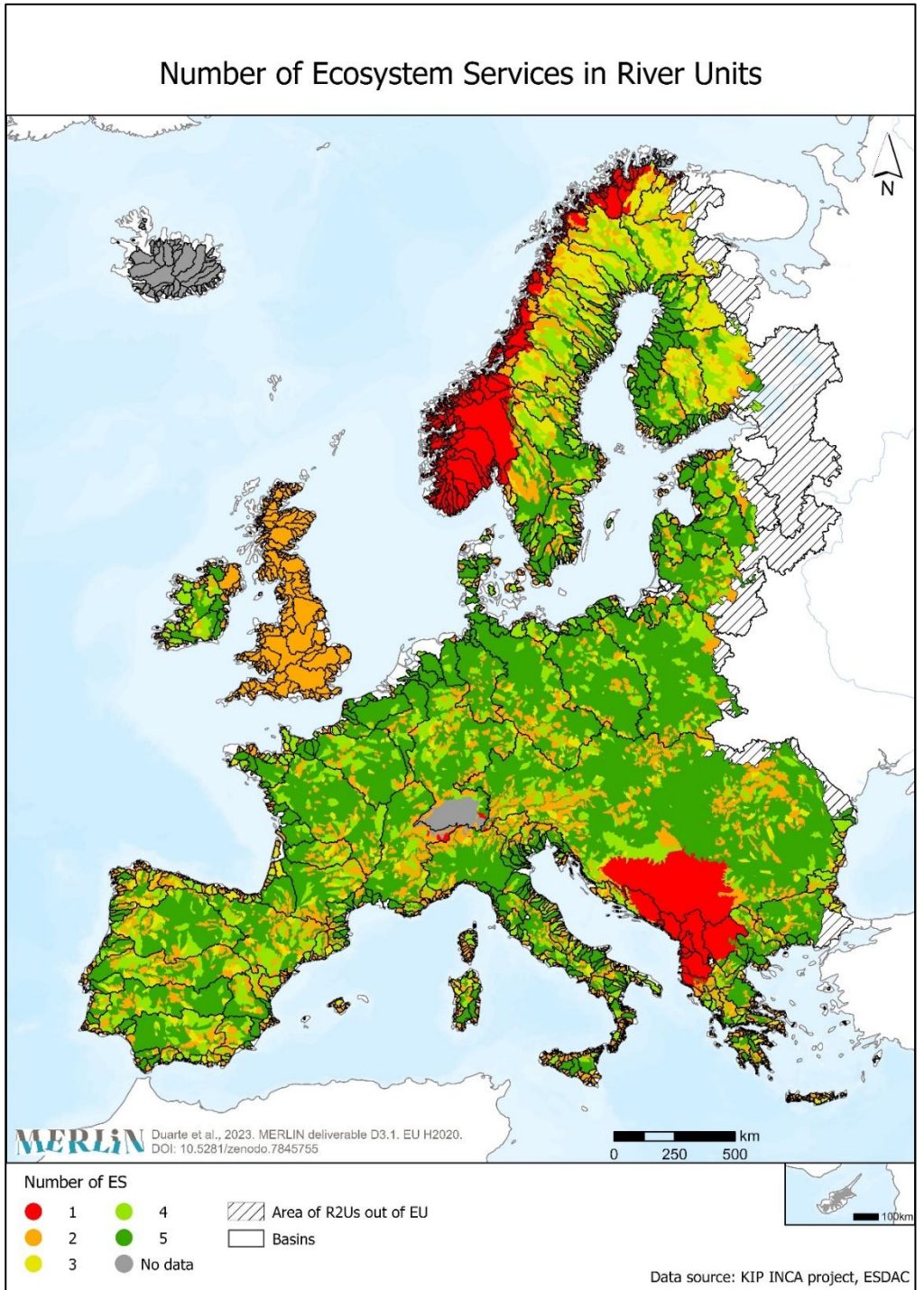

Restoration Needs -Integration of Habitats Directive and WFD related needs
N
MERLIN
Duarte et al., 2023. MERLIN deliverable D3.1. EU H2020.
DOI: 10.5281/zenodo.7845755
km
0
250
500
Fav. Biodiversity CS - Abiding WFD GES
Fav. Biodiversity CS
Non-abiding WFD GES
Unfav. Biodiversity CS
Abiding WFD GES
Unfav. Biodiversity CS - Non-abiding WFD GES
Unfav. = Unfavorable
Fav. = Favorable
CS = Conservation Status
GES = Good Ecological Status
WFD =Water Framework Directive
Area of R2Us out of EU
Basins
No data / Unclassified
No data / Unclassified Species
No data / Unclassified Habitats
100km
Data source: Vigiak et al., 2021. European Commission,
JRC Dataset. Habitats Directive Article 17 Database

Restoration needs

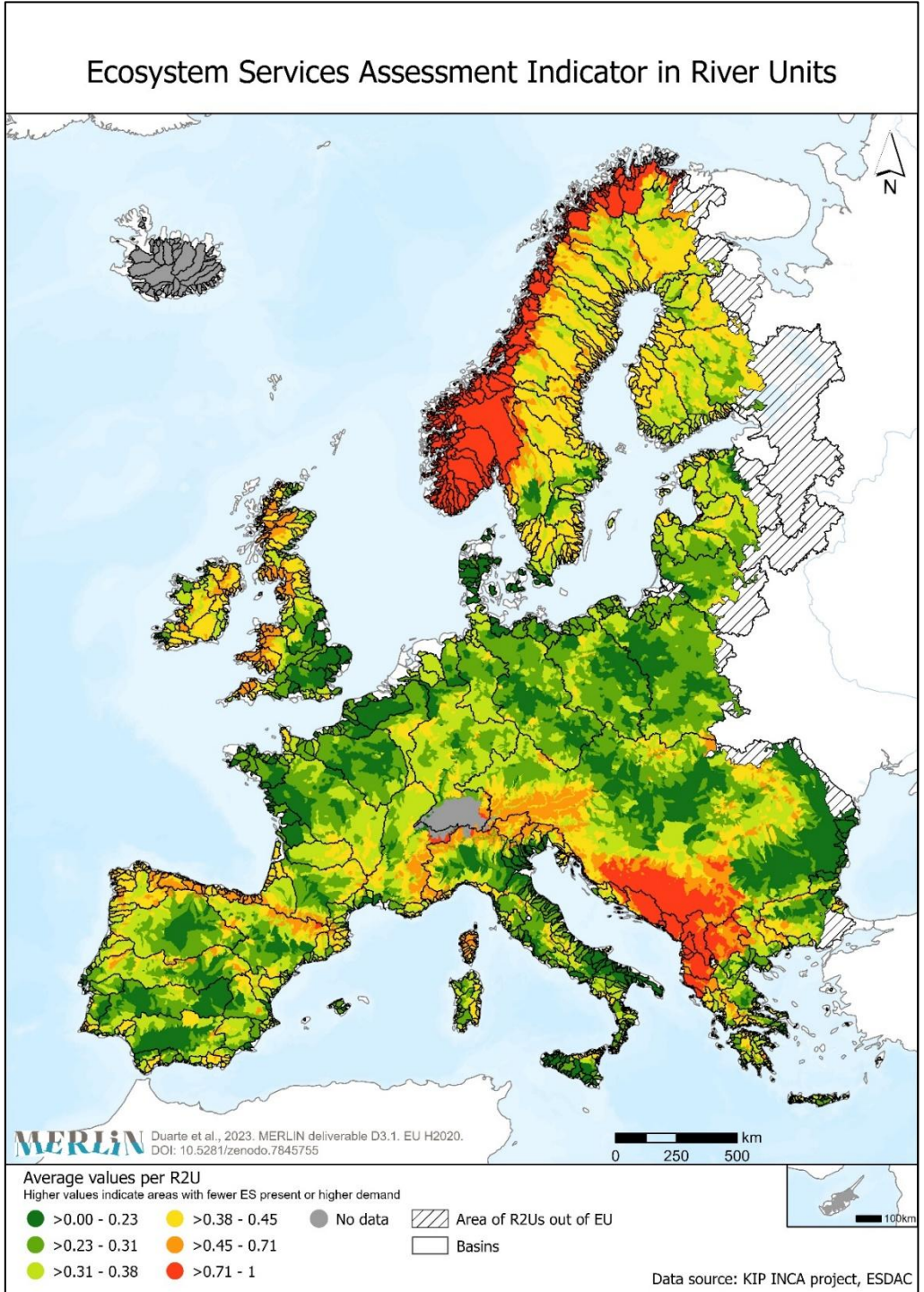


Restoration potentials

Restoration potentials

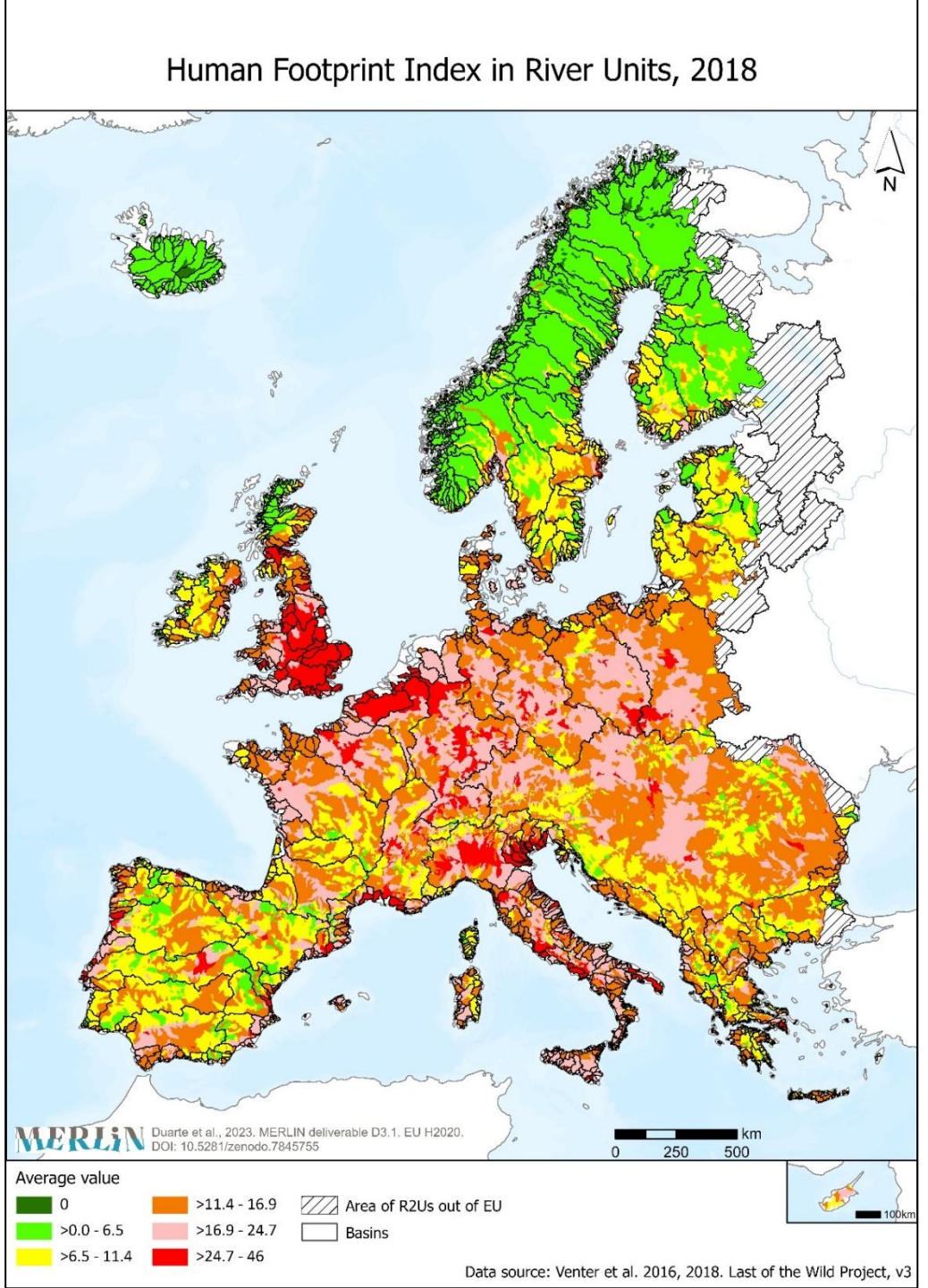


Restoration potential Co-benefits



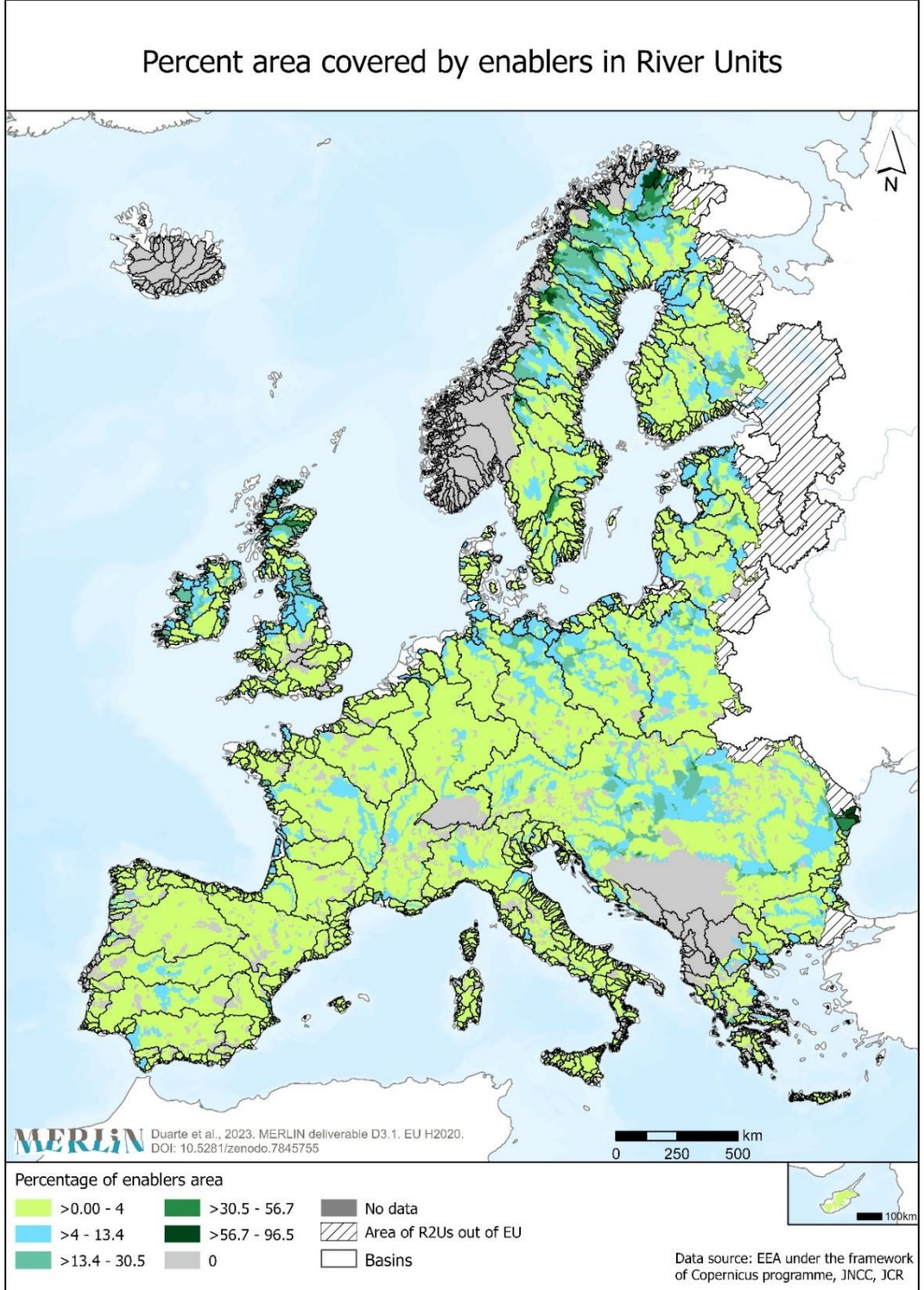
Restoration constrains

Restoration constrains



Restoration enablers

Restoration enablers



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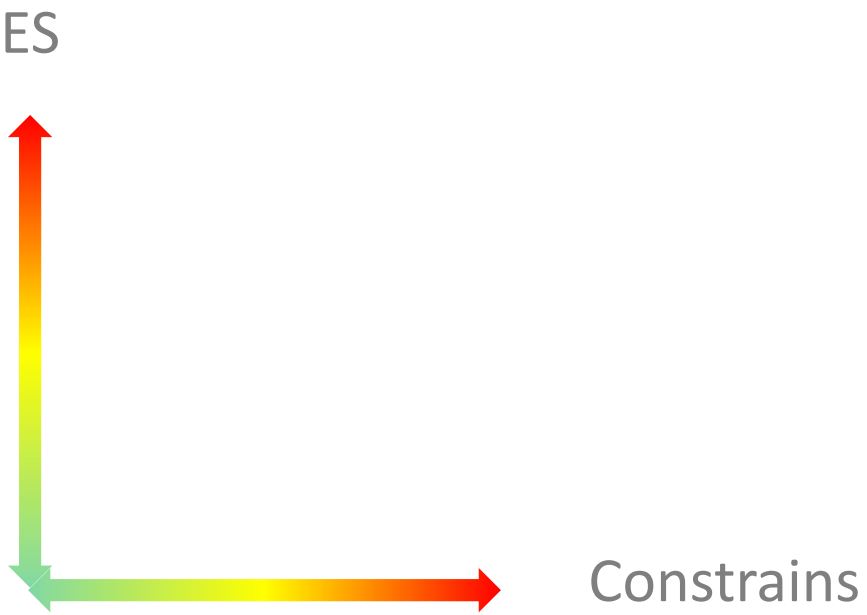
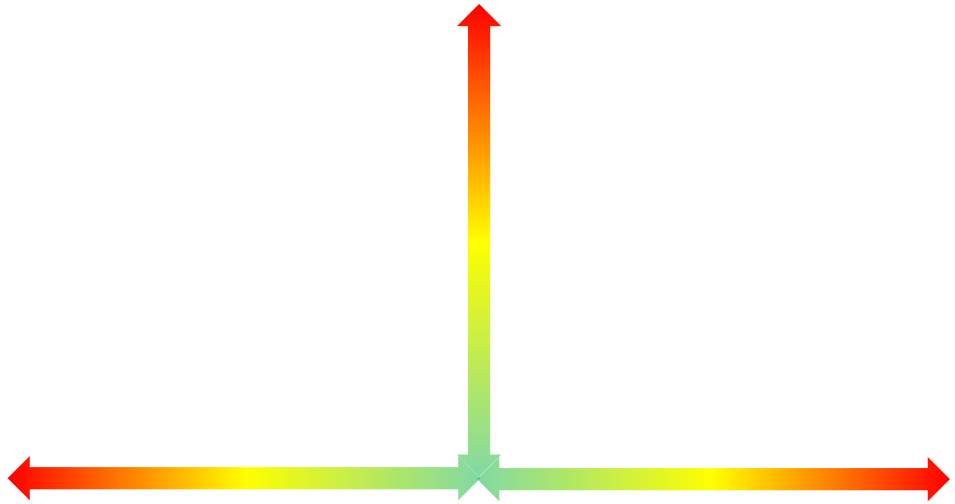

ES
Constrains

ES



Enablers

Constrains

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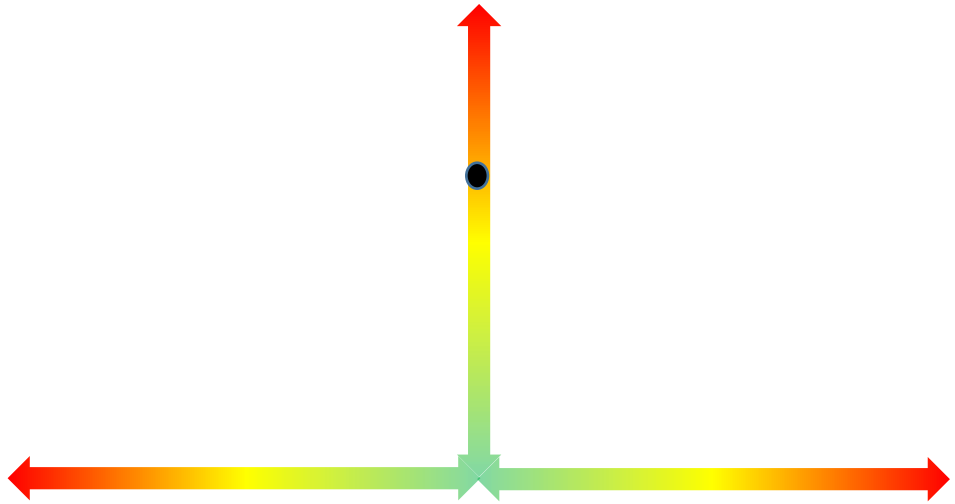

Enablers

Constrains

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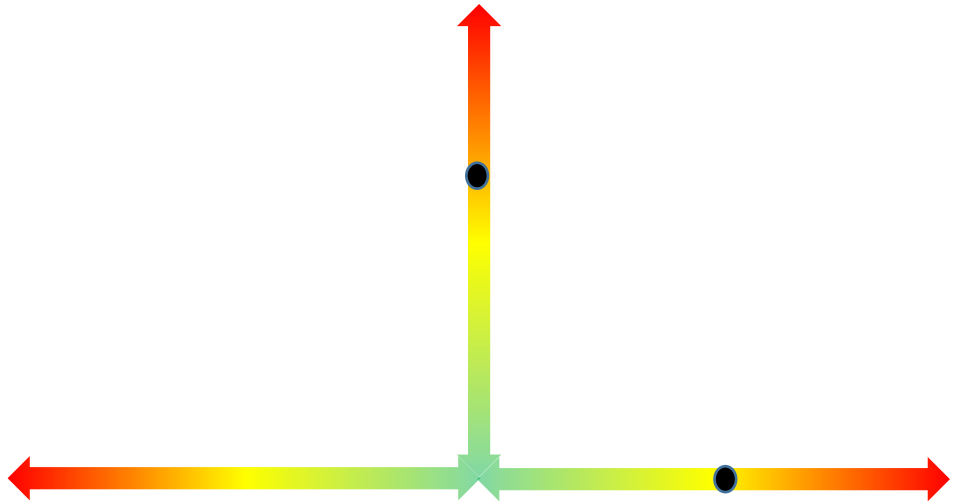
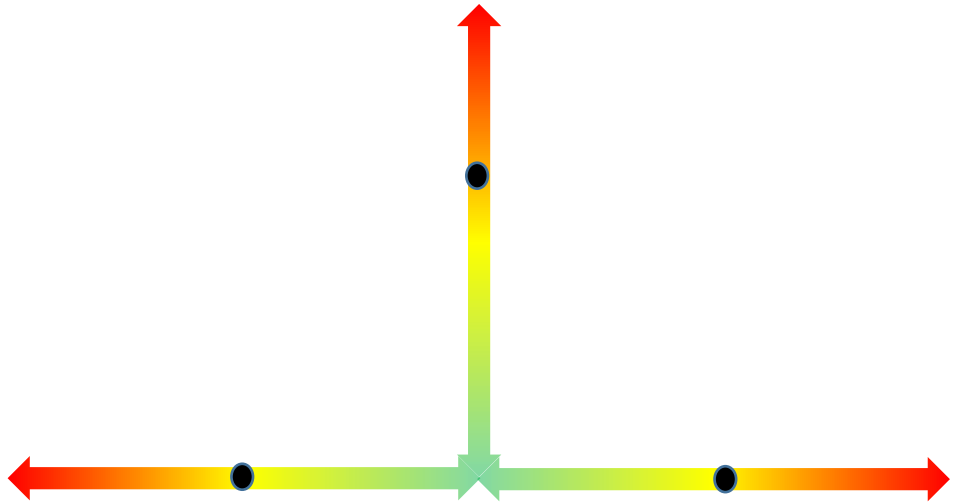


