

IKT 2014 – Infrastructure Knowledge and Technology

Britt-Marie Alvem
Björn Embrén

Tree Officer

Street Department, Stockholm, Sweden



***Trees and Stormwater Management
– The Stockholm solution –***

Problems for Mature Urban Trees



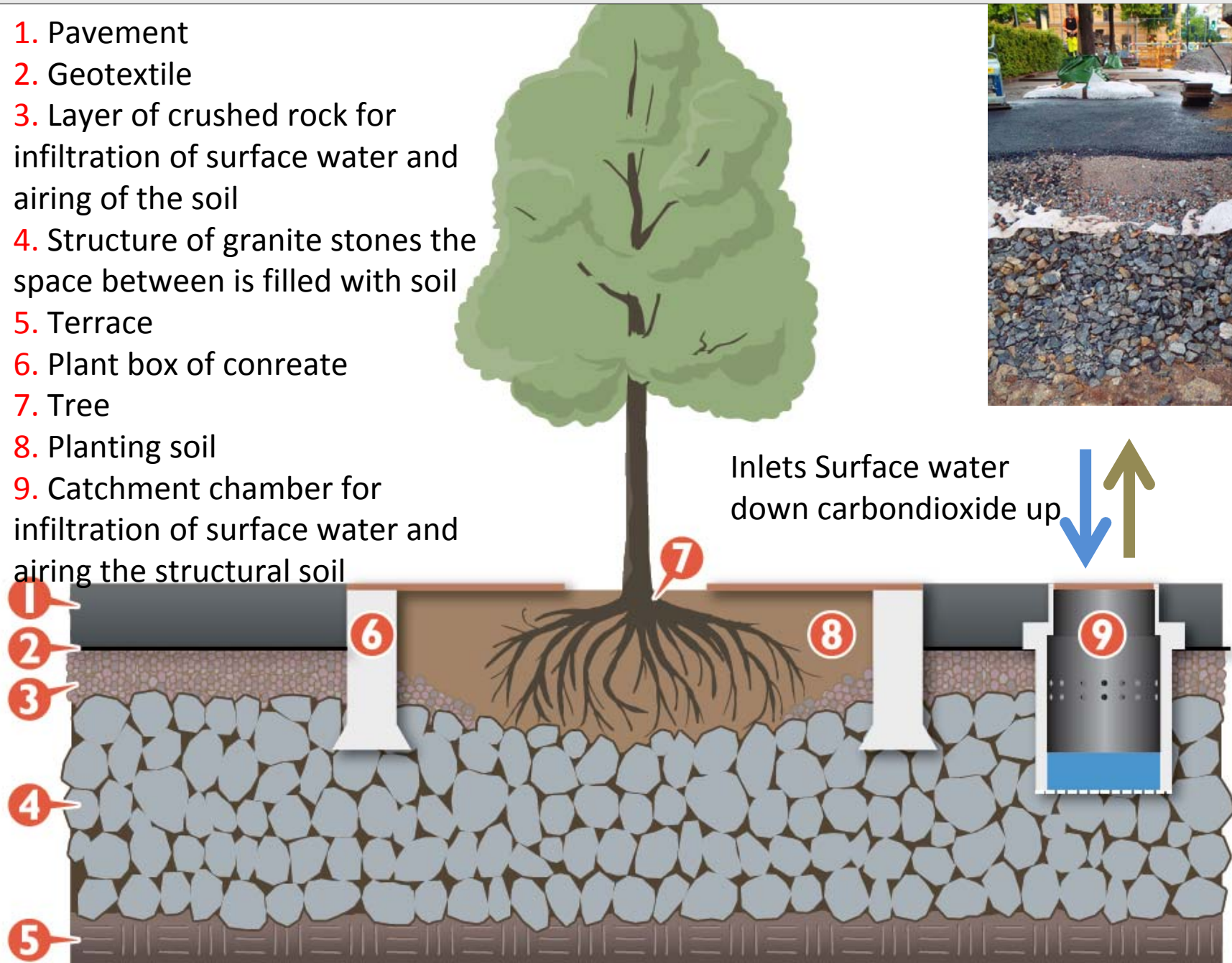
which in this condition has lost its environmental value

Using a rock based growing substrate as a benefit for both for trees and stormwater management



How to create good growing conditions and taking care of the surface water

1. Pavement
2. Geotextile
3. Layer of crushed rock for infiltration of surface water and airing of the soil
4. Structure of granite stones the space between is filled with soil
5. Terrace
6. Plant box of concrete
7. Tree
8. Planting soil
9. Catchment chamber for infiltration of surface water and airing the structural soil

