

# Urban planning and the subsurface in the City of Rotterdam: the slow road from awareness to standard practice.

*Ignace van Campenhout, Petra van der Lugt,  
Kees de Vette, Jeroen Vuijk, Nanna Pluim, John de Ruiter, Freyre*

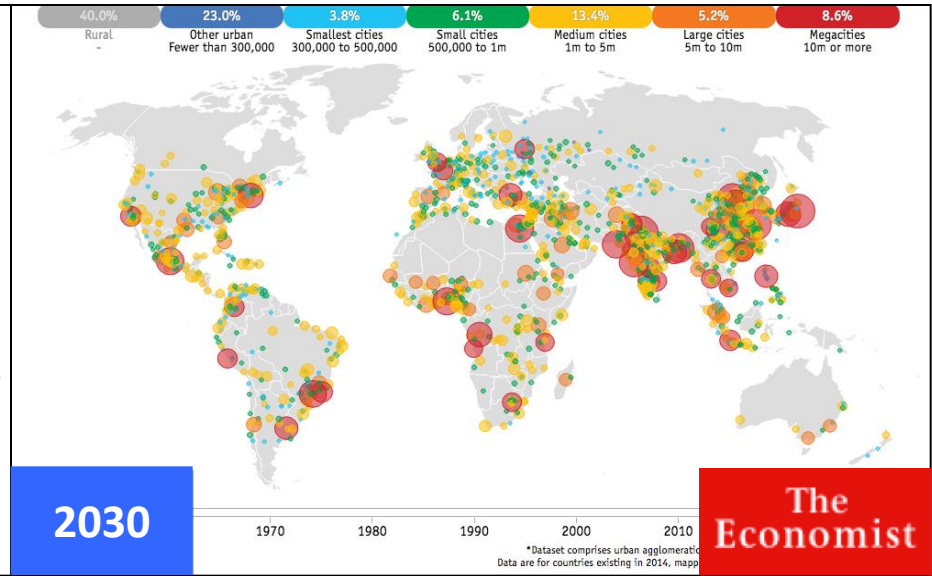
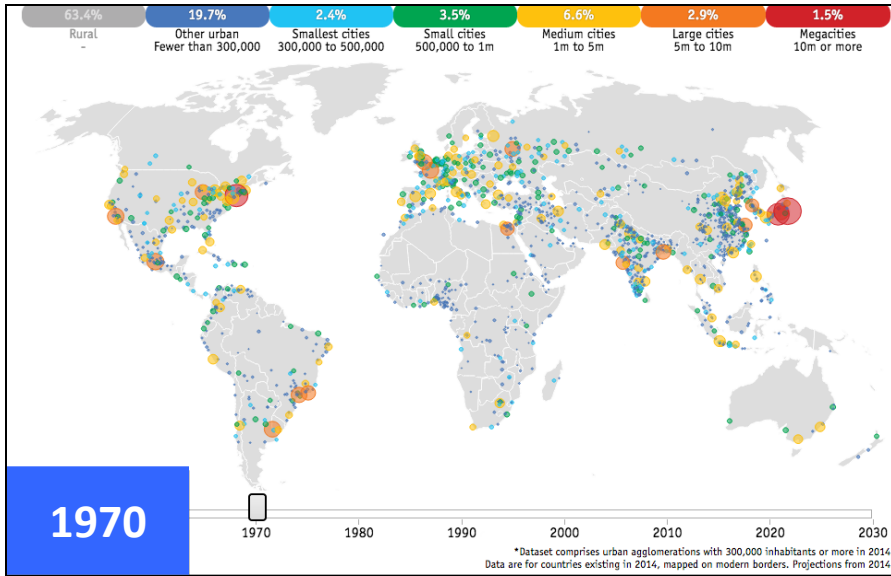


Engineering Consultants City of Rotterdam, May 2015



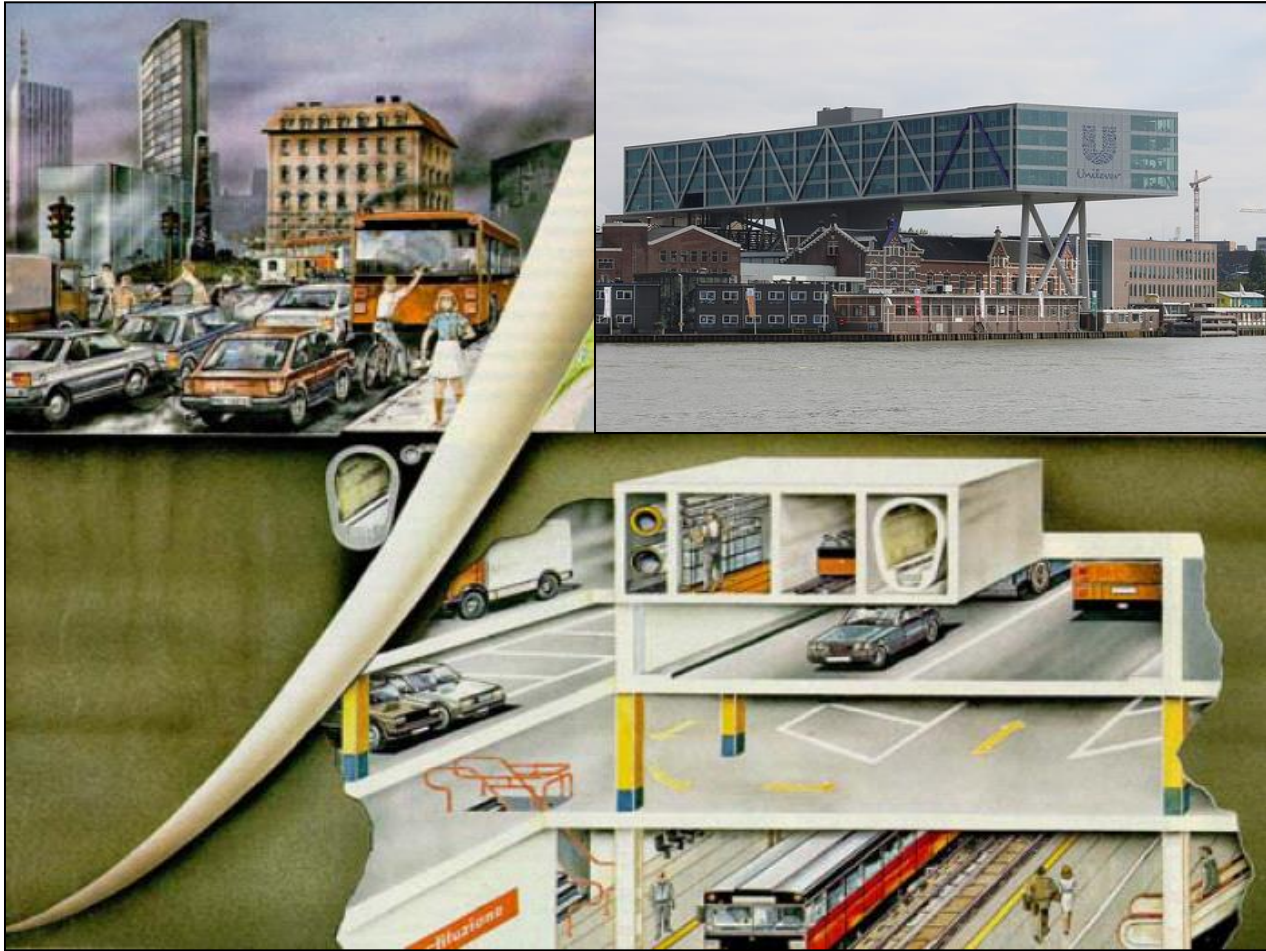
Gemeente Rotterdam





**The Economist**





Which challenges  
How we tackle them



Rotterdam



THE NETHERLANDS

GERMANY

BELGIUM

LUX.

CZECH REPUBLIC

FRANCE

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CROATIA

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TRIER

BERNKASTEL

PARIS

STRASBOURG

COLMAR

BEAUJOLAIS

TREVOUX

LYON

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TOURNON

VIVIERS

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LES BAUX

ARLES

MARSEILLES

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UTRECHT

ARNHEM

VENLO

DÜSSELDORF

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RÖDESHEIM

MAINZ

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WERTHEIM

KITZINGEN

MILTENBERG

HEIDELBERG

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BASSEL

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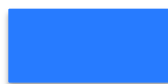
LES BAUX

ARLES

MARSEILLES



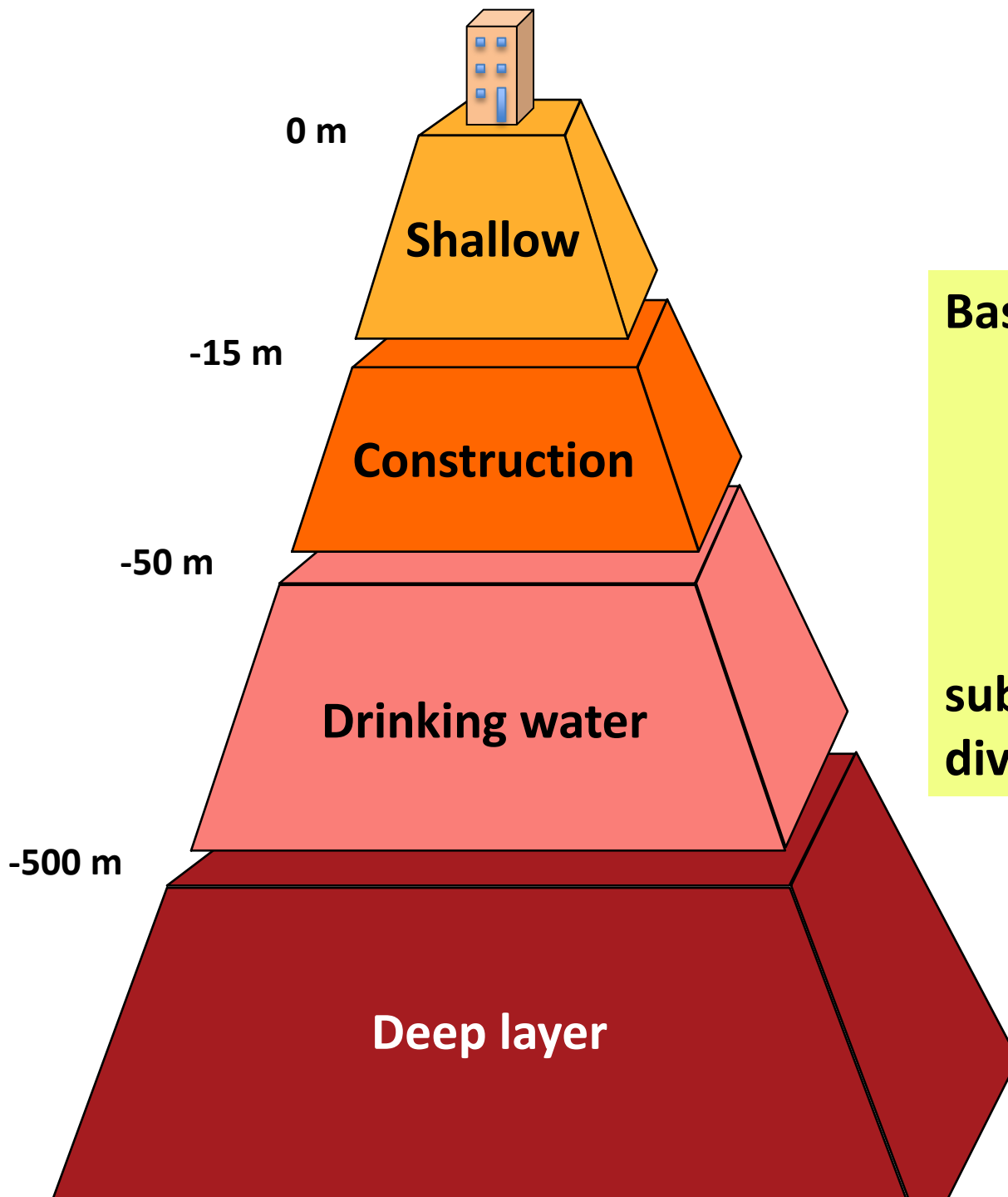
Bron: Actueel Hoogtebestand Nederland (AHN)



Below sea level



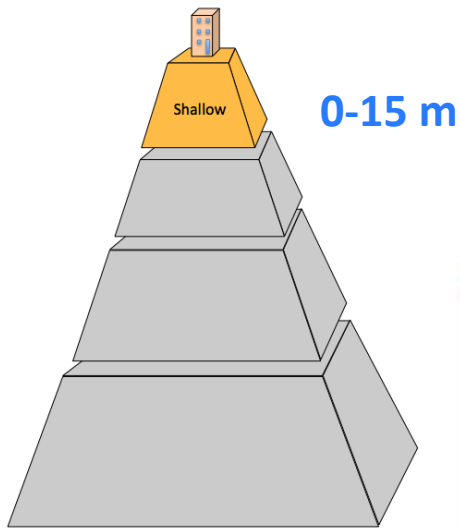
**Water boards** ( since 13th century)  
Responsible for ground waterlevel



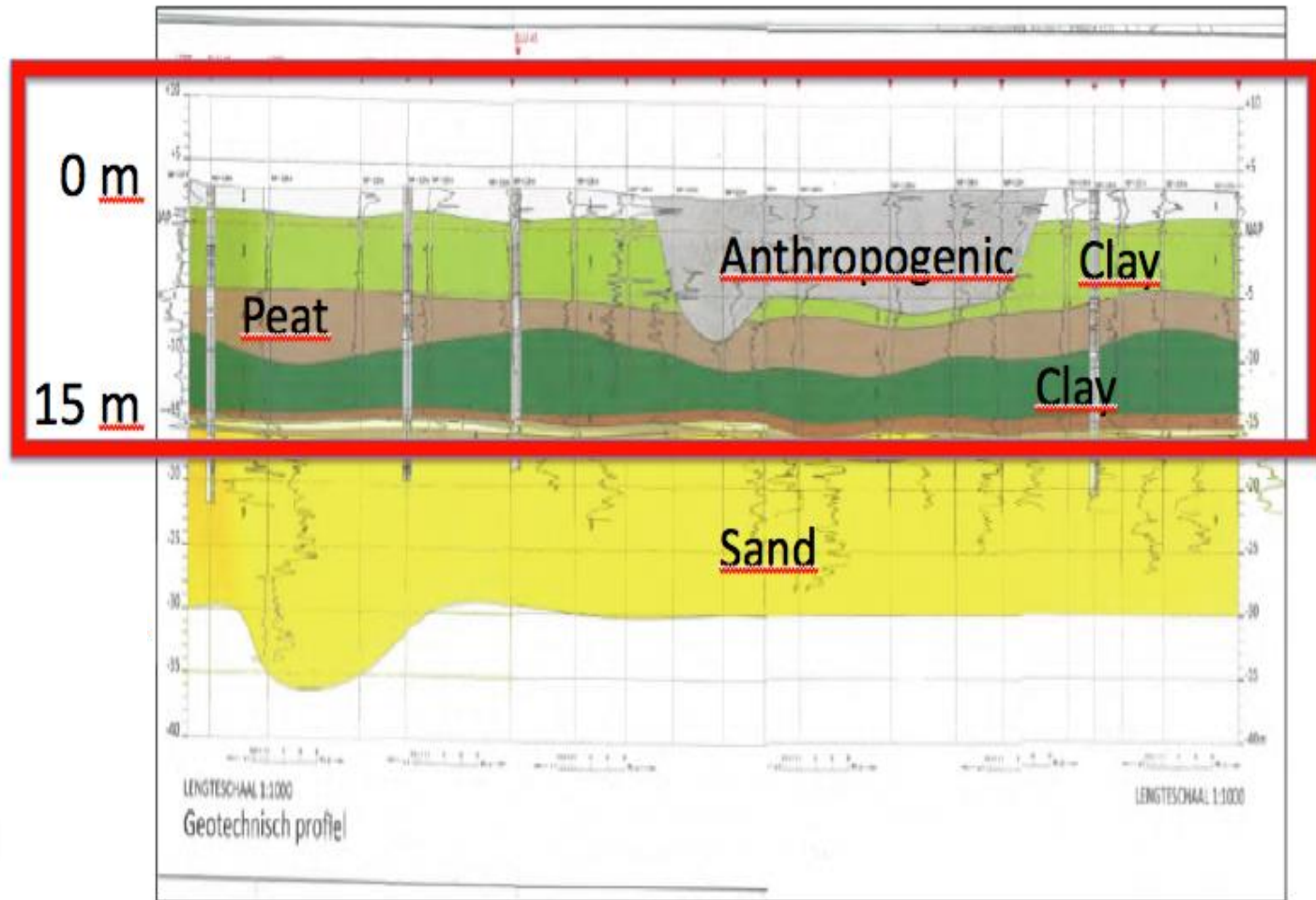
**Based on**

**Geology,  
Usage,  
Legislation**

**subsurface of Rotterdam  
divided in 4 layers**

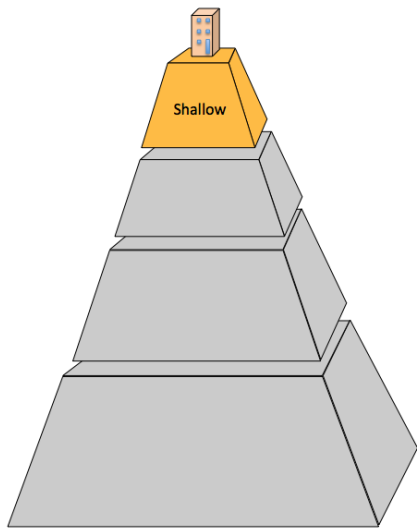


# Shallow layer



*+ water*





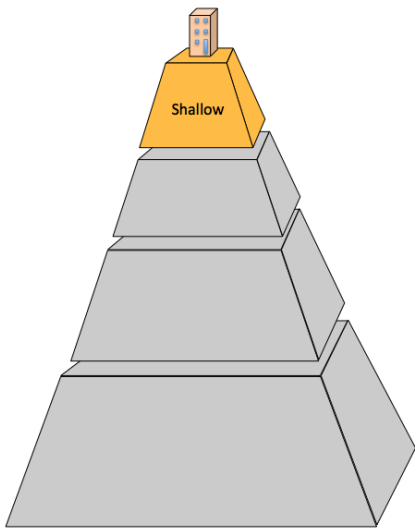
## Settlement of Peat and Clay: safety, economical, health

