LIFE07 ENV/B/000038

Pilot project « Walphy » : Walloon experimentation of river restoration

WALPHY

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Actions

SPW
Service public de Wallonie

Direction des Cours d'Eau Non Navigables

WALPHY

13 Coordination et gestion

Université de Liège

Laboratoire d'Hydrographie
et de Géomorphologie Fluviatile

FUNDP NAMUR

Unité de Recherche en Biologie
Environnementale et Evolutive

12 ✓ Monitoring

1 ✓ Site web

2 ✓ Mise au point méthodologie Qualphy détaillé

3 ✓ Application sur le terrain

Services extérieurs Namur

4 ✓ Travaux de restauration / Continuité longitudinale

5 / Continuité transversale

6 ✓ Concertations

7 ✓ Suivis géomorphologiques

8 ✓ Suivis écologiques

9 ✓ Elaboration d'un guide technique

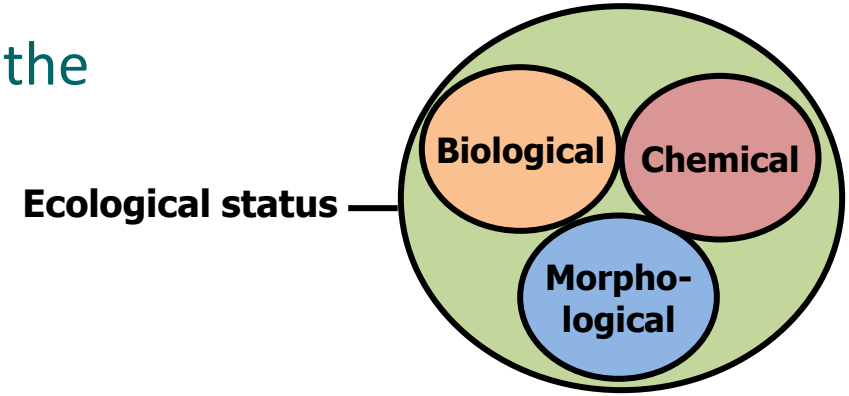
10 ✓ Organisation colloque

11 ✓ Sentier didactique

14 Plan de communication

Context & objectives of the project

Context : Water Framework Directive (2000/60/CE)
Water bodies are required to achieve the « good ecological status » by 2015

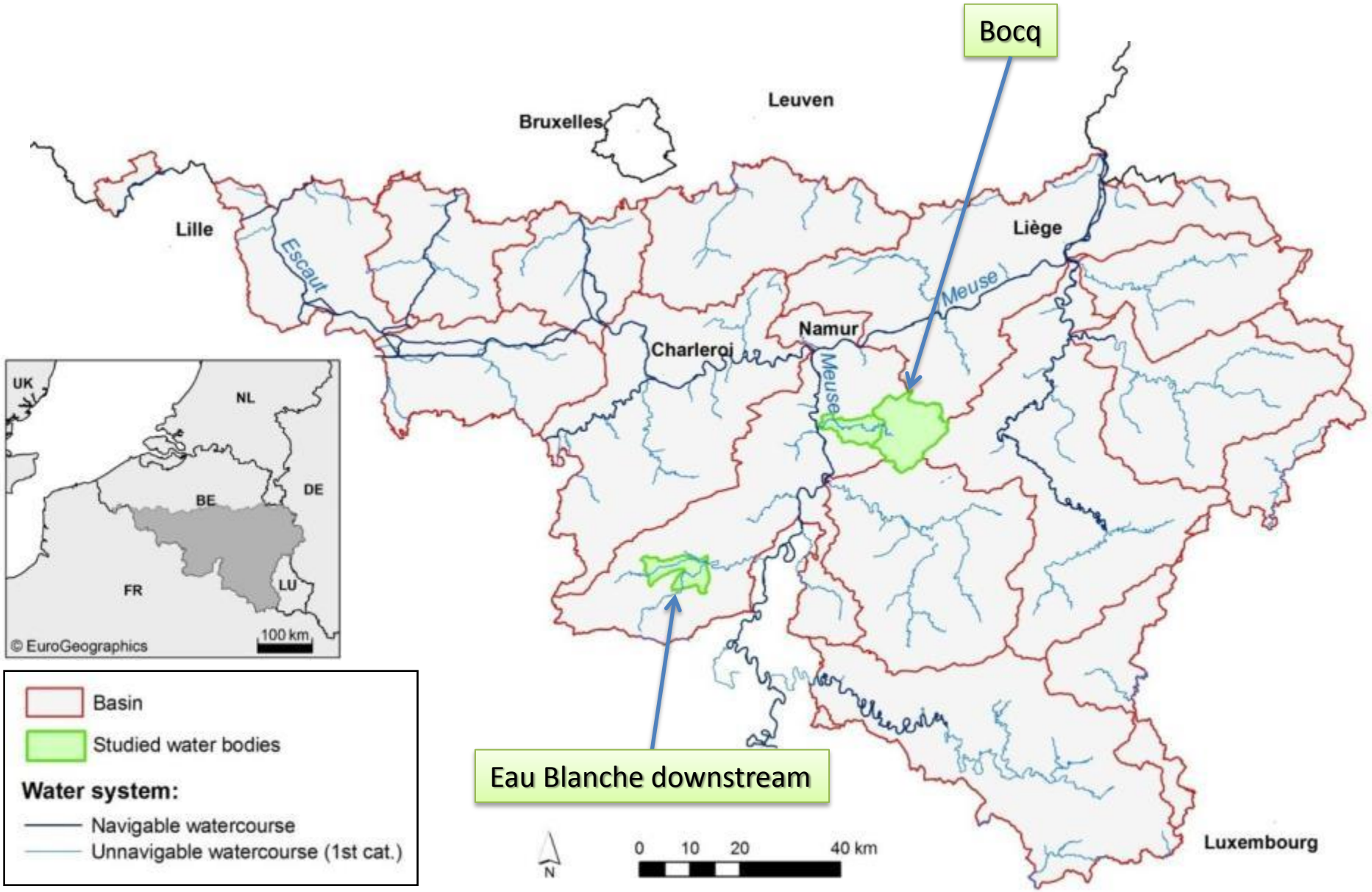


Pilot project « Walphy » - Design of a decision tool for hydromorphological restoration of water bodies in Walloon Region (LIFE07 ENV/B/000038)

Objectives:

- ✓ To develop a structured approach aiming at improving morphological quality of the upstream Meuse basin in order to achieve the “good ecological status”
- ✓ To carry out experimental river restoration works on several risk water bodies
- ✓ Ecological and geomorphological monitoring of the restored river systems