Enablers

Constrains

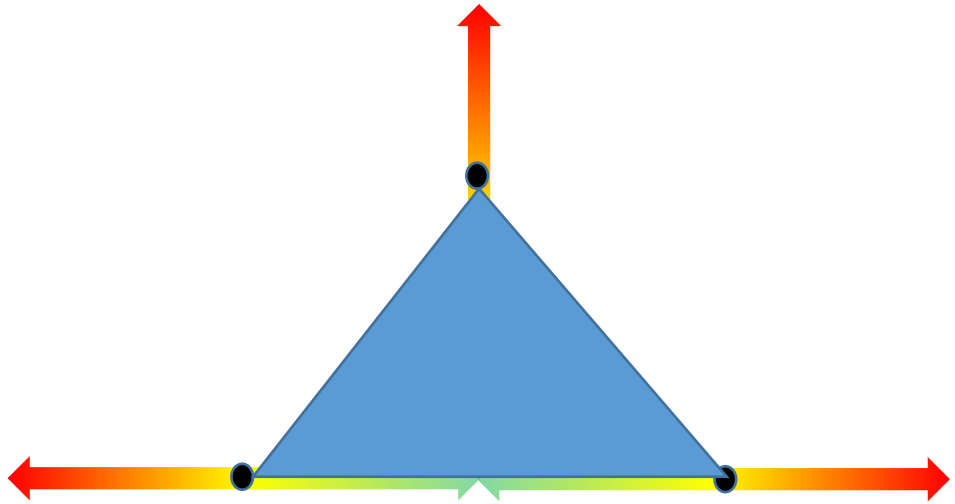
ES



Enablers

Constrains

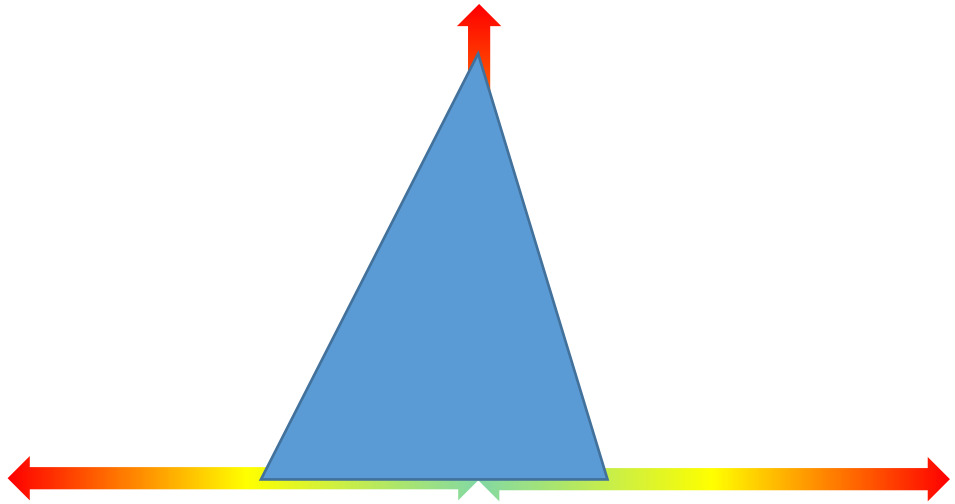
ES



Enablers

Constrains

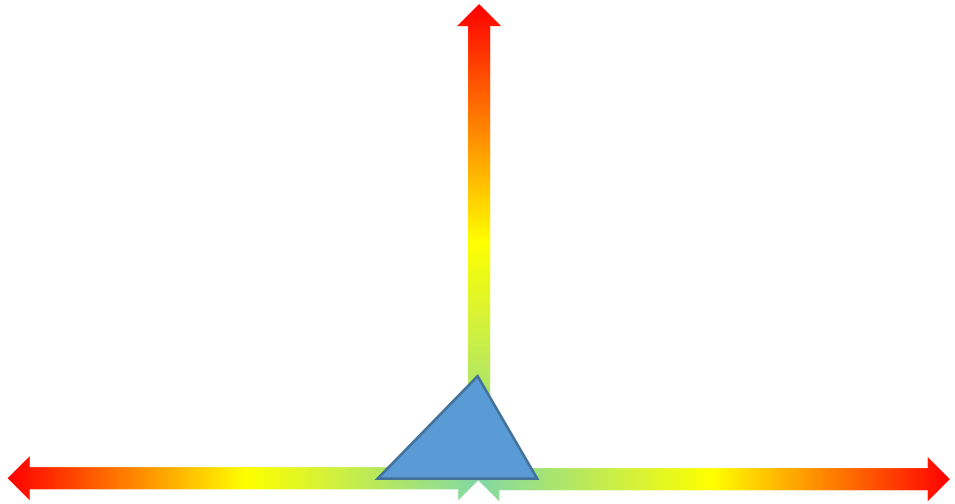
ES



Enablers

Constrains

ES



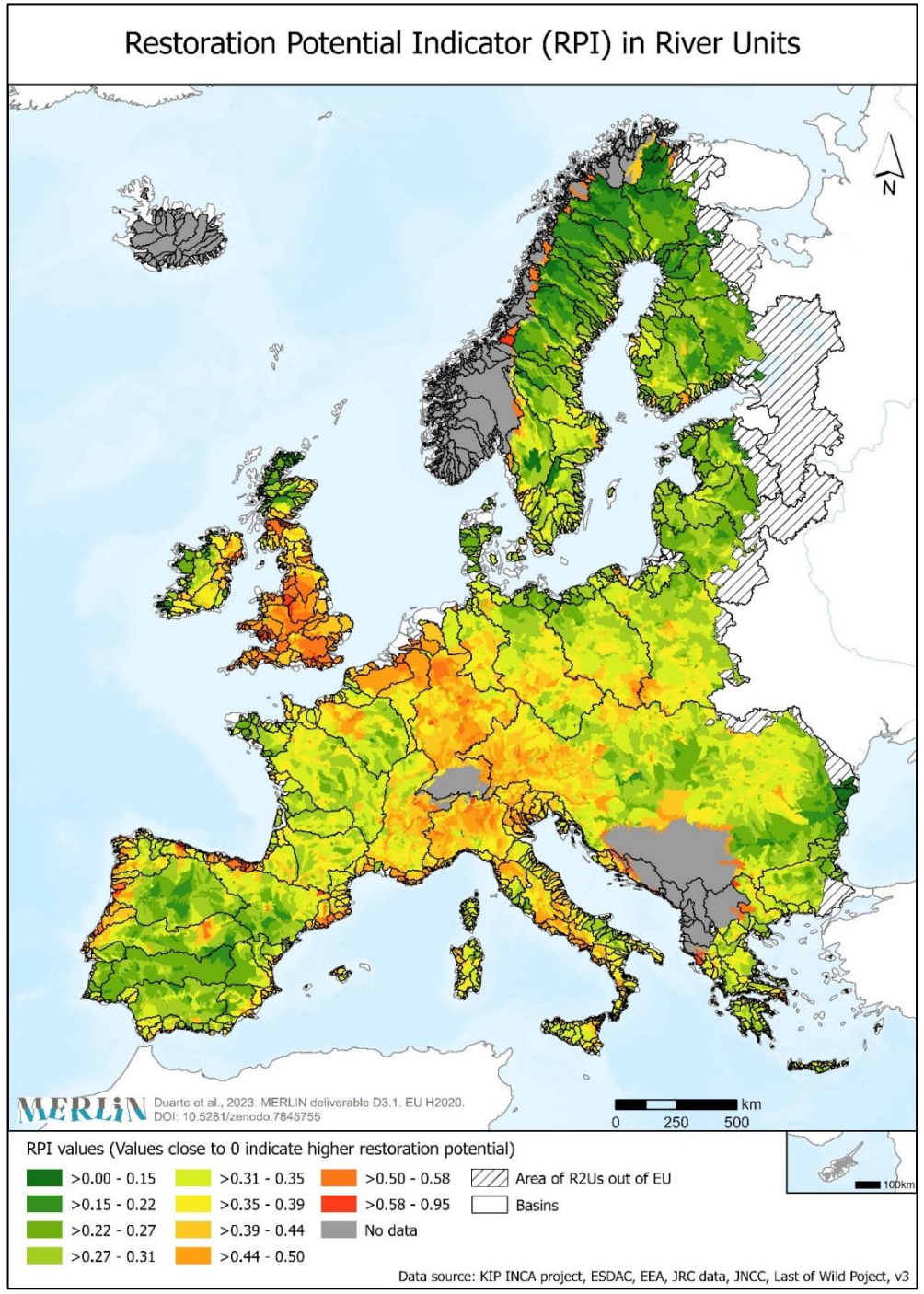
Enablers

Constrains

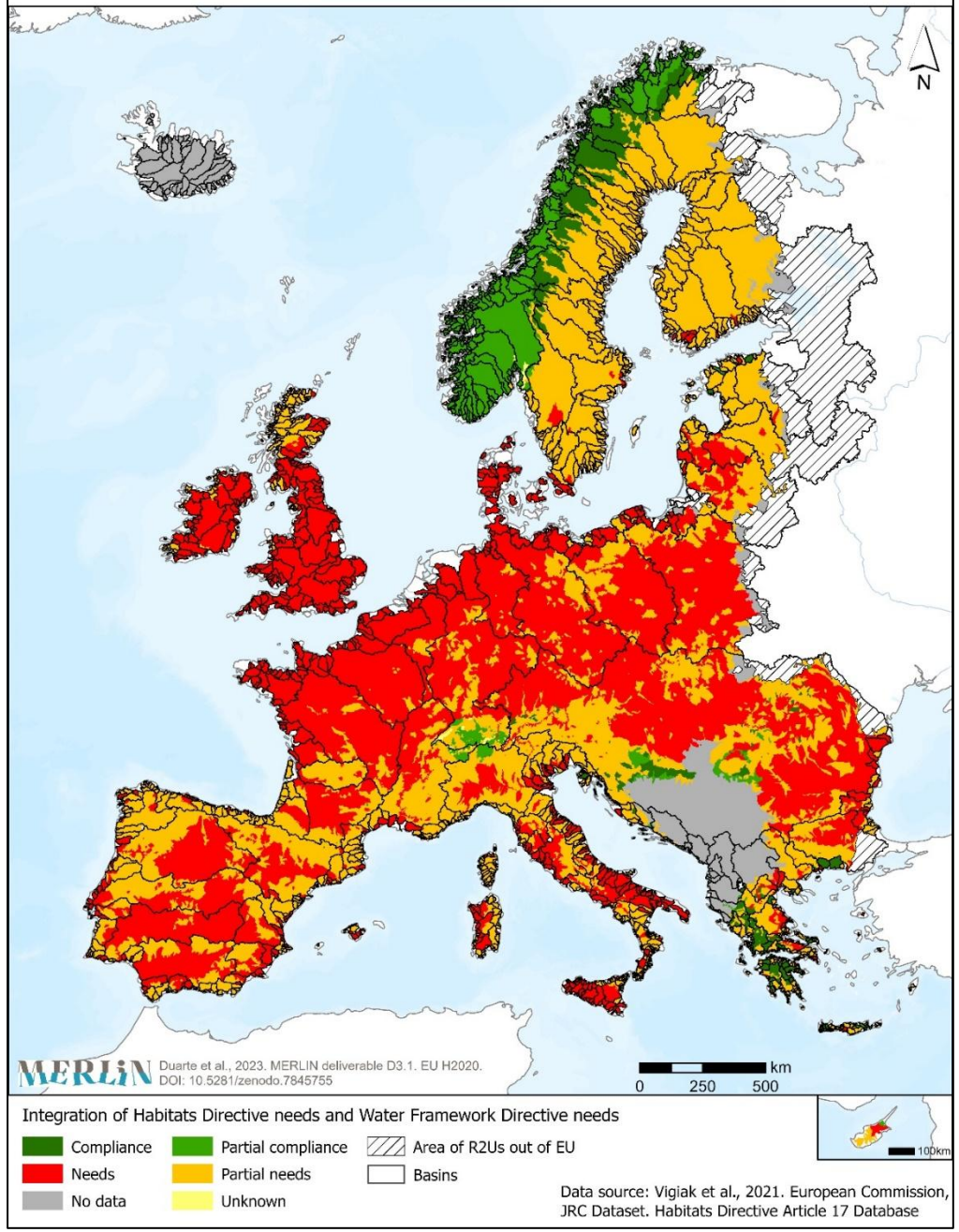
Restoration Potential Indicator

Restoration potential

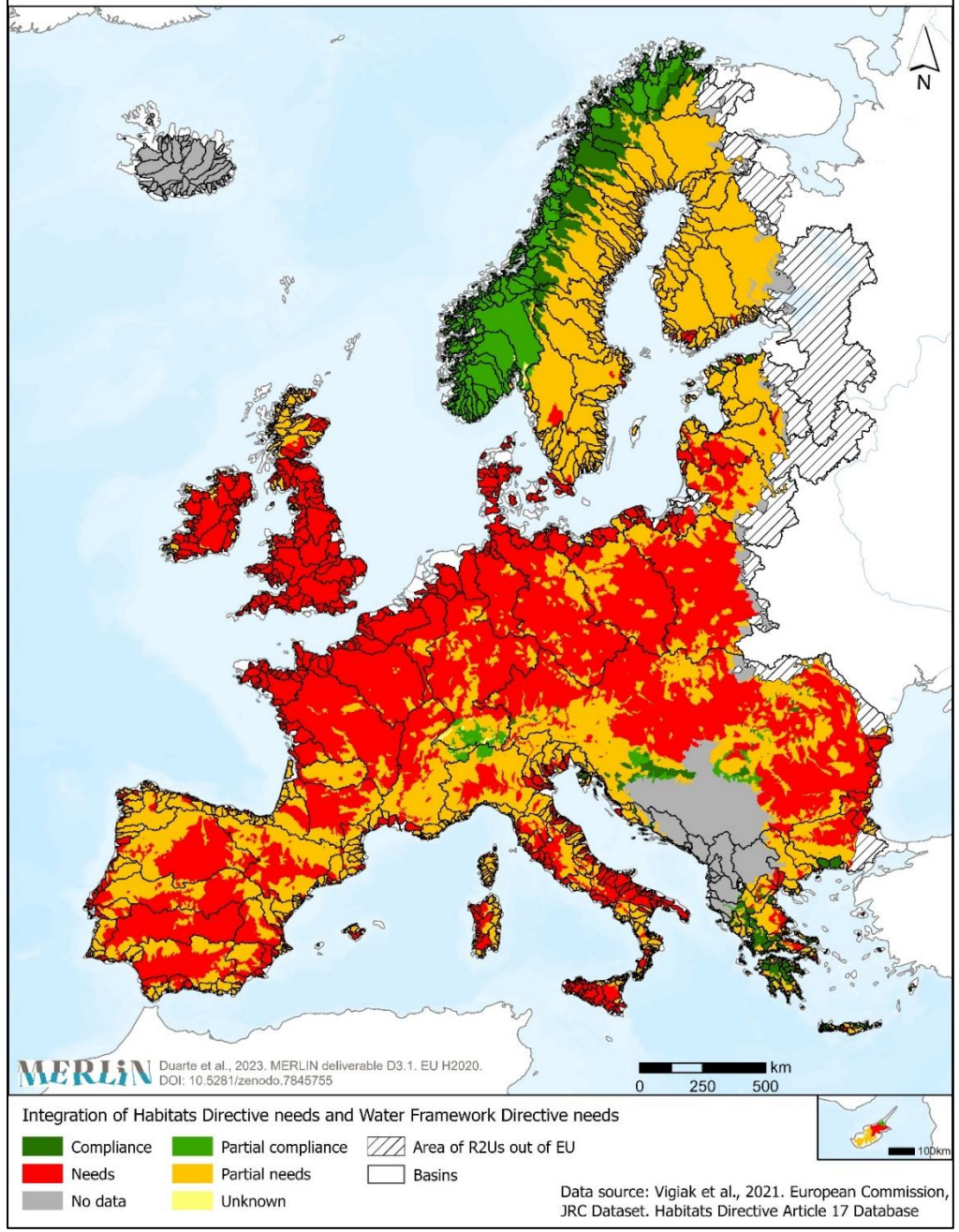
Restoration potential



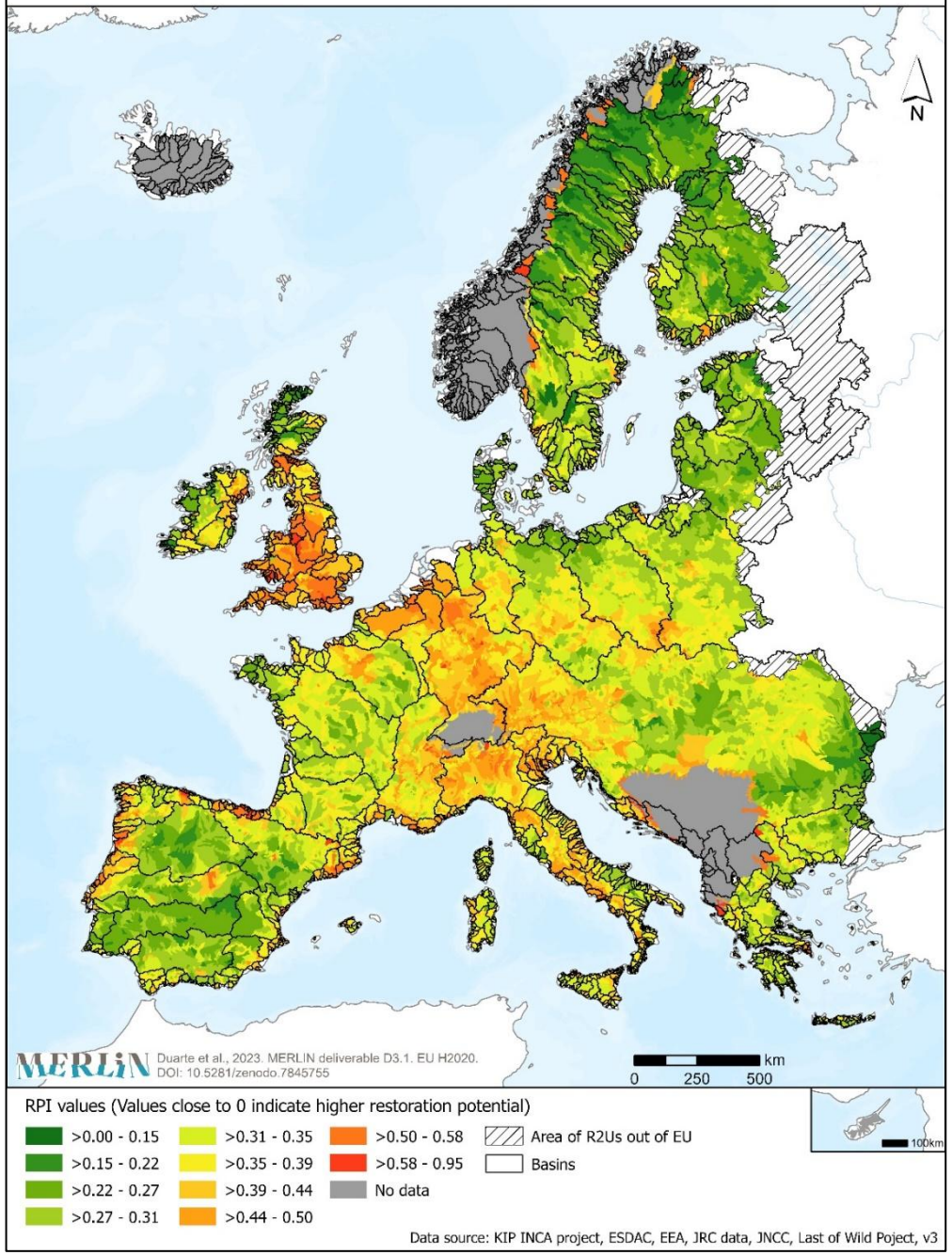
Restoration needs in River Restoration Units



Restoration needs in River Restoration Units



Restoration Potential Indicator (RPI) in River Units

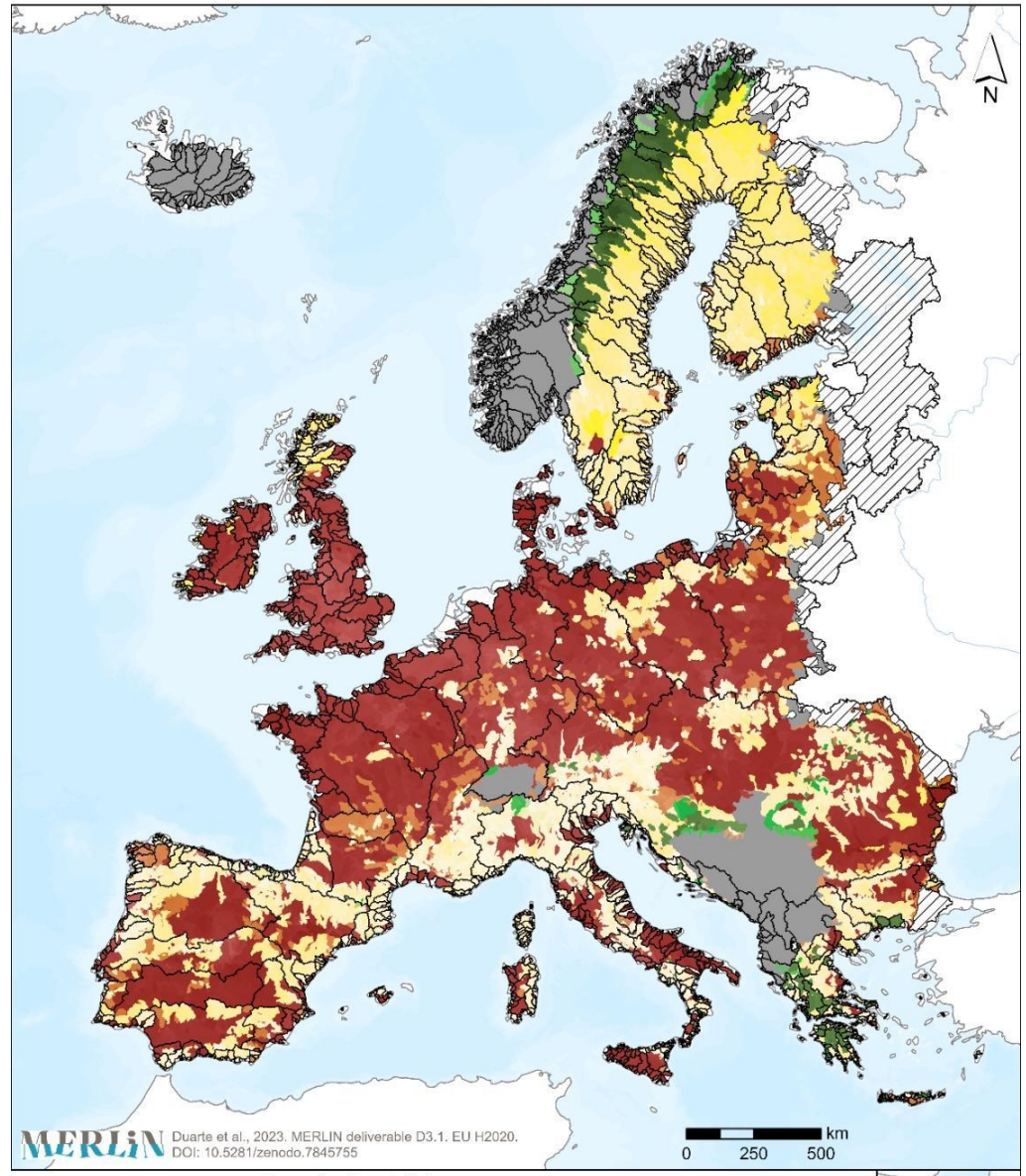


Restoration Potential Index
(the lower the values the greater the potential)

