



The Local Soil Loop: A Marseille Case Study on Integrating Soil Security into Climate-Resilient Brownfield Rehabilitation

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neo-eco
Un monde sans déchets

brgm
Géosciences pour une Terre durable

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ADEME
AGENCE DE LA
TRANSITION
ÉCOLOGIQUE



1. About the megasite
2. Epistemological considerations: what is Local Soil Loop?
3. The Marseille case study
4. Conclusions and perspectives



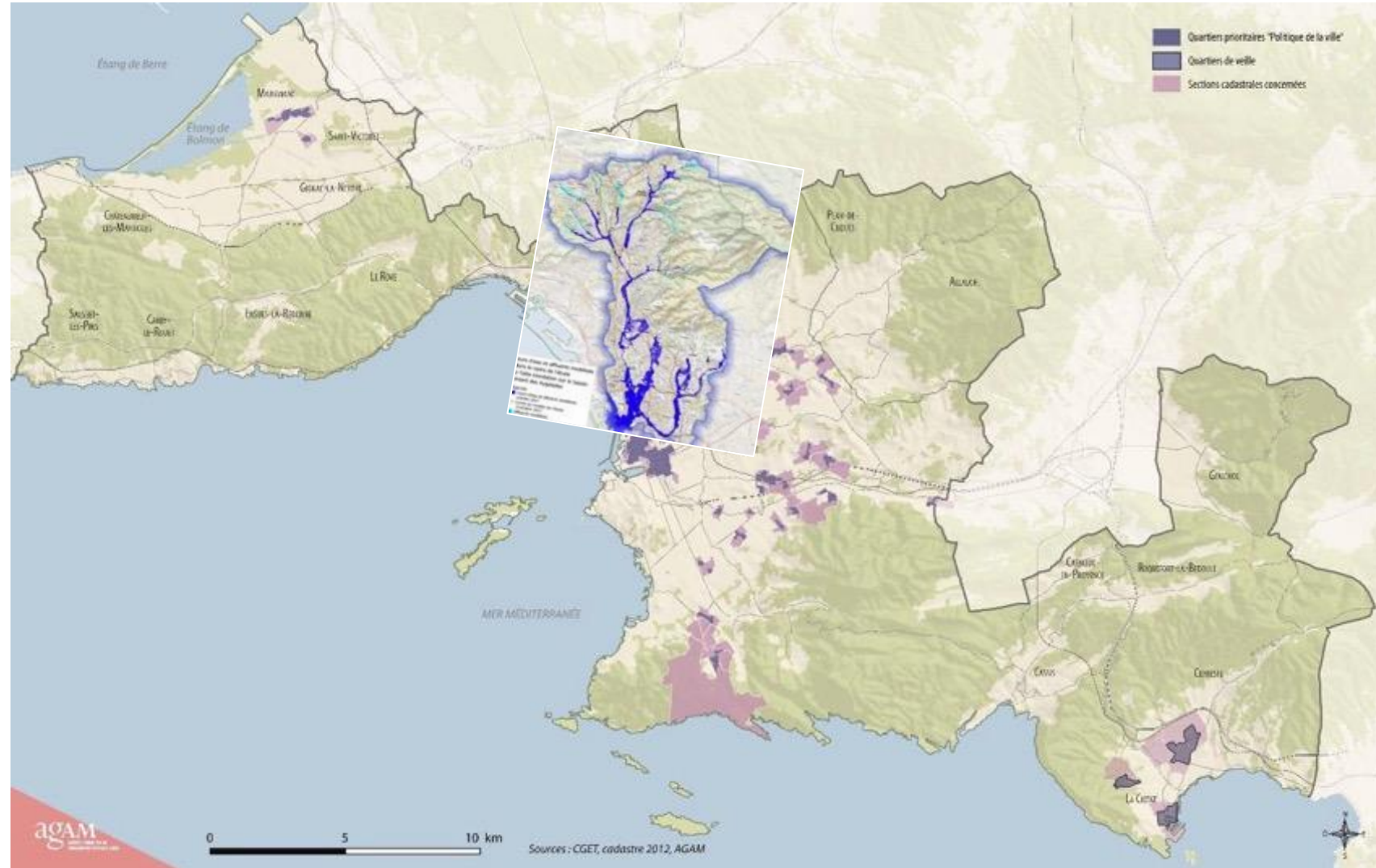
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ABOUT THE MEGASITE