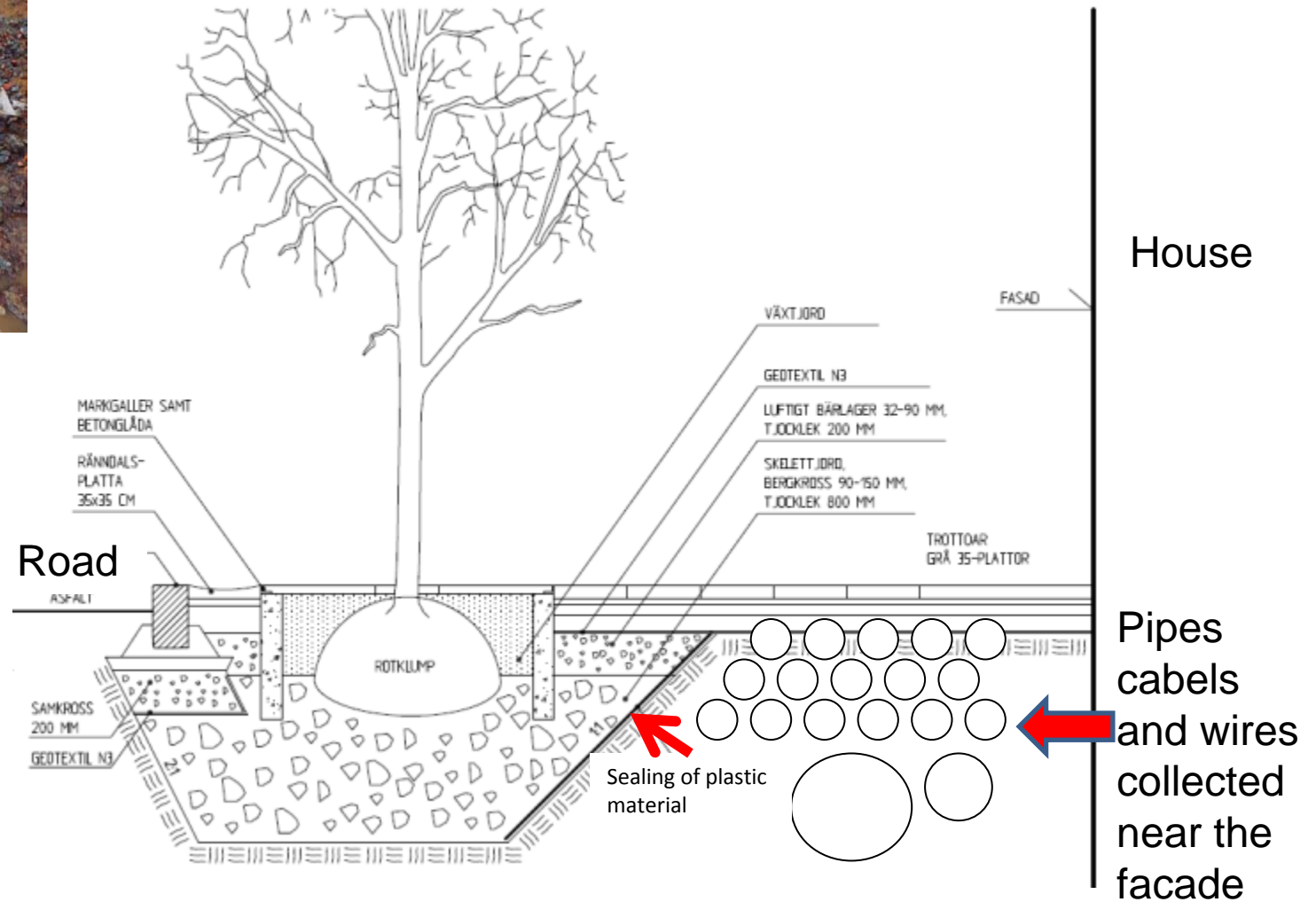


conventional construction
for sidewalks in
Stockholm

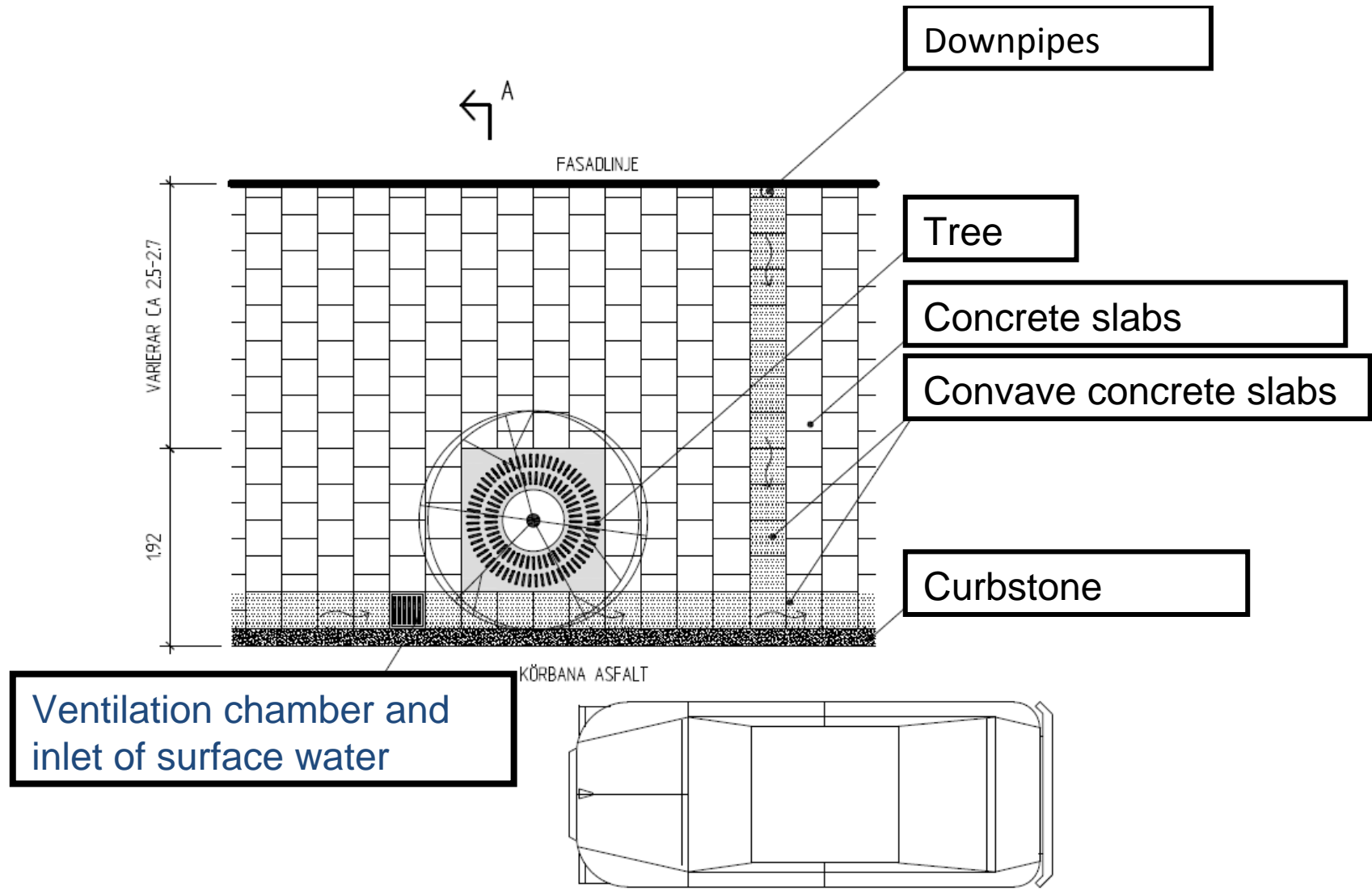




Sidewalk Cross section of planting bed



connected plant beds along the block for the best conditions for the trees



PLANDETALJ, PRINCIP

- We take water from roofs and pavements and lead it down to the structural soil by inlets



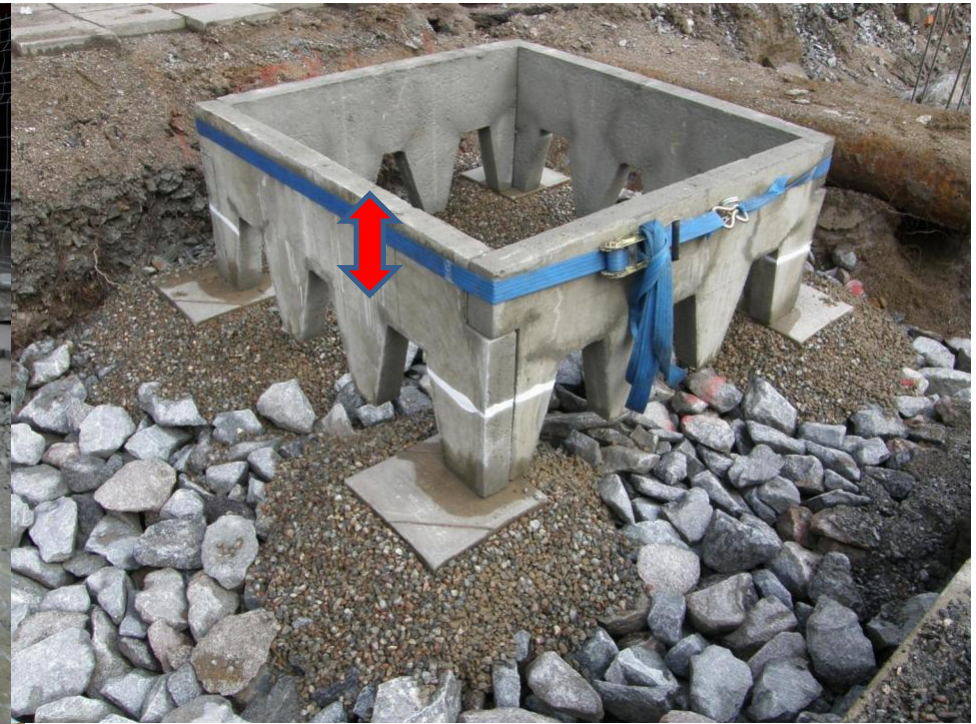
- Roof and pavement surface 4600kvm
Rainfall 600mm year (2 fot)
Approximately 2.3 million liters of water year
Saved cost for the treatment of stormwater = 2300 £ /year
Reduced load on the Baltic Sea / and lakes at torrential rains





