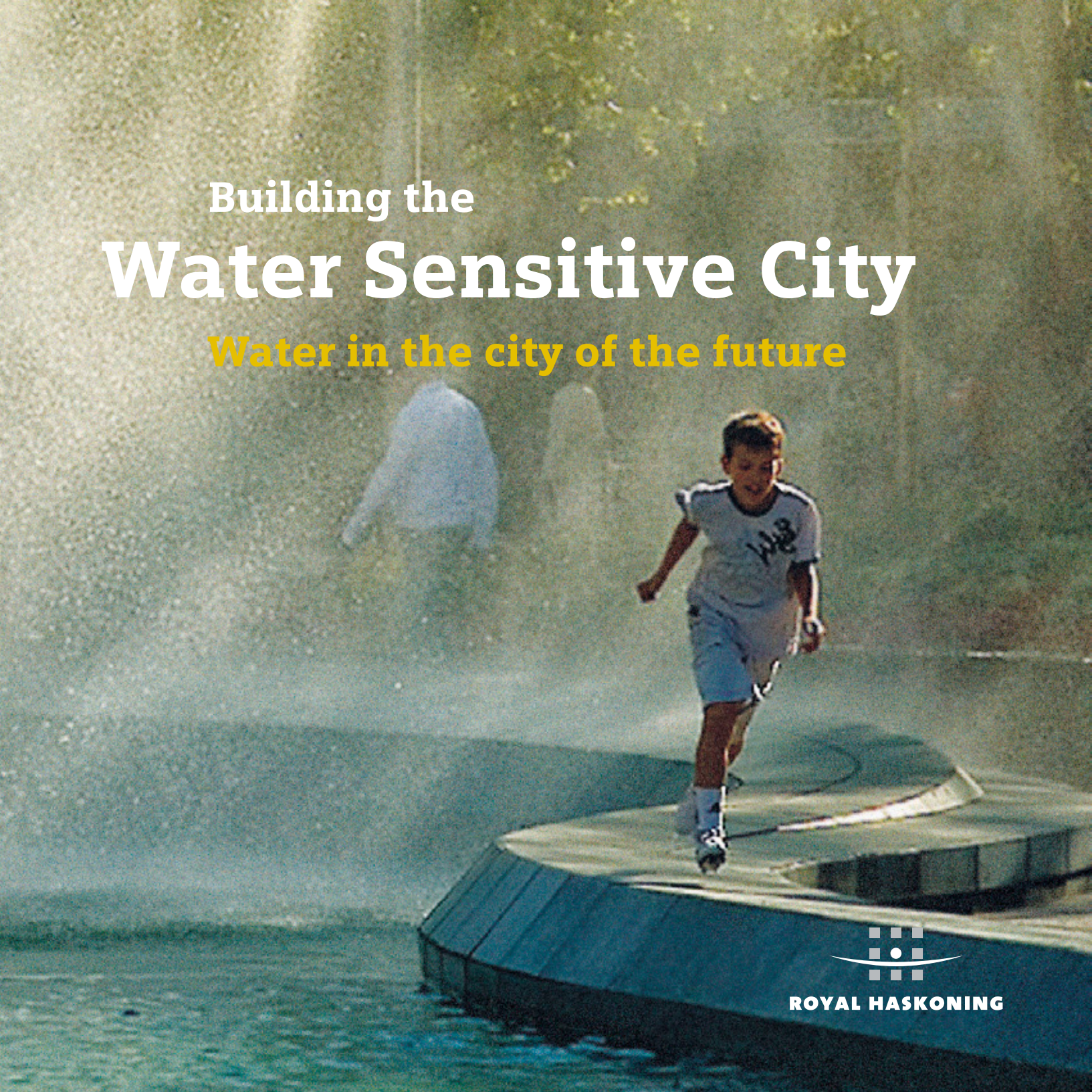

Building the Water Sensitive City

Water in the city of the future

ROYAL HASKONING

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Foreword

In this booklet we are pleased to present our vision on water in the city of the future by building the Water Sensitive City. Our vision includes an elaboration of principles for transitioning to a water sensitive city in the perspective of urban water management in the Netherlands by strengthening the integration of water in spatial planning and design process.

The essence of international challenges on climate, urbanisation and water management is the same as those facing the Netherlands. A fundamental step needs to be taken towards bringing about a new relationship with water. The technology is there, but the barriers to progress largely lie in the social-economic and administrative arena.

Enjoy this booklet as inspiration or join us in discussion on the experience to come to the actual application of (sustainable) opportunities to penetrate the standard practice when transitioning to a Water Sensitive City.