CONTEXT

When water leads towards a change of use



SOURCE : AGAM (2017) État initial de l'observatoire des quartiers, conseil de territoire Marseille-Provence

THE MEGA SITE

Development of the « Parc du ruisseau des Aygalades »

Brownfield redevelopment and circular economy

EPAEM's aim

- **Create a 16-hectare park for 2031** on the site of former railway activities north of Marseille

Objectives

- The watercourse will regain its historical geography:
 - **Flood control**
 - Renaturation of the Aygalades stream, which is currently covered
 - Landscaping
- **will require high volume of soil and produce 180K m³ of “waste”**

45,000 m³ of functional soil to be constructed using mostly materials from the site



2031
End of the project

128 M€
Cost of the project



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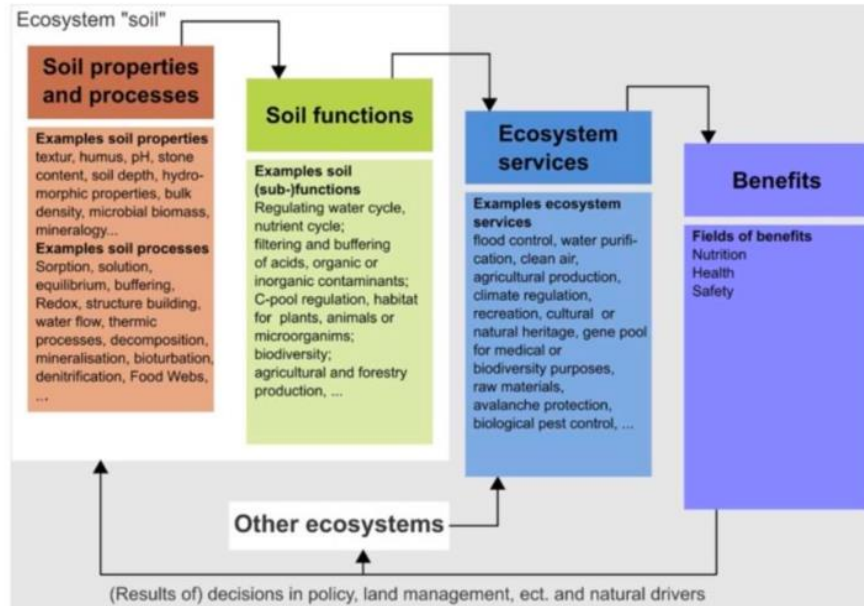


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EPISTEMOLOGICAL
CONSIDERATIONS: WHAT IS
LOCAL SOIL LOOP?

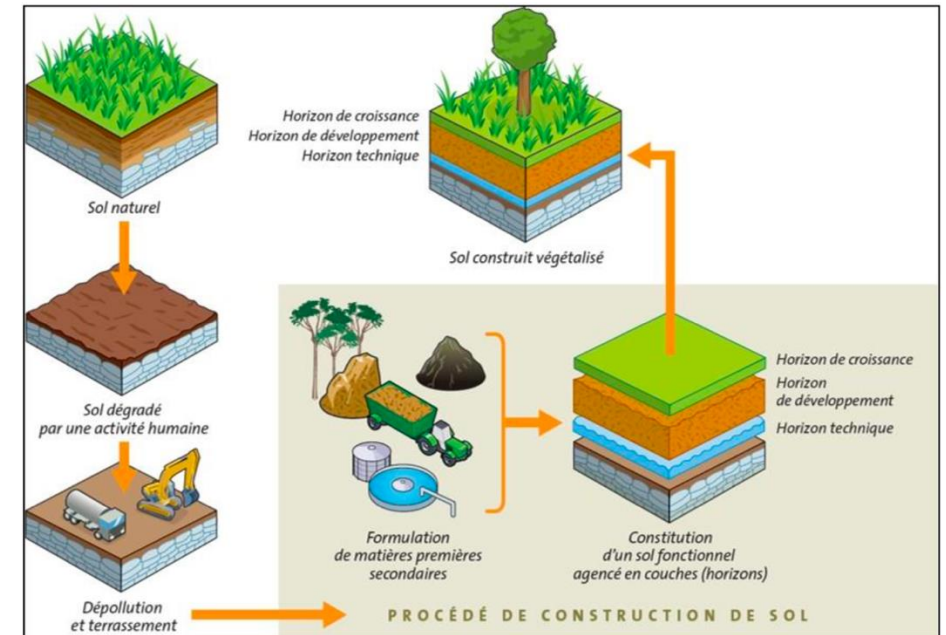
AN EMBEDDED AND EMBEDDING ECOSYSTEM" (PONGE, 2015)

