Technical handbook

Stormwater trees

MÉTROPOLE GRAND LYON

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Stormwater tree concept

Context and challenges

Since the 19th century, urban water management in France has been guided by the *tout-tuyau* ("all down the pipe") principle. However, this principle is being challenged by climate change, whose consequences are becoming more intense.
Episodes of extreme rain, which are becoming more frequent, overload the combined sanitation networks (sewers), causing untreated water to overflow directly into natural environments.
More frequent, longer-lasting droughts and heatwaves are disrupting ecosystems and human populations.
This is why it is becoming necessary to manage rainwater where it falls, reduce the volume of runoff that enters the networks, and take steps to keep urban spaces cool.
What's more, the increasing amount of impermeable ground cover and the limited area available for green space compel a rapid transformation of cities, to adapt them to climate change. That being the case, Lyon Metropole has ambitious plans on the subject. On the one hand, the Permeable City project, initiated by Lyon's Water Cycle Department, is aimed at de-paving the ground and encouraging rainwater infiltration.
On the other hand, the aim of the Nature plan, initiated by the Ecology department and implemented by the Supporting division on Plant Heritage, is to plant trees to reinforce the urban canopy. As such, stormwater trees are at the crossing-point of both strategies.
Stormwater trees show that in an urban environment, nature-based solutions can genuinely assist adaptation to the effects of climate change, by creating cool areas and helping to reduce the risk of local flooding.
In effect, **water is a resource that increases the cooling ability of vegetation, thanks to evapotranspiration**.
Stormwater trees also provide a boost for urban biodiversity and soil quality, and play a role in improving aquatic environments.
In addition, their presence in urban spaces makes for a nicer living environment, and they encourage citizen participation in measures to increase greenery in cities.
With stormwater trees, Lyon Metropole is reinforcing the ecosystem services provided by its planted spaces.

The recommendations proposed in this handbook apply first and foremost to existing tree pit renovation projects, but they must also be adapted and implemented for all new tree planting.

Type of development: aid for decision-making

Which technique is most suitable for managing rainwater?

Does the development already have trees?

NO

Find another solution for at-source water management: swale, trench, rain garden

YES

A single-unit tree pit

YES

Several single-unit tree pits on the street

YES

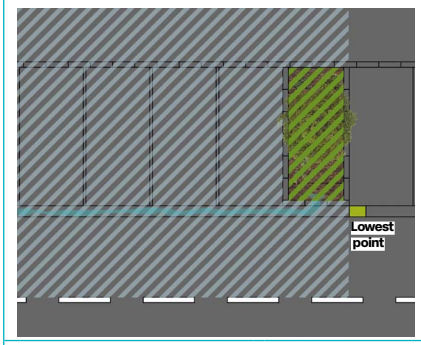
A continuous planting pit with a minimum area of 30 m²

Is it possible to enlarge the tree pit(s)?

It is mandatory for each pit to have a minimum area of 10 m² and for the solid edge to be at least 1.5 m away from the tree base.

YES

Calculate the permeable proportion of the development surface



Permeable surface / Impermeable surface x 100 =

= between 10% and 30%

Technique: Stormwater trees with infiltration trenches

- Create an infiltration trench for each pit (see p.16)
- Make an unobstructed, sloping entry route (with no kerb, or with kerbs that are 2/3 open and at a different height)
- Plan to include a lowered area (depression) and put fertile soil and vegetation in it to encourage biodiversity, including in the soil

= greater than 30%

Technique: Stormwater trees with storage hollows

- Make hollows between the trees in the row for water infiltration, if the permeable surface represents more than 30% of the impermeable surface to be disconnected from network, located upstream of the tree pits (catchment area). (p.23)

If there is sufficient available green space, a planted swale could be created (see photo on p.5)

NO

It is not possible to site a stormwater tree here

How to improve water management

- Create an unobstructed, sloping entry route (with no kerb, or with kerbs that are 2/3 open and at a different height)
- Plan to include a lowered area (depression) and put fertile soil and vegetation in it to encourage biodiversity, including in the soil.

This kind of green creation is neither a stormwater tree nor a hydraulic structure. However, water will be directed so that it irrigates the tree.

Stormwater trees with infiltration trenches

Rue Jean-Baptiste Anjolvy, Couzon-au-Mont-d'Or, France

Stormwater trees with storage hollows

Boulevard du Docteur Coblod, Vénissieux, France

Planted swale

Boulevard de l'Ouest, Sathonay Camp, France

Stormwater trees in rue Vauban, Lyon, France

Description of the stormwater tree concept

Stormwater tree

This is a tree planted in a pit whose surface area and depression in the ground have been designed and scaled so as to manage part of the runoff, promote the tree's growth and encourage biodiversity, including in the soil.
The concept can be used in urban redevelopment projects to help achieve to aims: to disconnect runoff water from the combined sanitation network, and to assist its infiltration into restricted urban spaces.

Permeability or infiltration capacity

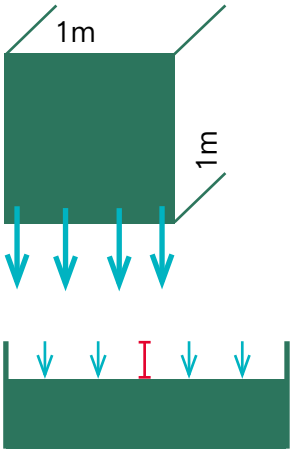
Permeability corresponds to the maximum quantity of water that infiltrates into the ground or substrate within a given period. It is characterised by the permeability coefficient K. Stormwater trees help to increase rainwater infiltration, and will provide a way to deal with the first few millimetres of rainfall, thereby reducing runoff.

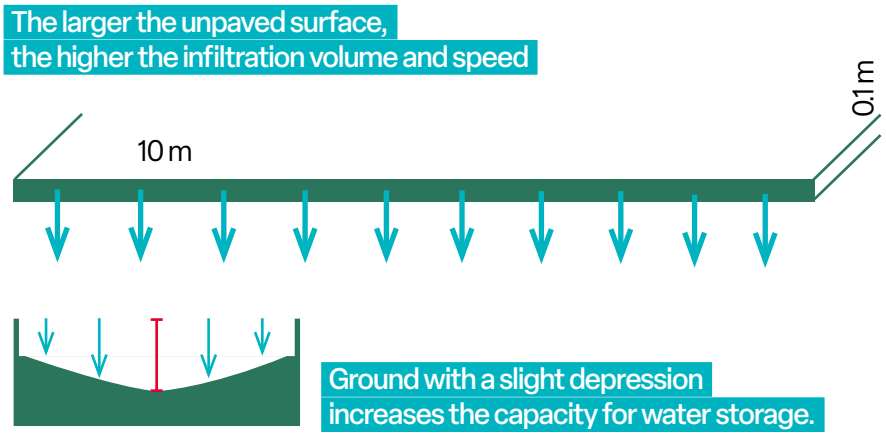
Soil, the best infiltration route for rainwater

Managing rainwater where it lands (= the source), using green spaces, is a simple and adaptable solution.
In fact, all soils allow water to soak in, and then store it.
Some types do this faster than others, depending on their permeability (for example, sandy soils with a high permeability allow water to infiltrate more quickly than clay soils, which have low permeability).

Water volume, infiltration surface and depression of the ground

The larger the unpaved surface, the faster the water volume will be absorbed.
This means that for water infiltration and storage features, it is recommended and preferable to place the infiltration surface at depth, to manage normal rainfall events.
Furthermore, for the same surface area, an area of ground with a slight depression will increase the storage capacity and enable a larger volume of water infiltration.

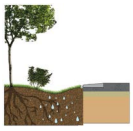




WHY INCLUDE STORMWATER TREES IN DEVELOPMENTS?

To integrate rainwater management into the urban planting plan, and to reinforce the ecosystem services provided by city trees.

Stormwater trees help to:



Reduce runoff and overloading of the sanitation networks (sewers)

Top up the water table

Create cool areas

Increase urban biodiversity

Improve the living environment

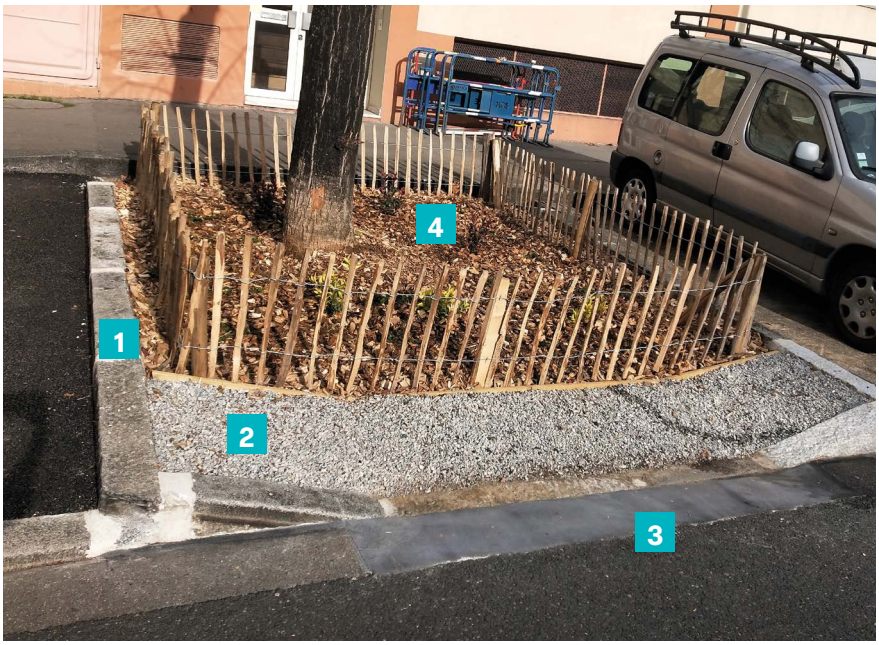
In order to deliver these ecosystem services, the tree pits must be constructed as follows:

1 Enlarge the tree pit so that there is at least 10 m² of permeable surface.

2 Storage zone: infiltration trench or storage hollow

3 Unobstructed, sloping entry route:
- with no kerb, or with kerbs that are 2/3 open
- at a different height

4 Lowered area (depression) with fertile soil and vegetation placed and planted in it to encourage biodiversity (in the air and in the soil)



Design objective

To disconnect an impermeable surface from the sanitation network, by enabling light rain or the first 15 mm of rainfall to infiltrate into the ground.

Continuous tree-planting pit

Continuous planting pits will follow a different design.
Storage hollows will be created between the trees, to aid infiltration (see p.23).

Stormwater tree implementation

The method described is for transforming an existing tree into a stormwater tree.
It can be used and adapted for planting a new stormwater tree.

