1 WATER/SEWAGE

Here are presented some relevant water/sewage sector issues that have been raised mainly through the analysis of PETUS water/sewage case studies, but also through the meetings with public and private professionals and with our own expertise and knowledge. Of course other water management important issues could be developed but the overall aim of this section is not to be exhaustive but to propose some reflection areas related to sustainable practices. The identified water sector issues are:

- Water resource quality and availability
- Management and conception of urban water infrastructures
- Sustainable management of water incities

1.1 WATER RESOURCE QUALITY AND AVAILABILITY (FR-DK)

WHAT'S THE PROBLEM?

The first issue concerns aquatic bodies. We will study here especially **urban groundwater management**. It will integrate projects about:

- Protection and management of the groundwater including the limitation of pollutants discharge and the limitation of water consumption.
- Management of groundwater and surface water
- Best management practices (BMP's) of storm water
- Interaction between surface activities (social and economical considerations) and groundwater management

Fig1. Aquatic body in "Porte des Alpes" project

The way of management and protection of groundwater can be different toward the country context. For instance, in Denmark the groundwater resources are reduced due to pollution and its over-extraction; there are many strategies possible as response to this challenge, such as pollution restriction, collaboration on groundwater protection, water consumption reduction, water purification, water import… and the problem seems to concern the implementation and production of tools/methods to evaluate, assess and compare different strategies. In France, the problems are defined in other way because the groundwater resources are relatively large and so challenges in this sector concern mostly the pollution reduction and control.

There is no country which is not concerned by this kind of problems. The water resource quality and availability are important issues because it can bring problems of health or costly waste water treatment.

The importance of such problem is highlighting by the establishment of an European Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy) in the field of water policy which recognises the need for action to avoid long-term deterioration of freshwater quality and quantity and called for a programme of actions aiming at sustainable management and protection of freshwater resources. In fact, waters in the Community are under increasing pressure from the continuous growth in demand for sufficient quantities of good quality water for all purposes. This Directive shows that this issue is a real preoccupation in many European countries.

The issue of new ways of collaboration for sustainable groundwater management is also an important need of end users. These new methods of collaboration should make it clearer where the best chances are for sustainable changes. Furthermore concerning urbanisation impacts, storm water source control is perceived as an efficient solution to resolve flooding, groundwater feeding and pollution problems. It is a key issue for sustainable development in the urban context. However, implementing the best solution remains difficult because the range of possible measures is vast.

In relation to the PETUS case studies, end-users (mainly employees from water supply company and municipal offices) have raised very specific questions related to this issue, including:

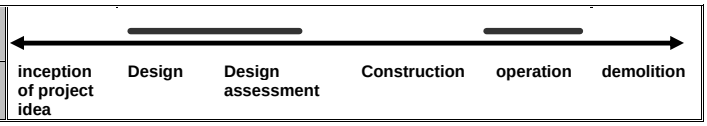
- How do we motivate people to save water?
- What is the realistic level to reduce water consumption to? – are there potentials for further reductions?
- Does water saving information campaigns still make a difference?
- How do we motivate people to install individual water-meters?
- What type of incentives can they be given not to pollute the groundwater?
- How do we co-operate with stakeholders around groundwater protection?
- Which water facilities can be implemented on an urban project to protect groundwater?
- How to combine protection of ground water with the evolution of land use?

TIME AND SPACE SCALES' CHARACTERISTICS?

Scale investigated	Component	Building	Neighbourhood	City	Region
			X	X	

The reference space scale is the catchment area of the sewage system or of the groundwater considered. It mainly deals with the management of natural resources. In the urban water management, the most relevant scale for defining problems and developing the most appropriate solutions is the catchment area.
A catchment area is the surface area determined by topographical features that will drain runoff or a channel / sewer network to a single point. It is the spatial unit from which is

defined the whole organisation of the drainage system of an urban area. The division of an urban area into catchment areas could depend on different elements. Its size could range from hundreds of square meter to hundreds of hectares. So we can link it to the city scale or to the neighbourhood scale. In practice, it is often in-between.

Stage(s) concerned	

Time scales are mostly design, design assessment and operation. However the subject discussed here, the groundwater management, advocates considering different time scales, from one event (accidental pollution) to the long term approach.