Granit 90-150mm

Granit size 90-150mm



Compacting befor soil is washed in to the voids



The stone shall fall into the box to get a stable construction



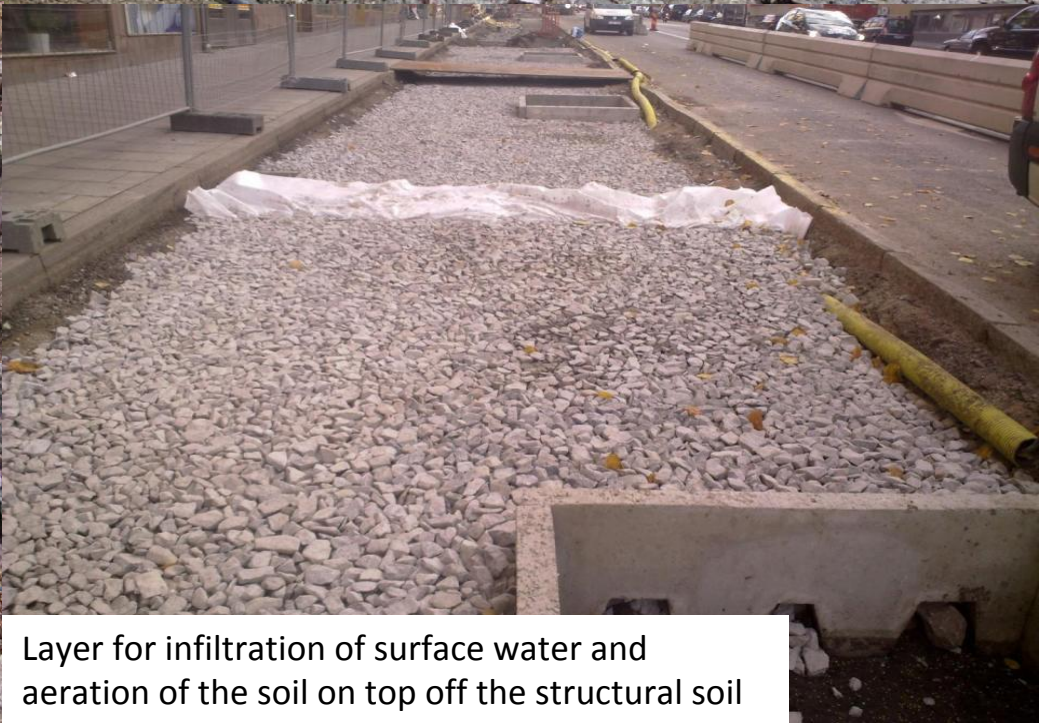
Flushing the soil into the structure



Ventilation chamber and inlet of surface water



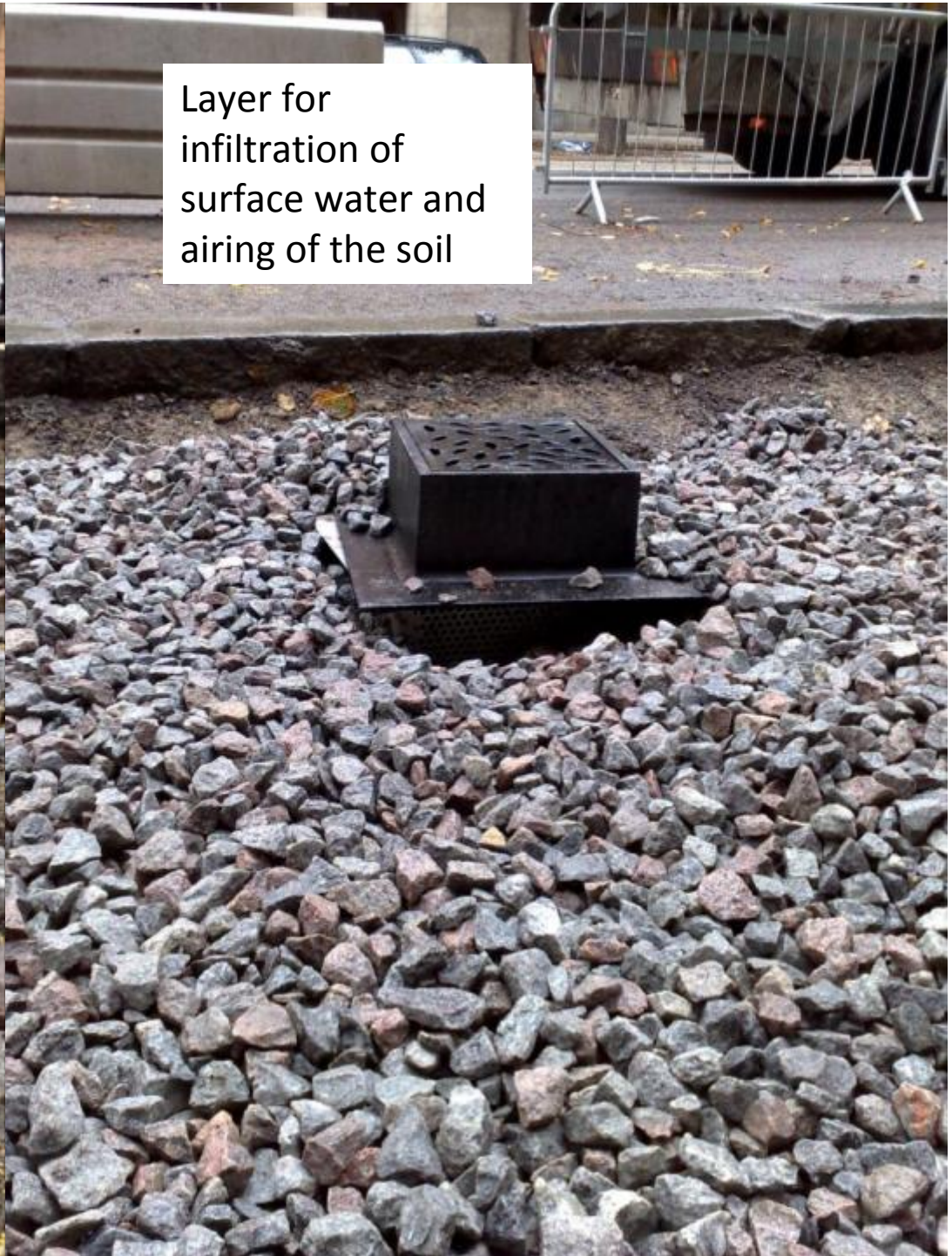
Slow release fertilizer

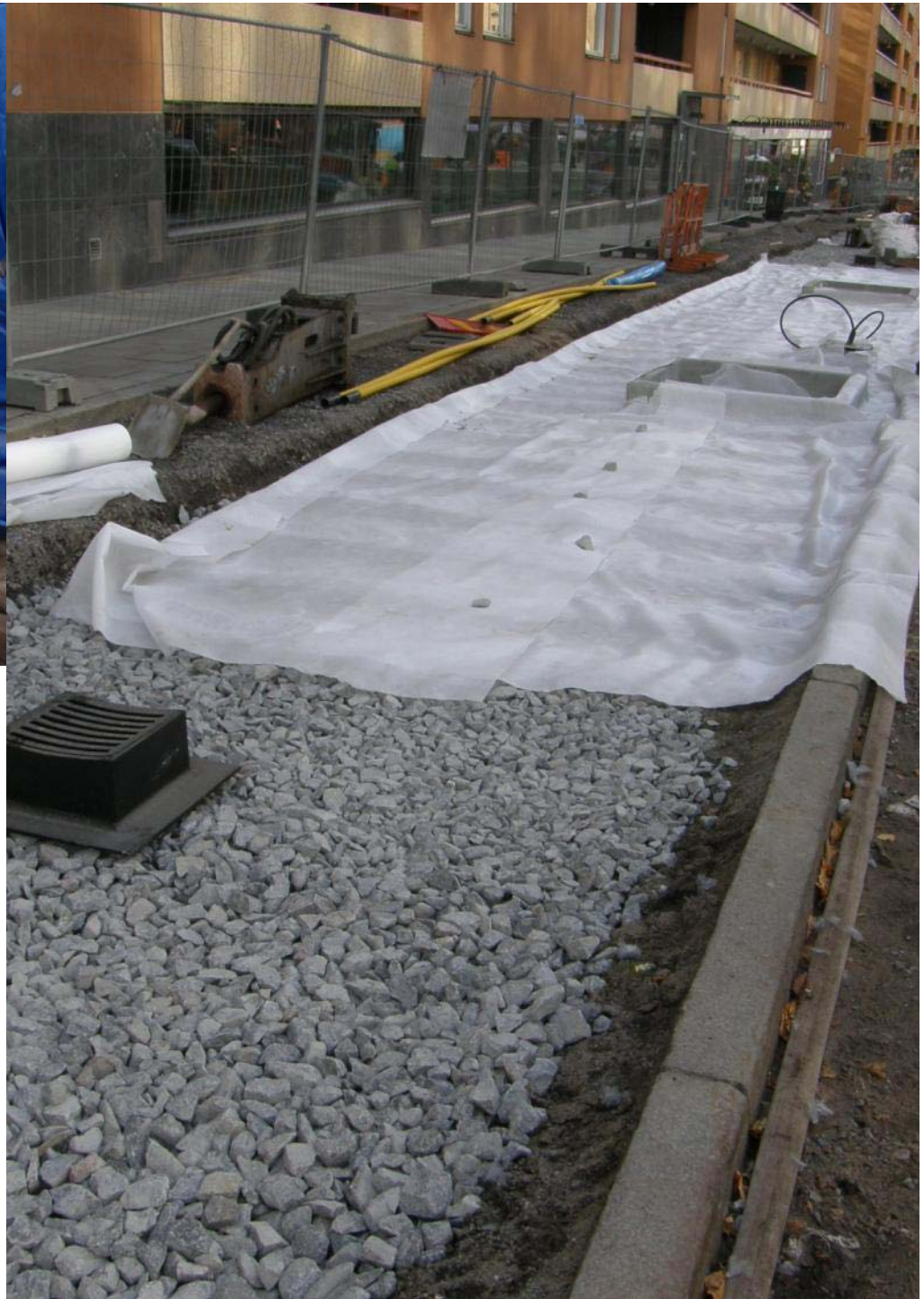


Layer for infiltration of surface water and aeration of the soil on top off the structural soil



Layer for infiltration of surface water and airing of the soil





Important with geotextile connection against curbs inlets concrete boxes etc.so that no fine material could run into the airy base course

