

Appendices

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Appendix A. Comparison of planning system using COMMIN

Table A.1. Comparison of the spatial planning systems in the Netherlands, Sweden and Flanders.

			NETHERLANDS	SWEDEN	FLANDERS
			Spatial Planning	Spatial Planning	Spatial Planning
CONSTITUTIONAL	1 Planning legislation	Which types of by-laws exist outside the central legislative council(s) of the state and by whom are they adopted?	Municipalities have the right to enhance the national building law with local regulations (gemeenteverordening)	As laws, by-laws can only be decided by the parliament in the field of planning.	Land and building Decree(to regulate social housing); Decree for renewal (to prevent empty stock); Housing Act
	2 State-municipal division	Which constitutional principle(s) regulating state-municipal relations exist and what is it called?	Planning Act (Wet Ruimtelijke Ordening)	State-municipal relations are regulated by municipal self-government.	Before 1970s, the Belgian Federal Government was the planning authority; this is now the regional governments. Brussels, Flanders and Walloon
	3 what are main responsibilities of:	state	Main responsibilities of the state are: legislative; Structure vision infrastructure & space	Main responsibilities of the state: national interests, sectorial planning.	Flanders planning system operates on a subsidiarity principle. Competences are regulated in 1996 Spatial Planning Decree
		regional and	Main responsibilities of the Provinces are: regional vision (Streekplan); check land-use plans against Streekplan; management of infrastructure; assist municipalities. Grant permits considering the middle deep layers. Water Boards are there for organising and maintaining the water system.	Main responsibilities of regional authorities (the County Administration Board): Guiding and scrutinizing Municipal comprehensive plans concerning national interests and addressing appeals for detailed plans.	Provincial plans are checked by the regional department; Provinces checks the municipal plans.
		municipal planning agencies	Municipal planning departments make development plans and land-use plans (bestemmingsplan; issue local ordinances and grant building	Main responsibilities of the municipal planning agencies: Comprehensive planning, legally binding detailed planning.	Main responsibilities of the municipal planning agencies are making Spatial Structure Plans and Implementations plans.

			permission. also involved by subsurface user functions related to land use planning (bestemmingsplan)		
4 Access to public authority matters	The people's right to be informed and their right to give their voice: Are they defined as constitutional rights and what is the name for that principle?	Yes, Wet Openbaarheid Bestuur New plans need to be published online.	Yes. The constitutional rights are the Principle of free access to official documents (offentlighetsprincipen) and the Principle of citizens' participation in planning.	Yes, Flanders has a Decree Publicity of Governance. Plans need to be published.	
5 Property rights	Does the constitution protect property rights against public intervention and what is the constitutional principle in case of public taking?	Yes, the constitution protects property rights against public intervention. In case of public taking the principle of expropriation for public needs against compensation is applied.	Yes, the constitution protects property rights against public intervention. In case of public taking the principle of expropriation for public needs against compensation is applied.	Yes, the constitution protects property rights against public intervention. In case of public taking the principle of expropriation for public needs against compensation is applied.	
6 Public rights to the use of land	Is there a general access to land and water and is there a specific right for it?	General access to land and water is not regulated. so-called 'recht van overpad' is private and historically present or not in contracts	According to "everyman's right" (alleman's rätt) everyone has the right to cross and stay temporarily on another's land and water areas provided his behaviour is not disruptive and he does not cause any damage. The right is guaranteed in the Constitution (Chapter 2, article 18, [Sveriges grundlagar]). It is allowed to pick mushrooms, wild berries, pinecones, wild flowers and suchlike on another person's land (regulated in Chapter 12, Section 2, Penal Code [brottsbalk 1962:700]).	The freedom to roam or everyman's right is the general public's right to access certain public or privately owned land for recreation and exercise. The right is sometimes called the right of public access to the wilderness or the right to roam.	

	8 Groups to be prioritized in planning	Is planning meant to give favour to particular groups of the population and if so, which groups are favoured?	Planning is meant to balance access to urban resources for all citizens	Planning is not meant to give favour to particular groups of the population.	Planning is meant to balance access to urban resources for all citizens
NATIONAL	1 Planning organization	A) Are the legal responsibilities for planning and management at national level within one ministry?	Legal responsibilities for planning and management at national level lie with the Ministry of Infrastructure and Environment (housing = Min. Internal Affairs). and Ministry of Economic Affairs	No, different ministries have different legal responsibilities for planning and management at national level. E.g. the Swedish National Board of Housing, Building and Planning [Boverket] is a central government authority administered by the Ministry of Health and Social Affairs responsible for planning legislation. The Environmental Protection Agency [Naturvårdsverket], the Ministry of the Environment, responsible for legislation with regard to natural resource management in planning projects.	legal responsibilities for planning and management at national level lie with the Ministry of the Environment, Nature and Energy
		B) What is the name of the planning law at national level?	Wet Ruimtelijke Ordening (Territorial Planning Act). Soon Environmental Act	The name of the law at national level is Planning and Building Act.	The name of the law at Flanders level is Planning Decree
	2 Laws of particular importance in planning	Which laws have a particular importance in planning at national level?	A number of Laws have impact on planning such as: Environmental Code, Noise pollution Act; Roads & dangerous transport Act, Railway Act (etc), Mining Law, WBB?	Laws having a particular importance in planning at national level are: Environmental Code, Roads Act, Railways Act.	Structural plans give guidelines. Decreeing power lies in implementation plans

3 Regulations and instruments in central government policies and planning	A) Which policy guidelines exist in central government policies and planning?	The National Territorial Structure Vison (SVIR) is informed by international competitiveness, flood protection and	The central government policy that governs a planning process includes environmental quality objectives summarized e.g. in The Swedish environmental objectives system 2013 (http://www.miljomal.se/Global/24_las_mer/broschyren/the-swedish-environmental-objectives-system-M201301.pdf).	SVIR 2012: Productive landscape; long term uncertainty & governance; welfare & wellbeing
	B) Which legally binding regulations exist in central government policies and planning?	A legally binding regulation in central government policies and planning is the Territorial Planning Act.	A legally binding regulation in central government policies and planning is the Planning and Building Act and Environmental Code.	A legally binding regulation in central government policies and planning is the Planning Decree and a number of ordinances.
4 EU regulations	Which EU regulations are adopted/ applied?	Natura 2000, Soil Protection Act; Malta Treaty, Water Framework Directive, Environmental Impact Assessment	Natura 2000, Water Framework Directive, Waste Directive, Environmental Impact Assessment	Natura 2000, Soil Protection Act; Malta Treaty, Water Framework Directive, Environmental Impact Assessment
5 Subsoil management	Which instruments / regulations considering soil management are applied?	There is a Nation Structure Vision Subsoil (STRONG) in preparation; soil covenant and SV shale gas (both in preparation), Basis registration subsoil (EU INSPIRE) National responsibility is >500m mostly considering oil and gas winning. For Cables and Pipes there is KLIK info-system and also archaeology is steered on national level.	Legislation related to the subsurface can be divided into four groups: (i) "soil and groundwater quality" regulated by the Environmental Code; (ii) "archaeology" regulated by the Heritage Conservation Act (kulturmiljölagen) of 1988; (iii) "use of natural resources" regulated by the Water Act (vattenlag) of 1983, the Mineral Act (minerallagen) of 1991, the Peat Deposits Act (lagen om vissa torvfyndigheter) of 1985, and the	

				Continental Shelf Act (lagen om kontinentalsockeln) of 1966; and (iv) "underground installations" regulated by The Pipelines Act (rörledningslagen) of 1978, the Water and Sewerage Act (lagen om allmänna vatten- och avloppsanläggningar) of 1970, the Public Heating System Act (lagen om allmänna värmesystem) of 1981, the Electrical Installations Act (ellagen) of 1985, and the Telecommunication Ordinance (teleförordningen) of 1985.	
6 Nature conservation and cultural heritage	Which nature conservation instruments, and which instruments relating to cultural heritage are applied?	Nature conservation instruments applied are: Flora & Fauna Act Heritage is protected by Monuments Act.	Nature conservation instrument being applied is the Environmental Code. An instrument being applied relating to cultural heritage is Heritage Conservation Act.	Nature, Forrest, Bird, Protecten Flora & Fauna and Habitat Decrees; Protection of Monuments and Town and City Scapes (1976), Decree Protection of Landscape (2010) and Decree Protection of Archaeology (1993)	
7 Integration of sectoral aspects	A) Are there certain bodies/ instruments for integration of sectoral aspects?	Strukturvisies, Streekplannen & bestemmingsplannen integrate sectoral aspects	Legally binding land and water use restrictions through special area regulations (områdesbestämmelser) in comprehensive plans, e.g. recreational amenities, communication routes, restricted areas and safety zones.	The Spatial Structure Plans are the integration of sectoral aspects.	
	B) Which formal duty for integration of	Every province has a planning commission for the coordination	The County administrative board has the formal duty		

		sectoral aspects exists?	of provincial spatial policies	for integration of sectoral aspects.	
	8 Environmental Protection	Is there an independent Environmental Impact Assessment Committee	Yes, it requires structure plans and zoning plans to consider all relevant data of environmental assessment in order to make a sound decision, advice is not binding but in case of a law suit it's advice is usually adopted by the court	No, EIA is done on the municipal level only for (not legally binding) comprehensive plans in consultation with the County Administration Board and sometimes neighbouring municipalities. EIA for the legally binding detailed plans is performed only if the municipality judges (behovsbedömning) that the proposed development may cause "substantial environmental impact" (betydande miljöpåverkan).	The project needs to hire a certified EIA expert to lead the team of experts that make the report. This certification is to ensure quality of the report and takes a procedure led by the Environmental Licences department and supported by different other departments. The report is assessed by the Department of EIA.
REGIONAL	1 Territorial organization	1) Are decentralized state agencies, regional and municipal entities acting authorities in planning?	Yes, decentralized state agencies, regional and municipal entities are acting authorities in planning.	Yes, decentralized state agencies, regional and municipal entities are acting authorities in planning. However, the municipality has a planning monopoly. Regional bodies only consult to ensure national and public interests in a planning process.	Yes, decentralized state agencies, regional and municipal entities are acting authorities in planning.

	B) What is the territorial unit of the regional level, what is the decentralized state authority and what is the regional planning authority?	The territorial unit at regional level is the Province, for regional planning and inter-municipal coordination. The decentralized state authority is the Province administrative board. The regional planning authority is the Regional planning body.	Regional planning is only undertaken for the Stockholm and the Gothenburg regions. The Stockholm County Council (Stockholms län landsting) and the Gothenburg Regional Association of Local Authorities (Göteborgsregionens komunalförbund) are governmental bodies responsible for regional planning in the respective region. Regional plan is adopted only for the Stockholm County. In the Gothenburg Region, regional planning is carried out without formal regional plans. In other cases the County Administration Boards are regional bodies which does not have planning competence but consult and coordinate the municipalities in the planning process to secure national and public interests in the plans.	The territorial unit at regional level is the Province, for regional planning and inter-municipal coordination. The decentralized state authority is the Province administrative board. There are also Arrondissements.
2 Forms of planning at regional levels (planning process)	Which forms of planning/ planning processes exist at regional level?	superimposed or self-organized regional (planning) associations	The forms of planning/ planning processes at regional level are regional development programming, regional planning for Stockholm and Gothenburg regions.	The Provinces and Arrondissements are part of the three step planning system of Flanders, regional and municipal scale.
3 Statutory categories of plans (planning products)	Which statutory categories of plans/ planning products exist at regional level?	Statutory categories of plans on regional level are development program and structure vision by the Provinces, the	The regional development programme and the regional plan (voluntary) are plans/ planning products at regional level.	The Provincial Development Agency makes a Spatial Structure Plan. This is translated to a Spatial Implementation Plan.

			water Boards make Water Plans		
	4 Body mandated for initiating and approval of plans	Which body is mandated for the initiation and the approval of plans at regional level?	The Provincial council are mandated for the initiation and approval of regional development programmes	The County Administrative Boards and the Regional Council are mandated for the initiation and approval of regional development programmes; the National government and the regional planning body are mandated for the initiation and approval of regional plans.	The Flanders government.
	5 Binding force of regional plan	A) Is the regional plan binding on subordinate planning?	Yes, municipalities must check building applications to provincial structural plans. The water boards do the water assessment of plans.	No, the regional plan is not binding on subordinate planning.	Yes, municipalities much check building applications to structure and implementation plans
	6 subsoil management		A number of provinces made a Soil Vision that is aiming at integrating the subsoil in planning. Methods to integrate subsoil in spatial planning like the Soil Ladder Provinces and water boards are responsible for water management, the province for layer in between (aquifers) in relation to extraction permits, they also deal with contamination. The water boards maintain the regional water system, dikes, pumps and open water. The Province is also framing archaeology.	The concession from the Government is needed for extraction of minerals. The permits for mineral extraction are granted on the national level. The archaeological and soil remediation procedures are coordinated on the regional level by the County Administration Boards. The County Administration Boards also oversee hazardous activities, such as energy facilities, quarries and mines.E46	Waterboards and <i>wateringen</i> for water management. For contaminated soil there are Brownfield decrees and covenants.
LOCA	1 Territorial organization	a) Which local territorial unit(s) exist(s)?	rural <i>buitengebied</i> , village <i>dorpskern</i> , town <i>stad</i> , area <i>wijk</i>	The territorial unit at municipal/ local level is the Municipality.	Municipality

	b) Is the local planning authority also the local building authority?	Planning and Building are 2 departments of the same authority	No, by law, the local planning authority is not the local building authority.	<i>Planning and Building are 2 departments of the same authority?</i>
2 Local planning authority bodies	A) Which are the local committees and/ or the local supreme authority for initialization and adoption/ endorsement of plans?	The local committee for initialization and adoption/ endorsement of plans is the Standing committee for planning matters (various names, depends on the municipality) and the local supreme authority for initialization and adoption of plans is the Municipal council.	The local committee for initialization and adoption/ endorsement of plans is the Standing committee for planning matters (various names, Specific name depends on the organisation of the municipality) and the local supreme authority for initialization and adoption of plans is the Municipal council.	<i>The local committee for initialization and adoption/ endorsement of plans is the Standing committee for planning matters (various names, depends on the municipality) and the local supreme authority for initialization and adoption of plans is the Municipal council.</i>
	<i>B) Do legally notified instruments exist to cooperate between municipalities and which are the instruments?</i>	Legally regional collaboration may be superimposed by national government, sometimes it is a voluntary initiative of municipalities (non legally notified)	Yes, there is a legally notified instrument to cooperate between municipalities: the Regional Plan (used only for Stockholm region). Otherwise, despite the planning monopoly of municipalities, the State has right to interfere in municipal planning in order to protect structures of national interests, national resources and inter-municipal issues.	<i>Yes, on the provincial lever the Structure Vision and the Implementation Plan are putting links between smaller units.</i>
3 Forms of planning	A) Which forms of planning for the territorial unit exist at local level?	Vision for municipal level, Masterplan for district level (both no binding status) and then on the lowest level the Land use plans (bestemmingsplan) are the legal instrument for planning at local level. These are	The form of planning for the territorial unit at local level is the Municipal comprehensive plan.	<i>Spatial Implementation Plans are the legal instrument for planning at local level</i>

		under development towards and Environmental Plan		
	B) Are there plans for various levels and how are they called?	City Vision, Master Plan, Urban Design Plan (Zoning Plan), Public Space Plan	Yes, there are plans for various levels: Municipal comprehensive plan, detailed municipal comprehensive plan, detailed development plan.	Yes, there are plans on two levels the Municipal Structure Plan and the Municipal Implementation Plan
4 Regulation instruments of local plans	A) Are land use zoning categories required in local plans?	Yes, land use zoning categories are required in 'bestemmingsplan'	Yes, land use zoning categories are required in local plans.	Yes, land use zoning categories are required in Municipal Structure and Impementation Plan
	B) Which formulations are applied for giving future directions in local plans?	Master plans contain guidelines; Zoning plans provide legally binding regulations concerning land-use and building envelope.	Comprehensive plans contain guidelines; detailed development plans provide legally binding regulations concerning building and land-use.	Structure Plans (sometimes called Master Plans) contain guidelines; Implementation Plans provide legally binding regulations concerning land-use and building envelope but also maintenance.
5 Overall local plan	A) What is the name of the overall local plan(s), and is it legally binding?	The overall local plan is usually the Municipal Development Vision. It is not legally binding	The overall local plan is the Municipal comprehensive plan. It is not legally binding.	The overall local plan is the Municipal Structure Plan. It is legally binding
	B) What are the main components of the overall local plan(s)?	The main components of the overall local plan are diagnoses, vision, maps and indicative timetable	The main components of the overall local plan are a plan map and an explanatory report.	The main components of the RUP are diagnoses (situation physical, jurisdictional, spatial option), urban guidelines in maps, drawings and texts.
	C) Which statutory zoning and land use categories are shown on the plan map?	Identification of districts and their future development, thematic in housing area or centre district.	The following should be clear from the plan: the intended use of land and water areas, how the built environment should be developed and be preserved and how the municipality intends to provide for areas of national interest and environmental quality standards.	The following should be clear from the plan: the vision of and intended use of land in the area,

	D) Is the time horizon of the overall plan(s) positively limited and for how long?	It differs per city but it usually is about 30-50 years.	There are no horizon limits of the overall local comprehensive plan but the plan shall be revised at least every 5-6th year.	There are no horizon limits.
6 detailed plans	A) Is there a free right to initiate a detailed development plan, what categories of these plan(s) exist and are they legally binding?	Yes, there is a free right to initiate a detailed development plan, the municipality need to check the plan before implementation against formal existing plans & regulations	Yes, there is a free right to initiate a detailed development plan but the municipality can without appeals refuse the initiative (Municipal Planning monopoly). The category of plan is Detailed development plan. It is legally binding.	The municipality makes the Municipal Spatial Implementation Plans.
	B) Are time limits set for the public handling of detailed development plans and is the time horizon/ validity of these plan(s) positively limited?	Zoning Plan needs to be updated within max 10 years	There are no time limits set for the public handling of detailed development plans. The time horizon of the plan is positively limited: the protection of not used development rights is limited to 5 - 15 years.	There is no time limit.
	C) Which statutory land use zoning categories exist in detailed development plans?	Type of plan, type of usage (housing, water, traffic, garden, sports, recreation, nature, societal, trade, green, mixed, service, industry, trade, culture, centre, forest, agriculture and office), double zoning, type of hindrance contour, type of plan, type of juristical level.	Main categories in the detailed plan are blocks for building purposes, streets, parks and special areas (railways, waste management). Blocks then can be given different uses as residential, industry, commerce and so on.	Boarder, Usage: housing four types), centre (two types), shops, leisure, industry, green, public space, trade and right of sale.
7 Development control	A) Which statutory density measures are implemented in addition to land use zoning categories?	In addition to land use zoning categories different means are used to regulate building within blocks, height of structures, number of storeys, floor space	In addition to land use zoning categories different means are used to regulate building within blocks, height of structures, number of storeys, floor space	In addition to land use zoning categories different means are used to regulate building within blocks, height of structures, number of storeys, floor space

			etc.	etc.	etc.
		B) What are the statutory categories of building permit matters?	Statutory categories of building permit matters are: Building permit, Demolition permit, <i>woonruimteontrekkings</i> permit.	Statutory categories of building permit matters are: Building permit, Demolition permit, Site improvement permit.	
		C) What are the categories of permits for projects requiring building application and are there time limits for the permit's validity?	Building activities may require a 'light' of 'full' building permit and need to start within a year.	There is a time limit for the permit's validity for projects requiring building application (2 years).	
		D) what relation has the Zoning plan to the building permits?	The zoning plan is checked to see if the building application is meeting the requirements in that zone. There is a very strong connection.	There is a very strong connection between building permits and the legally binding detailed plan. The latter is checked to see if the building application meets the requirements in the detailed plan.	
	8 subsoil management		Through the Zoning Plan some categories of the subsoil are touched on a municipal level. But next to water, remediation, archaeology and cables and pipes there is no active management or vision. Some municipalities are working on a Master Plan for the subsoil.	Only archaeological procedures integrated into a detailed planning process (early stage). The soil remediation procedures are usually carried out in the late stage of detailed planning or after approval of the detailed plan. Contaminated soil related issues are handled on both municipal and regional levels, but since the division of responsibilities is not clear in the legislation the Swedish Environmental Protection Agency is currently inquiring into this issue. There are special	

				regulations in the detailed plan defining land reserves (markreservat) for jointly owned facilities (gemensamhetsanläggningar), easements (servitut), and utility easements (ledningsrätter).	
PARTICIPATION	1 The entitlement to inform and the right to get access to information (answers sorted by levels)	Are there statutory requirements for informing the public and public access to information?	Zoning Plans need to be available online	Yes, at regional level, the statutory requirement for public access to information is firstly the constitution principle of free access to official documents (offentlighetsprincipen), secondly the rules for regional planning in the Planning and building Act.	All RUP's are available online.
	2 Particular participatory instruments beyond information in the planning process	Are there statutory instruments for public participation during the preparation of plans like number of hearings, meetings, etc.?	Yes, plans need to be made public and a period of time that citizens can appeal to the plans.	At regional level, there are no statutory instruments for public participation during the preparation of regional development programmes but regional plans require public reviews, public exhibition and comments on public opinions.	

	<p>3 The public opportunity to challenge the plan after the plan is formally adopted</p>	<p>Is there an option for an appeal in order to challenge the plan after it is formally adopted?</p>	<p>No</p>	<p>At regional level, nobody can appeal in order to challenge the comprehensive plan after it is formally adopted, because it is not legally binding. But the residents can express dissatisfaction with the planning process initiating the local appeal procedure (kommunalbesvär) under the Local Government Act (kommunallag) of 1991. The content of the adopted legally binding detailed plan can be contested by appeal to the County Administrative Board, whose decisions in turn can be contested to the Land and Environmental Higher Court (Mark- och miljööverdomstolen), and ultimately to the Supreme Court (Högsta domstolen).</p>	
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BUILDING PRACTICE	1. Who initiates urban development?	<p>Municipalities used to get an assignment for building a certain amount of houses in their region from the national state. Provinces support these numbers in their structure plan, municipalities would initiate the development. Today development takes foremost place in existing urban tissue; the initiative is with the project developer, housing cooperation or self-organized citizens.</p>	<p>There are several models of the development process depending on the ownership conditions within the development area and the role of the developer in the process. Initiative may come from the municipality because of need for housing, non-residential development or the enlargement and improvement of infrastructure provision. The initiative in changing the land use may also be taken by owners of a prospective development area.</p>	
	2. what type of process is used?	<p>There is an initiation phase that looks into the feasibility and formulates a vision, then there will be a master plan, a urban design plan and design for public space.</p>	<p>The process consists of vision formulation and detailed planning of the development area. When developer owns land, he plays an active role in a planning process. Municipality and developer may agree that land for streets and green areas are to be conveyed to municipality and that developer reserves space for services and communal facilities.</p>	
	3. what role does the government play?	<p>The government changes from initiator and producer to facilitator. They bring parties together and set out tenders for cooperations to propose a development.</p>	<p>The Government through its representative at the regional level (County Administration Board) ensures protection of structures of national interests, national resources and inter-municipal issues in the planning process. Planning of high-, rail-, tram- and</p>	

			subways is in responsibility of Government under the Road Act (väglagen) of 1971 and the Railway Act (järnvägslagen) of 2004.	
	4. How is knowledge integrated in the plan and design process?	Technical support always came from the municipality. In the new organic development it is unclear what the role of the municipality is in supporting knowledge integration.	Technical support comes from responsible divisions at the County Administration Boards and the municipality, as well as consulting agencies.	
	5. how is subsoil inserted in the development process?	There is now no common practice concerning introducing subsoil into the development, this works through experts who enter late in the process.	Archaeological procedures integrated into a planning process. Planning of subsurface electrical installations and municipal facilities (pipelines) are integrated into the planning process. The soil remediation procedures are usually carried out in the late stage of detailed planning or after approval of the detailed plan.	