High ◄——— Low

Full compliance	0.013		0.63	Restoration needs
Partial compliance	0.25		0.65	
Partial compliance + Partial needs	0.006		0.80	
Partial needs	0.041		0.76	
Full needs	0.015		0.96	High

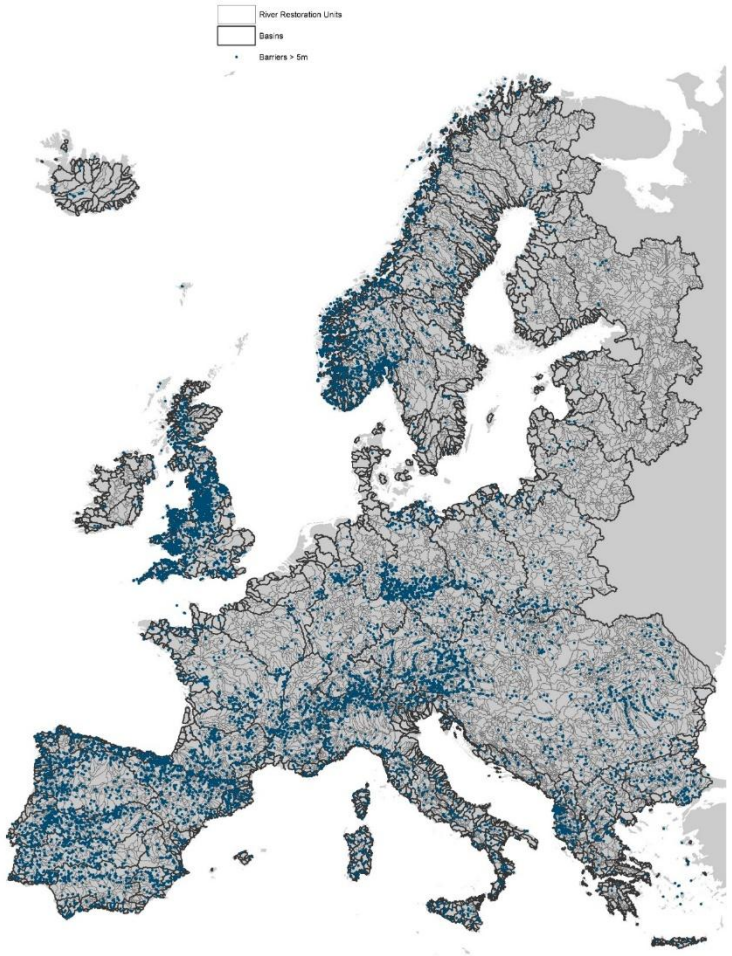
Integration of Restoration Needs and Potential in River Units

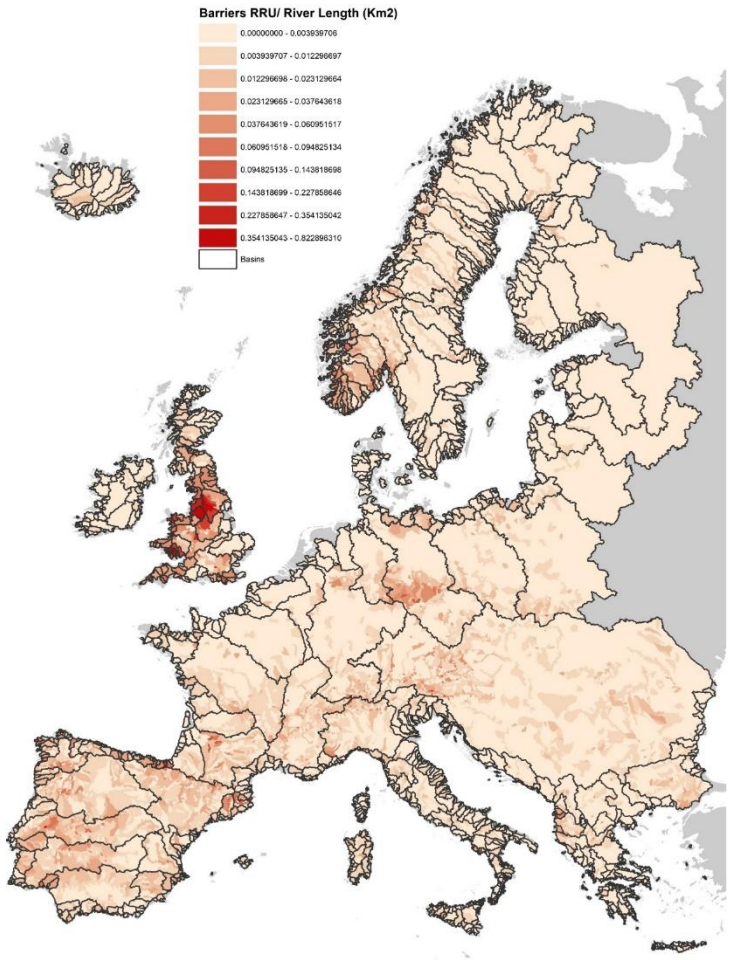


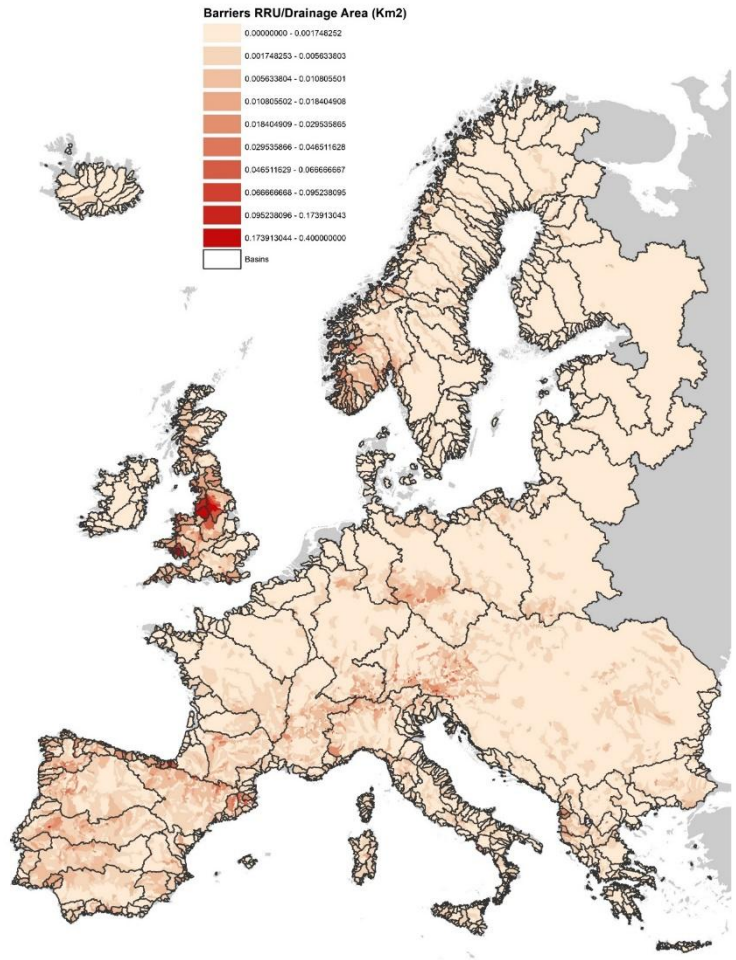
Dammed
Fish

Main goal

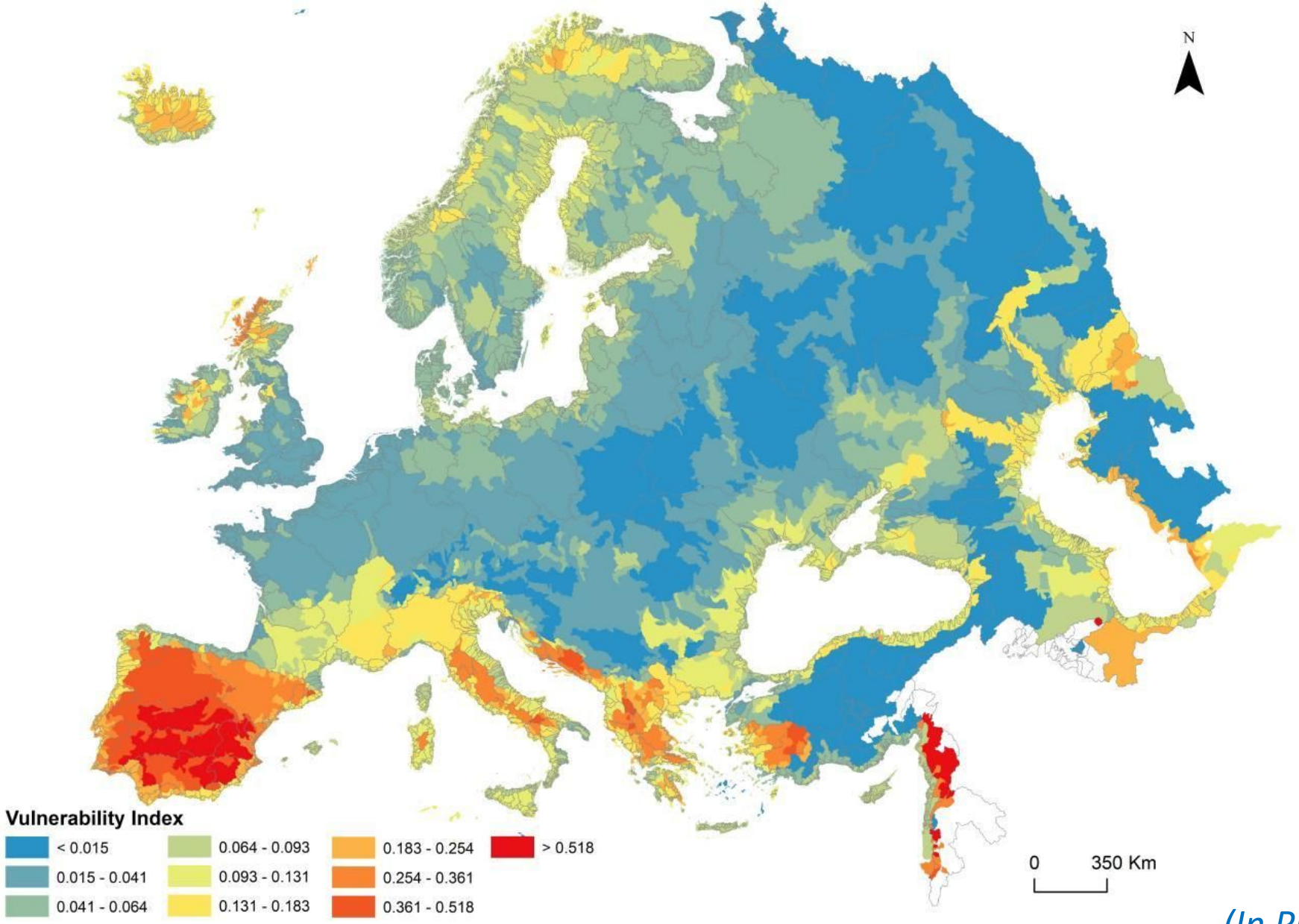
Evaluate river network structural and functional connectivity and propose tools to facilitate management to improve biodiversity and biotic quality of European rivers.


River Restoration Units
Basins
Barriers > 5m

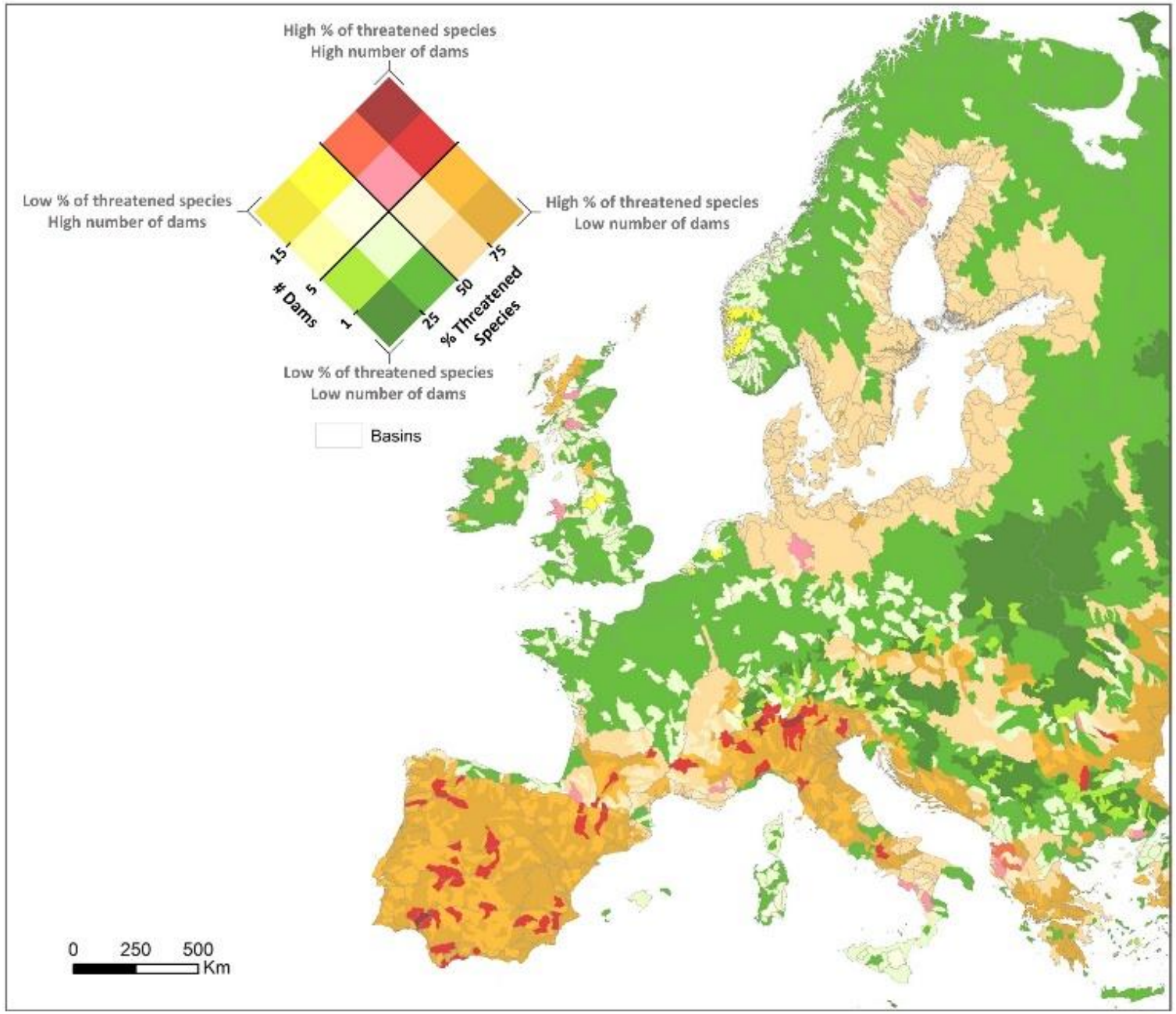

Barriers RRU/ River Length (Km2)
0.00000000 - 0.003939706
0.003939707 - 0.012296697
0.012296698 - 0.023129664
0.023129665 - 0.037643618
0.037643619 - 0.060951517
0.060951518 - 0.094825134
0.094825135 - 0.143818698
0.143818699 - 0.227858646
0.227858647 - 0.354135042
0.354135043 - 0.822896310
Basins


Barriers RRU/Drainage Area (Km2)
0.00000000 - 0.001748252
0.001748253 - 0.005633803
0.005633804 - 0.010805501
0.010805502 - 0.018404908
0.018404909 - 0.029935865
0.029935866 - 0.046511628
0.046511629 - 0.066666667
0.066666668 - 0.095238095
0.095238096 - 0.173913043
0.173913044 - 0.400000000
Basins

(In Prep)


N
Vulnerability Index
< 0.015
0.015 - 0.041
0.041 - 0.064
0.064 - 0.093
0.093 - 0.131
0.131 - 0.183
0.183 - 0.254
0.254 - 0.361
0.361 - 0.518
> 0.518
0
350 Km

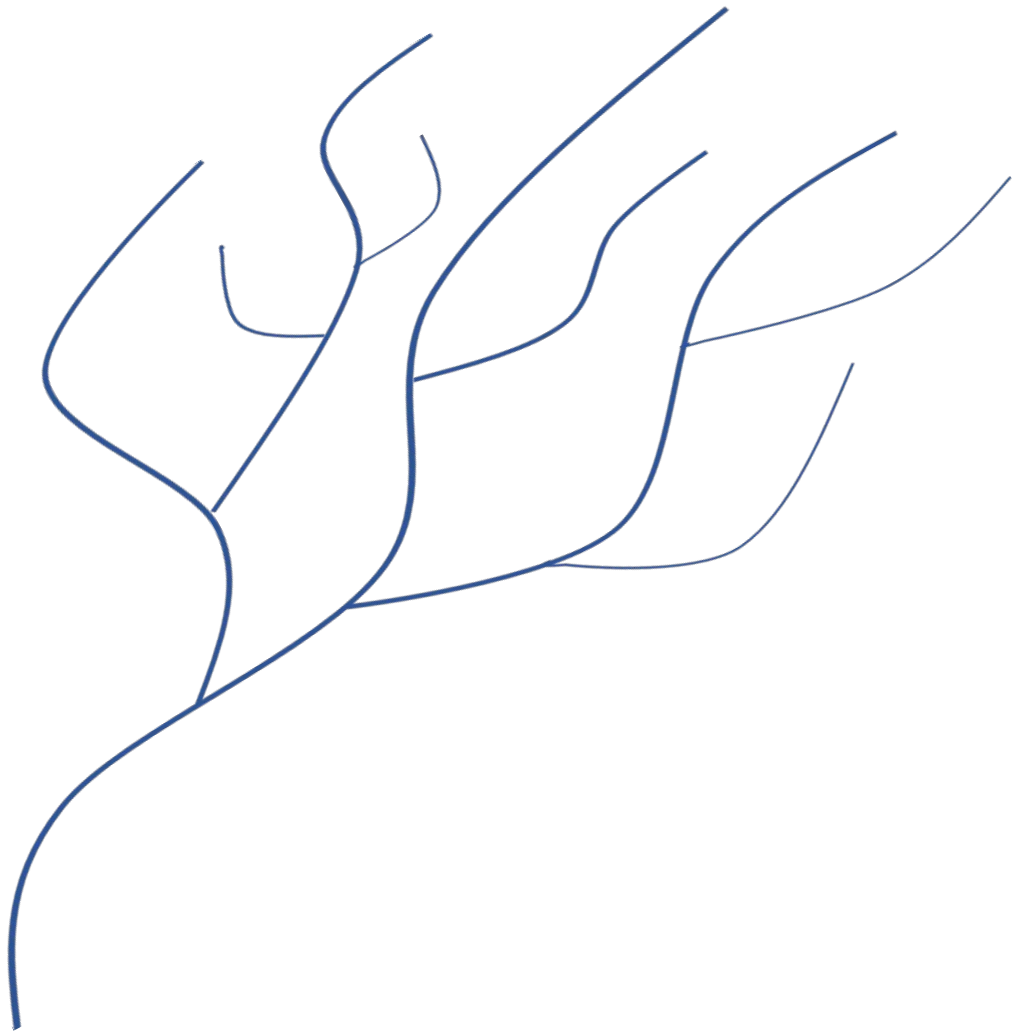
(In Prep)

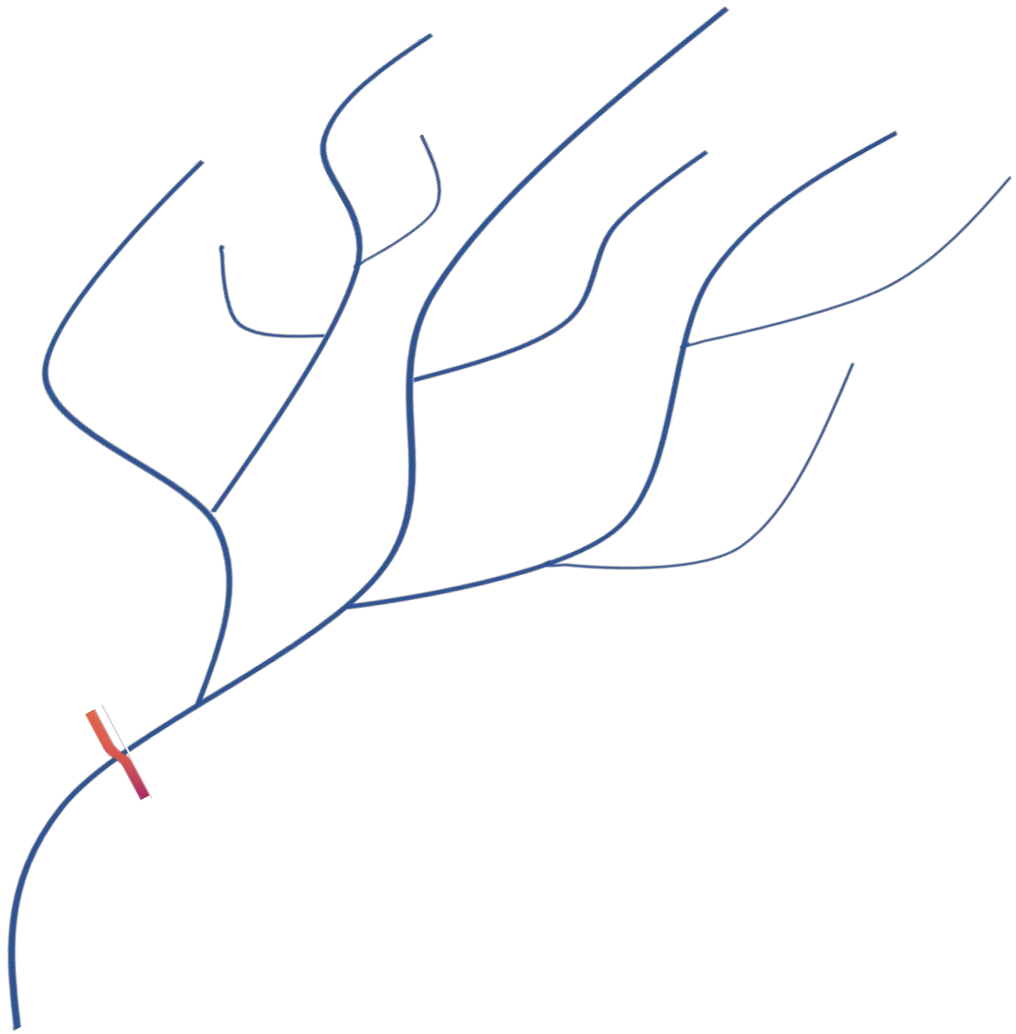

High % of threatened species
High number of dams
Low % of threatened species
High number of dams
High % of threatened species
Low number of dams
15
5
1
Dams
25
50
75
% Threatened Species
Low % of threatened species
Low number of dams
Basins
0
250
500
Km

