



# Balance 4P: Balancing decisions for urban brownfield regeneration – people, planet, profit and processes

- **Partners:**

Deltares (NL), TU Delft (NL), VITO (B), Chalmers (SE, co-ord.)

- **Subcontractors Chalmers:**

Enveco Environmental Economic Consultancy (SE), R3 Environmental (UK)

- **Funders:**

SNOWMAN network: Formas (SE), SKB (NL), OVAM (B)

The municipality of Rotterdam,

in-kind contribution from Deltares, TU Delft, VITO, municipality of Göteborg

# Background to B4P

- Redevelopment of urban brownfield sites and renewal of existing urban areas
- Subsurface conditions
- Sustainable remediation & redevelopment
- Sustainable urban development
- Two sectors: subsurface engineering & urban planning and design

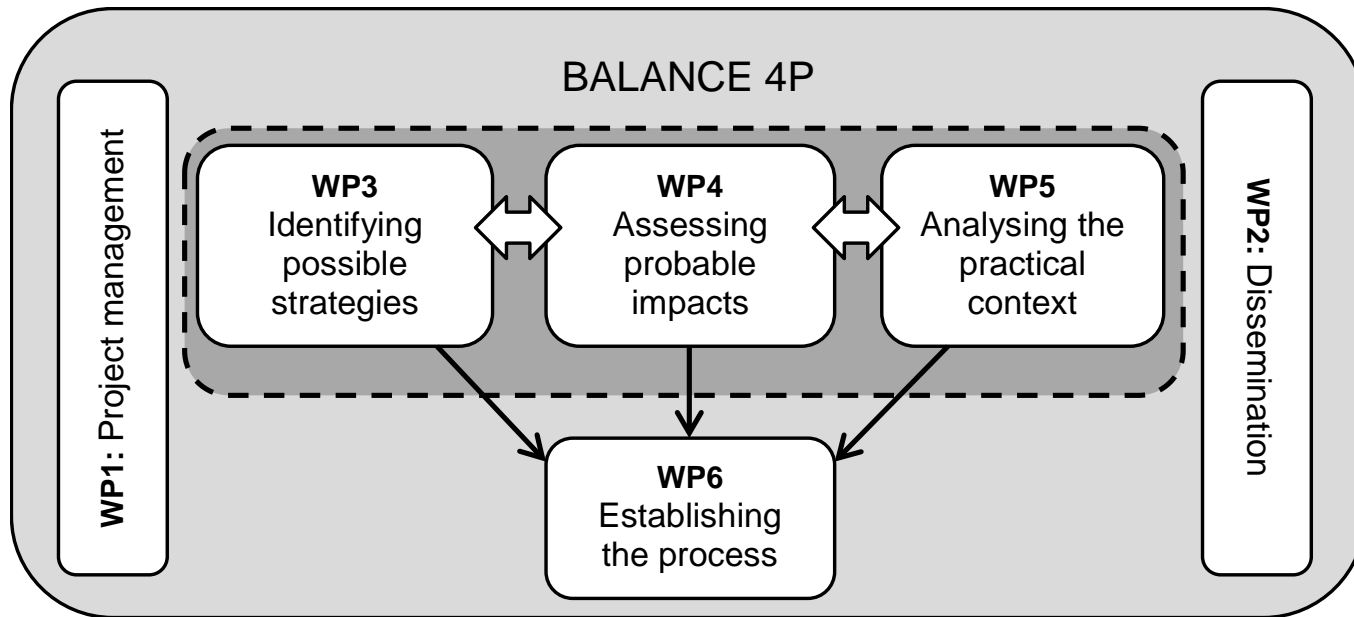
Need for holistic approach!

*CABERNET 2014, October 14-16, 2014, Frankfurt*



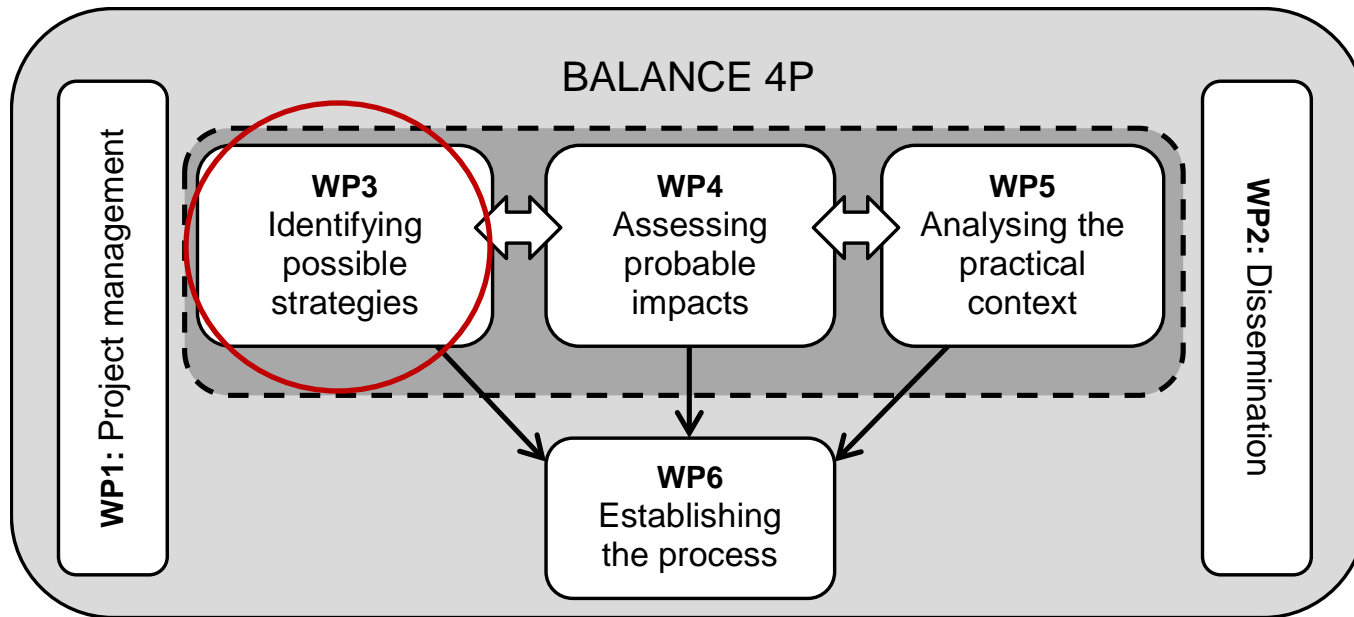
# Balance 4P outline

**Aim:** a holistic approach that supports sustainable urban renewal through the redevelopment of contaminated land and underused sites (brownfields).



