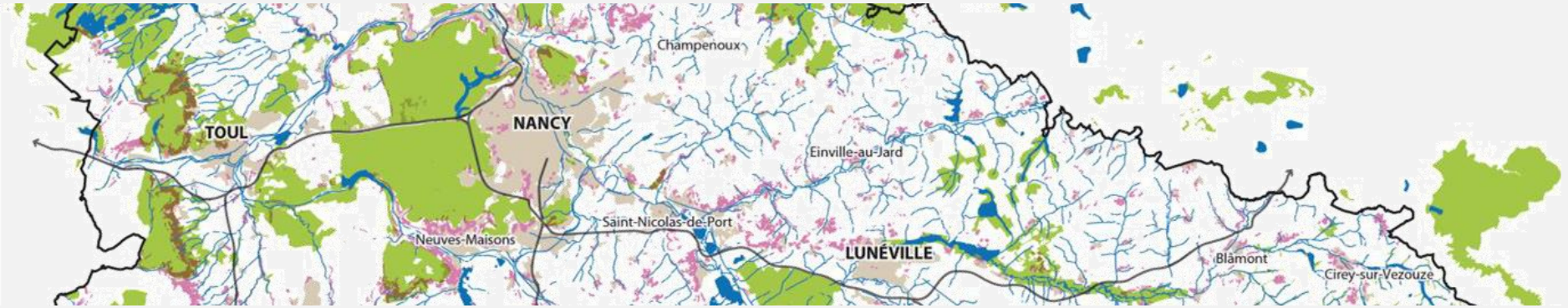
How to optimize ecosystem services into urban planning?

Comment optimiser les services écosystémiques en aménagement du territoire ?

Anne Blanchart[1,2,3], Johan Cherel[4], Marie Stas[1], Jean Noël Consalès[2], Gilles Warot[4], Geoffroy Séré[1], Christophe Schwartz[1]

1 Laboratoire Sols et Environnement, Université de Lorraine, INRA, Nancy
2 Institut d'Urbanisme et d'Aménagement Régional, Aix-Marseille
3 Agence De l'Environnement et de la Maitrise de l'Energie, Angers
4 SCE, Aménagement et Environnement, Nantes