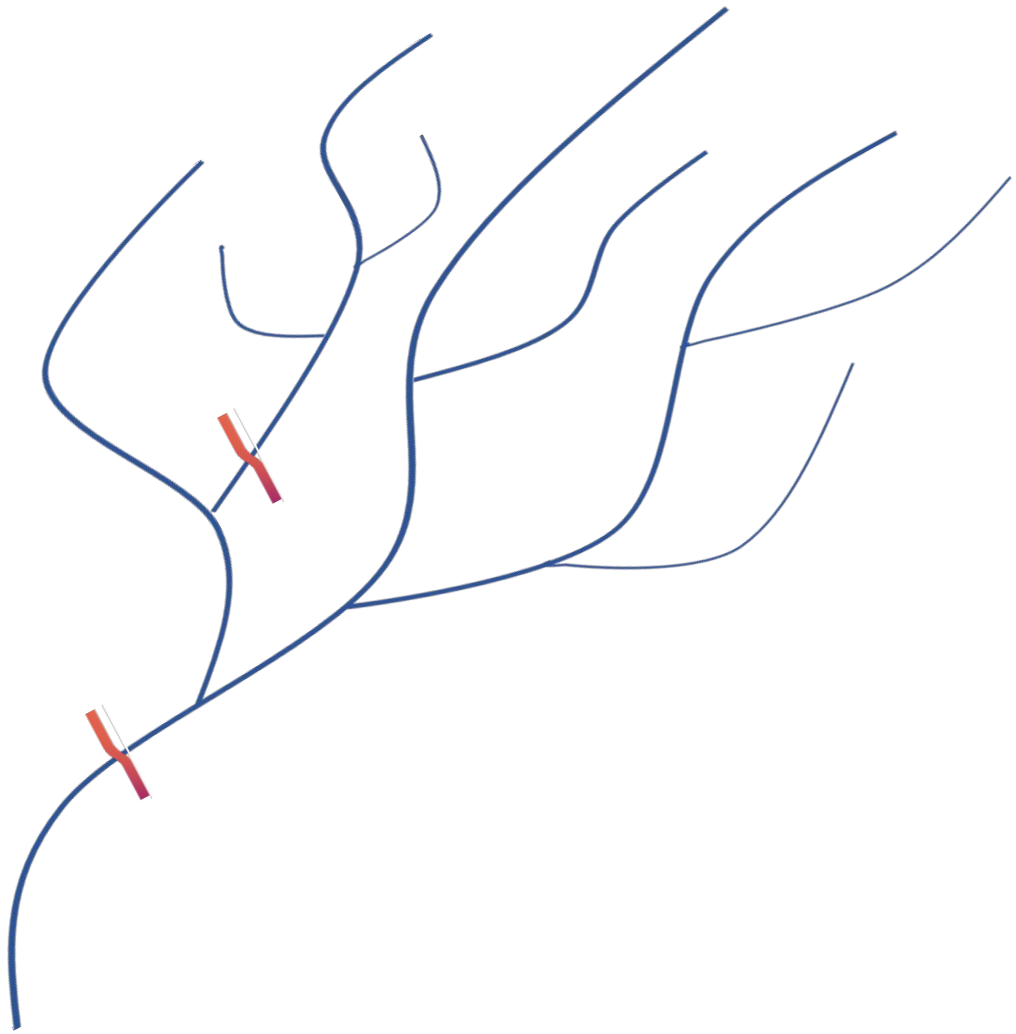
(In Prep)

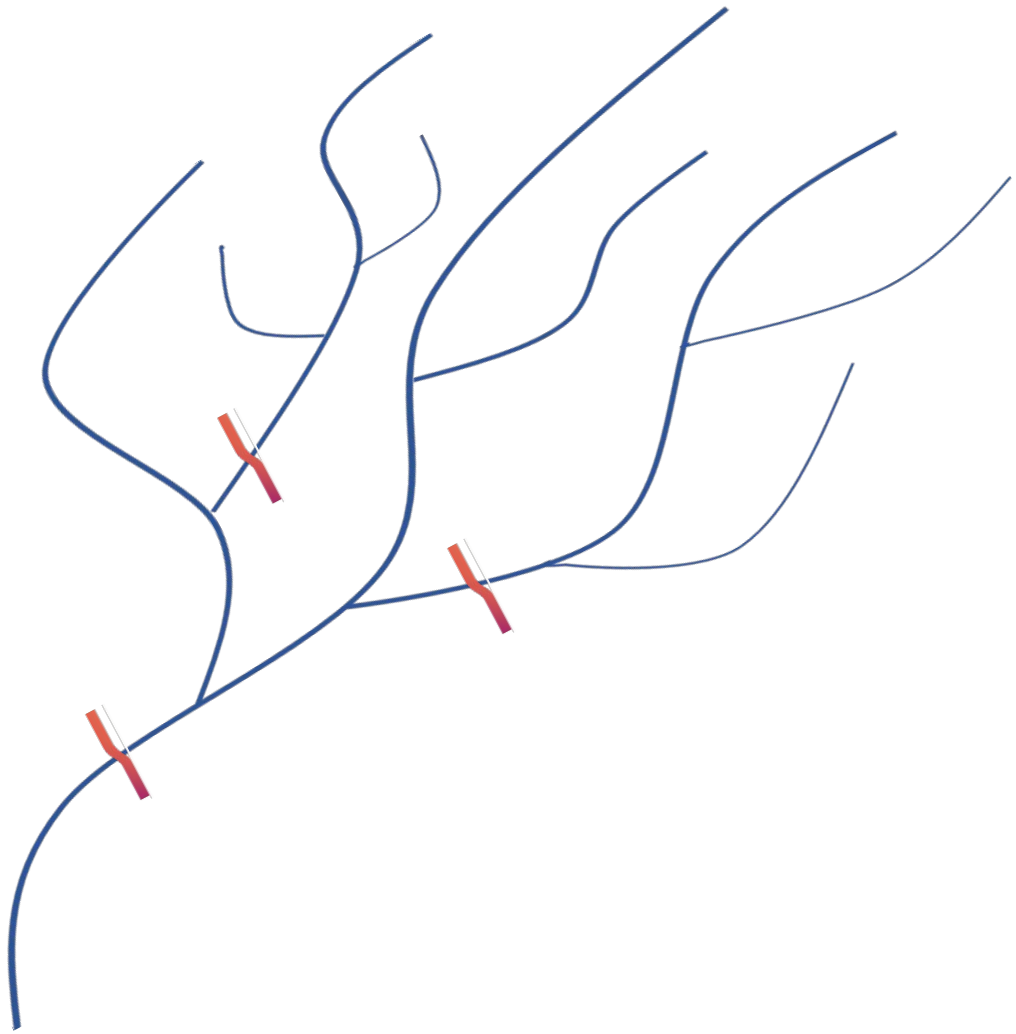
Main goal

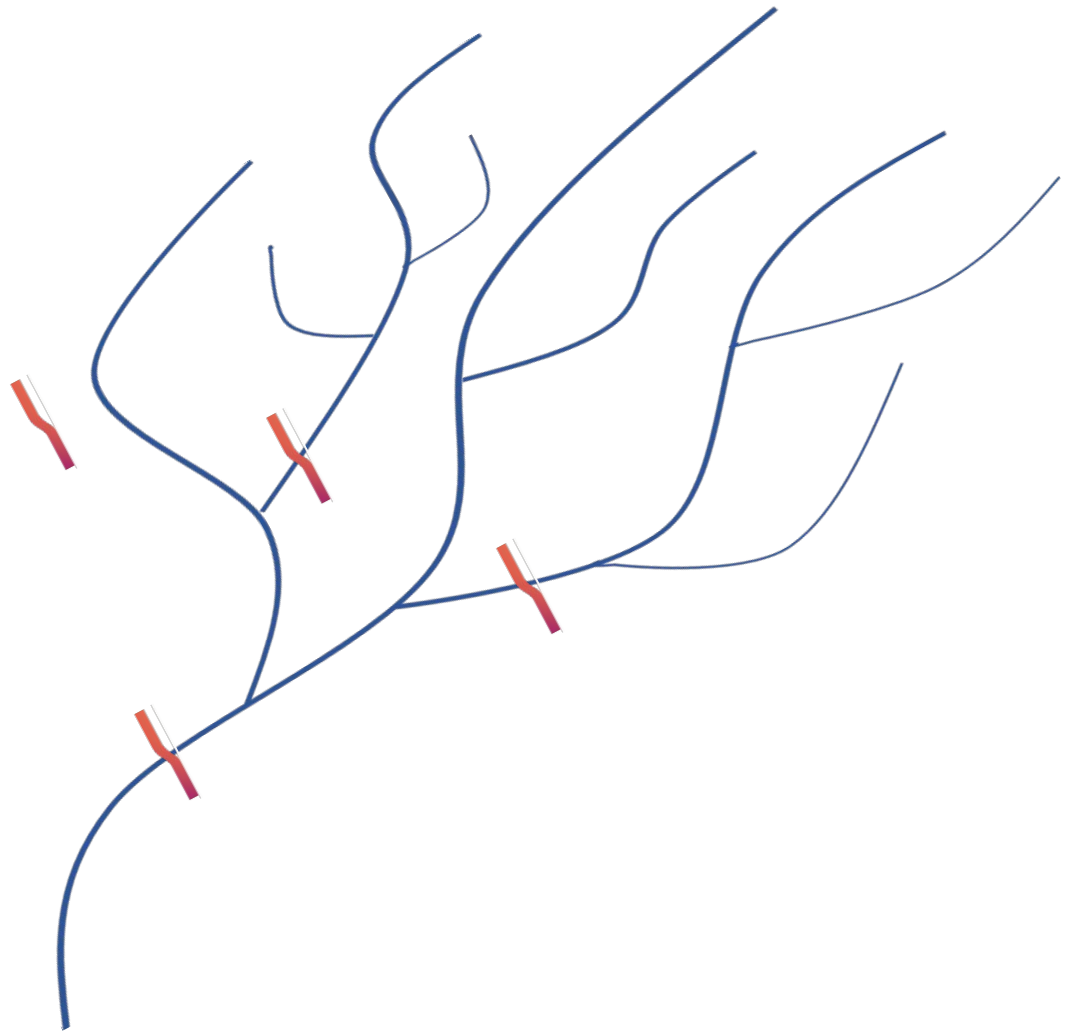
Evaluate river network structural and functional connectivity and propose tools to facilitate management to improve biodiversity and biotic quality of European rivers.