- Pile rot
- Dammage of roads
- Broken cables and pipes

(Contamination of groundwater)

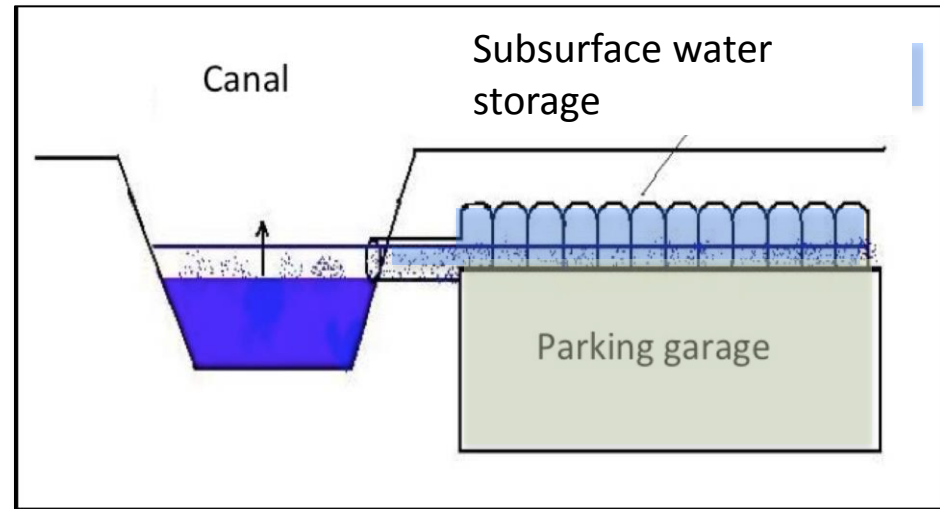




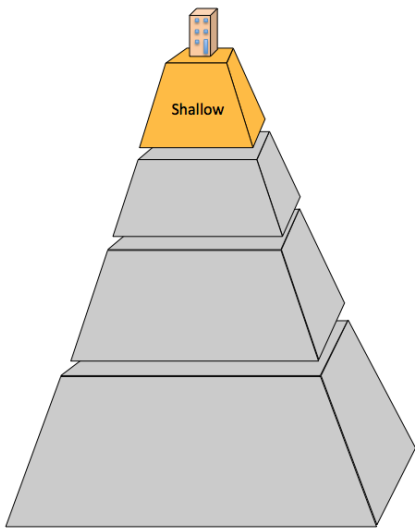


## Heavy rainfall: safety, economical,

- Sewers cannot handle the flow
- Dammage of roads, water in basements



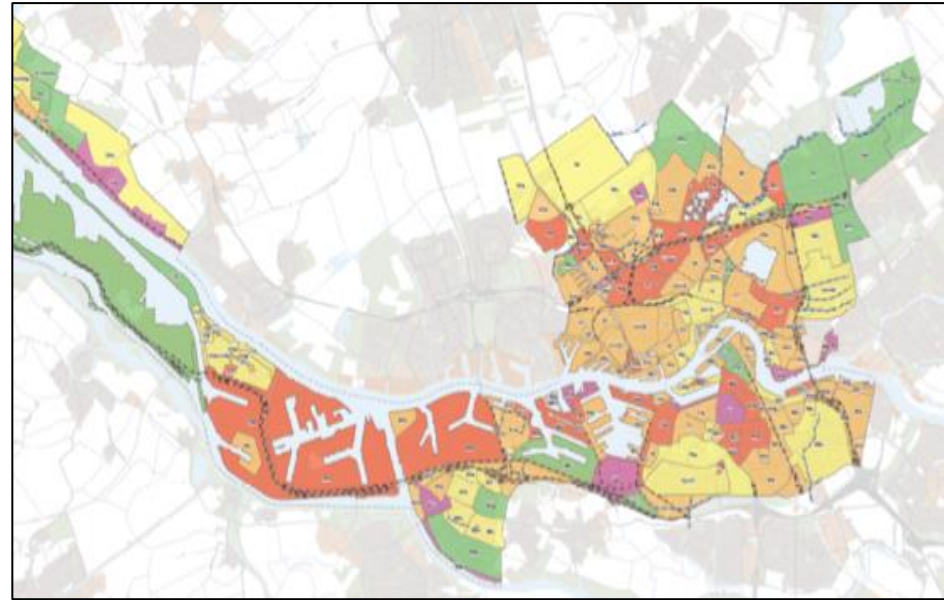
*Smart combination with parking facilities*



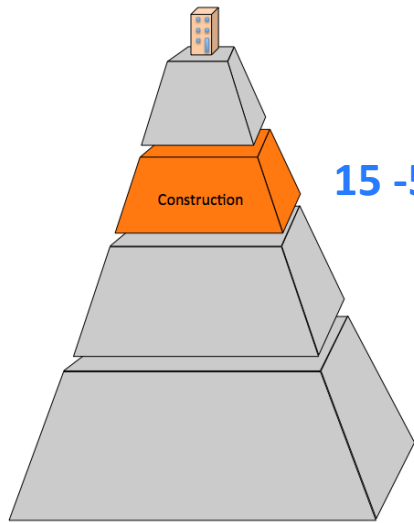
## Objects

### Safety, economical, health

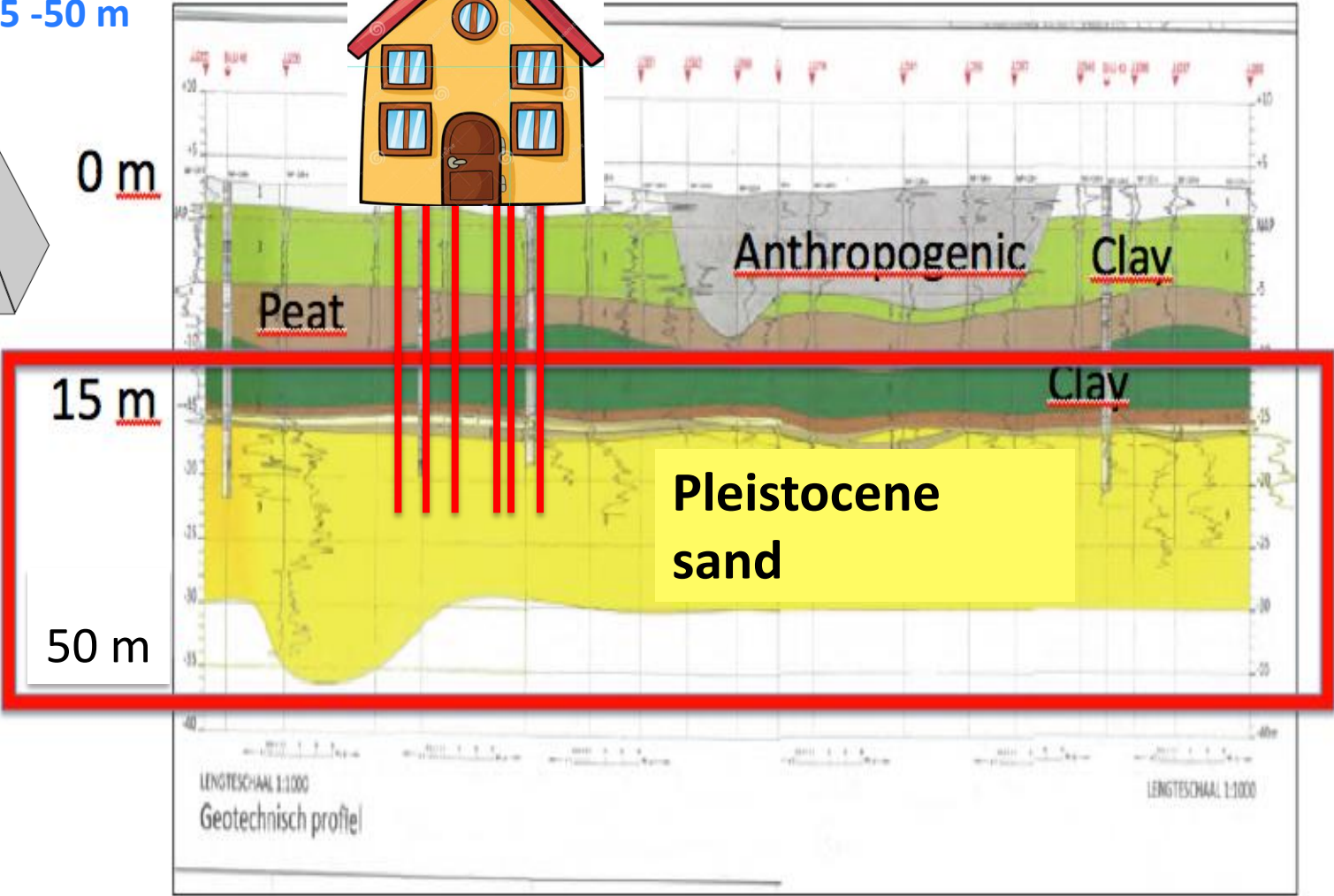
- Archaeological remnants
- Unexploded devices
- Contamination ( soil + ground water)



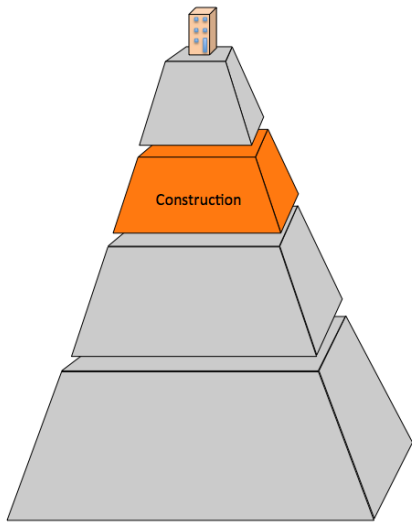
Soil Quality Map -1 to -2 meters



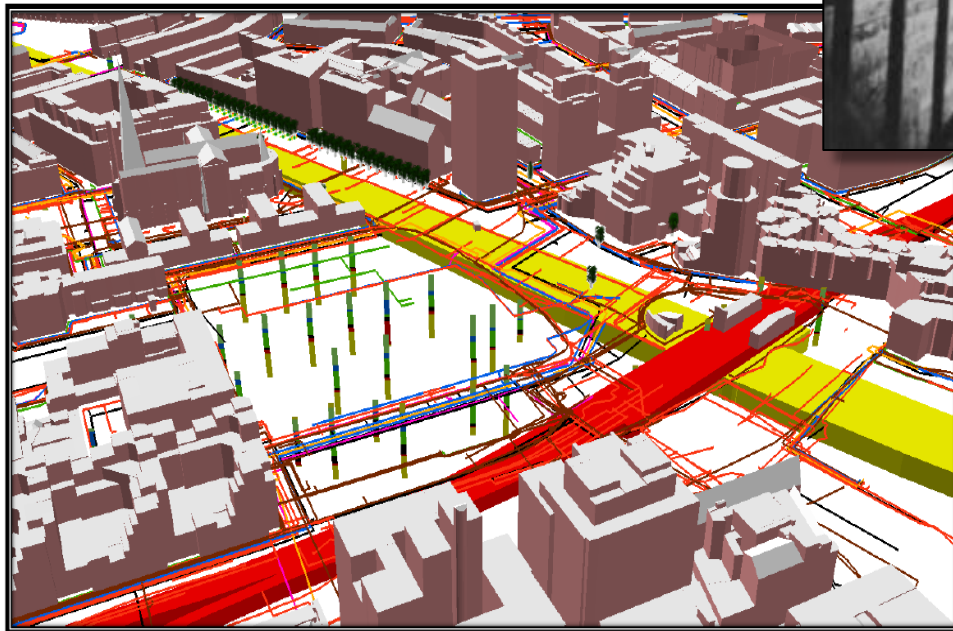
# Construction layer



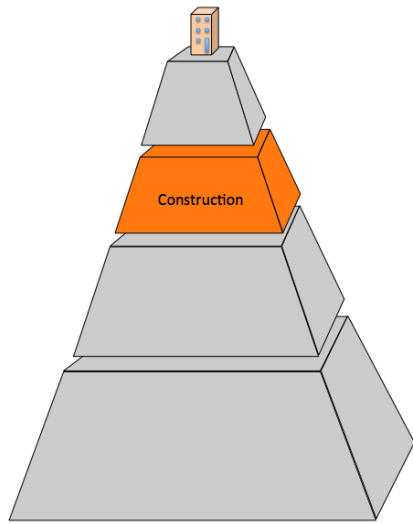
# Construction



**Example of wooden pile (1879)**



**Pleistocene sand layer solid bed for tunnels, shopping malls, parking**

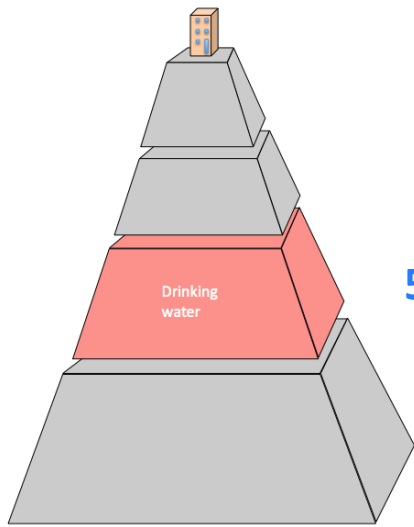


- **Potential not unlimited; overlapping space claims**
- **Constructions can obstruct the ground water flow**

