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Towards Water Sensitive Co-Design in Brussels: the Forest case study.

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Abstract:
Studies on the model Integrated Water Management (IWM) have extensively explained that a sustainable system of water has to be 'in tune' with the local ecosystem. The integrated management of water starts bottom-up and makes use of the context. Water resources, spatial conditions, and individuals and/or communities are key ecosystem's determinants to be engaged. If design methods like the Water Sensitive Urban Design (WSUD) provide tools to integrate both local water resources and spatial conditions in the urban context, how to actually mobilize individuals and/or local communities has still to be further understood. It implies a true process of democratization, accountability, and citizens' empowerment. In Brussels, an emerging Water Sensitive Urban Co-Design (WSUCD) process is leading the shift towards a more integrated management of water. Inhabitants, developers and institutions are actually engaged in the process of change that erodes the thick inertia manifested by the dominant socio-technical regime. In particular, the participatory design experience of Forest, a neighborhood of the Brussels Capital-Region (BCR), discloses a different relation between designers and citizens who are claiming for a more local-based management of water. This paper critically discusses the case of Forest stressing the potential synergies between water sensitive design and co-design, a process where citizens can have a proactive role.

Keywords: Water sensitive urban design; co-design; Brussels.

1. Introduction

It is now well accepted that the conventional urban water management approach based on centralized and compartmentalized water systems is inappropriate to addressing current and future sustainability issues [1–4]. The Water Sensitive City (WSC) is the alternative advocated [4]. Urban designers are called to be more and more 'water sensitive' in their way of thinking and in their practice. The Water Sensitive Urban Design (WSUD), for example, is a framework spread in Australia in the last 20 years which promotes the systemic cooperation between urban spaces and related flows at different scales. However, despite the number of water sensitive designapproaches worked out in the last decades, the WSC concept implies a radical shift that designers alone cannot provide.

The WSC incorporates the model Integrated Water Management (IWM), the counter-model to the conventionalone [4,5]. IWM integrates the different dimensions of water and their interrelationships; it asks to unfold the interactions among water, land and environmental systems; it includes awareness of interrelationships between water and socio-economic development in the long run [6]. In other words, IWM internalizes the eco-development technological paradigm [7] wherein human society and ecosystems co-evolve on an equal basis. As Tjallingii [8] explained in the Ecological Condition Strategy, in the eco-development paradigm, flow, area, and actor are fields equally regarded. The use of local water resources, the engagement of the local spatial conditions, the involvement of individuals and local communities is one thing. At this regard, Novotny [9] (p. 19) has noticed that, according to the literature, "people – including city dwellers – are participants in ecosystems" and "they are ultimately dependent upon the resilience and renewability of ecosystem resources and services". It follows that WSC implies the actual engagement of individuals and local communities. Hence, as Wong and Brown [4] insist, the implementation of the WSC requires a major socio-technical overhaul of conventional approaches. However, it is known that the present large urban infrastructure systems are typically locked into existing practices through institutional inertia and persistent socio-technical regimes [10–12]. Therefore, the shift from the conventional engineering approach to a water sensitive one means a significant transformative process of change that still appears difficult to be implemented [10,11,13–15]. This change corresponds to the revision of the 'hydro-social contract' introduced by Lundqvist et al. [16] to "describe the pervading values and often implicit agreements between communities, governments and business on how water should be managed" [4] (p. 675).

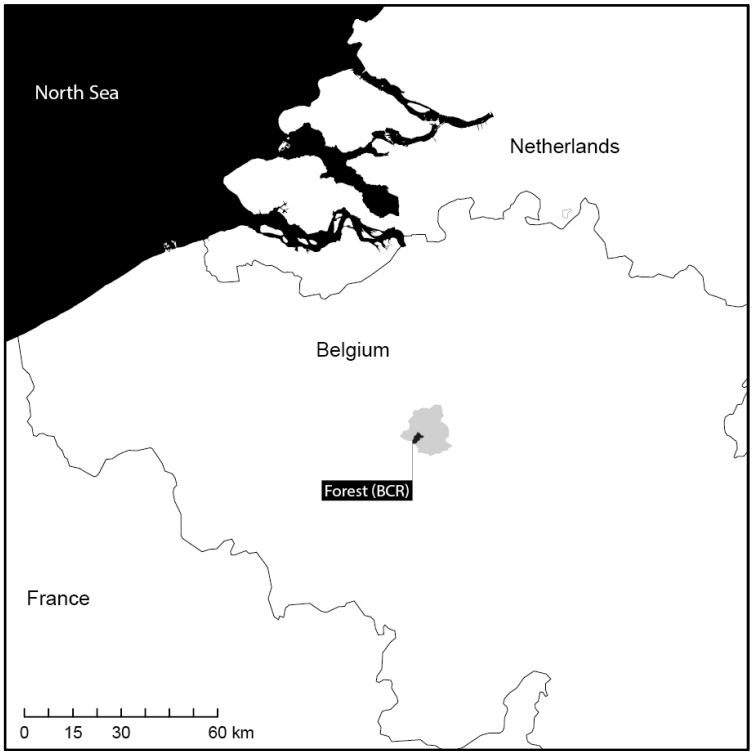
In Forest, one of the nineteen municipalities of the Brussels Capital-Region (BCR), Belgium, an interesting co-design process has recently brought citizens, urban developers, and local institutions together to reflect around the opportunity to introduce a more integrated management of water for counteracting the recurrent local inundations. This participatory water sensitive design process seems to drive real change. Participatory design is not a new concept. In Europe, "already in the 70s several research projects were deeply considering user participation in systems development" [17] (p. 7). However, co-design is recently acquiring a renewed interestfor its capacity to integrate and enhancesocial resources. According to Manzini and Rizzo [18] (p. 201), co-design links participatory design with social innovation, intended as commonly organized social change, thus reinforcing the actors' role in bringing local knowledge. Co-design commonly refers to the idea of including users in the design process, positioning users as experts in their own context [19] (p.179). It differs from 'collaboration' because it mainly produces a knowledge that was not known in advance [20].