Design phase

Catchment area to disconnect and reduce runoff

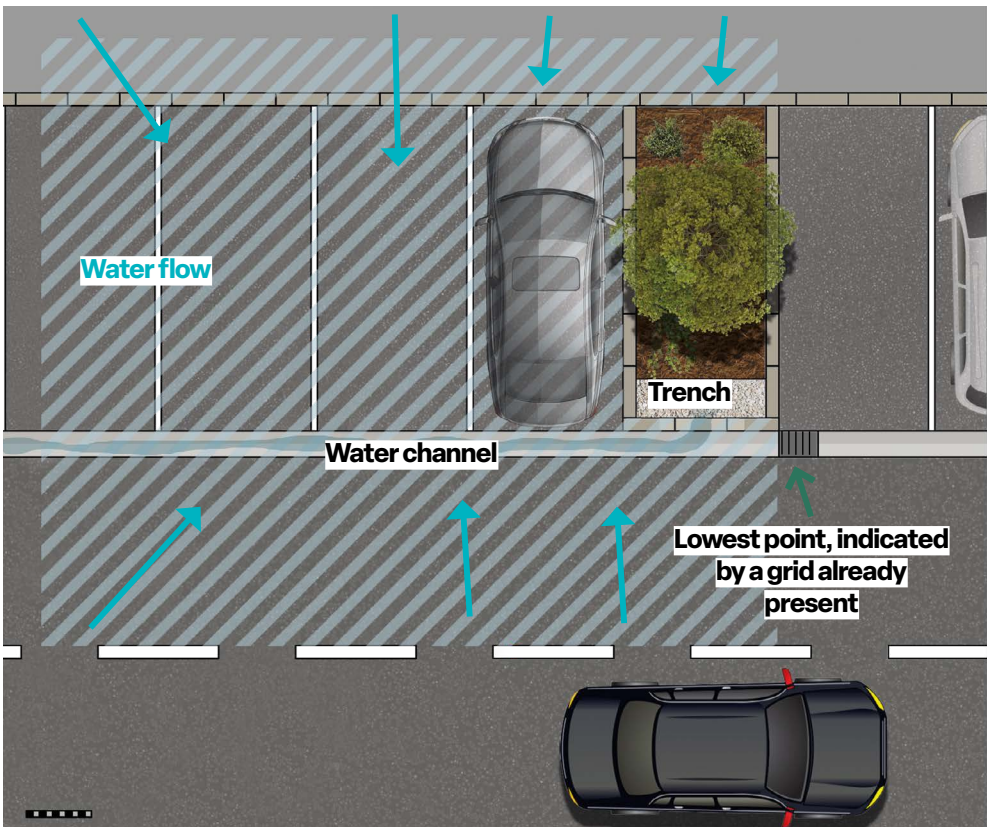
Because light rainfall is the most common kind, dealing with it at the source as early as possible is recommended.
To aid analysis, a factor of 10 will be used for the relationship between permeable and impermeable surfaces:

$$\frac{\text{Permeable surface (impluvium) in m}^2}{\text{Impermeable surface in m}^2} \times 100 = \geqslant 10\%$$

The stormwater tree is designed to enable infiltration of a maximum water height of 15 mm, which corresponds to a maximum of 1 m^3 of water temporarily stored in the tree pit, serving 100 m^2 of disconnected surface area (catchment area). Beyond this quantity of water or surface area, excess water will flow into the network.

The above storage figure has been calculated for soil permeabilities between 10^{-5} et 10^{-6} m/s.
For lower permeabilities, refer to page 11.

> Disconnected impermeable surface (catchment area) directing water to the stormwater tree



Surface area disconnected from the sanitation network: 100 m^2 per stormwater tree in an opening of 10 m^2

> Runoff water infiltrating into the trench of a stormwater tree

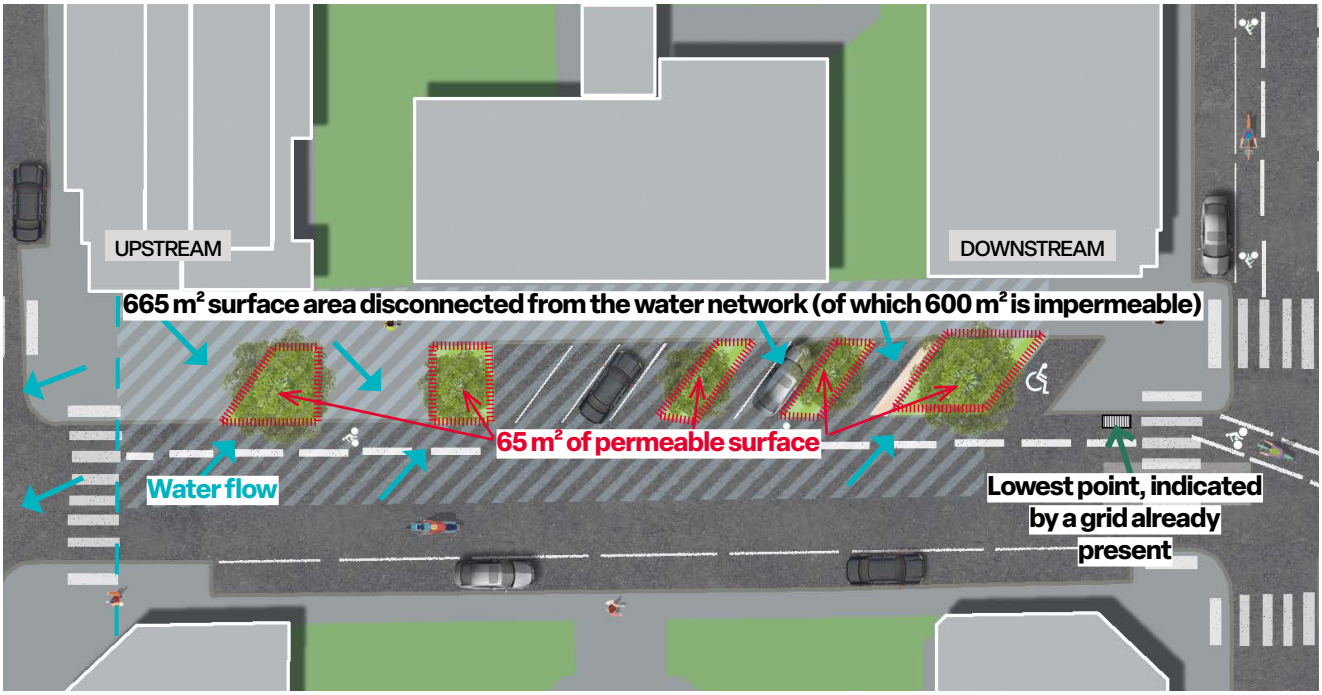
This table compares the water infiltration times for different permeable surface areas around a stormwater tree, for a given soil permeability and water height managed by the tree.

Scenario	1	2
Permeable surface: green space and trench	At least 10 m^2	At least 20 m^2
Permeability K	1x10^{-5} m/s	1x10^{-5} m/s
Permeability K	36 mm/h	36 mm/h
Rainfall management over a return period of one year	First 15 minutes	First 15 minutes
Water height	10 mm	10 mm
Water stored in the infiltration trench	1 m^3	1 m^3
Time until complete infiltration	⩽ 3 h	⩽ 1 h

Increasing the surface area of green space enables infiltration of the same quantity of water more quickly (scenarios 1 and 2).

Infiltration can be achieved with no issues of clogging or saturation, even with a surface area of 10 m^2 (scenario 1).

> Principle of stormwater trees at street scale. Transforming multiple trees in the same street provides more effective rainwater management and creates ecological corridors.



For new trees planted within a full redesign of the space, plans must seek to link the tree pits together underground ("brown network" to promote soil health).

Site studies (soil and underground)

Site studies are important because they determine how stormwater trees will be implemented and managed, and their durability. As such, to ensure the feasibility of these developments it is essential to get to know the man-made features of the location, including the underground utilities at different depths, and the soil permeability.

Detecting utilities

To find out whether utility networks are present underground before starting to dig, it is crucial to submit a declaration to commence works (near networks – DT-DICT in French).
If underground utilities are present, regulations stipulate minimum operating distances from them, and site procedures (see Lyon Metropole's protocol for coexistence of trees and utilities).

N.B. If new trees are to be planted on a site where utilities are too close to the surface, the tree planting level can be raised (see page 17).

Soil permeability

Stormwater trees need their surrounding soil to be sufficiently permeable that water does not stand in the tree pit for a long time, which could cause the tree to rot.

For stormwater trees, soil permeability must exceed $1x10^{-5}$ m/s or 36 mm/h.
The permeability of the site's soil is measured with a test called the "Porchet method". The test is available in the service catalogue of the roads and highways laboratory. If this test cannot be conducted, a Plant Heritage technician will be able to advise on the nature of terrain, the soil type and the permeability.

Soil permeability and quality

- If the existing soil is of poor quality, it must be reconstituted.
The test will be conducted at the depth of the earthwork of the future trench, to find out the permeability of the surrounding soil.

- The existing soil is of good quality.
It can be retained. The following processes are necessary:

1. A permeability test conducted at a depth of 40 cm.
2. Decompaction of the top 40 cm of the soil surface.

- The soil permeability is very low.

Permeability is less than or equal to $1x10^{-6}$ m/s.

To prevent asphyxiation of the roots, it is necessary to enlarge the permeable surface around the stormwater tree so that water does not accumulate in the pit and sit there for a long time.

It is a good idea to contact the Water Cycle Department to help calculate how much permeable surface is needed to install a stormwater tree.

Before any planned work, the Water Cycle Department must be informed of the permeability test results and the location(s) of any utilities.

Depth of the water table

When the water table depth is known, plans for new tree planting must allow one metre of "unsaturated zone" between the bottom of the infiltration trench and the water table.