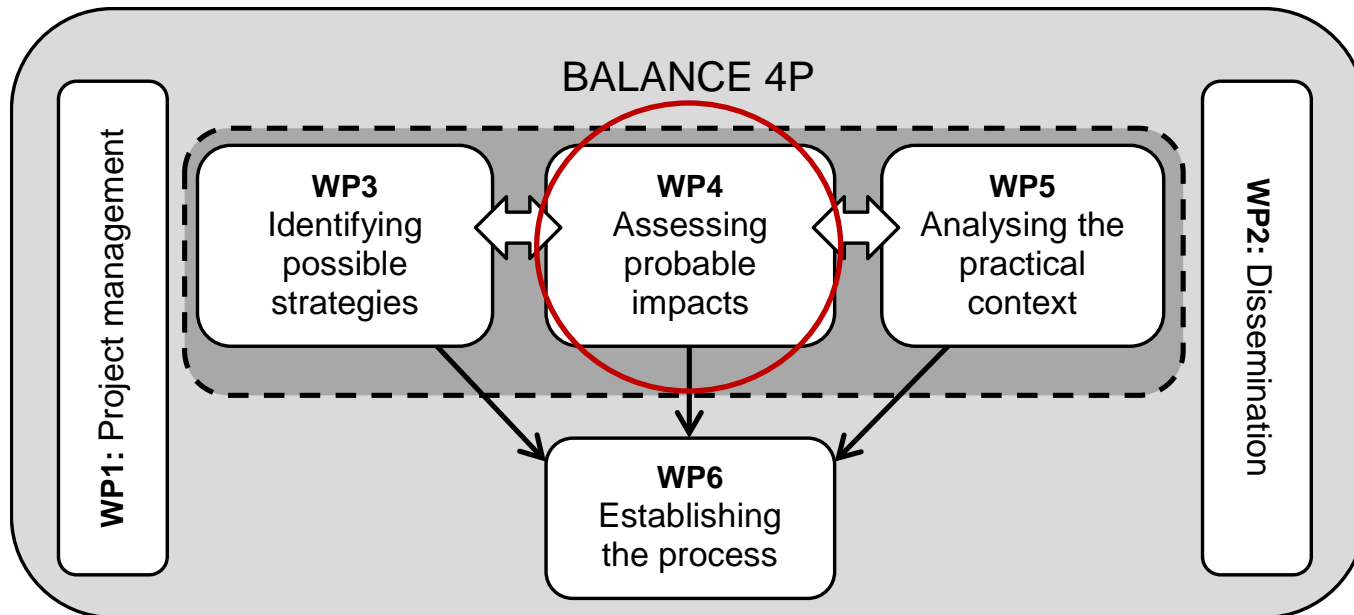
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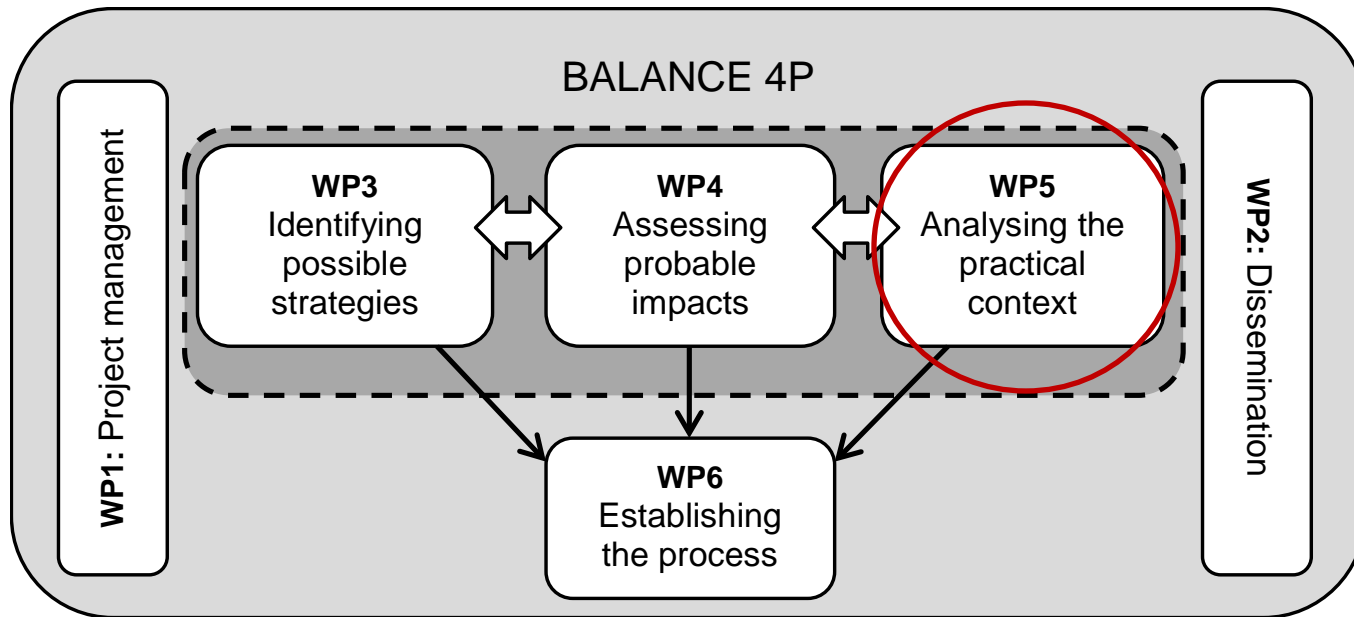
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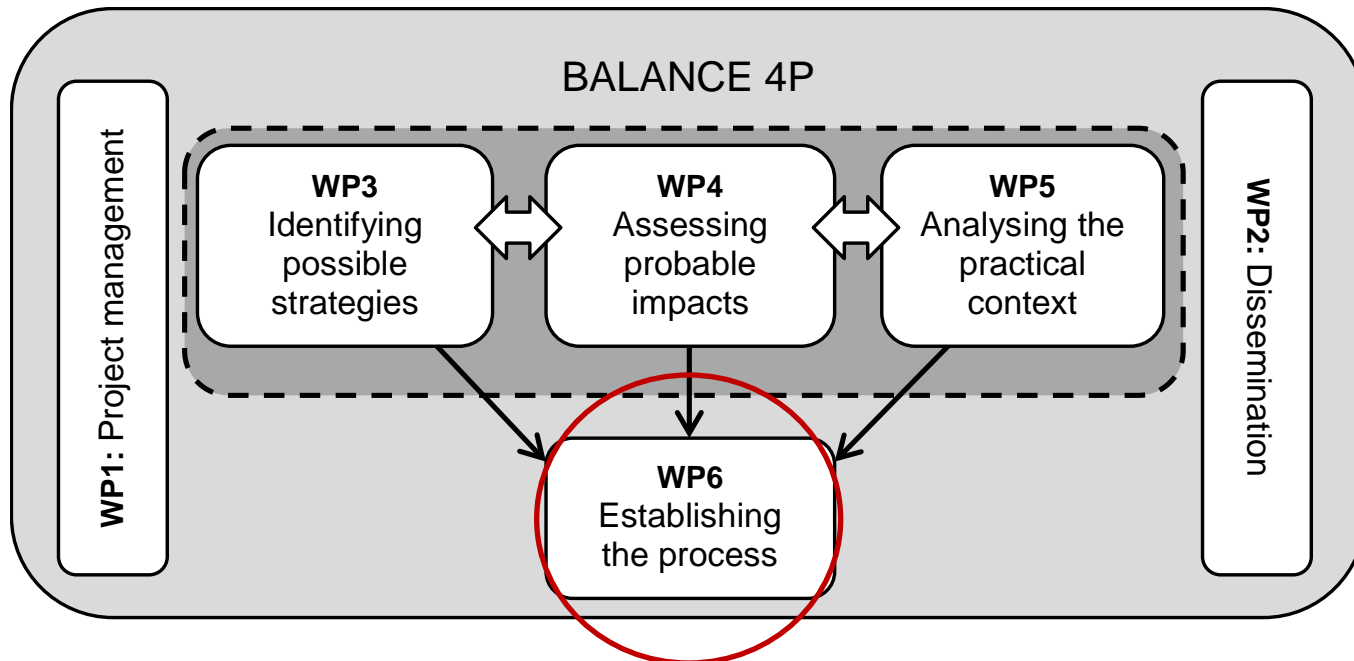
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# Case studies