This article introduces and critically reviews the concept of *Water Sensitive Urban Co-Design* (WSUCD) emerging in the case of Forest. The aim is to better position co-design in the process of learning that the shift to WSC brings with it. In Forest, co-design proves to be a reliable tool for changing cultural perspectives and values while bringing significant design innovation. The case is analysed considering the three key fields area, flow, actor of the ECS and stressing the role of the designer during the various stages of the design process.

2. Brussels' water related challenges

Since the second half of the XIX century, Brussels' water system has been progressively engineered to respond to the challenges posed by the increasing urbanization and hygiene standards [21–24], [Fig. 1]. Today, the Brussels' water system consists of an extended drinking water supply pipe network with the related points of abstraction and centralized reservoirs, and a pervasive combined sewerage and stormwater pipe network with centralized peak storage reservoirs and two centralized wastewater treatment plants. The combined sewage system proves to be inadequate to cope with the runoff produced by a regional surface that is extensively paved and smeared on relatively steep slopes. Floods occur frequently both in the lower and higher parts of this landscape of valleys [25]. The treatment plant processes considerable amounts of stormwater with significant expenditures on energy. In the near future, foreseen tendency to drier summers and rainier winters could exacerbate the situation [26,27].

Figure 1. The municipality of Forest in the frame of Brussels Capital-Region in Belgium.



In Brussels, the institutions currently struggle to quickly re-introduce strong, stable public health conditions by means of engineering projects of greater sophistication and dimension and set under the tacit philosophy of 'business as usual'. The main operative goal is the renovation of the out-

dated pipe networks that, in the case of wastewater, requires substantial structural investments in the coming decades (Olivier Pyren, personal communication, July 28, 2014). There is little room for IWM. The typical limited government requirements for control, stability, security and safety pointed out by Farrelly & Brown [28] seems to prevail.

Nonetheless, in BCR, different experiences of co-design integrating varying attributes of the water sensitive approach are fermenting. In Brussels, participationis a well-established tradition that dates the second part of the XX century. Towards the end of the '50s of the last century, the inhabitants started to organize themselves against the 'Bruxellisation' [29], that is the ripping of parts of the poorest central areas of Brussels to leave space to new mobility infrastructures and the new real estate demanded by the European Union. In the 1994, the BCR has introduced the Contract de Quartier (CQ), four-years programme of urban revitalization where the participatory dimension is key element[30]. From 2010, the regional government has upgraded the programme CQ in Contract de Quartier Durable (CQD) to emphasise the environmental dimension and the sustainable character of the operations and actions conceived within the programme (http://www.wijken.irisnet.be/). In the CQD, city's inhabitants and users are directly involved in the conception of projects of physical, social, and economic character. This vibrant participatory tradition has been the condition for several WSUCD initiatives to emerge. These experiences run counter to the very strong inertia to change shown by the local institutions responsible for water. Small-scale water sensitive projects have been co-produced and are now under discussion.