Ecosystem services as a boundary object



Cascade model linking soil properties and processes, soil functions, ecosystem services and benefits. Adapted from Greiner et al. (2017).

The Local Soil Loop describes an anthropogenic and territorial cycle of earthy materials and amendments (excavated soils, dredged sediments, mineral co-products, composts, biological inocula) reused as close as possible to their point of origin, to refunctionalise degraded soils and build robust urban infrastructures.



Project **AGREG** : an illustration of the local soil loop → **AGREG**ation technique, Economique, Environnementale et sociétale.



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MARSEILLE CASE STUDY

RESEARCH PROJECT OBJECTIVES

Research-action method

Soil fonctions

Water quality regulation

Water flow regulation

Supporting vegetation

Maintaining soil structure

Nutrient supply to soil biota

Soil health indicators

Aggregate stability

Bulk density

Available water capacity (AWC)

Basal soil respiration

Saturated hydraulic conductivity (Ksat)

Soil texture

Soil depth

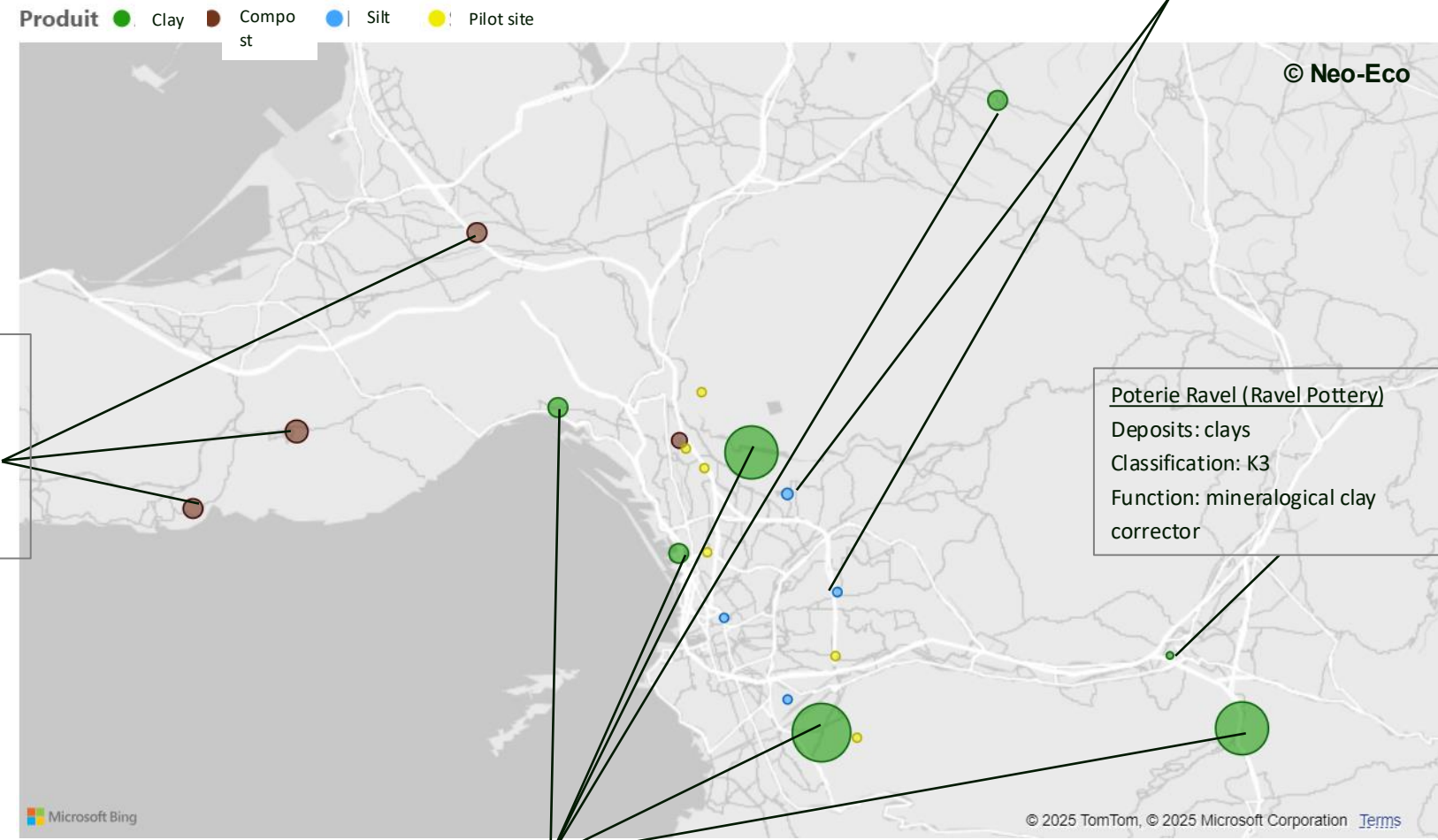
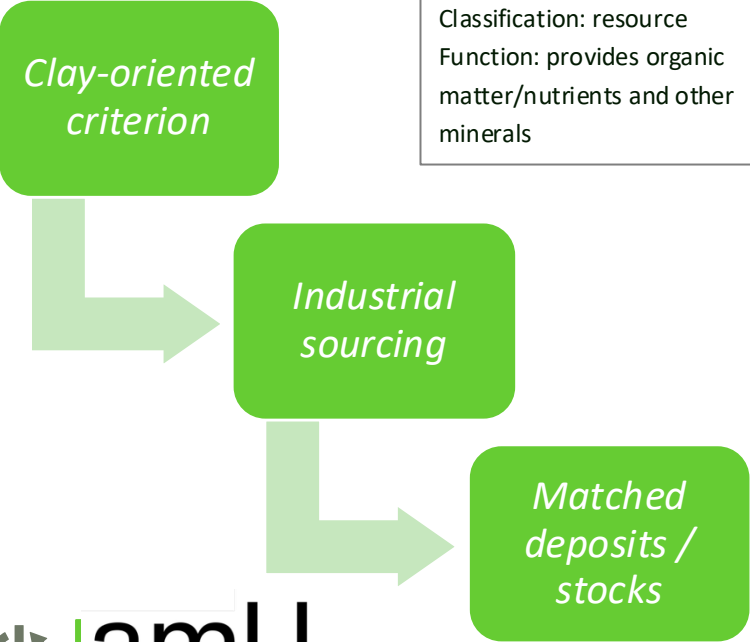
Soil organic carbon (SOC) content

N, P, K content

PHASE 1: MAPPING “THE LOCAL SOIL LOOP”

Synergies and opportunities

Identification of alternative materials



Drinking water production
Deposits: silt (agronomic capacity)
Classification: K2 and possible downgrading to K3+ (depending on lagooning time)
Function: particle size corrector, organic matter, clay

Industrial
Carrier: compost
Classification: resource
Function: provides organic matter/nutrients and other minerals

Poterie Ravel (Ravel Pottery)
Deposits: clays
Classification: K3
Function: mineralogical clay corrector

Quarries and other industrial operators
Carrier: Sterile material and other co-products
Classification: K3 or K3+
Function: base material or possible corrective deposit (currently being refined)

PHASE 1: MAPPING “THE LOCAL SOIL LOOP”

Qualifying possible soil improvers

robustness-driven selection
of « ingredients »