Table A.2. Expanded COMMIN system – the Netherlands.

	institutions	laws	policy/instruments	regulation
EU	Board of European Ministers of Spatial Planning	Waste Directives Natura 2000	European Spatial Planning Charter (1983); European Spatial Development Perspective (2003) INSPIRE Directive (2007): information gathering	EU Guidelines energy performance for buildings (EPBD)
National	Ministry of Infrastructure and Environment (Institute for Social Research, Environmental Assessment Agency) Ministry of Internal Affairs	Spatial Planning Act (2008) > Environmental Act Nature Protection Act	Structure Vision Infrastructure and environment 2040 (2012); Ministerial guidelines (no law) for gas and	

	Environmental Impact Assessment Commission Ministry of Education, Culture and Science (Cultural Heritage Agency) Forestry (staatsbosbeheer)	Noise Pollution Act Transport Dangerous Substances Act Building Act (2012) Environmental Protection Management Act Public Health Act Monuments and Historic Buildings Act	inflammable liquid transport: distance around networks. External Safety ordinance: obligation to register risk with dangerous material. National Waste Management Plan (LAP) National Environment and Health Plan 2008-2012 Noise and Fine dust zoning	Building Codes Environmental Impact Assessment (for structure and zoning plans)
Regional	Regions Provinces		Regional Plan Structure Plan Area Profiles Spatial Qualities Provincial Environmental Ordinance	
Local	VNG Municipalities		Vision, Master Plan Architectural Quality Assessment	Model Ordonnances (modelverordeningen) Zoning Plan Building Permits
Water	institutions	laws	policy/instruments	regulation
EU		Water Framework Directive Urban Wastewater Directive Ground Water Directive		
National	Ministry of Infrastructure and Environment (Deltares) National Water State Department	Water Act Environmental Management Act	National Water Plan Safety Qualification Primary Defence (veiligheids kwalificatie keringen)	
Regional	Provence Water Authority	Water Level Decree	Regional Water Plan Water Plan	Province regulates infiltration and extraction of water (new Waterwet/Water Act in preparation) Water Assessment Test

			waterschapslegger	
Local	Municipality		Water Plan local waste-water plan	
Subsoil	institutions	laws	policy/instruments	regulation
EU		Directive on Waste Directive on Landfill of Waste	European Soil Strategy	
National	Ministry of Economic Affairs Ministry of Infrastructure and the Environment (TNO)	Mines Act Soil Protection Act (1987) Excavation Act Environmental Management Act Nature Protection Act	STRONG (National Spatial Planning Strategy for the subsurface) (expected 2015) Information System Soil Soil Policy Letter (2003) Soil Convent	
Regional	Provinces		Soil Vision/Soil Ladder	soil remediation
Local				soil remediation
Civil constructions	institutions	laws	policy/instruments	regulation
EU			European Convention on the Protection of the Archaeological Heritage (1992)	
National	Ministry of Economic Affairs (Municipal Platform of Cables and Pipes, Cultural Heritage Agency, Centre of Underground Building) Ministry of Education, Culture and Science (Cultural Heritage Agency)	Information Exchange on Underground Infrastructure Act (WION) Excavation Act Archaeological Heritage Management Act Monuments and Historic Buildings Act	KLIC External Safety ordinance: obligation to register risk with dangerous material.	
Regional	Provinces		Structure scheme pipelines (SBUI): national main network for provinces to incorporate in structure plans. Provincial Research Agenda Archaeology Policy Cultural	

			Heritage; Programme Heritage	
Local	Municipality	Environmental Management Act		sewer regulations Local regulations considering cables and pipes in general.
Energy	institutions	laws	policy/instruments	regulation
EU		European Energy Strategy Plan (2013)	Energy Technologies and Innovation (2013)	
National	Ministry of Economic Affairs, Ministry of Infrastructure and the Environment and Ministry of Social Affairs and Employment	Nuclear Energy Law: regulates ministerial competences for storage of radio-active waste; Strategy on Shale Gas (expected 2015)	SER energy agreement (2013)	Energy Prestation Certificate
Regional	Provinces		IPO agreement geothermal	license issued under the General Provisions Environmental Law (Wabo) (open systems) reporting closed bottom energy ATES (recorded in amending soil energy, no separate Amvb)
Local				

Table A.3. Expanded COMMIN system – Sweden.

	institutions	laws	policy/instruments	regulation
EU	Board of European Ministers of Spatial Planning	Waste Directives Natura 2000	European Spatial Planning Charter (1983); European Spatial Development Perspective (2003) INSPIRE Directive (2007): information gathering	EU Guidelines energy performance for buildings (EPBD)
National	Ministry of Health and Social Affairs (National Board of Housing, Building and Planning [Boverket], Swedish Environmental Protection Agency, National Board of Health [Socialstyrelsen])	Riksdagen has 13 laws		

	<p>Planning and Building Act (<i>Plan- och Bygglagen - PBL</i> (2010:900))</p> <p>Environmental Code (Miljöbalken (1998:808))</p>	<p>Planning and Building Ordinance (plan- och byggförordningen 2011:338)</p> <p>Houskeeping Ordinance [Hushållningsförordningen 1998:896]</p> <p>Regulation on implementation of the Environmental Code (Lag om införande av miljöbalken 1998:811)</p> <p>Environmental Impact Assessment Ordinance (Förordningen om miljökonsekvensbeskrivningar 1998:905)</p>
<p>Ministry of Health and Social Affairs (National Property Board of Sweden [Statensfastighetsverket])</p> <p>Ministry of Culture (Swedish National Heritage Board [Riksantikvarieämbetet])</p>	<p>Cultural Heritage Act (kulturminneslagen 1988:950)</p>	
<p>Ministry of Health and Social Affairs (National Land Survey <i>Lantmäteriet</i>)</p>	<p>Property Subdivision Act (fastighetsbildningslagen 1970:988)</p> <p>Utility Easement Act (ledningsrättslagen 1973:1144)</p> <p>Joint Installation Act (anläggningslagen 1973:1149)</p>	<p>Registration of jointly owned facilities (gemensamhetsanläggningar), easements (servitut), and utility easements (ledningsrätter) in Land Registration System (fastighetsregister)</p>
<p>Ministry of Environment - Miljödepartementet (<i>Swedish Environmental Protection Agency - Naturvårdsverket</i>)</p>	<p>Environmental Code (Miljöbalken 1998:808)</p> <p>Lag om införande av miljöbalken (SFS 1998:811)</p> <p>Förordningen om avgifter för prövning och tillsyn enligt miljöbalken (SFS 1998:940)</p> <p>Expropriation Act (expropriationslagen 1972:719)</p> <p>Pre-emption Act (förköpslagen 1967:868)</p> <p>Joint Land Development Act</p>	<p>Förordningen om miljökonsekvensbeskrivningar (SFS 1998:905)</p>

		(lagen om exploateringssamverkan 1987:11)		
	Ministry of Enterprise, Energy and Communications (Transport Administration [Trafikverket])	Road Act (väglagen 1971:948) Railway Act (järnvägslagen 2004:526)		
Regional	County Council (<i>Landstinget</i>) is the link between national and municipality (County Administrative Board [Länsstyrelsen])		Environmental quality standards, shorelines and human health, safety, risks, flooding, erosion. Regional Plans (<i>Regionplan</i>) and Regional Development Strategies (<i>Regionala utvecklingsstrategier</i>)	
Local	Municipality (Urban Planning Departments (<i>Stadsbyggnadskontoret</i>), Urban Planning Committees (<i>Stadsbyggnadsnämnden</i>))		Municipal Comprehensive Plan (<i>Översiktsplan</i>) and Parts of a Comprehensive Plan (<i>Fördjupad översiktsplan</i>) building permit (<i>bygglov</i>) demolition permit (<i>rivningslov</i>) site improvement permit (<i>marklov</i>)	Detail Plan (<i>detaljplan</i>) Area Regulations (<i>Områdesbestämmelser</i>)
Water	institutions	laws	policy/instruments	regulation
EU		Water Framework Directive Urban Wastewater Directive Ground Water Directive		
National	Ministry of Health and Social Affairs (National Board of Housing, Building and Planning (<i>Boverket</i>)) Ministry of Environment - Miljödepartementet (Swedish Environmental Protection Agency - Naturvårdsverket)	Planning and Building Act (<i>Plan- och Bygglagen - PBL</i>) (2010:900) Environmental Code (Miljöbalken) (1998:808) Water Act Public Water and Waste Water Plant Act (lag om anmäla		

		vattentjänser) 2006		
Regional				
Local				Area Regulations (<i>Områdesbestämmelser</i>)
Subsoil	institutions	laws	policy/instruments	regulation
EU		Directive on Waste Directive on Landfill of Waste		
National	Ministry of Health and Social Affairs (<i>Swedish Environmental Protection Agency, Swedish Geotechnical Institute</i>) Ministry of Enterprise, Energy and Communications (<i>Geotechnical Survey of Sweden</i>)	Environmental Code (Miljöbalken 1998:808) Peat Deposits Act (lagen om vissa torvfyndigheter 1985) Mineral Act (minerallagen 1991) Continental Shelf Act (lagen om kontinentalsockeln 1966)		
Regional				
Local				<i>Special regulations in the Detail Plan (detaljplanebestämmelser), i.e. land reserves (markreservat) for jointly owned facilities (gemensamhetsanläggningar), easements (servitut), utility easements (ledningsrätter)</i>
Civil constructions	institutions	laws	policy/instruments	regulation
EU			European Convention on the Protection of the Archaeological Heritage (1992)	
National	Ministry of Culture (Swedish National Heritage Board [<i>Riksantikvarieämbetet</i>]) Ministry of Enterprise, Energy and Communications (Swedish Energy Agency [<i>Energimyndigheten</i>])	Heritage Conservation Act (kulturmiljölagen 1988) Electrical Installations Act (ellagen 1985) Public Heating System Act (lagen om allmänna värmesystem 1981) Pipelines Act (rörledningslagen 1978)		Telecommunication Ordinance (teleförordningen 1985)

	Ministry of Health and Social Affairs (National Land Survey Lantmäteriet)	Water and Sewerage Act (lagen om allmänna vatten- och avloppsanläggningar 1970) Joint Installation Act (anläggninglagen 1973:1149) applies to facilities common to two or more properties e.g. parking C12 play C14 water and sewerage facilities constructed and maintained by property owners Utility Easements Act (ledningsrättslagen 1973:1144) applies to e.g. water and sewerage facilities constructed and managed by municipalities (legal bodies), telephone lines		Registration of jointly owned facilities (gemensamhetsanläggningar), easements (servitut), and utility easements (ledningsrätter) in Land Registration System (fastighetsregister) by National Land Survey (lantmäteriet)
Regional				
Local				
Energy	institutions	laws	policy/instruments	regulation
EU		European Energy Strategy Plan (2013)	Energy Technologies and Innovation (2013)	
National	Ministry of Enterprise, Energy and Communications (Swedish Energy Agency [Energimyndigheten]) Ministry of Health and Social Affairs (Lantmäteriet)	Municipal Energy Planning Act (lagen om kommunal energiplanering 1977:439) Utility Easements Act (ledningsrättslagen 1973:1144) applies to heating main, high- and low-voltage power lines		
Regional				
Local			Energy plan (energiplan)	Special regulations in the detailed plan, i.e. land reserves (markreservat) for jointly owned facilities (gemensamhetsanläggningar) and utility easements (ledningsrätter)

Table A.4. Expanded COMMIN system – Flanders.

	institutions	laws	policy/instruments	regulation
EU	Board of European Ministers of Spatial Planning	Waste Directives Natura 2000	European Spatial Planning Charter (1983); European Spatial Development Perspective (2003) INSPIRE Directive (2007): information gathering	EU Guidelines energy performance for buildings (EPBD)
National		Planning Act (1962)		
national/ Flanders	Flanders Department for the Environment, Nature and Energy (Department Space and Monuments) Flanders Department for the Environment, Nature and Energy (Flanders Environment Administration) Flanders Department of Mobility and Public Works		Regional Zoning Plan (<i>gewestplan</i>); gradually replaced by Spatial Structure Plans (RUP) Spatial Structure Plan Flanders SVIR 2012	Planning Planning Decree 1996 Decree Protection of Monuments and Town and City Scapes (1976) Decree Protection of Landscape (2010) Nature, Forrest, Bird, Protecten Flora & Fauna and Habitat Decrees EIA decree (Milieueffectenrapport) Spatial Safety Report (ruimtelijke veiligheidsrapport; RVR) Mobility Impact Assessment (mobiliteitseffectenrapport; MOBER)
Regional	Provinces and Arrondissementen (Provincial Development Agency)		Regional Spatial Structure Plan Provincial Spatial Structure Plan Strategic Plan Tourism and Recreation and Scheldeland	Regional Spatial Implementation Plan Provincial Spatial Implementation Plan
Local	Municipality	Local Government Act 1991	Municipal Spatial Structure Plan	Municipal Spatial Implementation Plans
Water	institutions	laws	policy/instruments	regulation
EU		Water Framework Directive Urban Wastewater		

		Directive Ground Water Directive		
National	Flanders Environment Agency	Surface Water Act	Sigmaplan (flood protection)	
Regional	Provinces Water Boards			Decreet Integraal Waterbeleid
Local	<i>Watering</i>			Water Assessment Test
Subsoil	institutions	laws	policy/instruments	regulation
EU		European Strategy & Soil directive: protection and remediation. Covering, pollution, erosion, loss organic material, saltification, densification, biodiversity, landslides); Directive on Waste Directive on Landfill of Waste	European Soil Strategy	
National	Ministry of Economic Affairs (Belgium Geological Department)	Mining of Minerals Act		
National /Flanders	Flanders Department for the Environment, Nature and Energy (Public Waste Compagny) Brownfield Cel		Subsoil Information System Brownfield Decree	Soil Protection and Contamination Decree (2006) > Brownfield decree Brownfield Covenant
Regional				
Local				
Civil constructi ons	institutions	laws	policy/instruments	regulation
EU			European Convention on the Protection of the Archaeological Heritage (1992)	
National /Flemish	Flanders Department for the Environment, Nature and Energy (Department Space and Monuments, Flemisch Insitute for Heritage) Platform of Cables and Pipes			Decree Protection of Archaeology (1993) KLIP information system cables-pipes
Regional				

Local				
Energy	institutions	laws	policy/instruments	regulation
EU		European Energy Strategy Plan (2013)	Energy Technologies and Innovation (2013)	
National				Energy Prestation Certificate
Regional				
Local				

Appendix B – Example Inventory of stakeholders

Table B.1 shows an example of an inventory of stakeholders.

Table B.1. Example of stakeholder inventory (After: DPNH - Handreiking Ruimtelijke Adaptatie, Van de Ven 2014).

Party	Specific
municipality	College mayor and alderman
	public works
	sewerage / urban water
	roads
	spatial planning & design
	Landscape architecture
	maintenance public buildings
	maintenance public green
	police / fire fighters
	economics
	social affairs
	Engineering office
	other
water board	administration
Province (region)	council
	spatial planning
	road maintenance authority
	other...
national government	ministry of Infrastructure and environment
	other ...
knowledge providers	service providers /advisors
	research institutes
waterworks	Winning
	Distribution
housing corporation	Name
network operator	Electricity
	Gas
	Telecom/internet
	Water (see also waterworks)

Party	specific
real estate sector	shopping centres
	theatres / cinema
	hospital
	nursing home// home for the elderly
	amusement park
	zoo
	Other ...
green / garden companies	Name
Building companies	Name
Local industry	Type 1
	Type 2
	Other ...
Banks	Name
Insurance companies	Name
NGOs	Association
	interest group
	Other ...

Appendix C – Overview of instruments

The content in this appendix is derived from Kok, Sien (2014): A Guide Through the Forest of Sustainable Urban Redevelopment Instruments. Internship at Vrije Universiteit Amsterdam, The Netherlands.

The original aim of this study was to inform actors in the field of sustainable brownfield - and urban redevelopment on available methods and tools and provide directions to their use. To this end, an overview was made of 91 relevant instruments recently applied in Europe, and they are described in a short text and by using the following parameters: original aim, character, approach, tool/ method, project phase, target group, effort, costs, application history, launch date, international applicability, sustainability and incorporation of the subsurface. These parameters address some of the criteria important for users in applying these instruments: universality, simplicity, multidimensionality, transparency, adaptability/ flexibility, (legal) status and approach. Choosing the right instruments for a specific project and applying them in the right way is not a straightforward process, especially in a brownfield redevelopment: every brownfield has a different set of characteristics defining it (e.g. history, environmental circumstances, location in the urban system, economic potential) and there are often many different stakeholders and other aspects complicating the process. Ideally, instruments applied in the redevelopment process are chosen after the priorities and characteristics of the site are established and the problem is characterized carefully. Where (if at all) the focus in sustainability lies and which role the subsurface can play in the redevelopment project, depends on this assessment: several instruments are available addressing these topics. The need for adapting indicators, weighting and topics addressed in these instruments to local circumstances, is increasingly recognized in the field. Choosing the optimal instruments for a project becomes more difficult if there is lacking know-how and knowledge in an organization on available instruments: the overview in this study provides the potential user with ideas on available instruments.

Which type of instrument is applied, and which purposes they serve, differs over the project phases. In the Anticipating Change phase (pre-initiative), instruments are available to prepare organizations for change, predict future land use or assess climate risks. In the Initiative phase instruments are used to support communication (e.g. familiarize with the area and stakeholders and determine ambitions), the decision making process, and for gathering information. In the Design/ Planning phase instruments are used in developing and choosing project scenarios and optimizing the final design. In the Realization phase they are used in optimizing the construction process and communication of the projects' progress and in the Maintenance & Evaluation phase for evaluating the efficiency or sustainability of the project.

The role of the subsurface in the instruments assessed in this study ranges from very generic to quite specific. Especially in more recently developed instruments the subsurface gets more attention, often as part of a holistic approach. Several instruments are included in the overview that have the primary purpose of addressing the subsurface in spatial planning or urban (re)development: informing the spatial planner on important factors, familiarizing stakeholders or spatial planners with the possibilities and enabling them to create a collective vision and finding synergies between the subsurface and other project targets. Compared to other instruments, subsurface-related instruments have an even stronger need for adaption to local conditions: subsurface related factors are very site-specific (e.g. soil type, hydrological situation, contamination). It is recommended to address the subsurface early in the project by specifying a subsurface agenda for the area, including

local subsurface qualities, issues and urgency. Another advice for the early phases in the project (Initiative) is to include stakeholders as early as possible. This facilitates gathering local information and challenges, and enables engagement and goodwill under local stakeholders: not only during the process but afterwards as well. Instruments facilitating workshops and stakeholder sessions are available to support this. Participation can be improved by clearly defining and communicating - before application of the instrument- what will be done with the results, and making sure financial means and time to deal with them are reserved. When digital instruments are used in the project without complementing them with traditional, non-digital ones, it is good to note that they might decrease meaningful interaction between stakeholders and with the data; also they have an internal credibility which might not be justified. In general, it is best not to attach too much value to the outcome of one single instrument, especially when it concerns software tools calculating or assessing effects of a project or project scenario (remembering the old rule: the output is only as good as the input). A good understanding of the instrument before application and a clear definition of the desired outcome increases the result of applying a tool; especially when it concerns a workshop with various participants. In this case, an independent facilitator might be also advisable. Lastly, there is much development and change in the field of instruments and information available for brownfield and urban redevelopment. Therefore the set-up of a general, EU-wide database is recommended – as well as more local, national-scale databases of available instruments. This will enable users to find the best instruments for their projects and increase exchange of available knowledge.

Table C.1. List of instruments per category.

List of instruments per category Category	Instruments
<i>Design development options</i>	
General direction: possibilities and ambitions	Ambitieweb, Natuurlijke Alliantie, Matrix Ruimtelijke Kwaliteit, Prioritization tool, Land Use scanner, ABC Model
Communication & cooperation stakeholders/ Different disciplines	SEES, Ontwerpend Onderzoek, Meerwaardescan, Triple O, Ecodynamic Design, Schetsschuit, Ondergrond Stratego, Serious Game Ondergrond, Simlandscape
Supporting Software	Citymaker, Cityplanner, Gebiedsontwikkelaar, Autodesk software, MapTables
Process guide/ Concepts to attend	Cabernet Opportunity Matrix, Urban Renaissance
Temporary Destination	Tijdelijk Anders Bestemmen (TAB)
<i>Assess Project options</i>	
Effects	SAT, Cabernet Interaction Matrix, Matrix Decision Support Tool, UDEM, DEFINITE, Urban Strategy, Bodemtool, RICARDO
Cost-efficiency	GPR Onderhoud, STORM, Value Engineering, Geokalkyl
Sustainability	Megasite Management Toolsuite, GPR Stedenbouw, BREAAAM-NL Gebiedsontwikkeling, Omgevingswijzer, DPL, Duurzaamheidsmeter, SCORE tool
<i>Tools supporting aspect of process</i>	

Energy	Quickscan gebiedskenmerken, WKO-tool, ThermoGIS, EPL, CO2 Prestatieladder, EPASch, Energieatlas, EPM
Soil	Bodemloket.nl, BRO, INSPIRE Geoportal, Risicotoolbox bodem
Water	Kansrijke Gebieden Gebiedsgericht Grondwaterbeheer, Watertoets, Functiefaciliteringskaarten
Spatial quality	Spacemate
Climate change adaption	Ruimtelijke klimaatscan, Adaptatiescan
Other	www.Cultureelerfgoed.nl, www.aardkunde.nl, Klic: www.infracad.nl , etc
<i>Information: Guides, toolboxes, websites, databases</i>	
Incorporate subsurface in spatial planning	www.bodemvizier.nl, soilpedia.nl, Routeplanner Bodemambities , Handreiking Ordening Ondergrond: Financieel-Juridisch afwegingskader, Gebruik van de ondergrond: Ingrediënten voor een afweging, Redeneerlijn voor de ondergrond, Zeven sleutels voor gebruik van de ondergrond , Ontwikkelingsmodel Ondergrond, Afwegingskader Ondergronds/Bovengronds: Kwaliteit van de Leefomgeving, Duurzaam Gebruik Ondergrond: Gereedschap Structuur en Visie, Afwegingen bij Gebruik Grondwater en Ondergrond, De Bodem: een Stevige Basis
Executing a sustainable (re)development	www.ruimtexitmilieu.nl , Sustainable Urban Fringes, Duurzame Gebiedsontwikkeling: Doe de Tienkamp, Information System TIMBRE, Brownfield navigator, SMARTe, Aanpak duurzaam GWW, Stakeholder Engagement Toolkit, Self-Guiding Trail, www.werkpartners.net , www.handreikingdro.nl , Leidraad Brownfield Ontwikkeling PMV_BE, Optirisk: Recommendations for Action
Adaption to climate change	Klimaatwijzer
Brownfield regeneration case-studies & examples	Urban Regeneration Toolbox, COBRAMAN database

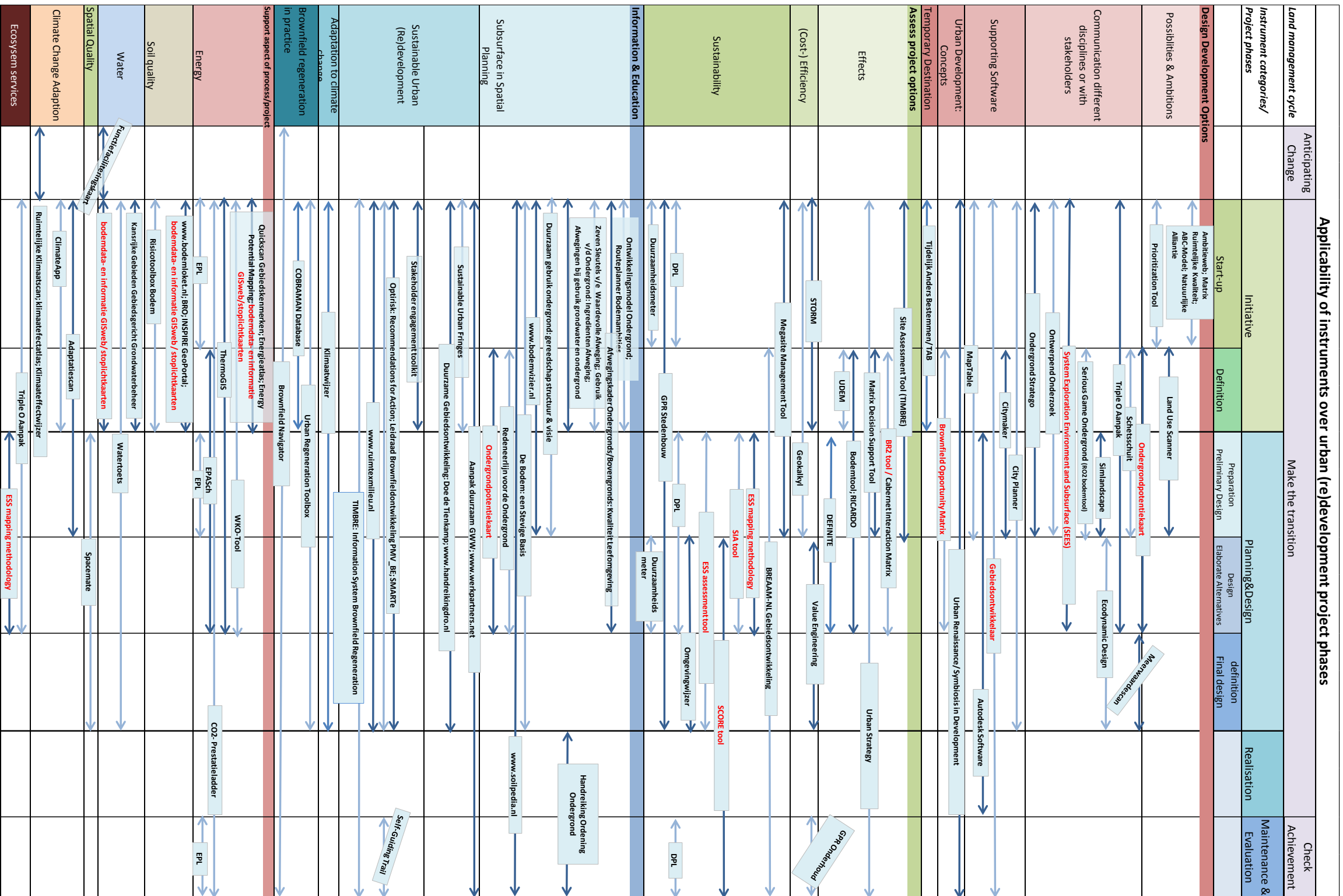
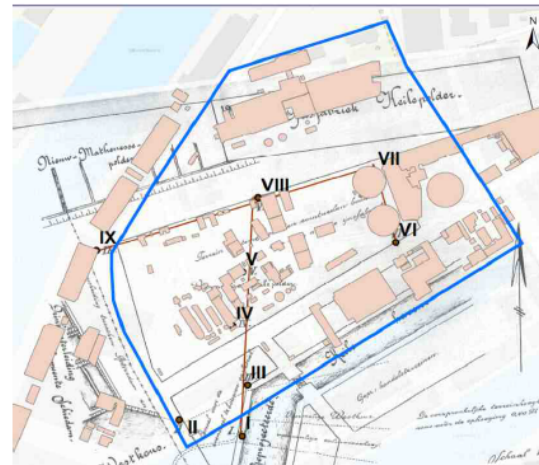


Figure C1. Overview of instruments along the project phases.