If the percolation layer is full, the storm water flows into the old street inlet.



- We take water from roofs and pavements through inlets to the aerated bearing layer and the structural soil.

100 mm (4 in) water on 600 mm (24 in) of structural soil



100 mm of water on 600 mm of wet structural soil



Recycled concrete
as skeletal soil.
Runebergsplan



4 years after
planting 3.5 meters
from tree

Erik Dahlbergsallén







and as a proof that we are on the right path, we find mykorrhitza in our structural soils which only thrives in good conditions

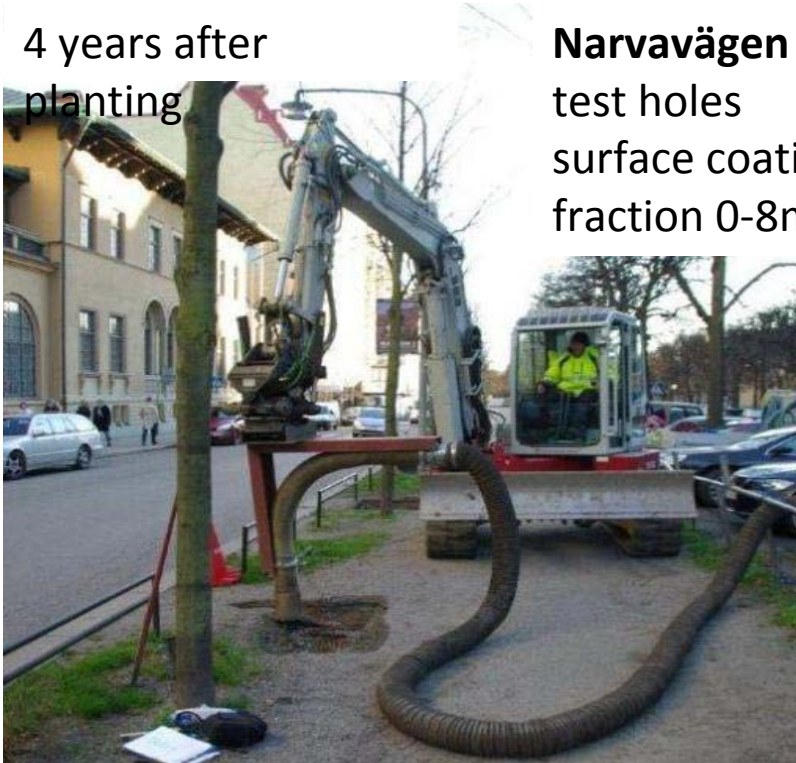
4 years after
planting

Narvavägen

test holes

surface coating pumice fraction 2-8mm mixed with crushed granite

fraction 0-8mm volume 1/1





Kocksgatan

Prunus
'Umineko'