Commentaire	Identifiant echantillon	Calcite	Dolomite	Quartz	Plagioclases et/ou feldspaths	Kaolinite	Illite/micas	Smectite	Chlorite	Goethite	Somme Kaolinite + Illite/micas + Smectite + Chlorite
Echantillon Poterie Ravel	MATP_fine	0,000	0,000	0,395	0,0000	0,112	0,387	0,106	0,000	0,000	0,605
Echantillon Poterie Ravel	TRavel	0,000	0,000	0,394	0,0000	0,182	0,270	0,132	0,000	0,021	0,584
Echantillon Poterie Ravel	2816	0,000	0,000	0,430	0,0000	0,381	0,121	0,057	0,000	0,000	0,559
Echantillon Poterie Ravel	NY+	0,000	0,000	0,349	0,0482	0,153	0,287	0,091	0,000	0,060	0,531
Echantillon BRGM	Agrege_boues	0,000	0,000	0,299	0,1745	0,125	0,123	0,246	0,032	0,000	0,526
Echantillon Bronzo Perasso	St_Marthe_Fine	0,437	0,000	0,042	0,0000	0,407	0,076	0,000	0,000	0,038	0,483
Echantillon Poterie Ravel	TRouge-Chaumettée PRVI	0,016	0,000	0,280	0,0000	0,169	0,288	0,021	0,000	0,024	0,479
Echantillon Poterie Ravel	MATP_grossiere	0,000	0,000	0,534	0,0000	0,072	0,232	0,162	0,000	0,000	0,466
	CARSO-SIMA	0,445	0,000	0,106	0,0000	0,024	0,249	0,149	0,017	0,000	0,440
Echantillon Lafarge	Argile_noire_1	0,288	0,000	0,279	0,0000	0,019	0,293	0,120	0,000	0,000	0,433
Echantillon Poterie Ravel	TB-PRAF	0,000	0,000	0,351	0,0000	0,244	0,143	0,030	0,000	0,000	0,416
Echantillon Lafarge	Boues_Bellegarde_Gros	0,052	0,000	0,388	0,1983	0,068	0,256	0,037	0,000	0,000	0,362
Echantillon NGE - carrière Boussard	Valtra_fine argile Boussard fraction fine	0,420	0,000	0,243	0,0000	0,030	0,179	0,114	0,014	0,000	0,337
Echantillon Lafarge	Argile_noire_2	0,244	0,000	0,312	0,0000	0,025	0,298	0,000	0,000	0,000	0,322
	CLOT	0,569	0,000	0,087	0,0000	0,024	0,280	0,000	0,017	0,023	0,321
	CARSO-SIBA	0,531	0,000	0,134	0,0000	0,019	0,118	0,151	0,018	0,019	0,307
Echantillon NGE - carrière Boussard	Valtra_fine argile Boussard	0,543	0,000	0,170	0,0000	0,027	0,123	0,126	0,010	0,000	0,287
Echantillon Lafarge - Tamisé à 125µ et séché - carrière de l'Estaque	Argile_Estaque	0,305	0,000	0,416	0,0000	0,049	0,196	0,000	0,000	0,034	0,245
	Adduction Four Buse	0,668	0,021	0,091	0,0000	0,027	0,090	0,102	0,000	0,000	0,219
	Adduction ASAMIA	0,671	0,017	0,101	0,0000	0,030	0,181	0,000	0,000	0,000	0,211
	Adduction BM Amont	0,739	0,000	0,073	0,0000	0,000	0,091	0,098	0,000	0,000	0,189