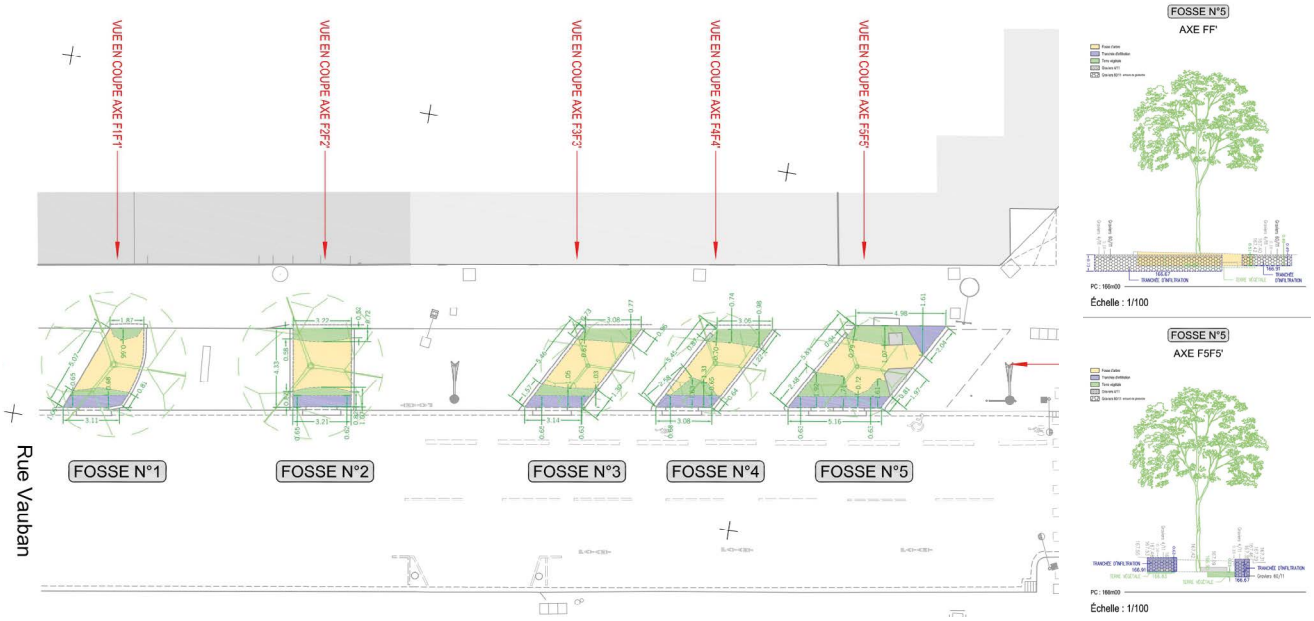
Generally, the water table in Lyon Metropole lies at a depth of at least two metres.

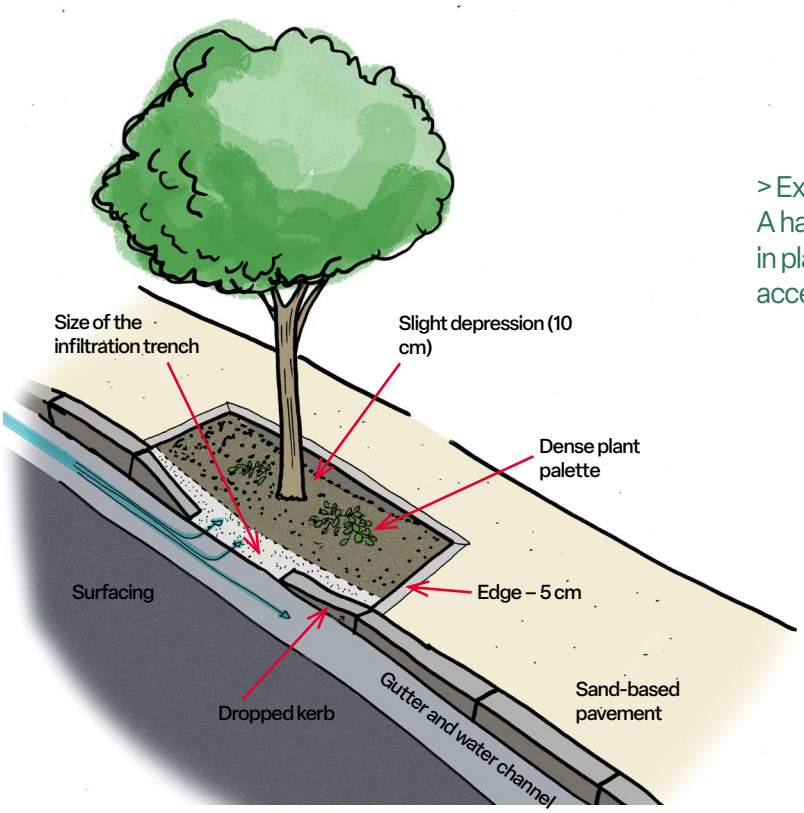
As-constructed drawing or schematic diagram

When the project is complete, an as-constructed drawing or schematic diagram must be produced. This is in order to incorporate the information about the stormwater tree(s) into the city's geographic information system (GIS), and ensure the management of this new heritage.

The as-constructed drawing may be created by the project owner (the Water Cycle Department or the Living Environment Improvement Department). The schematic diagram can be created by the Nature & Rivers Department.

> Example of an as-constructed drawing





> Example of a schematic diagram
A hand-drawn schematic diagram, in plan view and cross-section, is acceptable.

Administrative processes

Prior declaration to France's architectural review board (*Architectes des Bâtiments de France*)

To install a stormwater tree within 500 metres of a listed building, a declaration must be submitted beforehand to the architectural review board (ABF), for "construction, works, facilities and developments not subject to planning permission".

To do this, the declarer must fill in Cerfa certificate no. 13404*08, available via the following link:

https://www.demarches.interieur.gouv.fr/professionnels/declaration-prealable-travaux-dp

Applying for a grant from the Rhône-Mediterranean-Corsica Water Agency

The Rhône-Mediterranean-Corsica Water Agency provides grants for installing stormwater trees. It is imperative that the grant application is submitted before work begins. The aquatic management (GEMAPI) sanitation steering team within the Water Cycle Department can help with submitting funding requests.

Please e-mail the necessary information (street name, number of stormwater trees, projected total unpaved surface area) to:
arbresdepluie@grandlyon.com,
at least three months before work begins on the site.

However, to request the grant directly, simply complete the form on the Water Agency's website:
https://aides.eaurmc.fr/Tsa/#/login

To find out the usernames and passwords, contact the directors of each department.

See the Appendices of this document for a tutorial on filling in the application.

Stages of work to be done

1 Cutting / Stripping

- Removing kerbs
- Cutting the surfacing (or asphalt concrete) to the dimensions of the tree pit (minimum 10 m²)

2 Earth removal

- Prior advice from a Nature & Rivers Department technician should specify the following earth removal options:

  - Remove earth with a mechanical digger: when there is no underground utility less than 60 cm from the surface, and the root system is not particularly extensive so there is no risk of the shovel damaging the roots.

  - Remove earth using a vacuum excavator with a rubber nozzle, to protect the existing root system (see roads and highways regulation, mandatory vacuum excavator and excavating at least 1.5 m from the tree).

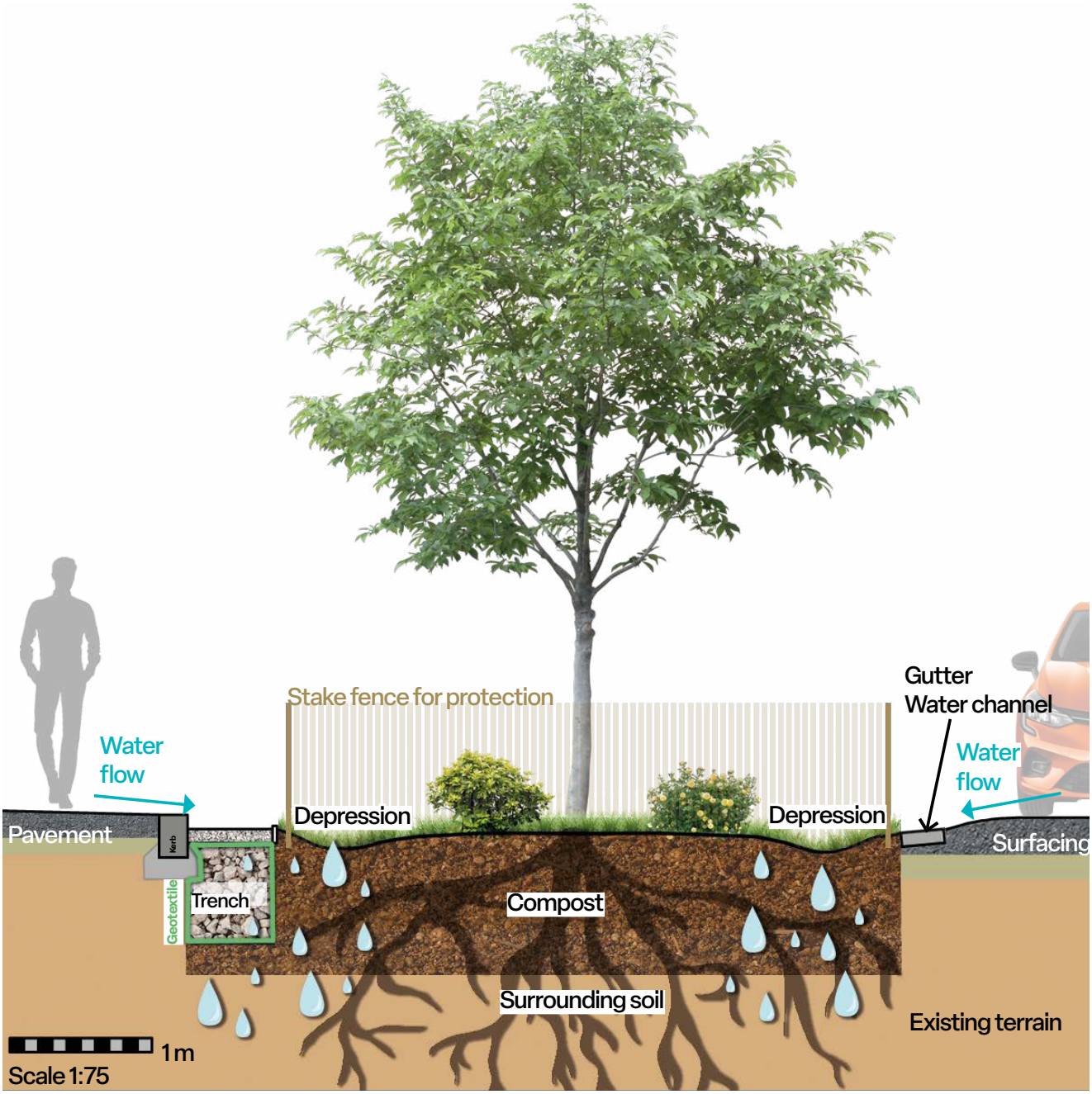
3 Reworking the road

- The entry for runoff water flowing to the tree pit must be unobstructed, and open for 2/3 of the total length of the tree pit. This will assist and ensure the inflow of all the runoff water.

- The water's entry route must also be sloping, to break up both speed and inertia in the water channel. To enable the water to flow, there should be no obstacle or difference in level lower down.


Open for 2/3 of the total length of the tree pit

> General planned cross-section of a stormwater tree; example for reworking an existing tree site



4 Creating a storage zone

Runoff water is stored:
- by means of an **infiltration trench** and a depression around the tree, for trees in single-unit pits;
- by means of **storage hollows, acting as swales, between the trees**, in the case of continuous planting pits.