Nanco Dolman – Royal Haskoning
Pascal Zuijderwijk – VHP landscape architects

Surplus storm water in the streets of Lagos, Nigeria (September 2011)

Introduction

Society is continually faced with the challenge of finding solutions to problems such as living safely in densely populated deltas, planning ahead for climate change, alternatives to fossil fuels, sustainability and urban redevelopment, etc. As the oldest engineering consultancy in the Netherlands, Royal Haskoning takes social responsibility seriously, and continuously seeks innovative and sustainable solutions to these problems.

With the publication of the "Samen werken met water" [working alongside water] report containing the findings of the Delta Committee 2008, there has been a further call for fresh ideas when planning for water in the development of urban areas. Ideas for climate adaptation and innovations in water management are being put forward in relation to development schemes, the various risks/threats (water draining from roofs, sewers, groundwater, polder systems and river basins) and management strategies.

Ensuring our environment remains a good and safe place in which to live demands creativity and that the right choices are made. The ambition and the technology are already there. In addition to producing technical solutions, we want to create a water management system that is sustainable and makes us more aware of the quality of our (living) environment. We have set ourselves the challenge of improving perception and experience, the multiple use of space, combining functions and encouraging awareness.

Combining our design experience and technical know how puts us in a position to link solutions to challenges and produce creative and innovative ideas when planning for water in the development of urban areas. Adaptation comes about through the interchange between politics, financial processes, the need to respond to climate change and growing awareness. In this way, the reality of a 'water-resistant' city comes ever nearer. By promoting the water sensitive city we are demonstrating our long term vision for cities in which the awareness of water, energy and our living environment are all connected and in which planning developments always take place in a robust and climate-proof way.

Living with water in the Amsterdam canals (2009)

The Dutch Water city

Water management, land use organisation and urban development have always been mutually dependent over the course of the centuries. The territory of the Netherlands was formed as a delta by several big rivers and the North Sea. Alongside the centuries-old battle with water, our position between the land, water and sea has also resulted in great wealth for the country. As the first modern trading nation, the Netherlands had the densest urban network in the world during the 16th and 17th centuries.

Inhabiting this delta region was not without its struggles and sacrifices. In the middle of this period of early urban development a series of major storm surges took place. Between the 12th and 18th century the Dutch landscape changed to become a hydraulic system of dikes, dams, drainage channels, storage basins and windmills. The formation of cities in this landscape builds on this hydrological technology. The main urban structure of the water city was in fact a combination of hydraulic engineering structures. Canals and wharfs formed the main traffic infrastructure, while dams were the most important public space.

Construction of one of the 1st sewers in the Netherlands (Groningen, around 1900)

After the middle of the 19th century, the map of the country changed dramatically. Town ramparts lost their military function and were pulled down. As a consequence of this, towns and cities began to expand. This was necessary to accommodate the growth in industrial activity and the growing population. With new energy sources such as steam and electricity, many large lakes and pools were pumped dry. At the same time, many canals lost their infrastructure function and were filled in.

In the middle of the 20th century the coastline became a good deal shorter due to the construction of the Afsluitdijk and the amount of surface water reduced significantly. The urbanisation pattern ceased to follow the (remaining) water network, but primarily followed the logic of the new motorway network. It seemed that water had stopped contributing an organizing role to urban development.

At the same time, it appeared that hydraulic engineering expertise had made it possible to permanently protect the land from flooding. Primarily after the flood disaster of 1953 it became official policy to focus on safety in favor of orienting towns around water. There was minimal interest in urban water management during the building explosion after the Second World War. Plans for water in urban areas were usually functional in nature. Water boards did not have any interest in the urban environment and municipalities had a department solely focused on the sewer system. There was no awareness at that time of urban groundwater. In reality, ponds were little more than an internal overflow for the mixed sewer system.