3. Forest, a source of water sensitive participatory design

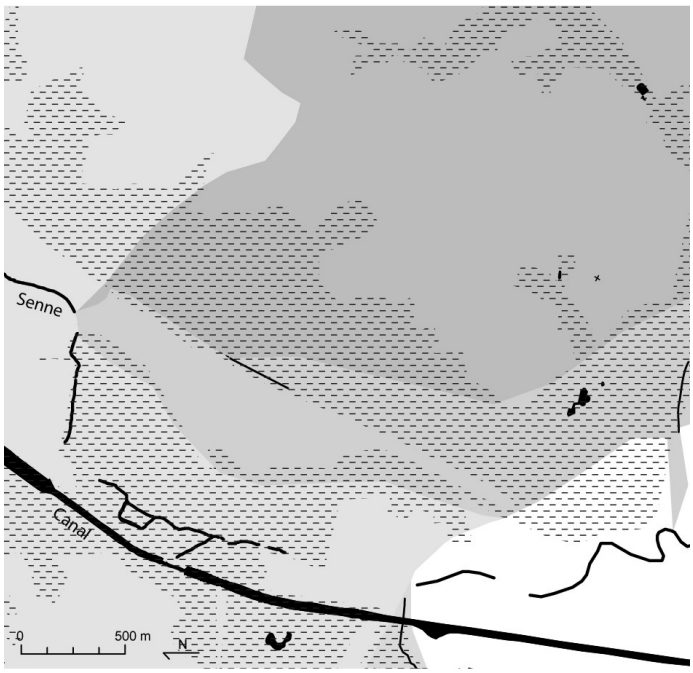
Today in Forest, in the South-West side of BCR, local institutions and developers are collaborating with the inhabitants to concretely implement water sensitive solutions.

Since the beginning of the XIX century, recurrent floods jeopardize the livability of the neighborhood (http://www.egeb-sgwb.be/PromenadesExploratoiresVersantForest), [Fig. 2]. Here, between 1985 and 2014, paved areas increased by 45% (Eric Mannes, personal communication, March 18, 2014). Recently, the regional and municipal institutions responsible for water have collaborated to introduce technical solutions meant to counteract the inundations. In the '00s, VIVAQUA, the public company responsible for the combined sewage network and the drinking water network of Brussels has realized the *Bassin d'orage de Forest*, an underground peak storage device with a capacity of 18,000 m^3. At present, SBGE/BMWB (Société Bruxelloise de Gestion de l'Eau), a public company controlling the main drainage pipe collectors and the peak storage reservoirs, is working on the construction of the *Bassin d'orage Lainé*, another underground peak storage device which capacity is 5,000 m^3. These engineering devices actually slow down the combined flow of stormwater and sewage. However, despite the fact that floods still occur in Forest and hence the inundation problem is not solved (Eric Mannes, personal communication, February 27, 2015), these engineering devices of highly technical character do not actually address an integrated approach to water.

Parallel to these official actions, the inhabitants have grouped in committees in order to raise their voice to challenge the risk of recurrent floods affecting the lower parts of the municipality. In 2007, a part of them started the committee Comité Stop Inondations Saint-Denis (CoSISD). The CoSISD's main goal is to act together for encouraging officials to finally address the real causes behind the floods (https://stopinondations.wordpress.com/about/). From that time, a process of learning about the integrated management of water has been triggered. Sense of belonging, awareness about the

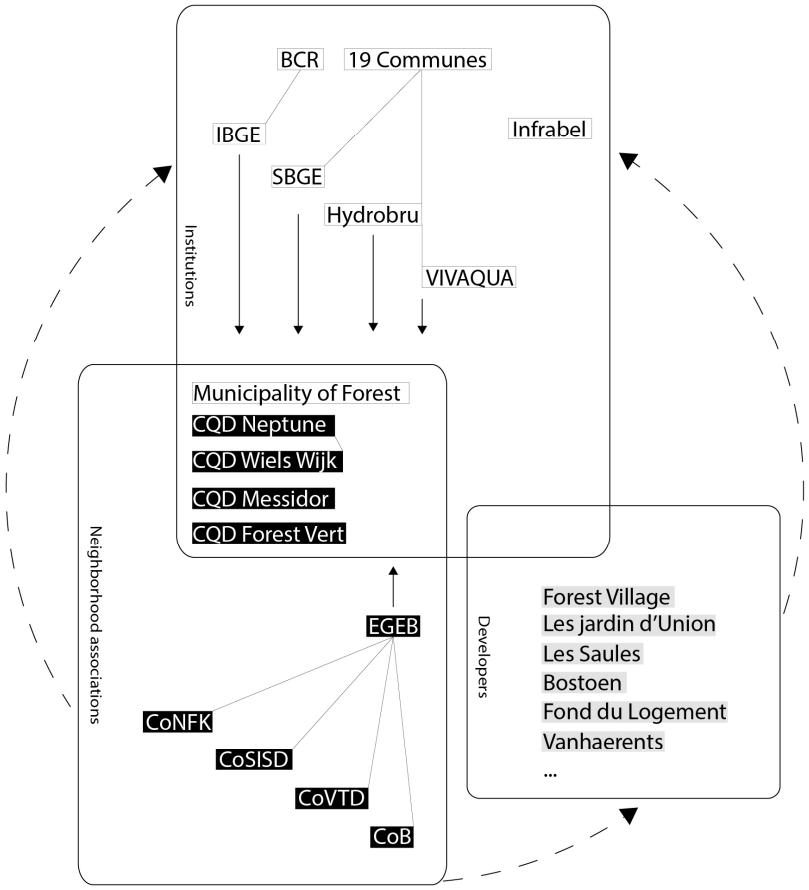
local landscape, its functioning and evolution result reinforced. Moreover, while raising their voice, the inhabitants have reaffirmed their citizenship and have established a fruitful dialogue with the civil servants of the municipal water department.