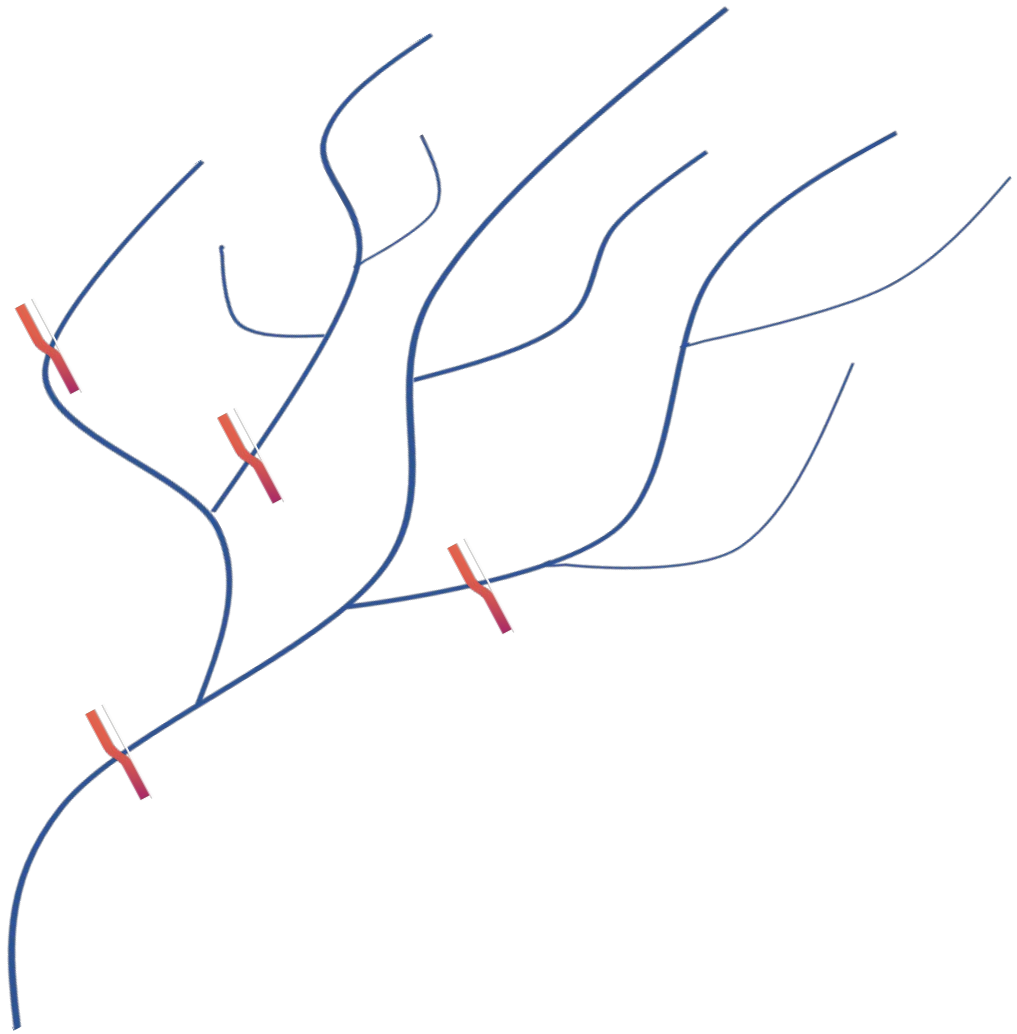


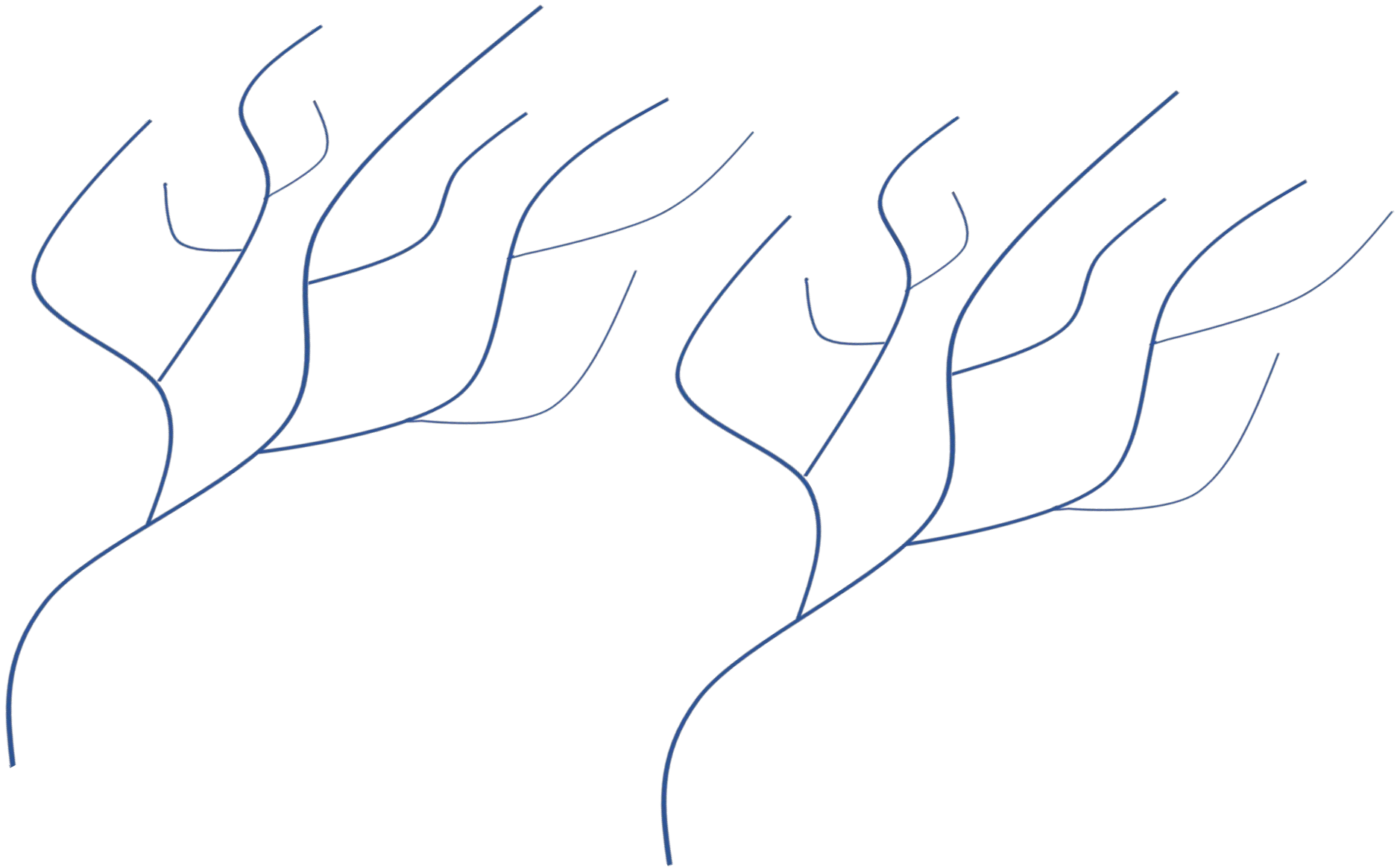


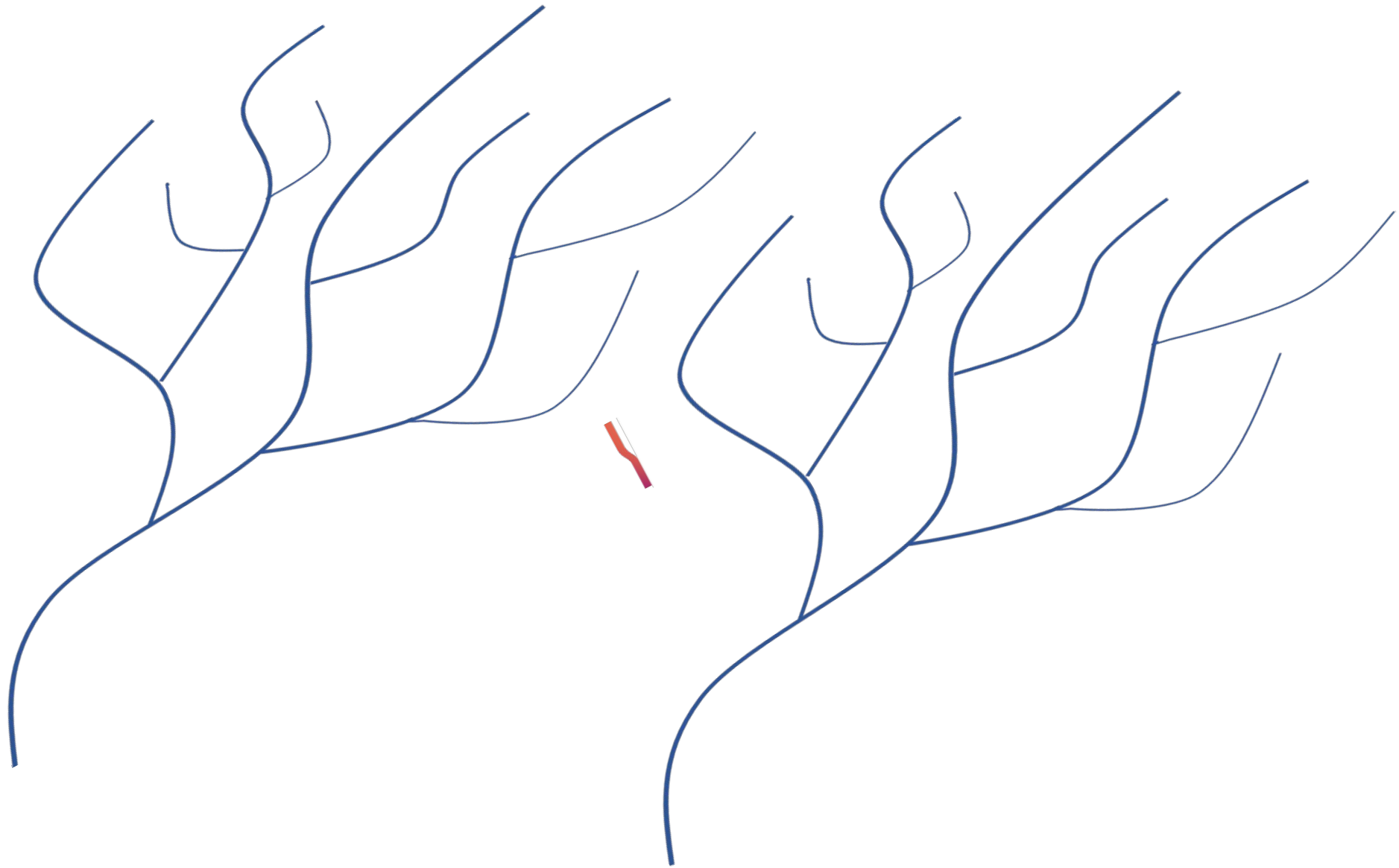


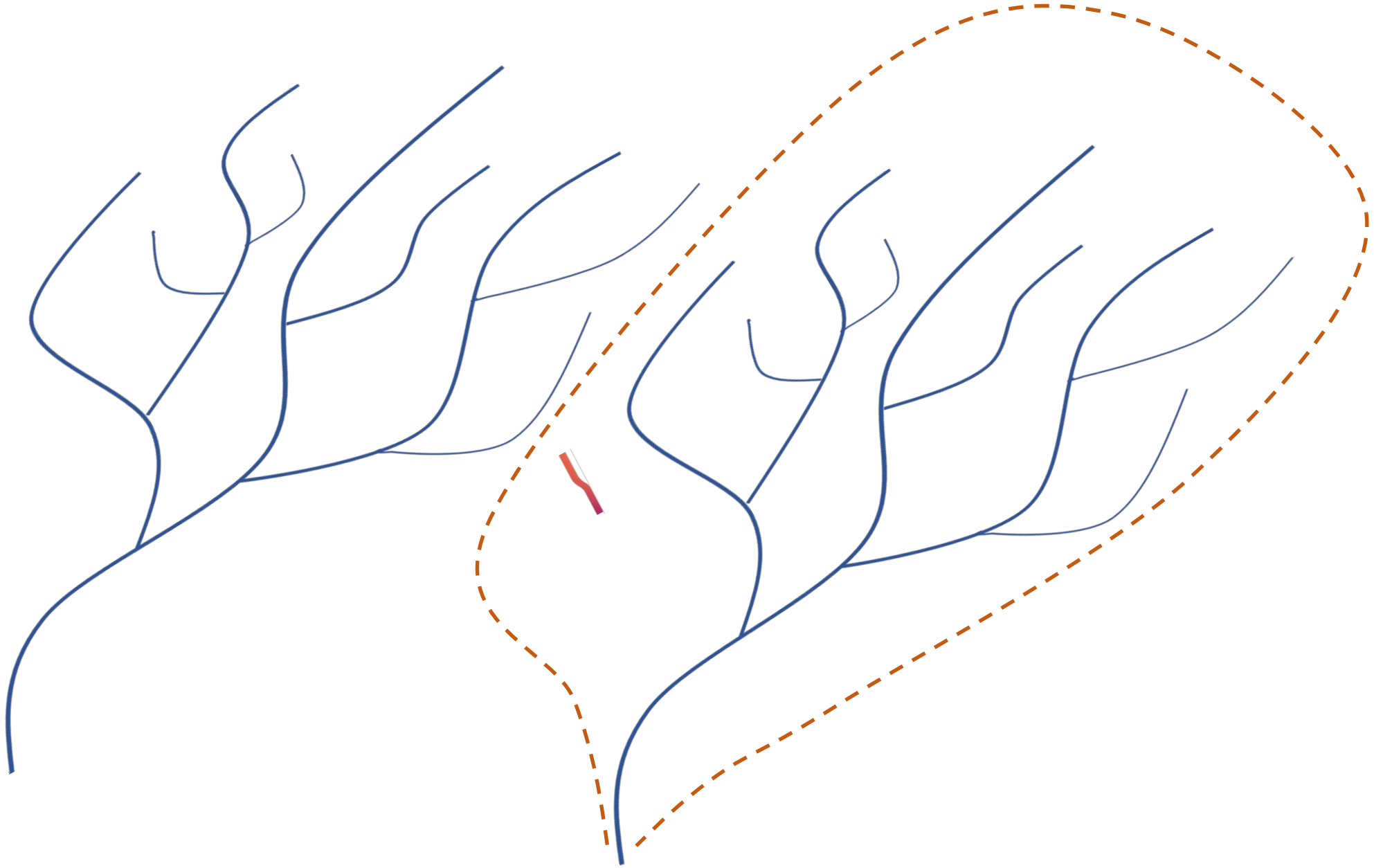


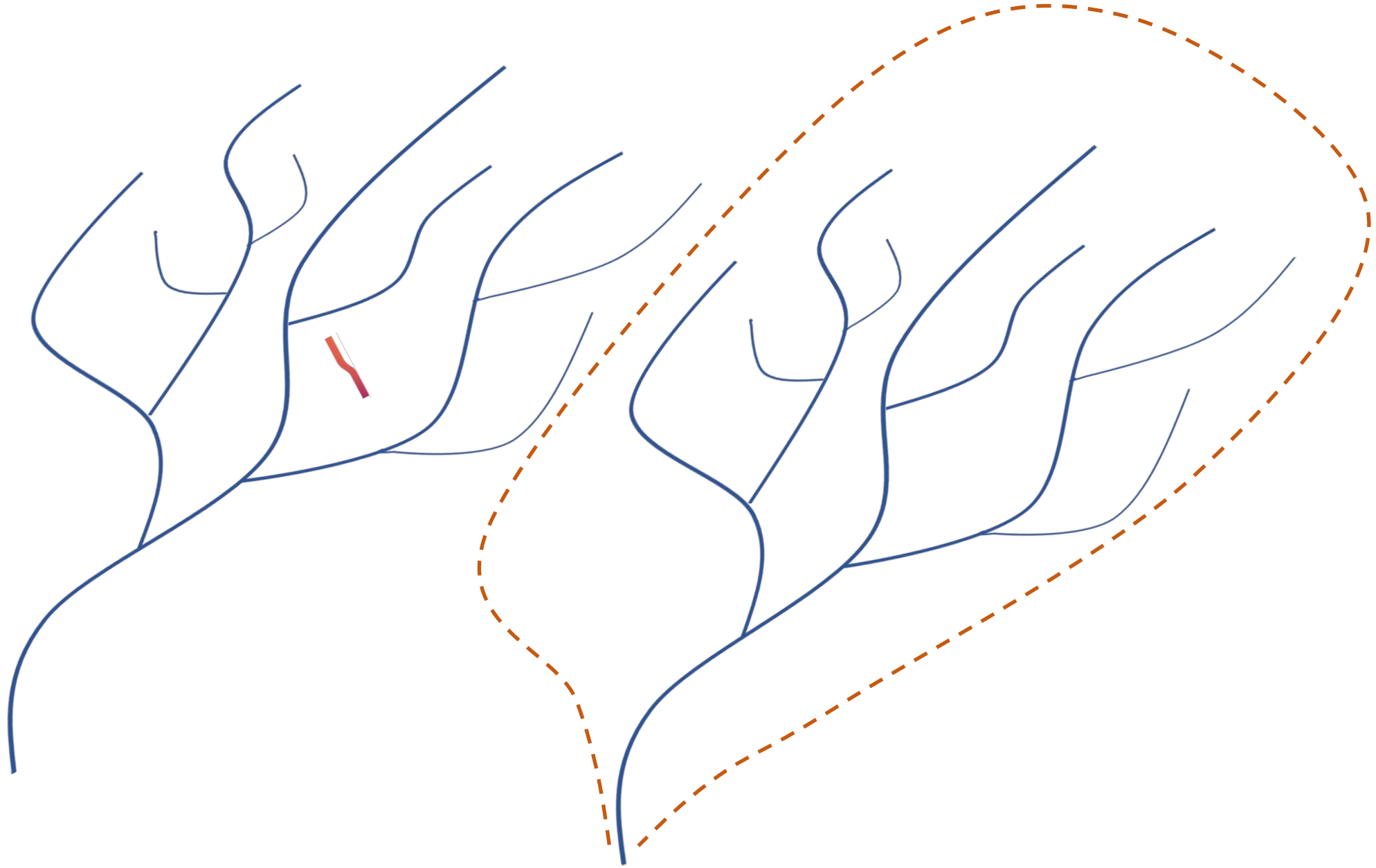


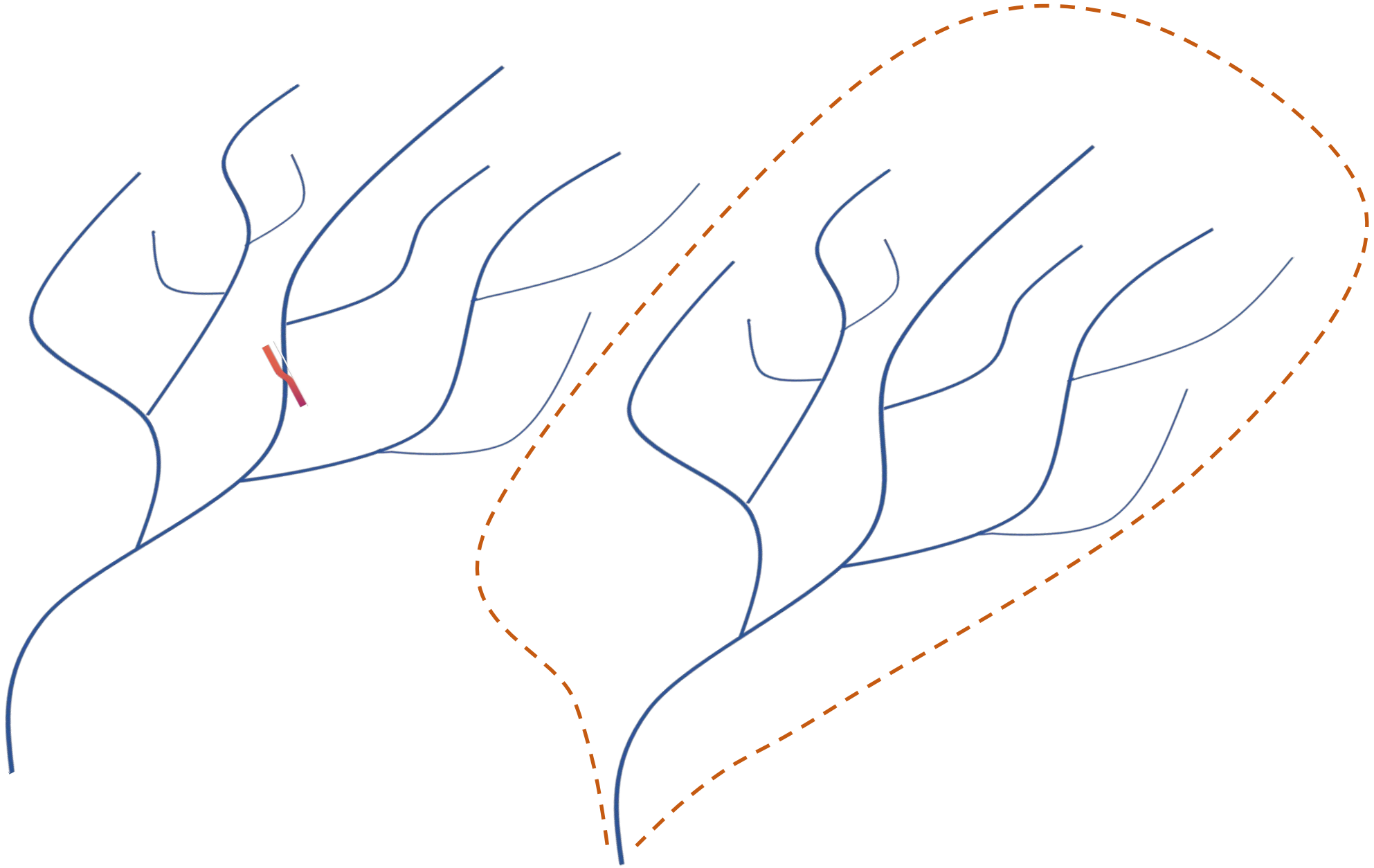


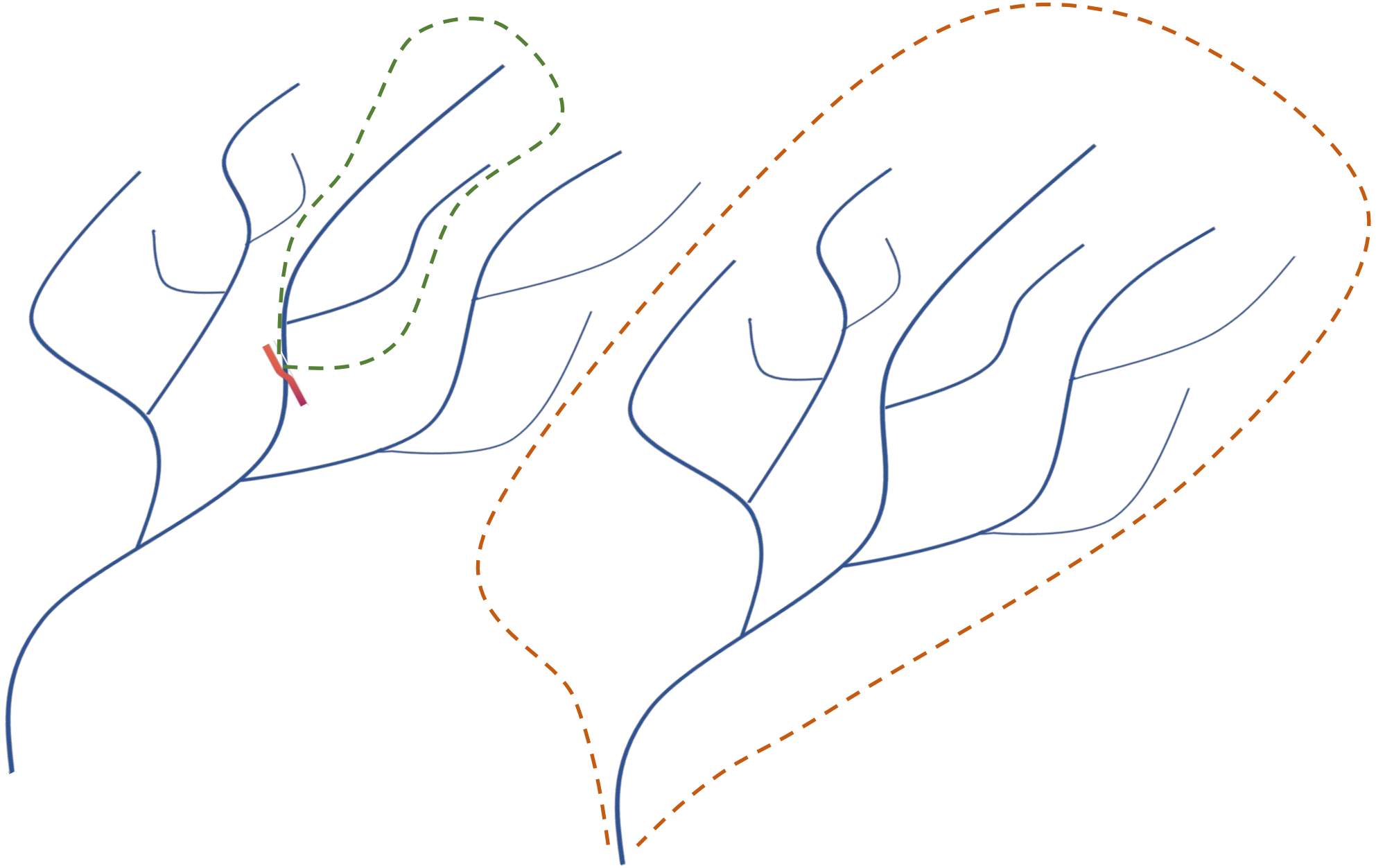


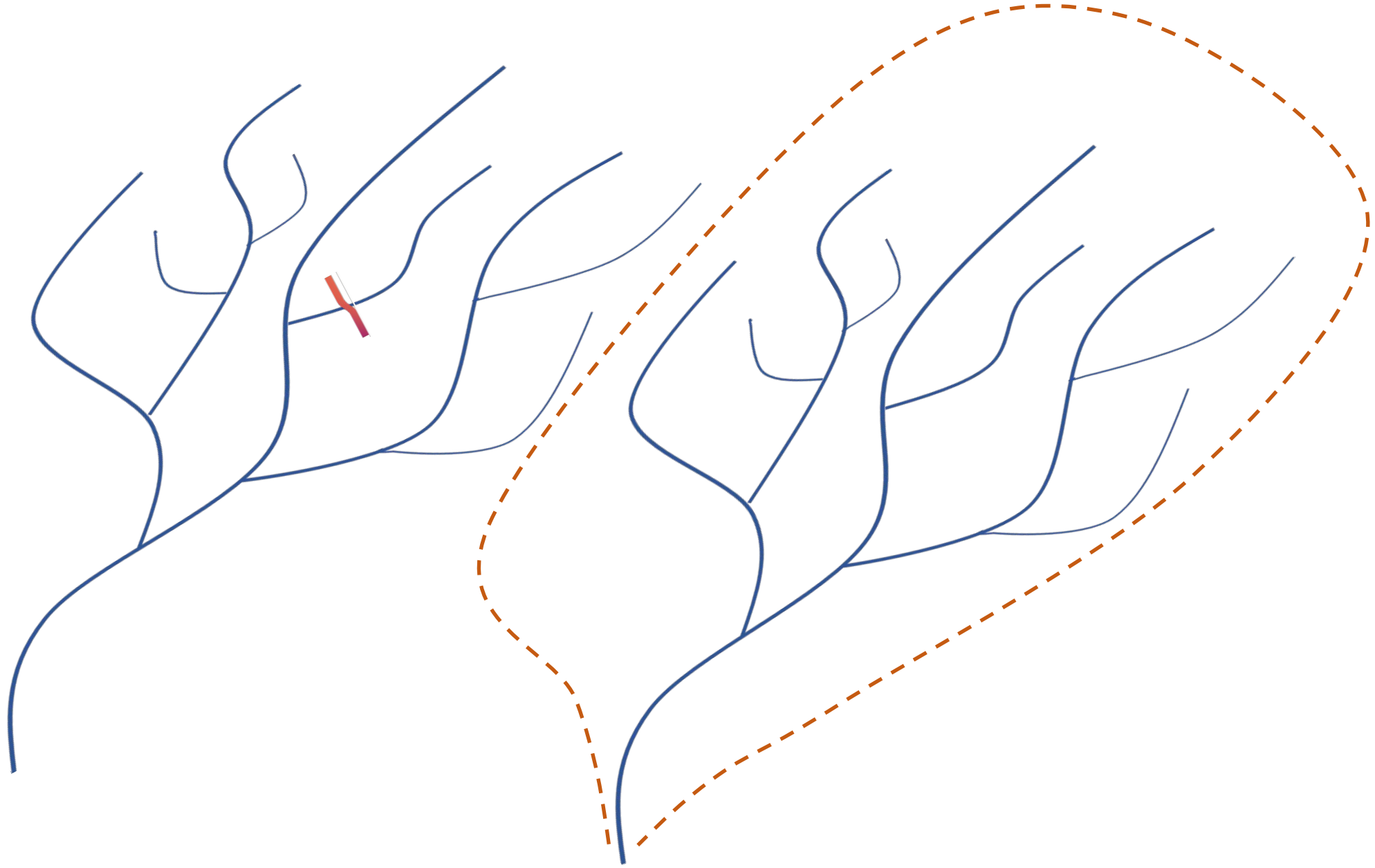


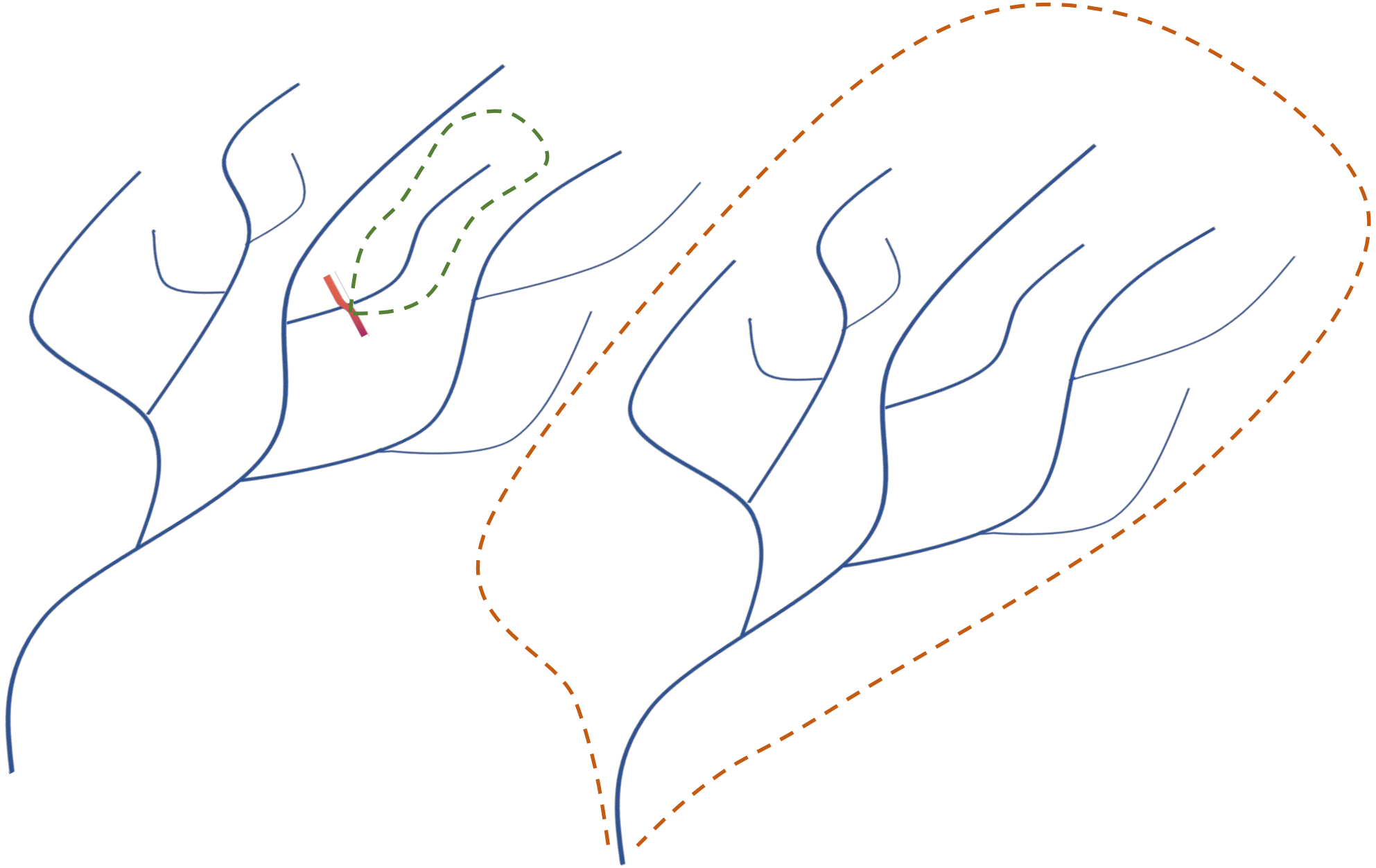


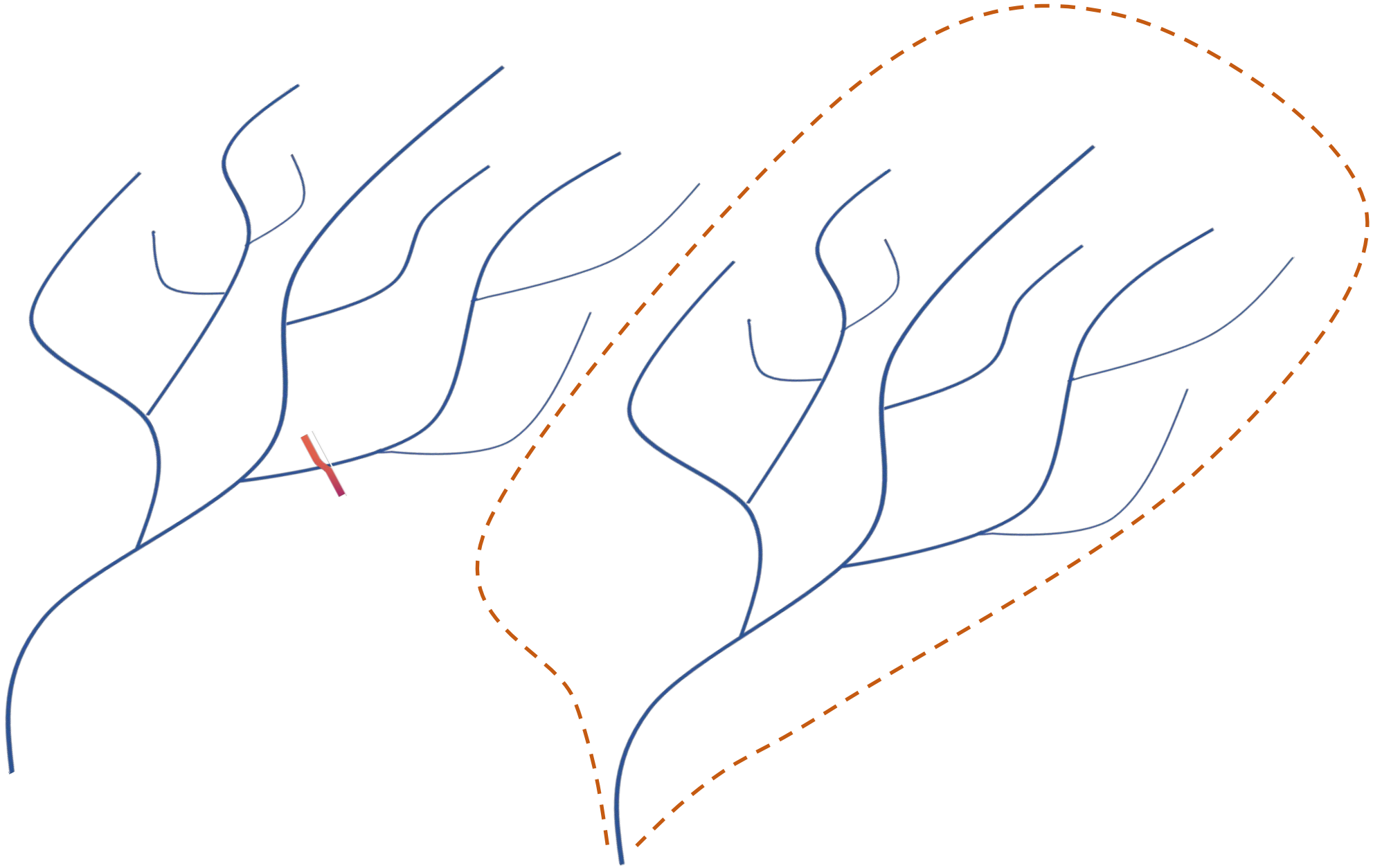


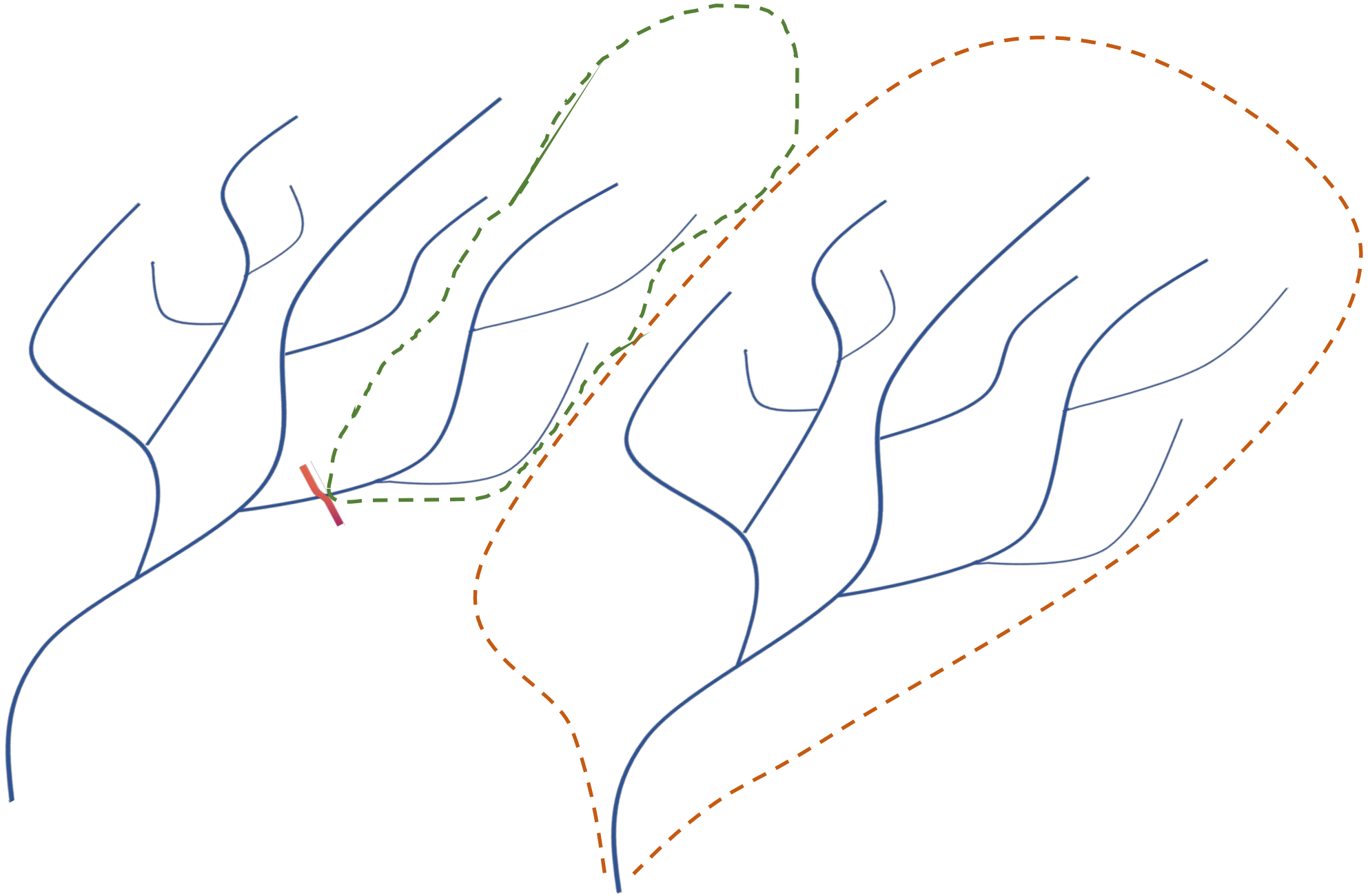