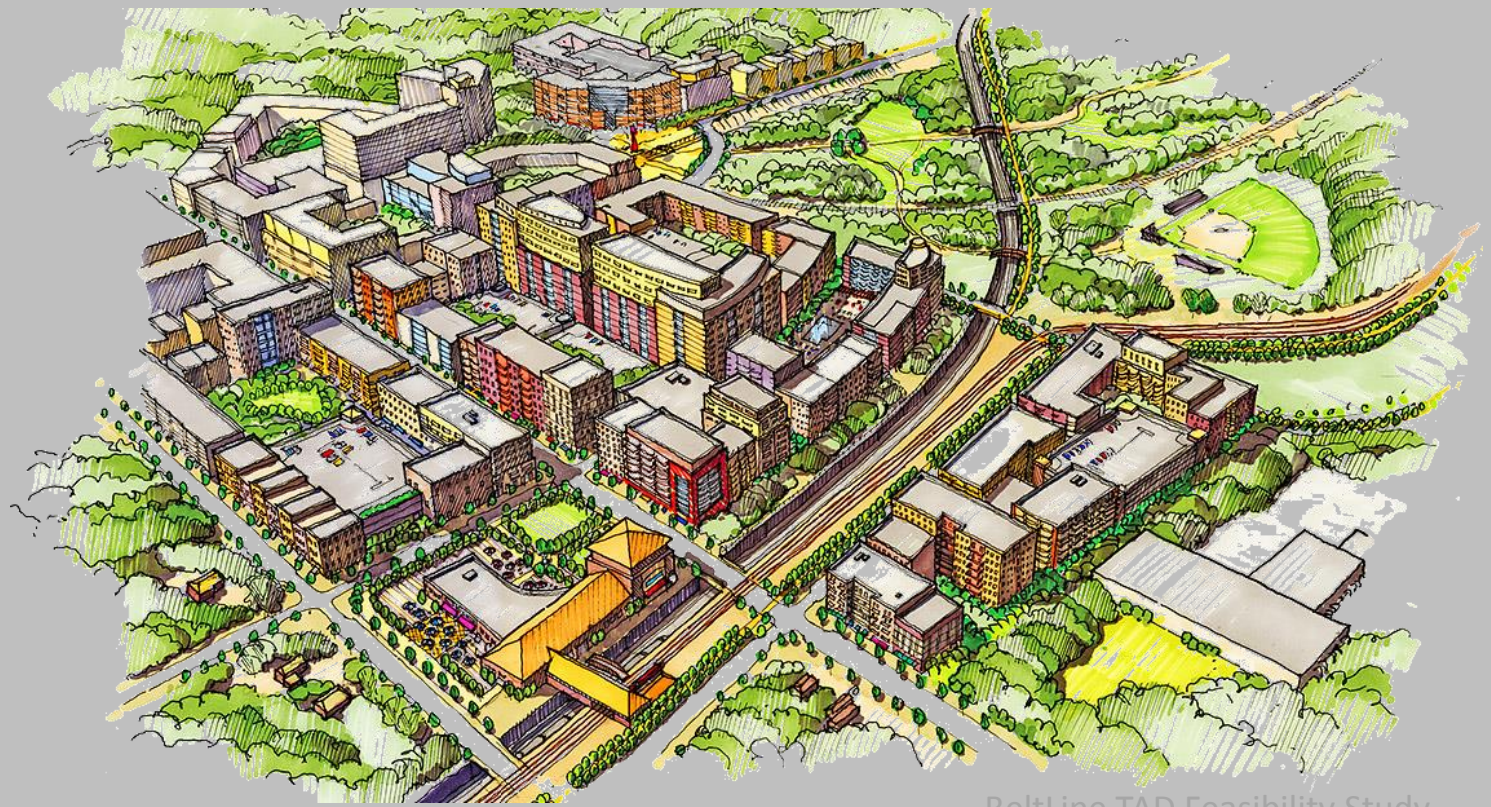


GENERAL PURPOSE

- **Urban areas** ➔ major **environmental issues**: *e.g.* water availability, air quality, food dependency, natural risks
- **Urban planning** ➔ has to face **sustainable** development criteria
- **Urban ecosystem** ➔ provide ecosystem services

Urban soil seems to be a good lever for enhancing sustainably urban planning

Urban planning and soils



BeltLine TAD Feasibility Study
Atlanta, GA

CONSIDERATION OF URBAN SOILS IN URBAN PLANNING

- **Soil sciences → urban soils** are a living and fertile **volume**, able to face environmental issues **(Lovell and Taylor, 2013; Vrščaj et *al.*, 2005)**

- **Urban planning → urban soils** are mainly considered two-dimensionally, as a surface area **(Lehmann, 2010)**

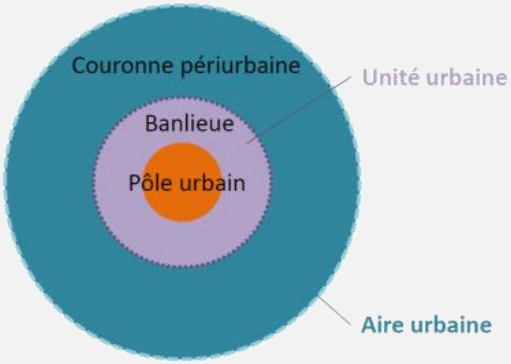
Hypothesis 1: Soils are poorly taken into account in urban planning

Question 1: What is the consideration of urban planners for urban soils?

LEXICAL ANALYSIS OF PLANNING DOCUMENTS WITH TROPES SOFTWARE

Material & methods 1

Selection of study sites



Selection of planning documents

Code de l'urbanisme

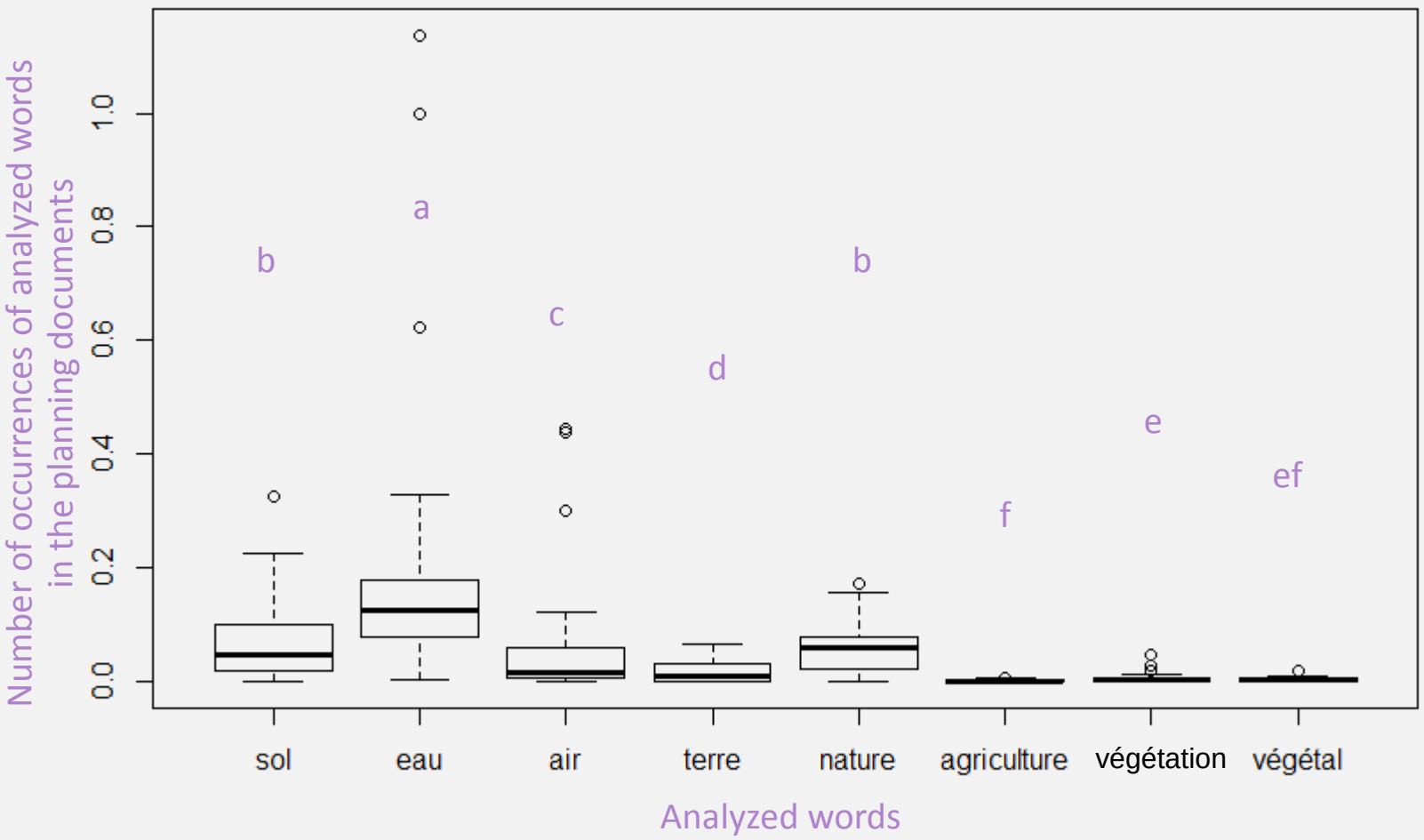
National scale — Local scale

Lexical analysis
➔ Quantitative analysis

SOIL?