Figure 2. Catchments (gray areas), surface water (black) and floodable areas (dashed line areas) in Forest.



It is in this context that a number of WSUCD initiatives have flourished. The project *Coulée Verte et Bleue* (2013, on-going), for example, conceived in the frame of the CQD Neptune, is the result of a participatory design process involving the inhabitants and promoted by the non-profit organization EGEB (Etats Generaux de l'Eau a Bruxelles), the Museum des Sciences Naturelles de Belgique, the Loterie Nationale and the Municipality of Forest. This new urban corridor located in the upstream parts of Forest envisages the introduction of new green swales along a road axis in order to exploit the permeability of the soil for increasing onsite infiltration. In this way, the volume of rainwater runoff that at every storm threatens the inhabitants of downstream areas should be reduced. At present, a landscape architect is in charge to give shape to the proposal. Another meaningful co-design case is the *Nouvelle Rivière Urbaine NFK*, a proposal by the inhabitants members of the committee Comité Neerstalle-Fuchsias-Kersbeek (Co-NFK) (2013, on-going). Born in opposition to a local urban development blueprint careless of the management of water, it sketches a new open-air urban stream. The new watercourse should be partially carved along the traces of former streams. Conceived to separate stormwater from the sewer, collect spring water and rainwater from nearby rooftops, the new stream should connect the ponds of an upstream park to those of a downstream green area (http://www.egeb-sgwb.be/VersFOrestNFK). In addition to these two examples, there are several other noticeable WSUCD projects. However, a project in particular named Source du Calvaire seems to find a transversal consensus involving a large number of stakeholders in the design process [Fig. 3].

Figure 3. Co-Design Actors Map of the project Source du Calvaire.