Hamngatan



2005-2010

Hamngatan



Approximately 2 000 planting beds have been rebuilt



Swedenborgsgatan

Planted
around
1935 about
80 year old

Planted in
autumn 2003
10 years at the
location



planted in as 30-35cm after 8 years, the trees are 70 - 83cm in circumference

2012-06-19

Erik Dahlbergsallén

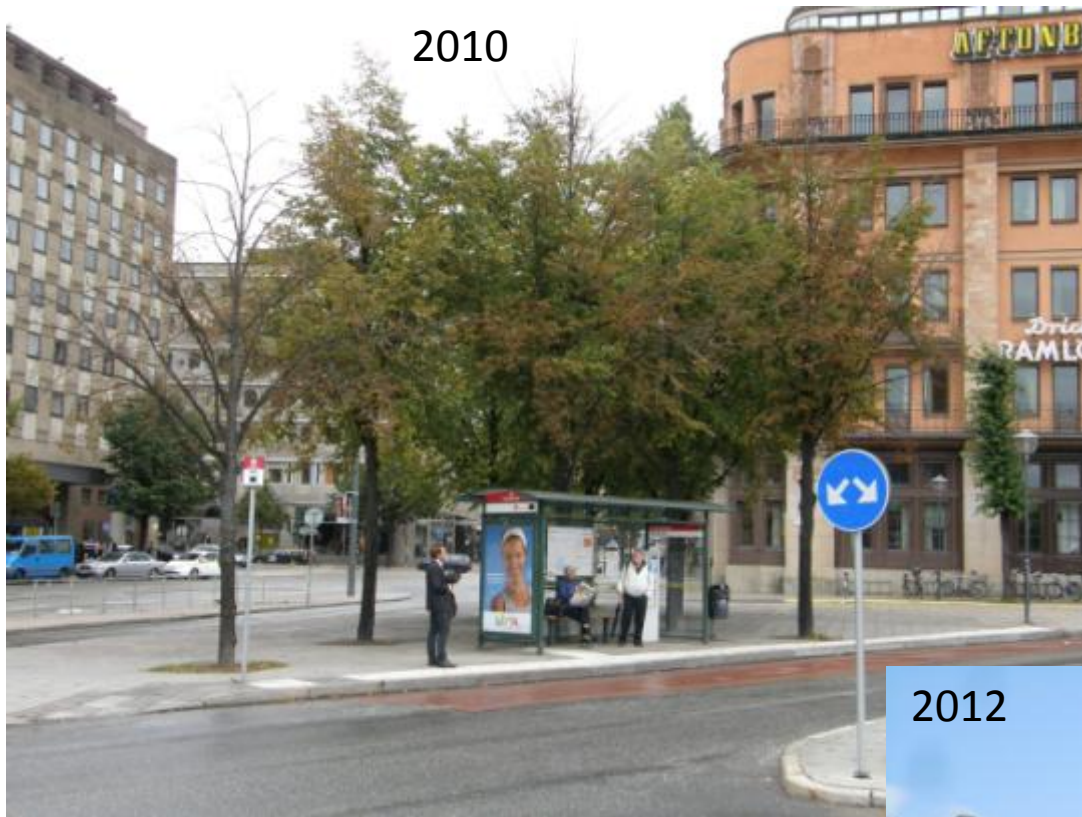


1965-2010

2005-2010



2010



Rödbotorget

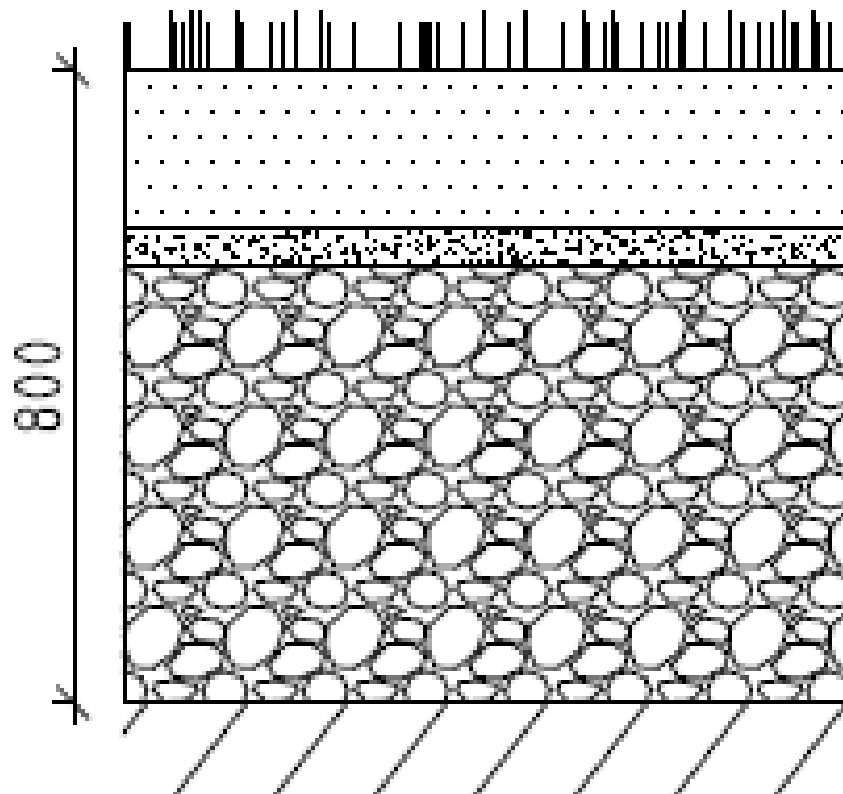
2012



left 2002 right 2013
Kungsbroplan

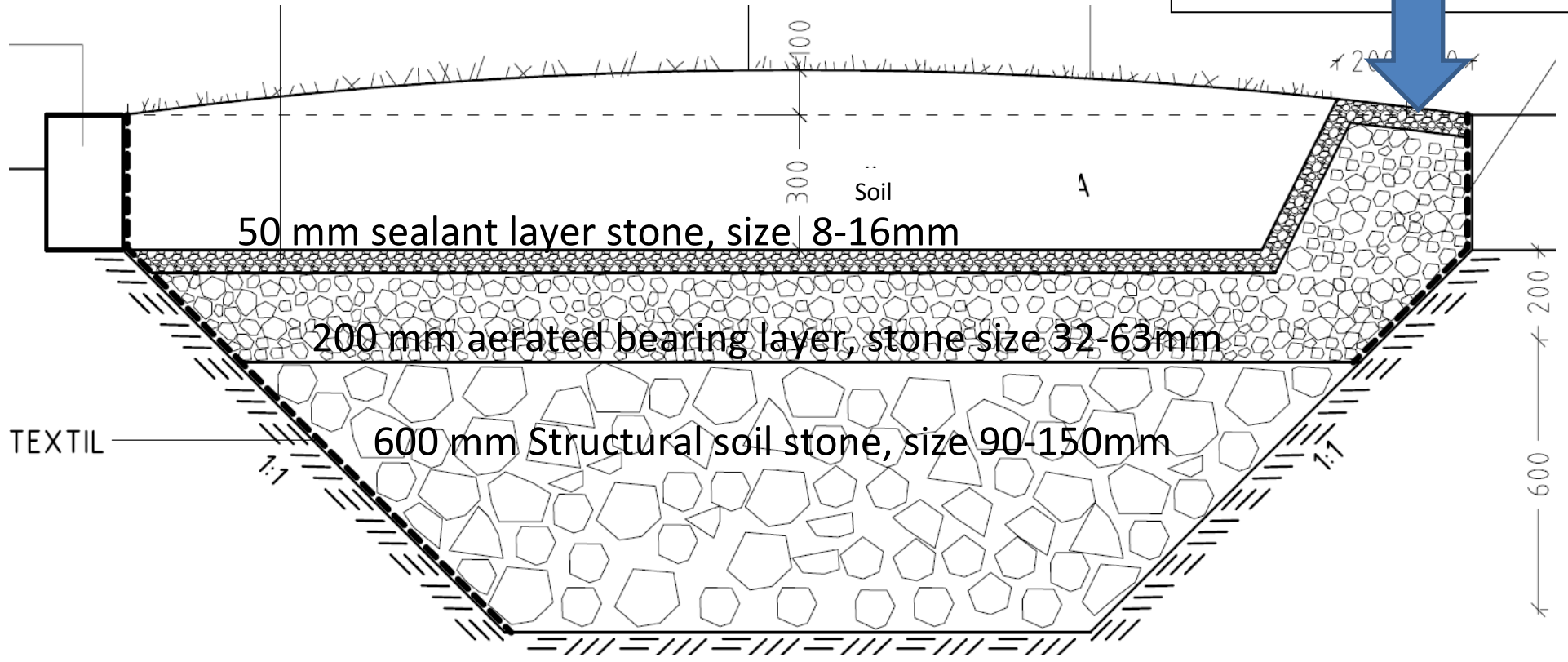


Three different planting beds,
a standard 2 x 3 meters and 80 cm deep with
soil-A
one with half soil-A half charcoal in the same
size as the first,
the third was pure rock that was covered
with coir mat and 3-inch soil charcoal blend
50/50 continuous plant bed 80 cm deep
about 2 meters wide





Ventilation and inlet
of surface water



2012-06-20



Charcoal is incredibly stable if we dig down it into the ground, it stays there for thousands of years as a Co2 sinker





Biochar is a name for [charcoal](#) when it is used for particular purposes, especially as a soil amendment. Like all charcoal, biochar is created by [pyrolysis](#) of [biomass](#). Biochar is under investigation as an approach to [carbon sequestration](#) to produce [negative carbon dioxide emissions](#).