Echantillons calcaires régionaux (site Mat'ILD)	Mathild1_argile	0,633	0,000	0,172	0,0451	0,034	0,067	0,037	0,012	0,000	0,150
Echantillon Lafarge - Boue de décantation	Boues_Mallemont	0,369	0,000	0,284	0,1358	0,033	0,110	0,000	0,000	0,000	0,144
Echantillon calcaire régionaux (site Mat'ILD)	Mathild2	0,640	0,000	0,174	0,0474	0,036	0,103	0,000	0,000	0,000	0,138
Echantillon Lafarge - Boue de décantation	Boues_Cavaillon	0,396	0,000	0,325	0,1342	0,037	0,032	0,000	0,065	0,000	0,134
Echantillons calcaires régionaux (site Mat'ILD)	Mathild1_grossiere	0,659	0,026	0,147	0,0384	0,033	0,083	0,014	0,000	0,000	0,130
Echantillons calcaires régionaux (site Mat'ILD)	Mathild3	0,713	0,000	0,165	0,0000	0,036	0,086	0,000	0,000	0,000	0,122
Echantillon Lafarge - Boue de décantation	Boues_Le-Beausset	0,116	0,000	0,701	0,0520	0,077	0,014	0,000	0,000	0,000	0,091
Echantillon Cemex - Fine lavage	Cemex_fine	0,710	0,207	0,000	0,0000	0,000	0,074	0,000	0,000	0,000	0,074
Echantillon BRGM	Agrege_T6	0,190	0,477	0,080	0,0923	0,000	0,000	0,070	0,000	0,000	0,070
Echantillon Lafarge	Boues_Bellegarde_Fin	0,073	0,000	0,423	0,2708	0,048	0,021	0,000	0,000	0,164	0,069
Echantillon Cemex - Fine lavage	Cemex_grossier	0,665	0,299	0,000	0,0000	0,000	0,036	0,000	0,000	0,000	0,036
Echantillon Cemex - Fine lavage	Cemex_fine-Dry	0,763	0,202	0,000	0,0000	0,000	0,035	0,000	0,000	0,000	0,035
Echantillon Carrière St Tronc - Bronzo Perasso	pp-06_Fine	0,221	0,753	0,000	0,0000	0,000	0,026	0,000	0,000	0,000	0,026
Echantillon Lafarge - Tamisé à 125µ carrière de l'Estaque	Sterile_Estaque	0,828	0,118	0,034	0,0000	0,000	0,021	0,000	0,000	0,000	0,021
Echantillon Carrière St Tronc - Bronzo Perasso	pp-06_Agregat	0,256	0,717	0,027	0,0000	0,000	0,000	0,000	0,000	0,000	0,000
Echantillon Bronzo Perasso	St_Marthe_Grossier	0,987	0,000	0,013	0,0000	0,000	0,000	0,000	0,000	0,000	0,000
Echantillon Cemex	Cemex_0-31.5_fine	0,141	0,859	0,000	0,0000	0,000	0,000	0,000	0,000	0,000	0,000
Echantillon Cemex	Cemex_0-31.5_grossier	0,328	0,672	0,000	0,0000	0,000	0,000	0,000	0,000	0,000	0,000
Echantillon Cemex	Cemex_0-31.5_2_fine	0,137	0,863	0,000	0,0000	0,000	0,000	0,000	0,000	0,000	0,000
Echantillon Cemex	Cemex0-31.5_2_Gros	0,321	0,570	0,000	0,0000	0,000	0,000	0,000	0,000	0,000	0,000
	Residu_Ballast	0,265	0,000	0,344	0,0769	0,000	0,000	0,000	0,000	0,000	0,000