- Merwevierhaven, Rotterdam city harbour – Rotterdam municipality



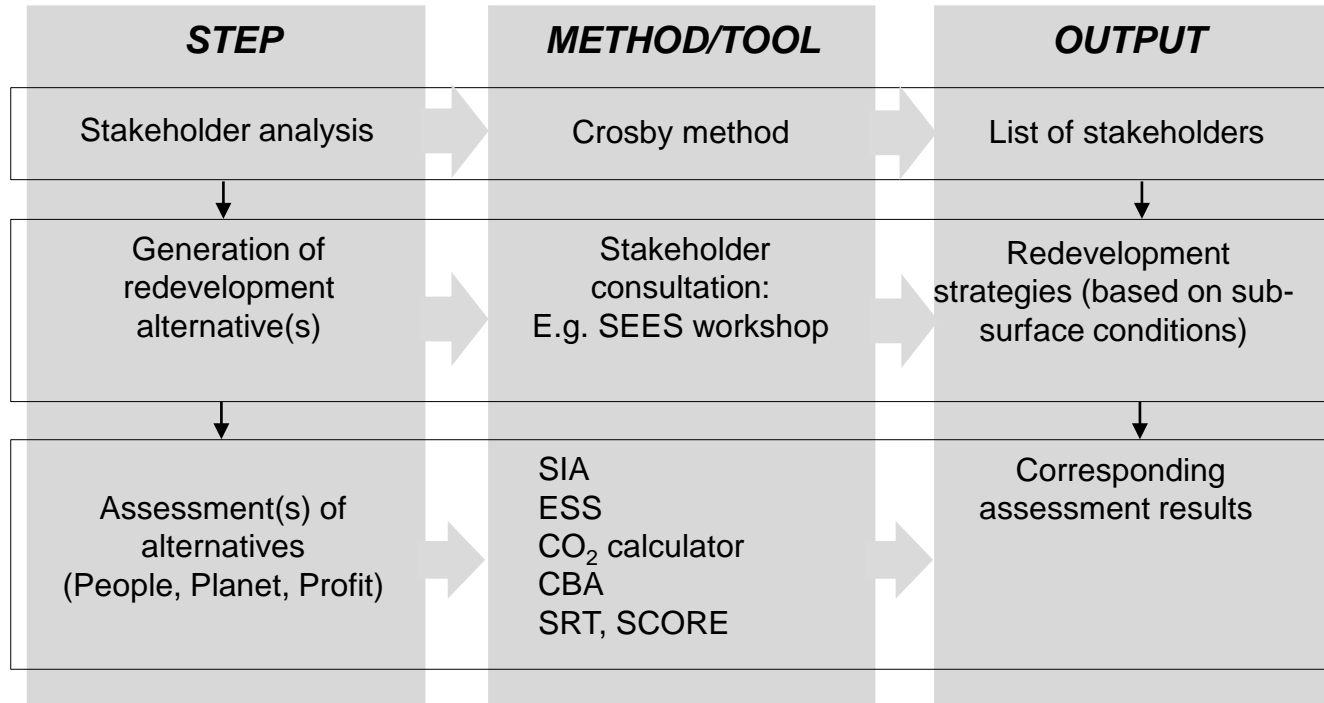
- Alvat – Buggenhout municipality



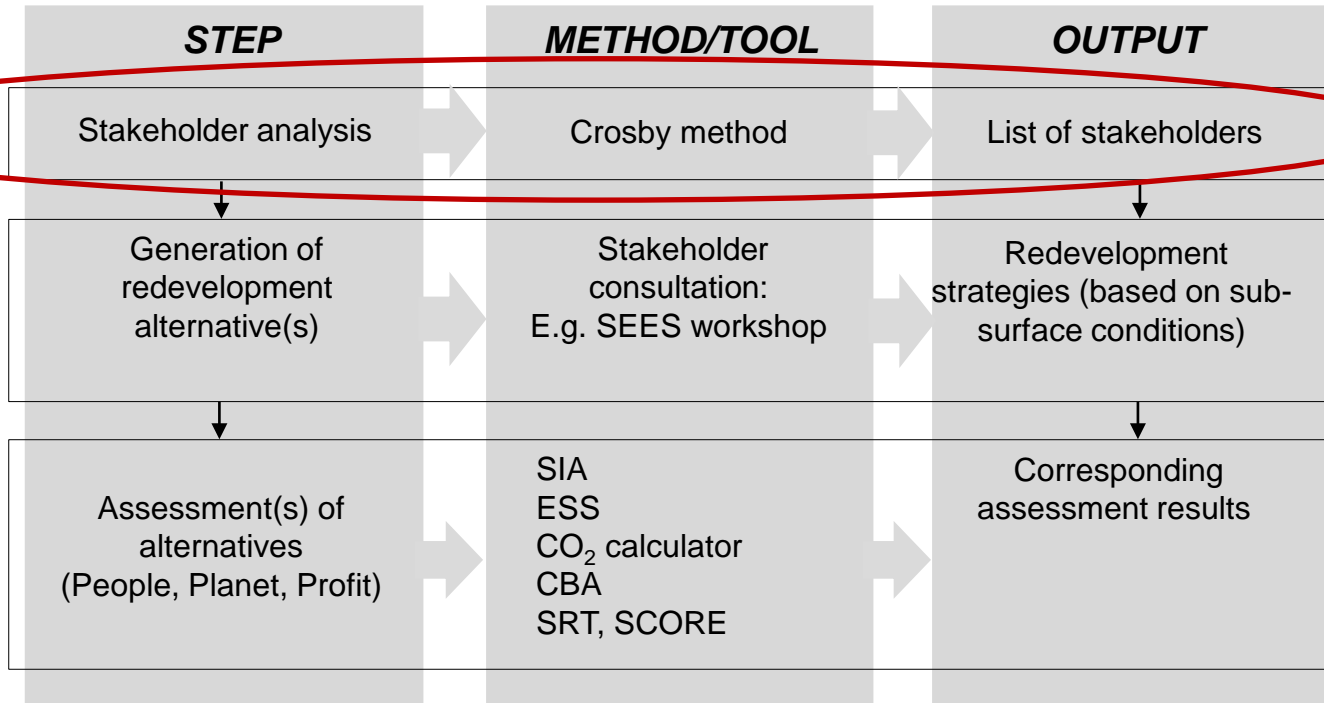
- Fixfabriken area – Göteborg municipality



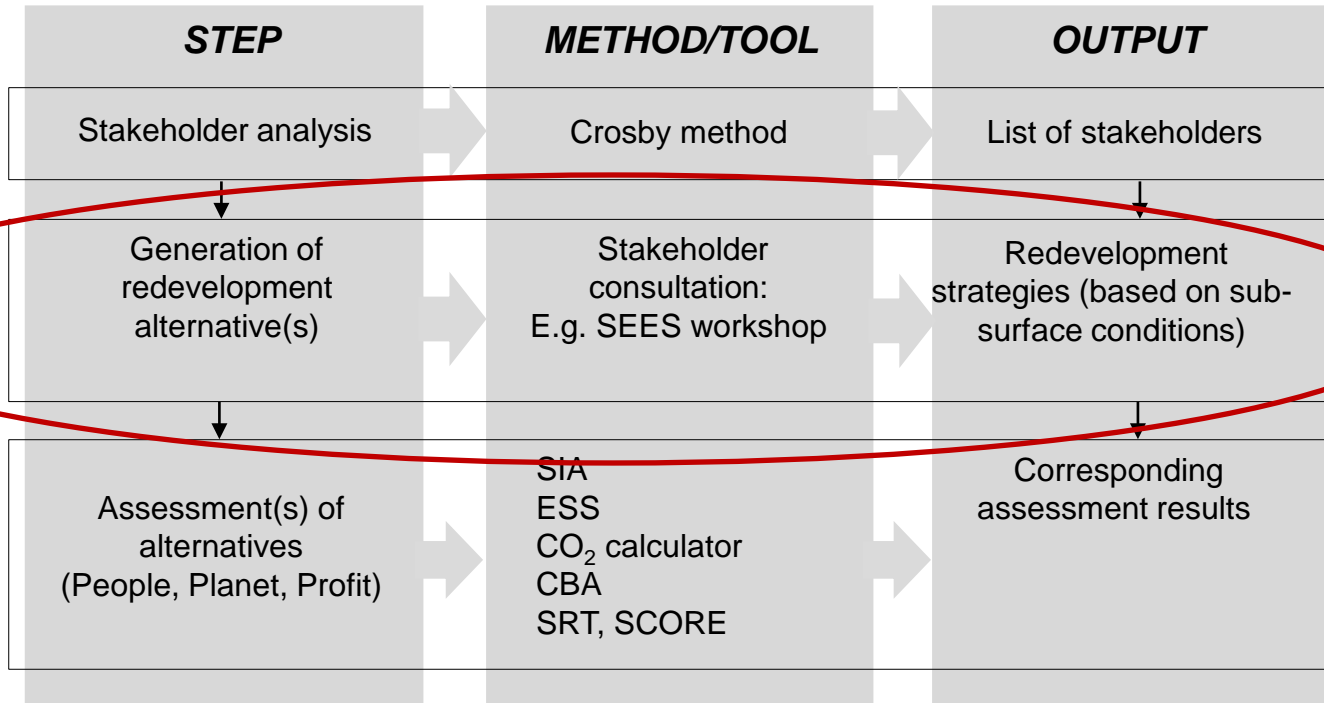
# Structure



# Stakeholder involvement



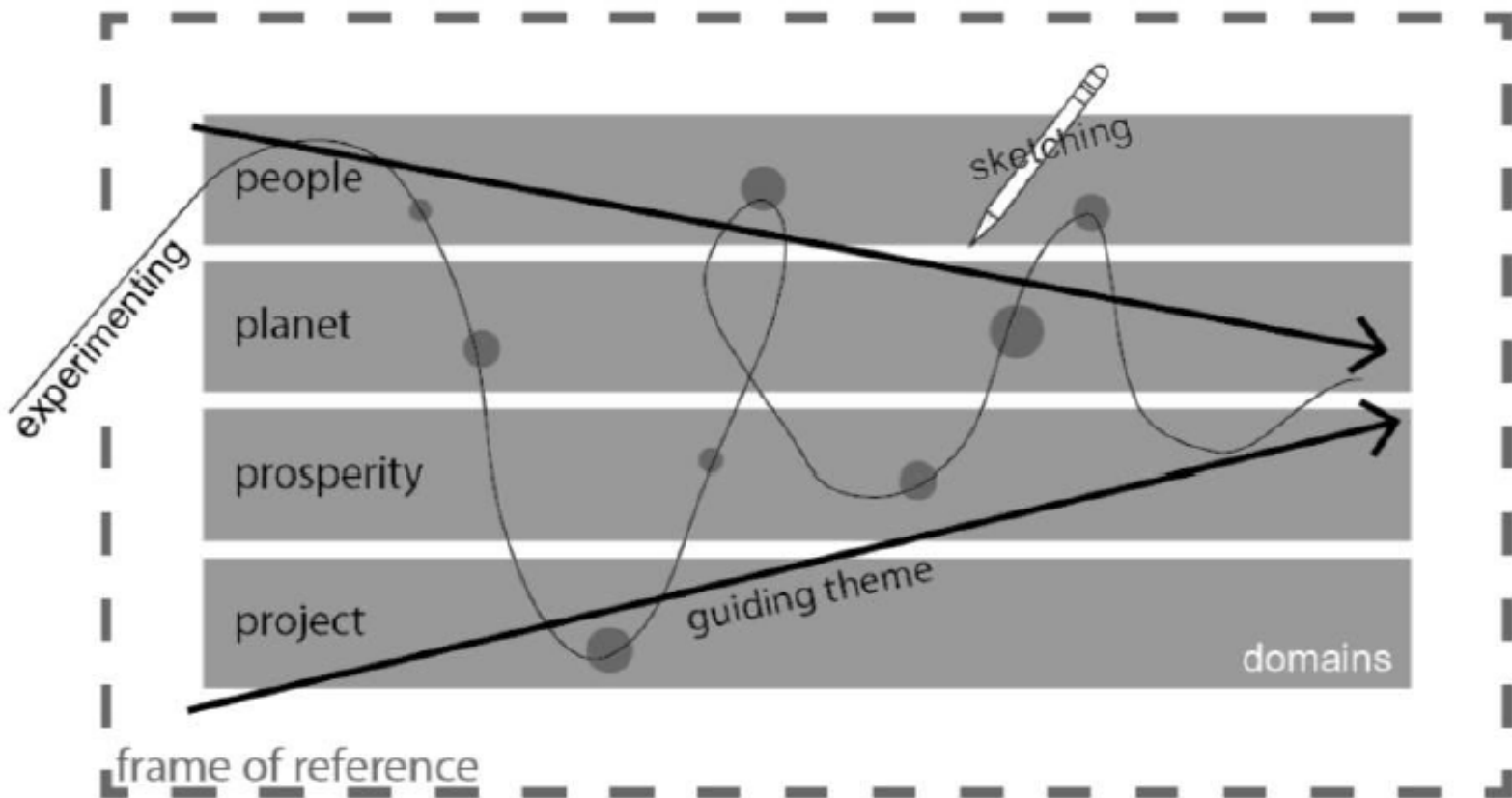
# Redevelopment alternative(s)