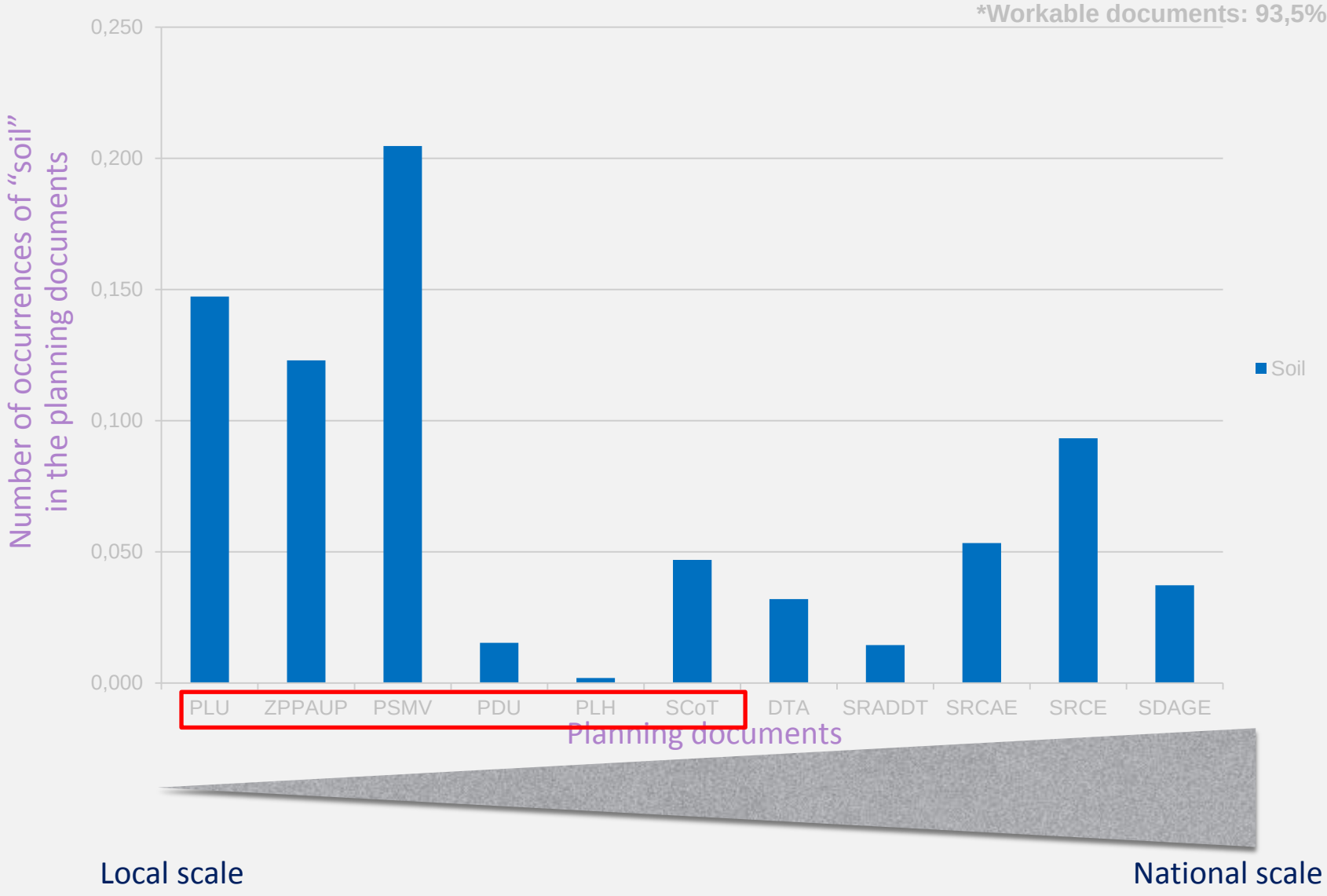
OCCURRENCES OF SOME WORDS IN PLANNING DOCUMENTS

*Workable documents: 93,5%



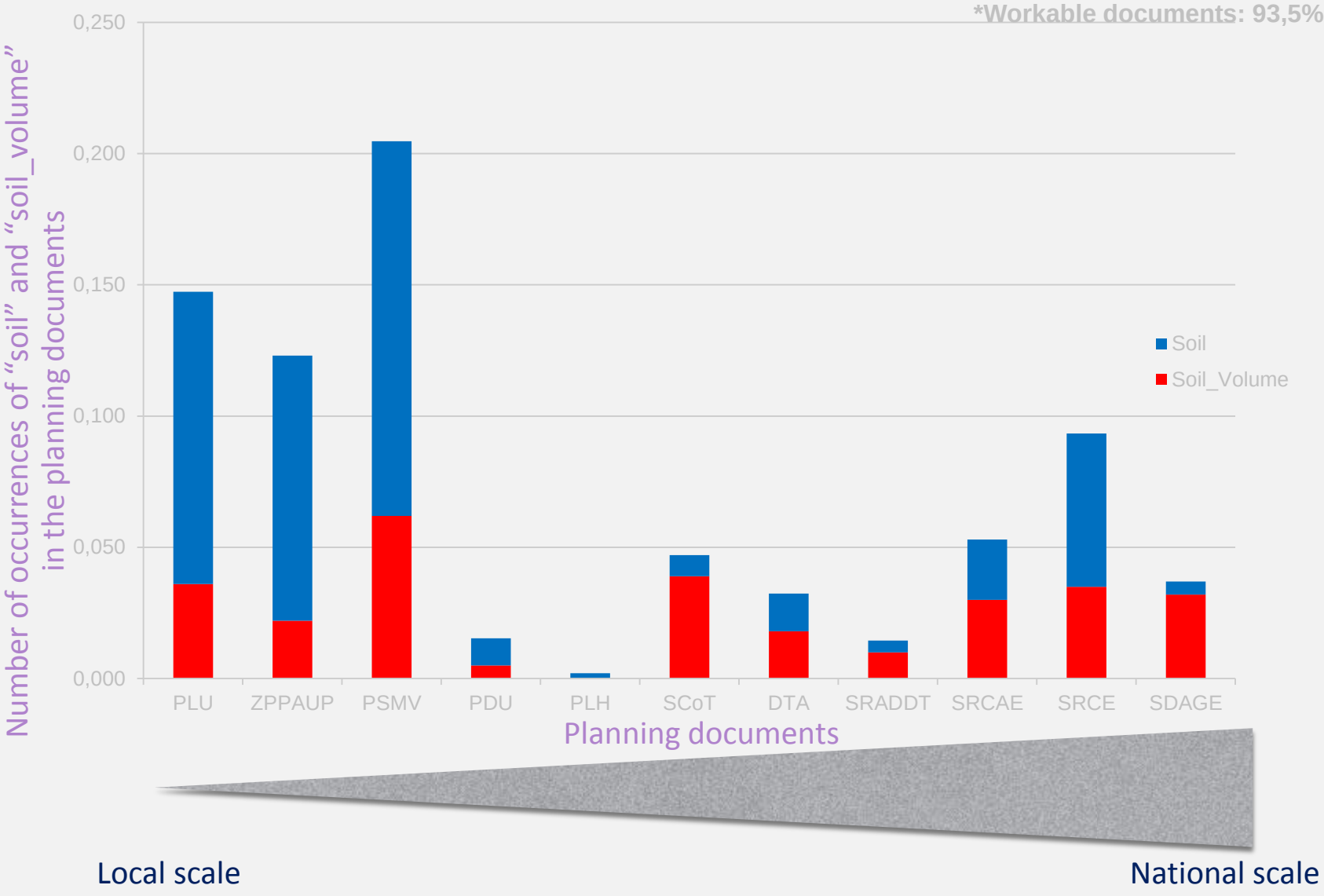
- "Soil" as a word, is poorly used in planning document (~0,1%)