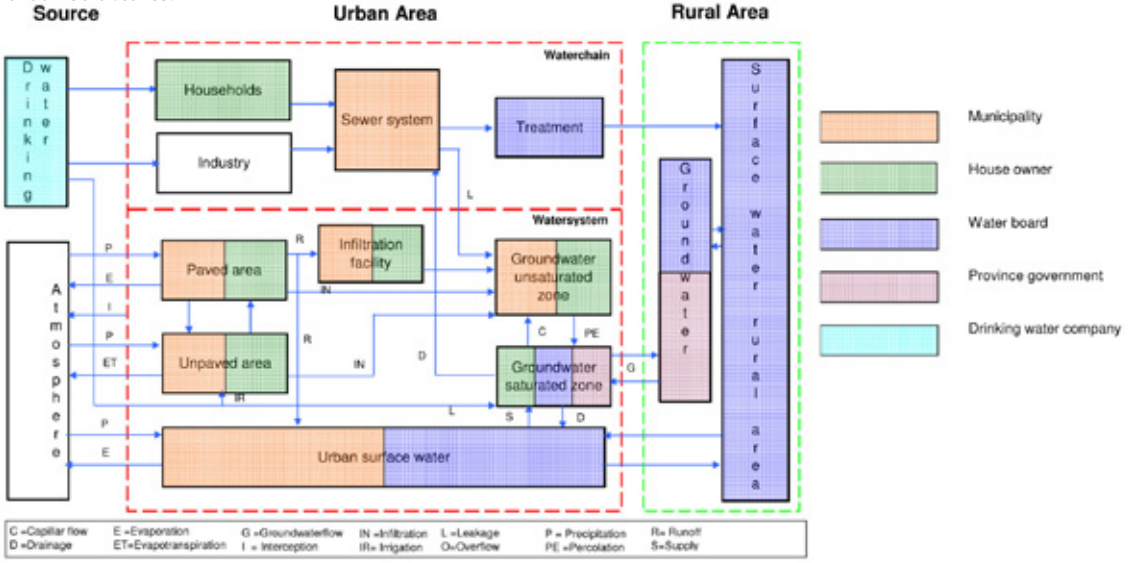
Breda quay (in 1966, quay filled during 1970-2005 and reopened in 2007), The Netherlands.

Cheonggyecheon creek in city of Seoul
(till 1968, creek filled during 1970-2000 and reopened in 2005), South Korea.

After water quality in urban areas fell to an all-time low at the beginning of the 70s, awareness of water issues gradually began to grow. The Pollution of Surface Waters Act and the Environmental Management Act were passed. The oil crises in 1973 produced an energy shortage. Homeowners started insulating their houses on a big scale and, as a result, water in crawl spaces and rising damp became a problem. It took until midway through the 80s before the urban groundwater problem got onto the agenda.

The message of the 3rd Water Management Memorandum that appeared in 1989 was: integrated water management. There was a growing awareness that sewers, groundwater and surface water all formed part of a whole and that water quality, water quantity and ecology were all interlinked. Water balance sheets were put together for the first time and it became clear that rainwater is the dominating factor for urban water systems.

The rediscovery of water in urban planning became apparent in a new generation of urban expansion projects (incl. VINEX) in the 90s. Water as an organizing principle was the message of the 4th Water Management Memorandum (1998). And since the Water Management Memorandum to launch the 21st century (2000) and the processes around the water assessment (2003), water has become one of the organizing principles in the (re)development of urban structures.



Urban water cycle and responsibilities (De Graaf, 2009)

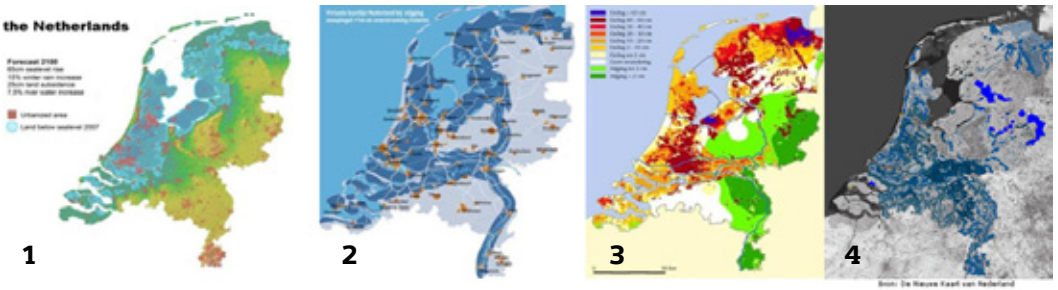
Flooding of New Orleans by Katrina in 2005

Dealing with Changes

Climate

The temperature of the earth has increased over the course of the last century. Climate scientists believe that this is primarily caused by emissions of the greenhouse gas CO_2. The warming of the earth has major consequences, such as an increase in:

- Flooding due to rising sea levels, drainage peaks into rivers and precipitation extremes as well as soil settlement due to drainage and natural subsidence
- Water shortages due to low groundwater levels, salt intrusion and saline seepage.
- Heat stress in urban areas due to higher temperatures.