1. Infiltration trench

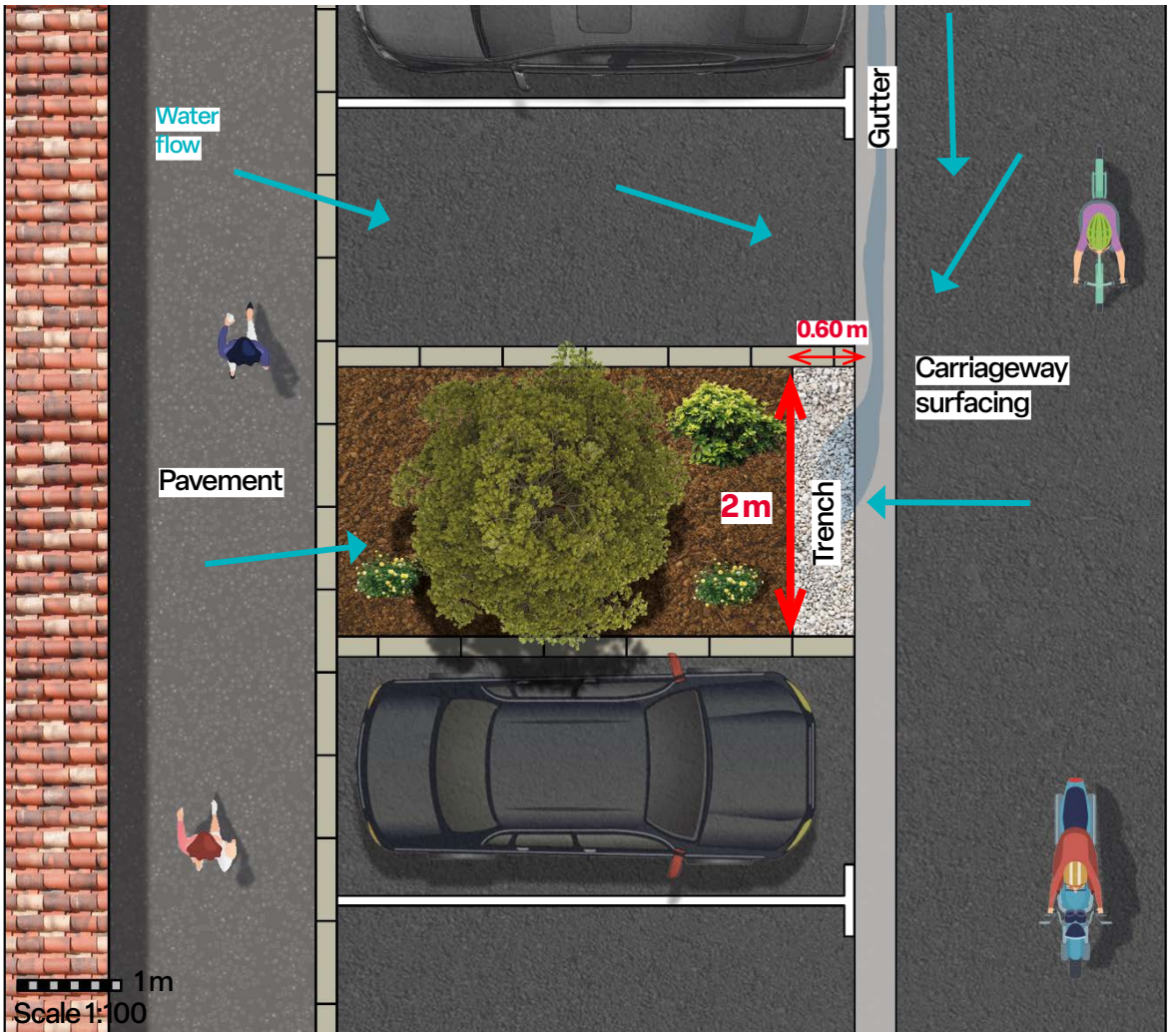
Reference dimensions

The trench dimensions must deliver a minimum earth volume of 1 m^3.
For improved infiltration, the trench length or width must be increased as a priority, rather than the depth.

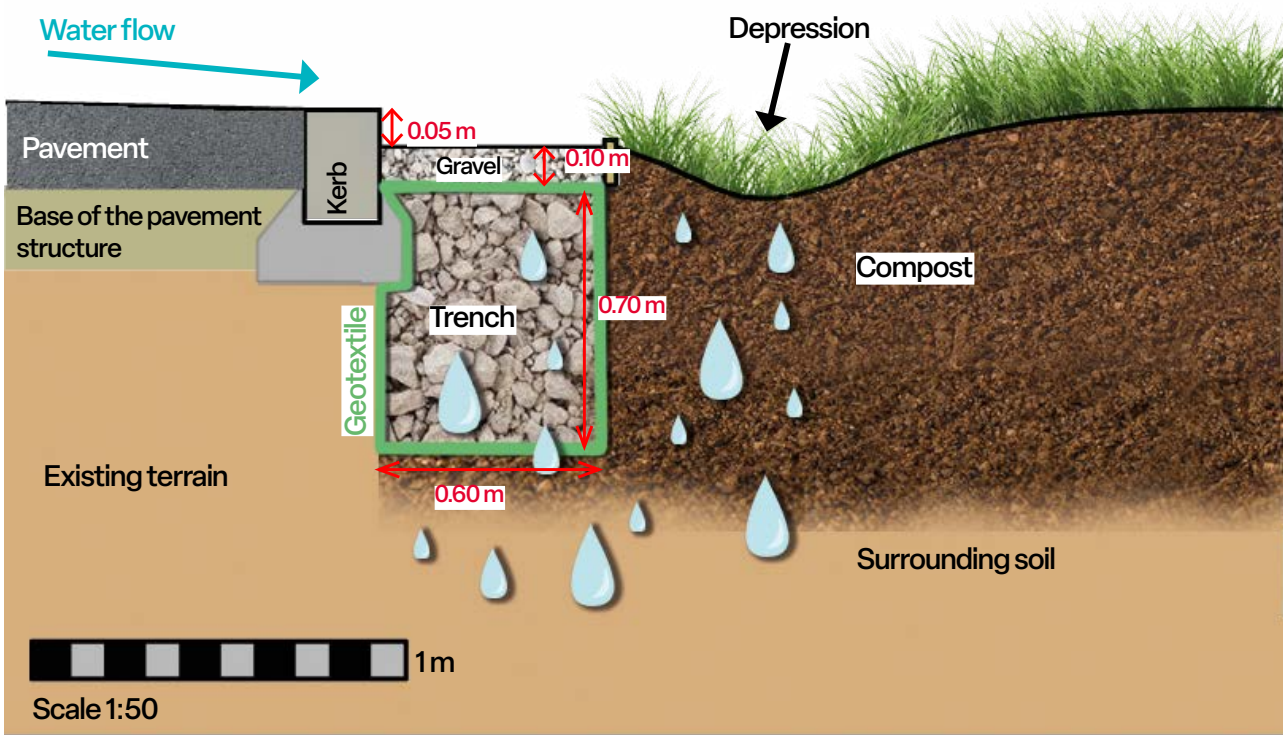
Earth volume = length x depth x width ≈ 1 m^3 minimum

Example of earth volume = 2 m x 0.8 m x 0.6 m = 0.96 m^3 → 1 m^3

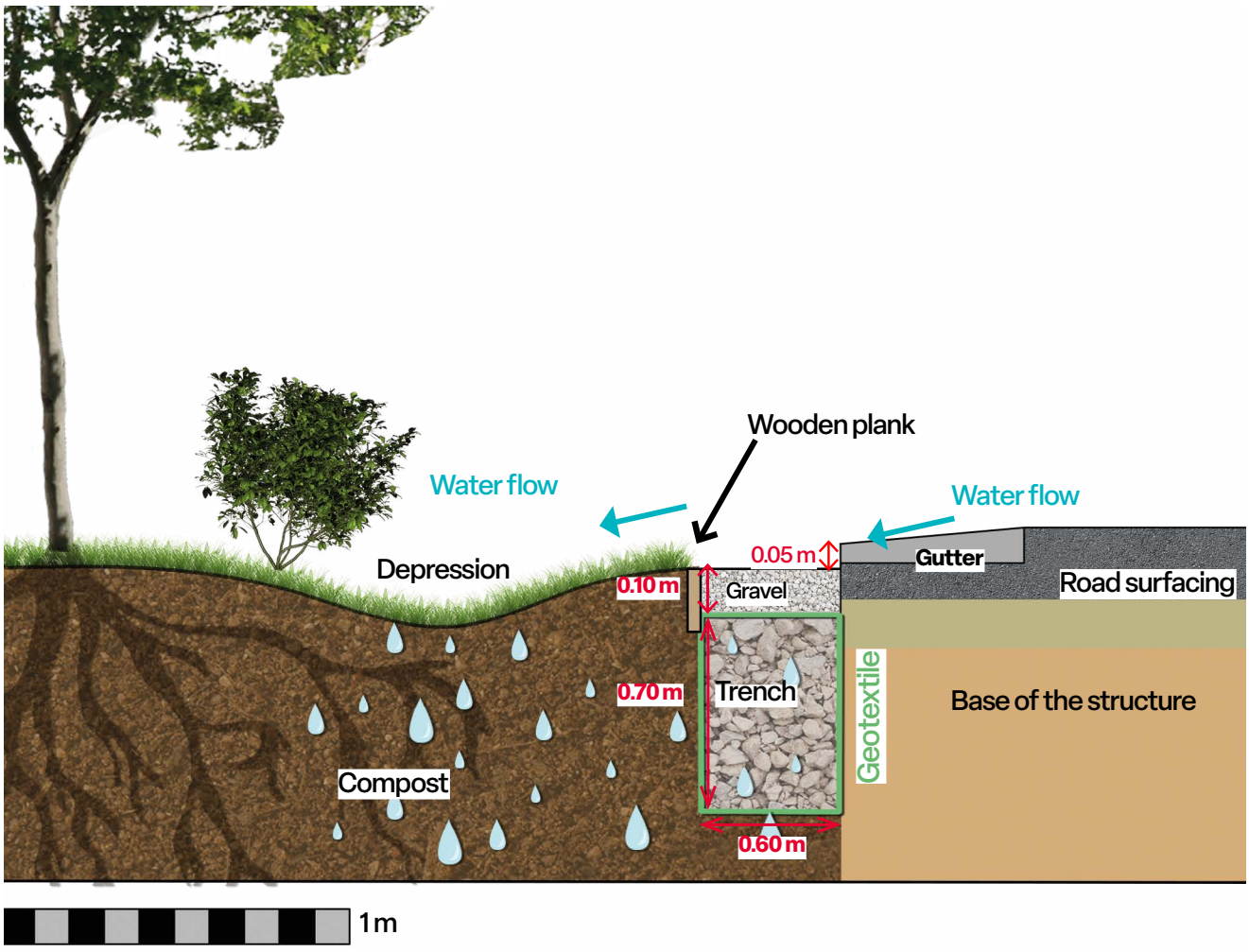
> Infiltration trench dimensions for a "traditional" tree pit in a parking bay



> Reference dimensions of a stormwater tree trench that allows water infiltration on the pavement side



> Reference dimensions of a stormwater tree trench that allows water infiltration on the roadway side



Reference dimensions of the infiltration trench

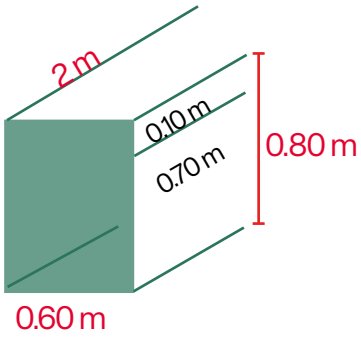
The trench dimensions are adjustable. The urban context where stormwater trees are placed can be highly variable, and often severely constrained: different geometries of the available spaces to be de-paved; presence of old foundations, utilities, mixed root systems, etc.
Therefore, it is appropriate to adjust the length, depth and width of the constructions for each situation, to try and attain a minimum earth volume of 1 m^3.