^[1] Biochar thus has the potential to help mitigate [climate change](#), via carbon sequestration.^[2] Independently, biochar can increase [soil fertility](#), raise agricultural productivity and reduce pressure on [forests](#), though the degree to which results offer long term carbon sequestration in practice has been challenged.^[3] Biochar is a stable solid, rich in [carbon](#) and can endure in soil for thousands of years.^[1]

Wikipedia



- The first time we use charcoal filters in structural soil was 2013 at Swedenborgsgatan. One block with coals under airy base course and in one block below the structural soil.



Photo: Christina Berger

Biochar and activated carbon filters for greywater treatment – comparison of organic matter and nutrients removal

Christina Berger

Plant bed for street trees charcoal macadam = crushed granite 32-63 mm mixed with 10% nutrient-enriched charcoal





2013

Magnolia planted in **1**. Charcoal stone chips = crushed granite (2-5mm) and nutrient-enriched charcoal 50/50. volume





Materials we use when we plant trees
shrubs and perennials

1. Charcoal stone chips = crushed granite (2-5mm) and nutrient-enriched charcoal 50/50.
volume



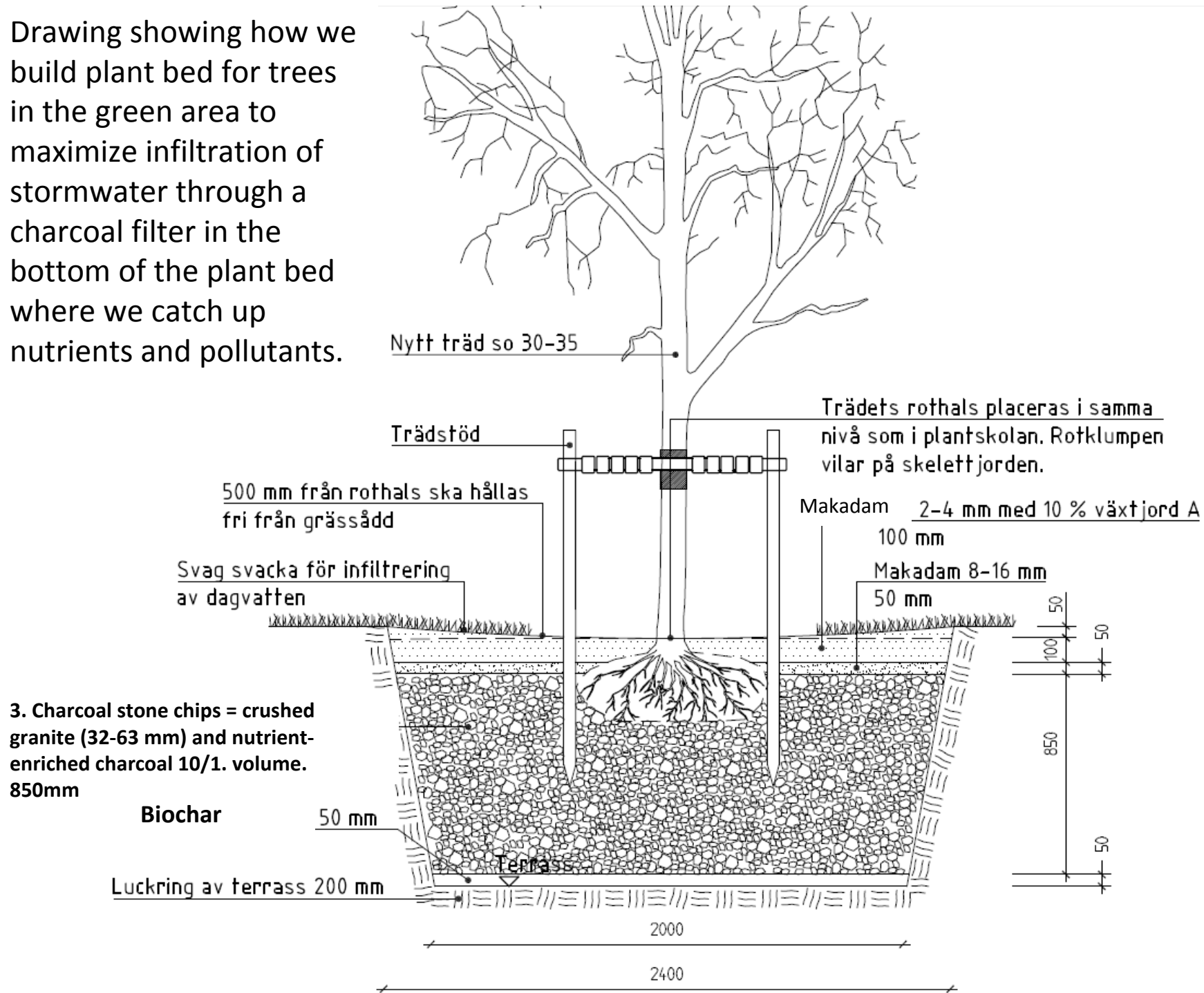
3. Charcoal stone chips = crushed granite (32-63 mm) and nutrient-enriched charcoal 10/1.
volume