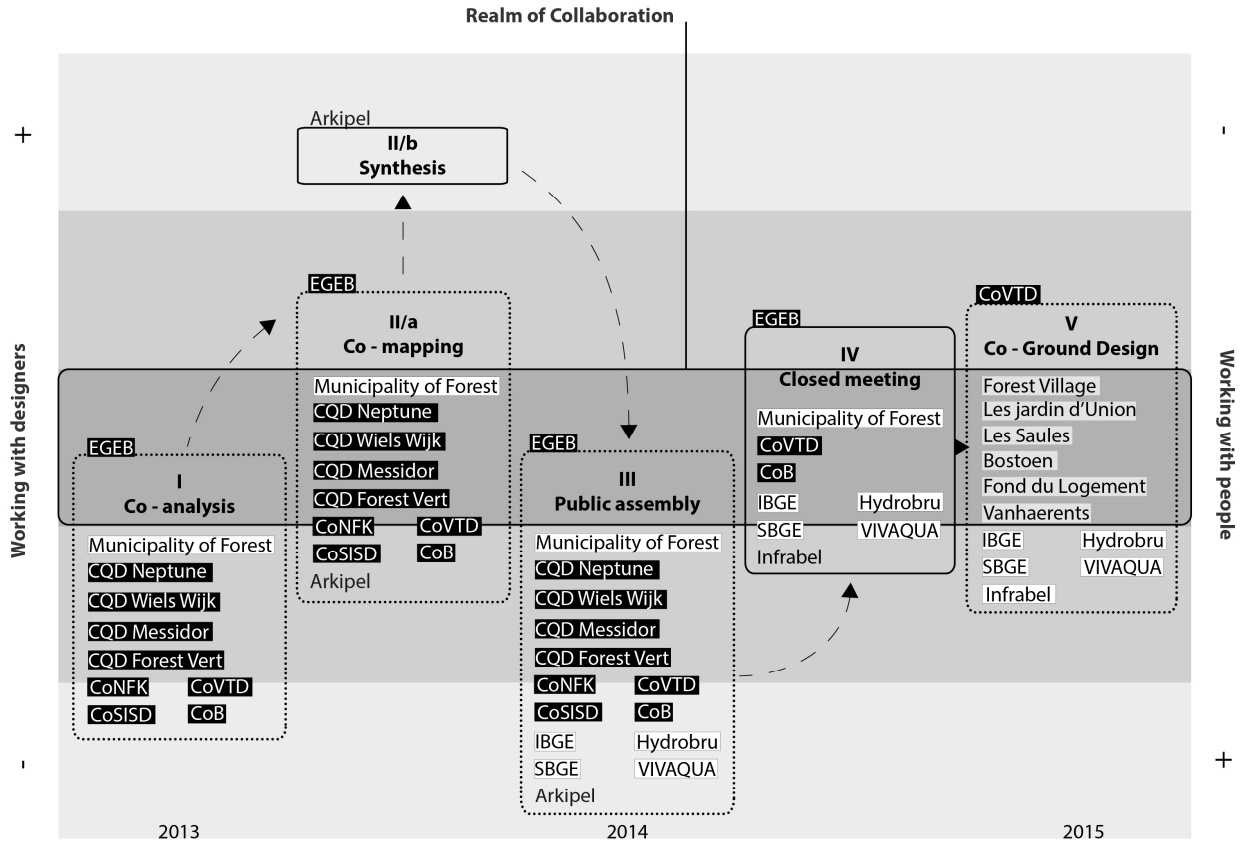


4. A Water Sensitive Urban Co-Design process

The water sensitive design project Source du Calvaire is the result of a complex co-design process where a variable number of actors has participated to the different key design stages [Fig. 4]. The name Source du Calvaire refers to the spring Calvaire. Now drained by the sewage system, this spring is located in the downstream parts of Forest, in one of the few leftovers of the urbanization. As the other vacant lots of the area, this plot has recently attracted the interest of a real estate company intended to realize the greater amount of housing possible. This is what has triggered the inhabitants to group in the committee Comité de quartier VanTroDel (CoVTD) and Comité de quartier Bervoets (CoB). The committees demand for a development on a 'human-scale' without additional risk of flooding. The inhabitants are aware of the value of the vacant lot Calvaire, the impropriety of a spring released in the sewage, and the increased runoff that new soil sealing could produce. On this basis, they have sketched together a counter proposal to that envisioned by the real estate company. In their design, new urbanization comes together with an integrated management of water. A turning point in the matter is the exchange that at some point happen between the committees and EGEB, a non-profit organization which in Brussels strongly claims that water is common good. Since 2013, EGEB has organized a number of participatory actions that centre around the concept *Bassin Versant Solidaire* (BVS). In the BVS or 'Solidarity-Based Catchment', topography controls water once again. Along its course from upstream to downstream areas, water crosses the urban landscape and establishes "interdependence

between the inhabitants of the heights of the catchment and those of the lower parts" [1] (http://www.egeb-sgwb.be/ForumApprocheBassinsVersants). The BVS equals to a true ecosystemic approach to water.

Figure 4. Collaboration between designers and people in the WSUCD process at the basis of the water sensitive project Source du Calvaire. Adapted from: Lee [31].



Co-analysis

During the second half of 2013, EGEB guides four collective walks – 'promenades' – through the slope of the Forest landscape. Supported by several local committees of inhabitants (CoSIDS, CoVTD, CoB, CoNFK, and others), some regional programmes Contract de Quartier Durable (CQD Neptune, CQD WielsWijk, CQD Forest Vert, CQD Messidor), and the Municipality of Forest, the initiative involves citizens, designers and experts in a collective exploration of the neighborhood in relation to its waters [Fig. 5]. The 'promenade' is a participatory analysis phase already integrating the exploration on possible future organization of water. In the diagnosis, the catchment is the key landscape unit against which the water system of Forest is observed. Participants are invited to note water springs, to imagine the paths followed by stormwater within the urbanized landscape, to find out sink points, to reflect on water related features of upstream/downstream areas like soil conditions, paving rates, vegetation distribution. Thanks to the voluntary research of some inhabitant, also an accurate historical dimension is offered. Participants also imagine together possible integrated

[1] Translation of the authors.

arrangements of water.During the collective walks, designers actively participate. They present possible best practices of IWM that could be adopted in the catchment.

Figure 5. Photo of the promenade.