CONFLICTING AREAS

- Water savings versus electricity consumption: in many projects on local water management (e.g. stormwater-collection in green buildings), the electricity consumption increases. This raises a question of "exchanging"-rates between water and energy – how many kWh electricity should we accept to pay per saved m^3 of water? (See example in Petus case study " Folehaven")

- Water consumption and building regulations: Initiatives for reducing water consumption in buildings are often stopped by building regulations. (See example in Petus case study "Water savings in Copenhagen")

- Groundwater protection is related to purchase of organic food; promoting organic farming and purchase of organic food will reduce groundwater pollution. Organic foods and organic farming is not included in PETUS, but it is a part of initiatives described in other case studies (See Petus case studies "Water co-operations" and "Dogme 2000")

- Groundwater protection versus land use. Urbanisation increases the human stress on water resources through heavy infrastructures construction (highway, commercial center, …). The consequences are pollution increase in groundwater and a higher consumption of water.

CASE STUDIE(S) LINKED TO THIS ISSUE?

Seven case studies produced by PETUS can be linked to this issue:

- "new methods of co-operation on groundwater protection",
- "water savings in Copenhagen",
- "Folehaven-green laundry",
- "harbour bathing in Copenhagen",
- "Lyon Confluence- water management"
- and "Porte des Alpes- storm water management".

WHAT COULD BE ENHANCED TO IMPROVE SUSTAINABILITY?

The management and protection of aquatic environment could be enhanced by the implementation of BMP's (Best Management Practices) and technical solutions that promotes a short cycle of water, by implementing recommendations on agricultural and industrial activities, by the improvement of co-operation between different actors involved in the cycle of water, by the implementation of water savings, …

The co-operation between different actors (industries, agriculture, farming, municipalities, associations…) stays as an important stake which could improve sustainability. The water management conception of these several stakeholders is expressed in different ways due to the geographical space scale in which they are involved and they are working. Programs, policies, and also enhancement of information communication should bring new opportunities to manage the water cycle in urban area in a more integrated view.

To provide tools, guidelines, experiences, frameworks, to help stakeholders to integrate the different part of the water management, to consider all the water management aspects as a whole in a more sustainable way is also an important stake which could enhance the current situation.

ANY OTHER INFORMATION

It is admitted that the relevant territory of the management of water is the catchment area, in other words the surface which receives the rain and restores it in a flow or even in a pollutograph at the outlet. Taking into account the nature of the outlet discharge (ramified sections of artificial networks or natural receiving water) the catchments are often encased entities. However, in urban environment, it is possible to extend or reduce the catchment area by artificially connecting or disconnecting surfaces from certain outlet system. This action remains however tributary of the hydraulic capacity of the work of connection or deconnexion which could be exceeded by strong rains.

1.2 MANAGEMENT AND CONCEPTION OF URBAN WATER INFRASTRUCTURES (FR-DK)

WHAT'S THE PROBLEM?

This issue is divided into 2 parts. The first one deals with patrimonial management of urban infrastructures. The second one concerns construction of new project of urban infrastructures.

On one hand, the management in the duration of pre existent water infrastructures (waste water treatment plants, water network, infiltration and retention systems…) raises difficulties stakeholders need to tackle. This kind of problem exists essentially in the west part of Europe because existing infrastructures to reduce conflicts between urban sprawl and water management are ageing. Nevertheless it appears crucial to manage these infrastructures in the most appropriate way to keep the asset in the best state for minimal cost.
In this category of projects, actors express the lack of indicator set which describes the project evolution in the duration and allows the project follow-up through time.

On the other hand, the creation of new water urban infrastructures raises problems of evaluation and comparison between different solutions (decision making). The construction of such infrastructures, which requires important investments, has of course to be as much adapted to the need of inhabitants as possible.

This issue should also approach the modelling of the different flows (water and pollutants) of urban water system (network, waste water treatment plants, aquatic bodies).

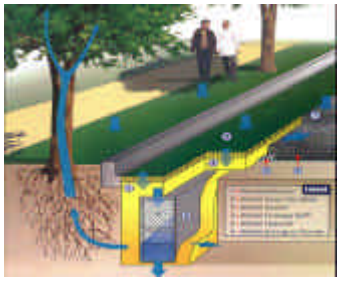


Fig 2. Infiltration trench system in Atlantis

These two main sections present the same entry point which is the urban infrastructures. It corresponds to the same kind of end users categories and consequently to similar space scales.

In relation to the PETUS case studies, end-users have raised very specific questions in relation to this issue, including:

- How is it possible to spend a given annual budget for rehabilitation on the most efficient projects?
- Which water facilities can be implemented to avoid increasing runoff concentration into pipes?
- How to build a sustainable water infrastructure?
- How to evaluate the sustainability of an infrastructure project? Is a project proposition sustainable or not?
- What kind of material is it possible to use for water network?
- How to ensure a good maintenance and operation of sewer network against problems of silting up, deterioration, corrosion, etc ?