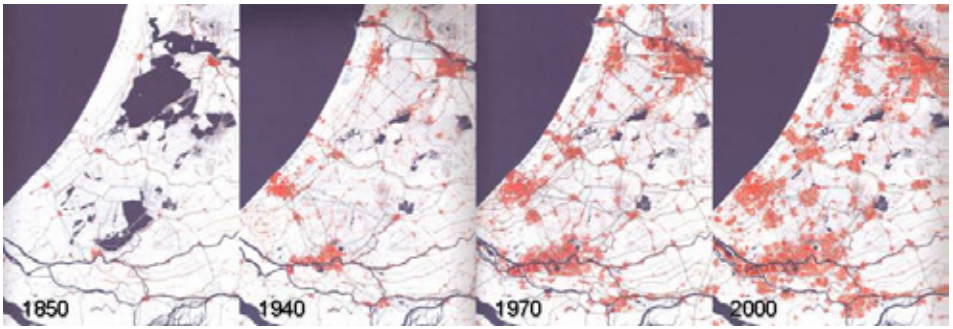
1. Sea level rise
2. River discharge
3. Subsidence
4. Search area water storage 2050

Some consequences of climate change in the Netherlands

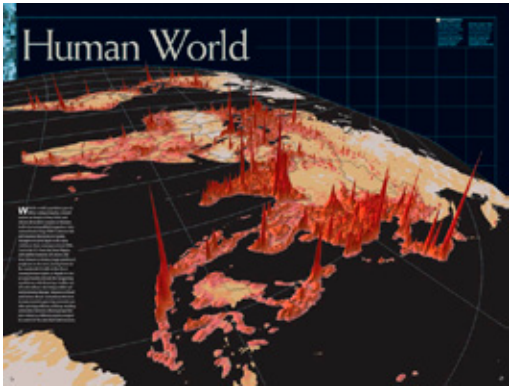
Urbanisation

For the first time in the history of the planet more people live in cities than anywhere else. The 21st century really is “the century of the city”. This same phenomenon of rapid urbanisation is also apparent in the Netherlands, particularly in the Randstad conurbation. Today, we live in one of the most densely populated countries in the world.

Urbanisation often has detrimental effects for water management in an area. Precipitation can no longer infiltrate the ground and water runs off faster into canals, rivers and streams that range over the area. As a result, they have to drain away greater volumes of water, increasing the risk of flooding, or even dike breaches in the lower reaches of rivers.



Urbanisation of the Randstad (Atlas van de Nederlandse Waterstad, 2005)



Urbanisation in the world (National Geographic, 2009)

Flooding of the A2 national highway at 's-Hertogenbosch in 1995

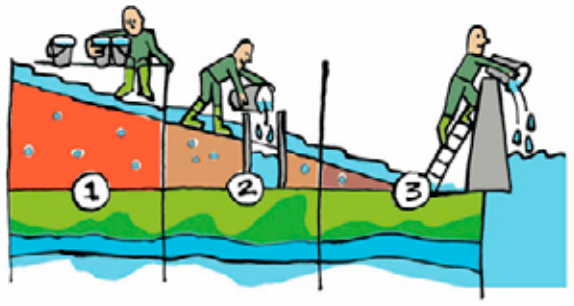
Water management

The floods of the 1990s formed an important turning point in thinking about the relationship between hydraulic engineering and urban development. Changes in the climate and the consequences for water management have also been behind a series of new government memoranda for water management and new planning and design concepts for urban and land development:

- National planning memorandum: space for development (2006)
- Delta Committee recommendation (2008)
- Spatial Planning Act (2008)
- Development of National Administrative Agreement on Water (2008) incl. the Water Framework Directive.
- Long-term vision for the water chain (2008)
- National Water Plan (2009)
- Water Act (2009)

Seeking to achieve a safe, healthy and sustainable system of water management is in the national interest. Subjects such as “water in the city” and “water as an organizing principle” and seeking to achieve “sustainable and robust water systems” are included as key topics in national policy. This has resulted in two three-stage strategies for:

- Water quantity (retaining, storing, draining)
- Water quality (preventing, separating, purifying)