- There is a strong variability in the use of the word "soil" from one urban area to the other

OCCURRENCES OF THE WORD « SOIL » IN PLANNING DOCUMENTS



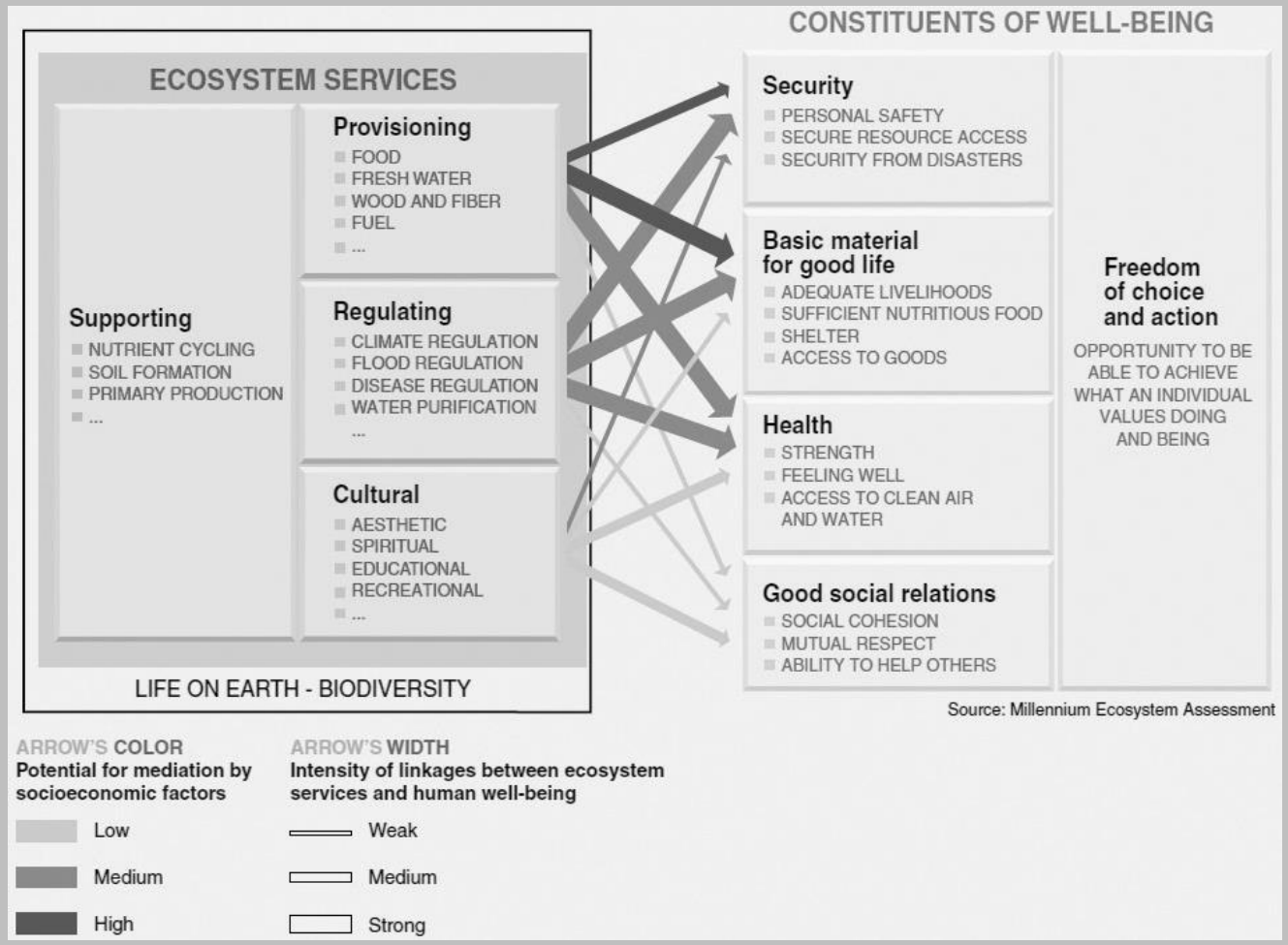
- "Soil" as a word is principally used in the planning documents related to the metropolitan scale