PHASE 2: TESTING WITH THE LOCAL INDUSTRIE

Real-world lab as a shared knowledge site: 600 tonnes upcycled / 11 formulations tested

Experimentation 1 (0-30 mm)						
	Formulation 1		Formulation 2		Formulation 3	
	%	m3	%	m3	%	m3
SEMM slits	85	44,6	65	34,1	45	23,6
PP0-30	0	0,0	20	10,5	40	21,0
Green waste compost	15	7,9	15	7,9	15	7,9
Total	100	52,5	100	52,5	100	52,5
Experimentation 1 (0-6mm)						
	Formulation 6		Formulation 7		Formulation 8	
	%	m3	%	m3	%	m3
SEMM slits	45	23,6	25	13,1	0	0,0
PP0-6	40	21,0	60	31,5	85	44,6
Green waste compost	15	7,9	15	7,9	15	7,9
Total	100	52,5	100	52,5	100	52,5
Experimentation 2						
	Formulation 9		Formulation 10		Formulation 11	
	%	m3	%	m3	%	m3
SEMM slits	95,0	49,9	90	47,3	85	44,6
Ravel clay	5,0	2,6	10	5,3	15	7,9
Total	100,0	52,5	100	52,5	100	52,5



PHASE 3: STRATEGIES FOR THE MEGASITE

Knowing and coding

Results: materials identification

Three groups of materials identified on the site

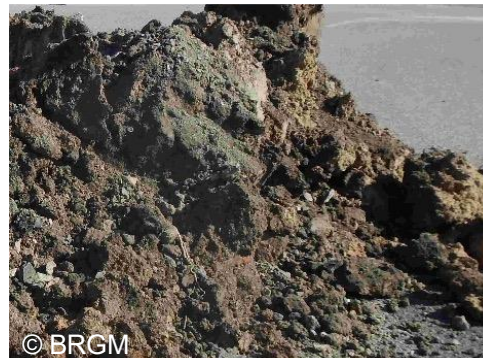
Group 1: sand with slag and coarse ballast



Group 2: sandy mixtures with coarse elements including silty-clay pebbles



Group 3: more homogeneous materials with a silty-clay appearance



Presence of an interesting formation (G3) on site for soil construction, but:

- Present at 2-3 m depth
- With a deficit of reactive mineralogical clay (less than 15 %)
- Not free from contaminants

Reading keys :

Mineralogical clay content (%)

Contamination index:

- A: no contamination,
- B: moderated contamination,
- C: high contamination.

14_C_C

Clay index argile :

- A: clay dominance 2:1,
- B: clay dominance 1:1,
- C: material not belonging to the 'clay' group.

Coding for the public procurement team © BRGM

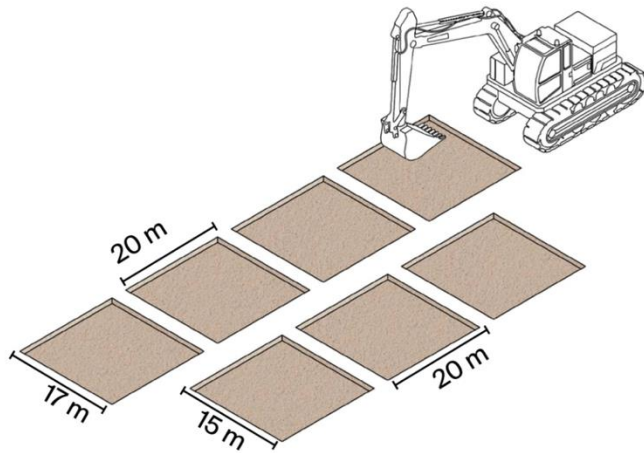
PHASE 4: PROVING

Testing in a redevelopment pilote: « Jardin d'expérimentation des Aygaldes »

4 - RÉALISATION DU JARDIN

TERRASSEMENT ET STOCKAGE DE TERRE

① - Terrassements des parcelles



② - Stockage des déblais



Après le terrassement des parcelles test les déblais sont stockés dans la zone de stockage hors PPRI.



Clay from the local potters of Marseille © Neo-Eco



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CONCLUSIONS AND PERSPECTIVES

KEY TAKE AWAY MESSAGES

■ **Proof in the making**

- The Local Soil Loop is developed and tested.
- First outcome already delivered: genuine interdisciplinary collaboration, advancing soil engineering as a shared practice.

■ **Engaging beyond expertise**

- Ecosystem services act as a boundary object and a shared language to co-build a narrative on urban nature with non-specialist actors.
- « Local Soil Loop » seems to get people onboard

■ **Scaling ambition together**

- From industrial pilot to Mediterranean living lab → an open invitation to join!