In all cases,
neither the **depth** nor the width must **ever be** smaller **than 0.4 m.**

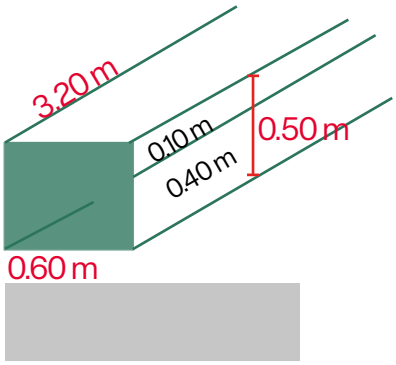
There **must be a minimum distance of 1.5 m between the** tree and the **trench.**

Options for adapting the trench size

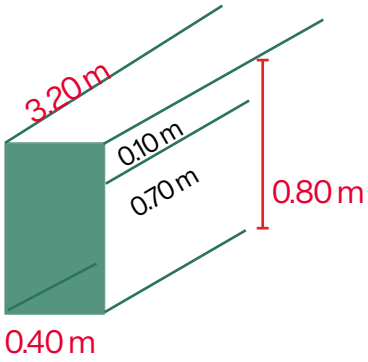
Reference dimensions



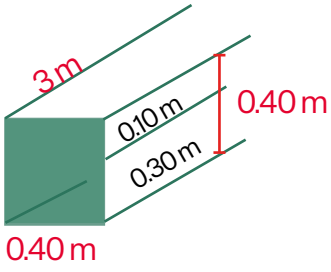
Depth limitation
(e.g. due to utilities)

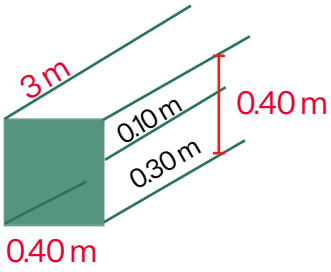


Width limitation
(e.g. extensive root system)



Creation of two trenches (one on roadway side, one on pavement side)
Width and depth limitation

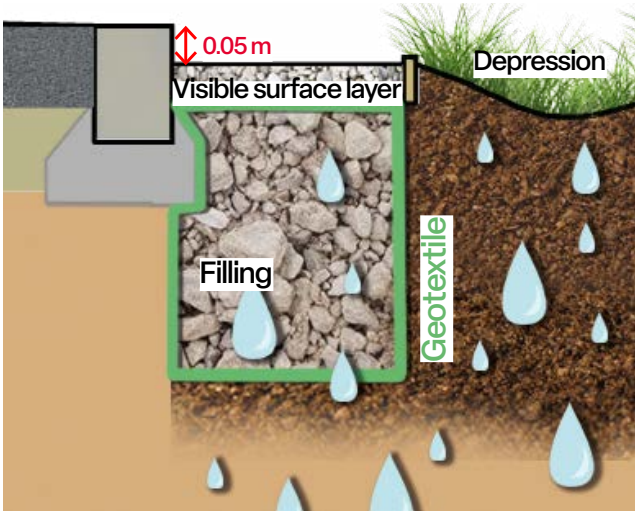




The infiltration trench usefully stores a large volume of water, while slowing the runoff.

Infiltration trench construction materials

The infiltration trench comprises three parts.



Filler materials

Gravel, natural or recycled (and sorted) in stone chipping form (e.g. 40 / 80, 60 / 100).
It is mandatory to wash the gravel before use, to avoid premature clogging of the trench.
The porosity index is 50% (recommended) or 30% (minimum).

Geotextile

The geotextile must offer the following characteristics:

Tensile strength
8 kN/m as per standard EN ISO 10319

Elongation at max load
40% as per standard EN ISO 10319

Dynamic perforation resistance
35 mm as per standard EN ISO 13433

Static puncture resistance (CBR test)
1.2 kN as per standard EN ISO 12236

Permeability 10 times higher than that of the soil (e.g. $1x10^{-4}$ m/s if soil permeability is less than or equal to $1x10^{-5}$ m/s)

Visible surface layer

Plan to have 5 cm of exposed vertical edge between the road level and the top of the visible surface layer, to prevent gravel from escaping.

The visible surface layer comprises either:

- fine untreated gravel, washed (to prevent rapid clogging of the trench) and in chippings of size 4-11 mm with a minimum porosity index of 30%.
A gravel stabiliser may be put in to aid cleaning.
For a planted appearance, the fine gravel can be mixed with seed-containing soil, so that plants will grow in this surface layer. In this case, **the stake fence should protect the entire surface of the tree pit**.

- gravel treated with an organic-mineral amendment (examples: Eco'Urba® by JDM Expert, loose granular mineral coating by Colas, Laquet, Roger Martin). This composition must be porous.

N.B. A wooden plank makes it easier to fill the tree pit with gravel and earth.

Gravel should be chosen in preference to gabion stones. Gravel is cheaper, easier to install and clean, and has a specified porosity index.

> Coarse untreated gravel, in chippings of size 60-100 mm, encased in a geotextile

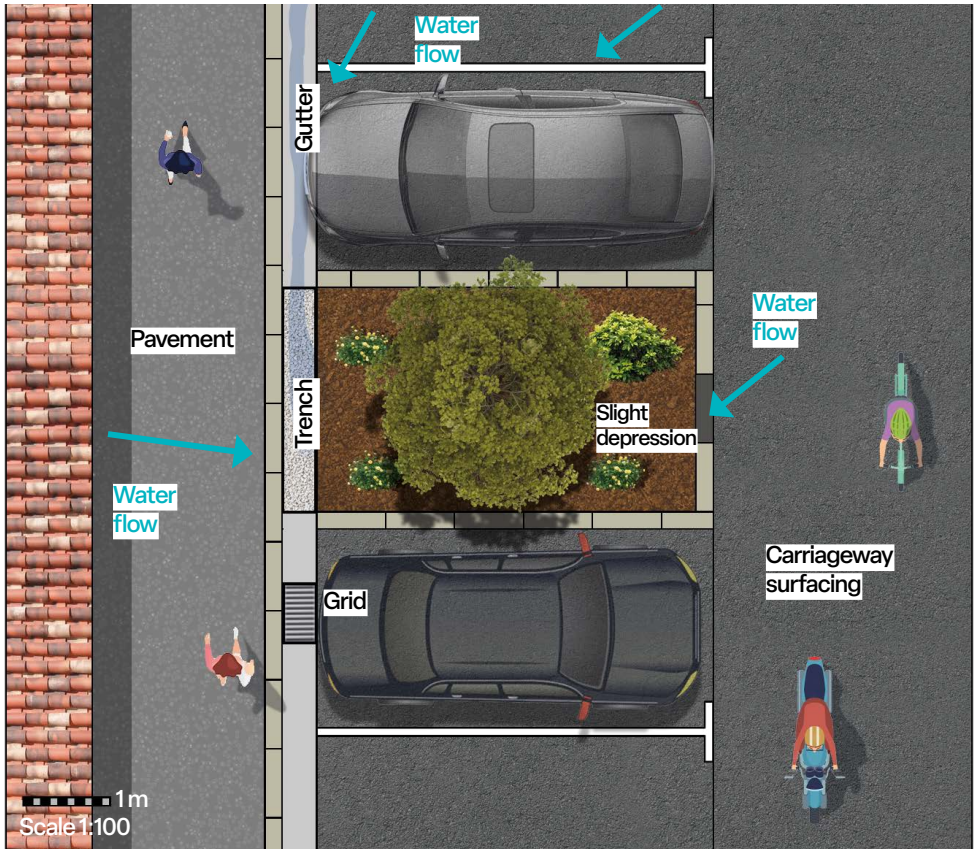
> Fine untreated gravel, in chippings of size 4-11 mm

> Gravel treated with an organic-mineral amendment

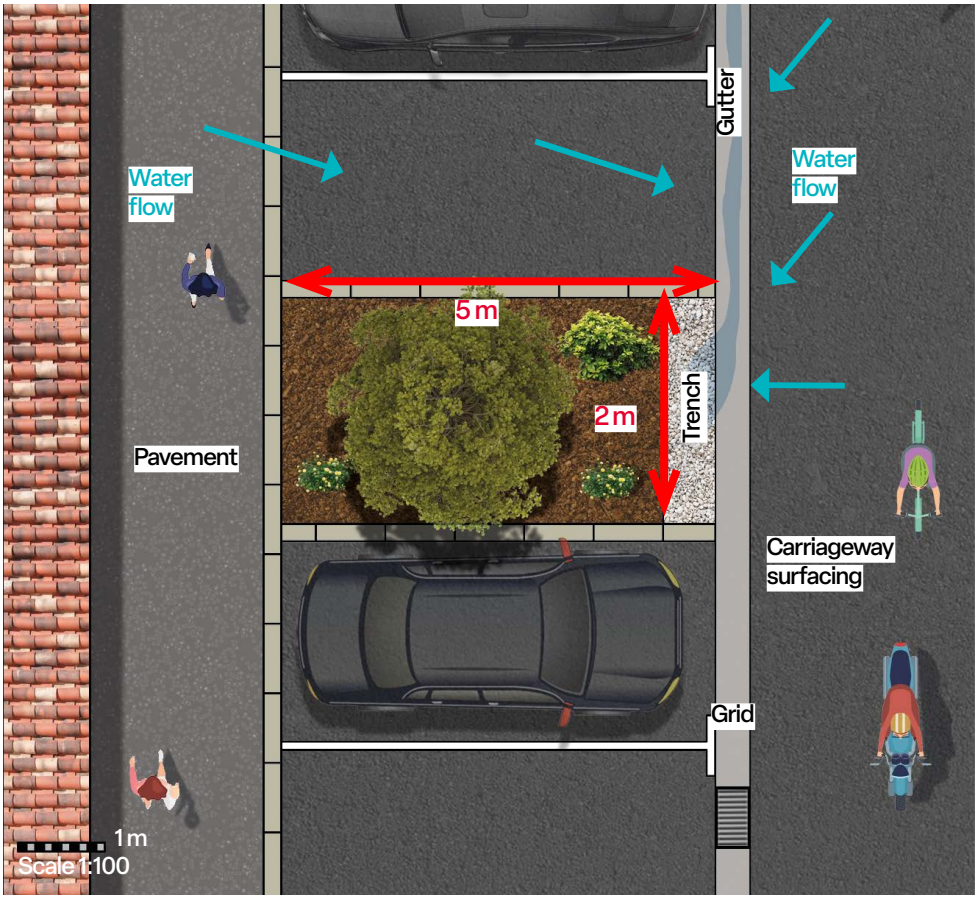
> Gravel stabiliser

Where to place the infiltration trench

The water channel and the gutter help to pinpoint the water flow route during rainfall. The infiltration trench must be placed somewhere on this route.
Here are some examples showing the trench location in the stormwater tree construction:

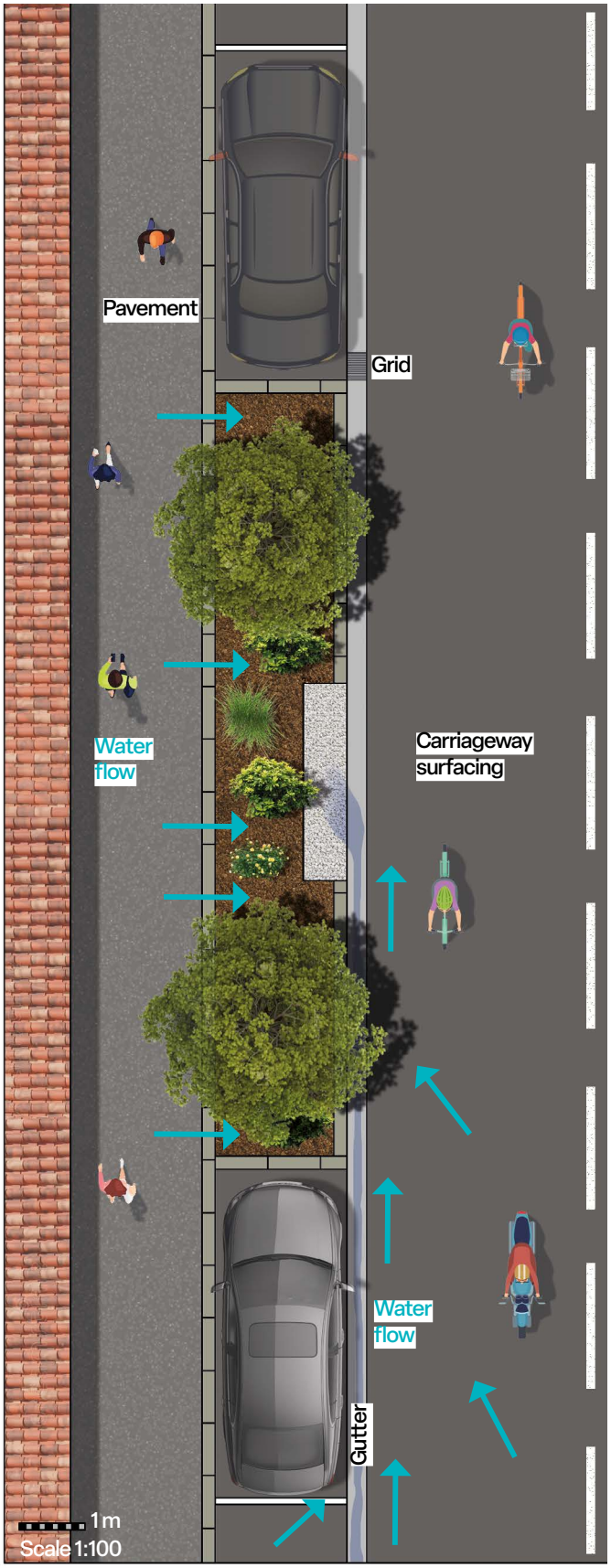


> Water channel on pavement side with vehicle parking at 90 degrees

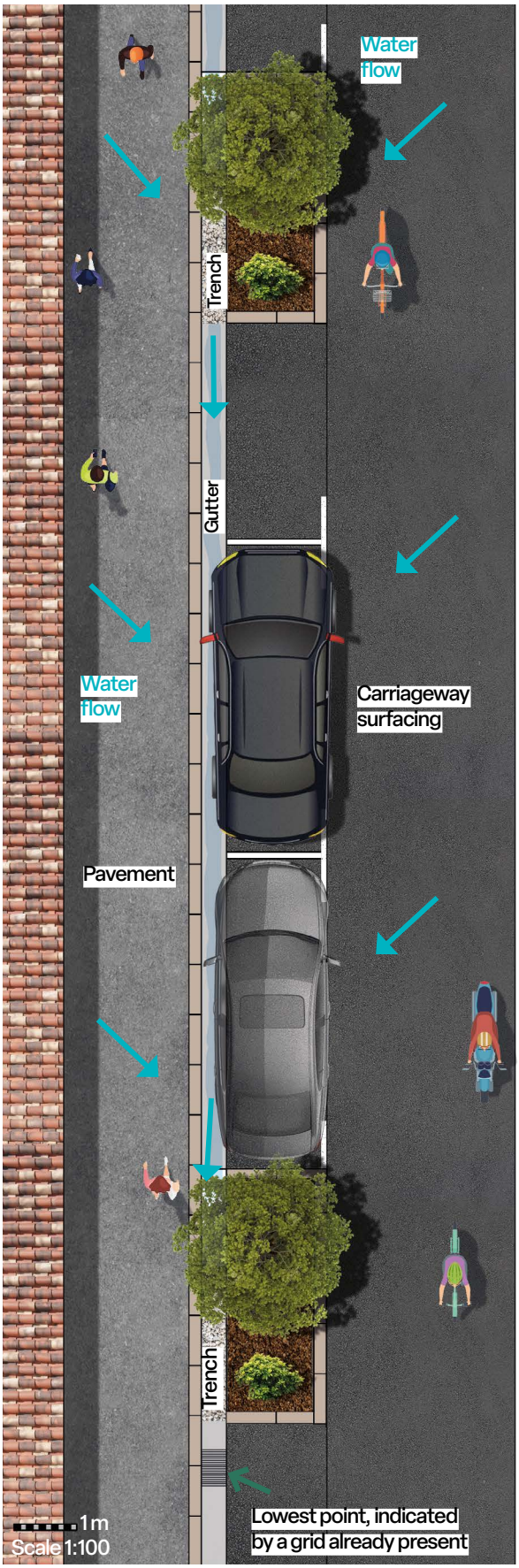


> Water channel on roadway side with vehicle parking at 90 degrees

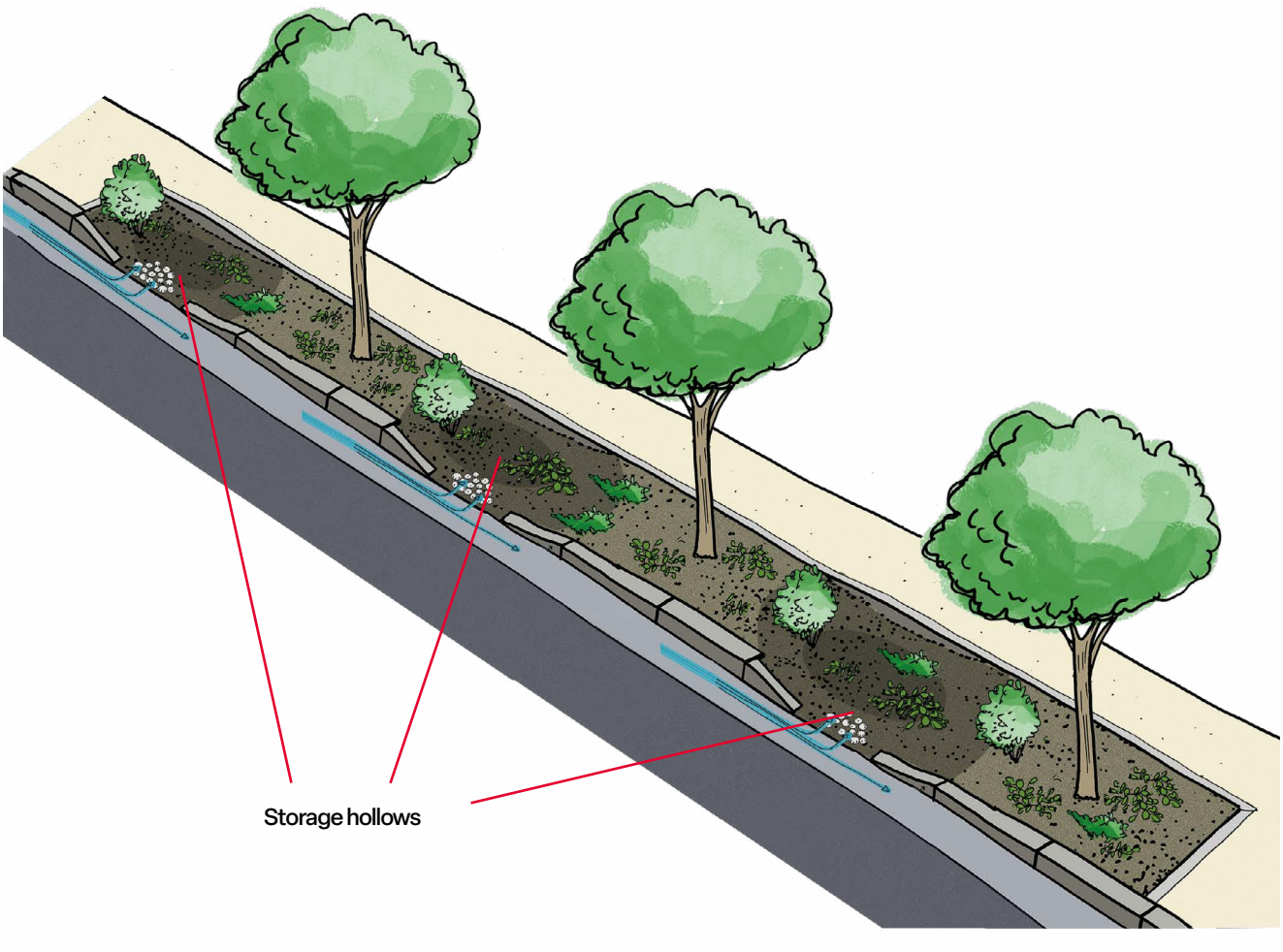
> Water channel on roadway side with parallel vehicle parking