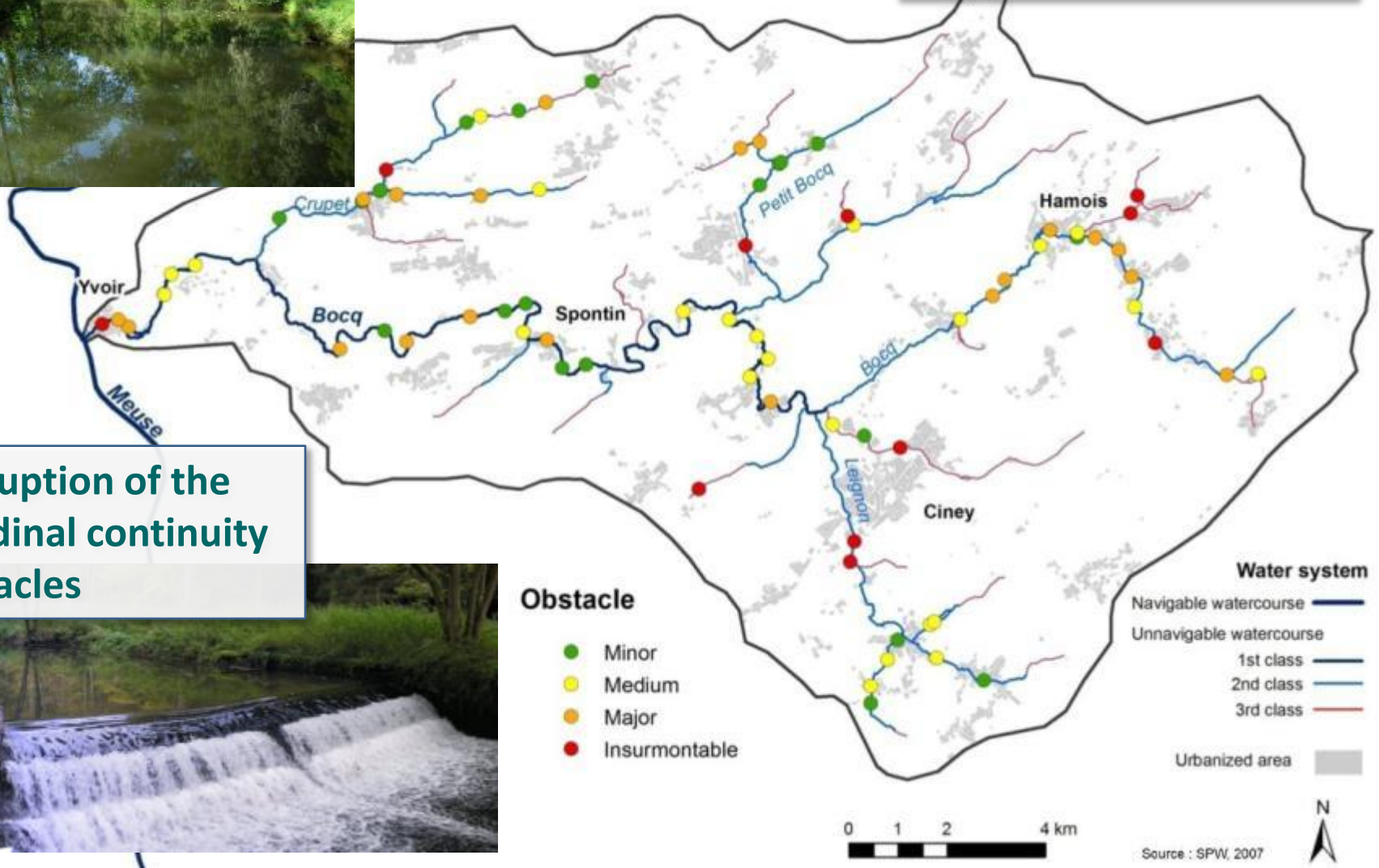
Two water bodies are studied



River restoration work

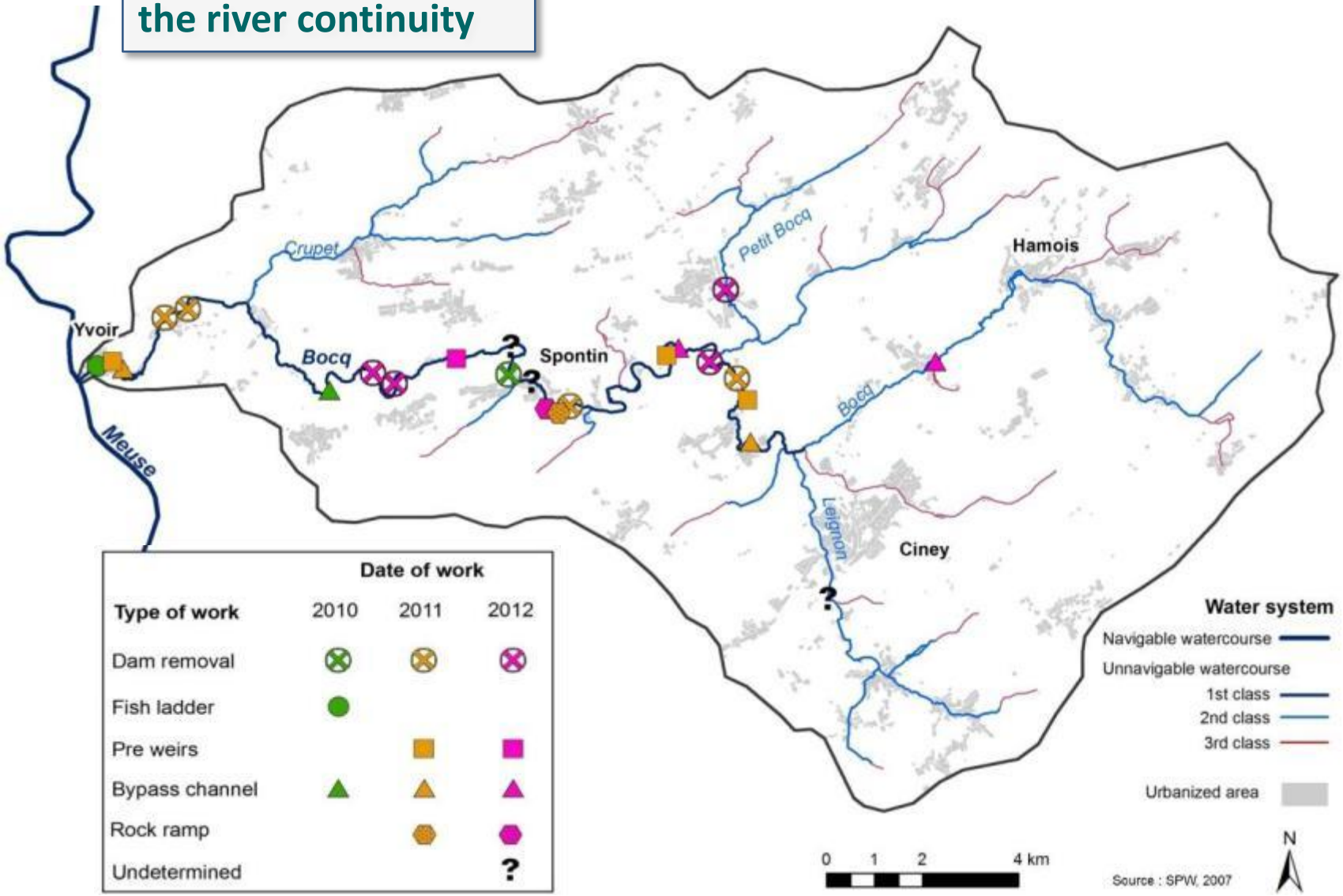
Bocq :

