OID
ŒUVRER POUR L'IMMOBILIER DURABLE

DESEALING SOIL

HAZARD

HEAT

RAINFALL AND FLOODS

IMPLEMENTATION STEP

CONSTRUCTION

RENOVATION

TERRITORY

AREA OF ACTION

OUTDOORS

COST

€ € €

low medium **high**

LEVEL OF SKILL

high

Soil can be partially or totally sealed by covering the ground with impermeable materials such as concrete, asphalt or paving slabs. Since the soil is no longer in contact with water and air, the natural cycles of organic matter, carbon and nitrogen cannot continue. Sealing, which takes into account the water cycle, is different from artificialisation, which involves the lasting alteration of all or part of a soil's ecological functions, in particular its biological, hydric and climatic functions, as well as its agronomic potential, through its occupation or use. Desealing involves restoring the soil's permeability to water and air, but cannot reinstate all of its ecological functions. When possible, it is recommended to implement other measures in addition to desealing.

IMPACTS

The presence of an impermeable layer on the surface of the soil prevents it from playing its role in infiltrating rainwater. For example, in a city centre, between 70 and 95% of rainwater will run off onto other surfaces, whereas only 2% of water on a soil surface will run off. By desealing the soil, most of the water will be infiltrated locally. This reduces the inflow of water, which avoids overloading the collective networks and **limits flooding** in the event of heavy rain. Furthermore, while a high level of impermeability considerably increases the **heat island** effect **in urban areas**, total or partial desealing can significantly reduce this phenomenon thanks to **soil moisture**.

After a desealing operation, renaturing the areas enables the soil to regain its function as a **support for biodiversity** and to increase the **ecosystem services** associated with biodiversity. The most effective areas to deseal are those that contribute to brown corridors (ecological continuity of soil ecosystems), which helps to amplify the positive impact of these operations.

INSTALLATION GUIDE

To foster soil permeability, it's advisable to replace asphalt surfaces with either open ground or permeable surfaces around the building and on the road.

To limit the amount of impermeable surfaces, one way of reducing a building's footprint is to **encourage verticality**. The most suitable areas for desealing can be identified using the hydraulic diagram defined for the building or neighbourhood. A soil survey must be carried out to avoid polluting the water table. A project is considered to be efficient when the waterproofing coefficient is less than 40%.

Desealing is not sufficient to restore all the ecosystem services provided by soils. **Renaturing** involves "returning ecosystems that have been degraded, damaged or destroyed by human activities to their natural or semi-natural state" (Aronson, 2004). Unlike simple desealing, renaturing soils can prevent pollutants from infiltrating the lower layers of the soil. A soil study is required before embarking on renaturing.

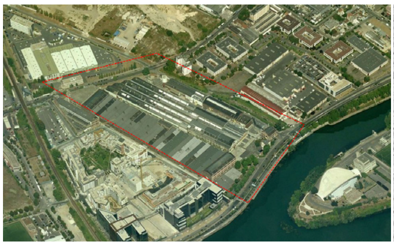
Depending on the permeability of the soil, it may not be possible to infiltrate rainwater directly. In this case, it is necessary to connect the desealed and renatured areas to a water retention and overflow system or to a controlled flow drainage system.

CLICK HERE TO CONSULT THE GUIDE TO ACTION FOR CLIMATE CHANGE ADAPTATION

Maintenance of open-ground areas is similar to that for parks and other green spaces. For porous pavements such as porous concrete, maintenance is carried out annually to prevent clogging. Sealing reduces the load handled by collective rainwater treatment networks, but **does not eliminate the need for connection and potentially a retention system**.

LEVEL OF WATERPROOFING

Aerial view of the former PSA business park (Asnières-sur-Seine), 99% waterproofed



Sealed floor (waterproof > 90%)

Examples: buildings, roads, car parks, etc.

Use: roads (light-coloured surfaces)

Porous concrete and grassed paving stones

Semi-sealed floor (between 50% and 90% waterproof)

Examples: porous concrete, grass-covered slabs and pavers, and other modular materials.

Use: pedestrian areas, car parks, terraces, etc.

Urban forest and DS park created on the PSA business park site

Unsealed floor (waterproof < 50%)

Examples: landscape ditches, rain gardens, urban forests and meadows

Use: park, green space, rain garden, etc.

WEAK POINTS AND STRONG POINTS

- ⊖ Depending on the operation, it may be necessary to review the accessibility of spaces.
- ⊖ Desealing requires a more detailed study of the surrounding environment in order to avoid soil pollution.
- ⊖ It may be necessary to install a system to manage rainwater that exceeds the infiltration capacity of the soil.
- ⊕ Legislation, in particular the French Climate and Energy Act (2019), encourages certain commercial buildings to use porous surfacing on parking spaces adjacent to buildings (art. 47).
- ⊕ Carrying out a desealing operation to reduce runoff can sometimes entitle you to financial support from the Water Agencies (up to 50%).

! MALADAPTATION

Maladaptation can result from the following:

Vulnerability of nearby facilities

In the absence of a feasibility and sizing study (depending on the soil, hydrological and topographical characteristics of the site), the vulnerability may be transferred to sensitive facilities close by. Climate change is likely to amplify extreme events and therefore the transfer of vulnerability to other systems.

Fragile coating

It is not advisable to lay porous concrete-type coverings on soils at risk of frost to avoid cracks appearing in the material. Porous concrete is not recommended on ground with a gradient of more than 2.5%, or on soil subject to the risk of shrink-swell, for which it is important to control the level of moisture.