Planning/design



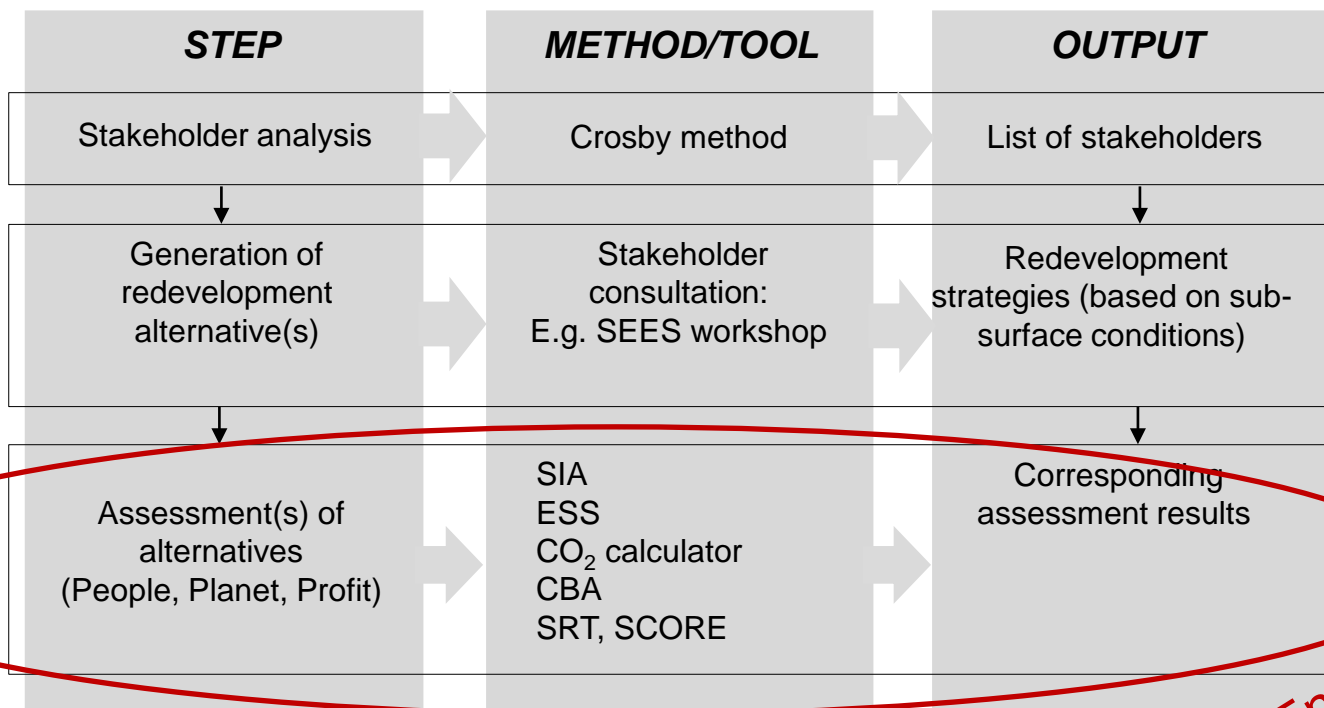
# Urban design/planning process



Van der Graaf, 2014



# Assessing alternatives (3P)



*Engineering/  
decision support*



# Merwevierhaven (M4H) - overview

- **Driver:** urban renewal
- **Landowners:** municipality + several private companies
- **Phase:** Vision-building
- **Balance 4P input so far:**
  - Student workshop subsurface issues in urban design + student project work
  - Stakeholder workshop 1: SEES – System Exploration Environment & Subsurface – overall picture
  - Stakeholder workshop 2: SEES – detailing on sub-areas



# M4H

## Subsurface challenges/chances

Large area – long time for  
development

Archaeology, cultural history

Foundations

Soil pollution

Geothermal energy

Cables and pipes







# Student workshop

Digging to Urban Quality - Anna, Juliska, Sien, Willard



SUBSURFACE / SUBSOIL	CIVIL CONSTRUCTIONS					ENERGY			WATER			SUBSURFACE					SUBSURFACE / SUBSOIL
LAYERS	foundations	retention	underground facilities	roads and parking	systems facilities	ATES (energy from sewage)	district heating	district cooling	water storage	water supply	water storage	water storage	water storage	water storage	water storage	water storage	LAYERS
PEOPLE																social structure (neighborhood typology) social behavior labor productivity labour capital	
METABOLISM																energy   food water air building material products	
BUILDINGS																office housing at 10 culture	
PUBLIC SPACE																long corridors cultural nature agriculture	
INFRA STRUCTURE																stability security	
SUBSURFACE	CIVIL CONSTRUCTIONS					ENERGY			WATER			SUBSURFACE					SUBSURFACE

■ BAD RELATION  
■ GOOD RELATION  
■ NEW RELATION

- Existing buildings
- New houses
- Urban farm
- Tidal park
- Sportsfield
- Dike
- Tunnel
- Floating pontoons

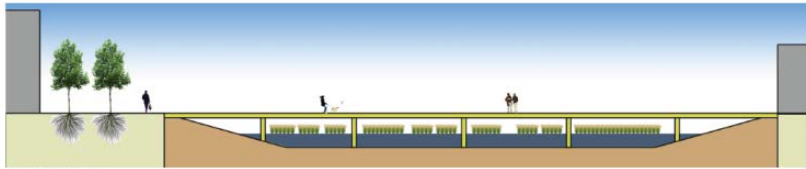
CABERINET 2014, OCTOBER 14-16, 2014, FRANKFURT



# Stakeholder workshop 2

## DESIGN

sections



Section 3: Wetland



Section 4: Energy park



Section 5: Waterfront

*Crossing Fingers - Merwe-Vierhaven - Sebastiaan Huls - AR0021 Aqua Terra Urban Design*

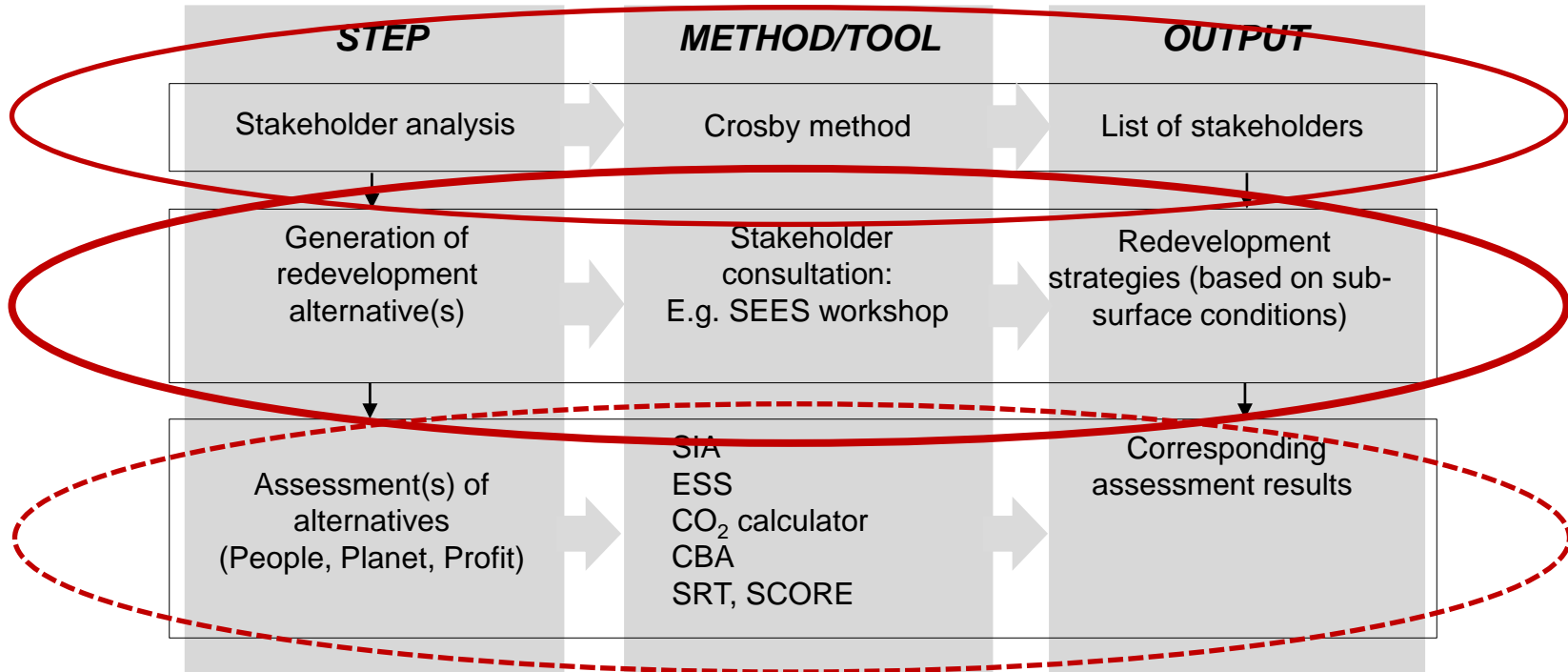


*noerassen, pilot Houtribsluizen Markermeer (Bron: Deltares)*

Schone bodem			Archeologie		Funderingen & Kades			Kabels & Leidingen		Energie				location
Afgraven	Monitored NA- Phyto	Stimulated NA	opgraven	Laten liggen	hergebruik	afkijpen	Staal/ nieuwe f.	opgraven	hergebruik	WKO	geothermie	Warmte opslag in de bodem	Decentraal bebouwing	
		█		█	█				█			█		EON
█	█		█				█	█		█				1.