TIME AND SPACE SCALES' CHARACTERISTICS?

Stage(s) concerned	inception of project idea	Design	Design assessment	Construction	operation	demolition

For the management issue the time scale considered is the project operation and for the creation of new project the time scale is the negotiation, design assessment.

Scale investigated	**Component**	**Building**	**Neighbourhood**	**City**	**Region**
		X	X		

The project space scale is the water infrastructure (from building to neighbourhood).

CONFLICTING AREAS?

- Land use versus sewer system conception. Urban sprawl means increase of impervious surfaces which cause increased volumes of flow and faster arriving. Drainage system which tries to reduce such effects does not always offer sufficient solutions and flooding problems arise. A compromise has to be found in order to extend cities with an appropriated sewer system and a strong policy of storm water management (source control solutions etc).

- Storm water BMPs (Best Management Practices) versus green space management: BMPs offer possibilities to manage storm water and enhance landscape (leisure function). Administrative issues appear when the following questions are rising: Who is in charge of the management of such facilities? Is it the water department or the green space department of the city who is in charge of the management? Such kind of questions exists also with the management of the permeable pavements between the road system department and water department (the use of salt or sand affects the efficiency of the permeable pavement and so increases the flows of run off water). (See example in PETUS case study "Porte des Alpes- storm water management")

- Transport versus Water sector: Conflicts appear between transport sector and maintenance of the water network. Too much weight on a road and high road use frequency can deteriorate highly the state of water network situated below. (See example in PETUS case study "CARE-W-ARP")

CASE STUDIE(S) LINKED TO THIS ISSUE?

At least 5 PETUS case studies are considering this kind of problem :

- "Rehabilitation of water supply network in urban fields",
- "Maurice Audin Storm water Detention Basin",
- "Construction of municipal waste water collector N°5 of Samokov",
- "Porte des Alpes- storm water management"
- " Harbour bathing in Copenhagen".

WHAT COULD BE ENHANCED TO IMPROVE SUSTAINABILITY?

To improve sustainability, some issues could be developed:

- All actors involved in the water management should consider the water cycle as a whole (and not consider only the part they are involved in like drinking water or storm water…).
- The opportunity to develop urban water infrastructures which take into account environmental requirements but also social and economic ones should be considered more frequently (see PETUS case study "Maurice Audin Storm water Detention Basin").
- Organisational structures often act as barriers for implementing solutions and innovations. Therefore, new ways of management, organising collaborations, can be enhanced to solve problems and implement innovations and new practices that can lead to a sustainable water management.

Improvement could be achieved:

- by promoting a better understanding of scientific phenomena. Challenges are the improvement of simulation models, the modelling of the whole water cycle (network + Waste Water Treatment Plan + aquatic bodies), the implementation of a relevant monitoring of infrastructure to allow the calibrate of models
- by implementing logbooks and indicator set to follow the project through time.

ANY OTHER INFORMATION

1.3 SUSTAINABLE MANAGEMENT OF WATER IN CITIES (FR-DK)

WHAT'S THE PROBLEM?

The problem deals with projects concerned by the necessity of combining water cycle and urban system. It can be a project linked with wastewater, storm water, run off water management in urban areas and urban development and planning documents.

Large numbers of problems exist within the sector of Water/Sewage and solutions should take into consideration the context of the project which depends on several parameters. For example, if we have a look on Paris, Lyon and Marseille rivers, the main problem in relation with water management is totally different even if it is the 3 main cities in France and only 400 km far away from each others. For Paris River the main problem concerns oxygenation of water, for Lyon it is the high concentration of heavy metal in the sediments due to barrages and for Marseille it is the protection of beach areas from the polluted rain water overflow. Thus it appears that practical answers to problems on water management are highly dependent on context and case studies can not develop enough information to respond to end user needs. That's why even if PETUS has a practical objective, this key problem could bring to end users a conceptual approach and new considerations that should lead them to practical solutions of their problems.

Fig3. Storm water management in urban area

Sewage system must be considered as a part of urban system. In many situations, solutions to urban sewerage system or water management problems can not be achieve without thinking in a more global way at the whole urbanization. This is true for quantitative and qualitative points of view. For example, about quantitative aspects, the creation of new storm water outlets in response to urban sprawl is not enough to avoid flooding risks; it depends also on the site vulnerability that have been chosen for this expansion. Relevant technical solutions are often easier to find if on one hand water management and urban sewerage system is integrated from the beginning of the project and on the other if their implementation is followed up at each stage of planned development (from urban planning to project realisation).