Co-mapping

A participatory mapping session follows each ‘promenade’. The co-mapping involves the same participants in the ‘promenades’. At this stage, perceived main problems and missed opportunities with regard to water are mapped. Concurrently, possible future integrated water arrangements of the local landscape are envisioned. *MAP-it* is the participatory toll employed. Conceived by the research group Social Spaces of the MAD-Faculty of LUCA/KU Leuven, MAP-it “enables designers to moderate participatory design processes through workshops in which people from different backgrounds collaboratively reflect on and set up new projects” [32] (p. 29). The architectural practice Arkipel leads the mapping process. Initially, the designer/moderator proposes a water sensitive scenario – ‘How the world could be like if…’–acting as ‘subject for conversation’ [18]. The scenario proposed comes directly from the objectives of the regional water plans Plan Pluie [33] and Plan de Gestion de l'Eau [23]: in 20 years span of time, reduction of floods, decrease of the sewage overflow, increase reuse and recycle of water (Dominique Nalpas, personal communication, March 3, 2015). Participants are split up into groups of 8 components. Guided by the designer, each group tries to answer the scenario positioning stickers on a background map. The use of these pictorial cards elaborated in advance by the designer to adapt the MAP-it tool at the scope of designing with water, is strategic to set up a new way of expression for all participants involved [34], [Fig. 6]. Finally, groups’ proposals are discussed. In the MAP-it, the on-going water sensitive co-design projects and the counter project for the vacant lot of the source Calvaire are all integrated and, partially, revised. At the end of the four participatory sessions, the moderator/maker (Arkipel) has produced a MAP-it summary reporting conclusions [Fig. 7].

Figure 6. The ad-hoc MAP-it's stickers for designing with water (source: Arkipel).

Figure 7. The MAP-it summary (source: Arkipel).