Appendix D – Rotterdam Merwevierhaven idea book

Ideëenboek EON/Eneco/Ferro Merwevierhavens, Rotterdam

- Ideeënboek naar aanleiding van de workshop op 23 sept 2014



CHALMERS
UNIVERSITY OF TECHNOLOGY
FRIST kompetenscentrum
Forum for Risk Investigation and Soil Treatment

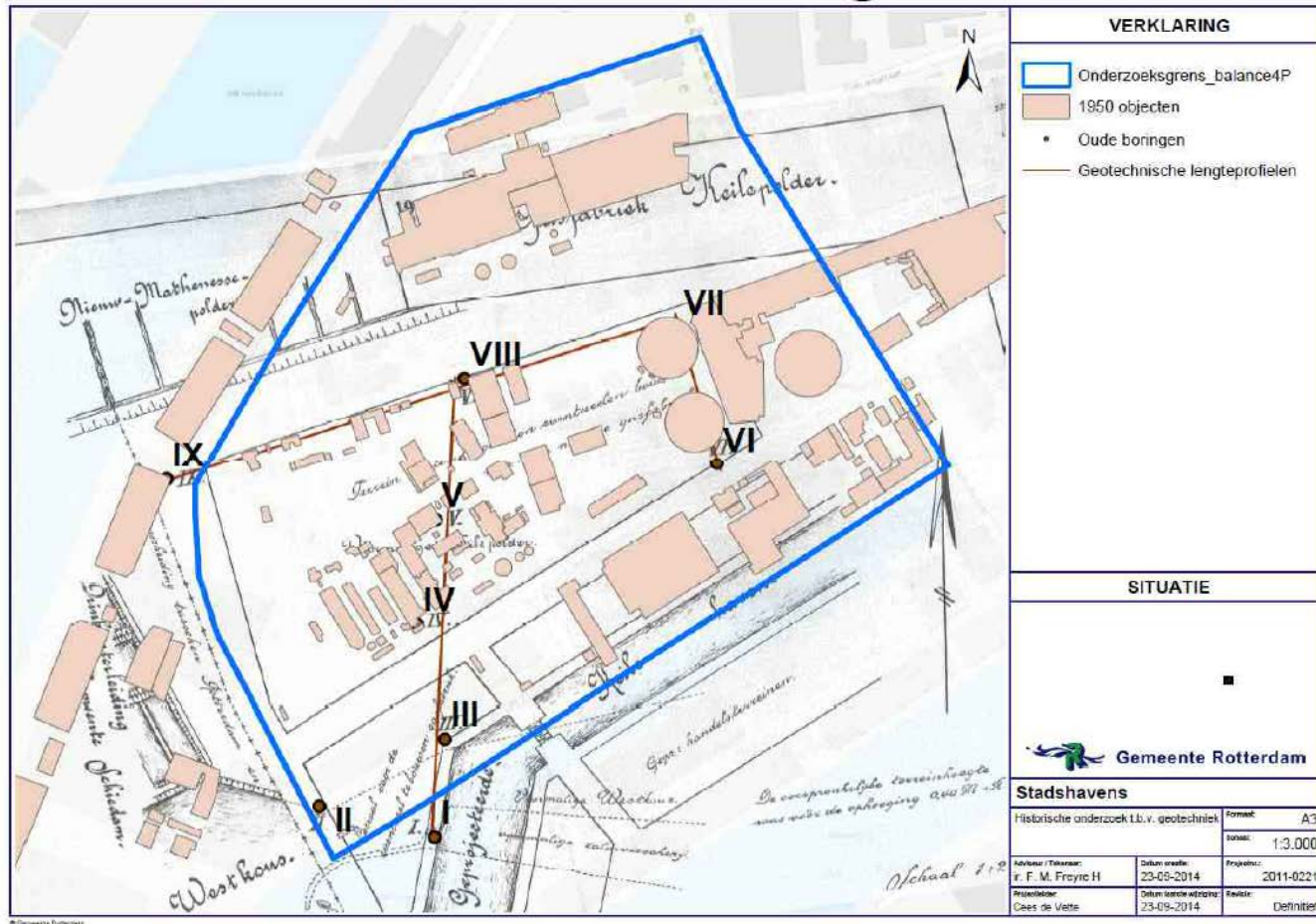


Deltares **TU Delft**
Delft University of Technology

Archeologie



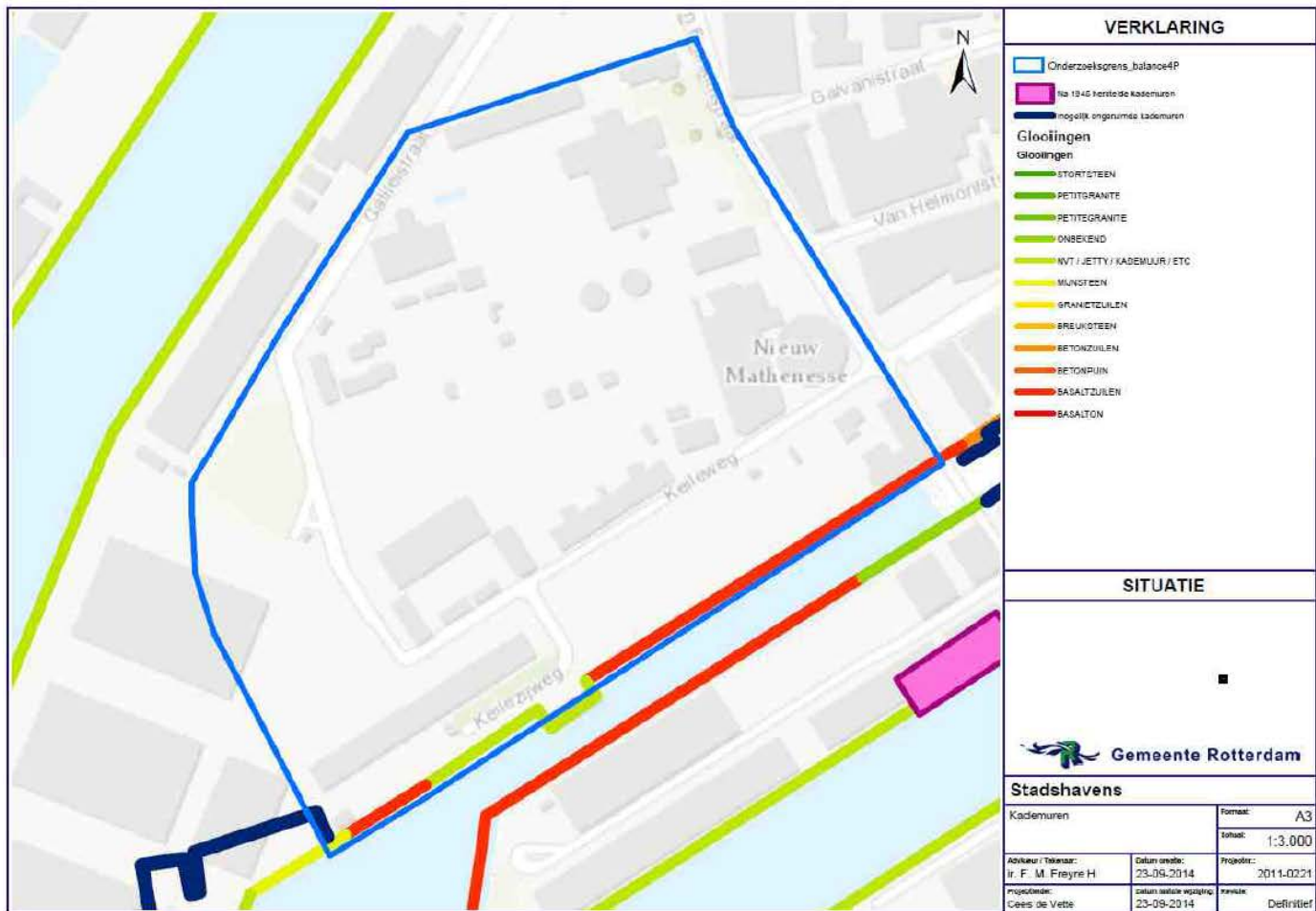
Historisch onderzoek geotechniek



Kabels en leidingen (openbare ruimte)

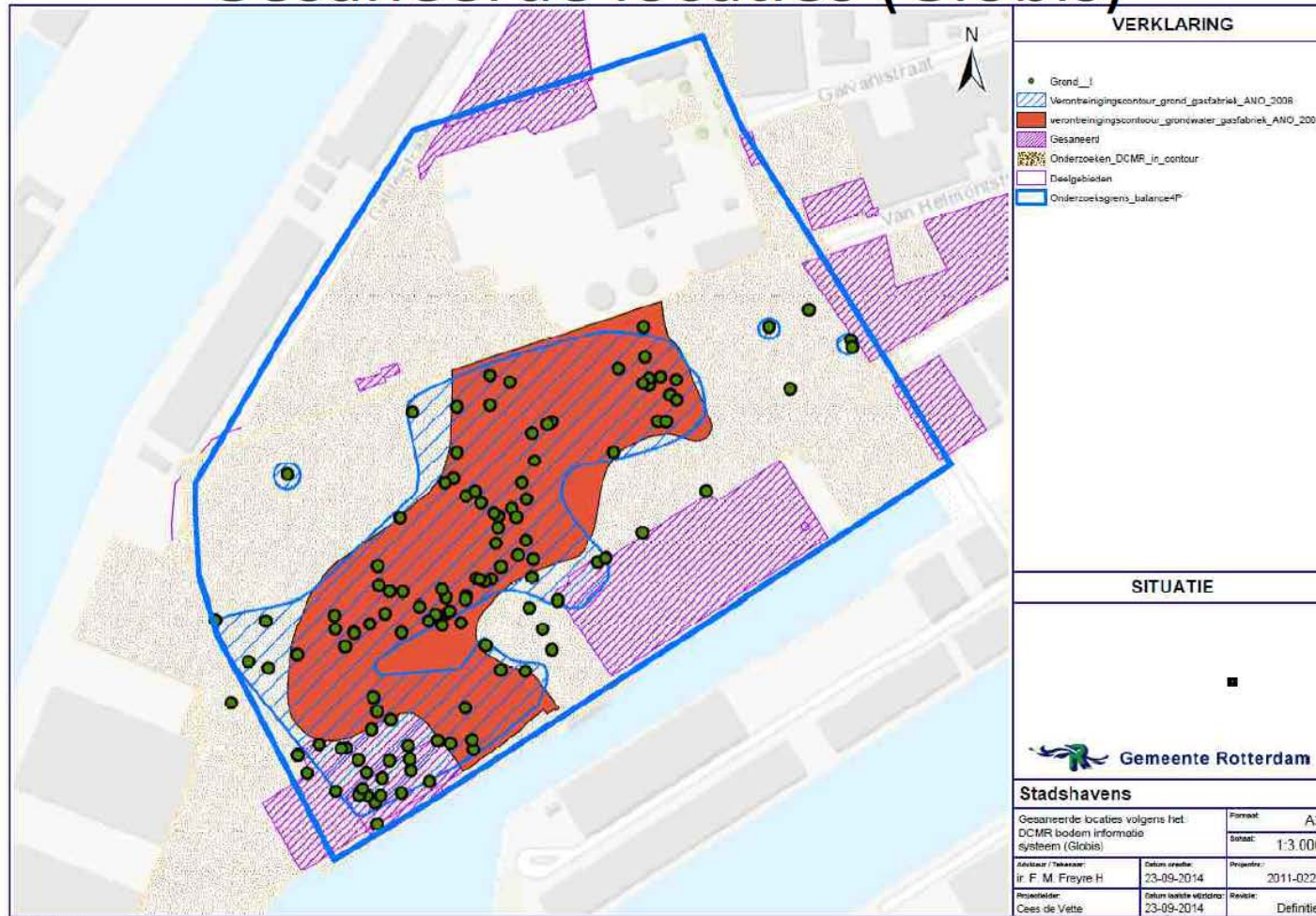


Kademuren

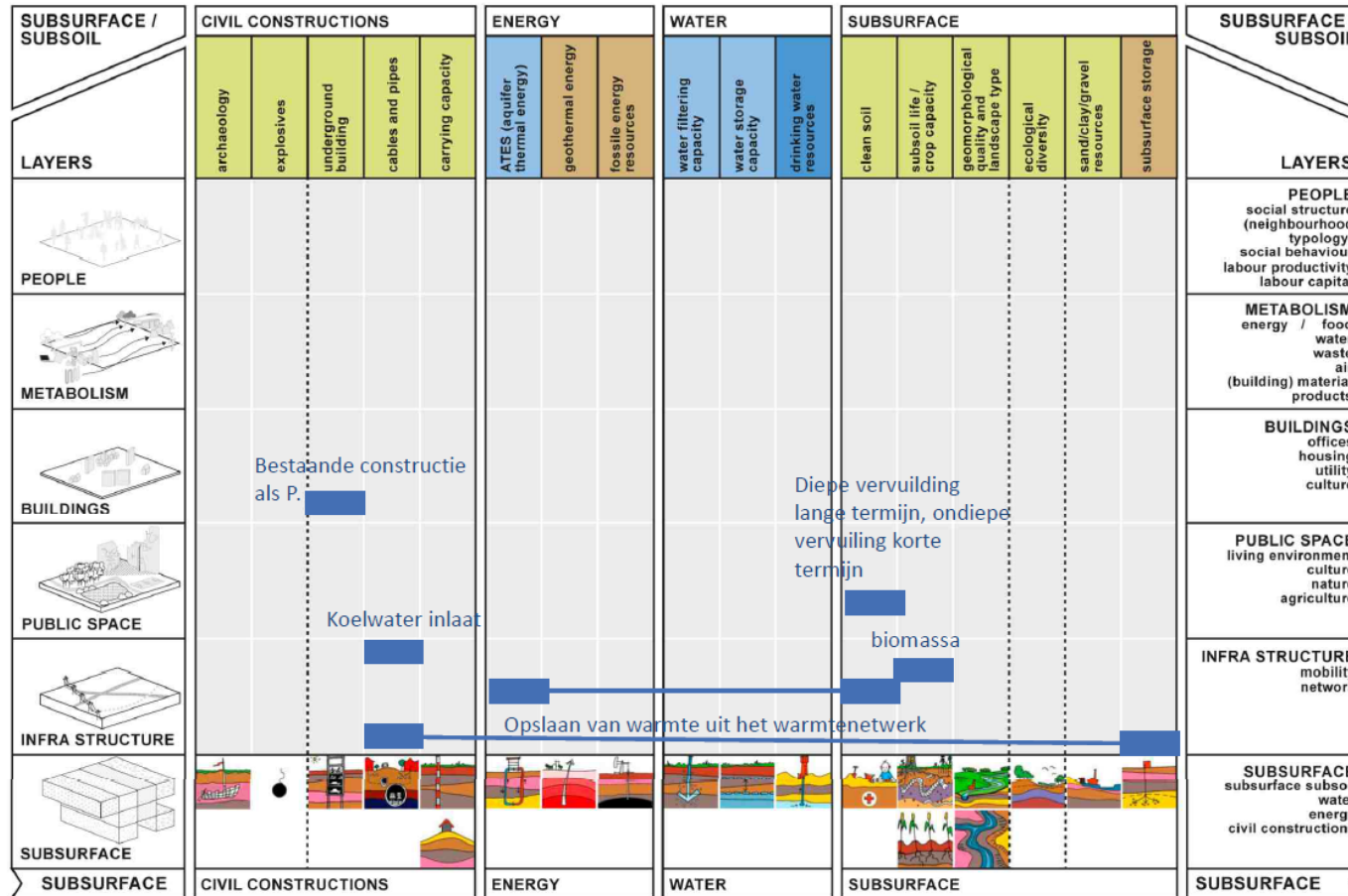


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Gesaneerde locaties (Globis)



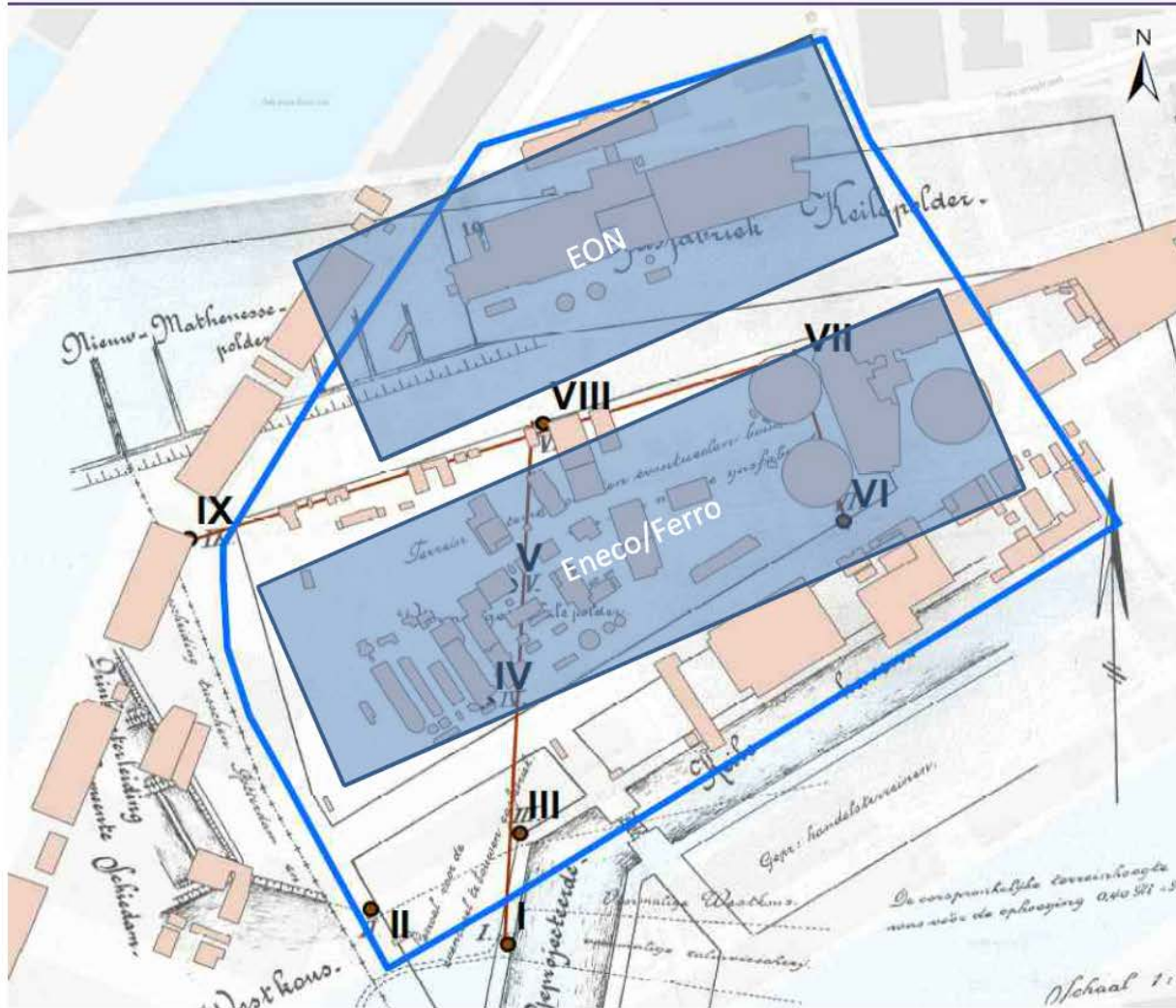
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shallow
 shallow and water layer
 water layer
 deep > 500 meter

SEES














Scenario's obv sanering(sduur) x andere leidende bodemthema's

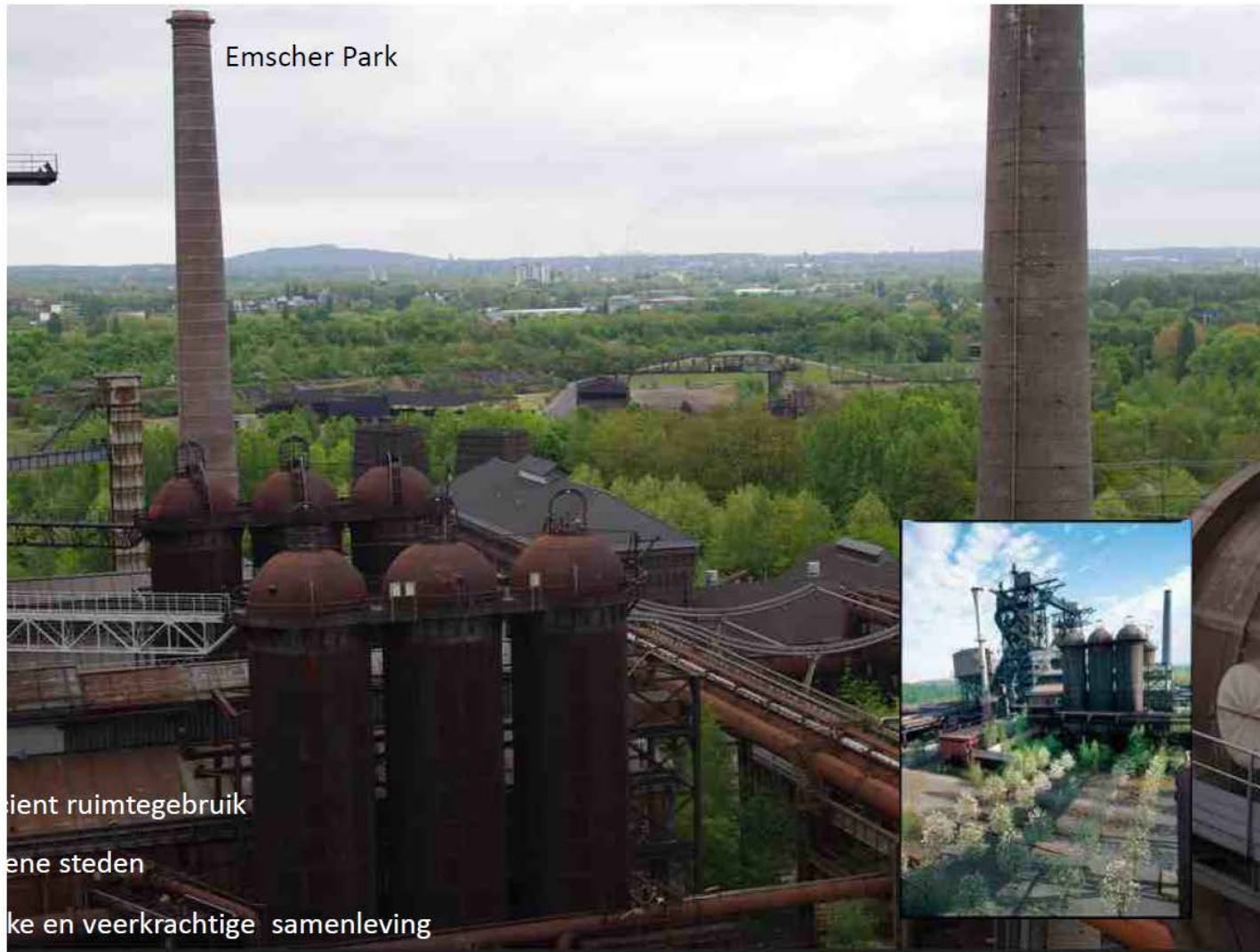
Schone bodem			Archeologie		Funderingen & Kades			Kabels & Leidingen		Energie				location
Afgraven	Monitored NA- Phyto	Stimulated NA	opgraven	Laten liggen	hergebruik	afknijpen	Staal/ nieuwe f.	opgraven	hergebruik	WKO	geothermie	Warmte opslag in de bodem	Decentraal bebouwing	
		■		■	■				■			■		EON
■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

Categorieën voor de ideeën

-  • Bereikbaarheid en connectiviteit
-  • Klimaatverandering
-  • Efficiënt ruimtegebruik
-  • Groene steden
-  • Gezondheid en leefbaarheid
-  • Resource efficiency
-  • Sterke en veerkrachtige samenleving
-  • Duurzame energie
-  • Duurzame voedselproductie

Ideeën EON terrein

- Productie Campus met bedrijvigheid in bestaand bebouwing
- Geen ernstige grondverontreiniging, grondwater onvoldoende in kaart. Mocht sanering toch nodig zijn, dan keuze voor snel: afgraven en/of langzaam: in-situ saneren (bijv gestimuleerde Natuurlijke Afbraak (NA), en/of fytoremediatie; lokale aanpak met beplanting)
- Sowieso transformatie van locatie naar een groene locatie met veel open bodem
- Energieconcept: warmte is er al, biedt aanleiding tot een distributienetwerk en koude gebruiken uit de rivier.
- Grote ondergrondse kelder in ondergrond (“bak”) hergebruiken voor parkeren, water/energieopslag?