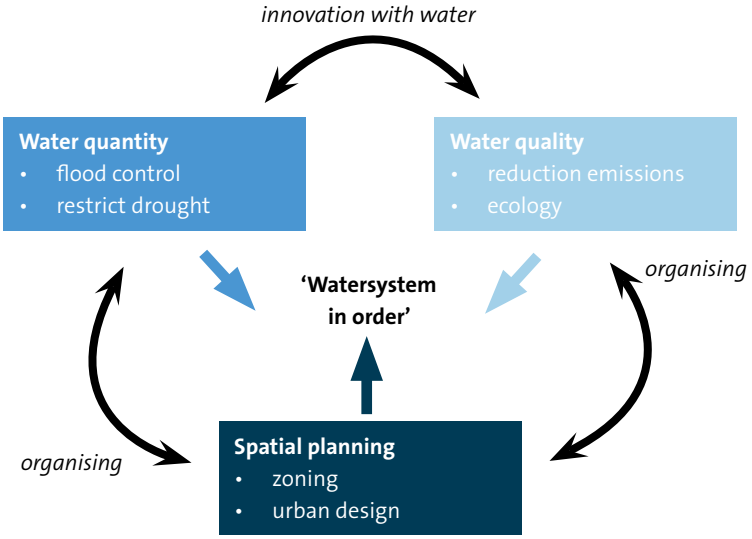


Three-stage strategy for water quantity (NW4, 1998)

Realizing the goals and principles of the national water policy is a joint task. This was agreed within the current National Administrative Agreement on Water (NBW-current, June 2008) when it was signed by the government, the provinces in the form of the Association of Provincial Authorities, the Association of Netherlands Municipalities and the Association of Regional Water Authorities. Basic principles in the NBW-current are:

- More space for water ("dry feet"),
- Stand-still situation: no further deterioration in current (2000) chemical and ecological water quality ("clean, healthy water") and
- Preventing water problems being shifted to other areas and a later date.

In accordance with the strategy and preconditions of the national water policy in the 21st century (WB21), this can also be referred to as fulfilling the water action plan. We pursue our ambition in the area of water to integrate the "water action plan" and to bring solutions for pressure points to bear in the water system in a logical way. Added value is created because the solutions chosen are sustainable and can easily be combined with other planning functions (protection, use, perception and management), not just those for water. Moreover, putting and keeping water management in order demands the organisation and coordination of interests so that solutions can be produced.



Challenges in urban water management (Dolman, 2004)

Living with water in Venice, Italy (2010)

International Experience

According to climate scientists, in 100 years' time the climate in the Netherlands will be the same as that in the south of France: Amsterdam will be like the Venice of the north. In other parts of the world, the more significant effects of climate change can already be seen with changes in climate, urbanisation and water management. Some world metropolises, such as Ho Chi Minh City (Vietnam) and Lagos (Nigeria) are under water several times a year. Following the flood disaster in New Orleans caused by Hurricane Katrina in 2005, hydraulics engineering expertise was used to strengthen the levees and construct dams in the Mississippi delta. On the other side of the world, the occurrence of tidal waves or tsunamis in densely populated urban areas is an issue of concern. Many countries, such as Japan, Australia and, closer to home Spain, are learning to live with restrictions on the use of drinking water.

These places feel far away and the problems seem to bear little resemblance to those we experience here. However, the essence of these international challenges is the same as those facing the Netherlands. A fundamental step needs to be taken towards bringing about a new relationship with water. The technology is there, but the barriers to progress largely lie in the social-economic and administrative arena.

With cities caught between drought areas and seasonal flooding as well as severe restrictions on the use of drinking water, the initiative has been taken in Australia to develop a strategy for "The Water Sensitive City". The "Water Sensitive Urban Design" (WSUD) approach plays an important role. WSUD is focused on the integration of the natural environment and sustainable technology in planning for urban water. This integrated approach that combines hydrology, landscape architecture and sociology is a source of inspiration for us.

Transitioning from water supply to water sensitive city (Brown, Keath and Wong, 2009)

Al Gore gives a presentation on climate awareness in the documentary “An inconvenient truth” (2006)

Oss - Piekenhoef

The Piekenhoef housing estate, designed by VHP, lies at the boundary between the low-lying Maas river valley and the higher-lying aeolian sand ridges of Brabant. It is important to infiltrate water directly into the subsoil in order to keep the housing estate green and to maintain the water table. It also prevents water related problems in the future during heavy rainfall.

Rainwater runoff and detention system therefore forms the principle starting point for the urban design and landscaping of Piekenhoef.

Piekenhoef also forms a hydrological link between Berghem and the extended nature reserve. This motivated the construction of five wadis, wide, grassy infiltration trenches that run through the residential area. The wadis allow runoff rainwater to percolate into the subsoil. They also establish a clear relation between the residential contexts and the surrounding landscape, and between the village and the forest.

Indicators (sustainable technology) and control parameters (processes) for the Water Sensitive City

Our vision on building the Water sensitive city

The water sensitive city is a place where the built and natural environments are in balance. It is a vibrant city with strong social values through which a healthy water system flows. It is a place with an integrated urban water system where the sustainable use of rainwater, groundwater, surface water, wastewater and drinking water is taken for granted. Ecosystems, infrastructure, communities, those in authority and businesses act together in a resilient and flexible way and are ready for the future.