OCCURRENCES OF « SOIL » AND « SOIL_VOLUME » IN PLANNING DOCUMENTS



- The use of the word "soil" in the planning documents is mostly linked with the idea of a surface area

Ecosystem services and urban soils

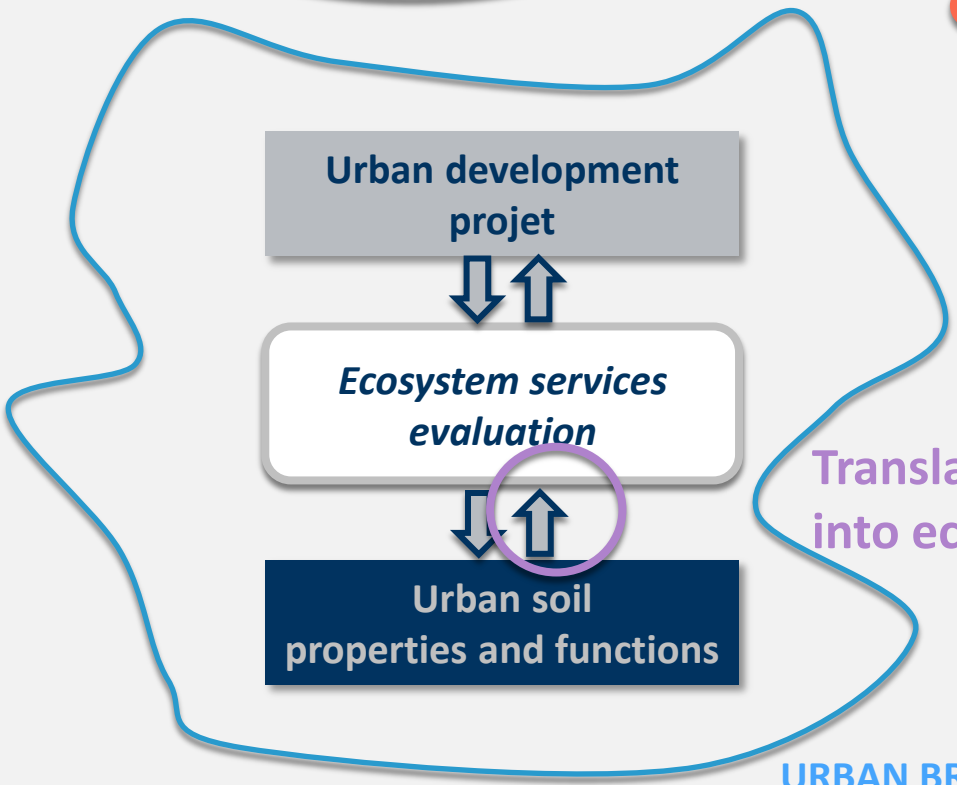


MEA, 2005

DESTISOL: TRANSLATE URBAN SOIL PROPERTIES INTO ECOSYSTEM SERVICES

Hypothesis 2: Soils properties are poorly taken into account by urban planners because there is no tool to estimate them

Question 2: How to evaluate soil properties in terms of ecosystem services?