Emscher Park

efficient ruimtegebruik

compacte steden

compacte en veerkrachtige samenleving

ANALYSIS

location analysis - green



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

Ideeën 1. Eneco/Ferro

- Immobiele (ondiep, tot 6m -mv) verontreiniging afgraven, of kiezen voor bronnen afgraven en dan in-situ (bijv Phytoremediatie). Mobiele verontreiniging (diep, 15-17 -mv, grondwater) oplossen met monitored Natural Attenuation (afhankelijk van de verspreiding van de pluim, waarschijnlijk niet i.c.m. WKO, andere diepte, ander WVP)
- Bij afgraven wordt de archeologie (dijk, 3.60m -mv) wordt hiermee verstoord, ook kabels en leidingen en funderingen gaan er uit
- Hergebruik van fundering Ferro silo's
- Energieconcept: nieuwbouw voldoet aan de eisen van het huidig bouwbesluit

Student TUD Sebastiaan Huls



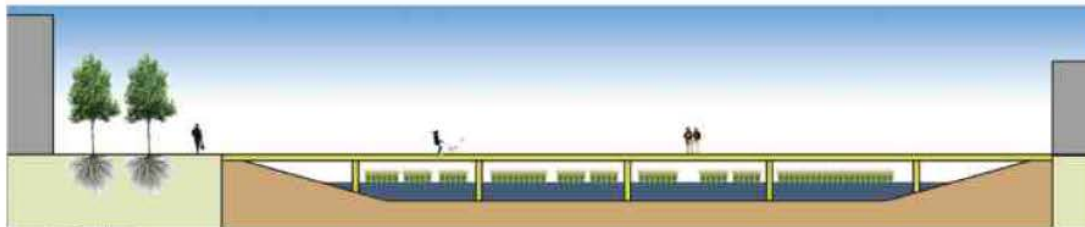
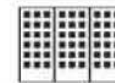
Student TUD Sebastiaan Huls





DESIGN

sections



Section 3: Wetland



Section 4: Energy park



Section 5: Waterfront

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



Duurzame energie
DoepelStrijkers Architecten

oeladstation voor elektrische auto

Ideeën 2. Eneco/Ferro

- Immobiele (ondiep) afgraven van de bronnen en dan verder oplossen met stimulated NA, mobiele verontreiniging (diep) oplossen met Monitored NA (WKO) en Phyto
- De archeologie blijft liggen, ook kabels en leidingen en funderingen kunnen worden hergebruikt
- Gebied wordt groen met ruimte voor tijdelijk gebruik



Gezondheid en leefb



Duurzame energie

DoepelStrijkers Architecten

DoepelStrijkers Architecten



Efficient ruimtegebruik



FLEXIBELE WONINGEN VOOR EARLY ADOPTERS





DoepelStrijkers Architecten



De Ceuveld Amsterdam

Studenten Workshop Balance4p TUD

-  Efficiënt ruimtegebruik
-  Groene steden

EXISTING



CABLES AT THE BORDERS, PARK IN THE MIDDLE



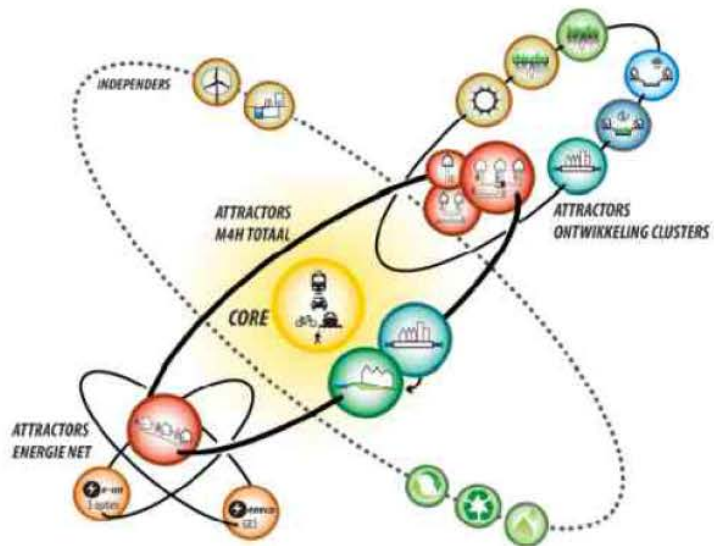


Efficiënt ruim
Groene sted

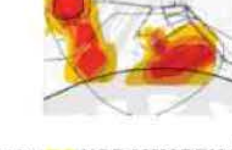
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SCENARIO CLUSTERGEWIJZE ONTWIKKELING vanuit bestaande hoofdstructuur

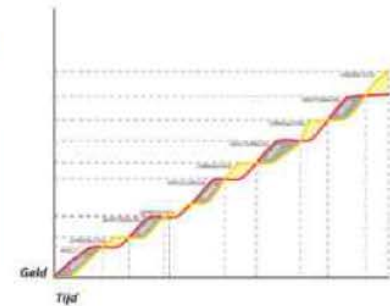
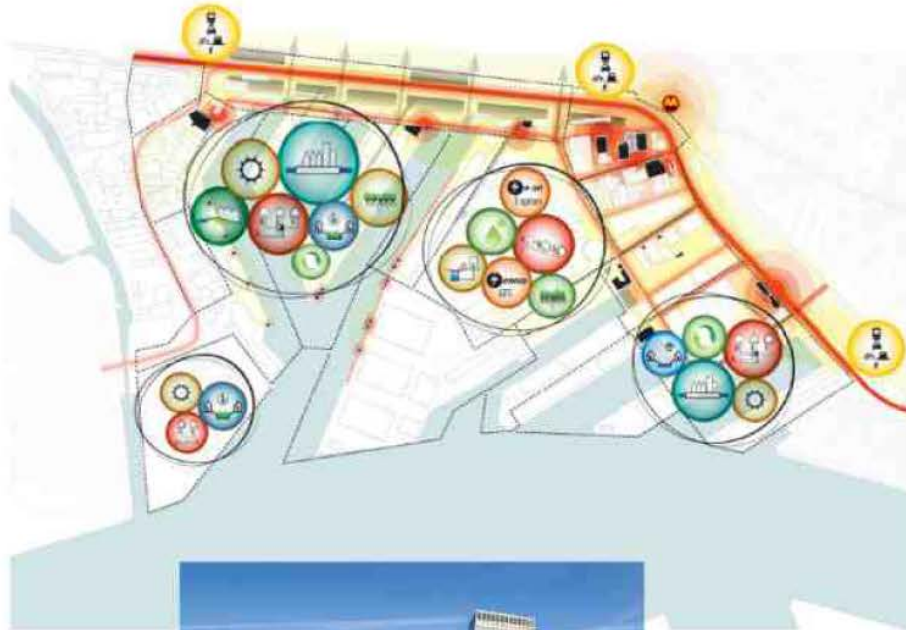
B Meerdere clusters van onderlinge aantrekking:
 Gedifferentieerde partiële private ontwikkelingen.
 Overheid: initiatieven reguleren, bijsturen en stimuleren.
 (urban rules en wensbeelden)



Welke systemen versterken elkaar en hangen samen:



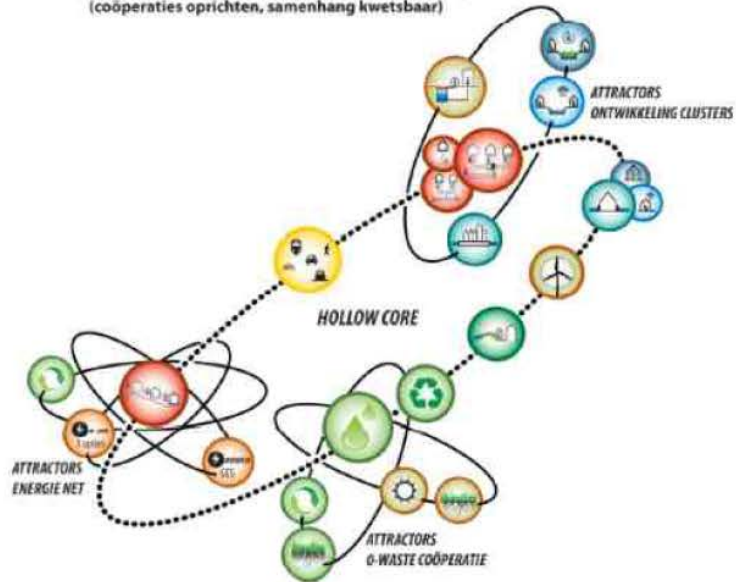
SCENARIO CLUSTERGEWIJZE ONTWIKKELING vanuit bestaande hoofdstructuur



Ruimtelijke & economische karakteristiek

SCENARIO BOTTOM UP ONTWIKKELING vanuit organische groei

- C** Meerdere zelfstandige clusters van onderlinge aantrekking:
Gedifferentieerde partiële private ontwikkelingen.
Overheid op achtergrond: faciliteren en helpen organiseren.
(coöperaties oprichten, samenhang kwetsbaar)



Welke systemen versterken elkaar en hangen samen:



SCENARIO BOTTOM UP ONTWIKKELING vanuit organische groei



Ruimtelijke & economische karakteristiek

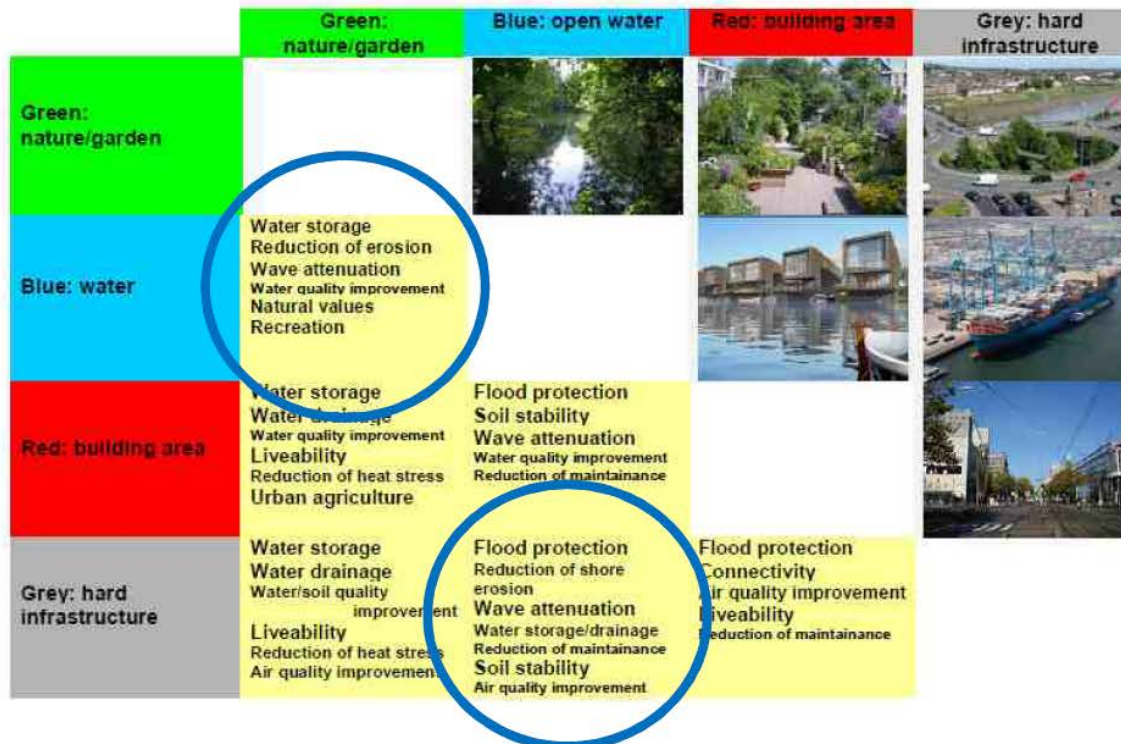
DOEPEL STRIJKERS ARCHITECTEN DE URBANISTEN TU Delft



Klimaatverandering

Groene steden

Voorbeeld stedelijke omgeving (KvK Rotterdam)



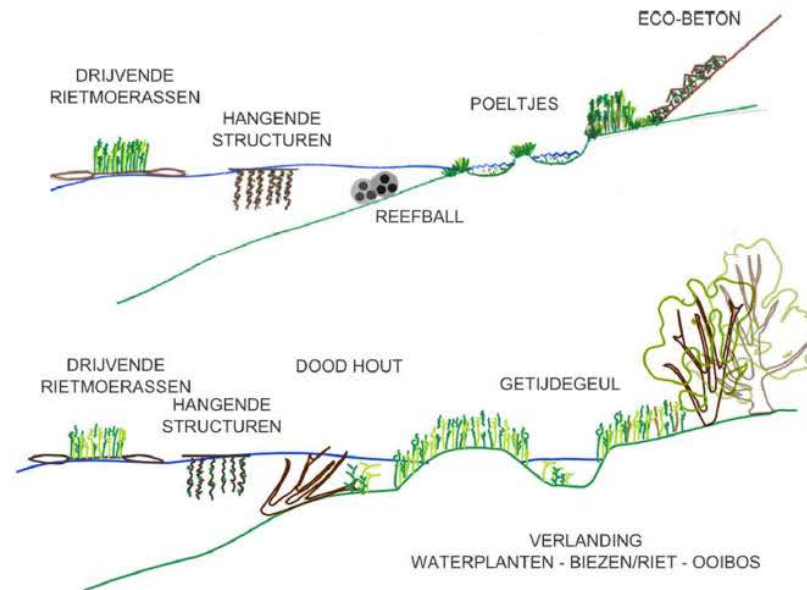
Systemanalyse getijdenwater



Klimaatverandering
Groene steden



NATUURLIJKE LAND-WATER OVERGANGEN
ZOUTE EN ZOETE WATEREN





Ecologie, ecosysteemdiensten , benutting bestaande structuren en processen
Ook urbaan toepasbaar (KvK Rotterdam)

Drijvende rietmoerassen hangende structuren



Drijvende rietmoerassen, pilot Houtribsluizen Markermeer (Bron: Deltares)



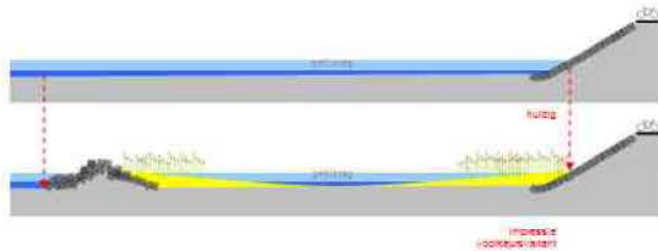
-  Klimaatverandering
-  Groene steden

Voorbeeld KRW-maatregel in de stad



LEGENDA
 — lang edam
 — intergetijd gebied
 — mogelijke ligging GLW

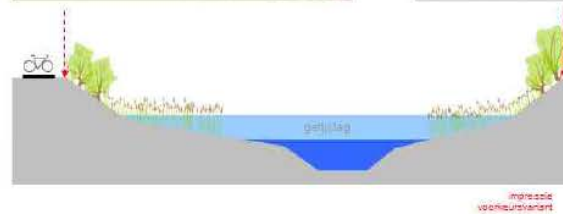
doorsnede A



Gors van de Lickebaert



LEGENDA
 — verwijderen dam
 — natuurvriendelijke oever
 — herprofiëren intergetijdgebied



Vijfsluizerhaven

Meer Building with Nature in de stad:

- http://www.ecoshape.nl/nl_NL
- Beumer, V., H. Hulsman, E. Koning (2012) **Exploring Opportunities for Green Adaptation in Rotterdam**, Kennis voor klimaat rapport number KfC 86/2012. ISBN 978-94-90070-62-5
- Velthuisen, O. van, J. van Leeuwen (2013) **Natuurvriendelijke oevers in de Nieuwe Maas van Rotterdam**, Kansen voor natuurvriendelijke oevers en andere mogelijkheden om de waterkwaliteit en de leefkwaliteit te verbeteren. Gemeente Rotterdam

Duurzaam saneren



Sustainable Remediation Technology

Conceived in 2010, SISR technology collects and harnesses renewable energy and redirects it back into the remediation process. All energy consumed is produced onsite by wind and solar power. Each renewable energy source has two functions:

Wind

1. To produce compressed air which is then injected into the soil to support the biodegradation process
2. To extract soil vapors generated from the biodegradation process

Solar

1. To generate electricity to run all the small pumps and electrical components
2. To produce warm water using a solar thermal collector system which is then circulated into the soil to increase subsurface temperatures by 7 to 12° C

When soil temperatures increase from 10°C to 20°C, it has a positive effect on the remediation process since it enhances desorption. Not only will bacteria activity increase, but the contaminants' solubility and volatilization will also increase. This results in the mobilization of the contaminants from the soil phase to the water phase, making the contaminants more readily available for microorganisms to consume. All of these factors assist in an accelerated remediation cleanup time.

Energy storage facilities are not necessary with SISR since the demand for energy and heat can always be directed towards the process. When compressed air is not produced due to wind deficiencies and heat is not generated due to solar restrictions, this lull in activity is not a problem. It is believed these temporary interruptions allow preferential pathways in the subsurface to be redistributed with bacteria making it easier for the bacteria to consume the contaminants once the system starts up again.

Prior to the installation of this system, wind and solar calculations will need to be completed to determine the renewable energy efficiency levels in the area.



SISR: Sustainable In Situ Soil Remediation



Gezondheid en leefbaarheid

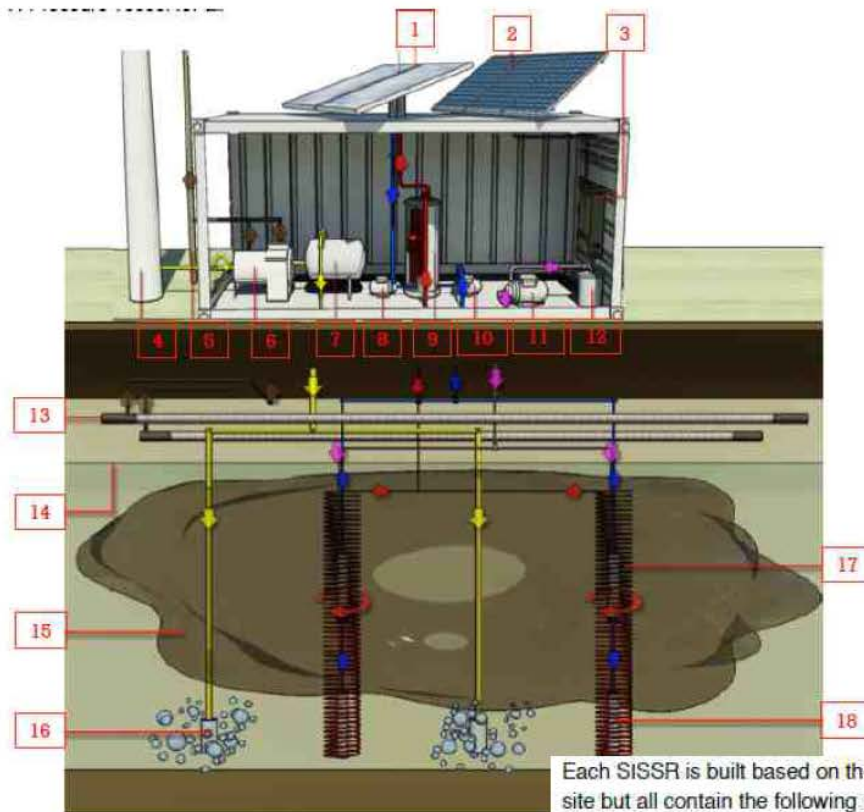
Resource efficiency



Sustainable-Phyto-pump-treatment

Recommended for:

- * Deep depth
- * Any size
- * Saturated zone
- * Biodegradable contaminants
- * Porous media
- * Extended treatment time



Gezondheid en leefbaarheid



Resource efficiency



SISSR: Sustainable In Situ Soil Remediation.

Each SISSR is built based on the conditions of the site but all contain the following pieces of equipment:

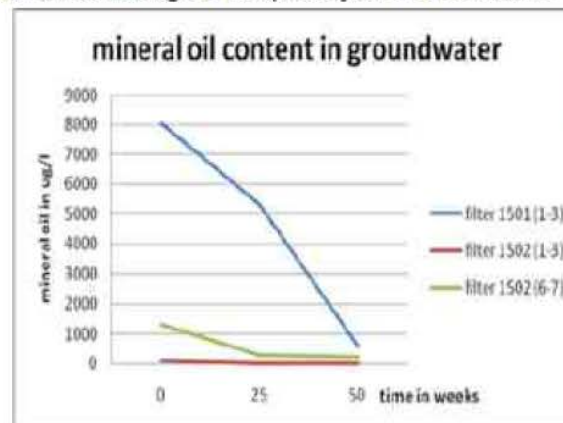
1. Solar collector- to heat the water
2. Solar cell- to generate electricity for the system
3. Solar inverter – to turn sunlight into energy
4. Turbine – to produce compressed air and extract vapors from the soil
5. Vent – to extract soil vapor
6. Compressor
7. Pressure vessel for air

8. Circulation pump 2
9. Boiler
10. Circulation pump 1
11. Nutrient injection pump
12. Nutrient storage
13. Vapor extraction
14. Groundwater level
15. Contamination area
16. Air injection
17. Soil heating elements
18. Nutrient injection

Case study in Bilthoven: Deltares en SBNS



The pilot study took place in Bilthoven, Netherlands on a site that has had a long history of industrial uses dating back to 1863. Rail line, warehousing, petroleum and coal distribution center, and a paint company were some of the operations that took place onsite. The site was contaminated with mineral oil ranging from a half meter to nine meters below the surface. In 2011, approximately two meters of the vadose zone was excavated leaving the remaining 7 meters of the saturated zone to be treated with SISR. At the beginning of this study, soil temperature was 10°C. After 20 weeks of operation the soil temperature increased to 17.6°C and eventually reached 22°C. This increase in soil temperature accelerated the rate of contamination destruction. The goal of this system is to immobilize and to destroy contamination while preventing rebound effect with the least amount of cost. Since temperatures do not reach as high as thermal remediation technologies it requires years of treatment.





Gezondheid en leefbaarheid

Meer In-situ: www.soilection.nl

SOILECTION SELECTING THE BEST SOLUTION FOR SOIL REMEDIATION

HOME | DATABASE | CASES | TECHNIEKEN | HIP-PILOTS | ACHTERGROND | INNOVATIE | LINKS | CONTACT

Technisken: 11
Cases: 32
HIP-pilots: 8

Zoeken

Hieronder kunt u zoeken naar voorbeeldprojecten (cases), techniekbeschrijvingen en HIP-pilots. U kunt één of meerdere zoekcriteria selecteren.

Op welke wijze wilt u zoeken:

- Resultaten moeten aan één of meerdere zoekcriteria voldoen.
- Resultaten moeten aan alle zoekcriteria voldoen.

Selecteer verontreiniging:
(U kunt meerdere opties selecteren door de CTRL-toets te gebruiken)

- Alle verontreinigingen

- VOC's (PER, TRJ, DCE/CIS, VC)**
- Vluchtige aromaten TEX (toluene, ethylbenzeen, xylenen)
- Vluchtige aromaten (RTEX)
- Vinyl chloride
- Pesticiden
- PAK
- Nuttalolen
- MIBK
- Mono- en dichloorbenzeen
- Minerale olie (licht)
- Minerale olie
- Methylenchloride
- Metalen
- Fluoraal
- Fenol
- Dichloormethaan
- Cyanide (vrij)
- Creosool
- Benzeen
- Overige

Selecteer techniek:
(U kunt meerdere opties selecteren door de CTRL-toets te gebruiken)

- Alle technieken

- Bodemluchtextractie
- Co-solvent flushing
- Electroremediatie
- Gestimuleerde biologische afbraak, aerob
- Gestimuleerde biologische afbraak, anaerob
- In situ Chemische Oxidatie (ISCO)
- In situ Chemische Reductie (ISCR)
- In situ Metaal Precipitatie (ISMP)
- Meerfasen extractie
- Perluichtinjectie in het kader van airstripping
- Pumps&reat
- Stoominjectie
- Surfactant flushing

▲ Klik hier om de eigenschappen van verontreiniging te selecteren. (U kunt meerdere opties selecteren door de CTRL-toets te gebruiken)

▼ Klik hier om de randvoorwaarden te selecteren. (U kunt meerdere opties selecteren door de CTRL-toets te gebruiken)

Maximale duur sanering:

- Maanden
- Jaren
- Decennia
- Geen keuze

Toegestane verstooring locatie:

- Laag
- Matig
- Geen keuze

Appendix E – Fixfabriken: SCORE analysis

In this appendix, the results of the SCORE analysis are presented. For details, the reader is referred to Garcao (2015) where all methods, assumptions and uncertainties of the analysis are presented. The analysis is carried out on a Swedish case and Swedish crowns (SEK) was used as monetary unit. Ten SEK is approximately 1 €.

Figures E.1 to E.3 presents the resulting mean score in each sustainability domain. Figure E.4 presents the mean sustainability score of each alternative, where it can be seen that Alternative 3 has the highest total sustainability score. The score is normalized and a relative measure, i.e. it is related to the reference alternative, and the figure shows the mean value.