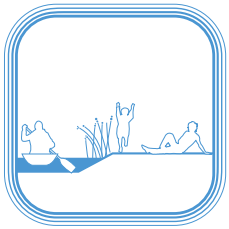
When promoting the water sensitive city we make a distinction between:

- Being aware of water in the design and planning – by the application of sustainable technology and
- Awareness of water – by sending on processes.

Being aware of water in the design and planning

We use our broad technical know how and design experience to produce creative and innovative ideas when planning for urban water. Our projects demonstrate that by realizing the integration of design, natural functions and technical concepts, a more attractive living environment and climate proofing can be achieved. We attach great importance to attractive design and ensure technology is at least partly visible so that people can see and experience it.

Use of water squares for surplus storm water storage in urban areas (VHP 2007)

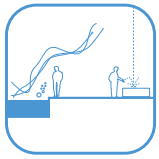


Quality of living environment

We are using up more and more space for living, for recreation and for economic purposes, such as agriculture and industry. This results in water problems, and it becomes harder and harder for plants and animals to exist around us. As a consequence, the quality of our environment is significantly reduced.

The contribution of green spaces and water in urban areas to the quality of the living environment may come about through the use, the presence and the ongoing effect of the use or presence of green spaces and water. In the (re)development of urban environments, we aim for balance between the built and natural environment. Water is assumed as an integral and visible part of the urban landscape, with a resilient and healthy water system at its heart.

We deliberately opt for a spatial planning approach through flexibility in developments and by building adaptively with water in mind, as well as investing in green infrastructure. Useful and visible examples are: above ground discharge (such as surface drainage systems), buffering (such as water squares), infiltration (such as wadis), ecosystem services (such as green roofs), but also through play, art and nature development.



experience value

recreation and sport

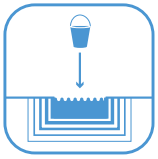
play

art

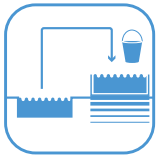
Sustainable use of water supplies

The surface and groundwater system could be used more sustainable. For example, by using the effluent from waste water purification and by recycling drinking or rain water. Examples in terms of recycling water include collecting rain water for use as “grey water” for flushing toilets or fire extinguishing, so as to save on drinking water supplies. In some cases, it could be cheaper to lay a new drinking water main.

infiltration

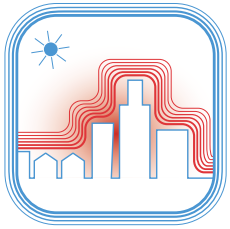


retaining



storing

separate water systems



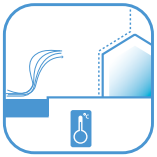
Climate control – urban heat island effect

The urban heat island (UHI) effect is the phenomenon whereby the temperature in urban environments is higher on average than in the surrounding countryside. The primary cause of UHI is the absorption of sunlight by the dark materials present in cities, reduced heat loss due to relatively low wind speeds, heat released by human activities and reduced evaporation. The UHI effect exacerbates problems during heat waves, such as heat stress. Due to the high temperatures during a heat wave, work productivity reduces while aggression increases. Heat stress results in an increase in morbidity and mortality. It also reduces the longevity of asphalt.

Building measures, more water and more greenery in cities help to reduce the UHI effect. New housing blocks can be built so that the wind is better able to carry the heat away. Houses can be designed or adapted to promote natural ventilation. For example, verandas and awnings can be used to keep the heat outside, without the need for air conditioning. Air conditioning produces more heat in the external environment and uses large amounts of power.

There are relatively few trees in cities. Trees have a cooling effect: the natural shading they produce means the temperature under trees is lower and trees absorb less sunlight than say asphalt. Trees also have a positive effect on water management and air quality.