Catchment area: 233 km²
Average slope: 4.8 ‰
2,3 m³/s



➡ **Disruption of the longitudinal continuity**
62 obstacles

➡ Improvement of the river continuity



Passe à bassins : Yvoir, salle du Maka
Fish ladder

1er obstacle depuis la Meuse
dénivelée : 1.85 m

attente de la mise en service de la centrale hydro-électrique

Coût : 200.000 €

Pré-barrages – Pre weirs

Yvoir (Forge Aminthe)
dénivelée = 1,50 m enrochements bruts liaisonnés au béton

Coût : 90.000 €

Natoye (Mouffrin)
dénivelée = 0,80 m (3 chutes)

Coût : 51.000 €

Rivières de contournement – Bypass chanel

Purnode (centrale hydro-électrique) 1,35 m

Coût : 67.000 €

Yvoir (Château Dapsens)

Coût : 89.000 €

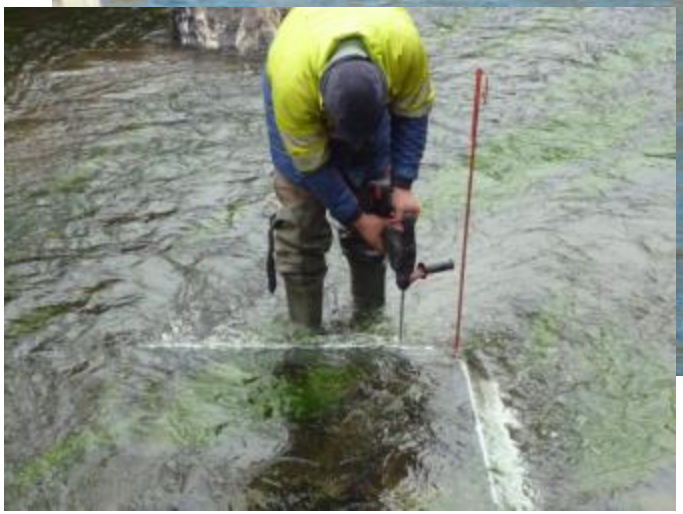
Effacements de barrages – Dam removal

Spontin village - dénivelée : 1.20m

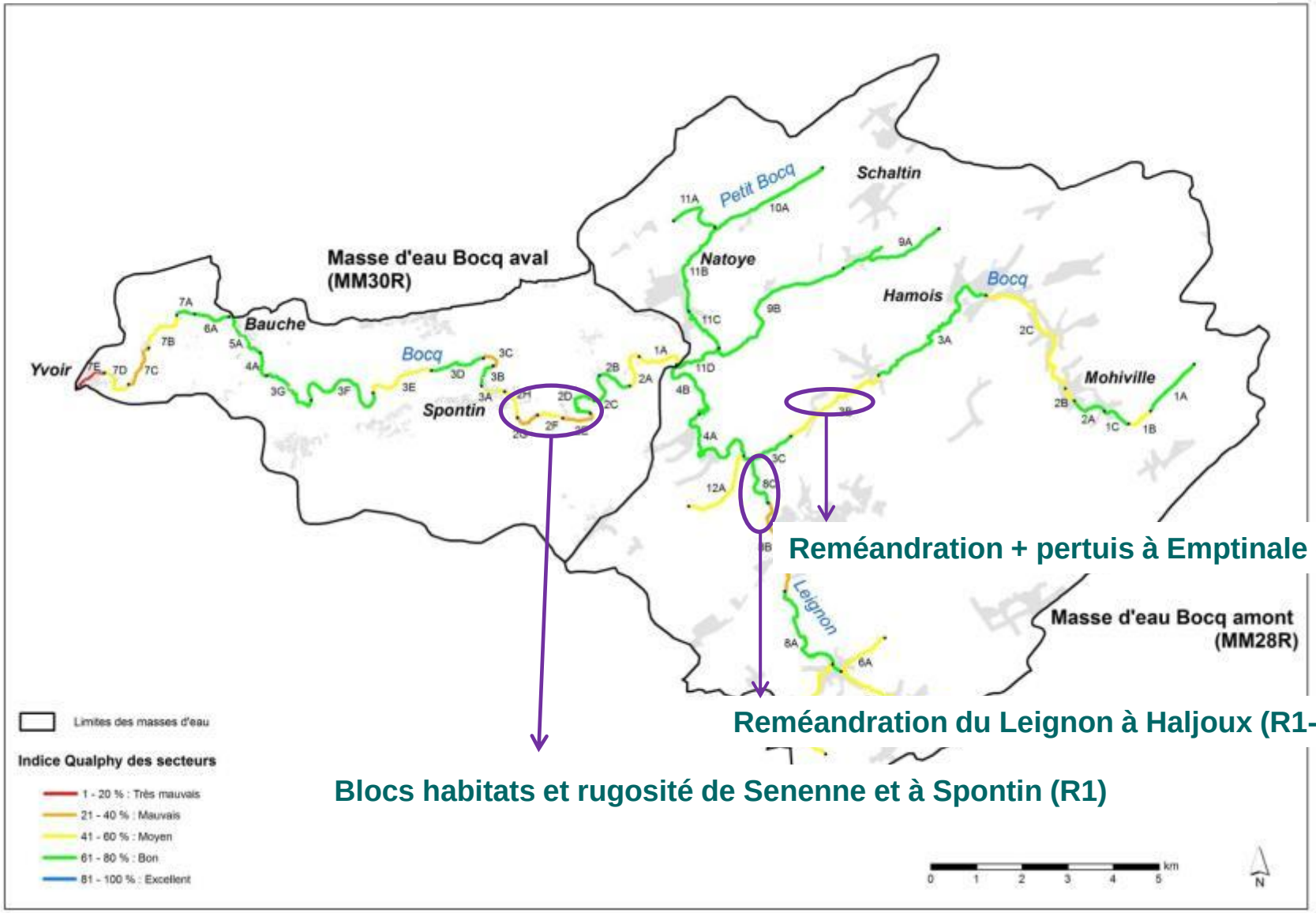
Coût : 40.000 €

Rampe rugueuse – Rock ramp

Spontin - Vivaqua



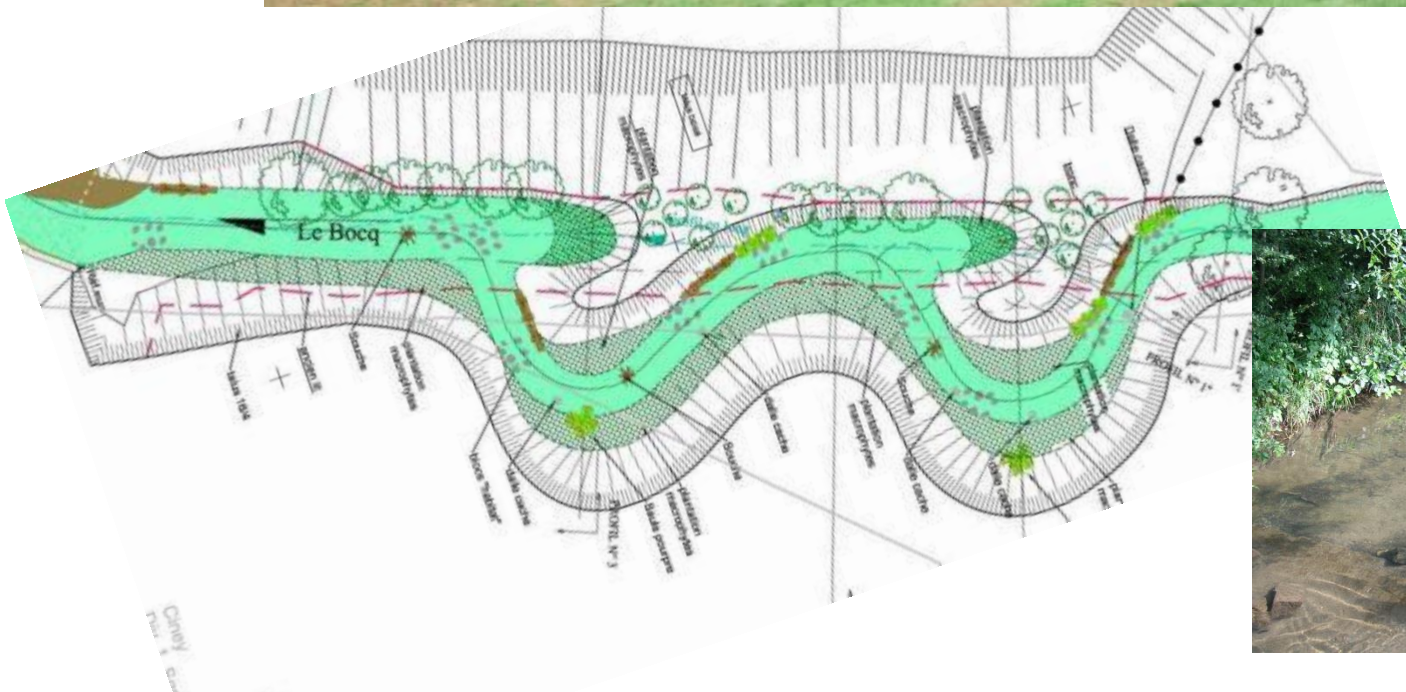
Rétablissement de la continuité latérale bassin du Bocq