# Balance 4P input – M4H



# Alvat - overview

- **Driver:** Contamination
- **Landowners:** private (bankrupt) company
- **Phase:** Contaminated soil management & Plan development
- **Balance 4P input so far:**
  - Student project work on site renewal designs
  - Stakeholder interviews on land-use
  - Assessment of alternative redevelopment strategies:  
OVAM MCA/CO<sub>2</sub>-calc., social sustainability evaluation  
(+ESS)





# Site challenges

Highly polluted soil (BTEX, VOCs, mineral oil, heavy metals, PCB and PAHs)

Industrial landfill (remediated)

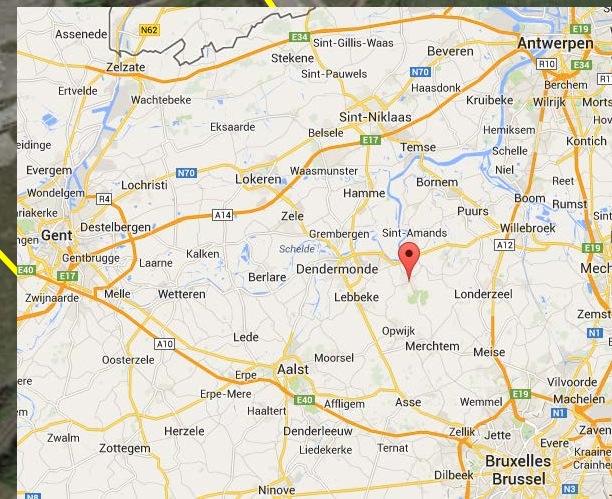
Future land-use

Ownership situation

Interest in development?



20m



# OVAM MCA/CO2 calculator

## OVAM MCA

### Environmental aspects

#### Local aspects

- Legal remediation objectives soil
- Legal remediation objectives groundwater
- Total reduction of contamination load
- Direct emissions to environmental compartments
- Duration of remediation & policy objectives

#### Regional/global aspects

- Use of raw materials and recycled materials (carbon calculator)
- Production of non-reusable waste during remediation

### Technical and social aspects

- Nuisance during remediation
- Restrictions for land use after remediation
- Damage caused by remediation works
- Safety measures during remediation

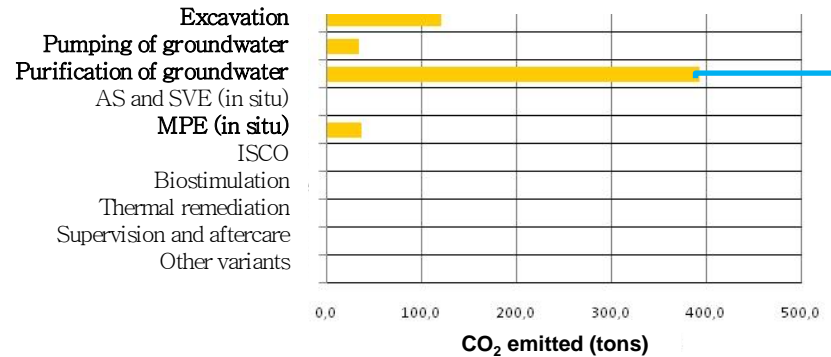
### Financial aspects

- Remediation costs
- Cost of residual contamination

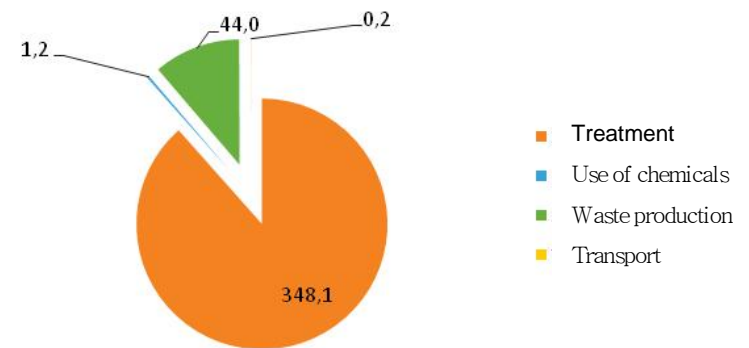
## CO2 calculator: carbon footprint

### Remediation technologies

### CO<sub>2</sub> emitted by the selected technologies



### Purification of groundwater



[http://www.ovam.be/sites/default/files/CO2\\_rekenmodel\\_versie\\_1-3-1-VL.xls](http://www.ovam.be/sites/default/files/CO2_rekenmodel_versie_1-3-1-VL.xls)

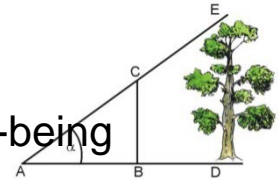


# Social Indicator Set for Sustainable Brownfield Revitalization

## Indicator Approach

From A. Beames, 2014

- » Objective: Get an indication of social impacts of alternative redevelopment options
- » Based on indicators from existing literature in other fields
- » Physically mappable features of the environment that contribute to human well-being

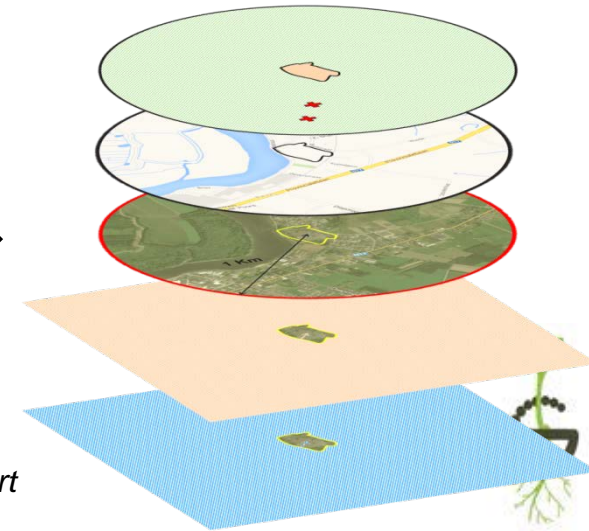
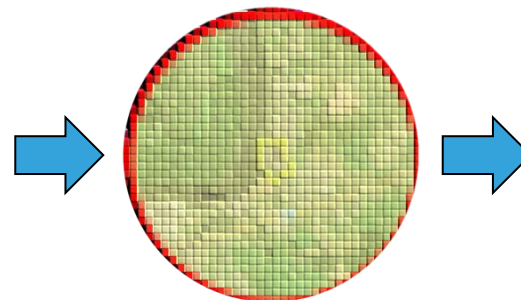
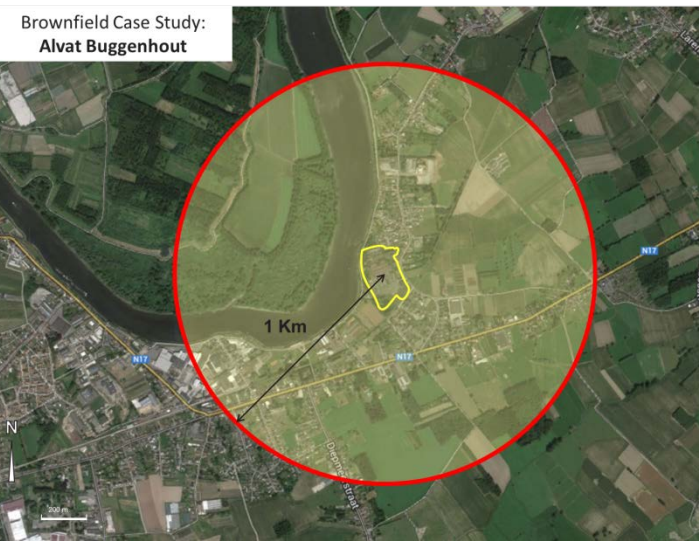


### 6 Key Indicator Categories:

1. Accessibility and Mobility
2. Community Health and Safety
3. Human Capital
4. Livability and Convenience
5. Social Cohesion
6. Urban Aesthetics