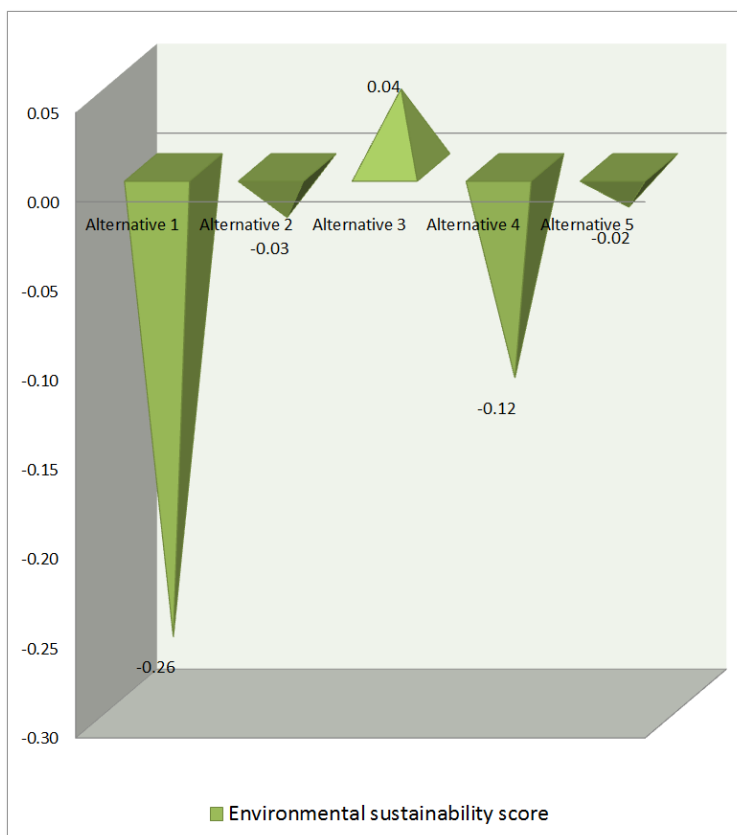


Figure E.1. Resulting score in the environmental domain.

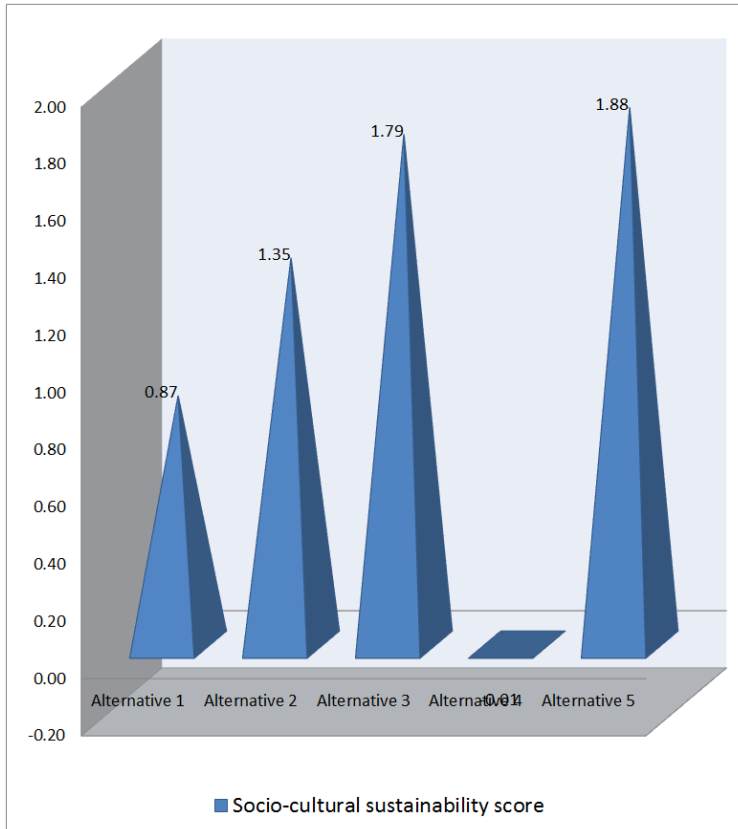


Figure E.2. Resulting score in the socio-cultural domain.

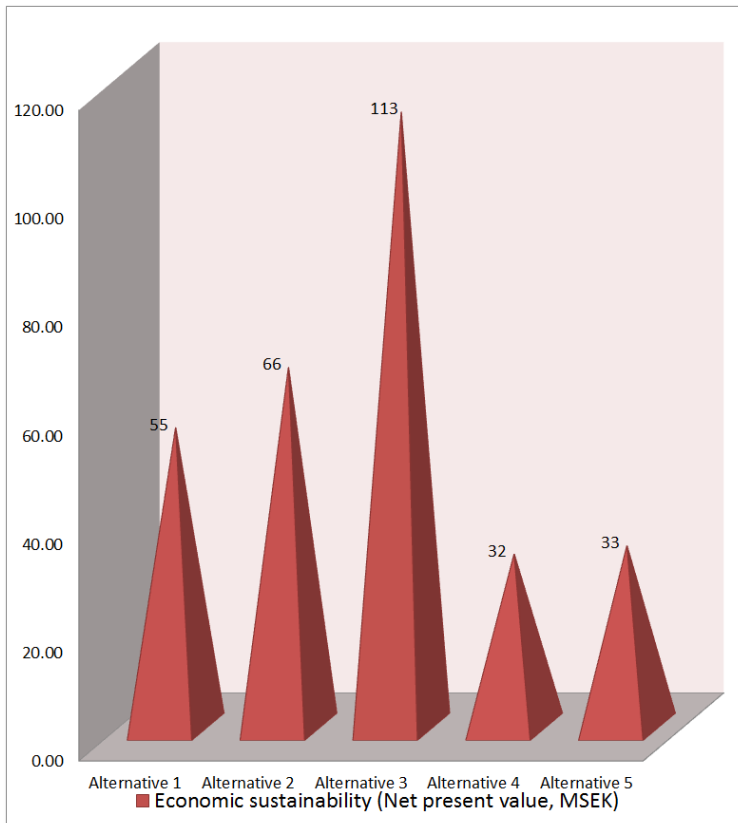


Figure E.3. Resulting score in the economic domain.

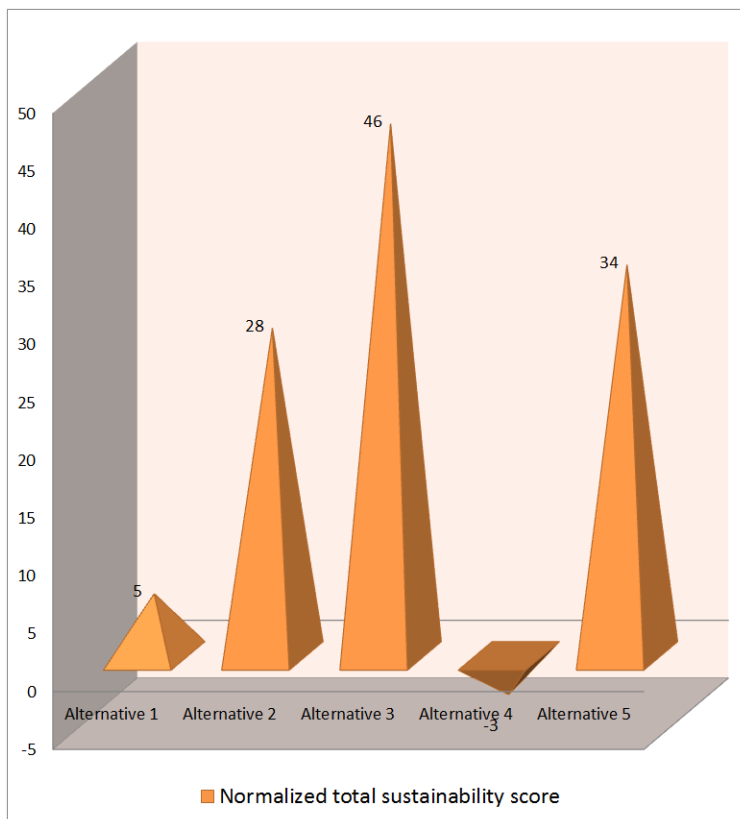


Figure E.4. The resulting sustainability score of the alternatives.

The uncertainty intervals of the sustainability scores are shown in Figure E.5. The uncertainty intervals are very wide, informing that the uncertainties are high in the analysis. Figure E.6 shows the probability for each alternative of having the highest sustainability score as a way of translating what the large uncertainty intervals means. For example, Alternative 3 has the highest score with a probability of approximately 48%, whereas Alternative 4 only has 2% probability of having the highest score. Alternative 1 has 0%, but Alternative 2 and 5, have 21% and 24% respectively.

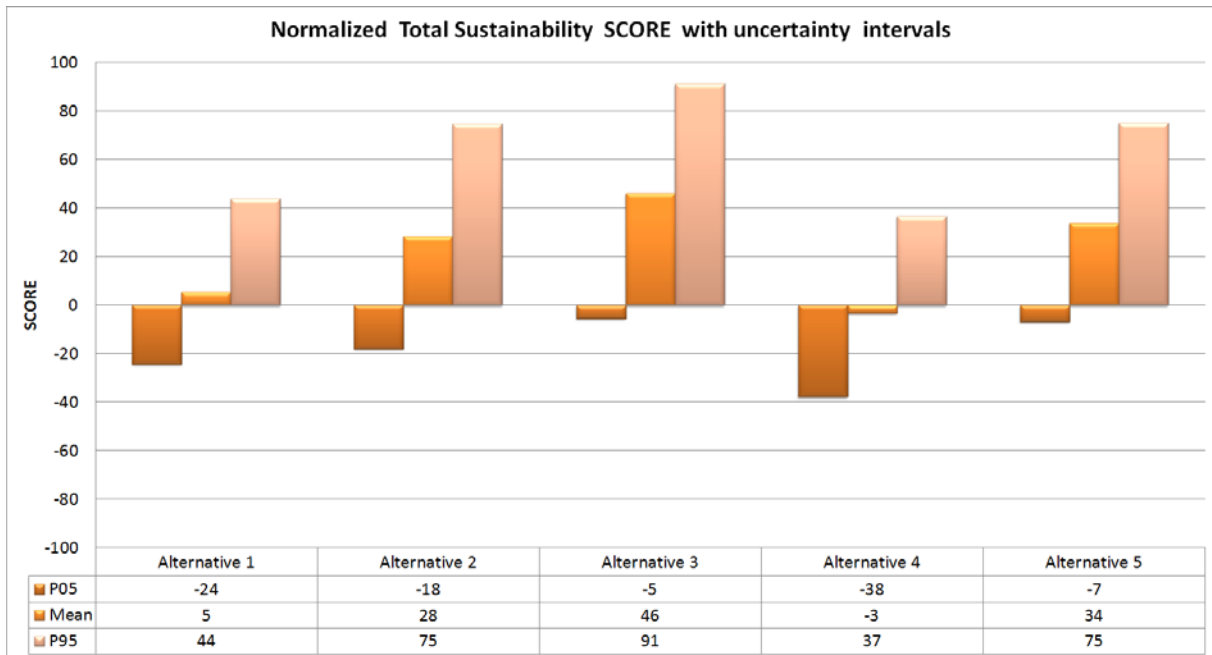


Figure E.5. The uncertainty intervals of the sustainability scores.

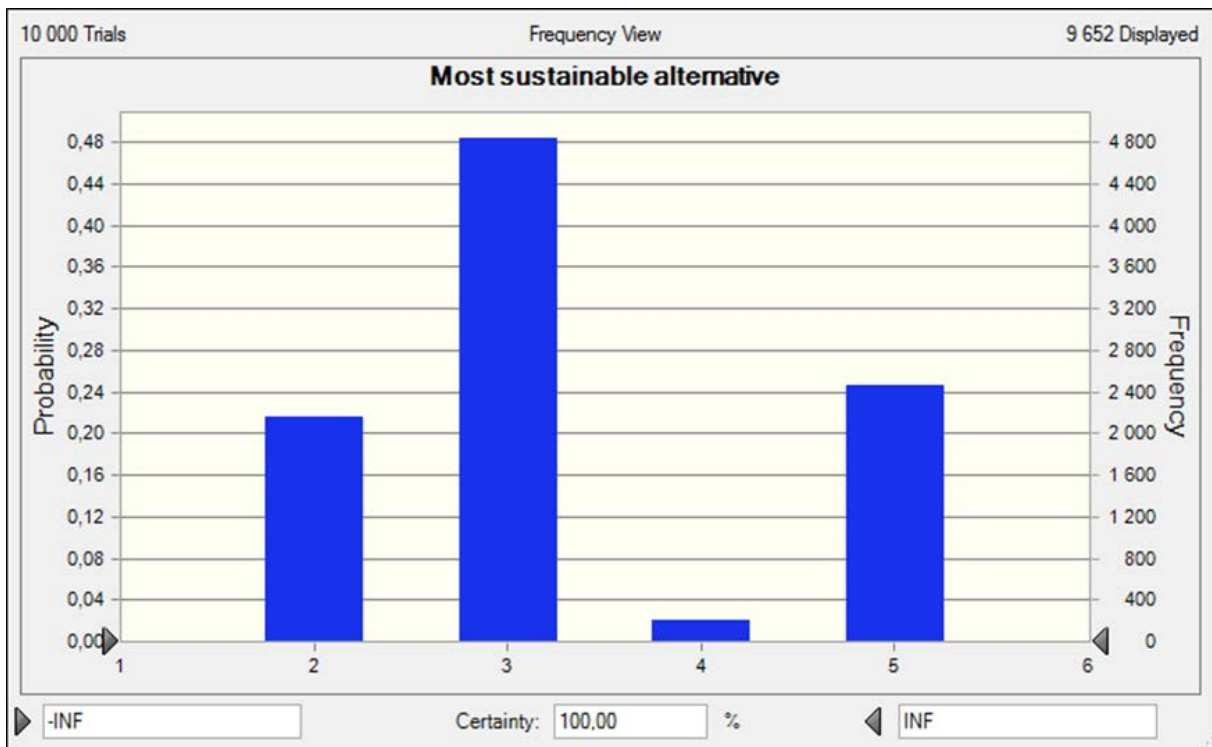


Figure E.6. The probabilities for each alternative of having the highest sustainability score.

The uncertainty analysis in SCORE allows the user to investigate which criteria have the highest impact on the uncertainty of the result. Figure E.7 shows an example for Alternative 1, where the increased property value has the largest contribution to the uncertainty of the sustainability score of

Alternative 1. For all alternatives the increased property value is the item contributing most to the uncertainty in the sustainability score, indicating that the uncertainty is very high in this item.

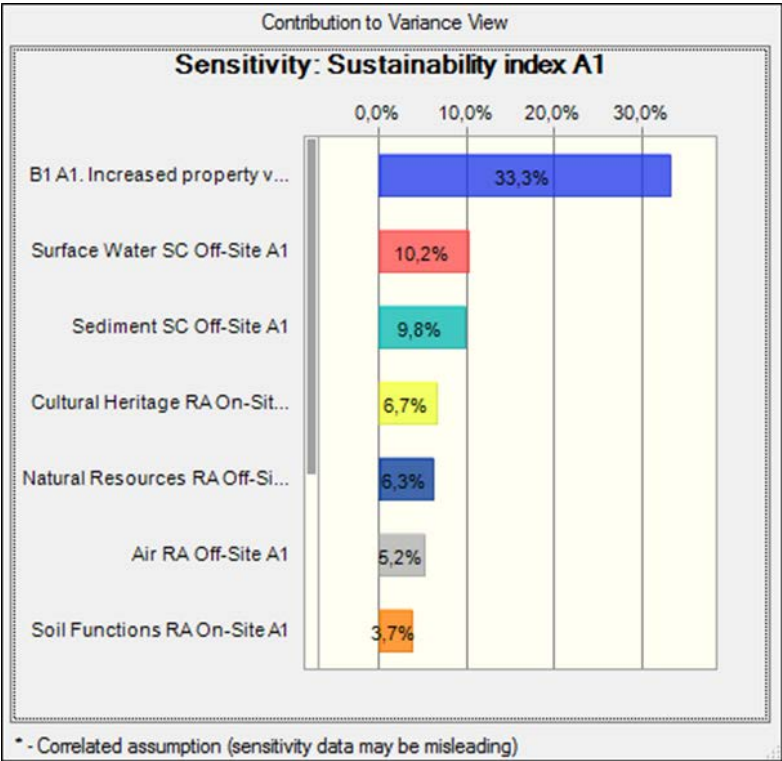


Figure E.7. Sensitivity analysis for Alternative 1. The uncertainty of the increased property value is the item contributing most to the uncertainty of the sustainability score in Alternative 1.

The economic analysis in SCORE is a cost-benefit analysis (CBA), and it is also necessary to check distributional effects of the costs and benefits in the CBA. Figure X.8 shows the costs and Figure E.9 shows the benefits, and how they are distributed with regard to different groups: the public (PUB), employees (EMP), developer (DEV) and others. Here it can be seen that Alternative 3 is the only alternative which does not incur higher costs than benefits for the public with regard to the monetized items in the CBA.

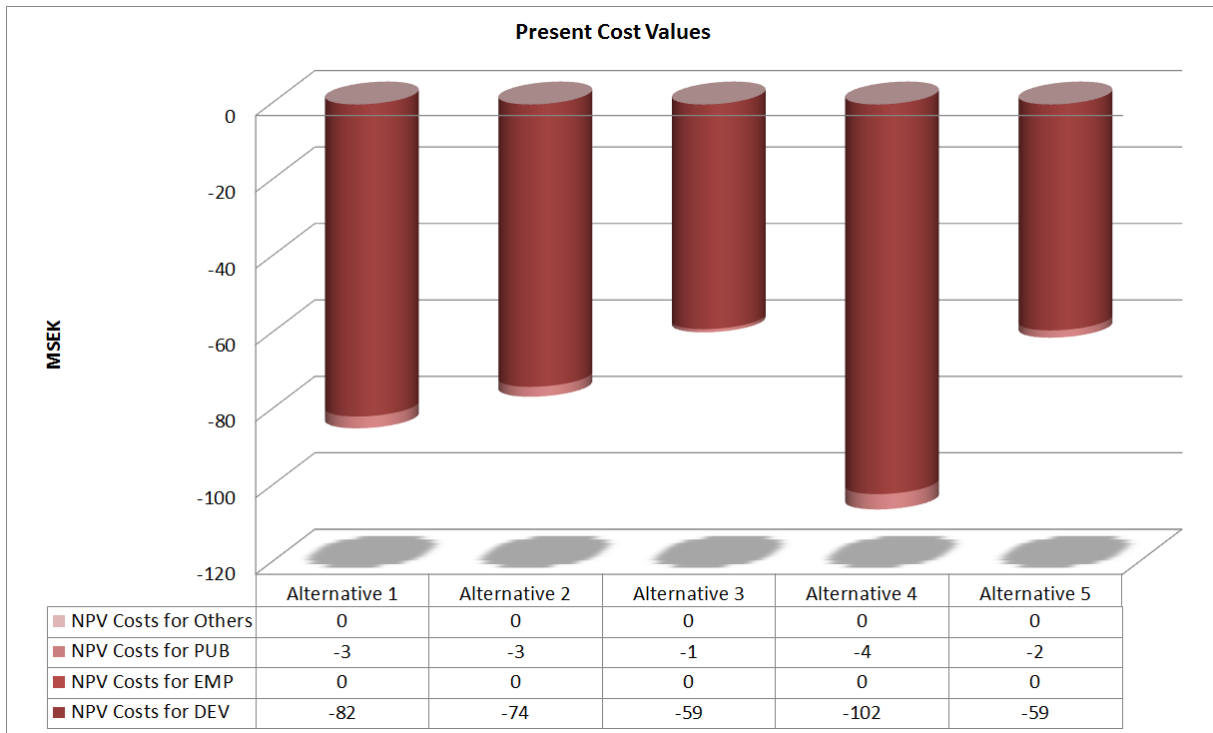


Figure E.8. The present costs of the CBA and how they are distributed with regard to different groups: the public (PUB), employees (EMP), developer (DEV) and others.

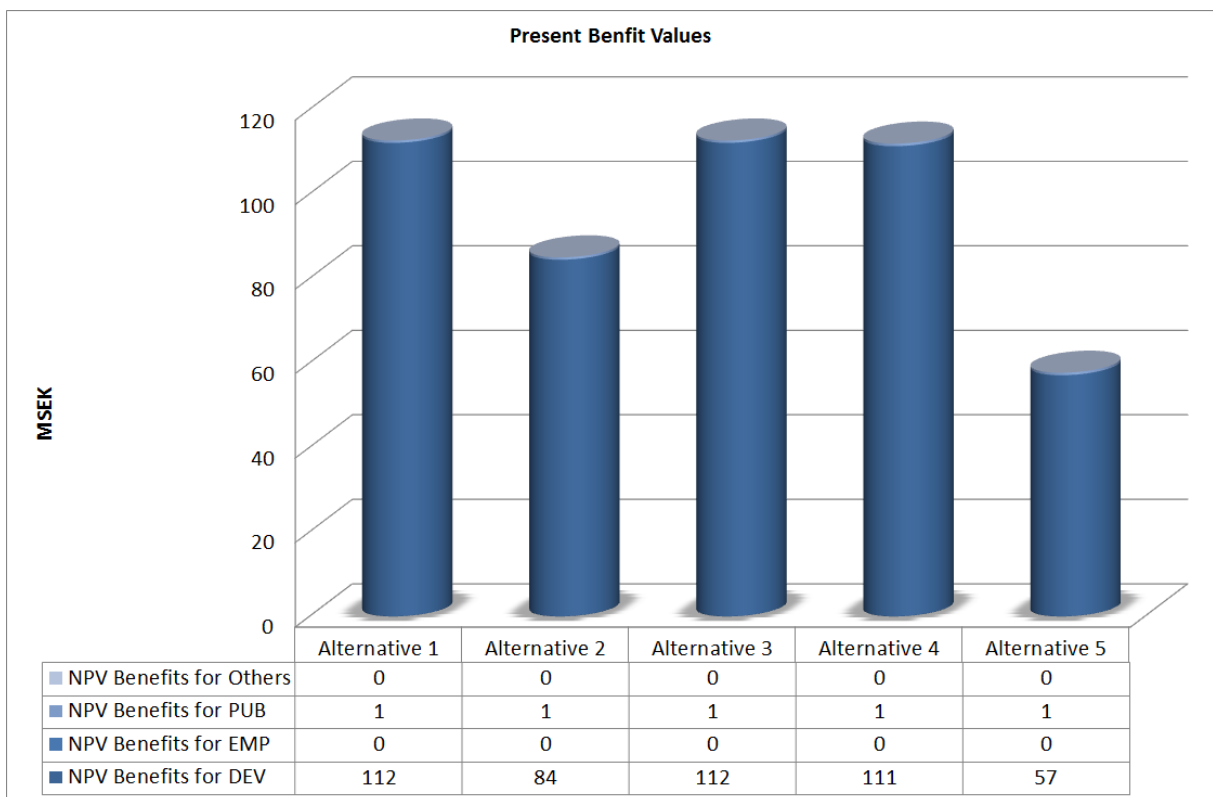


Figure E.9. The present benefits of the CBA and how they are distributed with regard to different groups: the public (PUB), employees (EMP), developer (DEV) and others.

Figure E.10 shows the complete table of the CBA, indicating which items were monetized and which were not. An X indicates that the item is important but not monetized, and an (X) indicates a somewhat important item which is not monetized. As can be seen in Figure E.10, several items are not monetized and could potentially affect the outcome of the CBA and thus also the full SCORE analysis. Several of these items are costs and benefits for the public, thus also affecting the distributional analysis.

Benefit item	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
B1. Increased property value on site	112	84	112	111	57
B2a. Reduced acute health risks	nr	nr	nr	nr	nr
B2b. Reduced non-acute health risks	0	0	0	0	0
B2c. Other types of improved health, e.g. reduced anxiety	0	0	0	0	0
B3a. Increased recreational opportunities on site	(X)	(X)	(X)	(X)	(X)
B3b. Increased recreational opportunities in the surroundings	(X)	(X)	(X)	(X)	(X)
B3c. Increased provision of other ecosystem services	(X)	(X)	(X)	(X)	(X)
B4. Other positive externalities	(X)	(X)	(X)	(X)	(X)
Cost item					
C1a. Costs for investigations and design of remedial actions	0	0	0	0	0
C1b. Costs for contracting	0	0	0	0	0
C1c. Capital costs due to allocation of funds to the remedial action	2	2	2	3	2
C1d. Costs for the remedial action, including transport and disposal of contaminated soil minus possible revenues of reuse of contaminants and/or soil	66	58	43	84	47
C1e. Costs for design and implementation of monitoring programs including sampling, analysis and data processing	13	13	13	15	10
C1fa. Project risks	X	X	X	X	X
C2a. Increased health risks due to the remedial action on site	0	0	0	0	0
C2b. Increased health risks due to transports to and from the remediation site, e.g. transports of contaminated soil	1	1	0	2	1
C2c. Increased health risks at disposal sites	(X)	(X)	(X)	(X)	(X)
C2d. Other types of impaired health due to the remedial action, e.g. increased anxiety	(X)	(X)	(X)	(X)	(X)
C3a. Decreased provision of ecosystem services on site due to remedial action, e.g. reduced recreational opportunities	0	0	0	0	0
C3b. Decreased provision of ecosystem services outside the site due to the remedial action, e.g. environmental effects due to transports of contaminated soil	2	1	1	2	1
C3c. Decreased provision of ecosystem services due to environmental effects at the disposal site	X	X	(X)	X	(X)
C4. Other negative externalities	X	(X)	(X)	X	(X)

Figure E.10. Complete list of items in the CBA. An X indicates that the item is important but not monetized, and an (X) indicates a somewhat important item which is not monetized. The numbers indicates the expected present value (not the mean present value).

Finally, the user specifies weights of the domains and the criteria in SCORE, and the results sheet produces graphs of these weights, see Figures E.11 – E.13. The economic domain does not use weights, as all items are measured in the same unit (SEK).