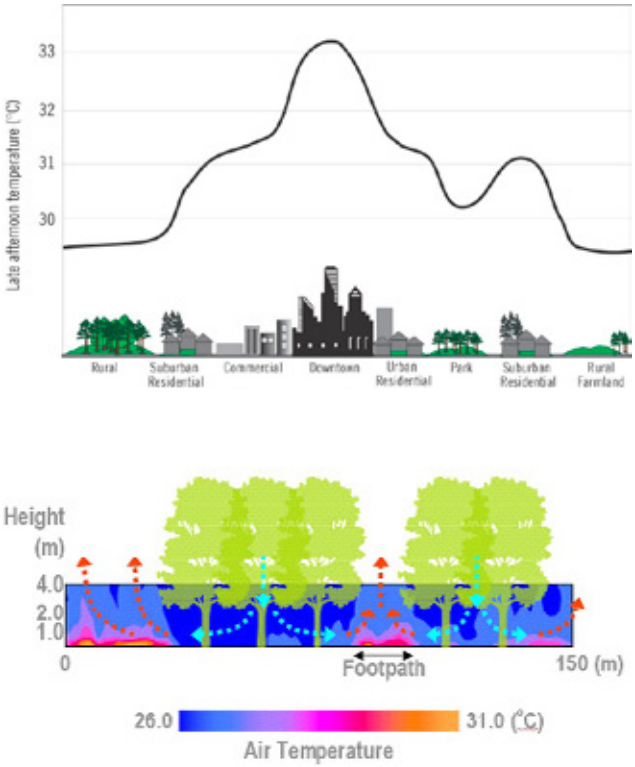
Other measures to reduce the urban heat island effect include the construction of green roof gardens and green facades, and the use of road surfacing materials that absorb less heat.



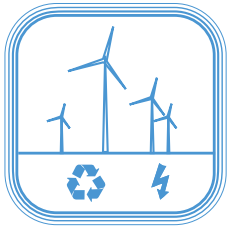
cooling with water

roof gardens and green spaces

surface water



Differences in temperature: urban/rural and grey/green

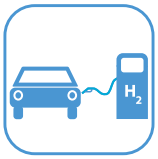


Energy from water

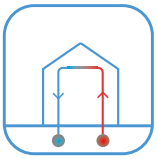
In hotter periods water provides for cooling. In this case energy is consumed in order to extract heat. If this principle is reversed, there is the possibility of extracting energy. This method of energy extraction using water depends on physical principles, practical applications and a level of scientific knowledge based on:

- Water movement, such as energy from water flow through weirs and sluices, from waves and the tide;
- Energy extraction based on the composition of water, such as energy from salt/salt gradients and aquatic biomass;
- Energy extraction based on the thermal properties of water, such as energy from the temperature gradient between water and the environment, underground thermal energy storage and geothermal heat.

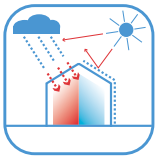
There is currently strong interest in underground thermal energy storage (UTES) systems. In this type of system the groundwater is connected to climate control in buildings. Surface water can be used as well as groundwater, e.g. as a solar collector.



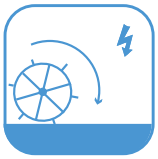
alternative energy



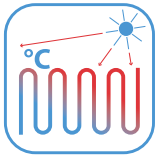
underground thermal energy storage



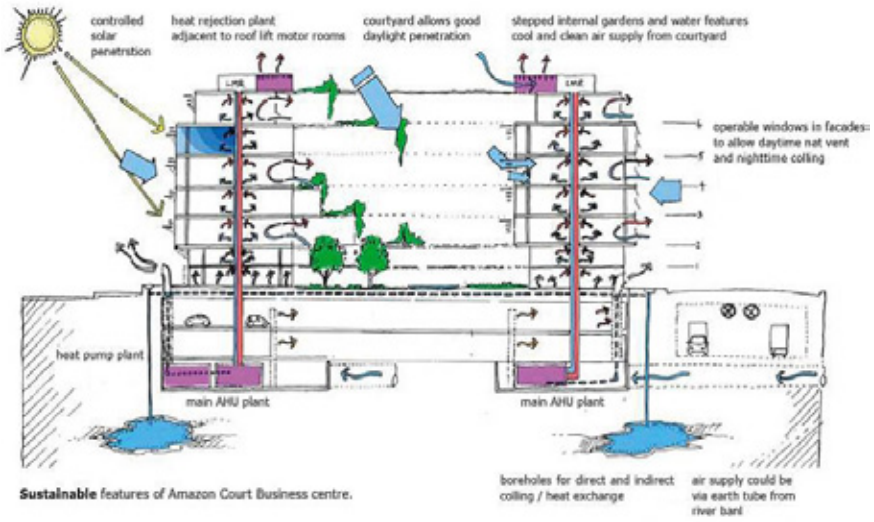
building conditioning



hydropower

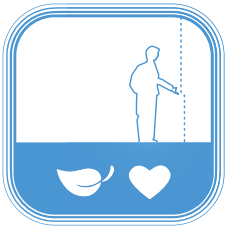


solar collector



Sustainable features of Amazon Court Business centre.