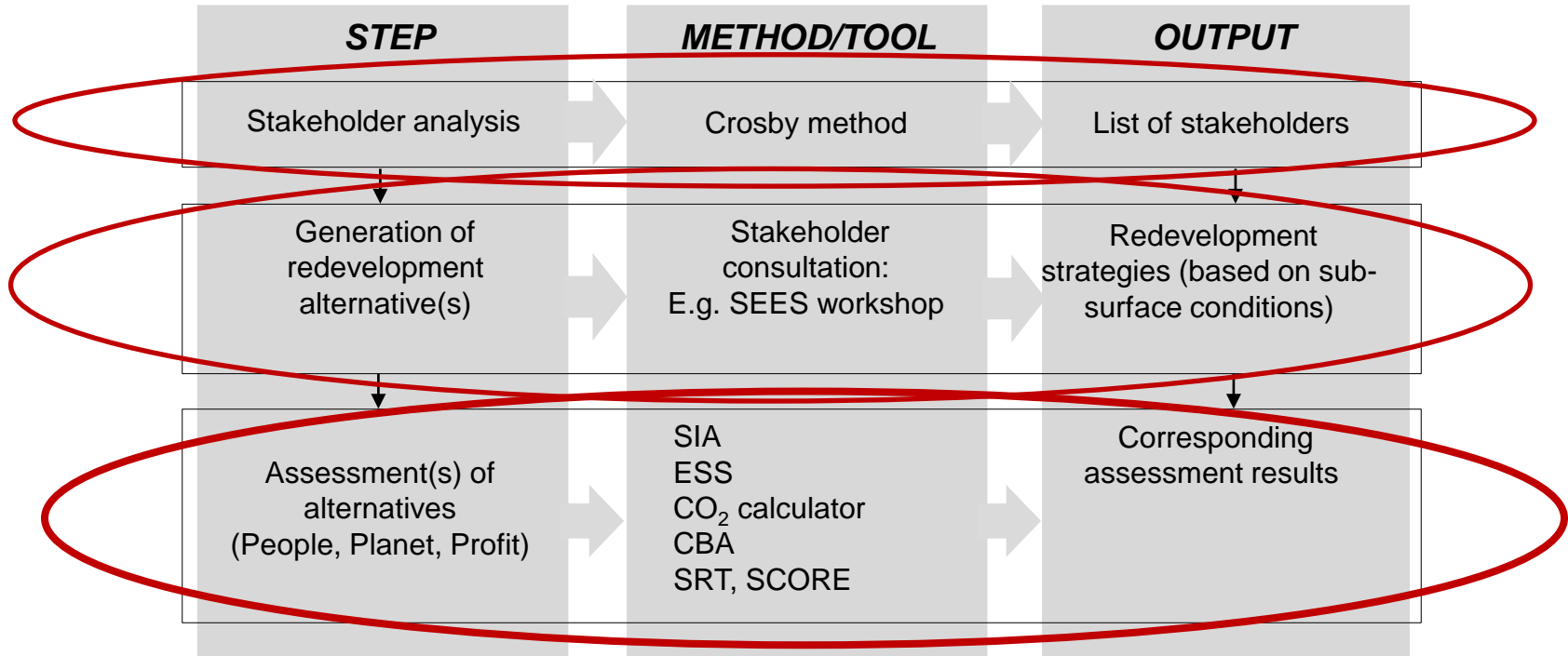
### Method:

- GIS based spatial analysis
- 10X10m pixel resolution
- Land-use and infrastructure layers
- Distance to / per inhabitant
- Evaluation of redevelopment scenarios





# Balance 4P input - Alvat



# Fixfabriken - overview

- **Driver:** land-use change (urban renewal)
- **Landowners:** municipality + large private developer + small private landowners
- **Phase:** compilation of a detailed plan
- **Balance 4P input so far:**
  - Student workshop subsurface issues in urban design + student project work
  - Stakeholder workshop 1: SEES – System Exploration Environment & Subsurface
  - Stakeholder workshop 2: Results assessment of alternative redevelopment strategies: SCORE, (ESS-mapping), SIA



## Urban planning challenges

Areas of national interest:  
cultural history, transportation  
(roads, seaways), energy  
distribution (natural gas)

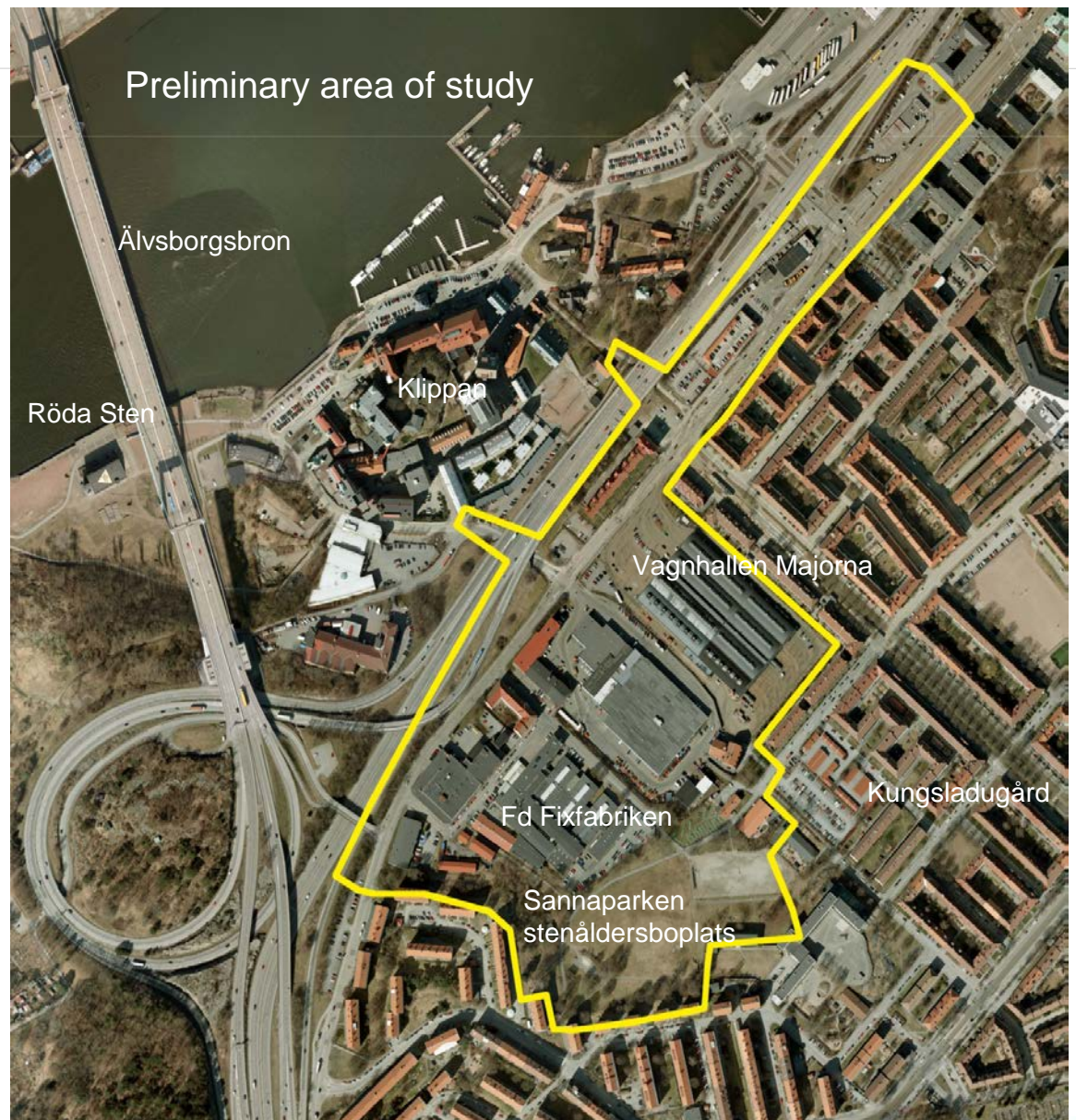
Archaeology

Cultural history

Geotechnics, soil pollution

Noise

Risk management (heavy  
transports)