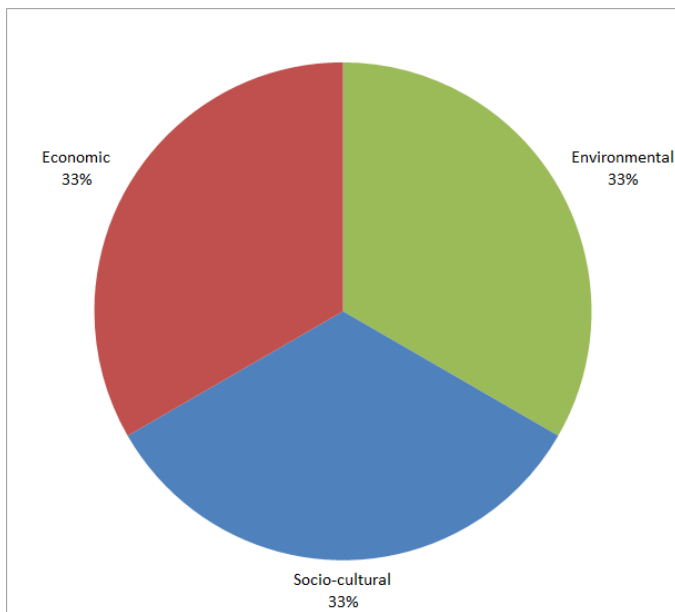


Figure E.11. Chosen weights for the different domains: equal weights to all three domains.

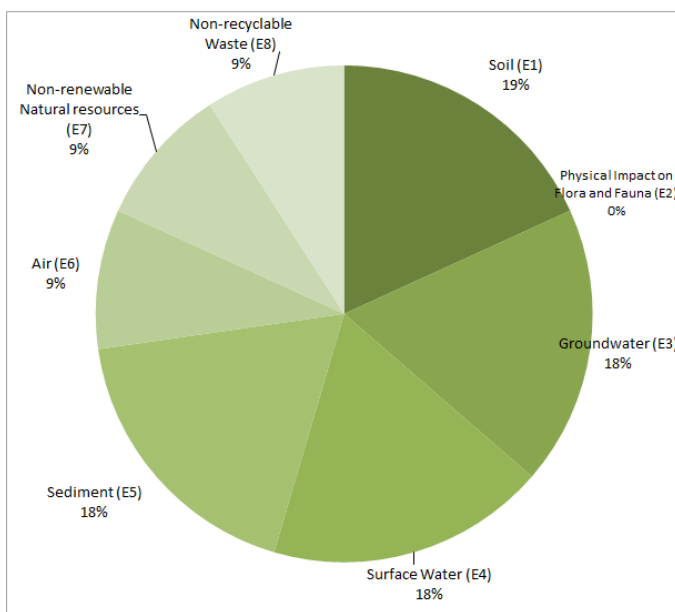


Figure E.12. Chosen weights for the environmental domain. Secondary effects associated with remediation are weighted lower.

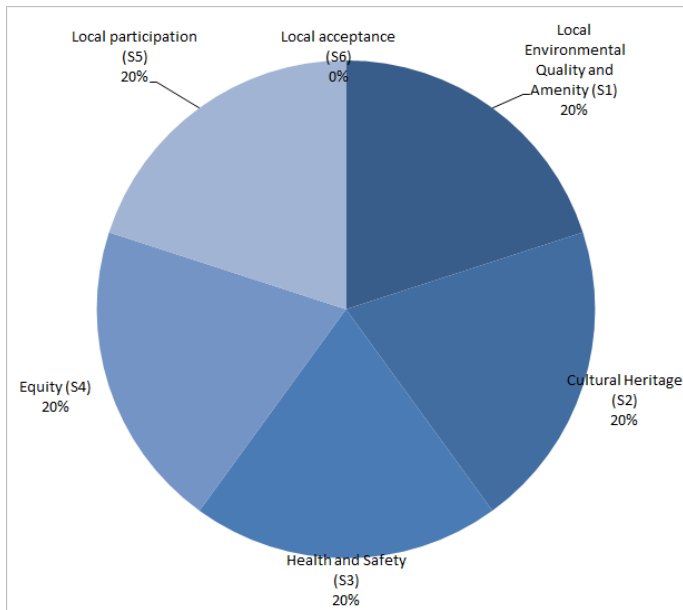


Figure E.13. Chosen weights for the socio-cultural domain.

Appendix F – Mapping of ecosystem services

Mapping of ecosystem services, or ecosystem services analysis, has been applied on the Fixfabriken case study in Göteborg as one of three methods for evaluating sustainability in remediation projects. The objective of the analysis has been to investigate the potential of this method in adding useful information to the sustainability appraisal of identified remediation alternatives and future land use.

Method

The method applied follows the principles outlined in a guidance for implementation of the Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC); *Development for Integration of Ecosystem Service Assessment into WFD and FD Implementation*. (COWI 2014);

1. Identification of relevant ecosystem services and their status on the remediation site given present land use (baseline).
2. Quantification of changes in quality and quantity of ecosystem services affected in the identified remediation alternatives.
3. Valuation of the welfare effects from the identified changes.

The third step of the methodology, *Valuation*, has not been applied in the Fixfabriken application. The analysis was delimited to a semi qualitative/quantitative comparison between the baseline scenario (business as usual) and the resulting changes in the provision of ecosystem services in five different remediation/future land use scenarios, see Garção (2014) for a detailed description of the alternatives.

The steps described above is also in accordance with the 6-step approach to ecosystem services analysis put forward in a World Resource Institute guidance document; *Weaving Ecosystem Services into Impact Assessment* (WRI 2013).

Identification

The process starts with identification of relevant ecosystem services. The Fixfabriken application takes its point of departure in an inventory of existing ecosystem services with regard to two typologies:

- i) Urban Ecosystem Services (Baggethun et al., 2013), Table F.1, and
- ii) Soil Ecosystem Services (Finvers, 2008), Table F.2

Table F.1. Urban ecosystem services as presented by Baggethun et al. (2013)

Ecosystem service		Urban context
Provisioning	Food	Vegetables produced by urban allotments and peri-urban areas.
	Fresh water	Ecosystems provide cities with fresh water for drinking and other human uses and by securing storage and controlled release of water flows. Vegetation cover and forests in the city catchment influences the quantity of available water.
Regulation & Maintenance	Air quality regulation	Vegetation in urban systems can improve air quality by removing pollutants from the atmosphere, including ozone (O ₃), sulfur dioxide (SO ₂), nitrogen dioxide (NO ₂), carbon monoxide (CO) and particulate matter less than 10 µm (PM ₁₀).
	Climate regulation global	Carbon sequestration and storage by biomass of urban shrubs and trees.
	Climate regulation local (urban climate)	Water areas buffer temperature extremes by absorbing heat in summertime and by releasing it in wintertime trees. Urban vegetation provide shade, create humidity and block wind, water from the plants absorbs heat as it evaporates, thus cooling the air in the process.
	Water regulation	Soil and vegetation percolate water during heavy and/or prolonged precipitation events. Vegetation reduces surface runoff following precipitation events by intercepting water through the leaves and stems. The underlying soil also reduces infiltration rates by acting as a sponge by storing water in the pore spaces until it percolates as through-flow and base-flow.
	Noise reduction	Urban soil and plants can attenuate noise pollution through absorption, deviation, reflection, and refraction of sound. In row plantings of trees, sound waves are reflected and refracted, dispersing the sound energy through the branches and trees.
	Water purification and waste treatment	Wetlands and other aquatic systems, for example, filter wastes from human activities; this process reduces the level of nutrients and pollution in urban wastewater. Likewise, plant communities in urban soils can play an important role in the decomposition of many labile and recalcitrant litter types.
	Pollination and seed dispersal	Urban ecosystems provide habitat for birds, insect and pollinators. Pollination, pest regulation and seed dispersal are important processes in the functional diversity of urban ecosystems and can play a critical role in their long term durability.
	Maintaining nursery populations and habitats	Urban systems can play a significant role as refuge for many species of birds, amphibians, bees, and butterflies
Cultural	Natural hazard regulation	Storm, flood and wave buffering by vegetation buffers, wetland areas; heat absorption during heat waves.
	Knowledge systems	Allotment gardening as preservation of socio-ecological knowledge.
	Aesthetic values	Urban parks, sea view, urban scenic view in sight from houses.
	Cultural heritage values	E.g Neolithic settlement
	Recreation and ecotourism	Urban green areas provide opportunities for recreation, mediation and relaxation.

Table F.2. Soil ecosystem services as presented by Finvers (2008).

Ecosystem service		Soil context	Functional process
Provisioning	Food	Nutrient cycling to support plant growth (primary production) including food and fibre production	Soil biota recycle dead organic matter into mineralized for usable by plants and required for vegetative cell information and growth.
	Biomass	Basis of all terrestrial ecosystems –life support	Soil (horizon) development and disturbance regime controls ecosystem development
Regulation & Maintenance	Fresh water	Water purification and soil contaminant reduction	Atmospherical deposits, applied fertilizers, pesticides or other contaminants are adsorbed into soil aggregates, by clay particles and organic matter, and degraded (chemically altered) by soil biota
	Climate regulation global	Carbon Sequestration	Carbon in short-lived to more stable forms of soil organic matter are (SOM) is stored (and recycled). SOM is approximately 58% organic carbon.
		Regulation of greenhouse gasses	Soil biota affect fluxes of CO ₂ , CH ₄ and N ₂ O.
	Water regulation	Flood regulation	Rainfall infiltration and storage in soil reduces the rates of surface runoff, reducing and delaying peak flows, and reducing flood risk. Decreased surface runoff also result in lower rates of erosion, reducing sediment load in flood water (reducing their volume).
	Erosion regulation		
	Water purification and waste treatment	Water purification and soil contaminant reduction.	Atmospherical deposits, applied fertilizers, pesticides or other contaminants are adsorbed into soil aggregates, by clay particles or organic matter, and degraded (chemically altered) by soil biota.
Remediation of soil contaminated by diffuse airborne pollution.		Soil biota metabolize contaminants through oxidative or reductive processes	

The baseline

The baseline scenario is compiled from information on relevant ecosystem services at the site and qualitative assessments of their present supply of services. The identification is preferably based on as many sources of information as possible, including e.g. maps (GIS, photos etc.), monitoring data, personal visits to the site, interviews with experts with knowledge about local conditions, etc. In the Fixfabriken case, aerial images complemented with information on future land use, geological and archaeological investigations on the site, as well as planned remediation actions, are used to make qualitative assessments of the present supply of relevant ESS for the baseline, and changes due to remediation and future land use, see example in Figure F.1.

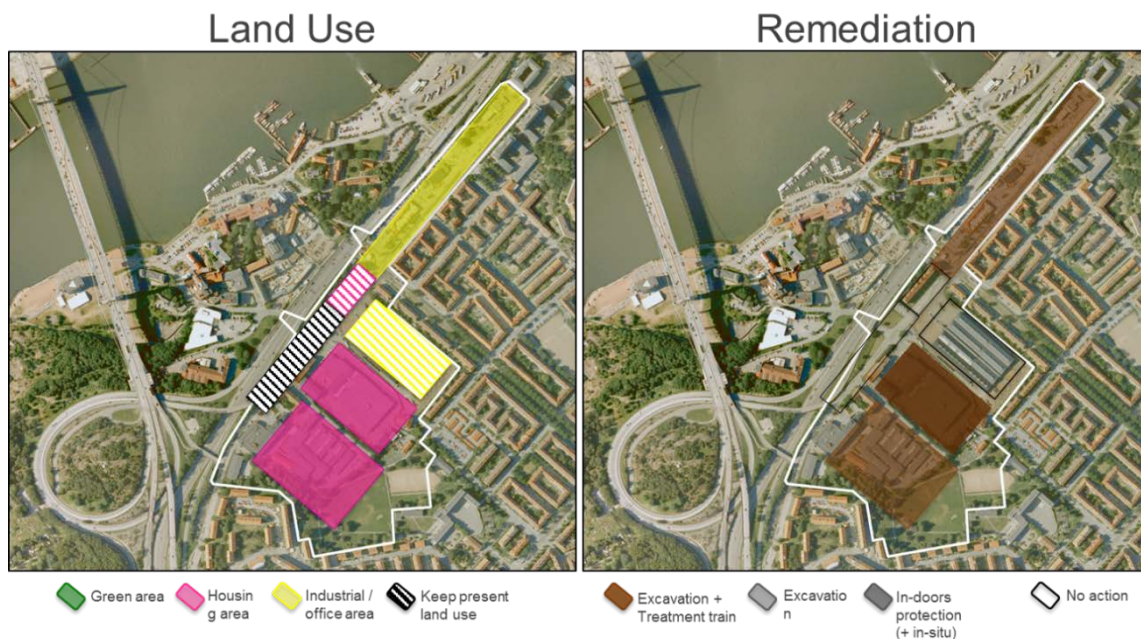


Figure F.1. Aerial image of the Fixfabriken area. The image reveals information on both the present and future land use as well as planned remediation actions.

Once identified, the ecosystem services at the site are given qualitative scores (Table F.3) reflecting their status in the present day land use (baseline scenario) at the site.

Table F.3. Qualitative scores used to describe the status of ecosystem services in the baseline scenario.

Score	Explanation
-1	Present land use not only hinders the supply of the ESS but is also affecting its local potential negatively
0	Present land use hinders the supply of ESS
1	Present land use has a severely negative effect on the supply of ESS but allows for some supply of ESS
2	Present land has a somewhat negative effect on the supply of ESS
3	Present land use is not affecting the supply of ESS negatively

The score -1 is used in situations where the present land use not only inhibits the supply of the ESS but also have an active counteracting effect due to ongoing or historical activities. One example is given by the soil ESS *Fresh water* in the Bus garage and Fixfabriken areas on the remediation site, see Table F.7 below. The hardened surfaces themselves prevent the supply of the ESS in an area where the potential is very high due the geological conditions at the site. This situation would by itself render the score 0 to the supply of the ESS. But the soil under the hardened surfaces is in this case also heavily polluted which implies that the adsorption of pollutants into soil aggregates, and degradation (chemically alteration) by soil biota is diminished. The latter condition renders the score -1 to the present status of the ESS at the two parts of the remediation site.

The score 0 is used in situation when the supply of the ESS is hindered by the present land use. One example is found in the ESS *Food*; for obvious reasons there are no vegetables produced in urban allotments in the Bus garage area due to the ongoing land use.

The score 1 is used in situations where the supply of the ESS exists but is impaired by the present land use, e.g.; there is some vegetation along the Karl Johansgatan Boulevard (trees and bushes) with a positive noise reducing effect in relation to the road passing just north of the area. This effect could be enhanced if the present land use, in terms of buildings, roads, infrastructure etc. allowed for more vegetation.

The score 2 is used in situations where the supply of the ESS is somewhat negatively affected by the present land use, e.g. fields of lawn and vegetation are found in the areas surrounding the future remediation sites. These areas have positive effects on the ESS *Air purification* and *Local climate*. The supply of these ESS is however impaired by buildings and roads which implies that the full potential is not achieved.

The score 3 is used in situations when the ESS can be considered to be unaffected by the present land use. An example is given by the high cultural values represented by the Neolithic remaining south of the Fixfabriken factory area.

The remediation scenarios

The changes in provision of ESS resulting from different remediation/land use alternatives are assessed qualitatively/quantitatively by use of information on excavation of soil, on site/off-site remediation actions, transports and future land use. In order to facilitate comparisons of the supply of ESS between the baseline and remediation scenario, the same scores previously used to illustrate the ESS-status in the baseline scenario are again used to illustrate the expected ESS status at the site in each of the remediation scenarios.

Quantification

The quantification step implies continued analysis of the identified ESS by,

1. identification of suitable indicators to describe changes in relation to the baseline, and
2. identification of sources of information and/or data with regards to the indicators.

The indicators that have been identified for the urban and soil ESS (Table F.4 and F.5) have been collected from literature (Finvers, 2008 and Baggethun et al. 2013) or from ongoing projects. In cases where no information have been found, indicators have been suggested based on the features of the ecosystem services they are designed to describe, e.g. the indicator for the ESS *Pollination and seed dispersal* was chosen to be *Area of vegetation (ha)* which is motivated by its function as habitat for birds and insects providing the mechanism for the service.

The indicators serve as physical interpretations, or proxies, of the impacts on ecosystem services that can be expected from the remediation process itself and the future land use at the site. The indicators may also be used to perform monetary assessments of the changes in provision of ecosystem services that follows from remediation projects, this has not been done in this study.

Table F.4. Indicators for quantifying changes in provision of urban ecosystem services

Ecosystem service		Indicator
Provisioning	Food	Production/Harvest (ton/year), Areas available suitable for production (m ²)
	Fresh water	Groundwater generated (m ³ /ha/year;m ³ /year)
Regulation & Maintenance	Air quality regulation	Area of vegetation (ha)
	Climate regulation global	Carbon bound in ecosystems = C sequestration (ton C/year; ton C/ha/year) O ₂ -CO ₂ balance (+/- kg C /year) Production or reduction of other GHG (kg/yr;kg/ha/year)
	Climate regulation local (urban climate)	Area of vegetation (ha)
	Water regulation	Area of vegetation (ha), water storage capacity (m ³ /ha/year)
	Noise reduction	Area of vegetation (ha)
	Water purification and waste treatment	Volumes of soil available for filtration (m ³ /ha)
	Pollination and seed dispersal	Area of vegetation (ha)
	Maintaining nursery populations and habitats	Area of vegetation (ha)
	Natural hazard regulation	Area of vegetation (ha)
Cultural	Knowledge systems	Area of vegetation (ha)
	Aesthetic values	Scenic landscape (ha) (e.g. revealed through prices on real estate)
	Cultural heritage values	Number of visitors/tourists
	Recreation and ecotourism	Number of visitors/tourists

Table F.5. Indicators for quantifying changes in the provision of soil ecosystem services

Ecosystem service		Soil context	Indicator
Provisioning	Food	Nutrient cycling to support plant growth (primary production) including food and fibre production	Area of vegetation (ha)
	Biomass	Basis of all terrestrial ecosystems –life support	Soil (horizon) development and disturbance regime controls ecosystem development
Regulation & Maintenance	Fresh water	Water purification and soil contaminant reduction	Volumes of soil available for filtration (m ³ /ha)
	Climate regulation global	Carbon Sequestration	Area of vegetation (ha)
		Regulation of greenhouse gasses	Area of vegetation (ha)
	Water regulation	Flood regulation	Natural water retention capacity (m ³)
	Erosion regulation		
Water purification and	Remediation of soil contaminated by diffuse airborne pollution.	Area of vegetation (ha)	

Results Fixfabriken

Identification and present state assessment of relevant ESS (Baseline)

After analyzing the sources of information regarding the physical conditions and present land use at the site (e.g. aerial images of the Fixfabriken site, project information on planned future land use, geological surveys and archaeological surveys), a number of urban and soil ESS were selected as relevant for the Fixfabriken area, Table F.6 and F.7. The present state of each ESS is assessed using the scores described above.

The present land use with large areas of hardened surfaces and factory buildings implies low status in many urban and soil ESS in the baseline scenario. The *Adjacent area* just south of, but within the remediation site, is however given higher scores due to vegetation with positive effects on *air quality* and *noise reduction*, and geological conditions suitable for infiltration of ground water, water purification etc. Parts of the *Adjacent area* also contains the remains of a Neolithic settlement which implies cultural heritage values, the settlement also protrudes under the Fixfabriken part of the site.

Table F.6. Status of urban ESS identified as relevant at the Fixfabriken site.

Ecosystem service	Parts of the Fixfabriken area				
	Fixfab. ¹	Bus garage	Tram hall	K-J Blvd ²	Adj. areas ³
Air quality regulation	1	0	0	1	2
Climate regulation local	1	0	0	1	2
Noise reduction	1	0	0	1	2
Aesthetic values	0	0	0	1	2
Cultural heritage values	2	0	0	0	3
Recreation and ecotourism	0	0	0	0	2

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions.

Table F.7. Status of soil ESS identified as relevant at the Fixfabriken site.

Ecosystem service	Parts of the Fixfabriken area				
	Fixfab. ¹	Bus garage	Tram hall	K-J Blvd ²	Adj. areas ³
Fresh water	-1	-1	0	1	3
Climate regulation global	1	0	0	1	2
Flood regulation	1	0	0	1	2
Water purification and waste treatment ⁴	0	0	0	1	2

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Refers to remediation of soil contaminated by diffuse airborne pollution.

Quantification of effects from remediation scenario compared to baseline

In order to evaluate the effects on urban and soil ESS from the remediation actions and the planned future land use at the site, the changes in indicators chosen to represent the identified ESS are

quantified. The results are presented in Tables F.8 through 27. In addition to the different parts of the actual remediation site, some concern is also given to “areas off-site” (AOS). This is of particular importance when polluted soil from the remediation site is transported off-site for deposition on landfills or further treatment. The potentially negative effects on local ecosystem services at disposal sites need to be considered in order to for the analysis to be complete.

In the final step, scores are appointed to the estimated changes in supply of ecosystem services in the different remediation alternatives based on the estimated changes in quantified indicators.

Alternative 1(A1)

This remediation alternative is described in detail in section 6.3.3 of the main technical report. Details concerning the quantified changes in the indicators representing soil and urban ecosystem services are described in Tables F.8 and F.9 below, the consequent scores appointed to changes in soil and urban ecosystem services area presented in Table F.10 and F.11.

Table F.8. Changes in indicators representing urban ESS as a result of remediation alternative 1(A1) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation	- 0,5 ha vegetation, trees and lawn								
Climate regulation local (urban climate)	- 0,5 ha vegetation, trees and lawn								
Noise reduction	- 0,5 ha vegetation, trees and lawn								
Aesthetic values	Urban park and urban scenic view in sight from houses.(no. of apartments)		Urban park and urban scenic view in sight from houses (no. of apartments)						
Cultural heritage values	Parts of the Neolithic settlement is excavated								Parts of the Neolithic settlement is excavated
Recreation and ecotourism	Removal of the buildings creates opportunities for recreation, mediation and relaxation.	Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.	Removal of the Garage creates opportunities for recreation, mediation and relaxation	Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.	Change of activities in the tram hall creates opportunities for recreation, mediation and relaxation			Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas - area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Table F.9. Changes in indicators representing soil ESS as a result of remediation alternative 1(A1) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁵	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water	-54 000 m ³ contaminated soil	+27 000 m ³ contaminated soil	-70 000 m ³ contaminated soil	+35 000 m ³ contaminated soil				+26 000 m ³ contaminated soil	Approximately 0,5 ha of vegetated land is removed
Climate regulation global									Approximately 0,5 ha of vegetated land is removed
Flood regulation									Approximately 0,5 ha of vegetated land is removed
Water purification and waste treatment ⁴		+27 000 m ³ contaminated soil		+35 000 m ³ contaminated soil				+26 000 m ³ contaminated soil	Approximately 0,5 ha of vegetated land is removed

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Refers to remediation of soil contaminated by diffuse airborne pollution, ⁵ Areas Off-site

Effects on urban ecosystem services (1(A1))

The effects in terms of strengthened or diminished supply of ecosystem services from the remediation compared to the baseline scenario are presented in Table F.10. Positive effects are indicated with green color and the change in score is presented in each cell with the baseline score in the upper left part, and the resulting score after the remediation in the lower right part of the cell. The overall effects are summarized for each of the areas comprised by the remediation site.

Table F.10. Summary of assessments regarding changes in **urban ESS** as a consequence of remediation alternative 1(A1) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in Table F.3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation	1 0								
Climate regulation local (urban climate)	1 0								
Noise reduction	1 0								
Aesthetic values	0 2		0 2						
Cultural heritage values	2 1								3 2
Recreation and ecotourism	0 1	-1	0 1	-1	0 1			-1	
Total change in provision	-1	-1	+3	-1	+1			-1	-1

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Air quality regulation, Climate regulation local (urban climate) and Noise reduction

A decrease in the provision of the ESS above is foreseen as a result of the removal of 0,5 ha vegetation, trees and lawn.

Aesthetic value

The provision of this ESS is considered to increase considerably due to the scenic view offered from the planned residential areas.

Cultural heritage values

Excavation of parts of the Neolithic settlement is considered to have a negative impact on the ESS. However, the negative effect could be turned into a positive effect if a thorough archaeological investigation is performed previous to the excavation.

Recreation

The future planned land use will offer improvements in terms of recreation at the site compared to the present land use. There is however a risk that this positive effect might be cancelled out by negative effects in areas off-site used as disposal sites for polluted soil.

Effects on soil ecosystem services (1(A1))

The effects on soil ecosystem services that can be expected from the remediation actions are presented in the same manner as for the urban ecosystem services above.

A decrease in the provision of the ESSs *Fresh water*, *Climate regulation global*, *Flood regulation* *Water and purification and waste treatment* is foreseen as a result of the removal of 0,5 ha vegetation, trees and lawn in the adjacent area. An increase is on the other hand expected for the ESS *Fresh water* in the parts of the Fixfabriken where the soil at present is heavily polluted, this positive effect might be cancelled out by negative effects in areas off-site used as disposal sites for polluted soil.

An increase in the provision of the ESS *Fresh water* and *Water purification and waste treatment* can be foreseen in K-J Blvd as a result of excavation of polluted masses, it is however questionable if the positive effect is great enough to motivate a higher score than that of the base line. The disposal of polluted soil off-site might however bring about a negative effect that could be considerable given the conditions on the landfill site prior to the deposition.

Table F.11. Summary of assessments regarding changes in **soil ESS** as a consequence of remediation alternative 1(A1) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in table 3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water	-1 / 1	-1	-1 / 1	-1	-1 / 1			-1	3 / 2
Climate regulation global									2 / 1
Flood regulation									2 / 1
Water purification and waste treatment ⁴		-1		-1				-1	2 / 1
Total change in provision	+2	-2	+2	-2	+2			-2	-4

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas - within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Alternative 2(A2)

This remediation alternative is described in detail in section 6.3.3. Details concerning the quantified changes in the indicators representing soil and urban ecosystem services are described in Table F.12 and F.13 below, the consequent scores appointed to changes in soil and urban ecosystem services area presented in Tables F.14 and F.15.