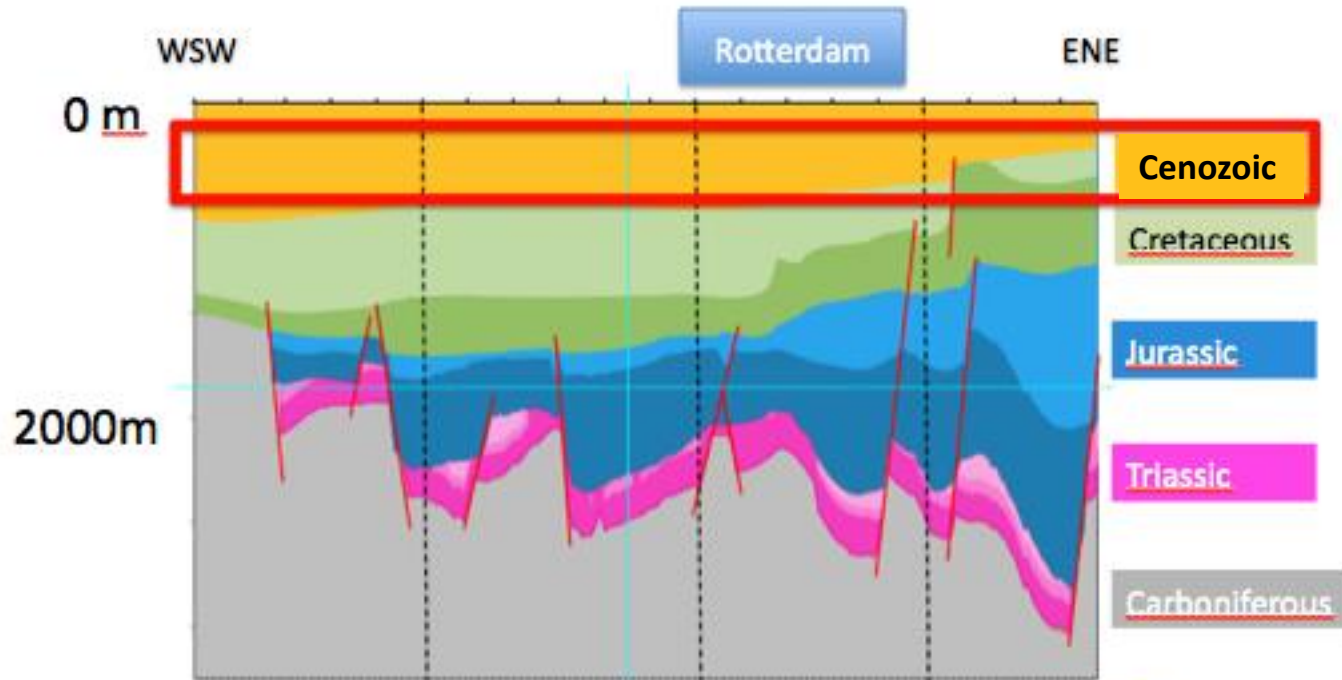


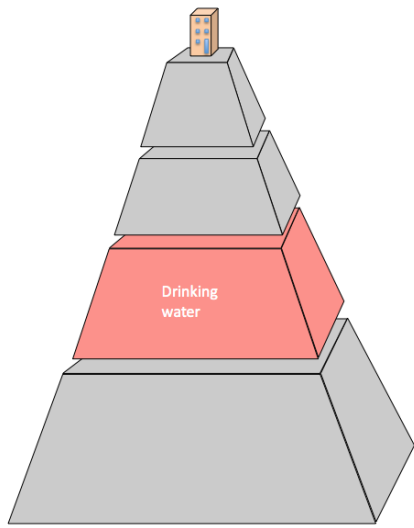
**Added weight in form of concrete blocks on the floor to prevent further damage**

# Drinking water zone



50 - 500 m

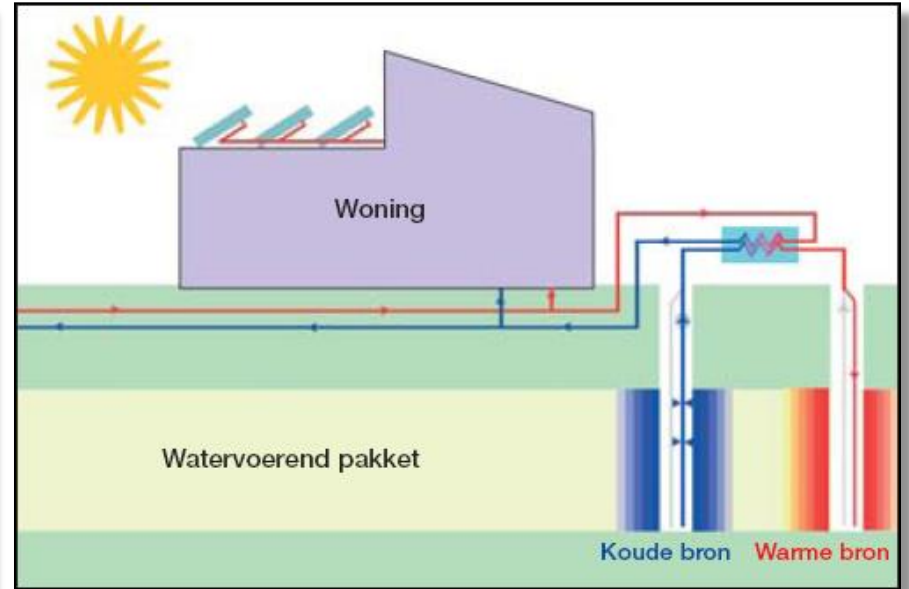




# Drinking water

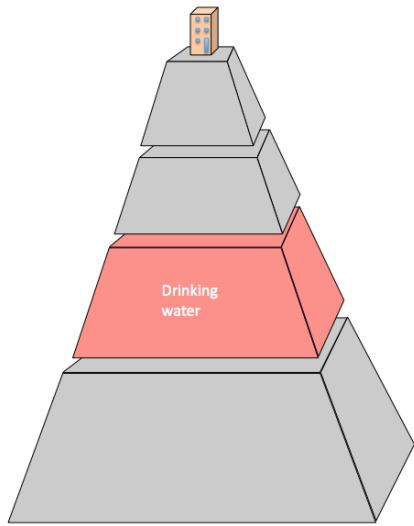
Environmental, Health

## Shallow Geothermal Units (aquifer storage)



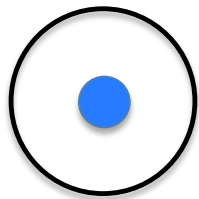
*Smart Combinations between SGU and remediation of shallow layer*

# Shallow Geothermal Units

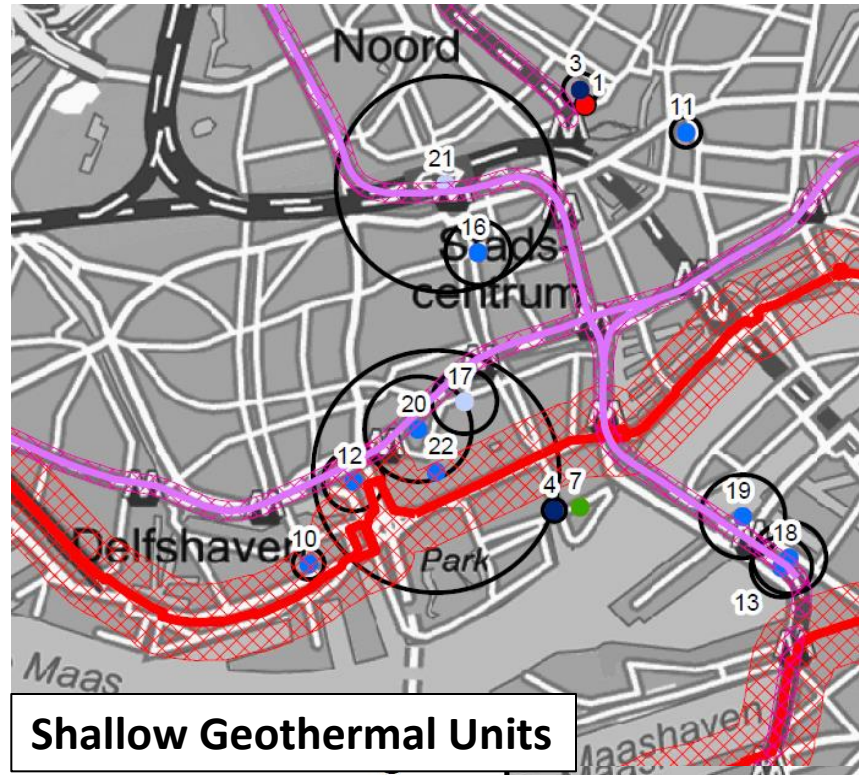


**Overlapping space claims between SGU's**

**And between SGU's and tunnels, embankments**

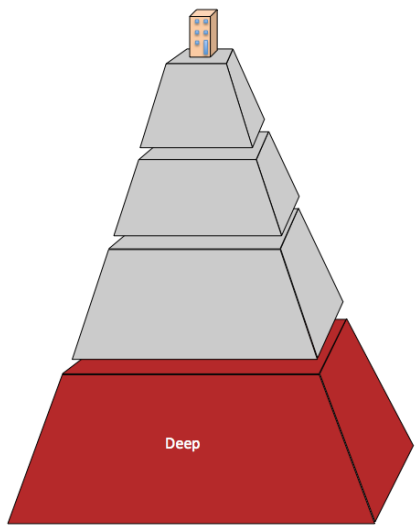


*SGU and influence sphere*

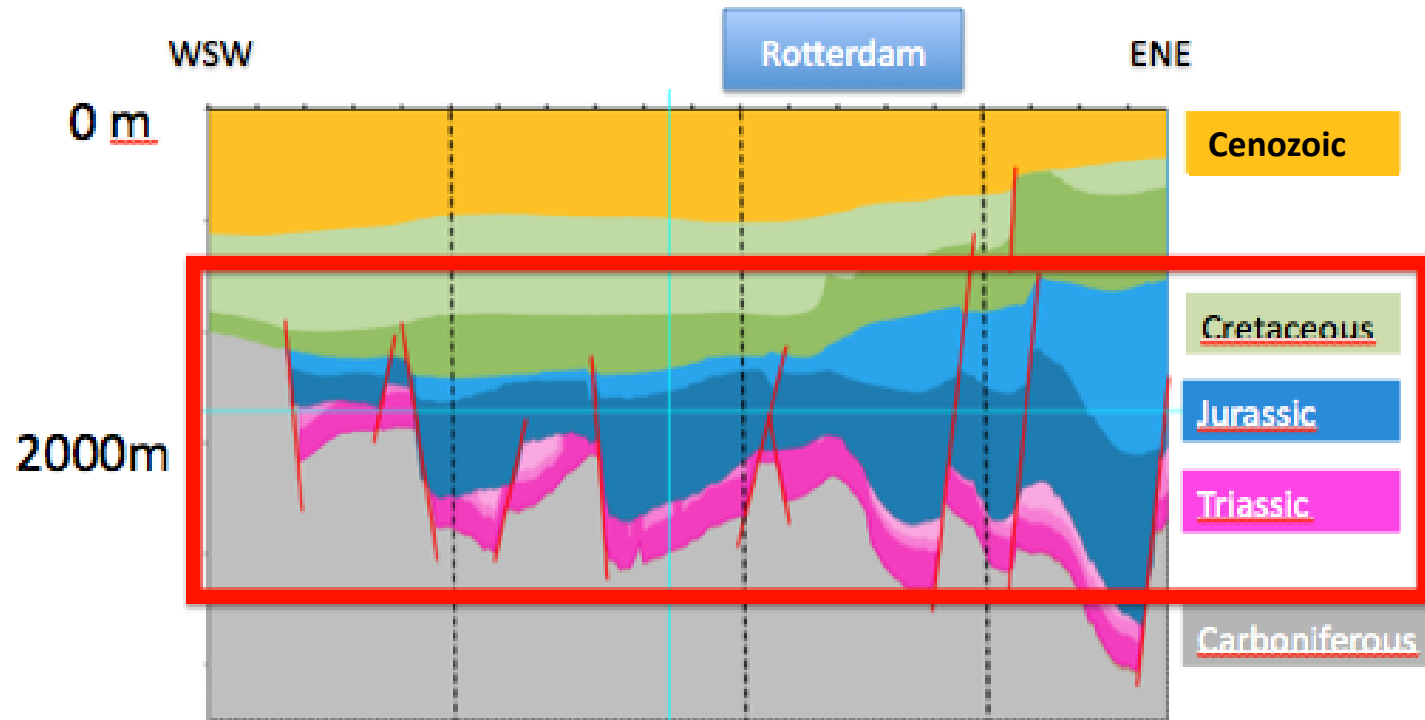


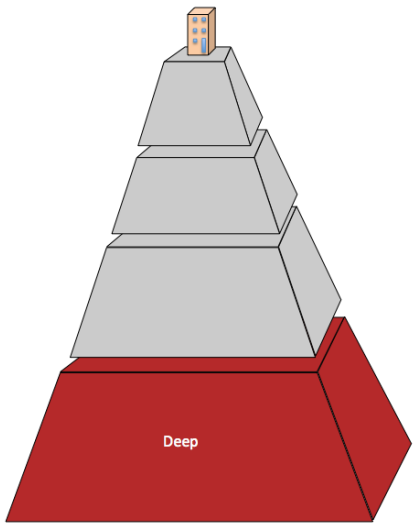


# Deep Subsurface

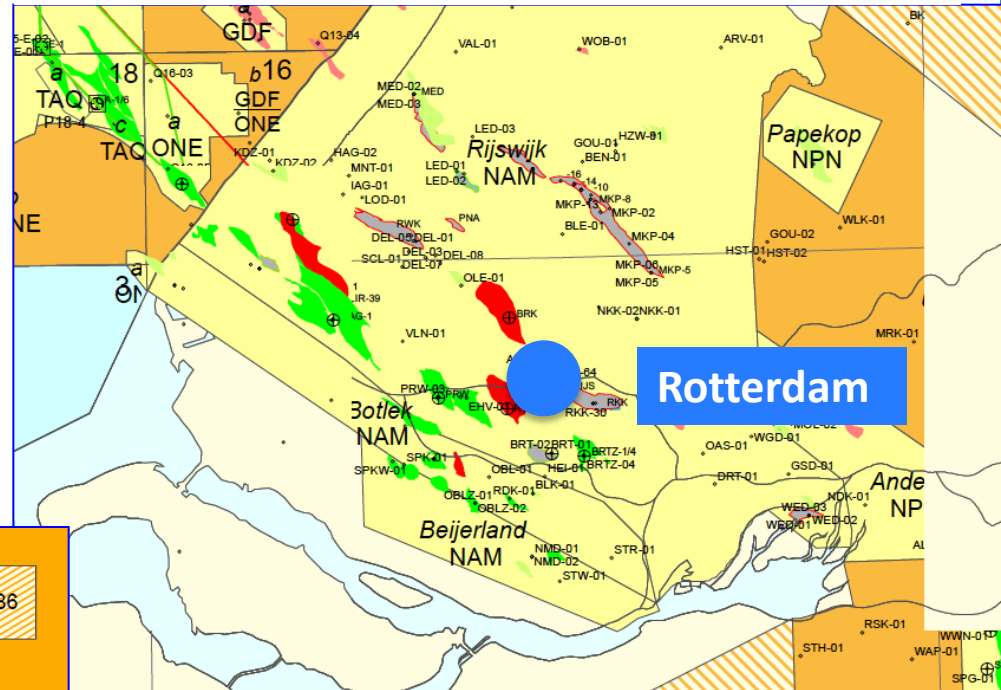


500 - < m





# Oil and Gas fields



Rotterdam

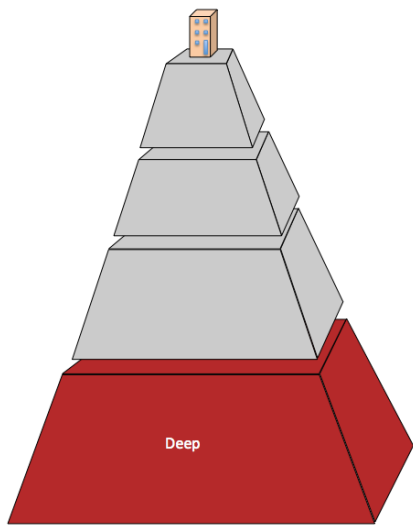
# Geothermal exploration permits



Rotterdam

*also:*

*Potential for  
CO2 storage,  
Shale gas*



- Health: drilling through water layer
- Need for space at ground level
- Safety, Political





**Rotterdam**

www.ad.nl



Dagelijks  
filmpjes uit  
Rotterdam



Rotterdam

vrijdag 18 april 2008

Autotrack

Banen

Kleintjesmarkt

Winkelplein

## Onrust CO2-opslag Barendrecht groeit

Door MARLIES VAN LEEUWEN

**NIEUWS**

Voorpagina

Binnenland

Sportwereld

Buitenland

Economie

Multimedia

Showbiz

Cultuur en media

Bizar

ADtv

**DICHTBIJ**

Rotterdam

Den Haag

Utrecht

**BARENDRECHT - Barendrecht**ers en inwoners van de Rhoonse nieuwbouwwijk **Portland** blijven zich verzetten tegen de komst van een koolstofdioxideopslag in de 'kelder' van de gemeente. Sommige bewoners bereiden acties voor om te voorkomen dat de opslag in de lege gasvelden onder het dichtbevolkte gebied doorgaat.