A MEDITERRANEAN LIVING LAB

Cité des Arts de la Rue

Lead partner: Lieux Publics

Category: Cultural space / habitability

Scope: Narratives, neighbourhood openness, soil desealing, river connection

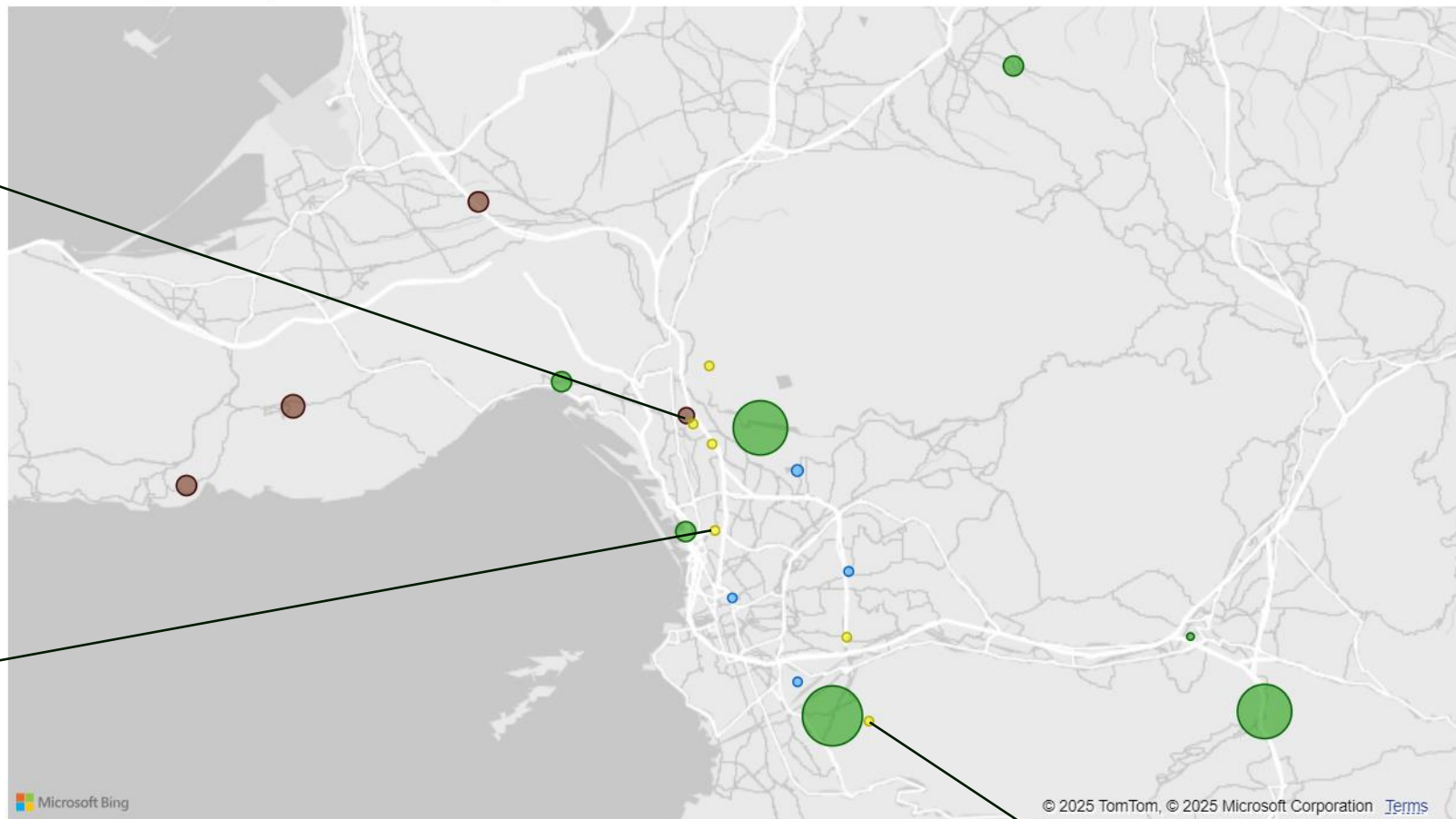
Parc des Aygalades

Lead partner: EPAEM

Category: Brownfield redevelopment, urban park, hydraulic infrastructure

Focus: renaturation, soil upcycling platform, experimental garden

Produit ● Argile ● Compost ● Limons ● Site pilote



Industrial real world lab'

Lead partner: Bronzo Perrasso

Category: Quarry, industrial sector

Focus: process development, industrial scale-up, industrial synergies