The classic conception of water management in which water system is considered as the interception of urban system and catchments area should be reconsidered. The new conception of water management advocates thinking about solving problems not in terms of "sewerage" or "water supply" or "storm water management" but in terms of "management of the urban part of the water cycle".

This issue corresponds also to a need of end users. As the French legislation imposes to bring up to date water master plans (for drinking water and waste water), questions on how to insert sustainable elements and recommendations on water planning documents (water master plan) become more and more important to water direction of important cities public utilities. This question is definitely a new one but appears as crucial for the following decades because of legislation requirement. This issue is in discussion in Denmark, and in particular, in Aarhus (second largest city in Denmark) where groundwater protection has already been integrated in the urban development plans, and has got a rather large influence on pointing out and prioritising possible zones for urban development. This relation between water planning documents and sustainable principles can also be a relevant input for new Eastern European countries where water management is a new objective. Indeed, the Water Framework Directive (Directive 2000/60/EC) imposes to "achieve a good status" of all the waters considered (surface water, groundwater, transitional waters…) before 2015 and it imposes also to implement a "river basin management plan" before 2009.

Some questions linked with this issue and raised by end users are:

- How will the WFD (Water Framework Directive) influence our water management?
- How can we involve stakeholders, intermediaries and citizens in developing a sustainable water strategy?
- How do find out which strategy is the most effective?
- How to insert sustainable elements and recommendations on water master plan?
- How to combine urban development with the protection of ground water?

This issue is the opportunity to make a link with the other sectors. To think on water management as a part of the whole urban management raises the connections with green spaces or building sector. For example, during the maintenance of green spaces, the rational use of fertilizers or pesticides is a mean relatively easy to reduce the run off water pollution.

TIME AND SPACE SCALES' CHARACTERISTICS?

Scale investigated	Component	Building	Neighbourhood	City	Region
				X	

Time and space scales are here very large. Space scale is at least the city and should be a group of communities. Time scale taken into account is the one of a planning document (2-3 years at least, up to 10 years).

Stage(s) concerned	inception of project idea	Design	Design assessment	Construction	operation	demolition

CONFLICTING AREAS?

Water planning and urban planning: Water management highlights the fact that the impervious areas must be reduced and that some areas should not be built in order to allow the infiltration of water and so to avoid flooding. It is easier to avoid building in a site liable to

flooding than to design a way to manage flows while flooding. Thus water management do not purchase the same goals than the limitation of urban sprawl and land-use. The challenge could be to combine both approaches. This last conflict domain exists also between water planning and transport sector as urban development and transportation patterns have a similar evolution.

CASE STUDIE(S) LINKED TO THIS ISSUE?

This issue is less practical than the two other ones. It can be more difficult to link it with one particular water case study done in the PETUS consortium but if we look at it in a broader sense, each water case study is directly link with it.

WHAT COULD BE ENHANCED TO IMPROVE SUSTAINABILITY?

Technical or political solutions for water management can significantly be improved if the whole water cycle is taken into account. To take into consideration the fact that water management can have other objectives than only environmental ones, but also social and economic ones could also improve sustainability: control of the water price for users, reduction of flooding costs and limitation of their psychological effects, exclusion reduction in the district liable to flooding…

Improvement could be achieved:

- by providing a methodology to implement water planning document
- by providing different scenarios for water management future developments. They can show that a sustainable solution cannot be found without an equilibrium between technical, political and economical issues
- by providing tools to evaluate different possibilities for water management planning document
- by enhancing the public participation in the planning document process

ANY OTHER INFORMATION

The re-use of storm water for toilet uses, garden watering, or car washing makes at present time a great debate. As we observe the diminution of fresh water availability, it is important to reduce the water that we take from the groundwater and the re-use of storm water is an efficient solution. In Germany, new buildings are often fitted out with a storage tank to stock storm water before re-using it for different purposes. However the first feedbacks of storm water re-use show that this solution presents also some negative points. There are no sustainable solution- a solution is always context dependant. More, a solution which can be relevant at one scale could be less relevant at another scale. For example, the re-use of storm water means that the consumption of water taken from the drinking water network is reduced, which raises two problems. First, as the network need the same maintenance and investments, the price of water increases. The second one is that water stagnation problems are encountered (creation of bio films) due to less water movement. Furthermore the use of storm water avoid little streams to have enough water and so disappear.

Thus we can see that a solution which is relevant at the scale of the building is not always relevant at another scale (these ones of the network or the catchment basin). There are few solutions that can be definitely defined as sustainable.