Leignon à Haljoux

Reméandration et aménagement d'un pertuis

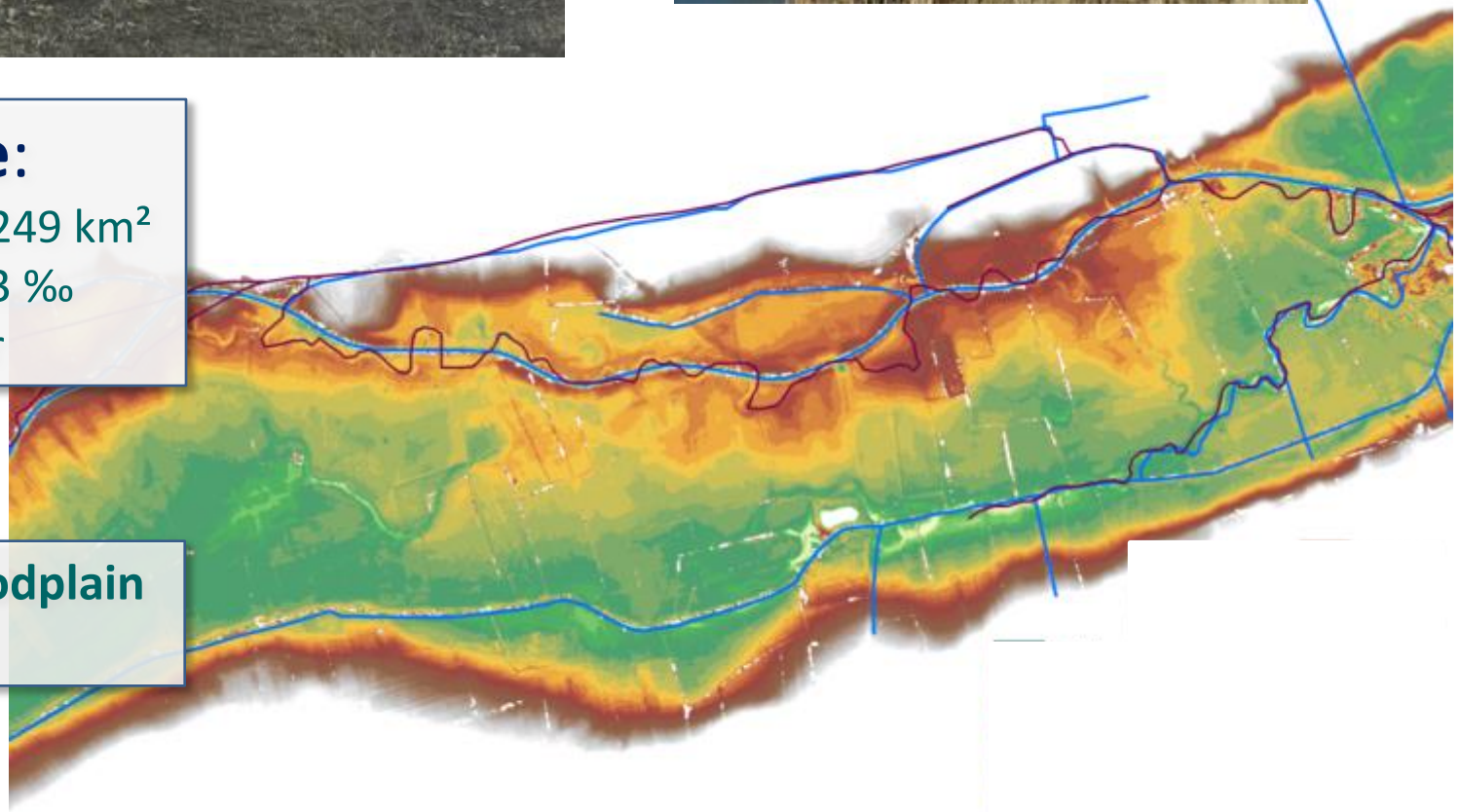
Emptinale
Ciney



Eau Blanche:

Catchment area: 249 km²
Average slope: 2.3 ‰
Straightened river

Poor stream-floodplain connectivity



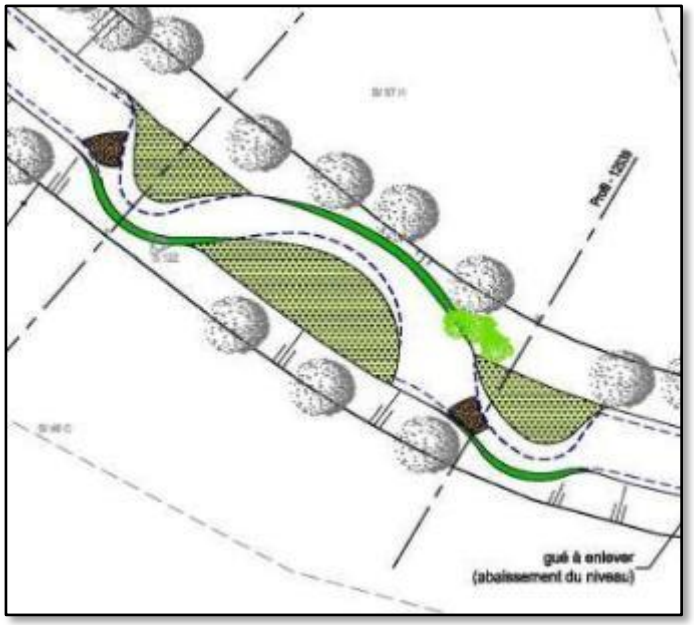
Varied restoration techniques

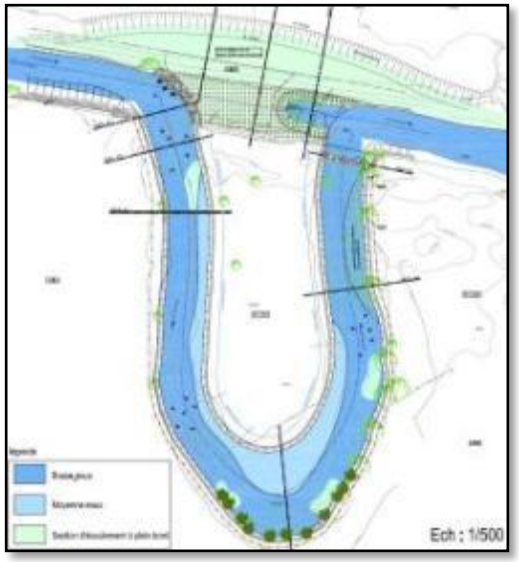
Flow deflectors and gravel re-introduction