Soil pollution

On surfaces where there is a high risk of pollution from precipitation (roads, car parks, etc.), desealing the soil without anticipating water treatment can lead to pollution of the soil, surface water and groundwater. This risk can be reduced or even prevented by installing retention areas where plant-based water treatment is possible (valleys, trenches and planted basins). A full feasibility study is then required.

MONITORING INDICATORS

ESSENTIAL RECOMMENDATIONS WORTH THINKING ABOUT

- CARRY OUT A FEASIBILITY AND SIZING STUDY OF THE OPERATION (TOPOGRAPHY, SOIL, GEOLOGY & HYDROLOGY OF THE SITE, HYDRAULICS OF THE INSTALLATION)
- PROVIDE FOR A MAXIMUM LEAKAGE RATE OF 1 L/S.HA AT THE PLOT OUTLET AND 0 L/S.HA IN THE CASE OF INFILTRATIVE SOIL
- SIZE WATER MANAGEMENT SYSTEMS TO ABSORB TWO RAINFALL EVENTS IN 24 HOURS

MONITOR MY ACTIONS FOR CLIMATE CHANGE ADAPTATION

+/- : Quantitative indicator ★ : Qualitative indicator

	INDICATORS OF MEANS	INTERPRETATION
+/-	Soil infiltration capacity (mm/h)	Between 18 and 18,000 mm/h to infiltrate without a retention and drainage system.
+/-	Soil infiltration capacity (mm/h)	-
+/-	Runoff coefficient (without unit)	To be minimised
+/-	Volume of water to be managed (m³)	-
+/-	Open ground coefficient for the plot	To be maximised
+/-	Percentage of essential recommendations followed (%)	To be maximised

	INDICATORS OF RESULTS	INTERPRETATION
+/-	Equivalent waterproofed surface (m³)	To be minimised
+/-	Comparison between the leakage rate at the outlet of the plot after the desealing operation and that of a control situation* (see definition section, "Creating a green roof").	Leakage rate at the outlet < Leakage rate of control situation*
+/-	Comparison between the average seasonal temperature on the plot after desealing and that of a control situation* (°C)	Seasonal mean temperature < Control* seasonal mean temperature
+/-	Comparison between the waterproofing coefficient of the plot before and after desealing	Waterproofing coefficient after operation < Waterproofing coefficient before operation

The control situation is defined by the parameters set to isolate the influence of the adaptive action (similar conditions: weather, time of measurement, space, etc.).

DÉFINITIONS

- **Soil hydraulic conductivity:** limit value of the flow velocity of water in saturated, homogeneous soil.
- **Soil infiltration capacity:** speed at which water infiltrates the surface, i.e. the infiltration rate of a soil per unit area. This parameter decreases as the water content of the soil increases until it approaches the value of the hydraulic conductivity of the soil in question.
- **Runoff coefficient:** Volume of water runoff / Volume of water precipitated for the different types of surface on the plot.
- **Equivalent waterproofed surface area:** sum of the various developed surfaces, weighted by their runoff coefficient (ratio between the height of water runoff and the height of water precipitated).
- **Volume of water to be managed:** volume of rainfall that runs off sealed surfaces and must be intercepted to be infiltrated, evapo-transpired or discharged at a regulated rate to an outlet.

FIND OUT MORE

CEREMA, *DREAL* and *Agence de l'eau* (2017), *Vers la ville perméable - Comment désimperabiliser les sols?*

Guide Bâtiment Durable (2013), *Identifier les contraintes physiques de la parcelle*

City of "Grand Lyon", *Revêtements de surface poreux*

Institut Paris région (2020), *Désartificialiser et renaturer les villes : un potentiel immense*

ARB Ile de France (202), *Renaturer les villes*

OFB – French Office for Biodiversity (2022), *Renaturater les sols*

LPO (2022), Technical guide *"Sols vivants"*

Wallonie environnement SPW (2020), *Gestion durable des eaux pluviales a la parcelle en zone urbanisable en région wallonne - Fiche n°15 : Les revêtements de sol perméables*

REAL-LIFE EXAMPLE

NEXITY

BUILDING: PSA ZAC (MIXED DEVELOPMENT ZONE), ASNIÈRES
SURFACE AREA: 7 HECTARES INCLUDING 120,000M² AVAILABLE FOR BUILDING
USE: COMMERCIAL, RESIDENTIAL
COST: €10 MILLION TO CLEAN UP THE POLLUTION

In 2010, the PSA development zone in Asnières was the subject of a redevelopment study by Nexity's subsidiary, *Ville et Projets*. Seven hectares of land, 99% of which had been sealed, were to be used for new offices and housing, with a buildable area of 120,000m². Because of the industrial buildings in the area (former installation classified for environmental protection), renaturing the soil required extensive decontamination, involving direct on-site treatment. After an initial stage of breaking down the pollution by gassing (venting) inside the existing buildings to eliminate volatile contaminants, the remaining pollution (particularly hydrocarbons) was treated by biological methods on site or by excavation. As a result of this work, 4 of the 7 hectares of the site were returned to open ground, allowing the soil to regain its functions as a regulator, a public space and a support for vegetation. All the rainwater collected on the buildings is infiltrated on site, entitling the project to a €530,000 subsidy from the General Council. The complexity and duration of the process (2-3 years) make this project more affordable on neighbourhood scale than building scale, but methods accessible for building projects are also being developed.