## Urban planning challenges

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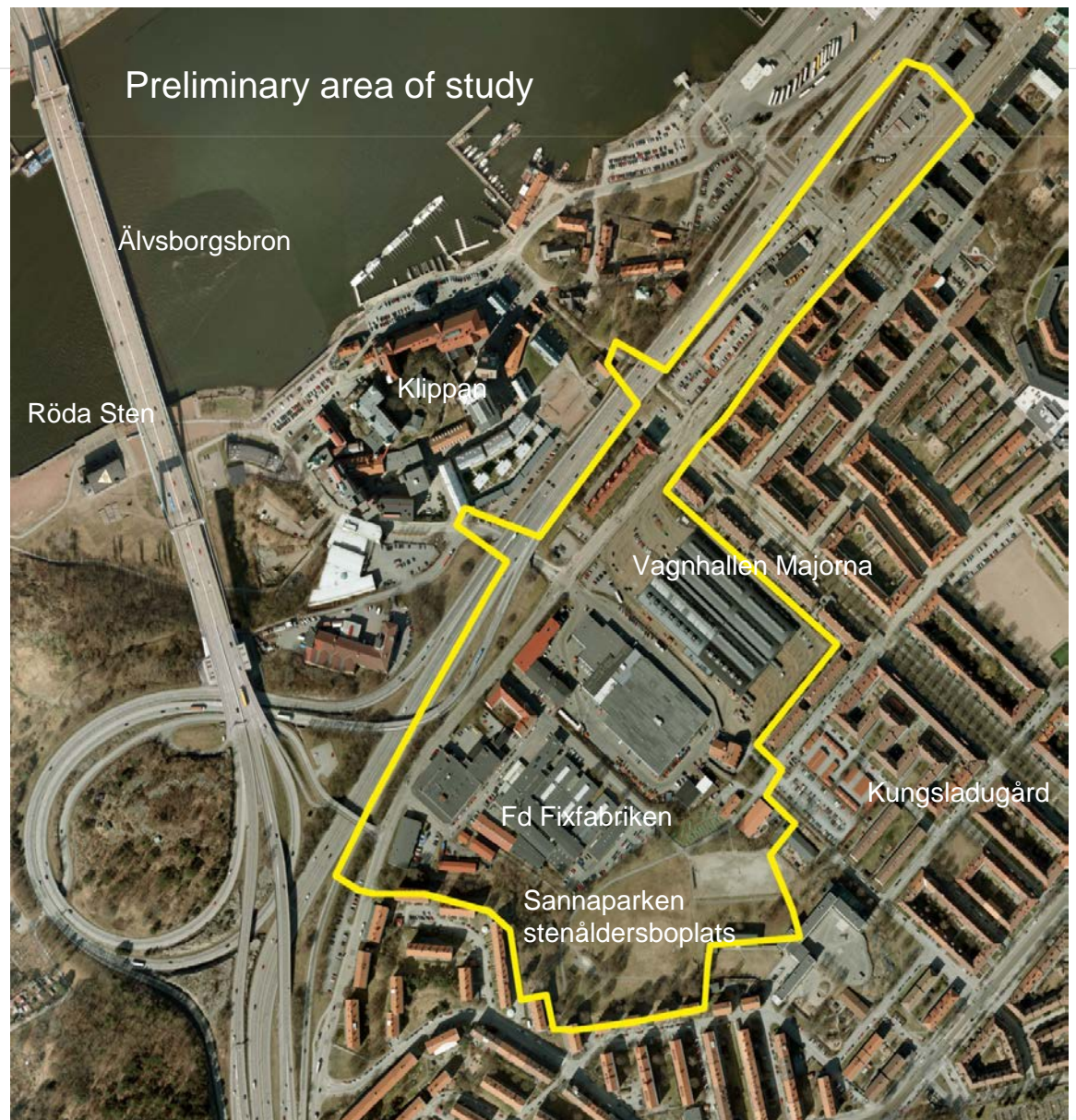
### Archaeology

Cultural history

**Geotechnics, soil pollution**

Noise

Risk management (heavy  
transports)



# Student workshop

BINDING THE PATCHES  
Andrea, Eelco, Ingrid, Mick, Willard

GROUP 4 25 april

## MASTERPLAN (from 2035 onwards)



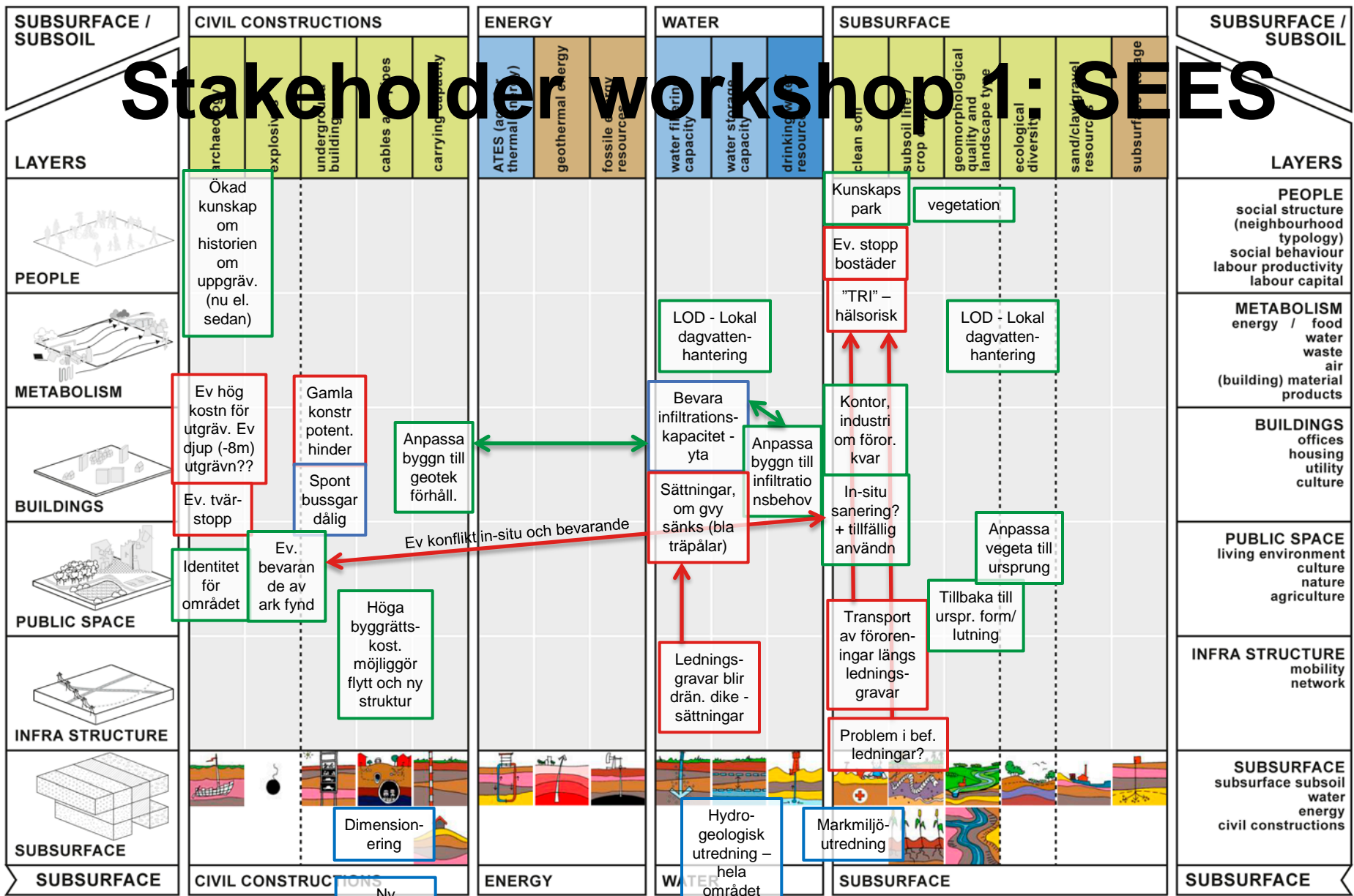
SUBSURFACE / SUBSOIL	CIVIL CONSTRUCTIONS					ENERGY			WATER			SUBSURFACE					SUBSURFACE / SUBSOIL	
LAYERS	anthology	explosives	underground building	cables and pipes	carrying capacity	hydro-thermal energy	geothermal energy	bio-thermal energy	water flowing capacity	water storage capacity	drinking water resource	clean soil	subsoil life / crop capacity	geomorphological landscape type	ecological diversity	arable/irrigated resources	subsurface storage	LAYERS
PEOPLE	+			o														PEOPLE social structure (neighbourhood typology) social behaviour labour productivity labour capital
METABOLISM	-		-	o		+							-	-				METABOLISM energy / food water waste air (building) material products
BUILDINGS	-		o	-					+	+			-	-	-			BUILDINGS offices housing utility culture
PUBLIC SPACE	+			+					+	+		+	+	+	+			PUBLIC SPACE living environment culture nature agriculture
INFRA STRUCTURE	-			+														INFRA STRUCTURE mobility network
SUBSURFACE	[Diagram: Civil constructions]					[Diagram: Energy]			[Diagram: Water]			[Diagram: Subsurface]					SUBSURFACE	
SUBSURFACE	[Diagram: Civil constructions]					[Diagram: Energy]			[Diagram: Water]			[Diagram: Subsurface]					SUBSURFACE	

shallow  
shallow and water layer  
water layer  
deep > 500 meter

+++ Very positive relation  
++ Positive relation  
+ Neutral relation  
- Negative relation  
-- Very negative relation  
--- No apparent relation



# Stakeholder workshop 1: SEES







shallow  
shallow and water layer  
water layer  
deep > 500 meter

Pot. svårighet  
Pot. möjlighet  
Behov

# 5 redevelopment strategies

Garcao, 2014

## Land Use

-  Green area
-  Housing area + commerce + office + services
-  Industrial / office area
-  Keep present land use