Woody trunk

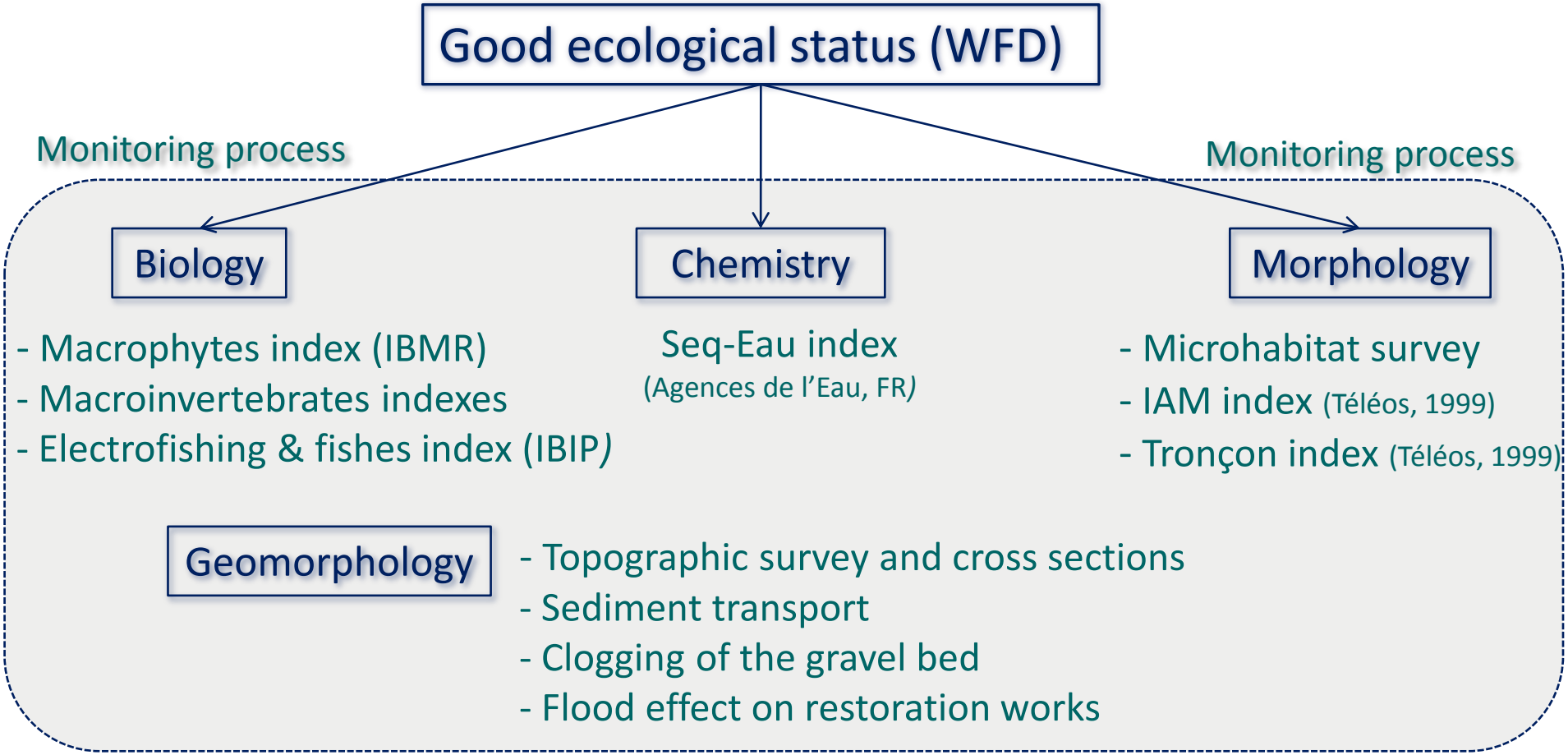
Low level berm

Meandering channel





Monitoring : data collection and analysis



Aim : assessing the effectiveness of restoration projects

Morphology

Microhabitat mapping

Water depth model

Field survey of the stream channel :