> Trench offset on pavement side, so as not to harm the root system



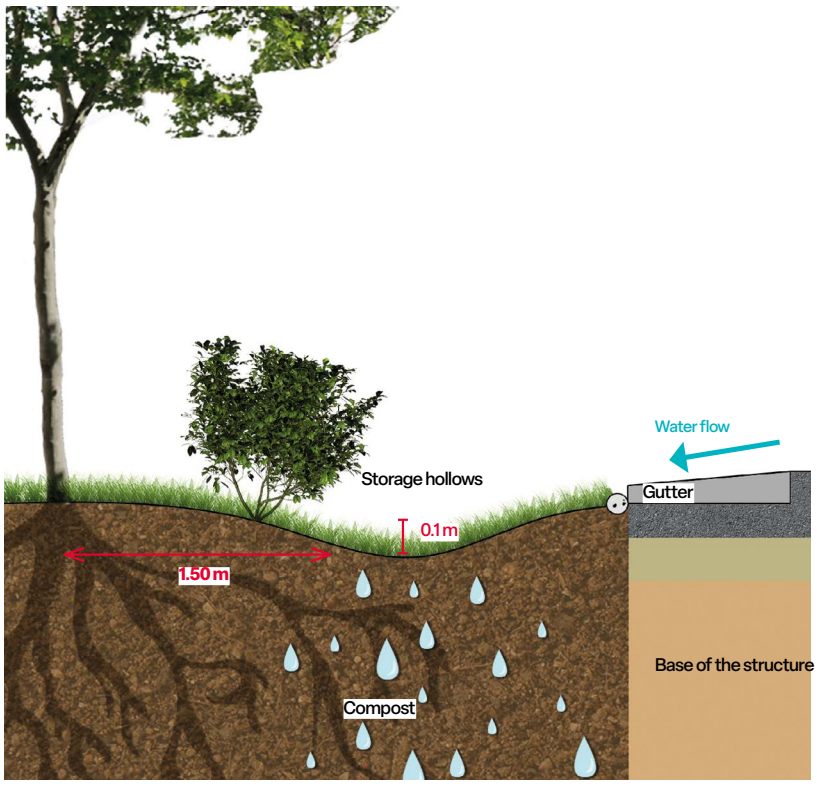
2. Storage hollows for continuous tree-planting pits



- For a continuous tree-planting pit with a minimum surface area of 30 m², it is advisable to create storage hollows between the trees. These are concave spaces with a minimum depth of 20 cm. These storage zones play the same role as a trench, and reduce the need for maintenance.

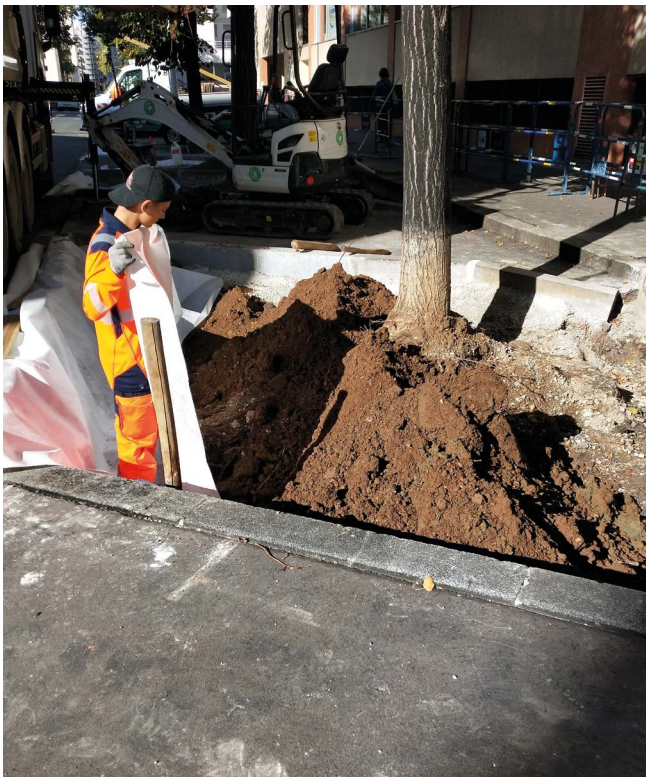
- If more than 30% of the surface of the catchment area is permeable, the hollows will allow infiltration of rainwater.

- Plan for the edge of the construction to be least 1.5 m away from the tree base.



> Pre-existing grid at the low point of the development on Boulevard du Docteur Coblod, Vénissieux

5 Filling the pit after earth removal



Soil quality

Before any planting project or earth removal, it is necessary to observe the condition and type of soil present: has the soil been disturbed (anthropic) or is it natural?

If the soil is anthropic, it will have to be reconstituted.

This will require advice from a Nature & Rivers Department technician, who will assist with the choice between fertile soil and a loamy mixture (recommended for supporting the weight of pedestrians).

This earth must have a texture balanced between sand, silt and clay, with maximum sieve retention of 20% for a 2 mm particle size, and a trace metal study conducted.

The other criteria to take into account are described in theTERNATEC GUIDE, Greater Lyon's specifications on natural excavated soil from the circular economy.

Fact sheet and analyses

A fact sheet about the soil to be supplied, plus the analyses of this soil's physical, chemical and biological properties, must be sent to the project manager in advance for validation.

Depression in the ground

To improve infiltration, it is advisable to make a depression in the ground 1 metre away from the tree base.

If this cannot be done (e.g. not enough space, or a problematic slope) a depression in the ground is not mandatory.

6 Selecting plant species

Species to use are chosen according to different criteria:

- Exposure of the site (shady or sunny)
- Nature of the soil
- Space available overhead: avoid having too much of the tree's form next to the road
- Future management
- Uses of the site
- Heritage situation: development is more complex in a heritage context such as a historical centre, and should be understated in an industrial zone
- Impluvium available
- Desired aesthetic

The tree

"The right tree in the right place"
The plant palette for the other layers (trees, herbaceous plants, lichens and fungi) is chosen to suit the location.

When it comes to creating a stormwater tree, there are no inadvisable species. All species can cope with having their roots in water for a few hours at a time (even magnolias and evergreen oaks).
However, young trees will always be slightly more sensitive than adult trees.

The low layer

The choice of plants for the low layer should be simple, as they tend not to be very durable (short life expectancy, sensitivity to urban site, damage by pedestrians, droppings, etc.).
On the other hand, the plant palette design must include local plants and support biodiversity.

> Creation of a local plant palette

7 Protection and maintenance

Flow management

The flows through the infiltration trenches of stormwater trees are managed by the Water Cycle Department, on condition that the stipulations of this handbook are adhered to, especially the provision of an as-constructed drawing or a schematic diagram.

Cleaning

The Living Environment Improvement Department takes care of cleaning. The stormwater trees have a low wooden fence (stake fence) around them.
This limits damage by pedestrians, dog droppings and other waste, while allowing cleaning operatives to access the tree pit.

The stake fence is quite low, to facilitate access. However, if necessary, a side gate could be put in to provide access for the cleaning operatives.

Plants and stake fences

The plants and stake fences will be attended to annually by the Plant Heritage departments, or by local people as per established conventions.

Snow clearing

If snowfall and the risk of ice occur in Lyon Metropole, brine with a salt concentration of 17 g/m^2 is used. This low dosage is not harmful to trees. In addition, brine does not build up in soils over the long term.

However, in areas with a high risk of snowfall or ice (common at altitude or in areas with steep slopes) salt is used occasionally.

Yet it is a soil pollutant, and toxic to plants at high doses. In these situations, it is best to avoid collecting water from the roadway, and instead only take it from the pavements.

To ask anything about the preventive snow-clearing circuits during periods of extreme cold, contact the Cleaning service.

> Side access that could be provided for cleaning operatives.

Feedback

Results from the first street to have trees put in

Five stormwater trees were created in rue Vauban, in Lyon's 6th *arrondissement*, in November 2021.

According to monitoring of these trees, complete infiltration of on-street rain (660 m²) can be achieved with a permeable surface of 65 m², for light to medium rainfall corresponding to intensity return periods of 1 to 5 years. In winter, the trees allowed infiltration of 24 mm per day; in summer it was up to 40 mm per day, and 20 mm in 20 mins.

1. The trees' effectiveness in allowing infiltration of the first 15 mm of accumulated rainfall has been confirmed, and exceeded.

2. The quantity of infiltrated water improved the trees' living conditions (compared to adjacent trees of the same species that were not developed as "stormwater trees"): daily growth almost doubled, with no water stress.
These indicators illustrate the role these trees play as a source of coolness, thanks to their higher evapotranspiration.

3. Water availability in the soil is maintained at a higher level, because every drop that falls is guided, not wasted. The soil remains moist for longer, which has a twofold benefit during dry summer periods followed by very heavy rain because moist soil absorbs water twice as fast as dry soil.

4. Enlarging the tree pit, combined with the addition of fertile soil and a strategy for diversified low-layer planting, has a swift and positive impact on soil porosity (making it very high) and for pollinators.

Costs

		Price per pit	
Stormwater tree			
Redevelopment or new planting of a stormwater tree measuring 5 m x 2 m	Site preparation, cutting out and demolishing surfacing, earth removal, adding soil for planting, laying edges, restoring surfacing, finishing	€3,700 to €4,000	**€4,500 to €5,000**
	Provision and installation of infiltration trench, and stake fence to protect the pit	€800 to €1,000	
	Provision and planting of the tree (if a first-time planting) and other plants	€1,200	**€5,700 to €6,200**
Planting in a pit that does not have stormwater tree elements			
10 m^3 pit of compost	Site preparation, cutting out and demolishing surfacing, earth removal, adding soil for planting, laying edges, restoring surfacing, finishing	€3,700 to €4,000	**€4,900 to €5,200**
	Provision and planting of the tree and other plants, mulch and protection	€1,200	
Reworking a tree pit that does not have stormwater tree elements			
Existing structure measuring 2 m x 2 m replaced by a structure measuring 5 m x 2 m	Site preparation, cutting out and demolishing surfacing, earth removal, adding soil for planting, laying edges, restoring surfacing, finishing	€4,300 to €4,500	**€4,300 to €4,500**

Creating stormwater trees means planting trees in urban environments in a way that bolsters the ecosystem services delivered by vegetation, for a cost similar to traditional tree-planting or reworking an existing tree site structure, while also helping the city adapt to climate change.

Communication and citizen participation

To motivate people to respect these spaces, what's needed is simple, durable in-situ communication that helps citizens identify and properly understand the developments.

One possibility is to propose citizen management of individual trees. This will pave the way for acceptance of these projects (appropriation of and respect for green spaces), and also help with managing tree-planting that better serves biodiversity.
The Planting Permit programmes ensure participation (e.g. the Jardin de rue (Street garden) in Lyon).
If a municipality has no programme, it can apply to the Plant Heritage department for a participative planting package agreement.