DESTISOL

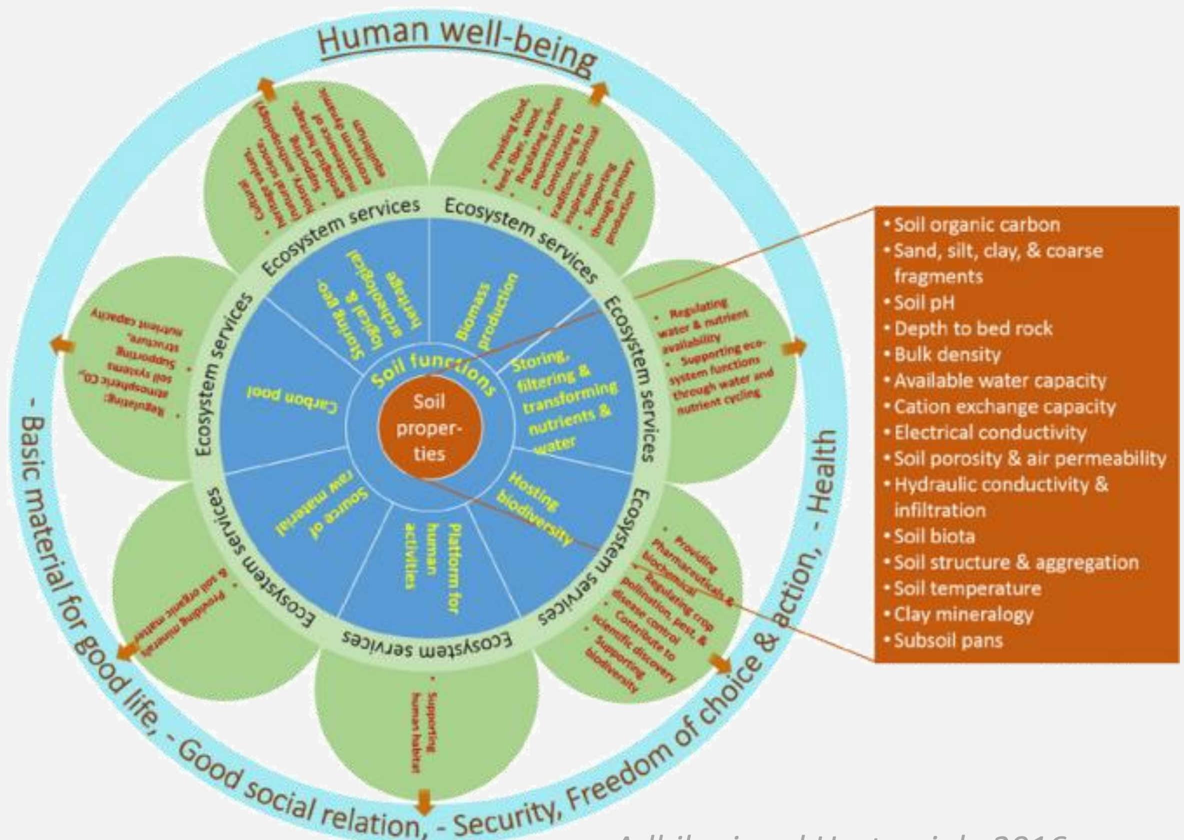
Translate soil properties into ecosystem services

URBAN BROWNFIELD

How ?

→ Identification of the ecosystem services provided by urban soils

→ Soil properties → Soil functions → Soil ecosystem services



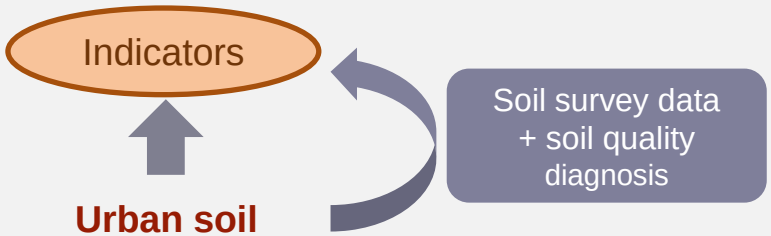
Adhikari and Hartemink, 2016

DESTISOL: IDENTIFY SOIL QUALITY INDICATORS

How ?

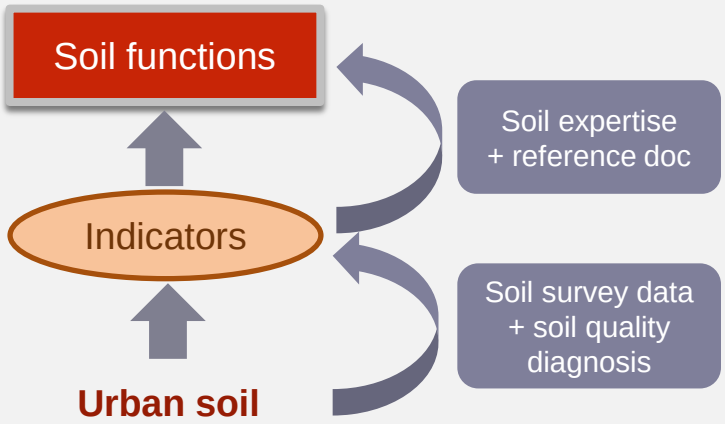
- Identification of relevant indicators of soil quality
- The existing literature **(Envasso, 2006 ; Keller *et al.*, 2012)**