Table F.12. Changes in indicators representing urban ESS as a result of the remediation alternative 2(A2) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation	+ 0,4 ha green area								
Climate regulation local (urban climate)	+ 0,4 ha green area								
Noise reduction	+ 0,4 ha green area								
Aesthetic values	Urban park and urban scenic view in sight from houses.(no. of apartments)		Urban park and urban scenic view in sight from houses (no. of apartments)						
Cultural heritage values	Parts of the Neolithic settlement is excavated								
Recreation and ecotourism	Removal of the buildings creates opportunities for recreation, mediation and relaxation.	Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.	Removal of the Garage creates opportunities for recreation, mediation and relaxation	Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.	Change of activities in the tram hall creates opportunities for recreation, mediation and relaxation			Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas - area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Table F.13. Changes in indicators representing soil ESS as a result of the remediation alternative 2(A2) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁵	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water	-54 000 m ³ contaminated soil	+27 000 m ³ contaminated soil	- 70 000 m ³ contaminated soil	+35 000 m ³ contaminated soil				+26 000 m ³ contaminated soil	
	+ 0,4 ha green area leads to increased infiltration to groundwater								
Climate regulation global	+ 0,4 ha green area leads to increased carbon sequestration								
Flood regulation	+ 0,4 ha green area leads to increased infiltration to groundwater								
Water purification and waste treatment ⁴	+ 0,4 ha green area leads to increased purification of diffuse airborne pollution	+27 000 m ³ contaminated soil		+35 000 m ³ contaminated soil				+26 000 m ³ contaminated soil	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Refers to remediation of soil contaminated by diffuse airborne pollution, ⁵ Areas Off-site

Effects on urban ecosystem services (2(A2))

The effects in terms of strengthened or diminished supply of urban ecosystem services from remediation alternative 2(A2) compared to the baseline scenario are presented in Table F.14. Positive effects are indicated with green color and the change in score is presented in each cell with the baseline score in the upper left part, and the resulting score after the remediation in the lower right part of the cell. The overall effects are summarized for each of the areas comprised by the remediation site.

Table F.14. Summary of assessments regarding changes in **urban ESS** as a consequence of remediation alternative 2(A2) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in table 3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation	1 2								
Climate regulation local (urban climate)	1 2								
Noise reduction	1 2								
Aesthetic values	0 2		0 2						
Cultural heritage values	2 1								
Recreation and ecotourism	0 1	-1	0 1	-1	0 1			-1	
Total change in provision	+5	-1	+3	-1	+1			-1	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Air quality regulation, Climate regulation local (urban climate) and Noise reduction

A increase in the provision of the ESS above is foreseen as a result of the creation of 0,4 ha green space.

Aesthetic value

The provision of this ESS is considered to increase considerably due to the scenic view offered from the planned residential areas.

Cultural heritage values

Excavation of parts of the Neolithic settlement is considered to have a negative impact on the ESS. However, the negative effect could be turned into a positive effect if a thorough archaeological investigation is performed previous to the excavation.

Recreation

The future planned land use will offer improvements in terms of recreation at the site compared to the present land use. There is however a risk that this positive effect might be cancelled out by negative effects in areas off-site used as disposal sites for polluted soil.

Effects on soil ecosystem services (2(A2))

The effects on soil ecosystem services that can be expected from the remediation actions are presented in the same manner as for the urban ecosystem services above.

Table F.15. Summary of assessments regarding changes in **soil ESS** as a consequence of remediation alternative 2(A2) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in table 3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water	-1 2	-1	-1 1	-1				-1	
Climate regulation global	1 2								
Flood regulation	1 2								
Water purification and waste treatment ⁴	1 2	-1		-1				-1	
Total change in provision	+6	-2	+2	-2				-2	

¹Fixfabriken factory area, ²Karl Johansgatan Boulevard, ³Adjacent areas - within the development site but separated from the actual buildings affected by the remediation actions. ⁴Areas Off-site

Fresh water, Climate regulation global, Flood regulation

An increase in the provision of these *Fresh water, Climate regulation global* and *Flood regulation* is foreseen as a result of the creation of 0,4 ha of green space. There is an additional positive local effect on the ESS *Fresh water* due to the fact that the polluted soil is transported off-site. The anticipated positive effect might however be countered by negative effects in the landfill areas used for disposal of the polluted soil.

Water purification and waste treatment

An increase in the provision of the ESS *Water purification and waste treatment* is foreseen as a result of the creation of 0,4 ha green space. An increase can be foreseen in K-J Blvd as a result of excavation of polluted masses. It is unclear if this positive effect will be large enough to motivate a higher score than that of the baseline, it is therefore left unchanged. The disposal of polluted masses off-site

might however bring about a negative effect that could be considerable given the conditions on the landfill site prior to the deposition.

Alternative 3(A3)

This remediation alternative is described in detail in section 6.3.3. Details concerning the quantified changes in the indicators representing soil and urban ecosystem services are described in Tables F.16 and F.17 below, the consequent scores appointed to changes in soil and urban ecosystem services area presented in Tables F.18 and F.19.

Table F.16. Changes in indicators representing urban ESS as a result of the remediation alternative 3(A3) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation									
Climate regulation local (urban climate)									
Noise reduction									
Aesthetic values	Urban park and urban scenic view in sight from houses.(no. of apartments)								
Cultural heritage values									
Recreation and ecotourism	Removal of the buildings creates opportunities for recreation, mediation and relaxation.				Removal of the tram hall creates opportunities for recreation, mediation and relaxation			Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas - area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Table F.17. Changes in indicators representing soil ESS as a result of the remediation alternative 3(A3) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁵	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water	Soft technique remediation of contaminated soil (phyto-remediation) around buildings.		Soft technique remediation of contaminated soil (phyto-remediation) around buildings.					+ 26 000 m ³ contaminated soil	
Climate regulation global									
Flood regulation									
Water purification and waste treatment ⁴								+ 26 000 m ³ contaminated soil	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Refers to remediation of soil contaminated by diffuse airborne pollution, ⁵ Areas Off-site

Effects on urban ecosystem services (3(A3))

The effects in terms of strengthened or diminished supply of urban ecosystem services from remediation alternative 3(A3) compared to the baseline scenario are presented in Table F.18. Positive effects are indicated with green color and the change in score is presented in each cell with the baseline score in the upper left part, and the resulting score after the remediation in the lower right part of the cell. The overall effects are summarized for each of the areas comprised by the remediation site.

Aesthetic value

The provision of this ESS is considered to increase considerably due to the scenic view offered from the planned residential areas.

Recreation

The planned future land use will offer improvements in terms of recreation at the remediation site compared to the present land use. Alternative 3(A3) does however also include deposition of polluted soil from K-J Blvd which potentially may impose negative effects at off-site landfills with regards to the ESS *Recreation*.

Table F.18. Summary of assessments regarding changes in **urban ESS** as a consequence of remediation alternative 3(A3) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in table 3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation									
Climate regulation local (urban climate)									
Noise reduction									
Aesthetic values	0 2								
Cultural heritage values									
Recreation and ecotourism	0 1				0 1			-1	
Total change in provision	+3				+1			-1	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Effects on soil ecosystem services (3(A3))

The effects on soil ecosystem services that can be expected from the remediation actions are presented in the same manner as for the urban ecosystem services above.

An increase in the provision of the ESSs *Fresh water* in the parts of the Fixfabriken where soft remediation techniques are applied (phytoremediation).

An increase in the provision of the ESS *Fresh water* and *Water purification and waste treatment* can be foreseen in K-J Blvd as a result of excavation of polluted masses, it is however questionable if the positive effect is great enough to motivate a higher score than that of the base line. The disposal of polluted masses off-site might however bring about a negative effect that could be considerable given the conditions on the site prior to the deposition.

Table F.19. Summary of assessments regarding changes in **soil ESS** as a consequence of remediation alternative 3(A3) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in table 3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water	-1 1		-1 1					-1	
Climate regulation global									
Flood regulation									
Water purification and waste treatment ⁴								-1	
Total change in provision	+2		+2					-2	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas - within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Alternative 4(B)

This remediation alternative is described in detail in section 6.3.3. Details concerning the quantified changes in the indicators representing soil and urban ecosystem services are described in Tables F.20 and F.21 below, the consequent scores appointed to changes in soil and urban ecosystem services area presented in Tables F.22 and F.23.

Table F.20. Changes in indicators representing urban ESS as a result of the remediation alternative 4(B) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation	- 0,5 ha vegetation, trees and lawn								
Climate regulation local (urban climate)	- 0,5 ha vegetation, trees and lawn								
Noise reduction	- 0,5 ha vegetation, trees and lawn								
Aesthetic values	Urban park and urban scenic view in sight from houses.(no. of apartments)								
Cultural heritage values	Parts of the Neolithic settlement is excavated								Parts of the Neolithic settlement is excavated
Recreation and ecotourism	Removal of the buildings creates opportunities for recreation, mediation and relaxation.	Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.		Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.	Removal of the tram hall creates opportunities for recreation, mediation and relaxation	Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.		Deposit of polluted soil potentially counters opportunities for recreation, mediation and relaxation at landfill sites.	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas - area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Table F.21. Changes in indicators representing soil ESS as a result of the remediation alternative 4(B) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁵	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water	-54 000 m ³ contaminated soil	+27 000 m ³ contaminated soil	- 70 000 m ³ contaminated soil	+35 000 m ³ contaminated soil	- 58 000 m ³ contaminated soil	+ 29 000 m ³ contaminated soil		+ 26 000 m ³ contaminated soil	Approximately 0,5 ha of vegetated land is removed
Climate regulation global									Approximately 0,5 ha of vegetated land is removed
Flood regulation									Approximately 0,5 ha of vegetated land is removed
Water purification and waste treatment ⁴		+27 000 m ³ contaminated soil		+35 000 m ³ contaminated soil		+ 29 000 m ³ contaminated soil		+ 26 000 m ³ contaminated soil	Approximately 0,5 ha of vegetated land is removed

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Refers to remediation of soil contaminated by diffuse airborne pollution, ⁵ Areas Off-site

Effects on urban ecosystem services (4(B))

Alternative 4(B) implies excavation in all four areas of the remediation site. Since no on-site remediation of polluted soil is included, this is the remediation strategy among the five alternatives that leads to the largest amounts of polluted soil being deposited at off-site landfills. This is reflected in negative scores on AOS for the supply of the ESS *Recreation*.

In the same way as for alternative 1(A1), the partial excavation of the Neolithic settlement is considered to have a negative impact on the ESS. However, the negative effect could be turned into a positive effect if a thorough archaeological investigation is performed previous to the excavation.

Table F.22. Summary of assessments regarding changes in **urban ESS** as a consequence of remediation alternative 4(B) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in table 3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation	1 0								
Climate regulation local (urban climate)	1 0								
Noise reduction	1 0								
Cultural heritage values	2 1								3 2
Aesthetic values	0 2								
Recreation and ecotourism	0 1	-1		-1	0 1	-1		-1	
Total change in provision	+1	-1		-1	+1	-1		-1	-1

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Effects on soil ecosystem services (4(B))

Since excavation without on-site remediation of polluted soil is planned in all four areas within the remediation site, potentially large negative effects can be anticipated in off-site landfills after deposition. This is reflected in negative scores at AOS for the ESS *Fresh water* and *Water purification and waste treatment*.

Alternative 4(B) also implies removal of ca 0,5 ha of vegetation in the adjacent area, this results in negative scores for the ESS *Freshwater*, *Climate regulation global*, *Flood regulation* and *Water purification and waste treatment*.

Table F.23. Summary of assessments regarding changes in **soil ESS** as a consequence of remediation alternative 4(B) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in Table F.3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water	-1 / 1	-1	-1 / 1	-1		-1		-1	3 / 2
Climate regulation global									2 / 1
Flood regulation									2 / 1
Water purification and waste treatment ⁴		-1		-1		-1		-1	2 / 1
Total change in provision	+2	-2	+2	-2		-2		-2	-4

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas - within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Alternative 5(C)

This remediation alternative is described in detail in section 6.3.3. Details concerning the quantified changes in the indicators representing soil and urban ecosystem services are described in Table F.24 and F.25 below, the consequent scores appointed to changes in soil and urban ecosystem services area presented in Tables F.26 and F.27.

Table F.24. Changes in indicators representing urban ESS as a result of remediation alternative 5(C) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation									
Climate regulation local (urban climate)									
Noise reduction									
Aesthetic values			Urban park and urban scenic view in sight from houses (no. of						
Cultural heritage values									
Recreation and ecotourism			Removal of the Garage creates opportunities for recreation, mediation and relaxation	Deposit of polluted soil counters opportunities for recreation, mediation and relaxation.	Change of activities in the tram hall creates opportunities for recreation, mediation and			Deposit of polluted soil counters opportunities for recreation, mediation and relaxation.	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas - area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Table F.25. Changes in indicators representing soil ESS as a result of remediation alternative 5(C) and in comparison to the baseline scenario. Green color indicates an improvement in provision of ecosystem services brought about by the remediation alternative in comparison to the baseline scenario, red color indicates a deterioration.

Ecosystem service	Fixfab. ¹	AOS ⁵	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water			-70 000 m ³ contaminated soil	+35 000 m ³ contaminated soil				+26 000 m ³ contaminated soil	
Climate regulation global									
Flood regulation									
Water purification and waste treatment ⁴				+35 000 m ³ contaminated soil				+26 000 m ³ contaminated soil	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Refers to remediation of soil contaminated by diffuse airborne pollution, ⁵ Areas Off-site

Effects on urban ecosystem services (5(C))

The effects in terms of strengthened or diminished supply of ecosystem services from the remediation compared to the baseline scenario are presented in Table F.10. Positive effects are indicated with green color and the change in score is presented in each cell with the baseline score in the upper left part, and the resulting score after the remediation in the lower right part of the cell. The overall effects are summarized for each of the areas comprised by the remediation site.

In alternative 5(C), both Fixfabriken and the tram hall are kept intact which is reflected in relatively small changes in supply of ecosystem services compared to the baseline scenario. Some positive effects are anticipated in the Bus garage area where new buildings for residential use with commercial/offices/services at the ground floor implies increased *Aesthetic values* in addition to increased possibilities for *recreation* compared to the baseline scenario. The remediation actions in this alternative implies excavation and deposition of polluted soils at off-site landfills which is reflected in potentially decreased possibilities for *recreational* activities at landfill sites. The planned change of activities in the tram hall is expected to increase the opportunity for *recreation*.

Table F.26. Summary of assessments regarding changes in **urban ESS** as a consequence of remediation alternative 5(C) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in Table F.3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Air quality regulation									
Climate regulation local (urban climate)									
Noise reduction									
Aesthetic values			0 / 2						
Cultural heritage values									
Recreation and ecotourism			0 / 1	-1	0 / 1			-1	
Total change in provision			+3	-1	+1			-1	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Effects on soil ecosystem services (5(C))

The effects on soil ecosystem services that can be expected from the remediation actions are presented in the same manner as for the urban ecosystem services above.

The effects on soil ecosystem services from alternative 5(C) is limited to the positive impact on the ESS *Fresh Water* in the Bus garage area from excavating and removing polluted soil. Consequently there might be a negative effect on the ESS *Fresh Water* from the deposited soil at landfill sites. The same is valid for the landfill site used to deposit polluted soil from Karl Johansgatan Boulevard.

*Table F.27. Summary of assessments regarding changes in **soil ESS** as a consequence of remediation alternative 5(C) and future land use. Green color indicates an improvement in provision of ecosystem services in comparison to the baseline scenario, red color indicates a deterioration. The figure in the upper left part of each divided cell indicates the qualitative score of the ecosystem service in the baseline scenario as described in Table F.3, the score in the lower right part indicates the expected score after remediation. A single score without the diagonal line indicates the relative change in locations where the prevailing status is unknown (i.e. landfill sites).*

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)								
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³
Fresh water			-1 1	-1				-1	
Climate regulation global									
Flood regulation									
Water purification and waste treatment ⁴				-1				-1	
Total change in provision			+2	-2				-2	

¹ Fixfabriken factory area, ² Karl Johansgatan Boulevard, ³ Adjacent areas - within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

Summary

The result from the summary of the analysis (Table F.28) shows that 2(A2) appears to be the most desirable remediation alternative from an ecosystem services perspective. This alternative is identical in terms of remediation actions and future land use to alternative 1(A1) with the exception of a green space which is planned in the south part of the Fixfabriken area. The creation of the green space has a strong impact on the final score due to its strengthening of the provision of both urban and soil ecosystem services while the corresponding negative effects in the adjacent area foreseen in alternative 1(A1) are avoided. Alternative 1(A1) is ranked as the fourth most attractive option in the analysis.

The second best alternative is represented by 3(A3) which is the alternative that involves the least deposition of polluted soil at off-site landfills. In addition, this alternative imposes no negative impact on the adjacent area or on cultural heritage values on the site. The only potentially negative impact

in comparison to the baseline is attributed to the deposition of polluted soil from the Karljohangsgatan Boulevard area on off-site landfills.

The third best score is attributed to alternative 5(C). This alternative makes the most use of existing buildings and structures leaving both the Fixfabriken and the tram hall intact. It does however imply excavation and deposition of polluted soil from both the bus garage and Karl Johangsgatan areas which renders negative scores from potentially negative effects at off-site landfills.

The two least attractive alternatives are 4(B) and 1(A1) which is mainly explained by two common features; both alternatives implies excavation and deposition of polluted soil with potentially negative effects on ecosystem services at off-site landfills, both alternatives also implies negative effects on the adjacent area just south of the Fixfabriken as a part of the existing green space is claimed by the planned land use.

Table F.28. Summary of effects on urban and soil ecosystem services from different remediation alternatives in the Fixfabriken case study.

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)									Summary			
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³	Pos. impact	Neg. impact	Total score	Rank
Alternative 1(A1)													
Urban ESS	-1	-1	+3	-1	+1			-1	-1				
Soil ESS	+2	-2	+2	-2	+2			-2	-4				
Summary	+1	-3	+5	-3	+3			-3	-5	+9	-14	-5	4
Alternative 2(A2)													
Urban ESS	+5	-1	+3	-1	+1			-1					
Soil ESS	+6	-2	+2	-2				-2					
Summary	+11	-3	+5	-3	+1			-3		+17	-9	+8	1
Alternative 3(A3)													
Urban ESS	+3				+1			-1					
Soil ESS	+2		+2					-2					
Summary	+5		+2		+1			-3		+8	-3	+5	2
Alternative 4(B)													
Urban ESS	+1	-1		-1	+1	-1		-1	-1				
Soil ESS	+2	-2	+2	-2		-2		-2	-4				
Summary	+3	-3	+2	-3	+1	-3		-3	-5	+6	-17	-11	5
Alternative 5(C)													
Urban ESS			+3	-1	+1			-1					
Soil ESS			+2	-2				-2					
Summary			+5	-3	+1			-3		+6	-6	0	3

¹ Fixfabriken factory area, ² Karl Johangsgatan Boulevard, ³ Adjacent areas – area within the development site but separated from the actual buildings affected by the remediation actions. ⁴ Areas Off-site

A major part of the negative effects are expected in the alternatives where polluted soil is excavated and removed from the remediation site to be deposited at off-site landfills. Whether or not these negative effects will materialize depends on the conditions at the landfill sites prior to the deposition. If the landfills have been previously used for similar purposes, then the new addition of polluted soil will not result in additional local negative effect on the supply of ecosystem services. If a new site is required for the deposits, or if the soil in question has a higher degree of pollution compared to the existing soils at the landfill site, then the negative effects might be of relevance for the analysis.

Another important part of both positive and negative impacts come from changes in the so called *adjacent area*. The remediation alternatives 1(A1) and 4(B) implies that some 0,5 ha of this area will be claimed by the new land use causing negative effects on several ecosystem services, e.g. *Air quality regulation, Climate regulation local (urban climate) and Noise reduction*. In addition, the future land use also implies excavation of parts of a Neolithic settlement in the development area.

The excavation is expected to have a negative impact on the ESS *Cultural heritage values*, this however depends on whether or not the excavation is preceded by an archaeological investigation that may turn the negative effect into a positive one by means of e.g. exhibitions of the findings.

Discussion and sensitivity reflections

It is clear from the analysis that local conditions at landfill sites might play an important role for the final result in the Fixfabriken case study. Assume for example that no *additional* negative effects on ecosystem services would occur in landfill sites used for deposition of polluted soil from the remediation site. The summation in Table F.28 would then turn out as below (Table F.29) after removal of negative effects on the ESSs *Recreation and ecotourism* and *Water purification and waste treatment*.

Table F.29. Ranking of the remediation alternatives under the assumption of “no negative effects” from deposition of polluted soil on the supply of ecosystem services at off-site landfills.

Ecosystem service	Effects in parts of the Fixfabriken area and areas off-site (AOS)									Summary			
	Fixfab. ¹	AOS ⁴	Bus garage	AOS	Tram hall	AOS	K-J Blvd ²	AOS	Adj. areas ³	Pos. impact	Neg. impact	Total score	Rank
1(A1)	+1		+5		+3				-5	+9	-5	+4	4
2(A2)	+11		+5		+1					+17	-	+17	1
3(A3)	+5		+2		+1					+8	-	+8	2
4(B)	+3		+2		+1				-5	+6	-5	-11	5
5(C)			+5		+1					+6	-	+6	3

The rank between the different options remains the same after removing the potentially negative effects on landfill sites. The most attractive alternative 2(A2) appears even more favorable while the

differences between the rest of the alternatives decreases, leaving 5(C) only marginally better than 1(A1).

The latter result indicates that the final ranking in Table F.28 is sensitive to the representation of the negative effects on off-site landfills. Due to lack of information, a uniform score of -1 was applied to describe all negative effects from deposition of polluted soils at off-site landfills. In order to increase the precision in the analysis, a differentiated approach could be applied where variability in terms of negative effects (e.g. level of pollution of the soil from different parts of the remediation site, amounts of those soils, impact at individual landfill sites) are reflected in the score.

This analysis indicates that a qualitative/quantitative approach to map the changes in provision of ecosystem services that will follow from different remediation alternatives will potentially add important decision support regarding the social desirability of available options. The principal strength of the method is its ability to map and quantify changes in wellbeing normally not included in traditional cost-benefit analysis of remediation projects. Further, quantitative information about the indicators, chosen to represent changes in the supply of ecosystem services, is crucial for the last step in the analysis; monetization of the benefits from different remediation alternatives, or benefits foregone.

Valuation of welfare effects was not performed in this analysis. Monetary valuation of changes in supply of different ecosystem services does however add economic information to the traditional financial assessment of costs and benefits accruing to different development or remediation options. This results in a more comprehensive and accurate assessment of all the changes in wellbeing brought about by specific remediation options. In cases where monetary valuation is not possible, or suitable, the result of the analysis can be used together with traditional financial assessment of costs and benefits in multi criteria analysis (MCA) allowing for both qualitative and quantitative (monetized) data in the assessment.

The ecosystem services mapping have a few drawbacks that need to be considered, these are discussed in the caveats section below.

Caveats

The result from the analysis can be used to give an indication on changes in the provision of ecosystem services that can be expected from different remediation strategies. Summing the scores of effects on different ecosystem services poses however a number of problems that need to be considered

- The effect from changes in the provision of different ecosystem services might differ greatly in importance but still have the same qualitative score in the analysis. There is for example probably a great difference between the negative effect on wellbeing from increased noise from traffic that might be expected from the removal of a tree line in the adjacent area, compared to the negative effect on wellbeing that might occur at a disposal site used for depositing 26 000 m³ of polluted soil. A way to deal with this would be to assign weights to the scores used to describe changes in the provision of ecosystem services in a way that would reflect their relative importance at the local scale.

- Summing the effects on all affected ecosystem services at individual parts of the remediation site will inherently hide details regarding changes that might be of great local importance. This problem will to some extent be remedied by the use of weights as discussed above to highlight the relative importance of different changes in the supply of ecosystem services. This must nevertheless be kept in mind when the resulting scores are evaluated.
- Knowledge about the local conditions in areas affected by remediation actions is of great importance, not only at the actual site but also at off-site landfills. The negative effect from disposal of polluted soil at a landfill is determined by the initial conditions at the landfill site as well as the degree of pollution (and amount) of the soil being deposited.

References

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Appendix G – Fixfabriken: Social impact analysis

The social impact analysis tool (SIA) was developed as a tool to be used in urban planning in Göteborg. It is typically used as an inventory tool to check what there is, what is needed and the anticipated impacts of the detailed plan. In the Balance 4P project, the SIA was used as a tool to investigate the social impacts with regard to each alternative. The SIA tool is displayed in the form of a matrix, which takes four different social aspects into consideration: Cohesive city, Interactions, Everyday life and Identity, see y-axis in Figure G.1. Those aspects are in line with the political objectives of the City of Göteborg and are analysed with regard to five different scales: Buildings and places, Neighbourhood, District, City, and Region, see x-axis in Figure G.1.



Figure G.1. The SIA tool matrix.