De bewoners zijn er niet gerust op dat de proef zo veilig is als initiatiefnemers Shell en de Nederlandse Aardolie Maatschappij (NAM) beweren. „CO2 is in hoge concentraties een gevaarlijk gas. Ze weten niet zeker wat er gebeurt, mocht het misgaan,“ zegt Barendrechter Alistair Woodburn.

„Uit onderzoeken blijkt dat als het gas ontsnapt, alles en iedereen in een straal van 16 tot 23 kilometer doodgaat. Dat zijn tienduizenden, zo niet honderdduizenden mensen. Hoezo veilig?“, vraagt Woodburn zich af. Een buurtbewoonster vult aan: „Die pijpleiding komt heel ondiep in de grond te liggen. Als een of andere idioot er een boor in zet, zijn de gevolgen niet te overzien.“

# Subsurface of Rotterdam:

**Potential for use, but:**

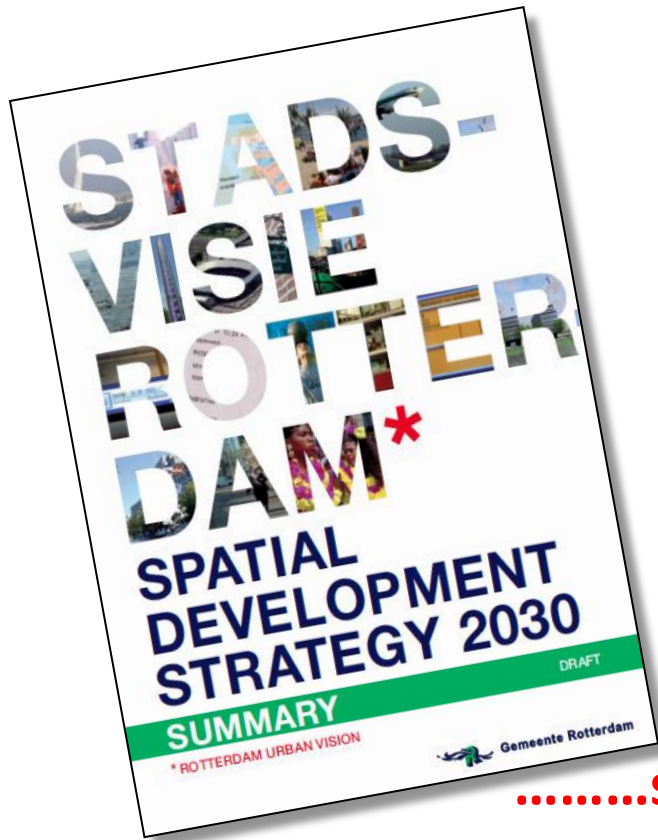
**complex (Safety, Health, Economics, Environment, Politics)**  
and its potential is **not unlimited**.

**Technical expertise** on individual subjects needed and available.

But to avoid delays, costs and to make full use of opportunities the subsurface offers it is necessary to:

- 1. Adapt a holistic view on the subsurface.** develop knowledge of the subsurface as a system.
- 2. Bring in the subsurface as early as possible** into the urban planning process.

Published in 2007

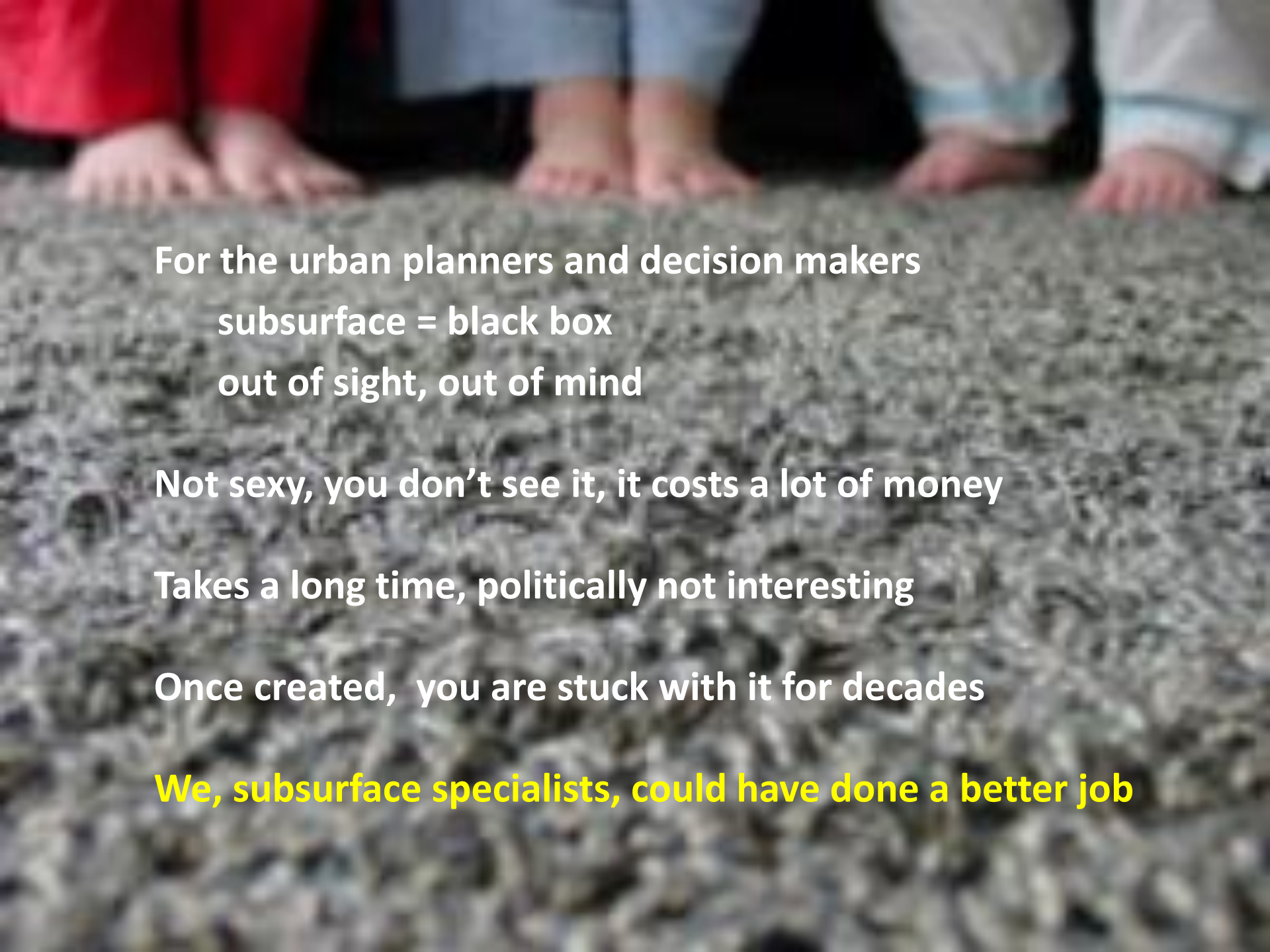


.....subsurface  
not mentioned  
once.

2015

Subsurface in Urban Planning  
process.....

.....not yet standard  
practice.



For the urban planners and decision makers  
subsurface = black box  
out of sight, out of mind

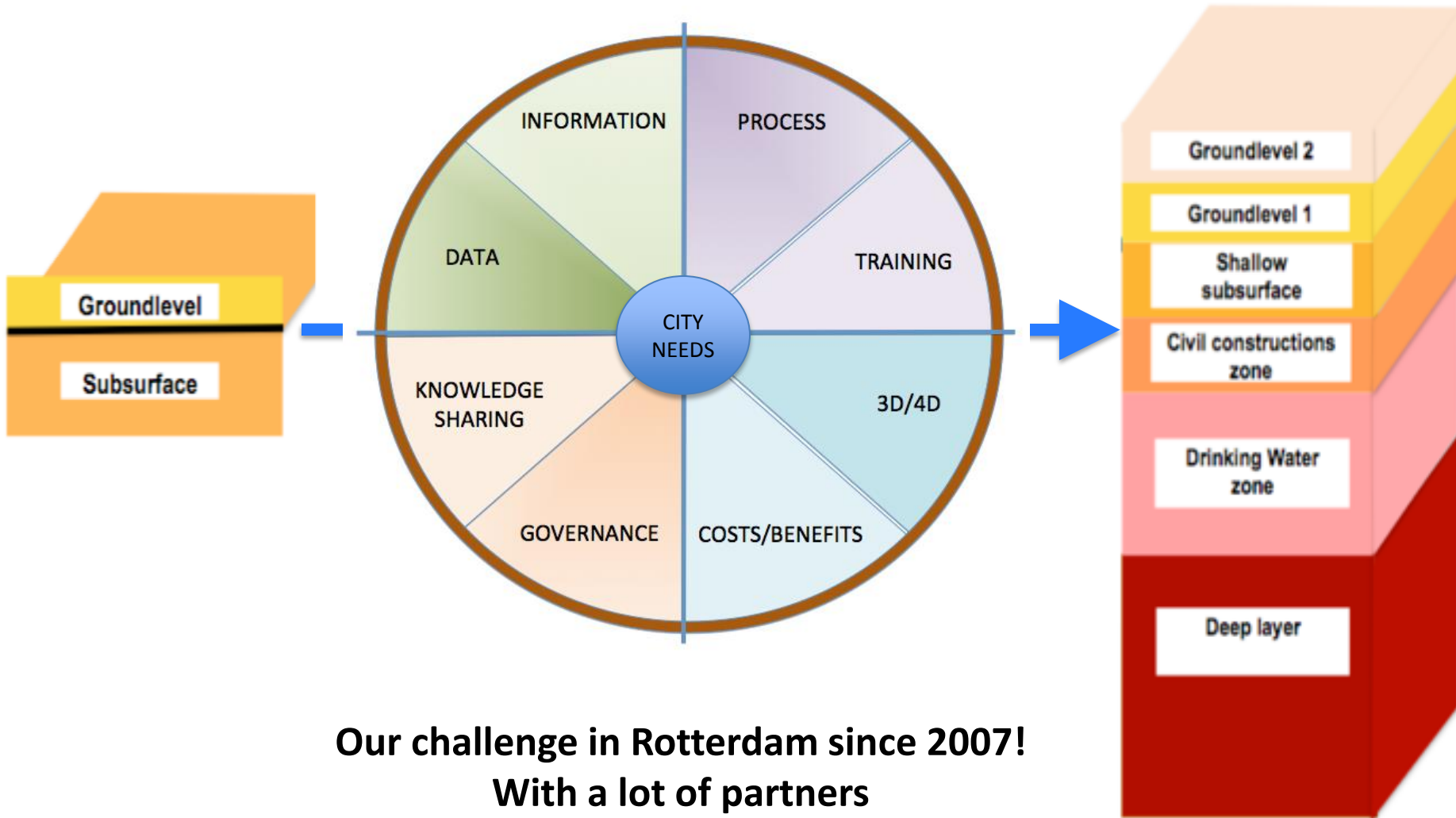
Not sexy, you don't see it, it costs a lot of money

Takes a long time, politically not interesting

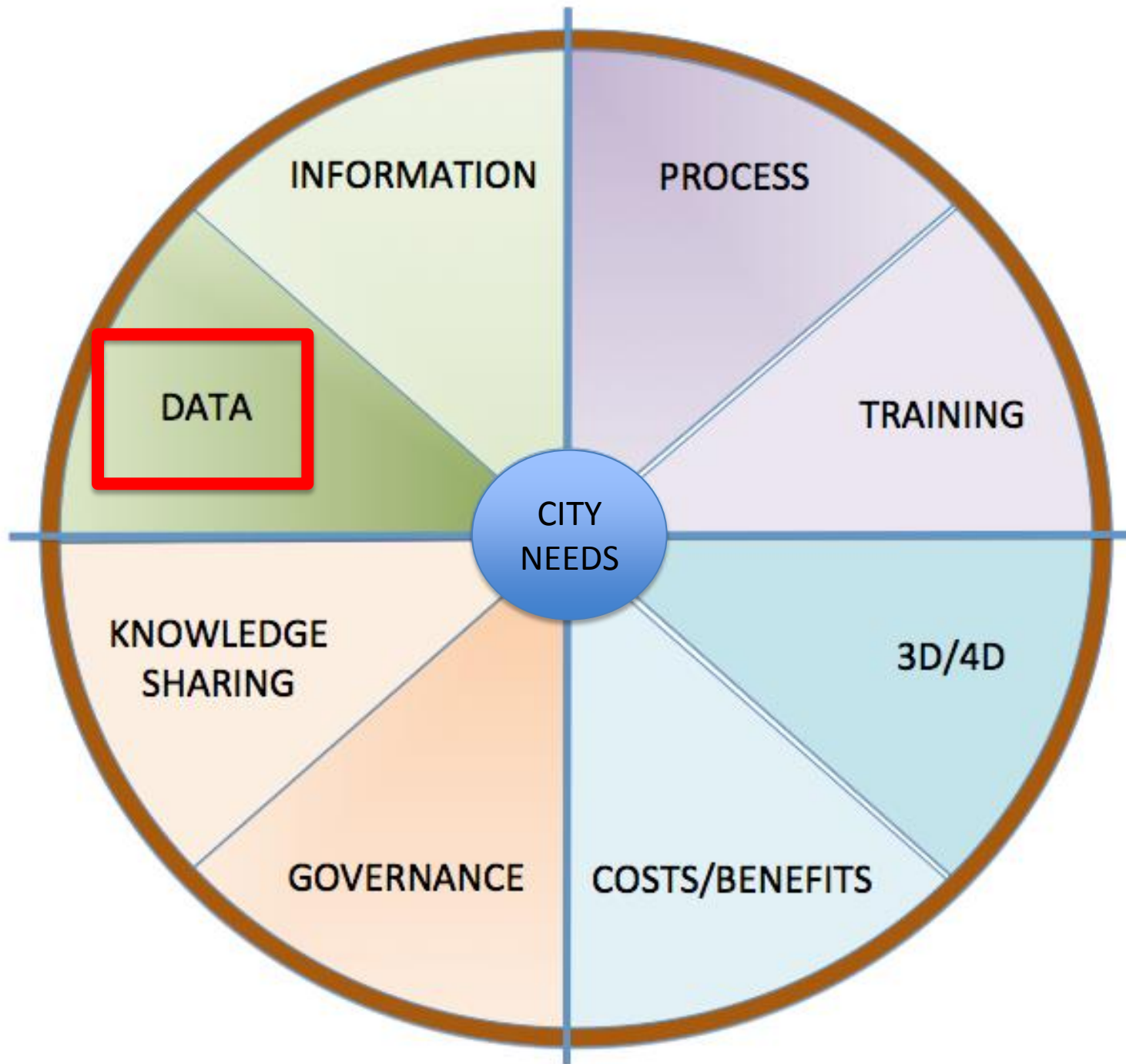
Once created, you are stuck with it for decades