	Indicateurs	Outil d'évaluation
Propriétés globales du sol	profondeur du sol	Urban SMS, Uqualisol-ZU
	pente	Urban SMS, Uqualisol-ZU
	scellement	ENVASSO
	état de surface	UQualiSol-ZU
Indicateurs chimiques	matières organiques	Urban SMS, Uqualisol-ZU, ENVASSO
	azote total	Urban SMS, UQualiSol-ZU
	ratio C/N	ENVASSO
	phosphore total	UQualiSol-ZU
	phosphore disponible	Urban SMS
	potassium disponible	Urban SMS
	pH	Urban SMS, Uqualisol-ZU, ENVASSO
	capacité d'échange cationique	UQualiSol-ZU
	$CaCO_3$ total	UQualiSol-ZU
	conductivité électrique	UQualiSol-ZU
Indicateurs biologiques	diversité bactérienne	Uqualisol-ZU, ENVASSO
	diversité macrofaune	ENVASSO
	diversité mésofaune	ENVASSO
	diversité microfaune & microflore	ENVASSO
	respiration du sol	Uqualisol-ZU, ENVASSO
	structures biogéniques	ENVASSO
	activités enzymatiques	Uqualisol-ZU, ENVASSO
	taux de dégradadation des matières organiques	ENVASSO
Indicateurs physiques	classe texturale	Urban SMS, UQualiSol-ZU
	argile	Urban SMS, UQualiSol-ZU
	sable	Urban SMS, UQualiSol-ZU
	masse volumique apparente	ENVASSO
	porosité totale	ENVASSO
	eau utile	UQualiSol-ZU
	conductivité hydraulique à saturation	Uqualisol-ZU, ENVASSO
	hydromorphie	UQualiSol-ZU
	érodibilité du sol	Uqualisol-ZU, ENVASSO
	résistance mécanique	Uqualisol-ZU, ENVASSO
	susceptibilité magnétique	UQualiSol-ZU
	porosité à l'air	ENVASSO
	classe de drainage	ENVASSO
Indicateurs de contamination	éléments en traces métalliques	Urban SMS, Uqualisol-ZU, ENVASSO
	polluants organiques persistants	Uqualisol-ZU, ENVASSO



DESTISOL!: DETERMINE SOIL FUNCTIONS

- How ?
  - Identification of soil functions: scoring procedure
  - The existing literature **(Schindelbeck, 2008 ; Vrscaj, 2008)**



Circulation et infiltration de l'eau

Indicateurs	Unité	Gammes de valeurs				Valeur indicateur	Note indicateur	Note fonction
		Note	Règle	Borne Inf	Borne Sup			
végétation (nature, état, densité)	*description*	0	entre	sol nu	clairsemé			
		1	entre	clairsemé	herbacé peu dense			
		2	entre	herbacé peu dense	herbacé dense			
		3	entre	herbacé dense	arboré			
masse volumique apparente	*kg.m^{-3}*	0	>	1,7				
		1	entre	1,5	1,7			
		2	entre	1,2	1,5			
		3	<		1,2			
hydromorphie	*description*	0	entre	saturé en eau	gley continu			
		1	entre	gley continu	taches grises			
		2	entre	taches grises	taches rouille			
		3	entre	taches rouille	pas de tache			
pente	*%*	0	entre					
		1	entre					
		2	entre					
		3	entre					
état de surface du sol	*description*	0	entre	scellé 100%	scellé 80%			
		1	entre	scellé 80%	scellé 30%			
		2	entre	scellé 30%	croûte de battance			
		3	entre	croûte de battance	pas de croûte			
analyse granulométrique < 2 mm	*classe texturale*	0	entre	argileux	argilo-limoneux			
		1	entre	argilo-limoneux	limoneux fin			
		2	entre	limoneux fin	limono-sableux			
		3	entre	limono-sableux	sableux			
granulométrie > 40 mm	*%*	0						
		1						
		2						
		3						
macroporosité	*%*	0	<		5			
		1	entre	5	10			
		2	entre	10	20			
		3	>	20				
porosité	*%*	0						
		1						
		2						
		3						
compaction	*description*	0	>		forte			
		1	entre	forte	moyenne			
		2	entre	moyenne	faible			
		3	entre	faible				
conductivité hydraulique à saturation	*m.s^{-1}*	0	<		4.10^{-6}			
		1	entre	4.10^{-6}	8.10^{-6}			
		2	entre	8.10^{-6}	1.10^{-5}			
		3	>	1.10^{-5}				

Destisol, Gesipol

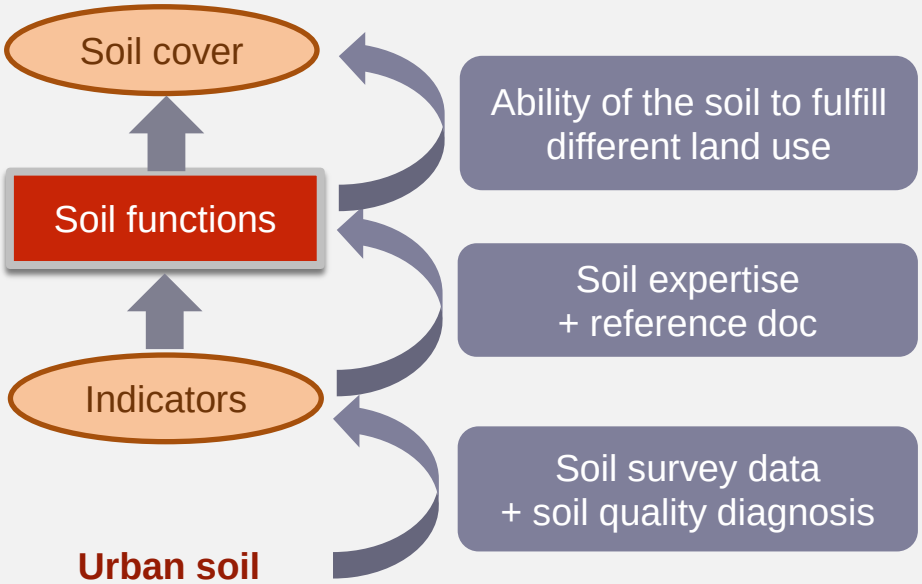
DESTISOL: INTEGRATE SOIL COVER

How ?