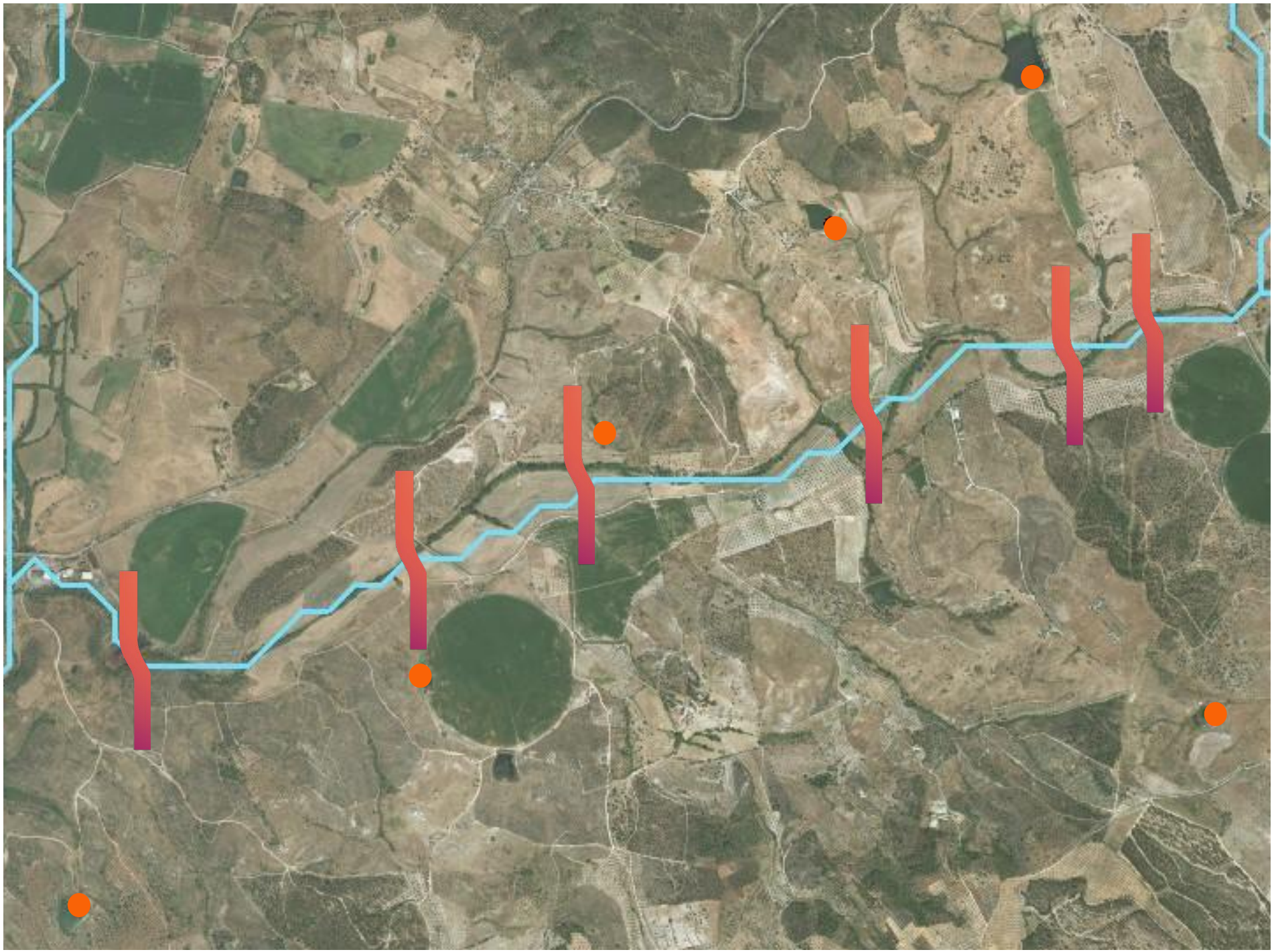






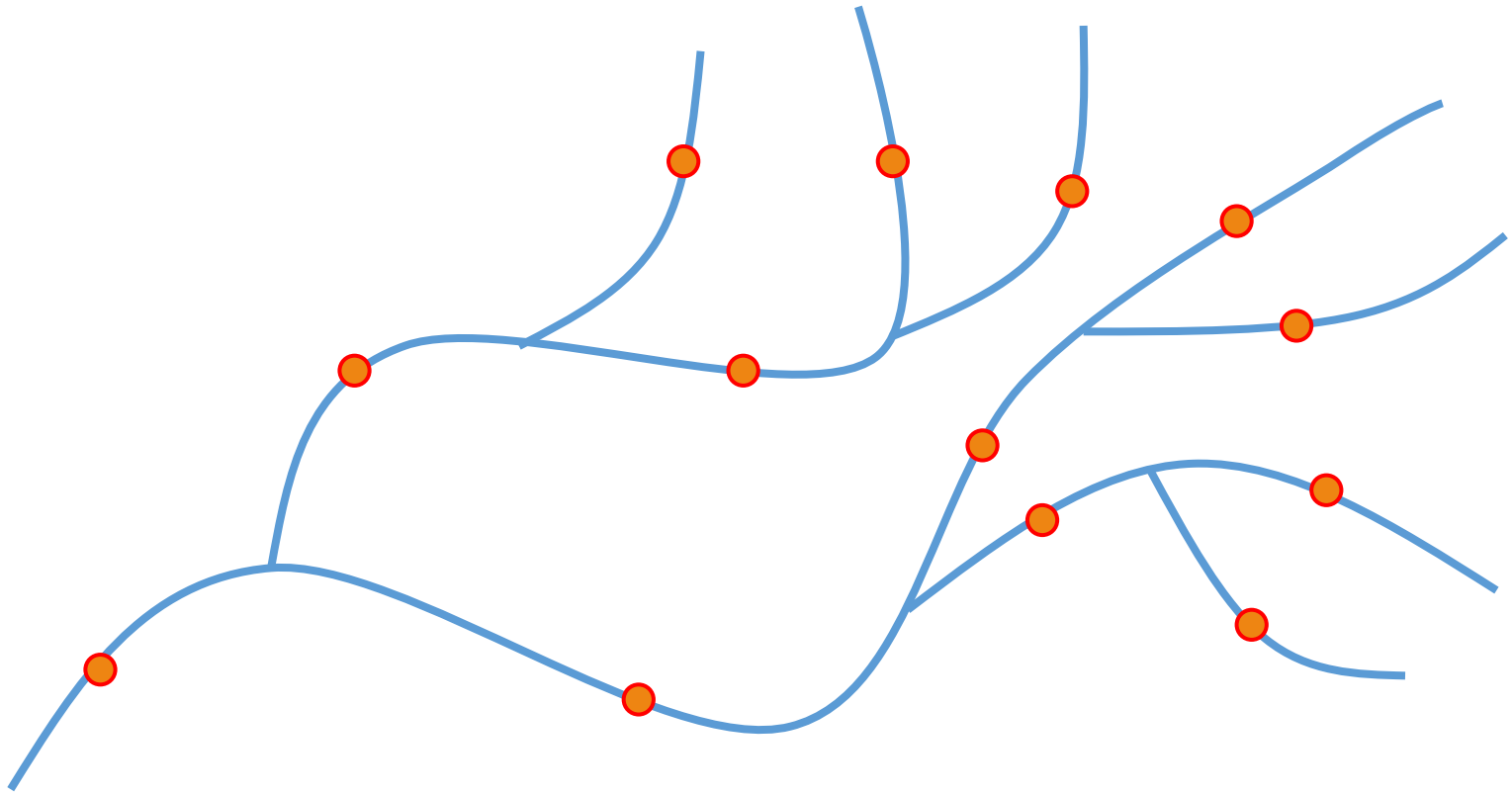


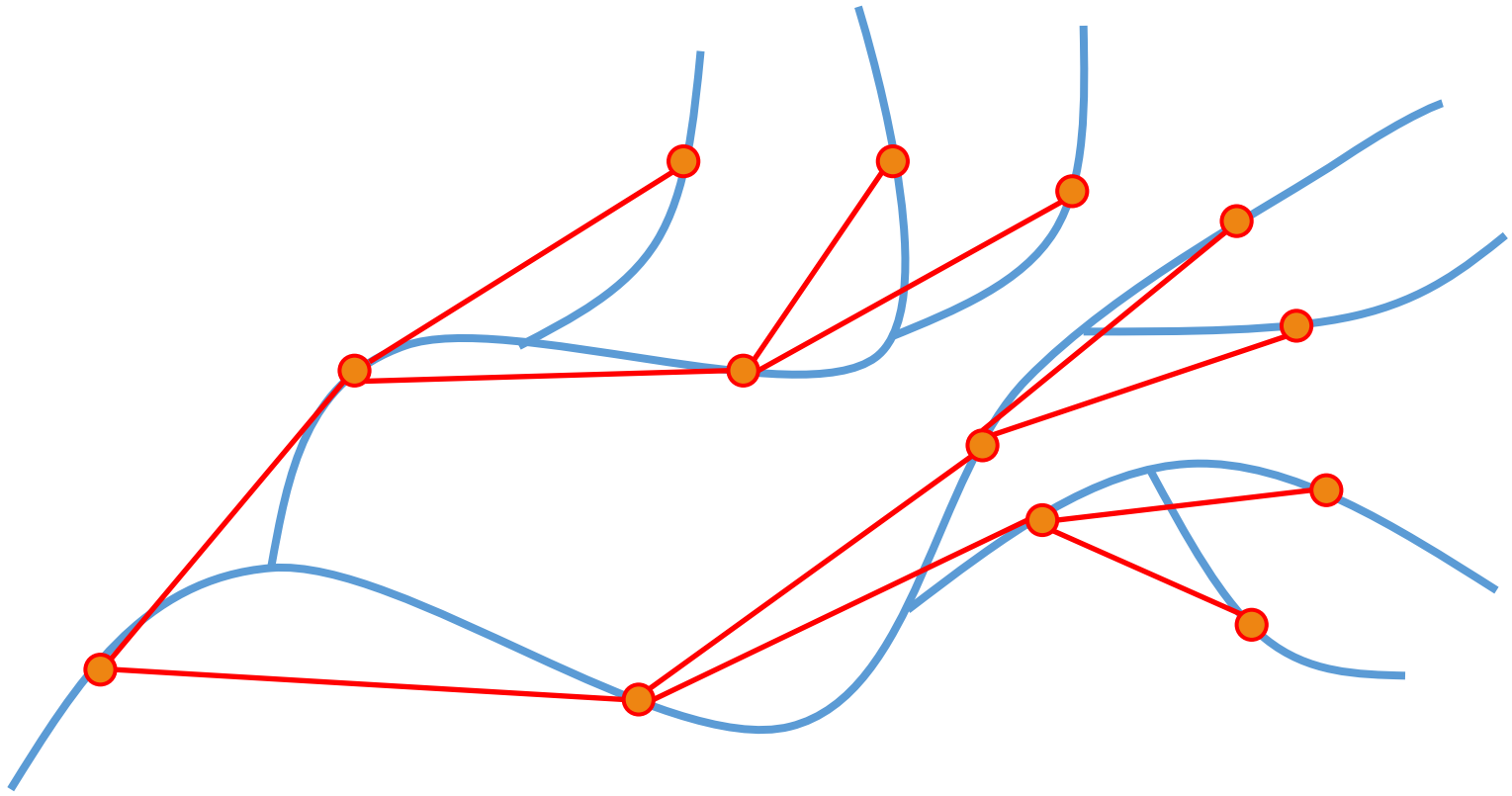


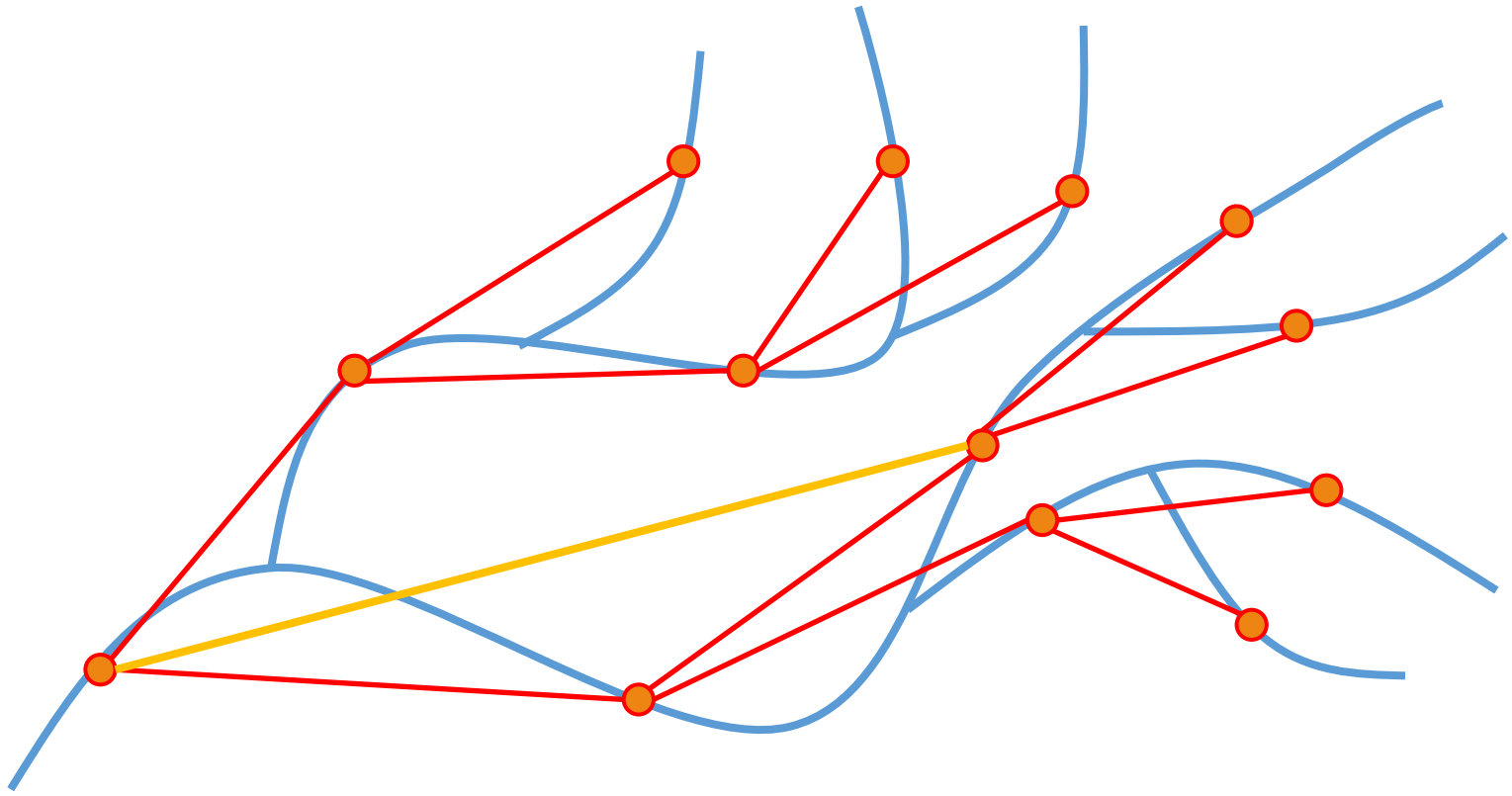


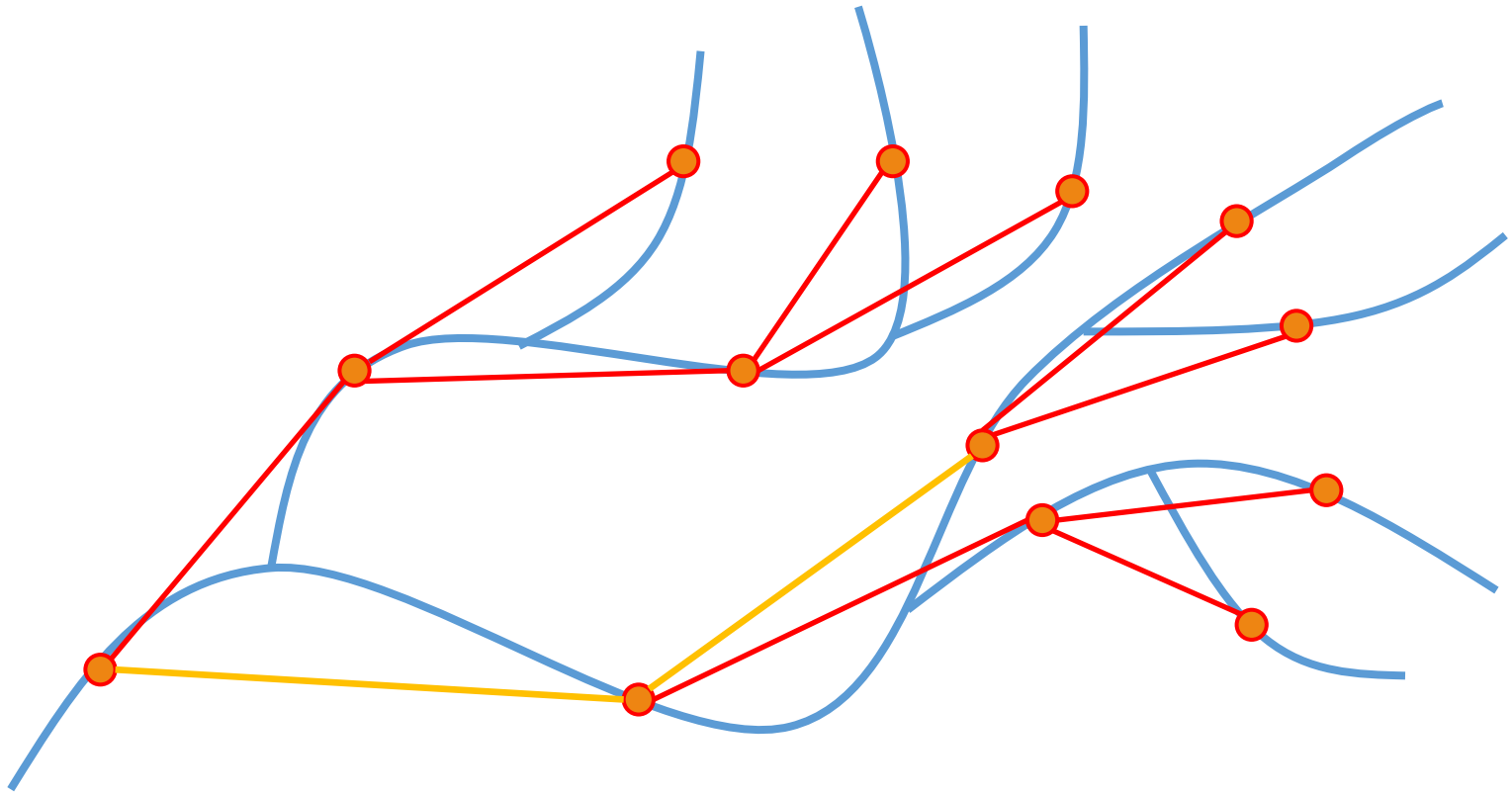
Main goal

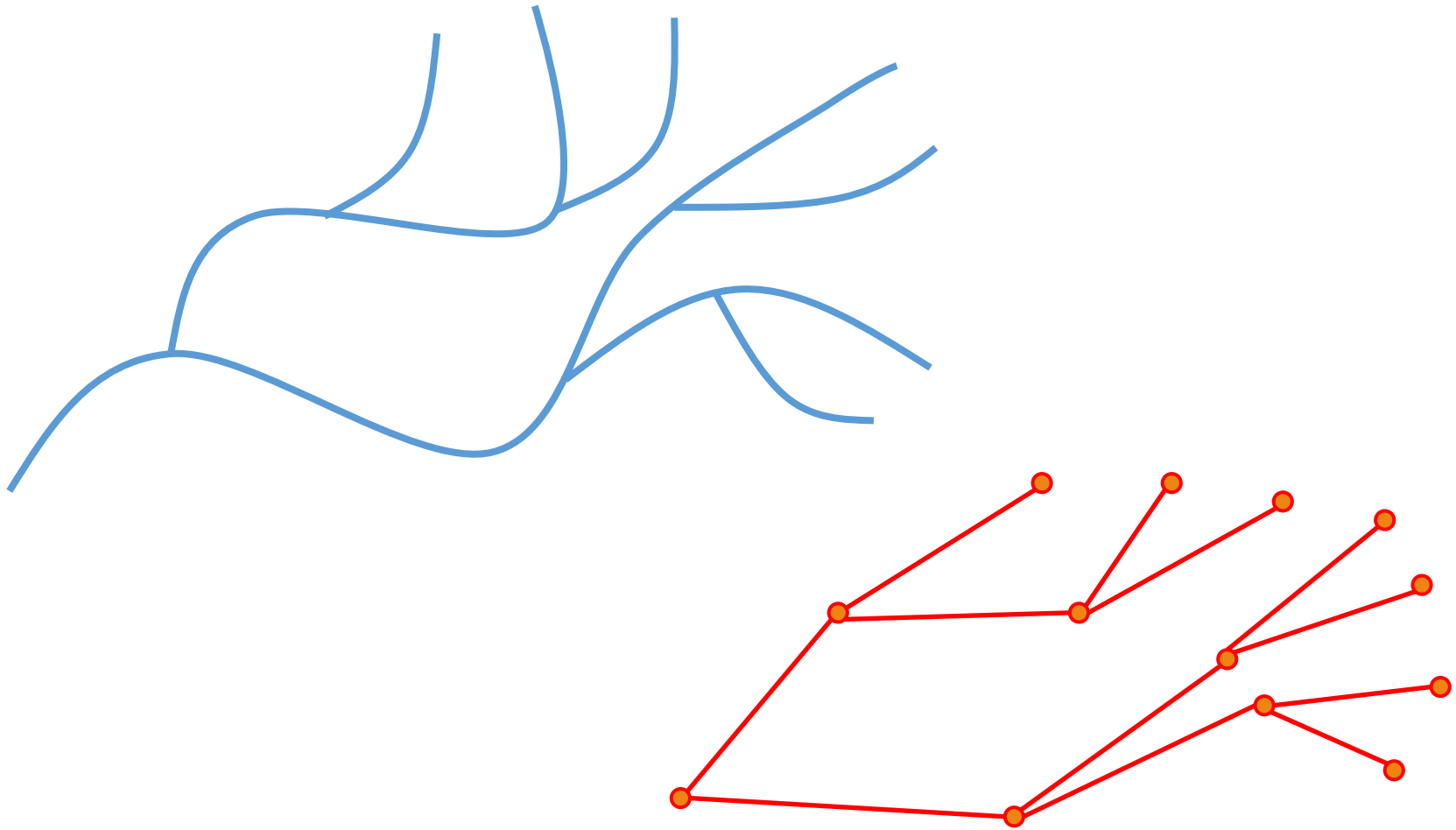
Evaluate river network structural and functional connectivity and propose tools to facilitate management to improve biodiversity and biotic quality of European rivers.