- Stream bed boundary
- Stream bed elevation
- Water surface elevation

- Stream bed DEM

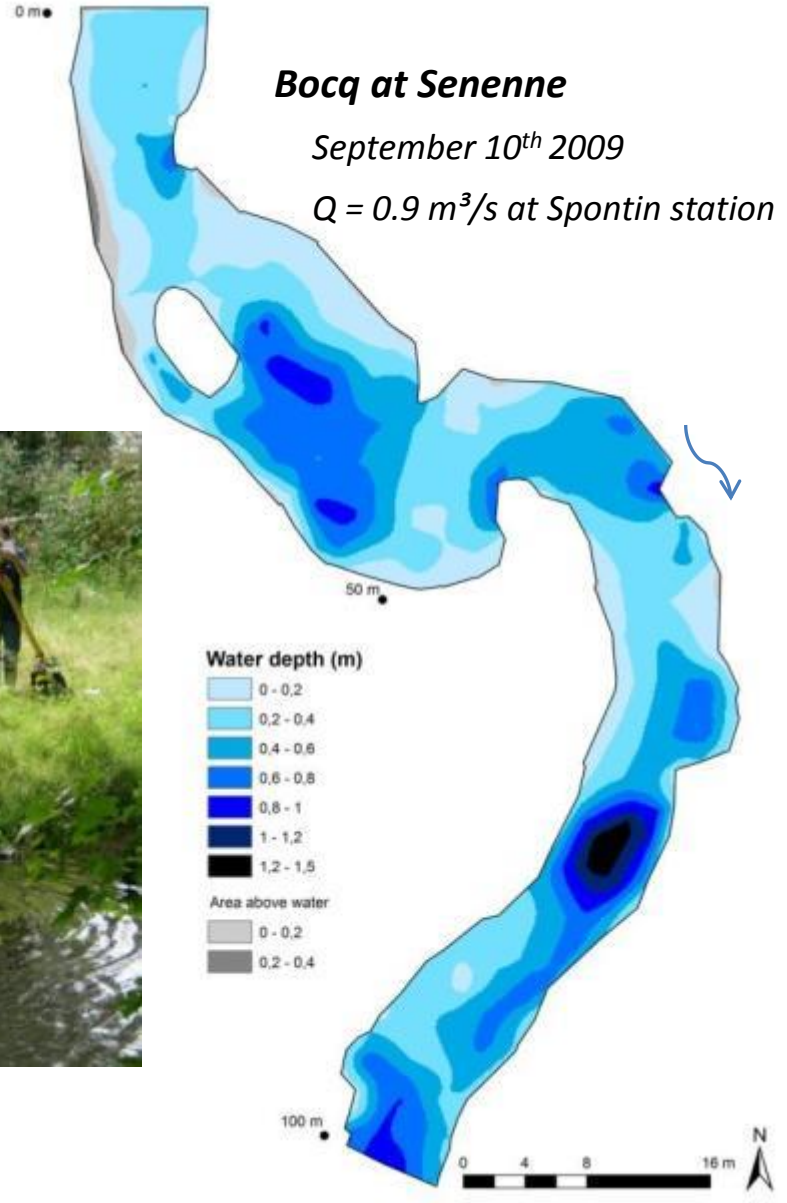
- Water surface DEM

Water depth model

Bocq at Senenne

September 10th 2009

Q = 0.9 m³/s at Spontin station



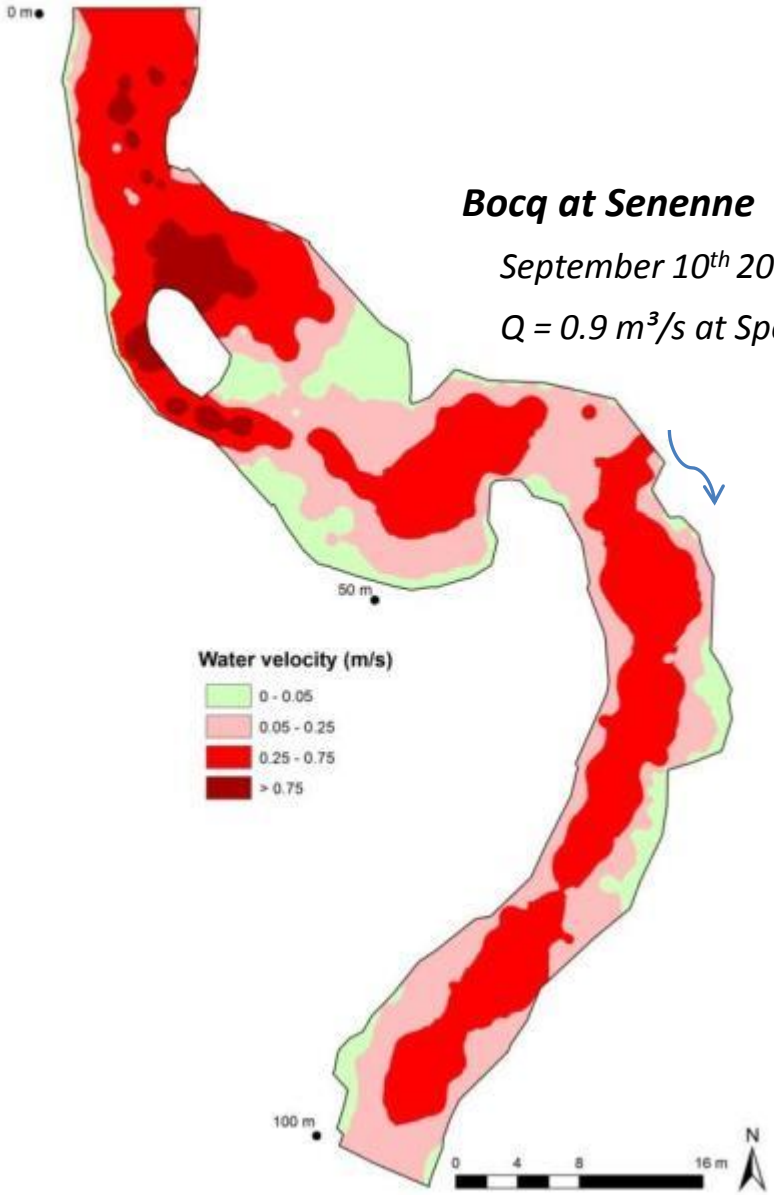
Water velocity model

Dominant substrate class

Bocq at Senenne

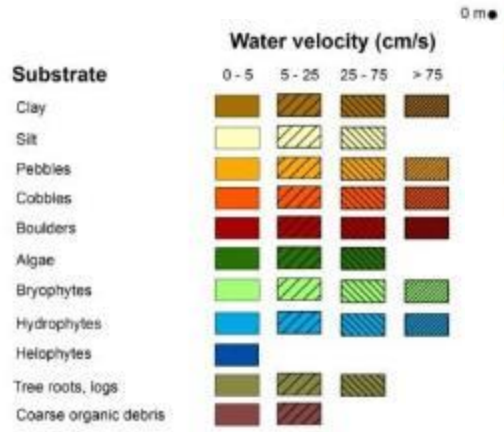
September 10th 2009

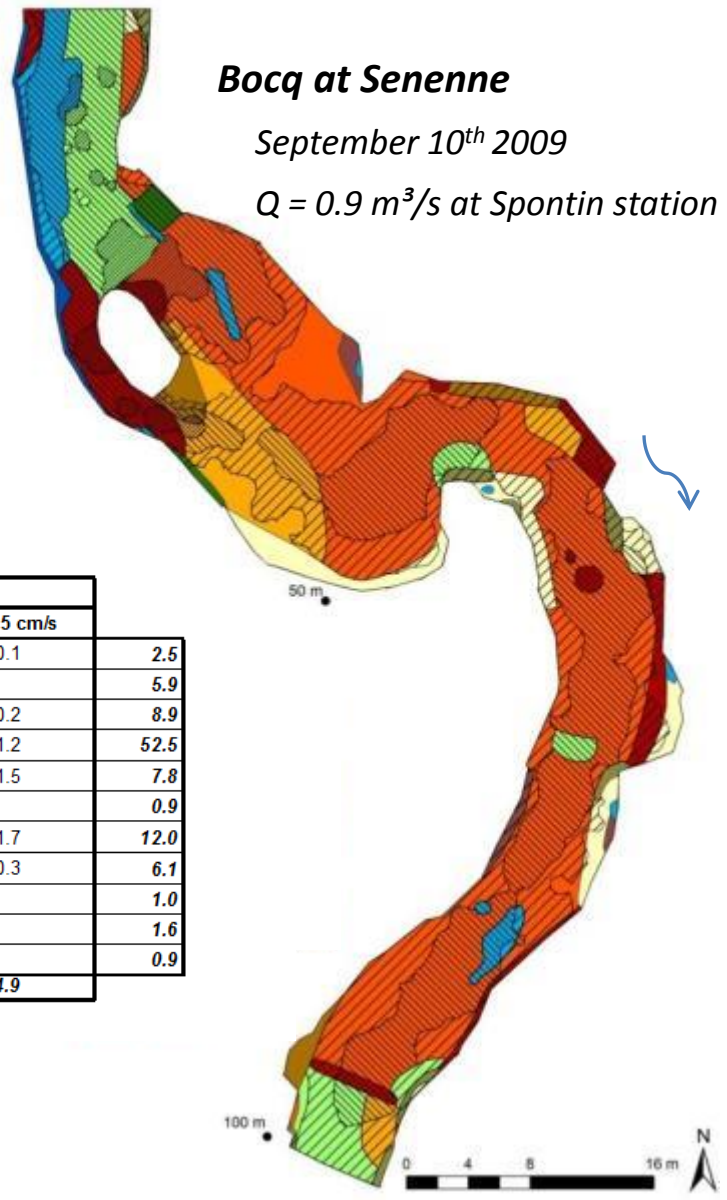
Q = 0.9 m³/s at Spontin station



Morphology

Microhabitat mapping





Bocq at Senenne

September 10th 2009

Q = 0.9 m³/s at Spontin station

	Area (%)	WATER VELOCITY				
		v < 5 cm/s	5 < v < 25 cm/s	25 < v < 75 cm/s	v > 75 cm/s	
SUBSTRATE	Clay	1.2	0.9	0.3	0.1	***2.5***
	Silt	3.5	2.1	0.3		***5.9***
	Pebbles	1.9	4.9	2.0	0.2	***8.9***
	Cobbles	3.3	19.9	28.2	1.2	***52.5***
	Boulders	0.6	2.2	3.6	1.5	***7.8***
	Algae	0.2	0.1	0.6		***0.9***
	Bryophytes	0.2	2.8	7.3	1.7	***12.0***
	Hydrophytes	0.2	1.0	4.6	0.3	***6.1***
	Helophytes	1.0				***1.0***
	Tree roots, logs	0.4	1.0	0.2		***1.6***
	Coarse organic debris	0.5	0.4			***0.9***
		12.8	***35.3***	***47.1***	***4.9***	

Morphology

Morphodynamic attractivity index (IAM) (Teleos, 1999)

$$IAM_{calculated} = \left(\sum_{1}^{n} (Si * Attract.(subs.) \right) * Var(subs.) * Var(he) * Var(v)$$

Si *= Area of the i substrate*
Attract*. = attractivity of the i substrate for the fish*
n *= Number of substrate*
Var(subs.) *= Number of substrate*
Var(he) *= Number of depth class*
Var(v) *= Number of water velocity class*

"IAM calculated" compared to "IAM reference"

Substrate	Attractivity
Root wads, woody coarse debris	100
Undercut banks	90
Hydrophytes	80
Boulders (with fish caches)	60
Cobbles	50
Helophytes	40
Root mats	40
Boulders (without fish caches)	30
Mix of pebbles and cobbles	25
Pebbles	20
Organic debris	10
Sands	8
Clay and silt	4
Mud	3
Concrete surface and slab	1
Affluents, spring	+25%