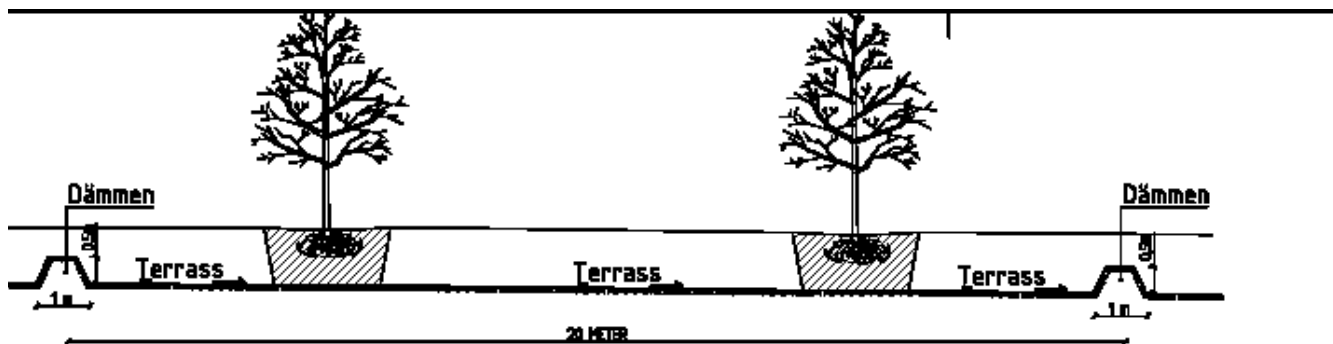


2. Charcoal earth =
soil + nutrient-enriched charcoal 50/50.
volume



Drawing showing how we build plant bed for trees in the green area to maximize infiltration of stormwater through a charcoal filter in the bottom of the plant bed where we catch up nutrients and pollutants.

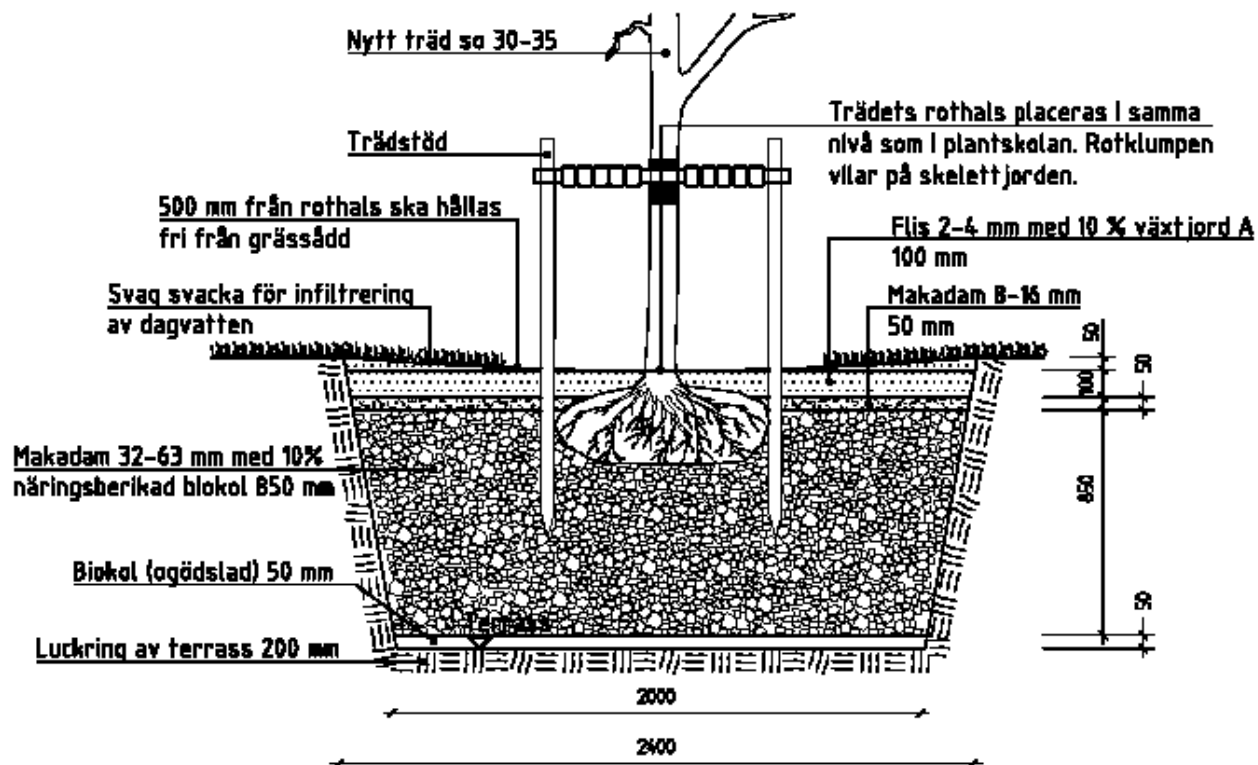




VÄXTBÄDD MED LUTANDE TERRASS

LÄNGDSEKTION

SKALA 1:100



VÄXTBÄDD MED KOLMAKADAM I GRÖNYTA, TYP 2

PRINCIPSEKTION

SKALA 1:20



Plant bed for street trees charcoal macadam = crushed granite 8-16 mm mixed with nutrient-enriched charcoal



2014

Perennials planted in
1. Charcoal stone chips =
crushed granite (2-5mm)
and nutrient-enriched
charcoal 50/50 volume



2014

4 months later



Om koncernen

Energi och produktion

Vattenkraft

Kärnkraft

Vindkraft

Värmeproduktion och kraftvärme

Värmeproduktion

Bristaverket

Hammarbyverket

Hässelbyverket

Högdalenverket



Högdalenverket

Högdalenverket, en av Europas modernaste anläggningar för avfallsförbränning, producerar el och fjärrvärme av avfall och andra biobränslen, såsom flis och behandlat industriavfall. Anläggningen har kapacitet att ta emot 700 000 ton avfall per år.



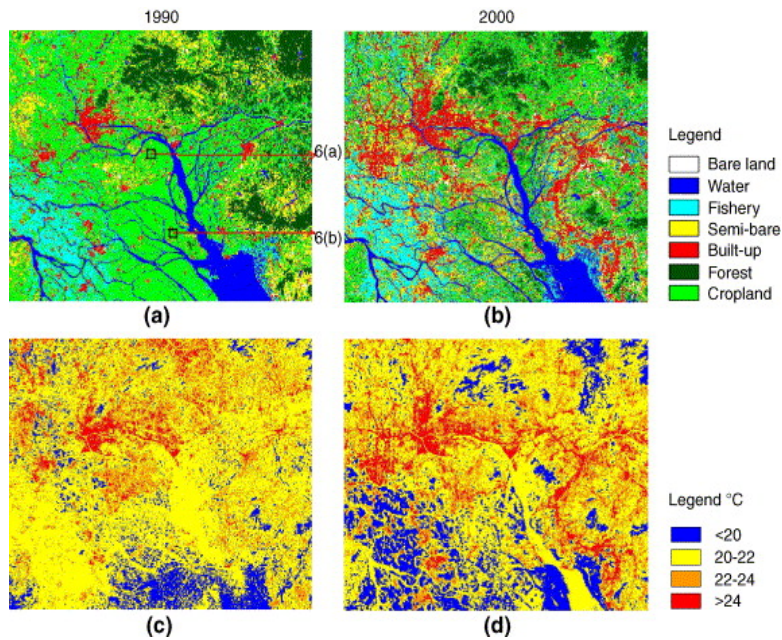
biochar unit
connected to
district
heating