**We, subsurface specialists, could have done a better job**

# From plan to volume

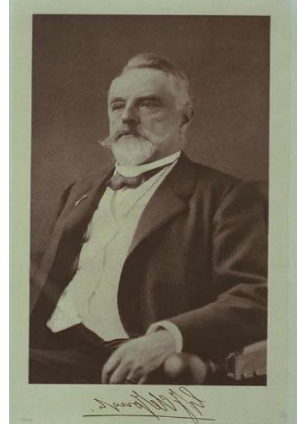


**Our challenge in Rotterdam since 2007!  
With a lot of partners  
Involves many activity fields**





# Data management



## Data

**reliable,  
up to date,  
accessible**

**In Rotterdam:**

**In accordance with directives:**

- **Inspire** European Initiative
- **BRO** National Initiative

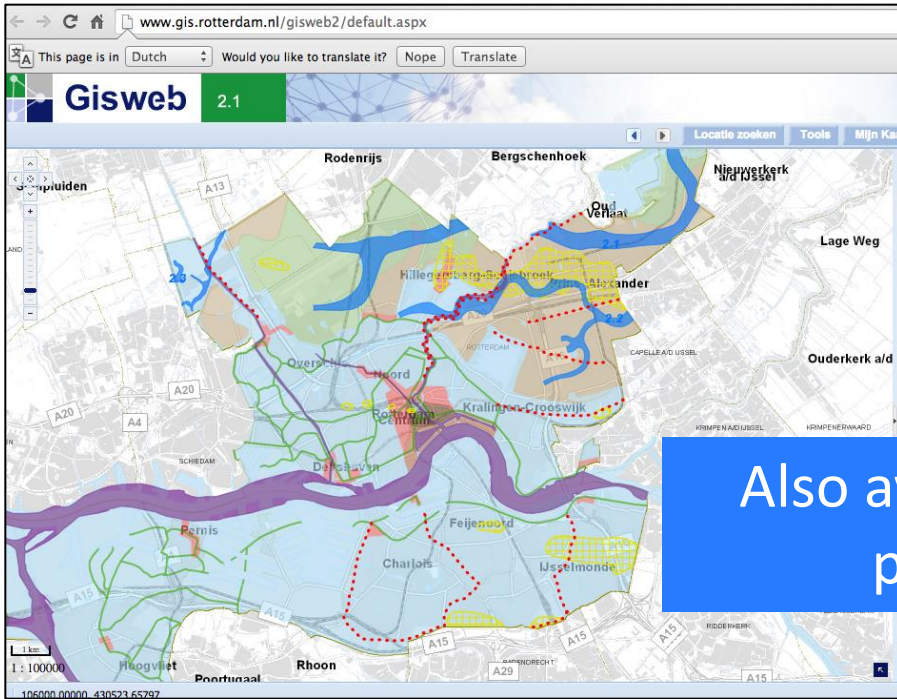
**“Single storage, multiple usage”**

## Organization

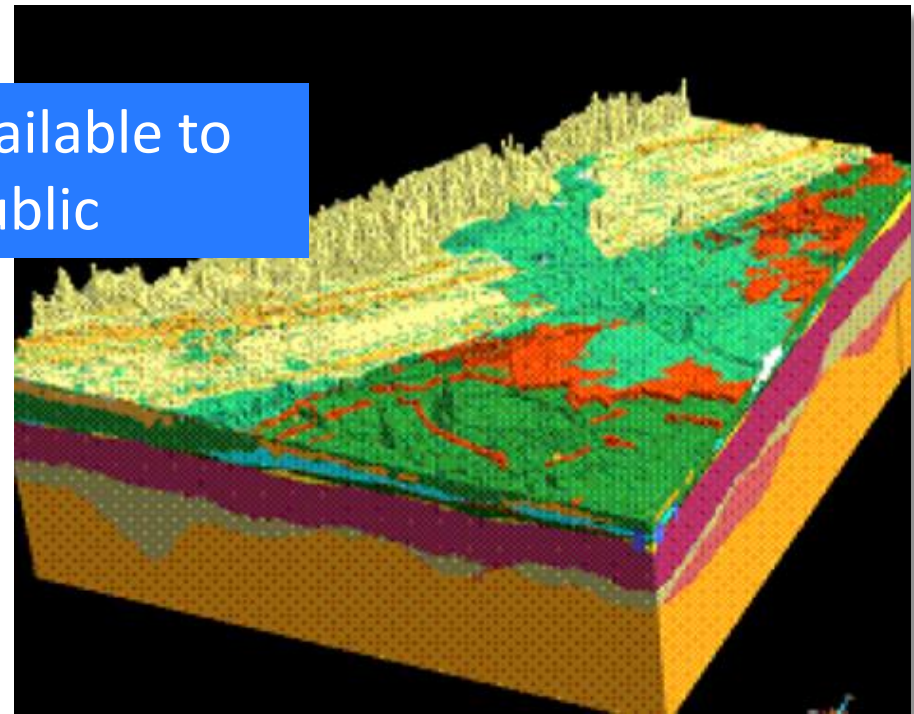
**Currently working on Data Organization with defined roles:**

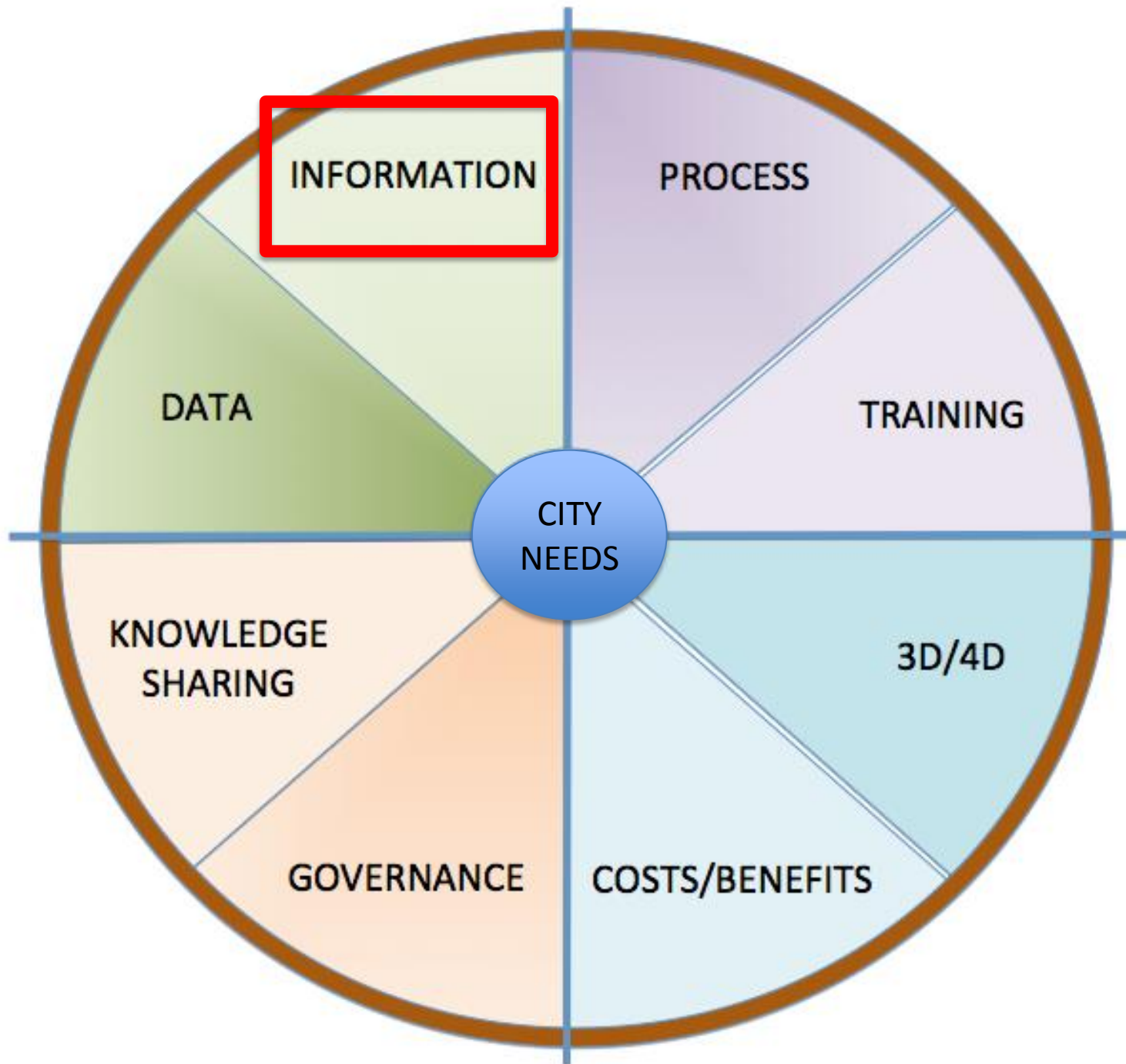
- **Resource holder,**
- **Resource administrator,**
- **GIS specialist**

# Data available for viewing and analysis with GIS



Also available to public







# Underground-scan

Maps showing costs, risks opportunities, tailored to their demand



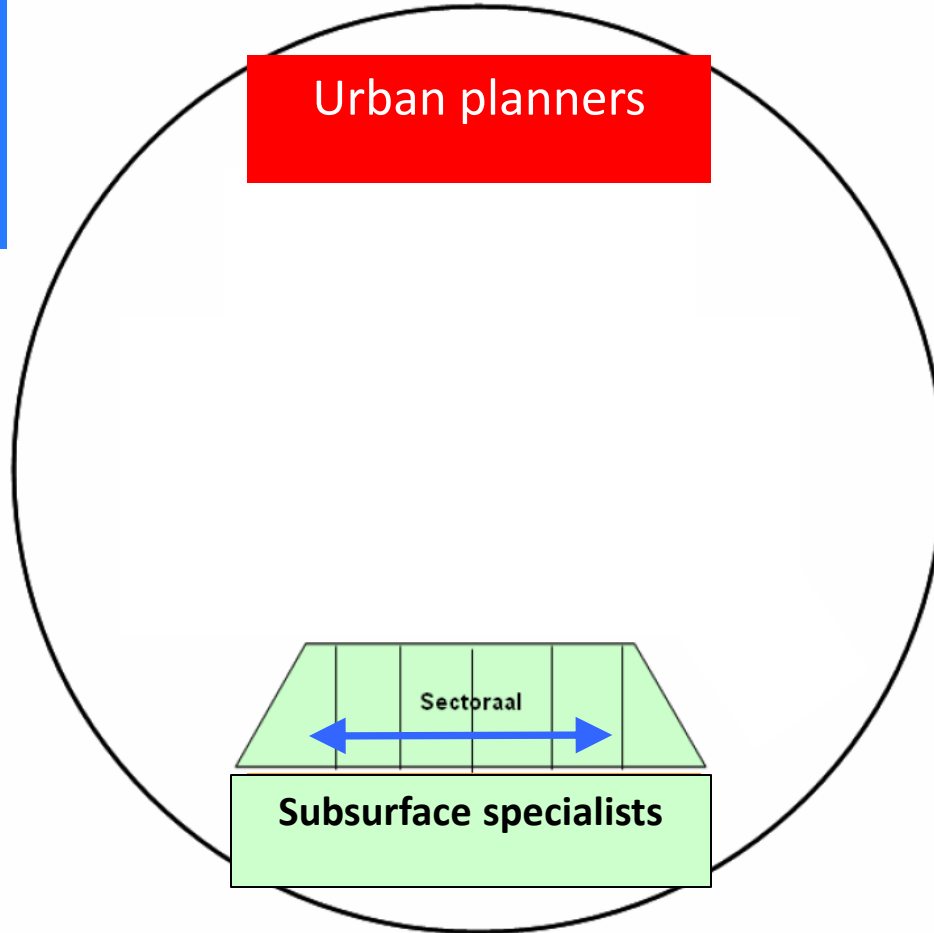
Information not tuned to needs of user,

Urban planners

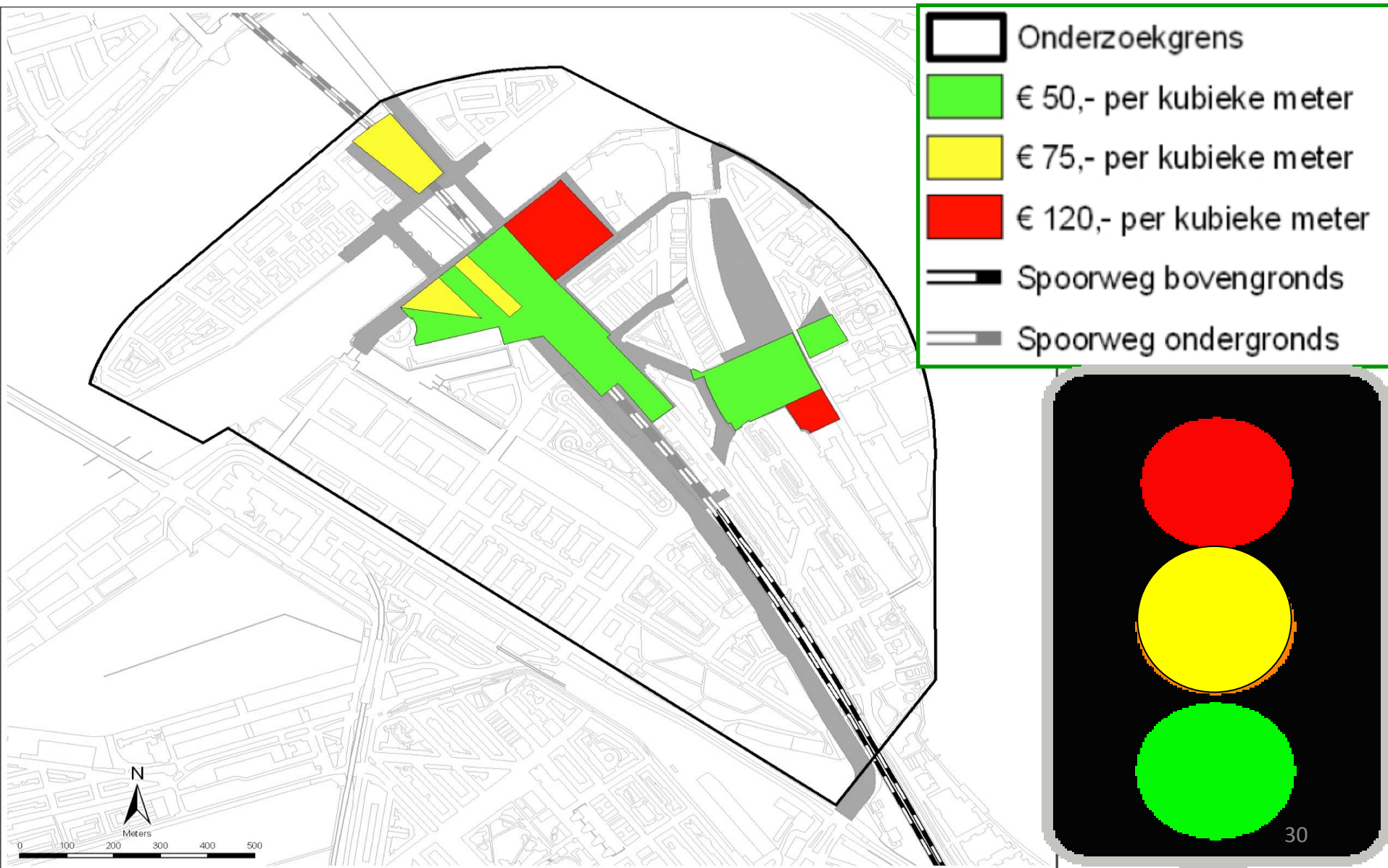
Information aggregated into quality maps, opportunity maps, economic maps