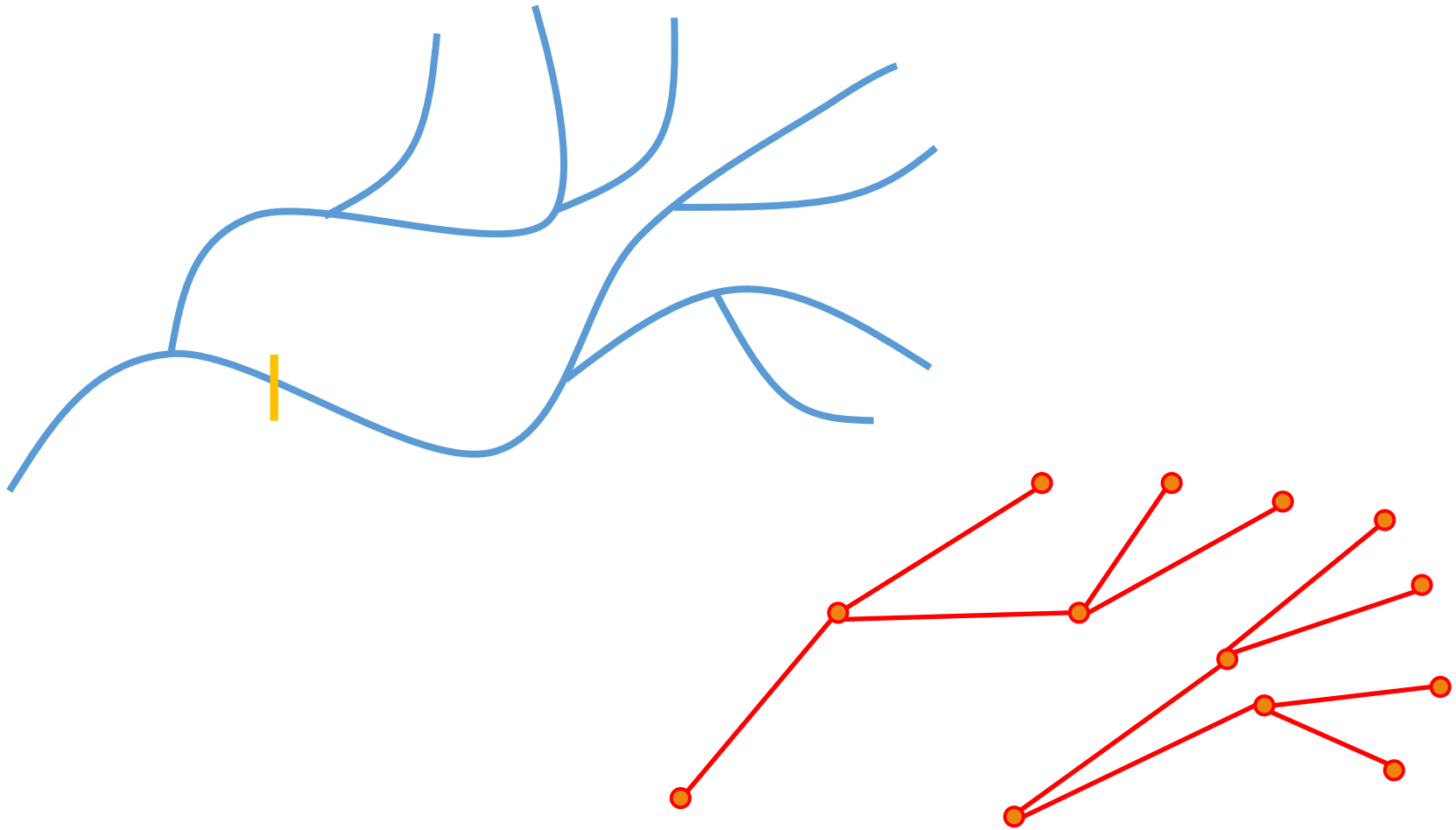






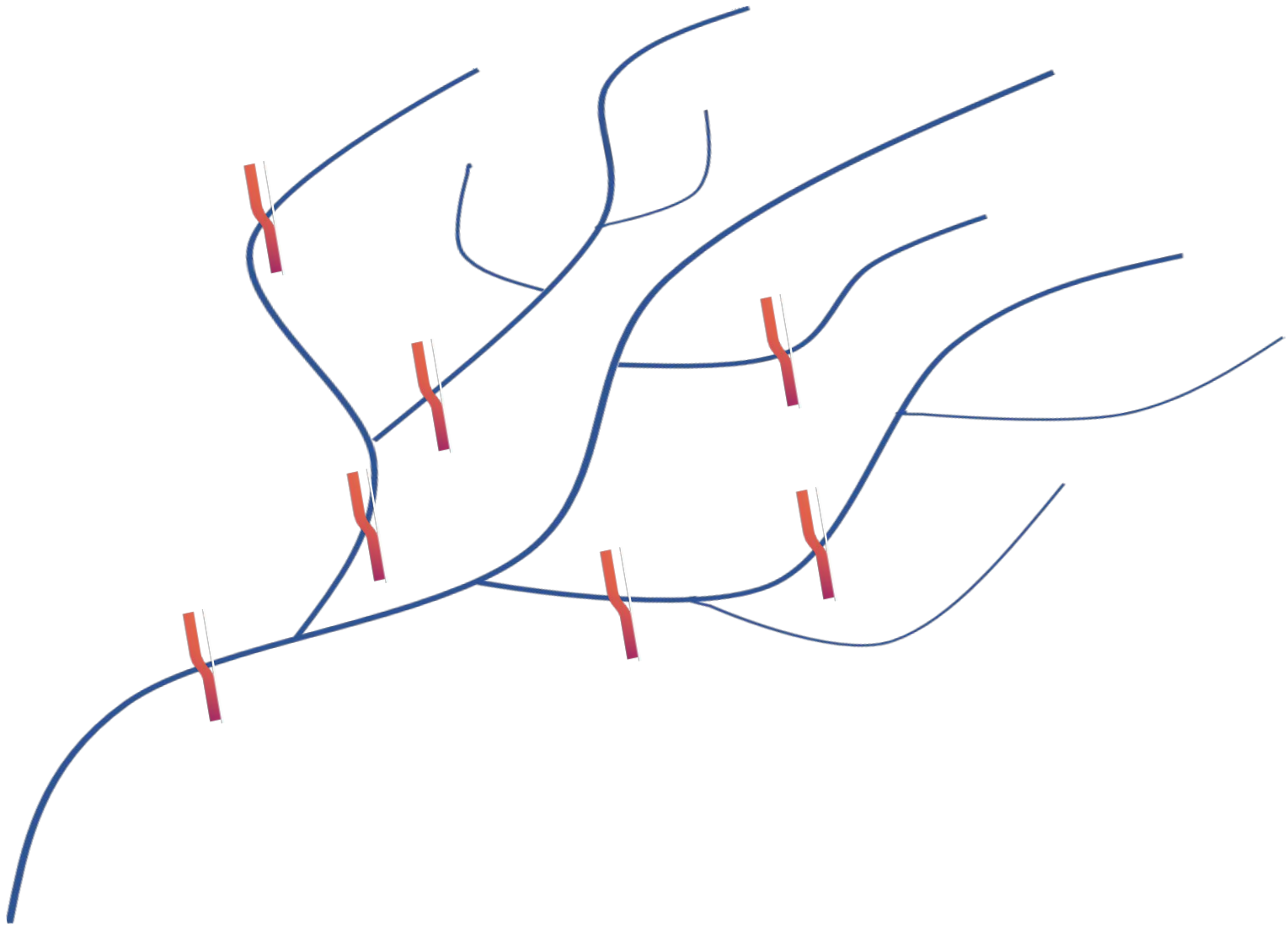


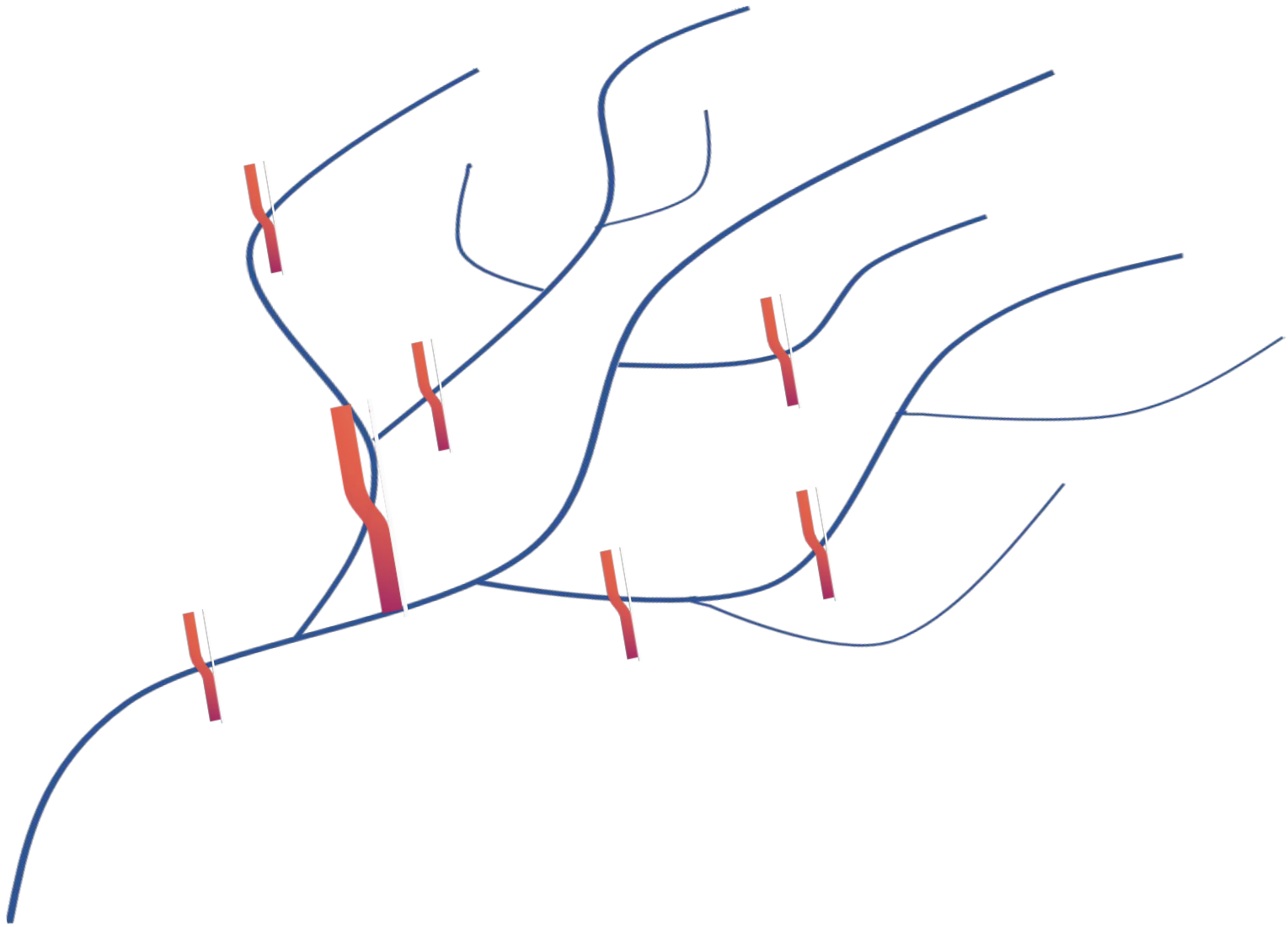




RVTool

RIVConnect





RIVConnect

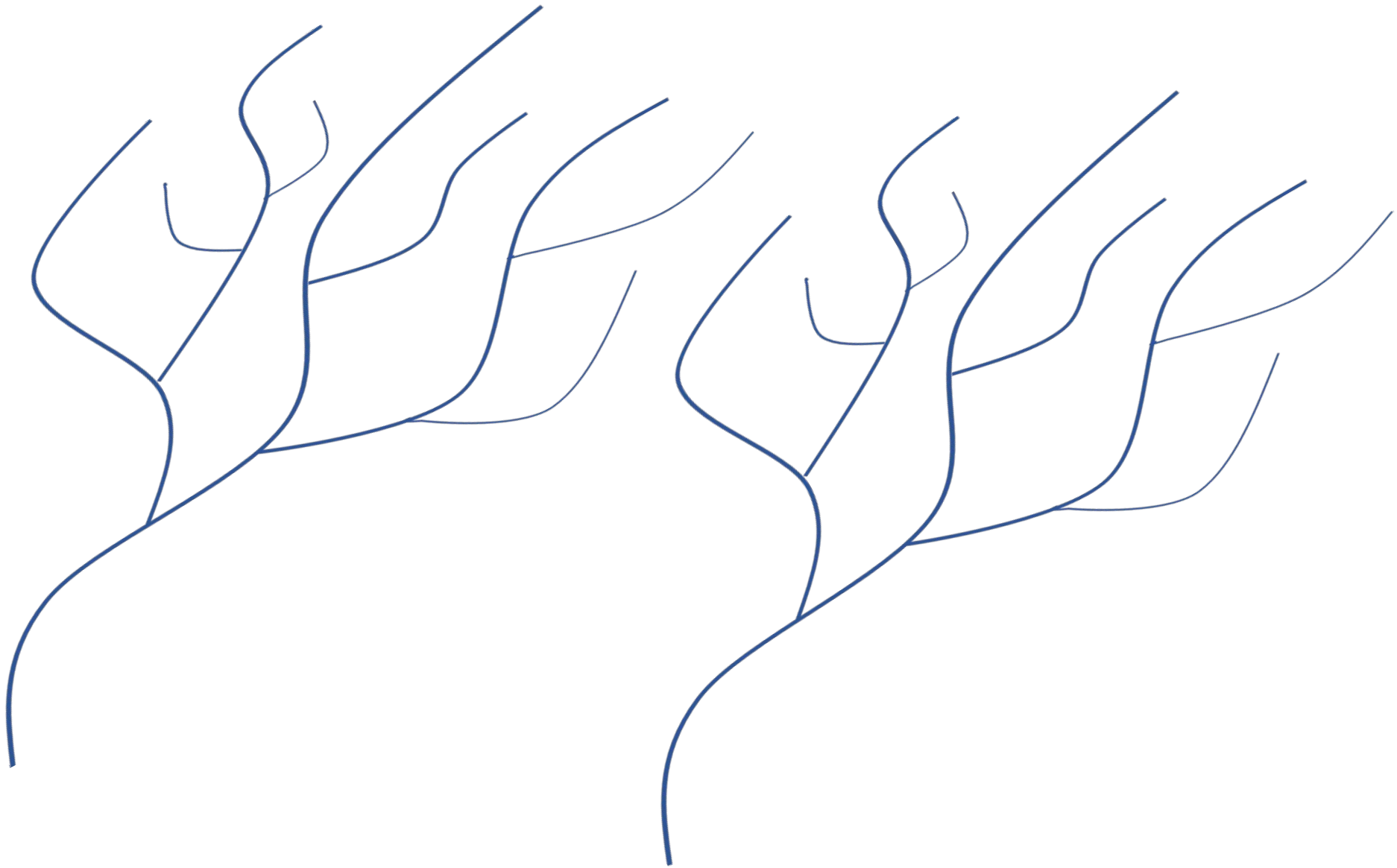
Main goal

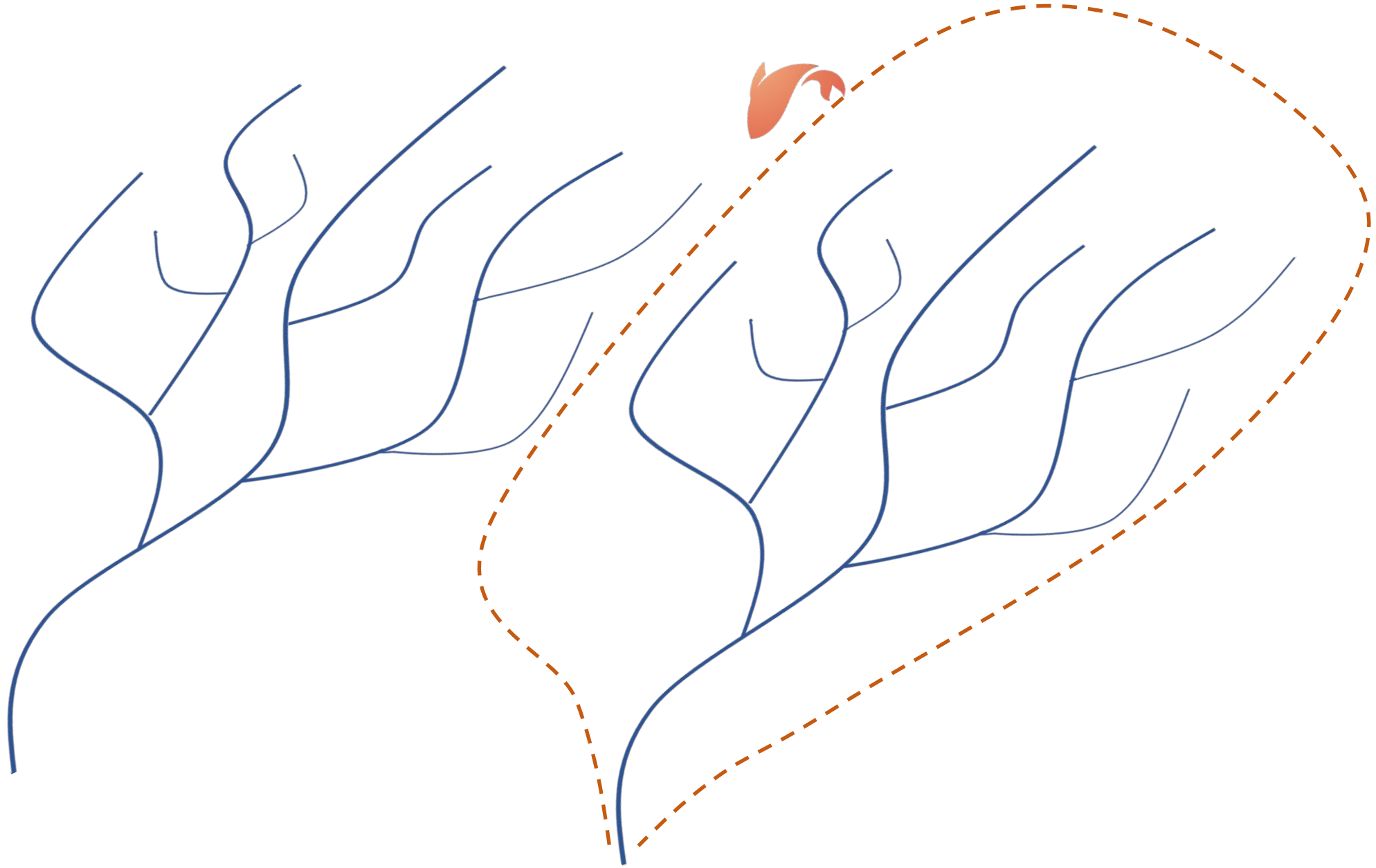
Evaluate river network structural and functional connectivity and propose tools to facilitate management to improve biodiversity and biotic quality of European rivers.

Main goal

Evaluate river network structural and functional connectivity and propose tools to facilitate management to improve biodiversity and biotic quality of European rivers.