Reduce the risk of flooding



Counteract heat island effect



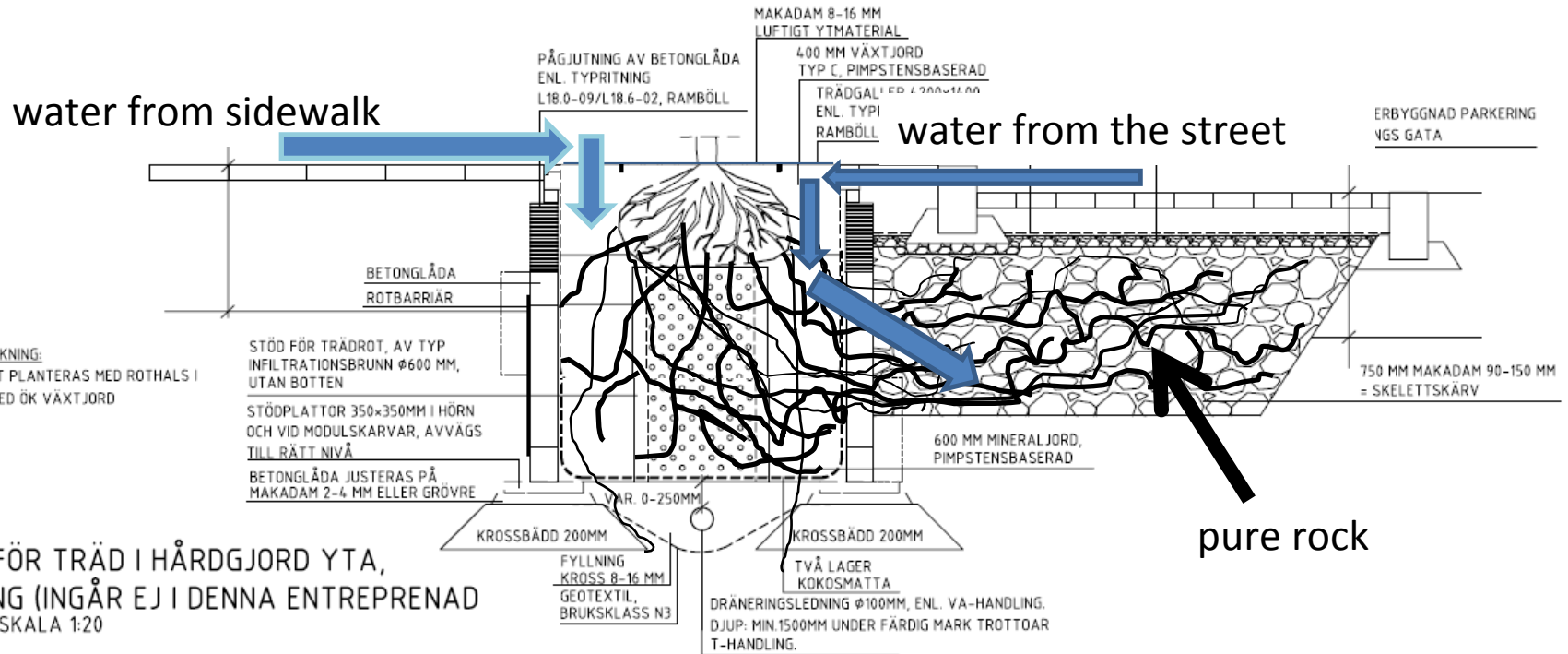
Reduce the presence of particles and carbon dioxide in the air



Reduce the load on storm water systems and thereby reduce pollution in Lake Mälaren and the Baltic Sea



Future



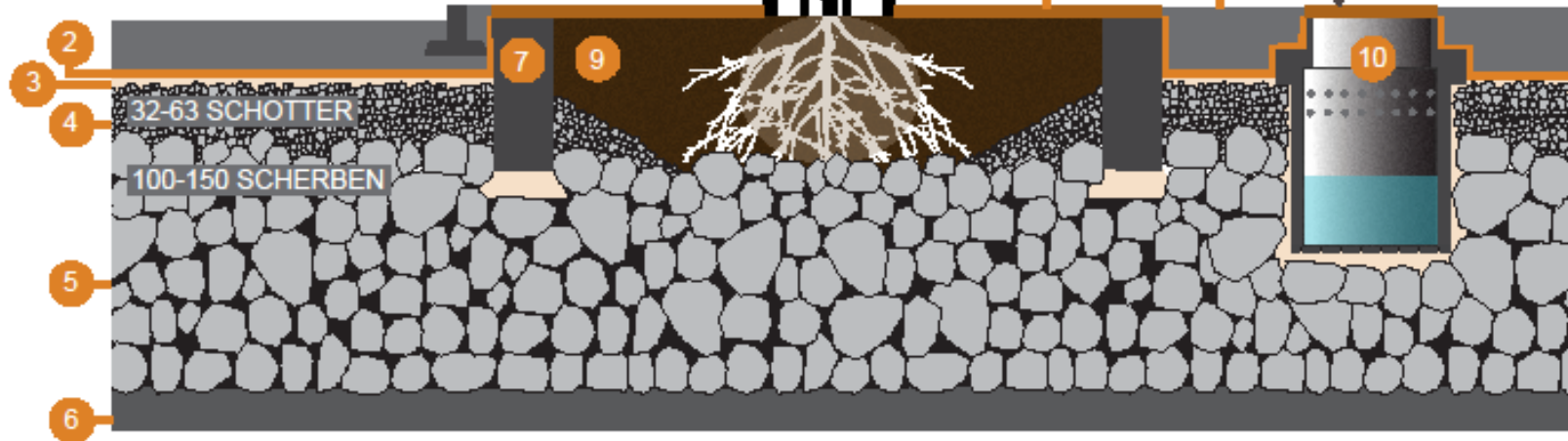
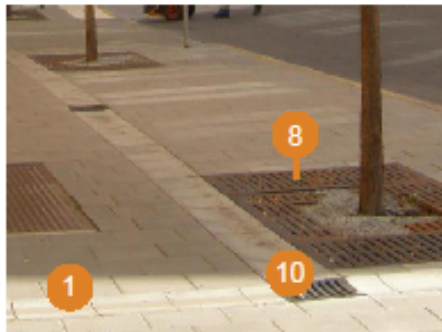


[WWW.google.se](http://www.google.se) <http://www.youtube.com/watch?v=UFXIsKOVmV8>

Our handbook is available at WWW.stockholm.se search for plant beds and select 'Plant Beds in Stockholm City'

Skeletterde

Eine stabile Bauweise, um mit Hilfe von Niederschlagswasser gute Pflanzbedingungen für Strassenbäume zu schaffen und gleichzeitig das Risiko von Wurzeleinwuchs in die Kanalisation zu vermindern.



1. Belag mit Rinne für Niederschlagswasser
2. Geotextil
3. Ausgleichschicht (8-16 Schotter) – auch unter dem Pflanzkasten und rund herum den Luftbrunnen
4. Versickerung und Lüftungsschicht (32-63 Schotter)
5. Skeletterde aus Granitstein (100-150 Scherben) mit untergespülter Erde in den Hohlräumen
6. Planum
7. Pflanzkasten aus Beton
8. Baumgitter
9. Pflanzerde
10. Brunnen für Versickerung von Niederschlagswasser und Gasaustausch



Thank you for your
attention, and if you
are passing,
Welcome to
Stockholm we would
be happy to show
our projects.