Focus in Balance 4P has been on Neighbourhood and District, since the conceptual redevelopment strategies are not detailed enough to provide information for an analysis on the scale of Buildings and places. The matrix was used to: 1) map the reference alternative, 2) map preferred changes, and 3) map the impacts on Alternatives 1 to 5. Figures G.2 – G.8 shows all matrices. The impacts are qualitatively valued on the following scale: very negative impacts (--), negative impacts (-), no impacts (0), positive impacts (+), very positive impacts (++)

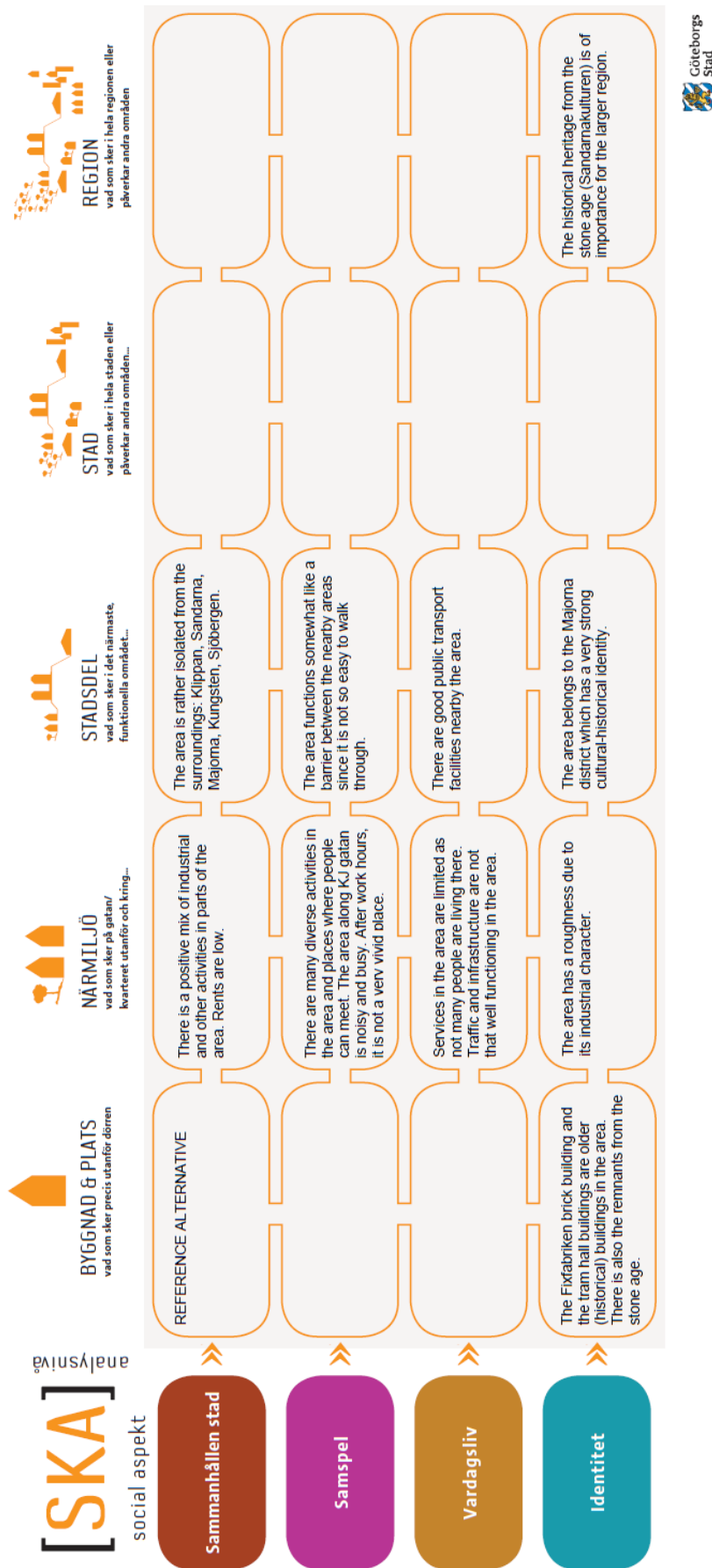


Figure G.2. The reference alternative.

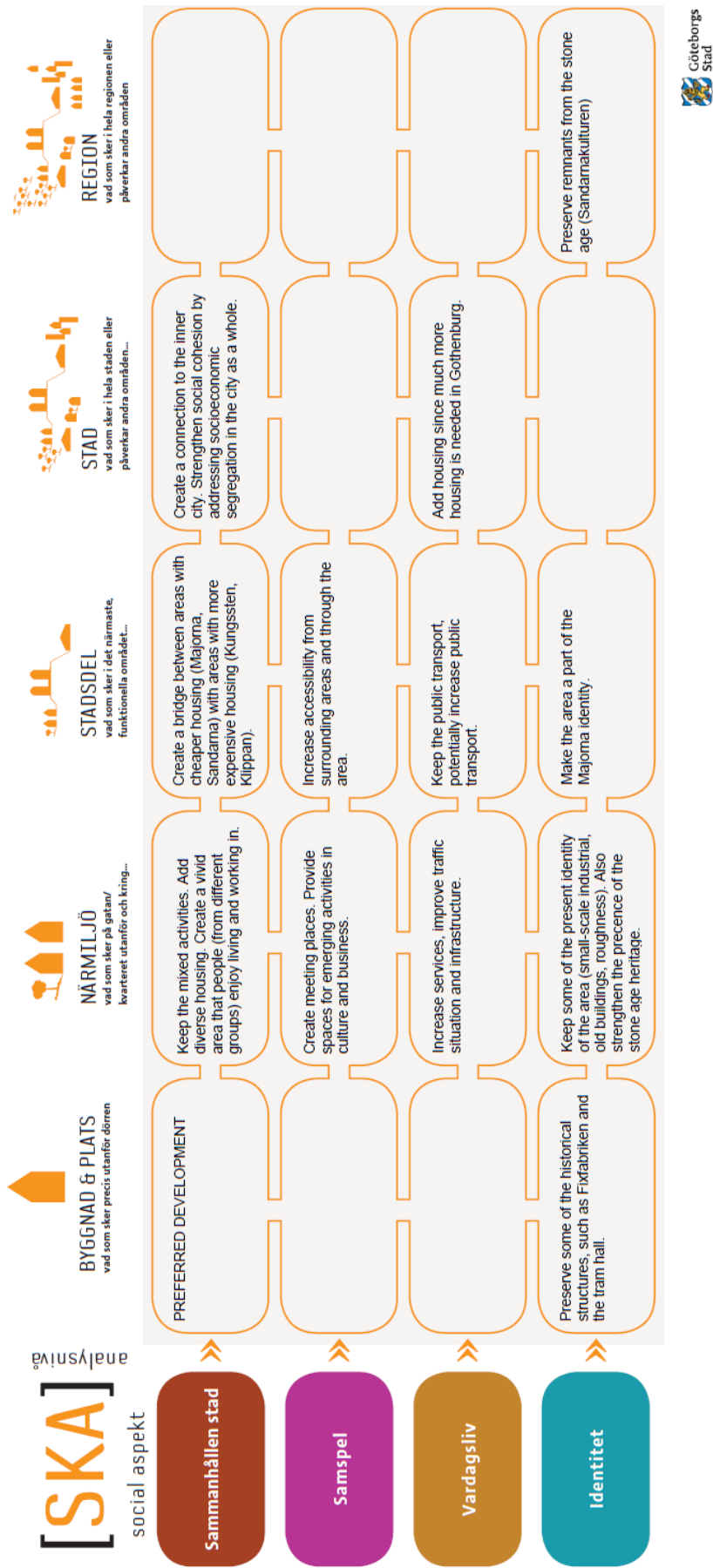


Figure G.3. Preferred changes.

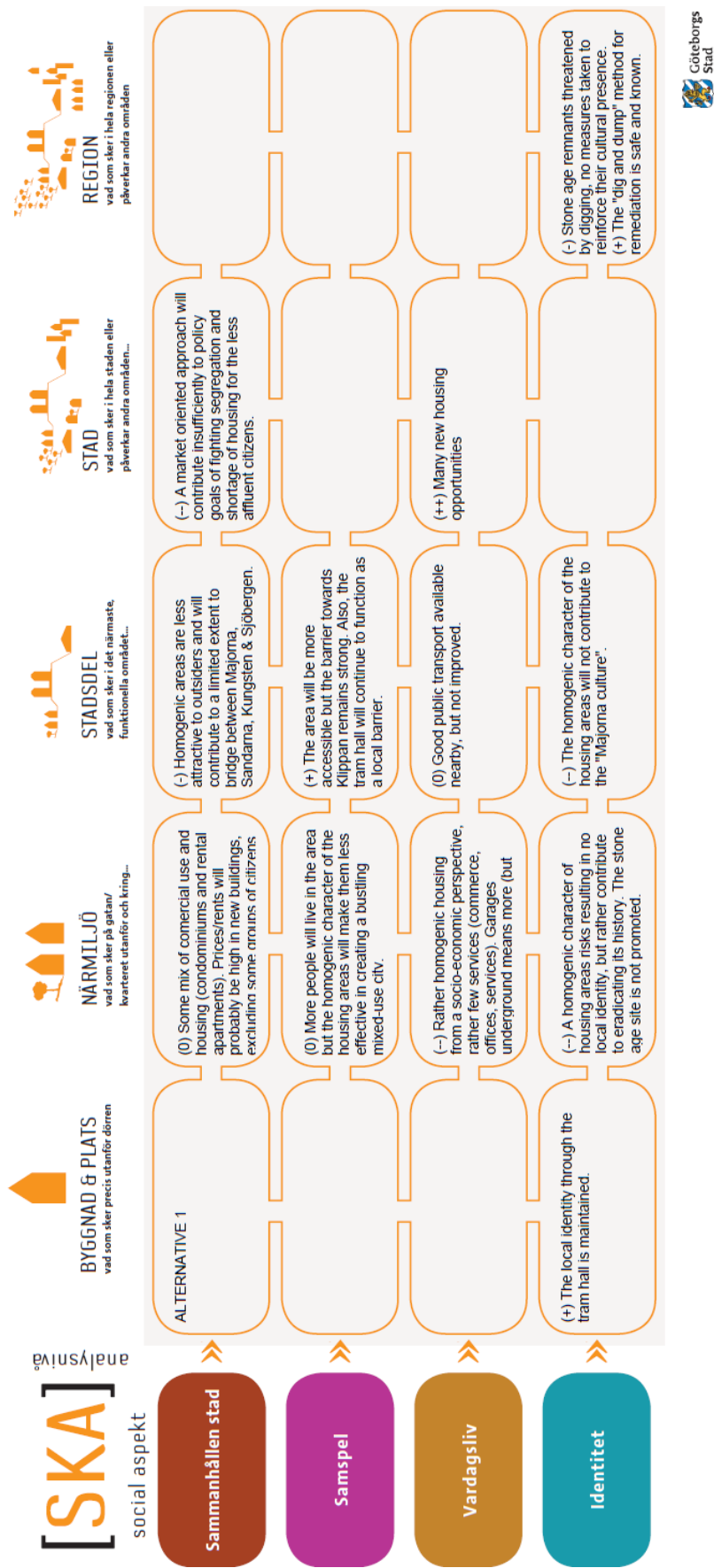


Figure G.4. Social impacts due to Alternative 1.

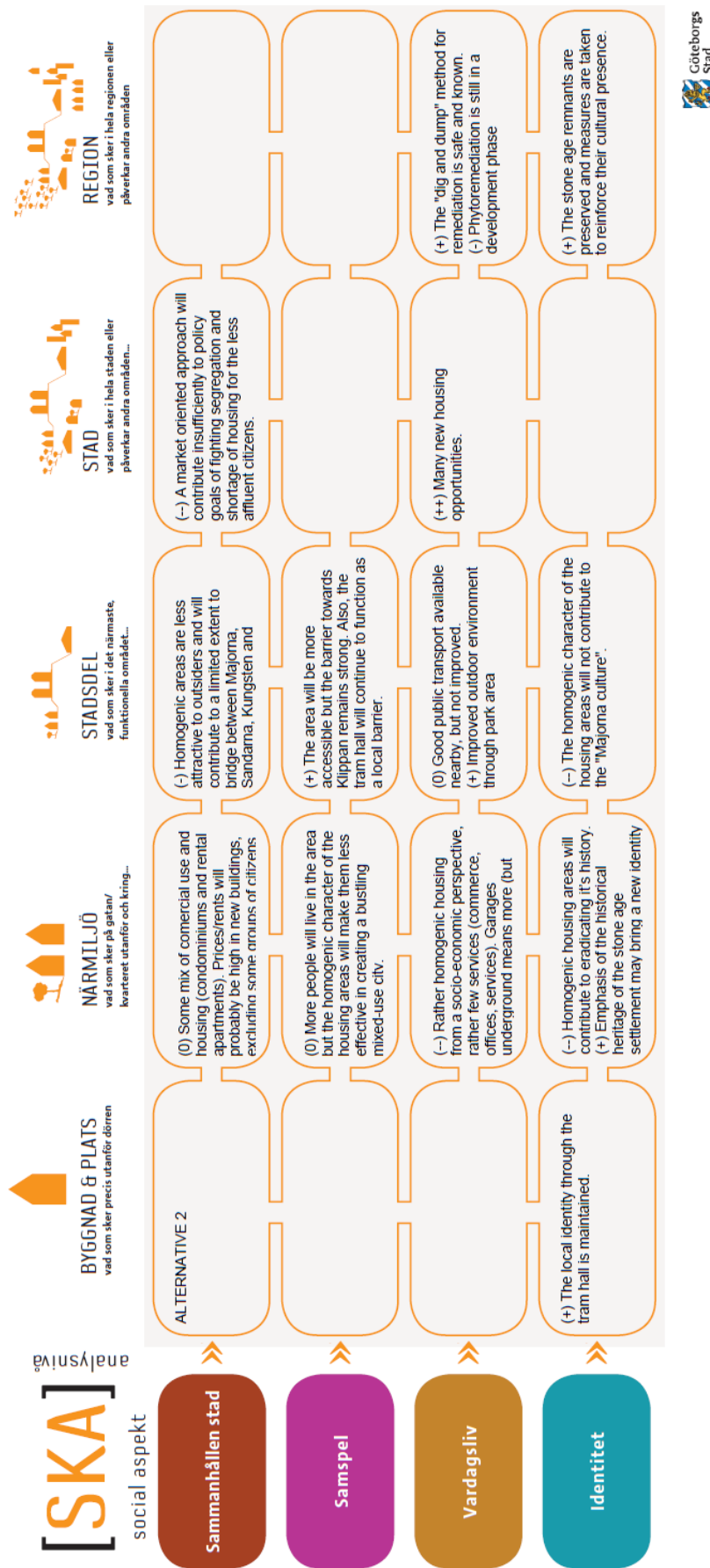


Figure G.5. Social impacts due to Alternative 2.

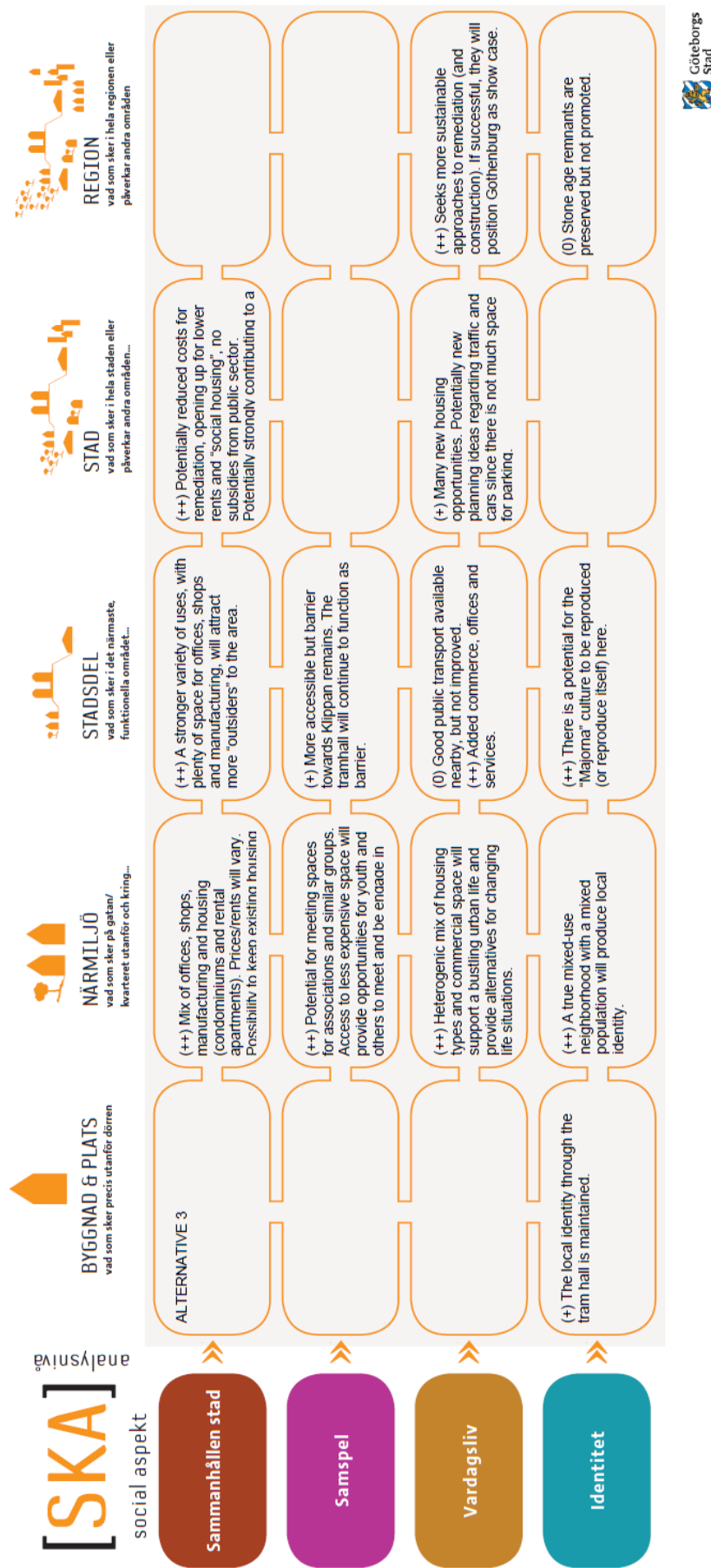


Figure G.6. Social impacts due to Alternative 3.

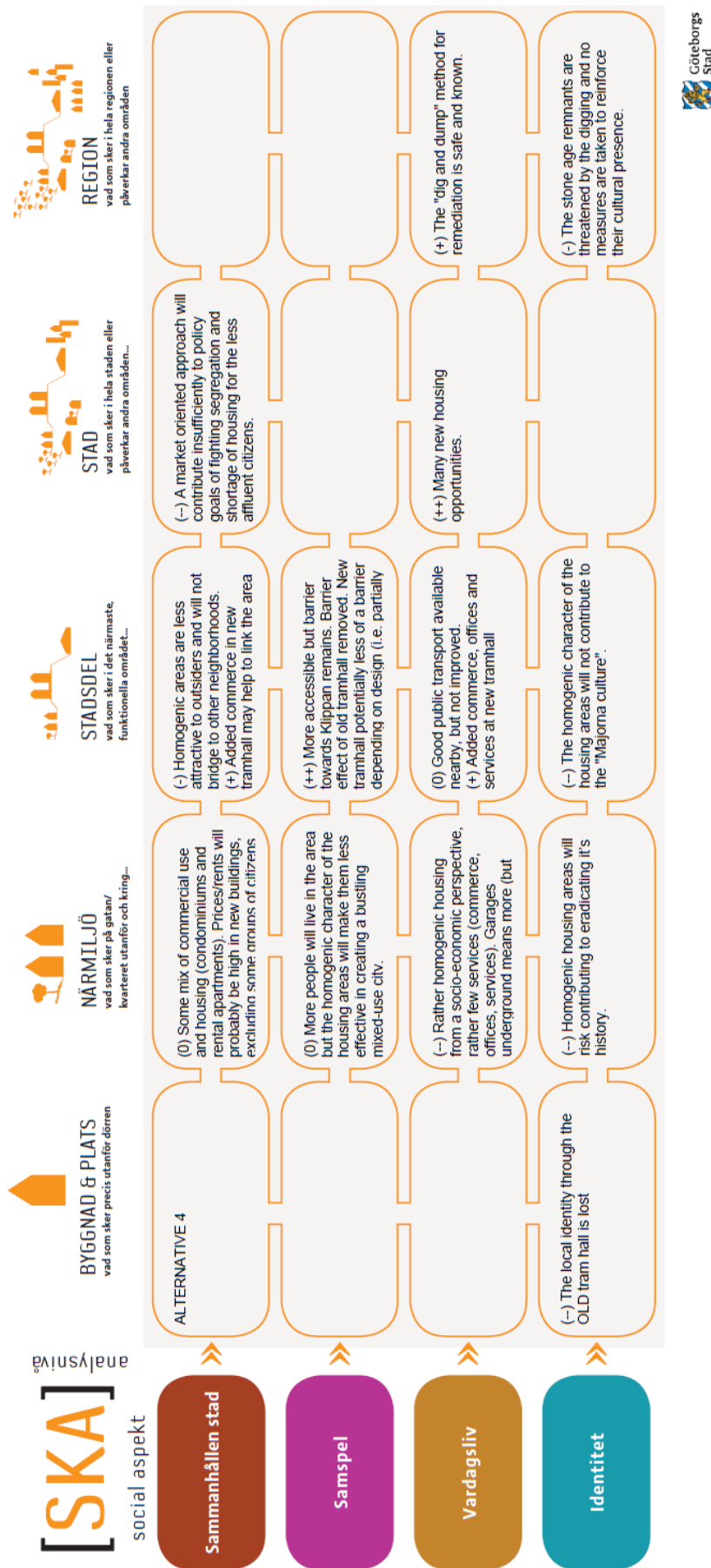


Figure G.7. Social impacts due to Alternative 4.

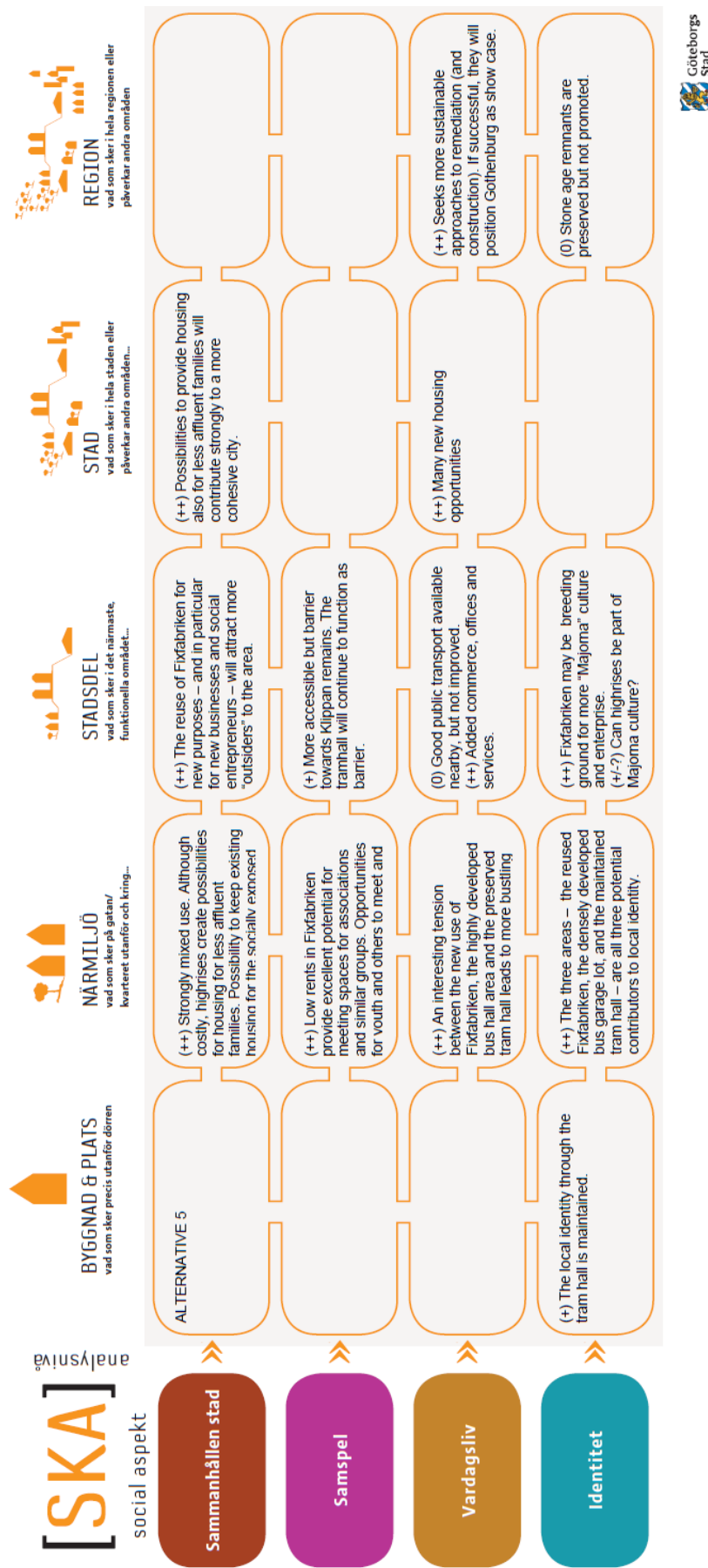


Figure G.8. Social impacts due to Alternative 5.

The impacts with regard to the different alternatives relative the reference alternative are summarized in Table G.1. For details, the matrices must be used.

Table G.1. Summary of impacts of the alternatives.

Alternative	Total negative impacts	Total positive impacts	Total	Rank
Alternative 1	-10	+5	-5	4
Alternative 2	-9	+8	-1	3
Alternative 3	0	+21	+21	2
Alternative 4	-12	+7	-5	5
Alternative 5	0	+22	+22	1