→ Integration of various soil covers

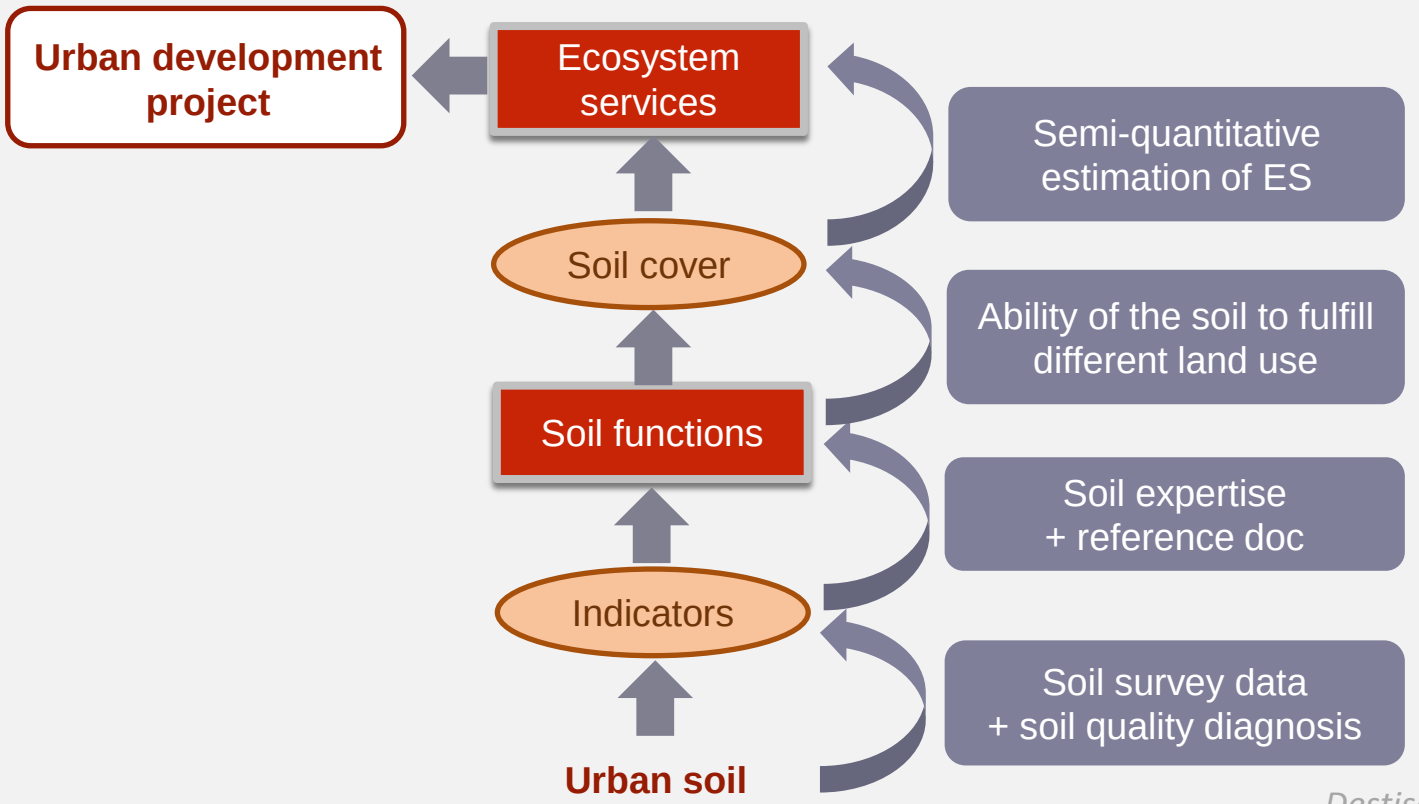
Sol scellé (imperméabilisé > 90 %)		Sol semi-scellé (50 % < imperméabilisé < 90 %)		sol non scellé (imperméabilisé < 50 %)				
Bâti	Voies de circulation	Voies de circulation	Voies de circulation	Non bâti	Non bâti	Non bâti	Non bâti	Non bâti
Sans végétation	Sans végétation	Sans végétation	Pelouse et prairie urbaines	Sans végétation	Pelouse et prairie urbaines	Jardin potager / ornemental	Arbustes	Arbres

Destisol, Gesipol



TRANSLATE URBAN SOIL PROPERTIES INTO ECOSYSTEM SERVICES

- Urban soil properties → urban soil functions → urban soil ecosystem services



Destisol, Gesipol

DISCUSSION: IMPROVE SUSTAINABLY URBAN PLANNING

- Urban soils should be considered by urban planners such as a living, fertile and tri-dimensional compartment

- Ecosystem services are understood and shared by the different actors of urban development, including researchers, policy makers and operators

- Planning → urbanism → urban project
  - → lexical analysis
  - → interviews with urban planners

- Urban soil = complex media → ecosystem services
  - → challenge to develop comprehensive & easy tool
  - → test in situ (Marseille, Lannion, etc.)
  - → creation of a technical guidance

CONCLUSION: IMPROVE SUSTAINABLY URBAN PLANNING

Urban development project

Revision of the urban development project

Expected services

Spotential > Sexpected

Revision dvpmt project?

Spotential < Sexpected

Revision dvpmt project?

Evaluation module's of ecosystem services

Revision of the management practices

Potential services

Yes

No

DESTISOL

Gesipol

Take home message