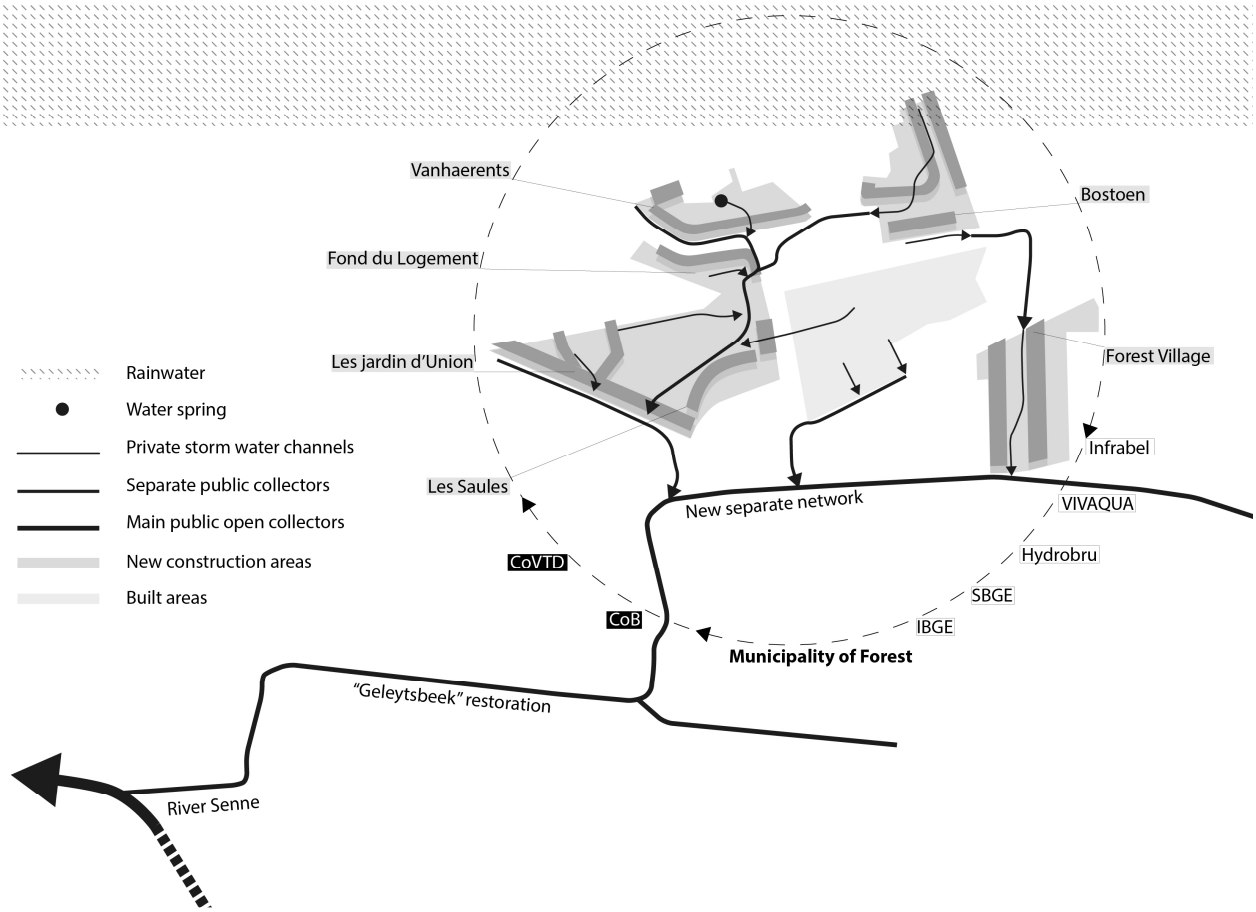
Public assembly

In March 2014, the results of two previous stages are officially presented in a public assembly. The public meeting, strongly supported by the municipal water department and the Forest's council member for the environment, is organized by EGEB and the local associations of inhabitants (both the committees and the CQD representatives). The assembly operated in the form of a round-table, is the occasion to officially present the contents of the MAP-it summary to the regional institutions responsible for water (IBGE, SBGE, Hydrobru, VIVAQUA). Experts and researchers are also invited. During the assembly, the proposed WSUCD solutions are implicitly introduced in relation and/or opposition to the official engineering projects conceived by the regional institutions. As such, they are rhetorically presented as the first step towards the BVS. The designer in charge of the MAP-it has 'simply' attended the assembly prompt to provide, if needed, technical support for describing the single water sensitive solutions.

Closed meeting

Few months after the presentation of the MAP-it to the public authorities, during an official neighbourhood commission in Forest, a number of coming urban development blueprints are presented to the civil society. In that context, some representatives of CoVTD, CoB, and EGEB, publicly remark that the new development projects generally lack of attention towards water and also that are poorly coordinated (Dominique Nalpas, personal communication, March 3, 2015). As a result of this controversy, CoVTD, CoB, and EGEB obtain a closed meeting with the urban developers, the municipal water department and the regional institutions responsible for water. For the occasion, CoVTD and CoB further elaborate the proposal. The water sensitive scheme takes on the appearance of a plan proposal [Fig. 8]. Adapted from CoVDT/CoB). Thanks to the reflections emerged during the co-analysis and co-mapping stages, the plan integrates all the six vacant lots surrounding the spring Calvaire concerned by a urban development blueprint. The area covered by the plan extends from the upstream Duden Park down to the bottom of the valley where the North-South thick railway line gets through and the Senne River flows. For this reason, the Belgian railway infrastructure manager Infrabel is also invited to the meeting.

Figure 8. Project Source du Calvaire, plan proposal.



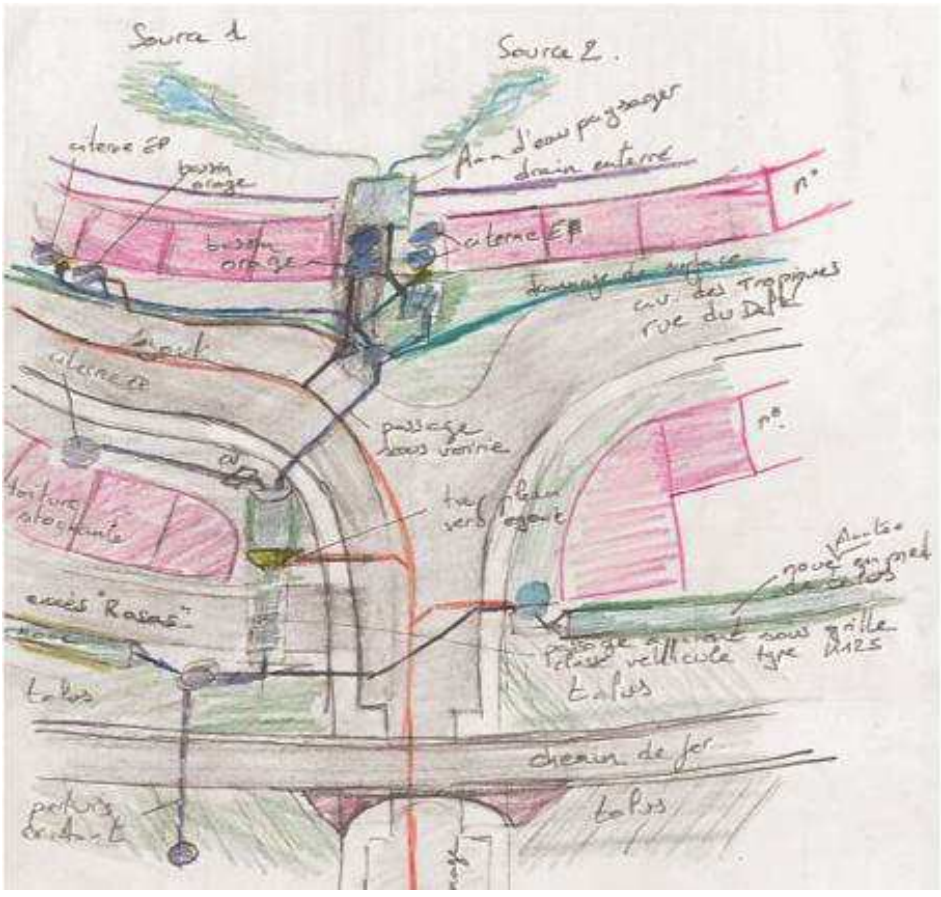
The plan foresees the separation of stormwater and spring water from the sewage via the implementation of new urban streams collecting stormwater from roads and adjacent built up lots. The proposed surface water network origins in the private urban developments, moves down through the road network to release the water in a watercourse that flows into the retrofitted stream Geyletsbeek,