GBIF
Global Biodiversity
Information Facility





RMFish

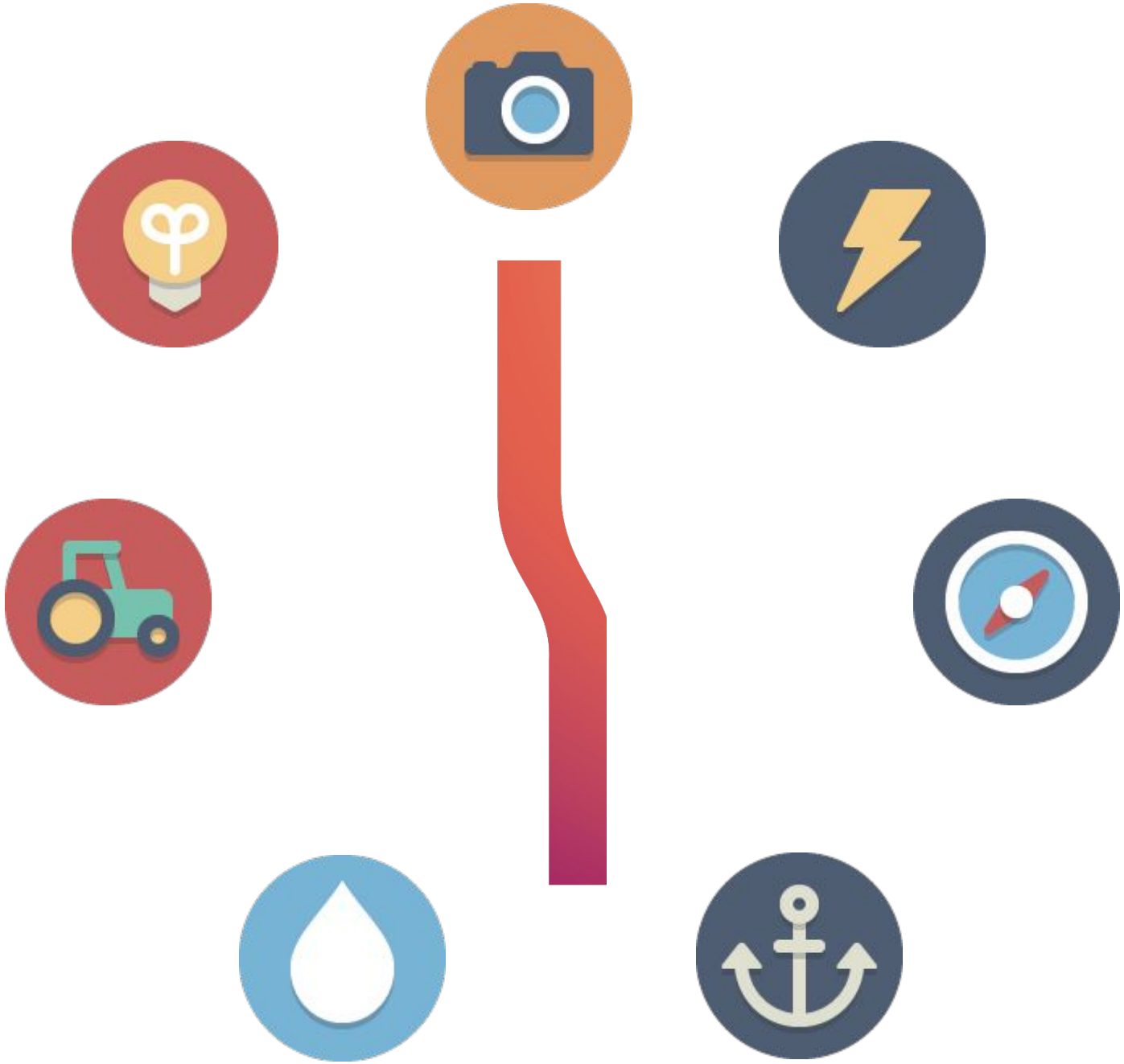
Main goal

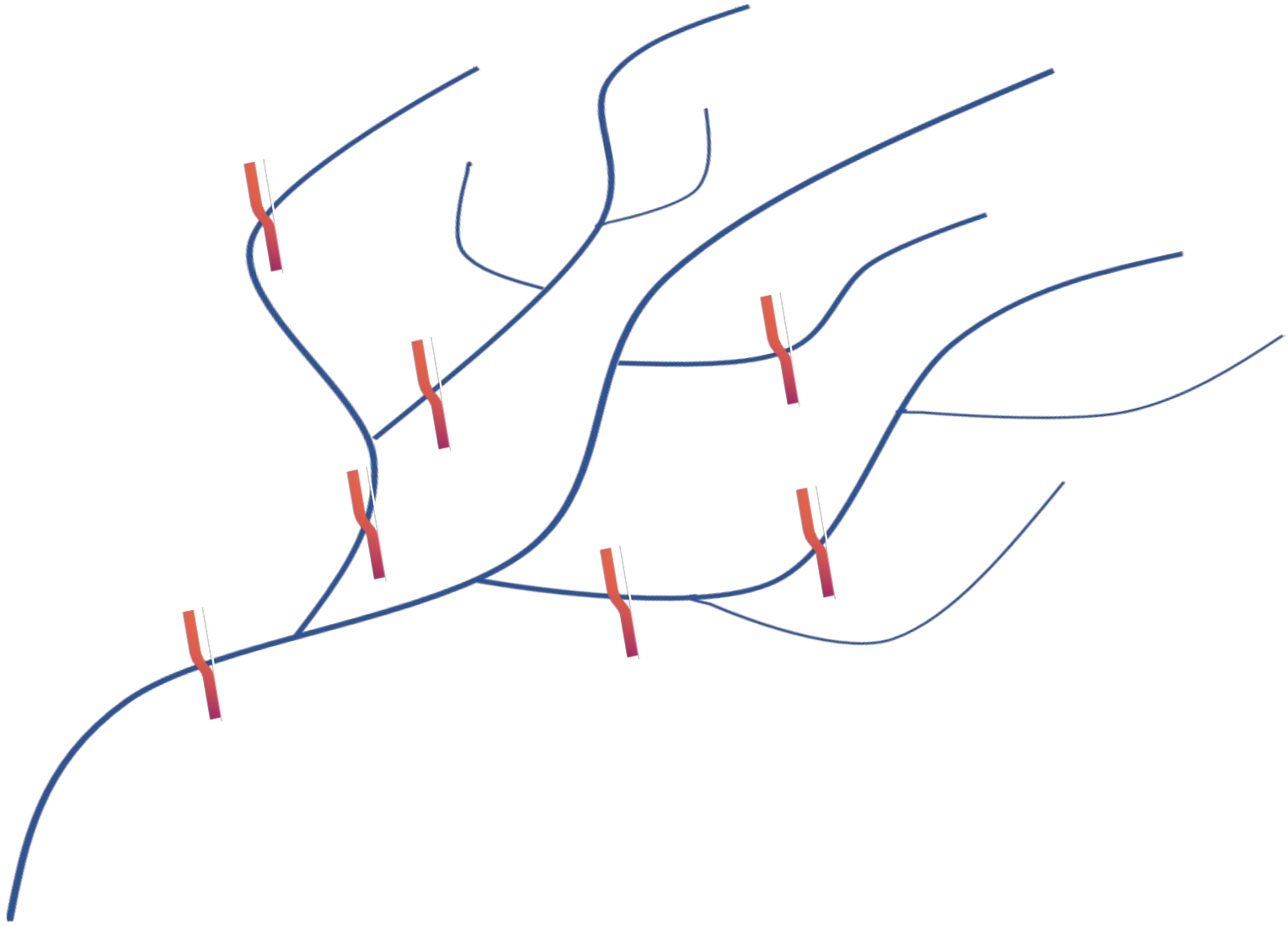
Evaluate river network structural and functional connectivity and propose tools to facilitate management to improve biodiversity and biotic quality of European rivers.

Main goal

Evaluate river network structural and functional connectivity and propose tools to facilitate management to improve biodiversity and biotic quality of European rivers.

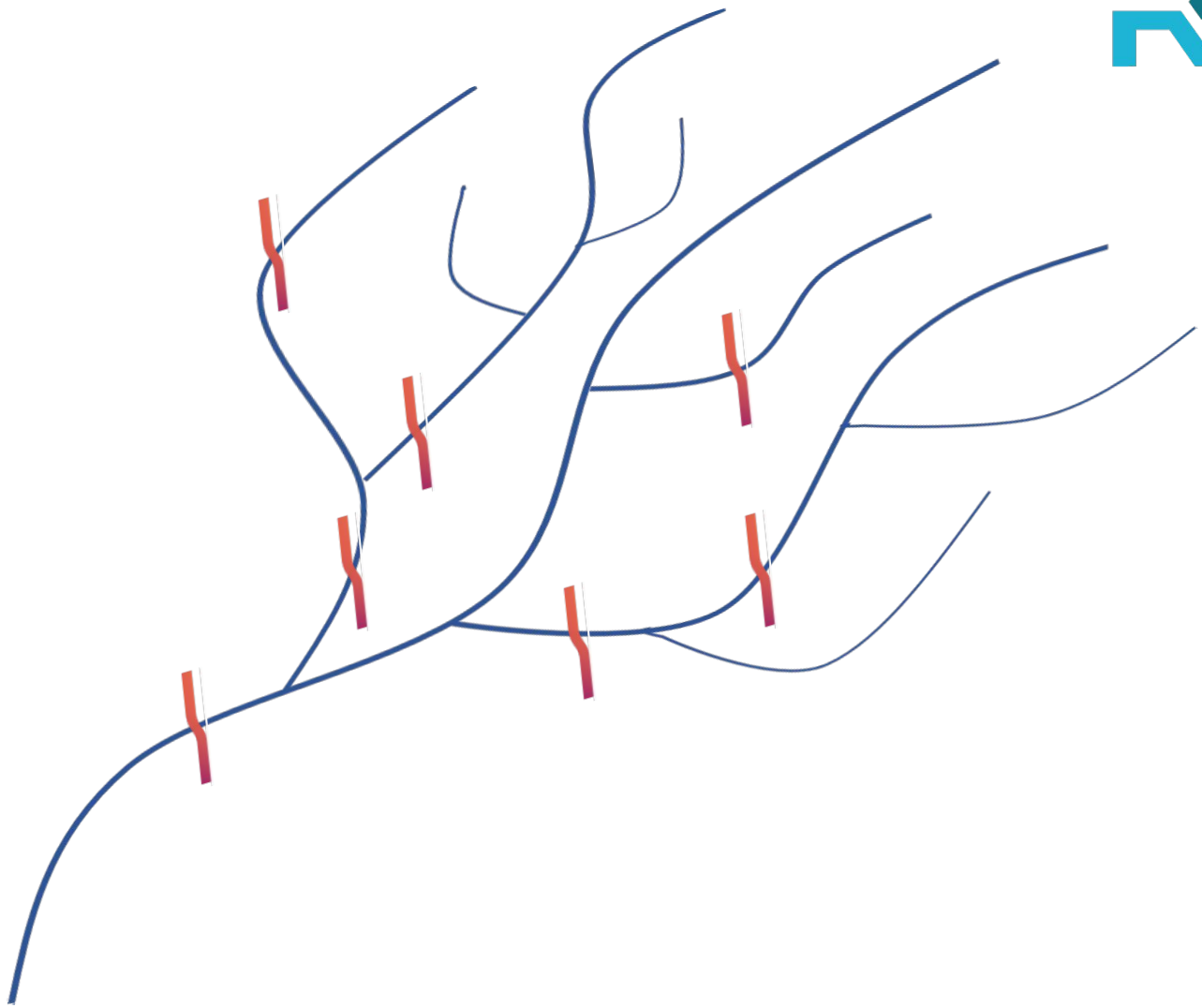
LASH
LIGHTNING
BOOM!
LIGHTNING, MASTER OF THE ELECTRIC BOLTS OF THE SKY, HAS VOWED TO AID HUMAN LIBERTY AND JUSTICE. HE FINDS HIS POWERS TESTED BY THE MAD AND HEINOUS PLOTS OF PROFESSOR GROSSKOP A NAZI WHO HAS BEEN SMUGGLED INTO THIS COUNTRY AND WHO SPEAKS PERFECT ENGLISH. UNKNOWN TO THE WORLD DEATH AND DESTRUCTION STALK THE GREAT POWER DAM ON THE COLORADO RIVER.

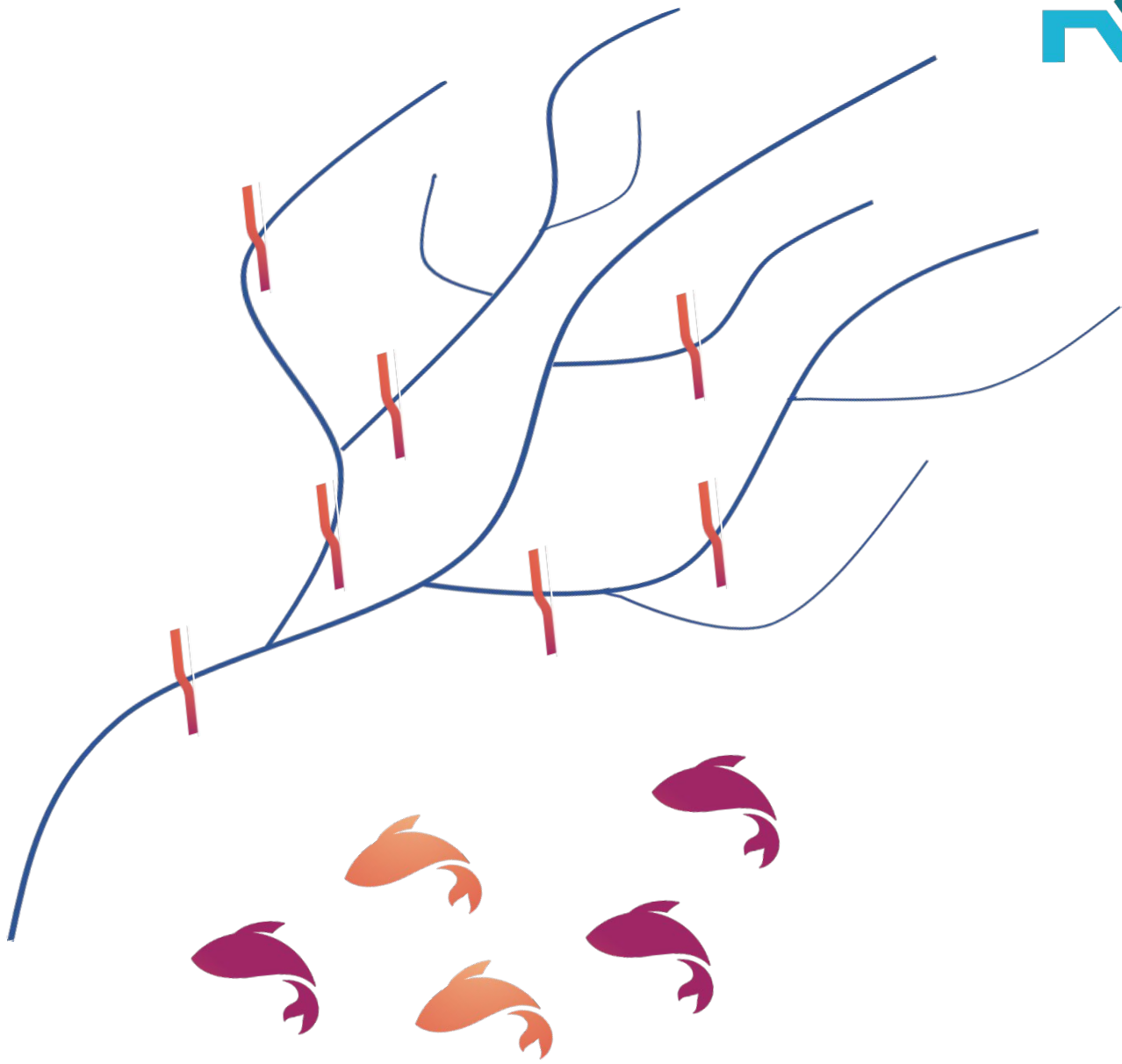


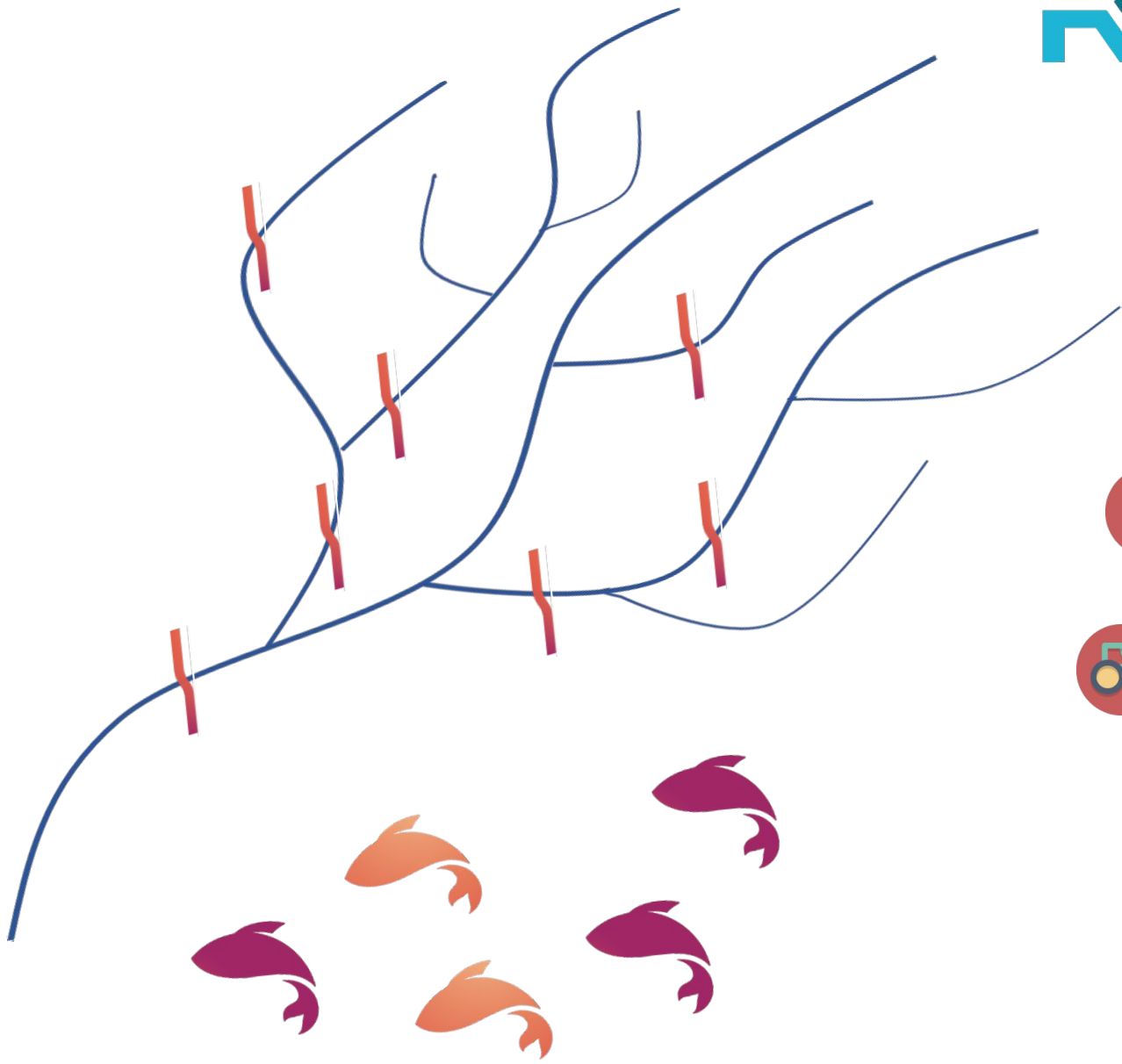


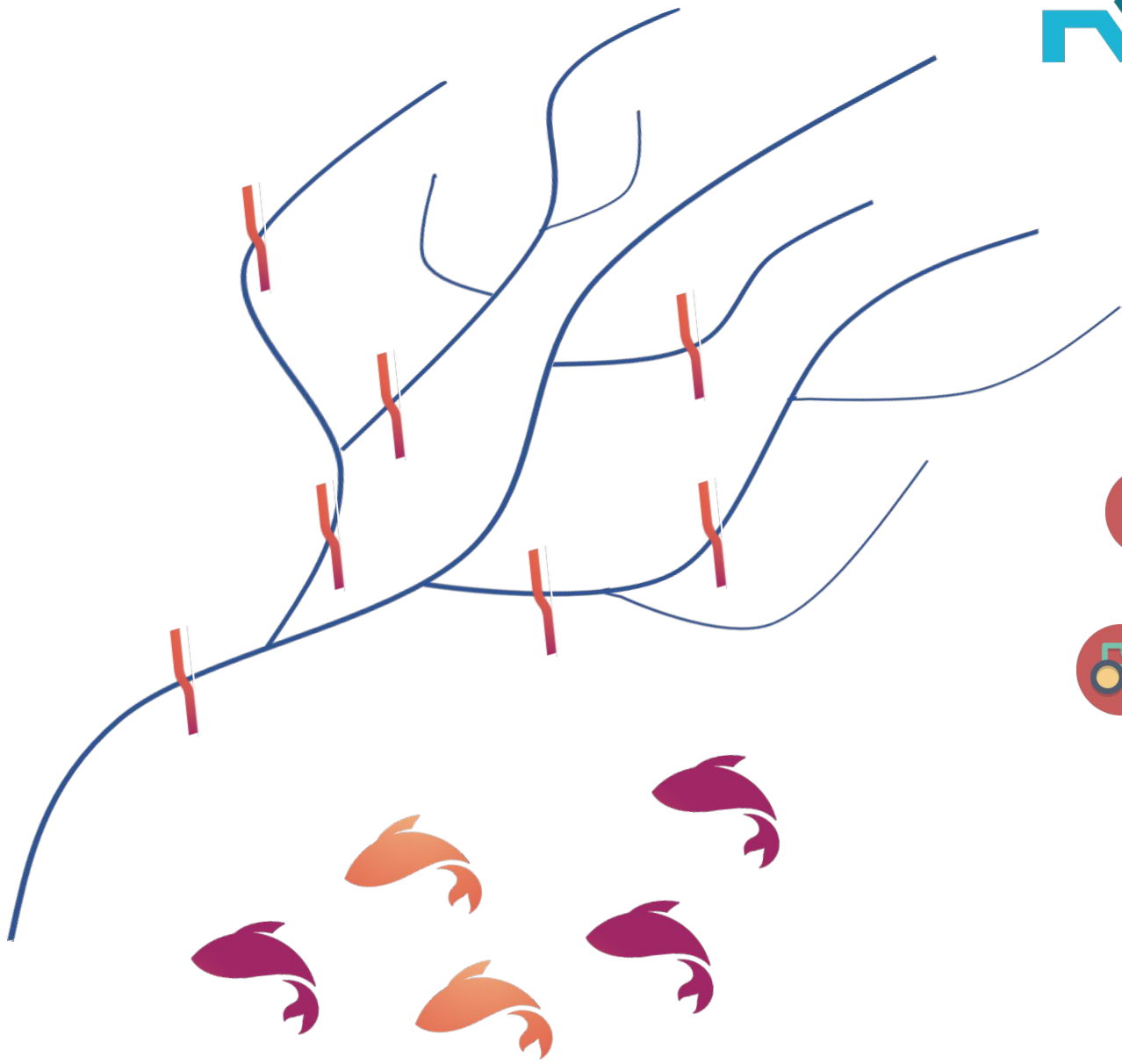
RiVTool

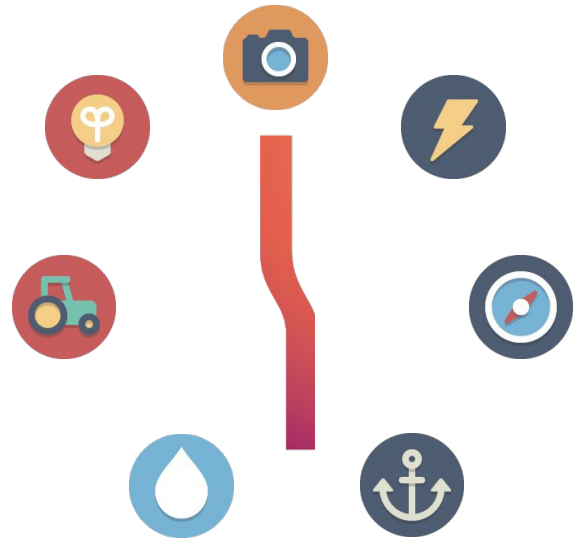
RiVOpt











RiVTool

RiVOpt

RivConnect

RivTool

RivFish

RivOpt

Paulo Branco

pjbranco@isa.ulisboa.pt