During the works, projects funded by the Water Agency must communicate with citizens via surrounds or signs at planting sites.

The inspiration (City of Angers)

Our proposal

> Example of the content of information surrounds or signs

Adoptez un arbre de pluie

La Métropole de Lyon vous invite à aménager et à prendre soin de ce futur espace végétalisé qui infiltre l'eau de pluie.

Pour plus d'infos, écrire à arbresdepluie@grandlyon.com

L'arbre de pluie permet de :

- **Réduire le ruissellement**
- **Recharger la nappe phréatique**
- **Développer un ilot de fraîcheur**
- **Favoriser la biodiversité urbaine**
- **Améliorer le cadre de vie**

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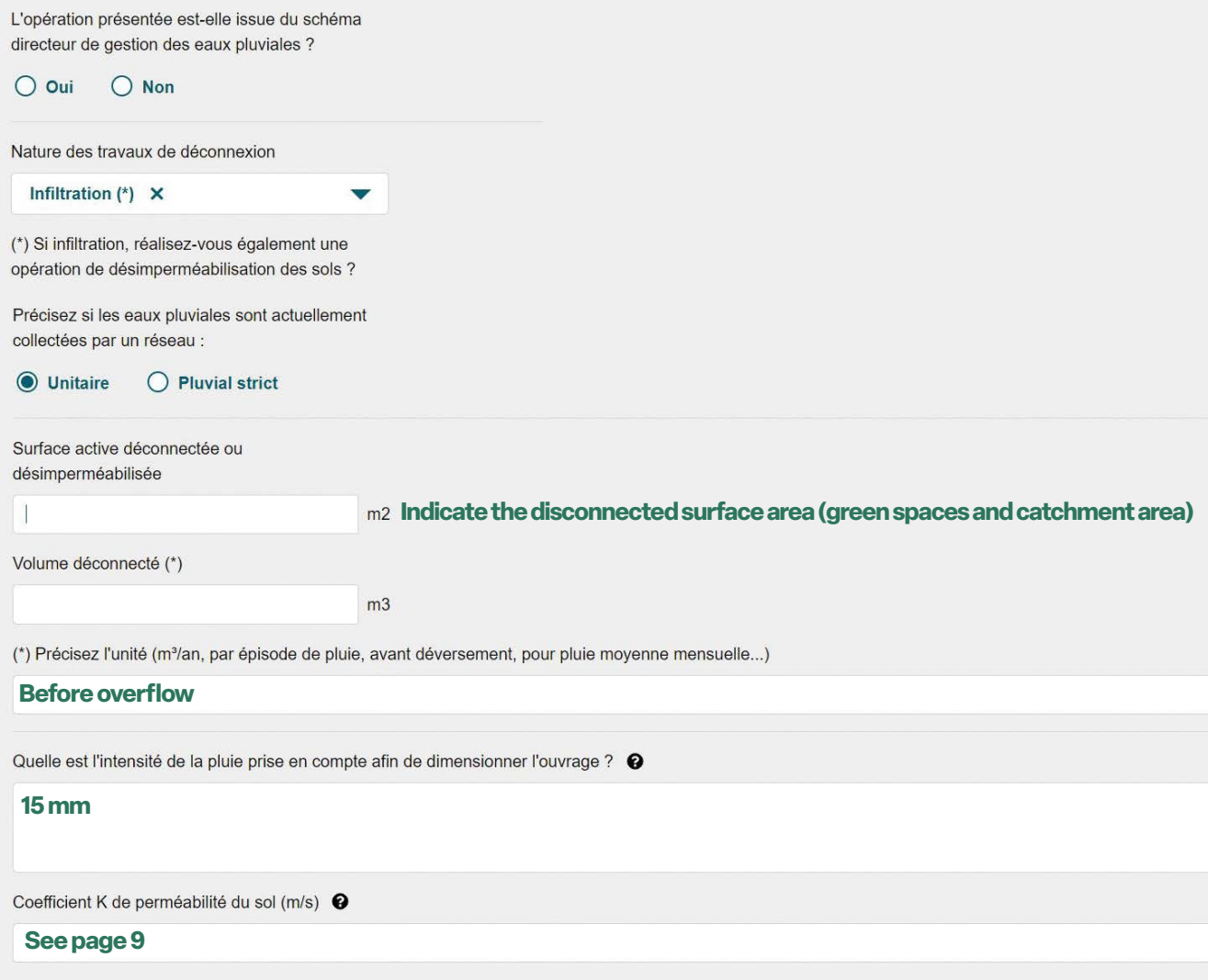
L'arbre de pluie a été réalisé dans le cadre du projet Life Artisan, initié par l'Union européenne. Il vise à expérimenter des solutions d'adaptation au changement climatique basées sur la nature.

Appendices

Tutorial: applying for a Water Agency grant

Log on by visiting: https://aides.eaurmc.fr/Tsa/#/login
The usernames and passwords are available from the directors of each department.



Calculating the disconnected volume

The water height (15 mm) and the size of the catchment area must be known.

V (m³) = Water height (m) ×Impermeable surface (m²)

V = **0.015** m x **100** m² = **1.5** m³ per stormwater tree

	With one stormwater tree	With five stormwater trees (rue Vauban)
Catchment area surface	100 m²	600 m²
Surface area of green spaces	10 m²	65 m²
Disconnected surface	110 m²	665 m²
Disconnected volume	1.5 m³	9 m³

Appendices

Example of biodiversity-friendly plant palettes

Very sunny location

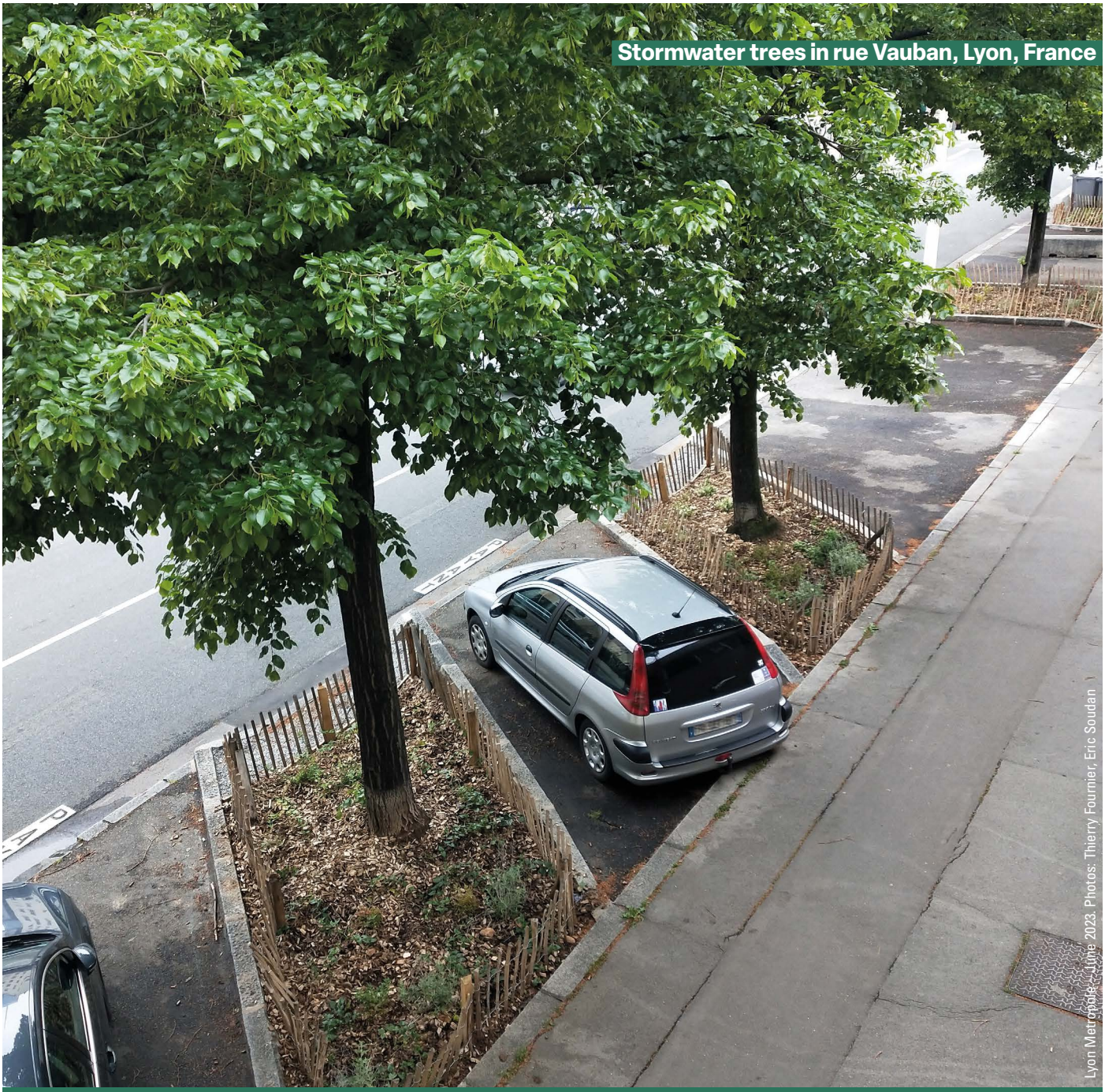
Shrubs	Cover plants
Hyssopus officinalis	*Origanum vulgare compactum*
Lanvandula angustifolia Hidcote	*Sedum album*
Perovskia atriplicifolia	*Sedum spurium Coccineum*
Potentilla fruticosa	*Teucrium lucidrys*
Salvia nemerosa	
Spiraea japonica	
Verbena bonariensis	

Sunny / slightly shaded location

Shrubs	Cover plants
Cistus parviflorus	*Delosperma cooperi*
Deutzia gracilis	*Erigeron karvinskianus*
Euphorbia characias wulfenii	*Geranium rosana Gerwat*
Forsythia intermedia	*Vinca minor*
Hyperricum sp.	
Syphoricarpos chenaultii	

Shaded location

Shrubs	Cover plants
Hyperricum sp.	*Ajuga reptans*
Nandina domestica	*Cyclamen hederifolium*
Syphoricarpos chenaultii	*Geranium sp.*
	Hedera helix
	Vinca minor



Stormwater trees in rue Vauban, Lyon, France

Lyon Metropole – June 2023. Photos: Thierry Fournier, Eric Soudan

Lyon Metropole
Publication managers

Hervé CALTRAN
Johana SANABRIA

Environment and Energy Transition Delegation
Water Cycle Department
Aquatic Management (GEMAPI) sanitation steering
Heritage management

Pascal GOUBIER
Hind NAIT BARKA
Anaïs HENRY

Delegation for management and use of public space
Living Environment Improvement Department
Supporting division on Plant Heritage

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