Morphology

Tronçon index (Teleos, 1999)

Heterogeneity
Sinuosity, diversity of width, depth, flow, substrate, presence of backwaters,…

Attractivity
Spawning ground, hiding places, presence of backwaters,…

Connectivity
Obstacles, banks, riparian areas,…

Heterogeneity (H)		Attractivity (A)		Connectivity (C)		Stability (S)		PHYSICAL QUALITY	
score of 111		score of 90		score of 130		score from -60 to +40		= (H + A) x C x K Score of 30 600	
A	≥ 50	A	≥ 45	A	≥ 65	Sedimentation	> +10	A	**≥ 6 500**
B	40 - 49	B	34 - 44	B	49 - 64	Balance	-10 / +10	B	**3 500 - 6 500**
C	28 - 39	C	23 - 33	C	33 - 48	Erosion	-25 / -10	C	**1 500 - 3 500**
D	14 - 27	D	11 - 22	D	16 - 32	Strong erosion	-60 / -25	D	**400 - 1 500**
E	≤ 13	E	≤ 10	E	≤ 15	*Gives a K coefficient*		E	**< 400**

K	*-60 < S < -26*	*-25 < S < -11*	*-10 < S < 9*	*10 < S < 40*
H ≥ 50	K = 0.85	K = 1	K = 1.25	K = 0.75
H < 50	K = 0.85	K = 1	K = 0.85	K = 0.75

Premiers suivis

Ruisseau de Leignon

état initial : juin 2008
travaux : août 2010
premier suivi : juillet 2011

Trç	Limite amont	Limite aval	Linéaire (m)	Score Hétérogénéité /111	Classe	Score Attractivité /90	Classe	Score Connectivité /130	Classe	Score Stabilité -60 / 40	Classe	Coef stab* 0,75 / 1,25	Qualité physique /30600	Classes
													=(Hét+Att)*Conn*Coef.stab	
Trç Haljou (avant trav)	Pont d'Haljoux	Fin du secteur des travaux de reméandrage (profil 17)	115	22	D	42	B	52	B	-12	érosion	1	3.328	C
Trç Haljoux (après trav)			125	49	B	47	A	67	A	-9	équilibre	0,85	5.467	B
			A	>50		> 45		> 65		>10	Sédimentation		> 6500	
			B	40 - 50		34 - 45		49 - 65		-10 / 10	Equilibre		3500 - 6500	
			C	28 - 40		23 - 34		33 - 49		-25 / -10	Erosion		1500 - 3500	
			D	14 - 28		11 - 23		16 - 33		-60 / -25	Forte érosion		400 - 1500	
			E	< 14		< 11		< 16					< 400	

↗ nbre faciès écoulement
meilleure sinuosité
largeur et vitesse diversifiées

présence frayères
systèmes latéraux

meilleure connectivité latérale

Eau Blanche – Mariembourg EI 6/10 travaux 9/10 suivi 9/11

Trç	Limite amont	Limite aval	Linéaire (m)	Numéros séquences	Score Hétérogénéité /111	Classe	Score Attractivité /90	Classe	Score Connectivité /130	Classe	Score Stabilité -60 / 40	Classe	Coef stab° 0,75 / 1,25	Qualité physique /30600 =(Hét+Att)*Conn*Coef.stat	Classes
Mariembourg - avant travaux	Pont N5	Limite communale entre Couvin et Viroinval	2 547	1+2+3	18	D	24	C	44	C	-8	équilibre	0.85	1 571	C
Mariembourg - après travaux	Pont N5	Limite communale entre Couvin et Viroinval	2 547	1+2+4	32	C	45	A	51	B	1	équilibre	0.85	3 338	C

A	>50	> 45	> 65	>10	Sédimentation	> 6500
B	40 - 50	34 - 45	49 - 65	-10 / 10	Equilibre	3500 - 6500
C	28 - 40	23 - 34	33 - 49	-25 / -10	Erosion	1500 - 3500
D	14 - 28	11 - 23	16 - 33	-60 / -25	Forte érosion	400 - 1500
E	< 14	< 11	< 16			< 400

Hétérogénéité : pas grands changements
Attractivité : augmentation de 2 classes liée aux caches et frayères
Connectivité latérale peu améliorée, longitudinale : suppression barrage

Essentiellement travaux « R1 » : amélioration pas très sensible

Biology

Macrophytes : IBMR index based on :

- ✓ cover
- ✓ ecological amplitude
- ✓ trophic level of taxa

Macroinvertebrates : indexes based on :

- ✓ abundance
- ✓ diversity
- ✓ species richness
- ✓ specific pollution sensitivity index
- ✓ habitat quality

Electrofishing and IBIP index based on :

- ✓ abundance
- ✓ density
- ✓ species richness

Feedback

- For long-term monitoring
- Reflects the quality of water and substrates

Multiple indexes

Optimized data analysis

Geomorphology

Sediment transport

Evaluating bedload mobility using traced pebbles and PIT-tags

PIT tagged pebbles placed in rivers at :

- ✓ reference reaches
- ✓ reaches impacted by obstacle

(e.g. upstream of weir)

- ➡ enable to highlight restoration of free movement of sediment
- ✓ reaches with spawning gravel
- ➡ reintroduction enable to characterize the mobility of new spawning gravel

Geomorphology

Clogging of the gravel bed

Sediment traps buried into the gravel bed on :

- ✓ reference reaches
- ✓ reaches impacted by restoration work
- ✓ reaches with gravel reintroduction

Geomorphology

Flood effect on restoration works

Restoration works and their stability and resistance to erosion : related to flood characteristics (discharge, recurrence, specific stream power, shear stress)

Leignon – Haljoux :
Bankful discharge (January 7th 2011)

Leignon – Haljoux :
Trash lines survey

Réalisation d'un sentier pédagogique
> octobre 2012 – sur l'Eau Blanche à Nismes
Panneaux sur le Bocq à Spontin

Tournage d'un film > début 2013

Organisation d'un colloque
> septembre ou octobre 2013

Elaboration d'un guide technique
> décembre 2013

Site internet : www.walphy.be

Extrait de Lachat 2007

Nottingham, April 20th 2012

www.walphy.be

DCENN : Francis Lambot – Bernard de le Court – Louis-Michel Petiau - Olivier Desteucq – Pierre Joye

ULg / LHGF : Alexandre Peeters – Eric Hallot – François Petit

FUNDP / URBE : Gisèle Verniers – Jean-Pierre Descy

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