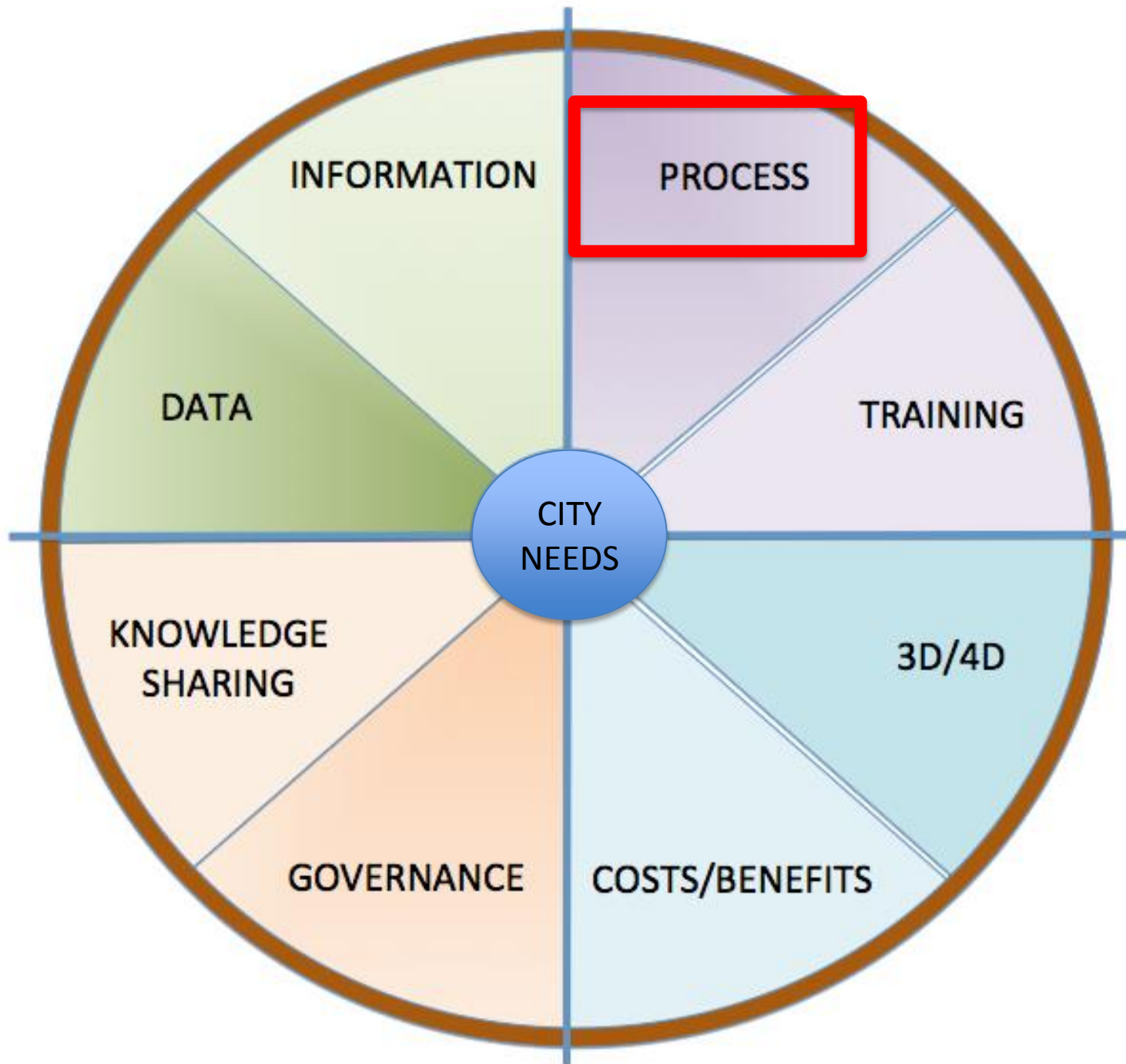
Sectoraal

Subsurface specialists



# Traffic Light legends, showing costs risks, opportunities





**Too late  
to avoid risks  
to exploit the  
opportunities**

**Old approach**

## **Spatial development cycle**



**Very late  
in the  
planning process**



In time to  
exploit  
the  
opportunities

Underground-scan

## Spatial development cycle

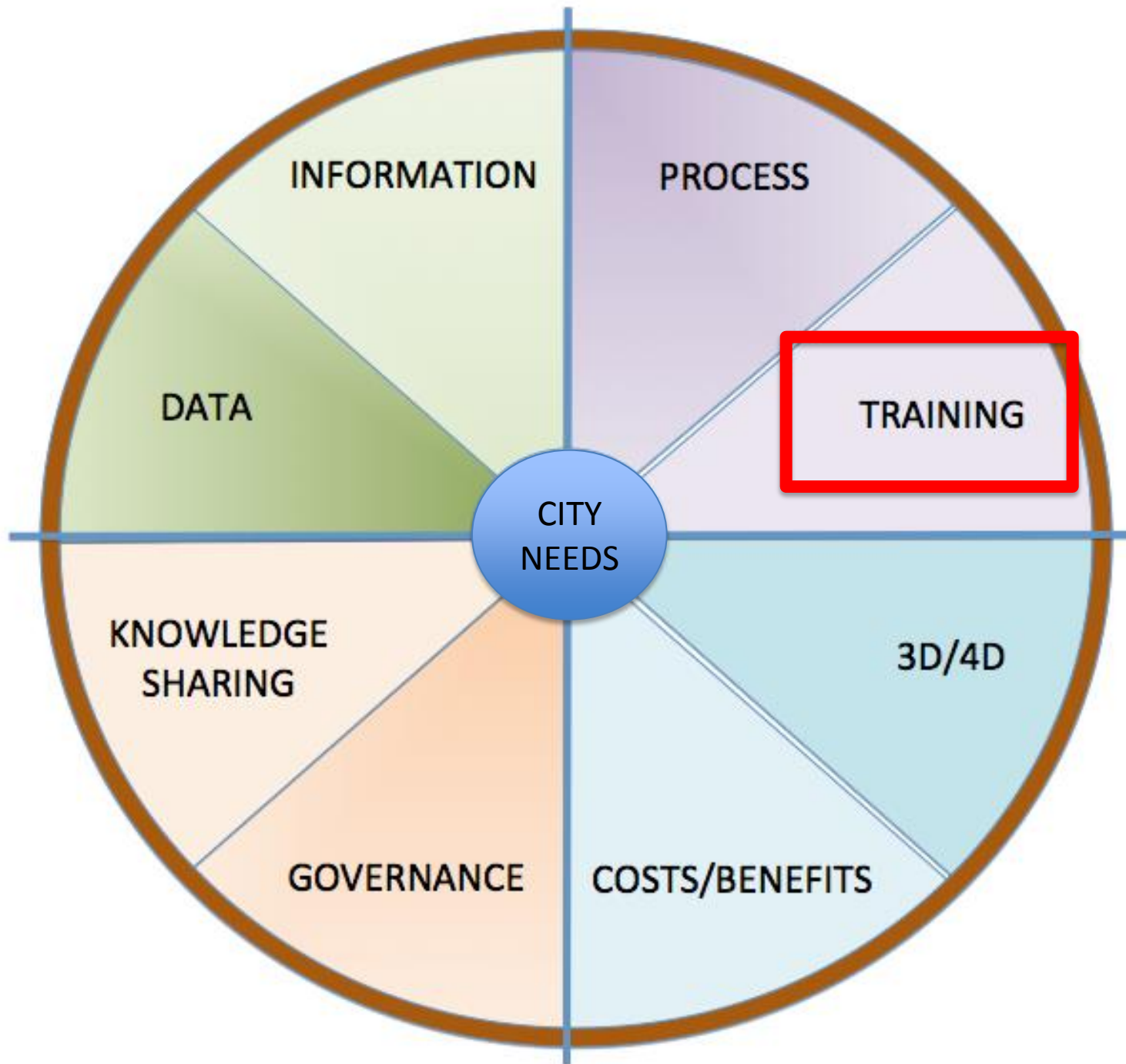


Earlier in  
the process

**“Maps on the wall” sessions  
with  
subsurface specialists and urban planners**



**Lively discussions between  
subsurface specialists and urban planners  
Developing a mutual understanding  
of each other's needs**



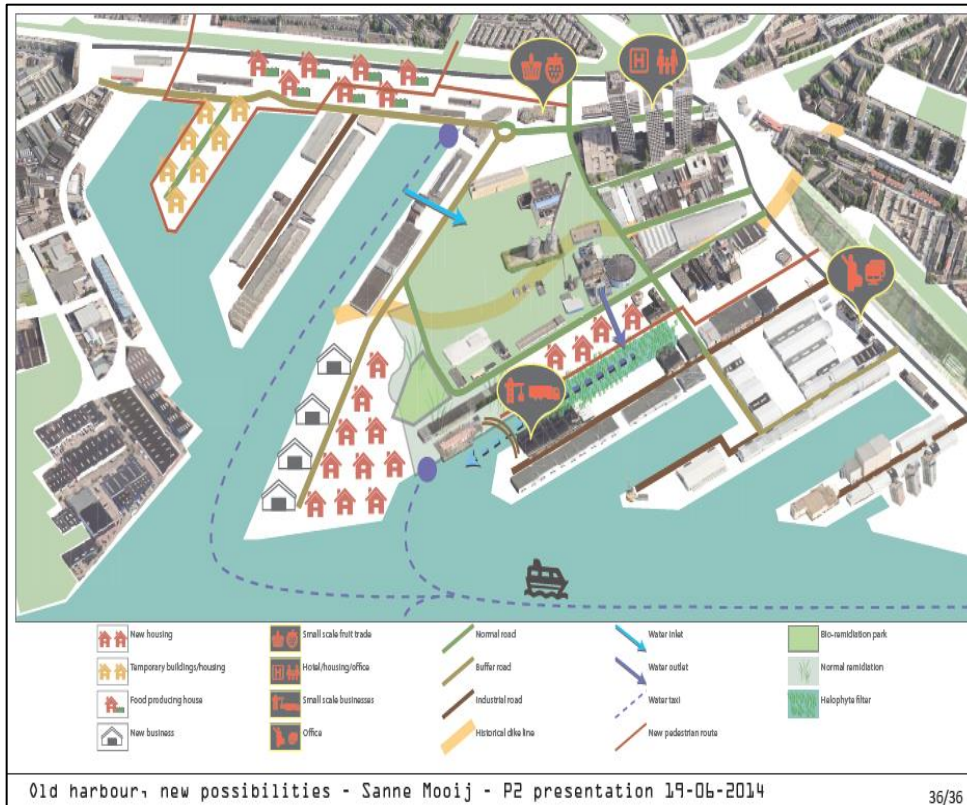


**Workshops for students of  
Urban Planning Faculty  
TU Delft**

*.....once a year, a week, working on our  
subsurface data, lectures from subsurface  
specialists.....from 30.....100 students*

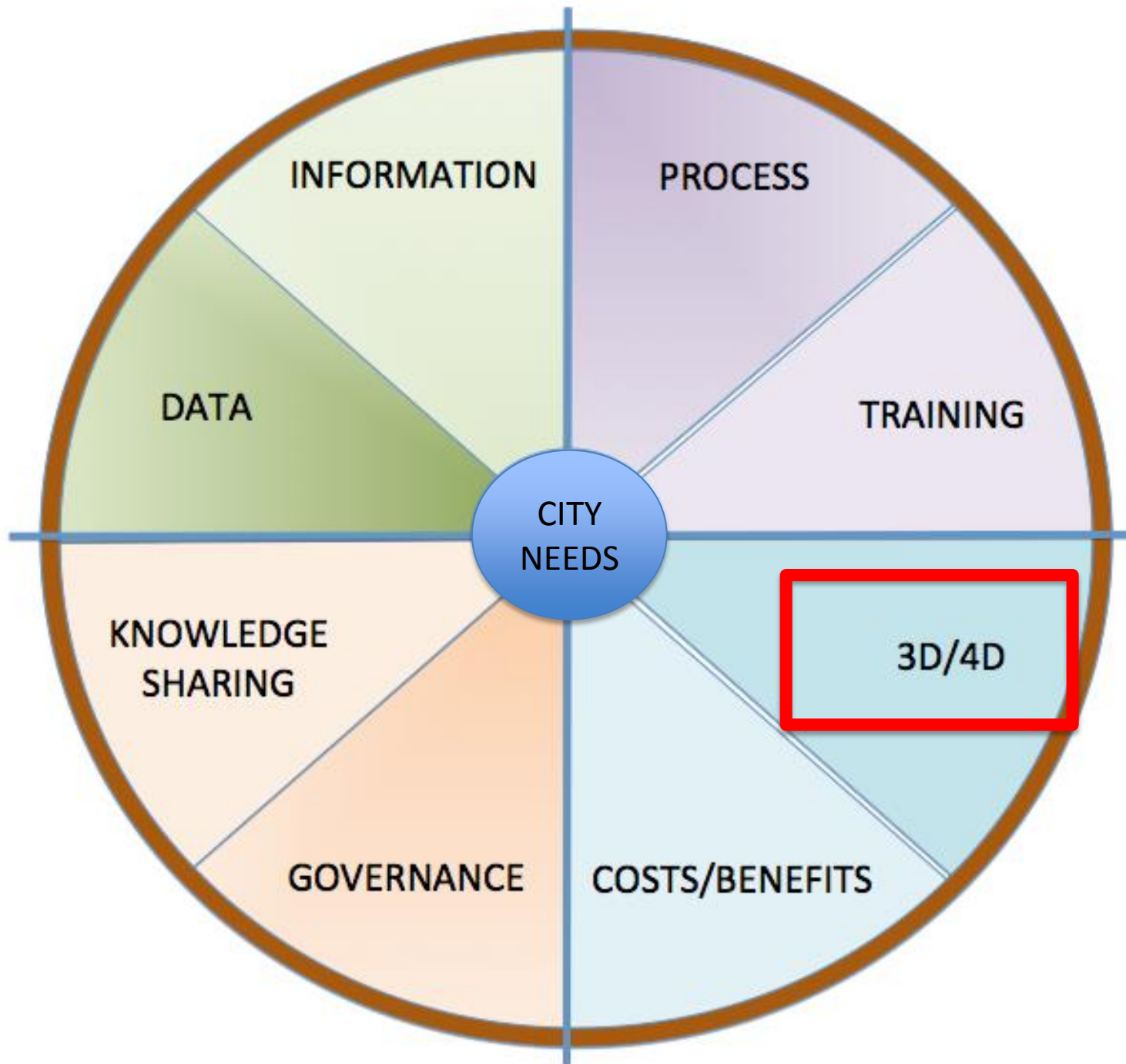
# Urban design optimally benefitting from subsurface

Sanne Mooij



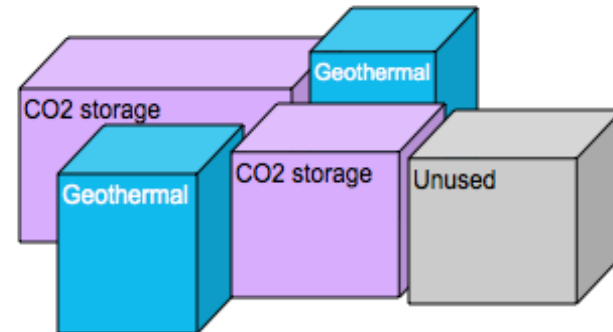
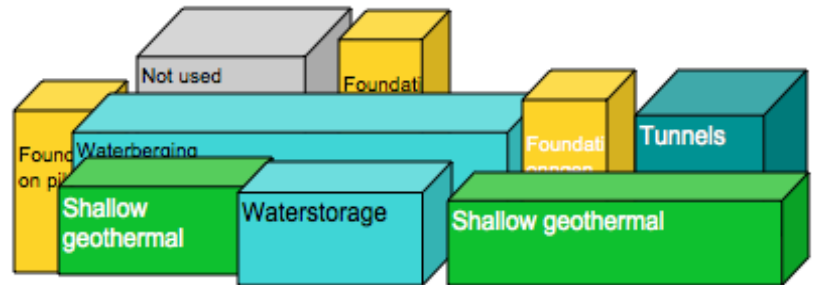
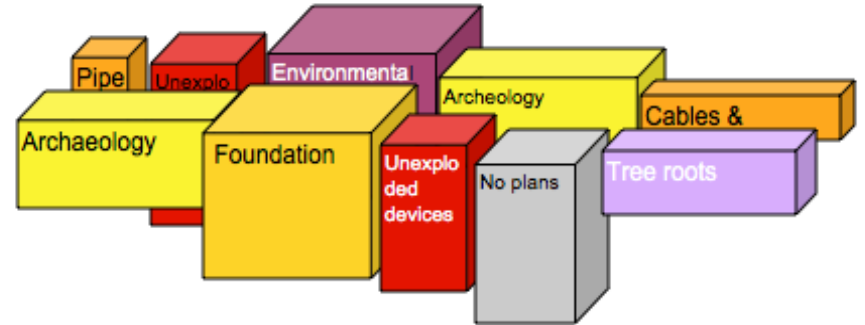
*.....learning how to incorporate the subsurface in their city designs*