**Alternative A1**  
(1)

**Alternative A2**  
(2)

**Alternative A3**  
(3)

**Alternative B**  
(4)

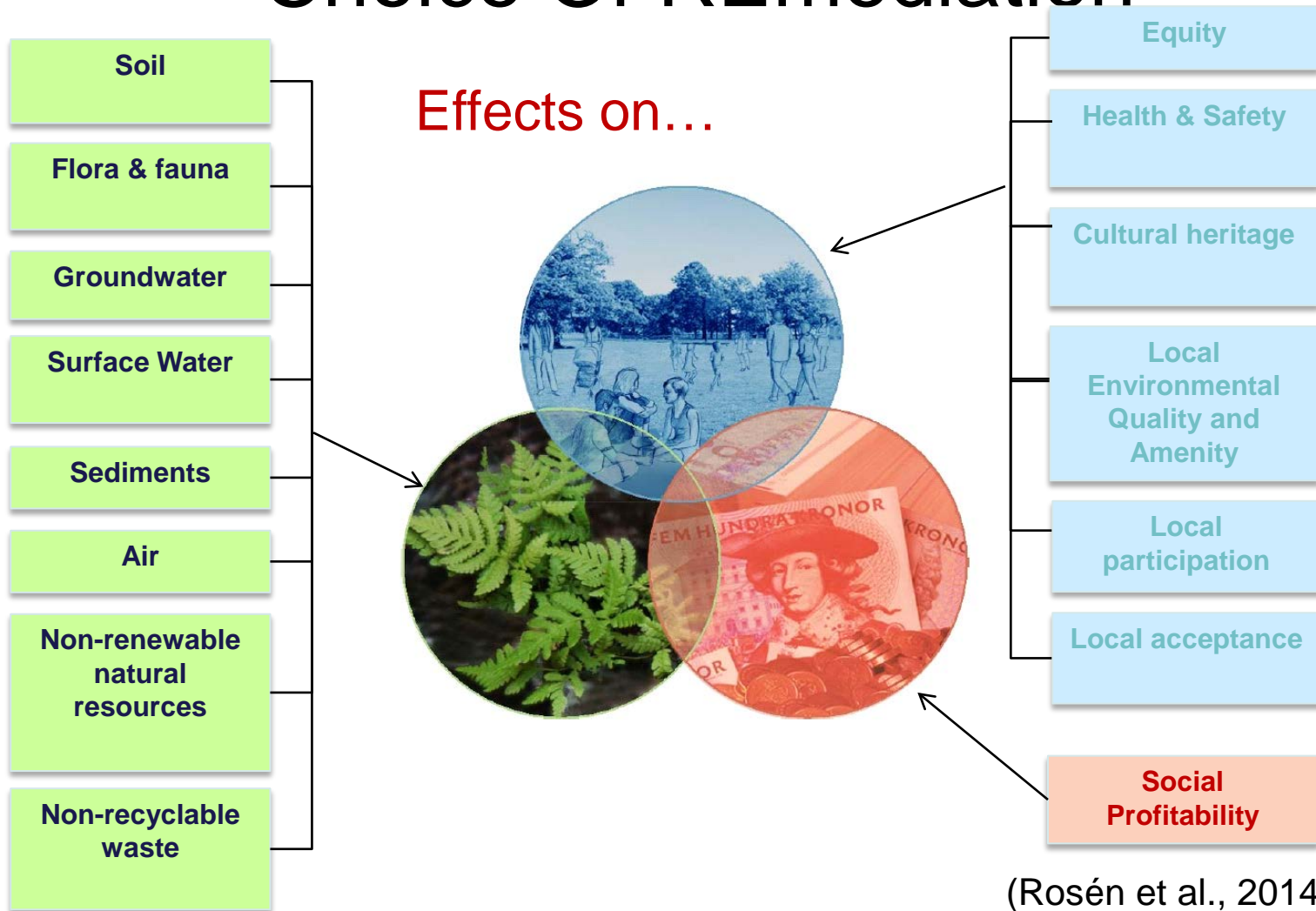
**Alternative C**  
(5)

-  Excavation
-  Soft treatment (e.g. phytoremediation)
-  No excavation + surface cover + in-situ hot spot remed. + ventilation system
-  Ventilation system + In-situ hot spot remediation
-  No action

## Remediation



# Assessment: SCORE – Sustainable Choice Of REmediation



(Rosén et al., 2014)



# Assessment: ESS-mapping

(Gomez-Baggethun et al., 2013)

Group	Service
Provisioning services	food
	fiber (e.g. wood)
Regulating services	air quality regulation
	climate regulation global
	climate regulation local (urban climate)
	water regulation
	erosion regulation
	noise reduction
	water purification and waste treatment
	pollination and seed dispersal
	natural hazard regulation
Cultural services	educational values
	aesthetic values
	social relations
	cultural heritage values
	recreation and ecotourism



# Assessment: Social Impact Assessment (SKA)

**[SKA]** analysnivå  
social aspekt

  
**BYGGNAD & PLATS**  
vad som sker precis utanför dörren

  
**NÄRMILJÖ**  
vad som sker på gatan/  
kvarteret utanför och kring...

  
**STADSDEL**  
vad som sker i det närmaste,  
funktionella området...

  
**STAD**  
vad som sker i hela staden eller  
påverkar andra områden...

  
**REGION**  
vad som sker i hela regionen eller  
påverkar andra områden

**Sammanhållen stad**

REFERENCE ALTERNATIVE

There is a positive mix of industrial and other activities in parts of the area. Rents are low.

The area is rather isolated from the surroundings: Klippan, Sandama, Majoma, Kungsten, Sjöbergen.

**Samspel**

There are many diverse activities in the area and places where people can meet. The area along KJ gatan is noisy and busy. After work hours, it is not a very vivid place.

The area functions somewhat like a barrier between the nearby areas since it is not so easy to walk through.

**Vardagsliv**

Services in the area are limited as not many people are living there. Traffic and infrastructure are not that well functioning in the area.

There are good public transport facilities nearby the area.

**Identitet**

The Fixfabriken brick building and the tram hall buildings are older (historical) buildings in the area. There is also the remnants from the stone age.

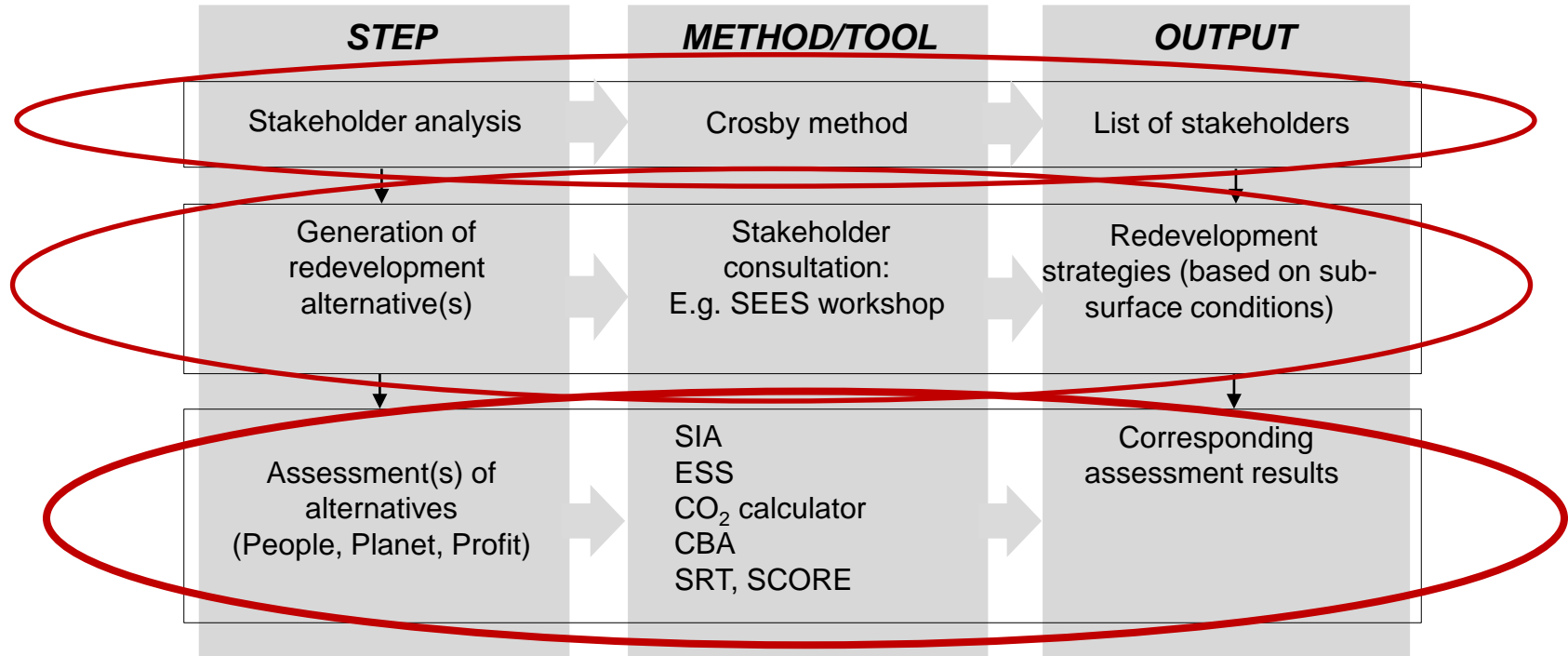
The area has a roughness due to its industrial character.

The area belongs to the Majorna district which has a very strong cultural-historical identity.

The historical heritage from the stone age (Sandarnakulturen) is of importance for the larger region.

(City of Göteborg, 2014)

# Balance 4P input



# Challenges

- Merging assessment results and perspectives on sustainability
- Suitable level of detail in analyses – what are suitable supporting tools – quantitative/qualitative
- Input data – who pays before decision on plan?
- Implementation in practice



# Coming work

- Finalising work in case studies
- International stakeholder workshop (November 12, 2014)
- Synthesis for holistic approach in practice
- ...



# Acknowledgements

- Students
- Stakeholders
- Funders



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