which flows into the Senne River. New pathways and riparian vegetation could follow the new network. This could have an impact on the local landscape and its accessibility. The design of the plan has fully considered the observations for the area contained in the MAP-it. Few representatives of the committees of inhabitants have carried out the design. Among them, an architect and an engineer have played a major role (Dominique Nalpas, personal communication, March 3, 2015). In the closed meeting, the plan has found general consensus. The real estate companies see in the collective project the possibility of rationalizing the costs. Moreover, they realize that giving room to water in the landscape can enhance its spatial quality and, in turn, help to ensure profits.

Co-ground design

The plan has recently entered a phase of detailing and negotiation. Developers, institutions and the CoVDT and CoB are in contact and are ready to discuss the details of the solutions as well as the best way to proceed. The municipal water department and EGEB act as filters between the two sides. At the moment, the collectives are working to detail the plan and to sketch possible punctual solutions of IWM. Water tanks, ditches, wetlands, peak storages, etc. are combined with the new housing, paths and roads [Fig. 9].Thanks to the water sensitive design skills of its components, the solutions already present a high degree of technical feasibility. Notwithstanding, the collectives and EGEB aim that the negotiation will bring, first, to find a common ground around the vision and its principles and, secondly, to the financing of an advanced plan.

Figure 9. Project Source du Calvaire, detail sketch (source: CoVDT/CoB).



4. Conclusions

As Pahl-Wostl [35] notices, collective learning and decision making processes are essential to move from so-called lock-in situations towards the new resource management that the shift towards WSC brings with it. The case of Forest shows that a strong process of social learning is actually taking place.

In Forest, the co-design process has brought to a polycentric, horizontal, and broad stakeholder participation [36]. The self-initiative of inhabitants has succeeded to bother the institutions responsible for water and those stakeholders, as the real estate companies, who have the power to bring about change. The co-design stages have allowed the participants to learn from each other while providing them with the technical knowledge that the integrated management of water requires. The committees, EGEB, and the municipal water department are aware that only a collective action can bring the implementation of the WSC. In the logic of the BVS, people have recognized their interdependence. They are aware that an adaptive attitude is key to trigger true synergic action. The designers, for example, have accepted to take on different roles during the process. Sometimes participants, animators,moderators, interpreters, perpetrators, the designers have simply left aside theirusual role of masters. Their expertise proves to be essential to integrate social innovation in the process. They have for example worked out the design devices needed to allow participants to express their own point of view, to confront each other, and, finally, to advance concrete proposals. Undeniably, the presence of designers and, in the last two stages, of participants with design skills, has been the condition for the Project Source du Calvaire to not end in a patchwork of punctual dreams. In the plan, the small projectsresult synergicand integrated in a coherent vision.

As stated in the introduction, in the move towards WSC the use of local water resources, the engagement of the local spatial conditions, the involvement of individuals and local communities is one thing. The co-design process has actually empowered inhabitants by enabling them to find a place in the discussion about the management of water. The user’s experience about the local landscape, a fundamental source of knowledge otherwise inaccessible by the experts,has been integrated in the plan. In these terms, local water resources and spatial conditions are the levers on which the design is based. Moreover, relevant is that in the project the private space is as implicated as the public one. The proposed surface water network starts in the private lots prescribed for the new real estates. The private and public built-up plots along the new ditches deliver to the network the stormwater intercepted by their roofs. In other terms, the overall space, its water, and the actors linked to them are engaged. It seems that WSUCD has triggered the comprehensive motion of the urban ecosystem.

In the co-design project, water follows once again the logic of the catchment area, interlaces upstream and downstream areas with mutual benefits, and breaks the administrative barriers to instate a greater permeability in the city landscape. However, this synergic and ecosystem-like character is also the limitation of the project. If just one actor – and the related puzzle piece – takes a step back, the project would fail (Alexandre Jongen, personal communication, April 30, 2015). This is the direct consequence of the strong voluntary nature of this co-design initiative. Nevertheless, such a condition cannot be extended to any WSUCD project. In Forest and in Brussels, the institutions responsible for water still show a certain resistance to change. More than the privates, they seem the stakeholders to mobilize and persuade. This is the reason why, at present, EGEB and the other partners are struggling in order for the concept BVS to find legitimacy at the regional level.This would give to the actions and projects of the inhabitantsthe strength required to bring real change.

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Conflict of Interest

The authors declare no conflict of interest.

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