***Next step:  
Training of earth science students in the process of Urban Planning.....??***



2D+

3D (LEGO) ... 4D Scenariotool

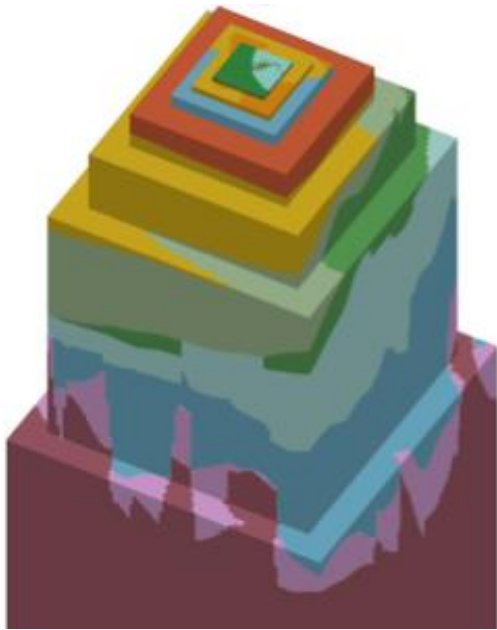


# “Rotterdam3D Pilot ”

Geology

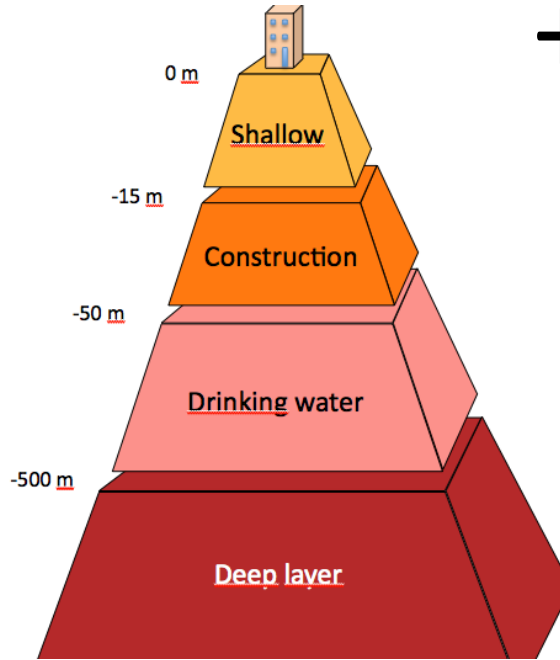
Use

Visualisation



3 km

+



+





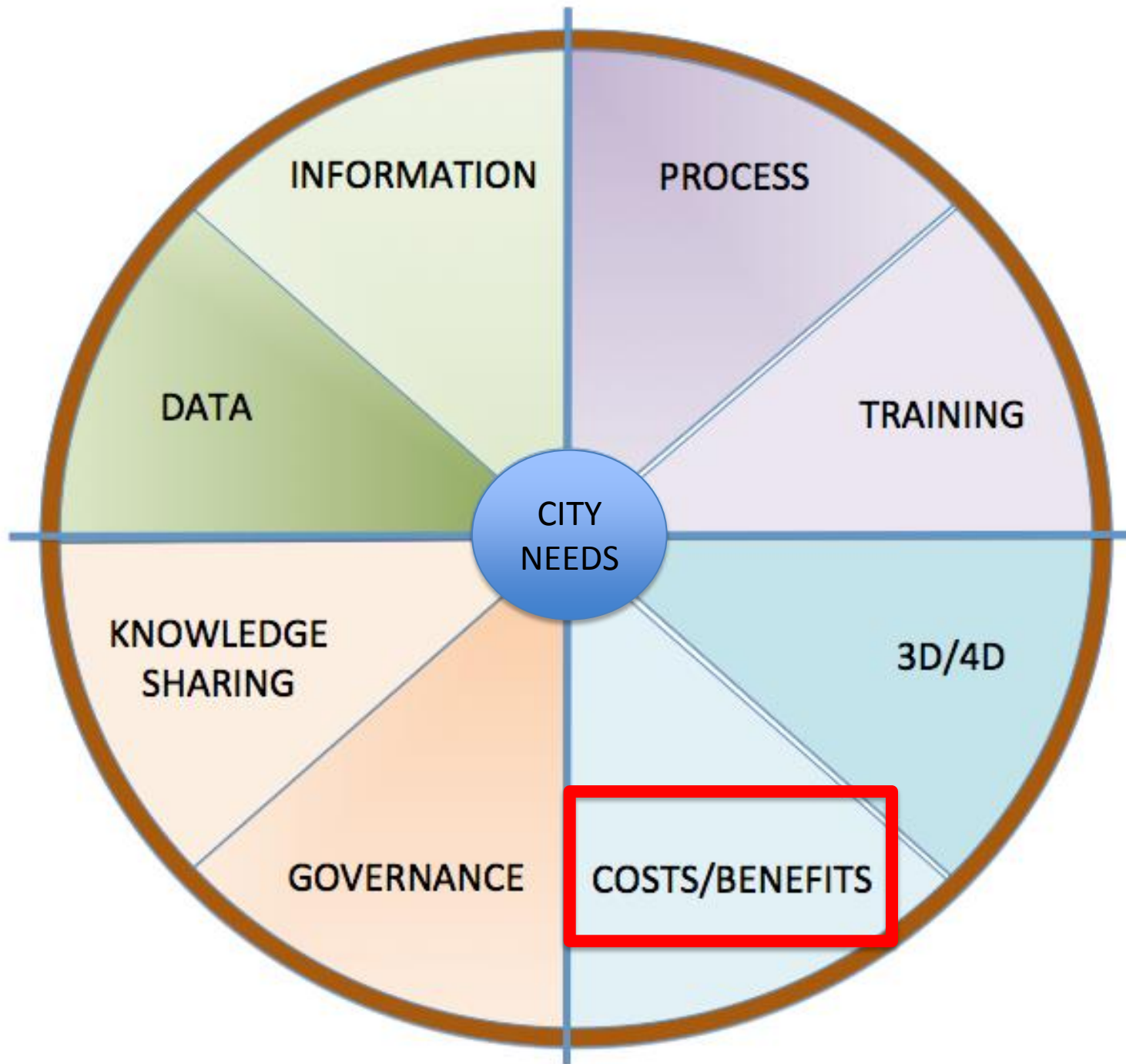
# 3D Serious Game Subsurface



*Aim: create liveable city by making optimal use of subsurface measures, people, planet, profit.....collaboration*



*For decisionmakers, project developers, building corporations .....with this game we stimulate their imagination.....*



# Costs and Benefits

Focus so far on Costs

**Benefits are more difficult to quantify**

**Who pays for the costs and who gets the benefits?**

**Often not the same parties**

Not only about physical assets, but also about natural, ecological assets

not only about “economics“, also about “values”

**Balance between Cost, Performance and Risks**

**“Maximum of utilization an optimal protection”**

**New topic for us.....**

**After Costs & Benefits.....Prioritizing**

# Prioritizing

- *Which functions where (3D)*

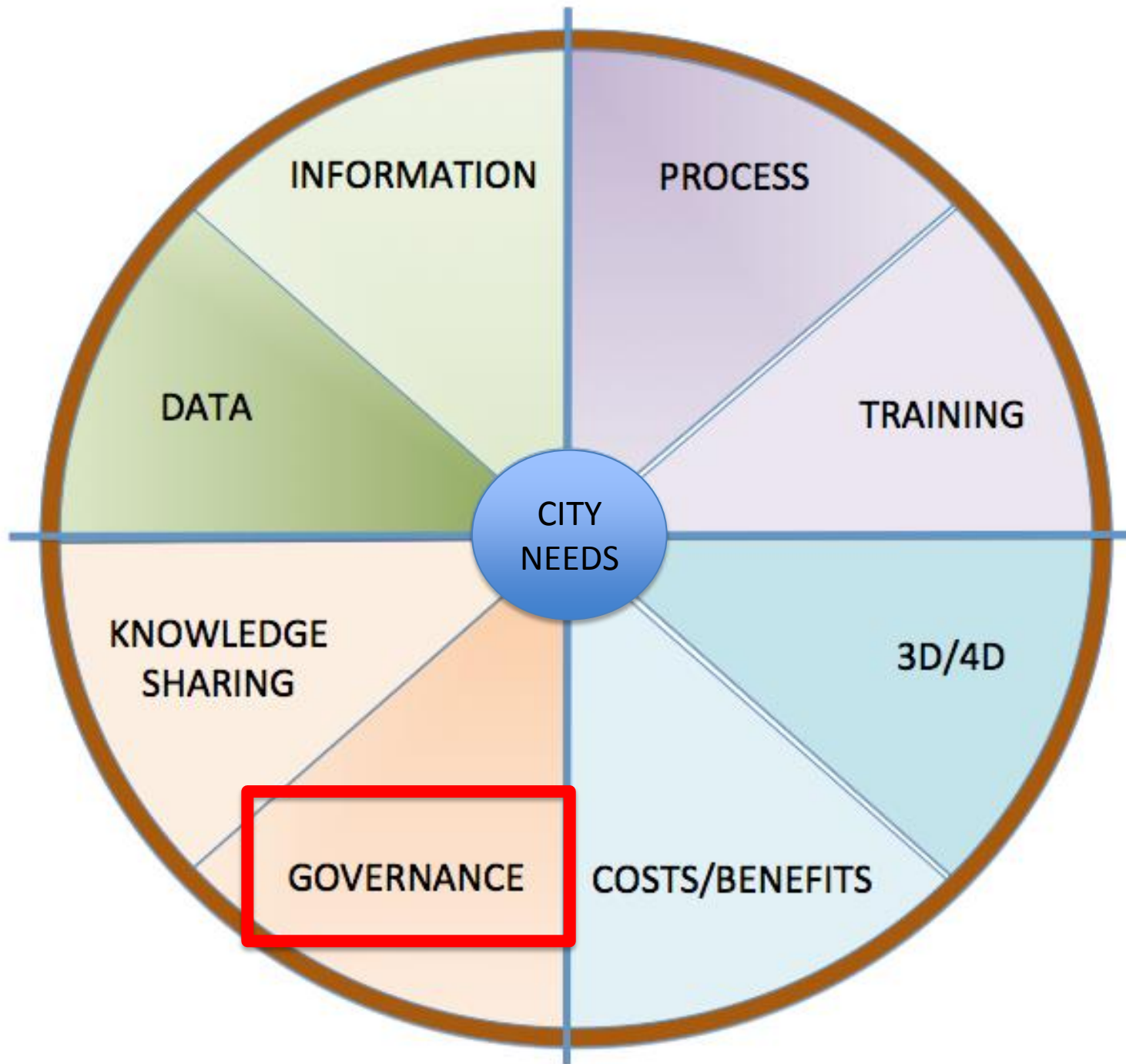
  - one geothermal project vs 100 SGU

  - SGU vs Tunnels

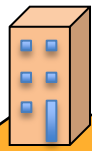
  - Trees vs cables and pipelines

- Taking into account new developments (4D)

- **Not project by project, but systembased**



# Authorities



**Shallow**

**Construction**

Drinking  
water

**Deep**

*Water boards*

**Municipalities**

**Provincial Authorities**

**National Government**



# Municipal > Provincial > National

**Pile rot: 60.000 euros/house;**

**municipality refers owners to water board and vice versa**

**Closed Shallow Geothermal Unit:**

**municipality,**

**Open Shallow geothermal Unit:**

**province, associated groundwater risks: municipality**

**Deep geothermal system, Gas & Oil:**

**only national government involved although well is drilled through the drinking water zone.**

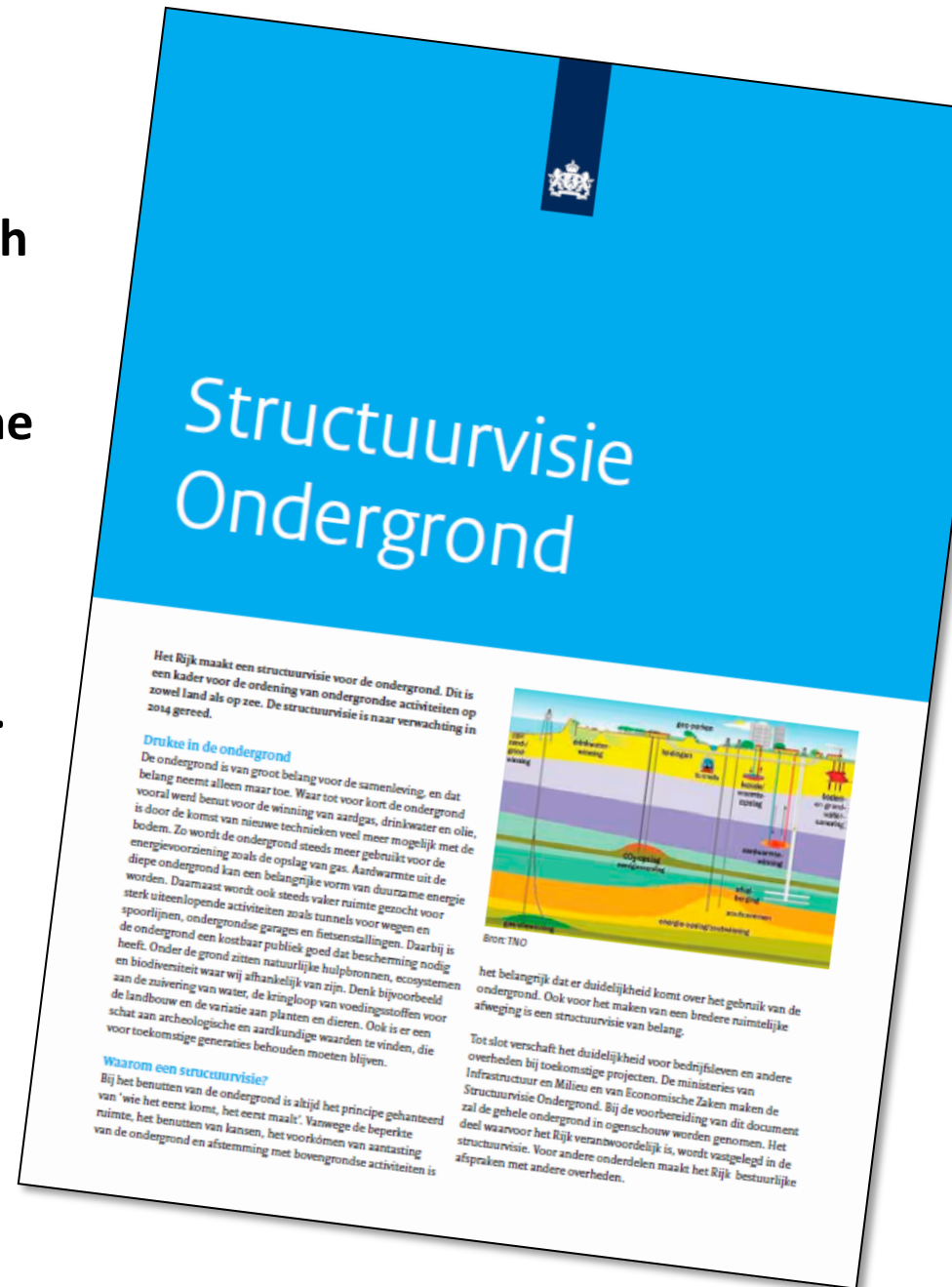
# Strong (“Vision on the Subsurface”)

National government, together with provinces and municipalities,

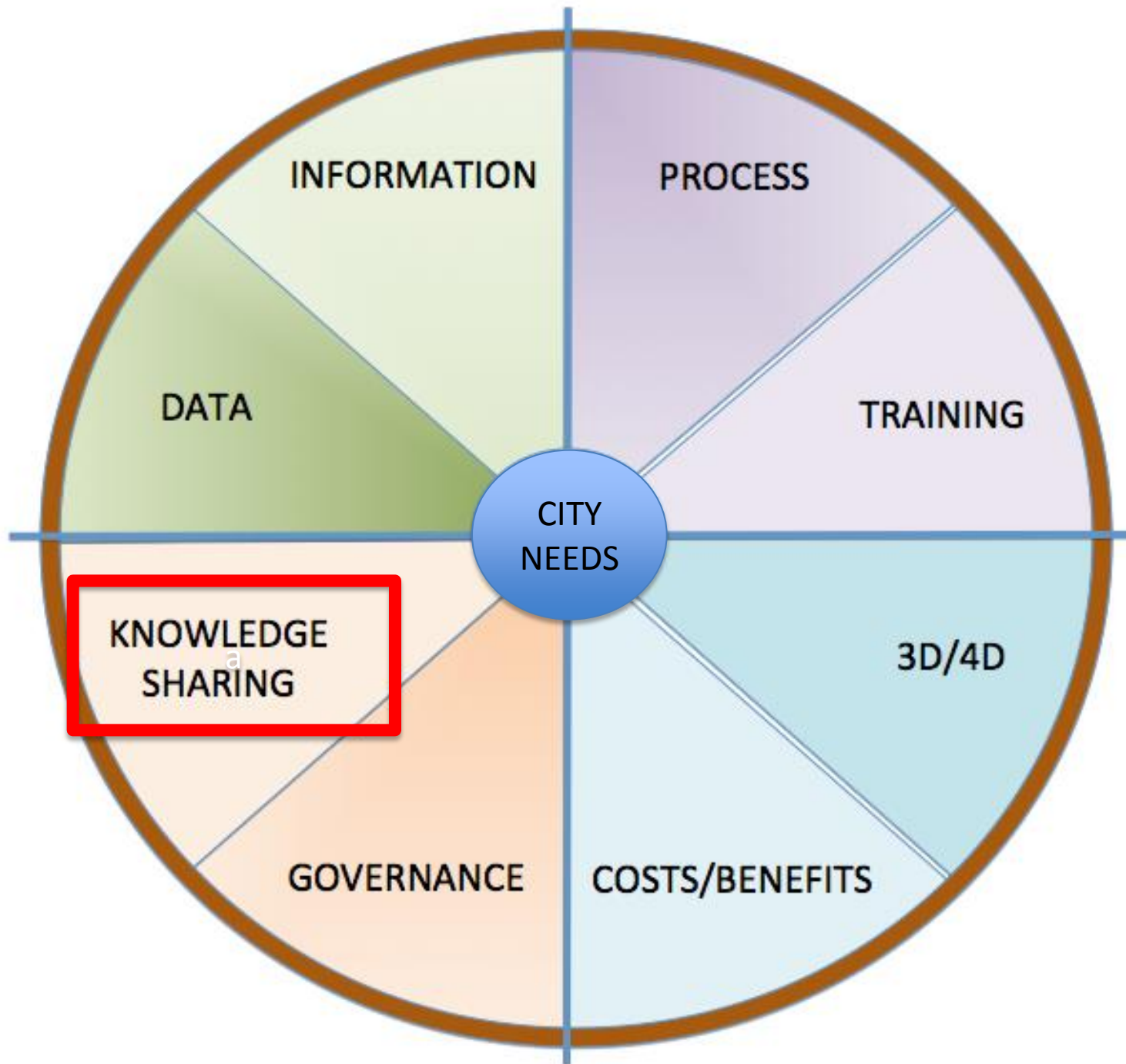
Working on a structure vision on the subsurface. This will offer a framework for the efficient and sustainable use of the subsurface.

Rotterdam is playing an active role.

from “soil”  
to “subsurface”







provincie Drenthe



sbns



TNO

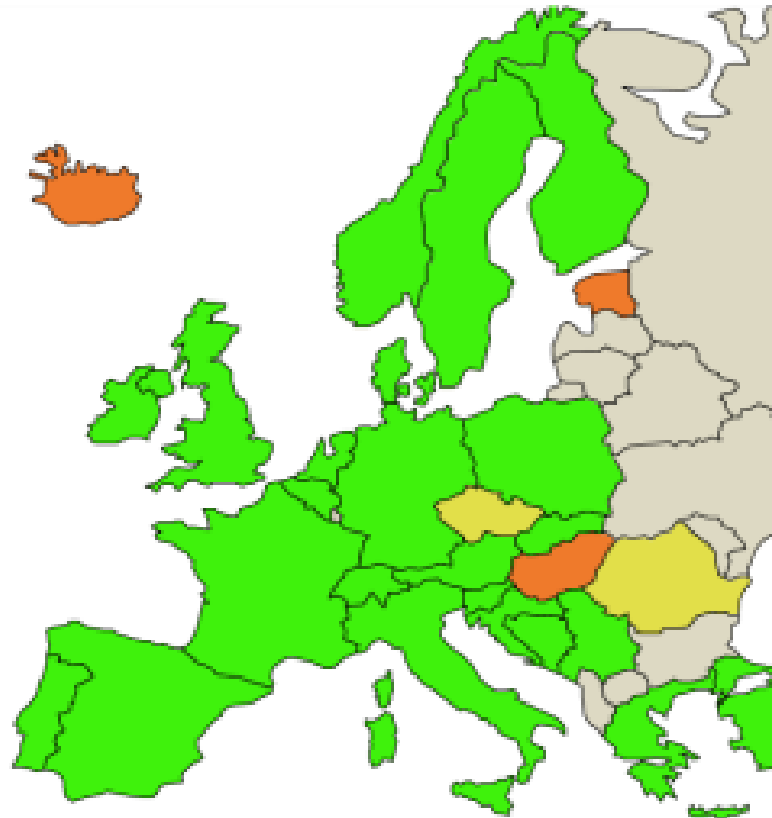


StrateGis Groep



Gemeente Den Haag

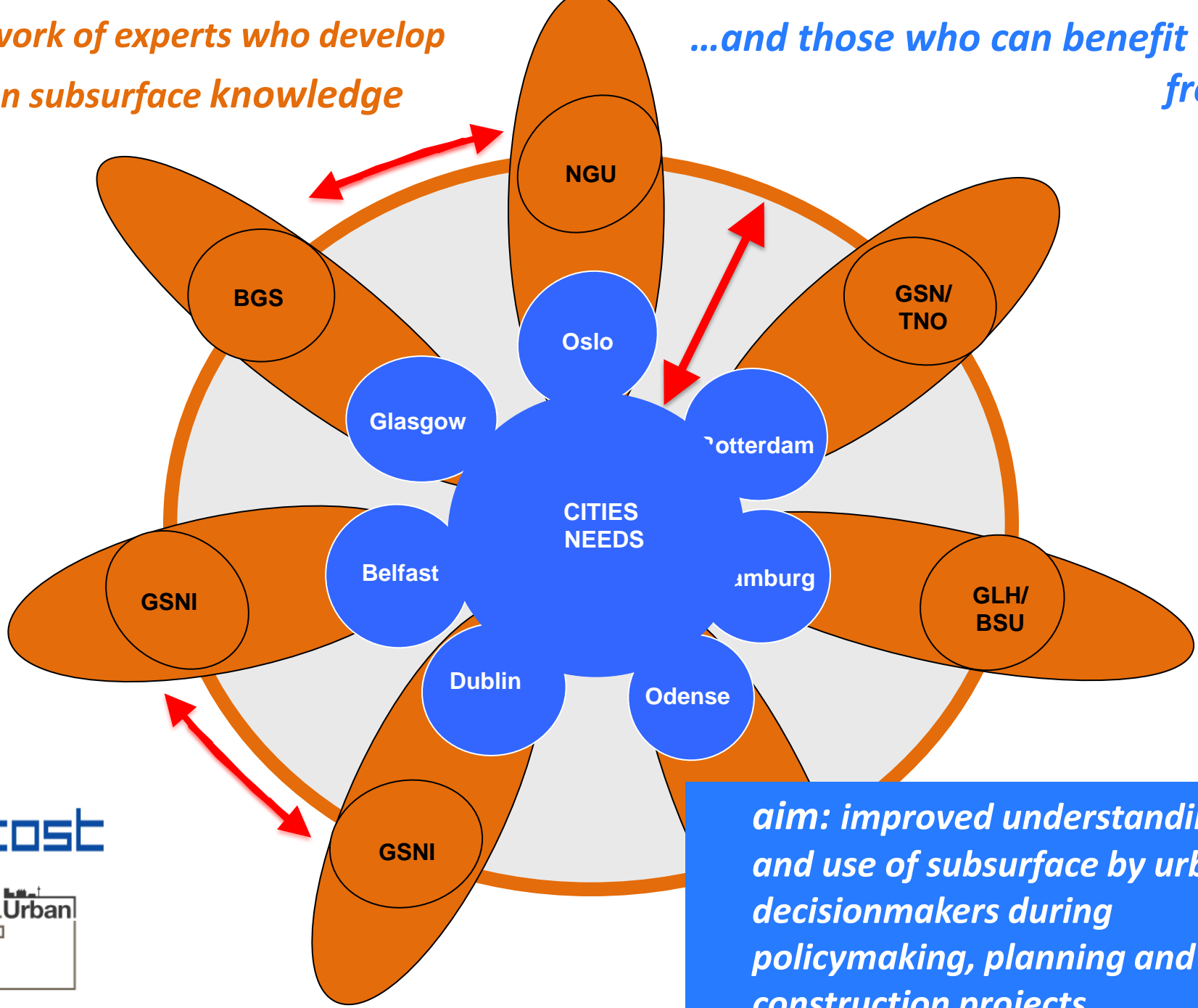
# SUB-URBAN - A European network to improve understanding and use of the ground beneath our cities



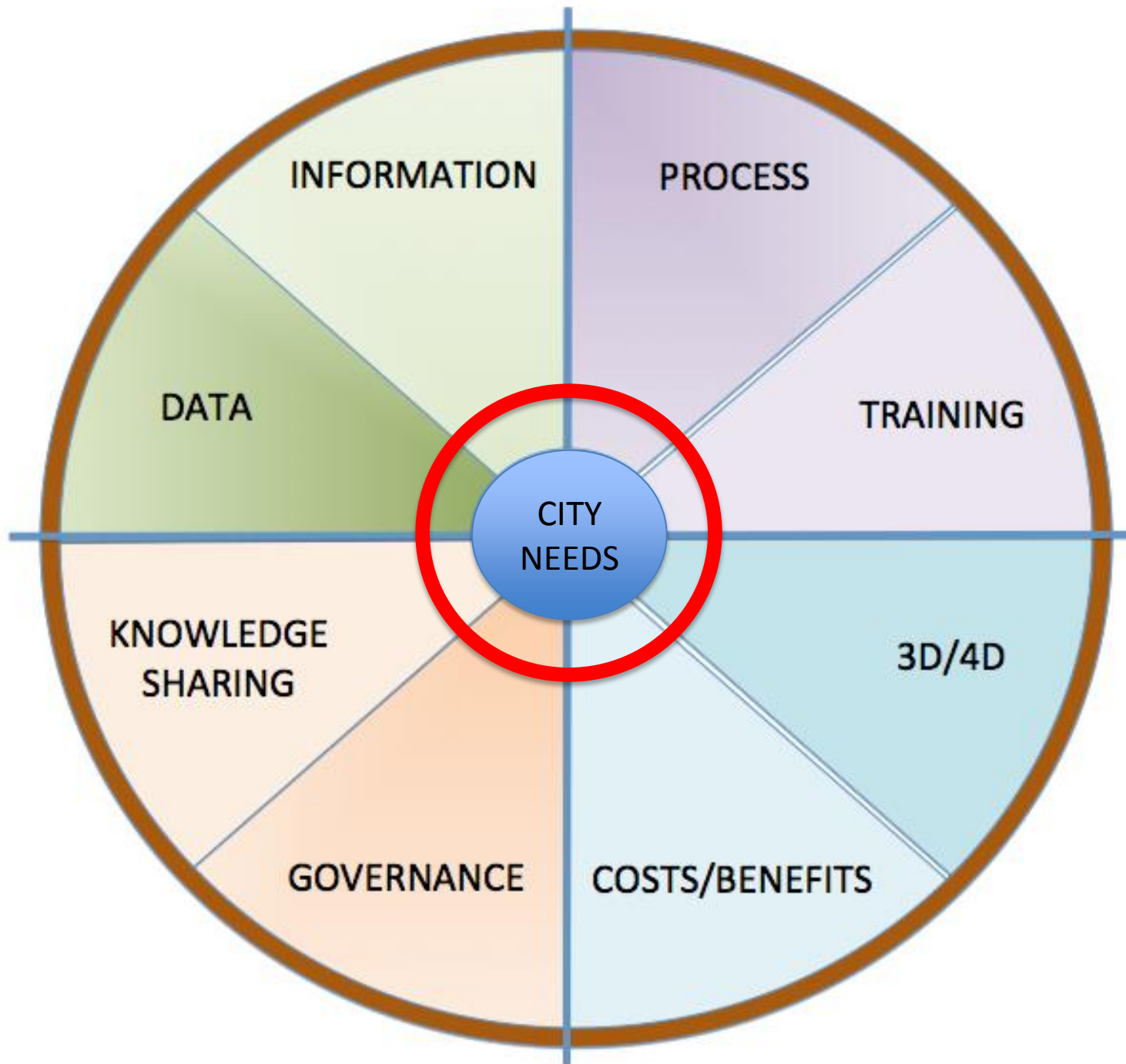
27  
countries

*Network of experts who develop urban subsurface knowledge*

*...and those who can benefit most from it*



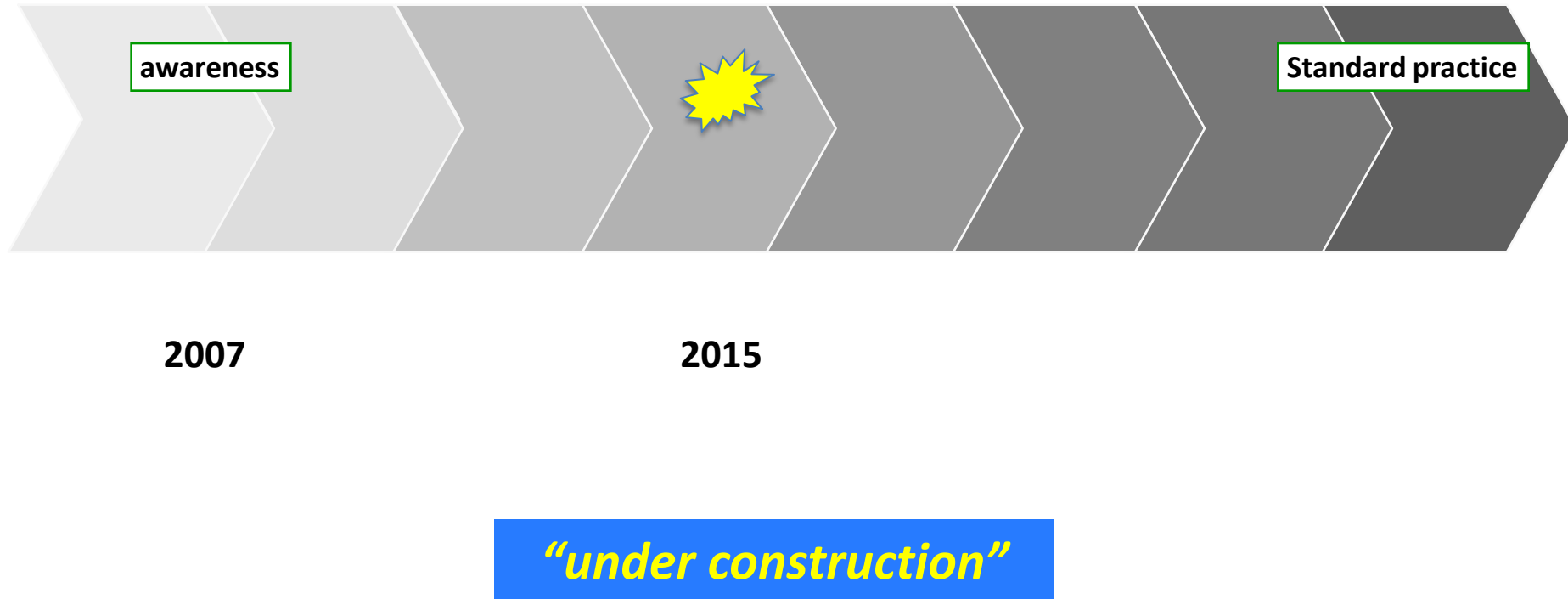
*aim: improved understanding and use of subsurface by urban decisionmakers during policymaking, planning and construction projects.*



# City Needs

- **Small team of subsurface “generalists”**
- **Brokers between subsurface specialists and urban planners, we participate in networks, initiate projects with partners**
- **So far focus on “supply side”**
- **Shift to “demand side”, focus on “City Needs”**
- **Incorporate urban planners in our team**

# Urban planning and the subsurface in the City of Rotterdam: the slow road from awareness to standard practice.



*Thank you!*

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Gemeente Rotterdam