Climate control in and around buildings



Clean and healthy water

Water offers a wealth of opportunities for recreation or for living by the water, it is the source of drinking water for people and livestock and for the irrigation of crops. Healthy water also provides a home for many different types of plants and animals, which we can all enjoy as part of the beauty of nature. Good water quality ensures that animal life (fish, plants, macro fauna etc.) can function effectively. This implies the need for good nutrient management and the absence of toxic effects due to low oxygen levels or (excessive) emissions of toxic chemicals.

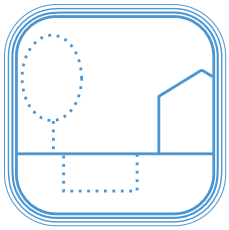
The aim is always to avoid pollution. There is a distinction to be made between the approach to managing (and maintaining) single discharge points and diffuse (water) pollution. Single discharge points include sewer overflows, rain water run-off and discharge from waste water treatment plants. Diffuse water pollution includes the presence of leached (building) materials, as well as issues relating to disasters, maintenance, etc. The diffuse pollution of surface water by building materials must be prevented by choosing suitable materials for building activities (sustainable building). The use of leachable and oxidisable building materials must be avoided. These measures relate both to material regulations for new build projects and preventing pollution caused by run-off from hard surfacing.

In some low-lying parts of the Netherlands (brackish) seepage and salinisation is a growing problem. The aim is to retain fresh rain water in the surface and groundwater system for longer. Establishing flexible water level management and realizing seasonal storage will produce benefits to counter salinisation in polders.

prevent pollution

reduce salinisation

water treatment

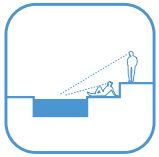


Planning solutions - water resilient

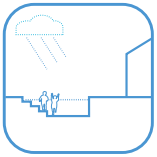
The fact that the climate is changing is evident from the rising sea level. Moreover, rivers will have to drain more water in certain periods. As a result, there is an increased risk of flooding. In addition, heavy rainfall that it is difficult to absorb locally will occur more frequently and could lead to flooding and damage.

The concept of multi-layer safety (*see intermezzo on the next page*) aims to make the water safety policy more robust and sustainable. A condition for this sustainability is that administrators, businesses and citizens are persuaded of the flood risk and take this into account in their considerations and in the way they act. So, maintaining and strengthening water-aware behavior will require ongoing input.

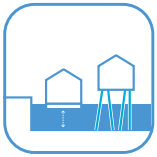
nature and ecology



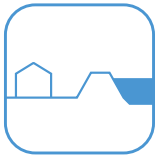
water visibility



adaptive solutions



building urban areas climate proof



protection from extremes

Multi-layer safety as a central concept (source: Programma Waterveiligheid in de 21e eeuw)
The central concept for the revised water safety policy is formed by 'multi-layer safety'. In this concept safety is assured through multiple layers.

1. The first layer is the prevention of floods through strong dikes, dunes and storm and flood water defences (more robust and future-focused). Prevention remains the primary pillar of the policy.
2. The second layer is achieving sustainable town and country planning. Careful town planning (choice of location and land use issues) can limit the numbers affected and amount of damage if flooding does occur. As a result, the flood risk will play a bigger role in considerations and decisions relating to town and country planning.
3. The third layer is disaster management if a flood occurs. Good preparation is essential to be able to respond effectively to a flood disaster. Preparation will also help to limit the amount of damage and the numbers affected.

Just as infrastructure and the choice of development site are key factors for planning considerations, so water management has a legitimate claim to be considered in the planning and decision-making process. And, it is not just about open water and river banks: the choice of rain and waste water systems also determines the water storage facilities required or the water action plan.

Added value is created by bringing solutions to bear in the water system in a logical manner. The solutions chosen are sustainable and can easily be combined with other planning functions (protection, use, perception and management), not just those for water. In addition to functional surface water, there are alternative methods for water storage. This is of interest in built-up areas. Examples include:

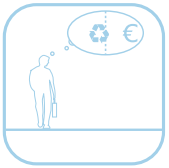
- infiltration to the groundwater via green storage or infiltration crates,
- buffering on (green or sedum) roofs, at (lowered) ground level, water squares or in water storage cellars,
- delayed drainage (above ground).

Processes for water awareness raising

Legal environment

In spatial planning regulations are very important. Laws and policies are often the conditions in a spatial process. The wishes of residents and entrepreneurs can play an important role.

citizens



entrepreneurs

plans

public authorities

Economical costs and benefits

Besides the financial costs and benefits, social aspects are also important in a spatial process. Involving the various stakeholders can lead to a broadly supported plan.

participation

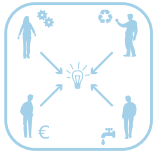
taxes

social issues

Organisation

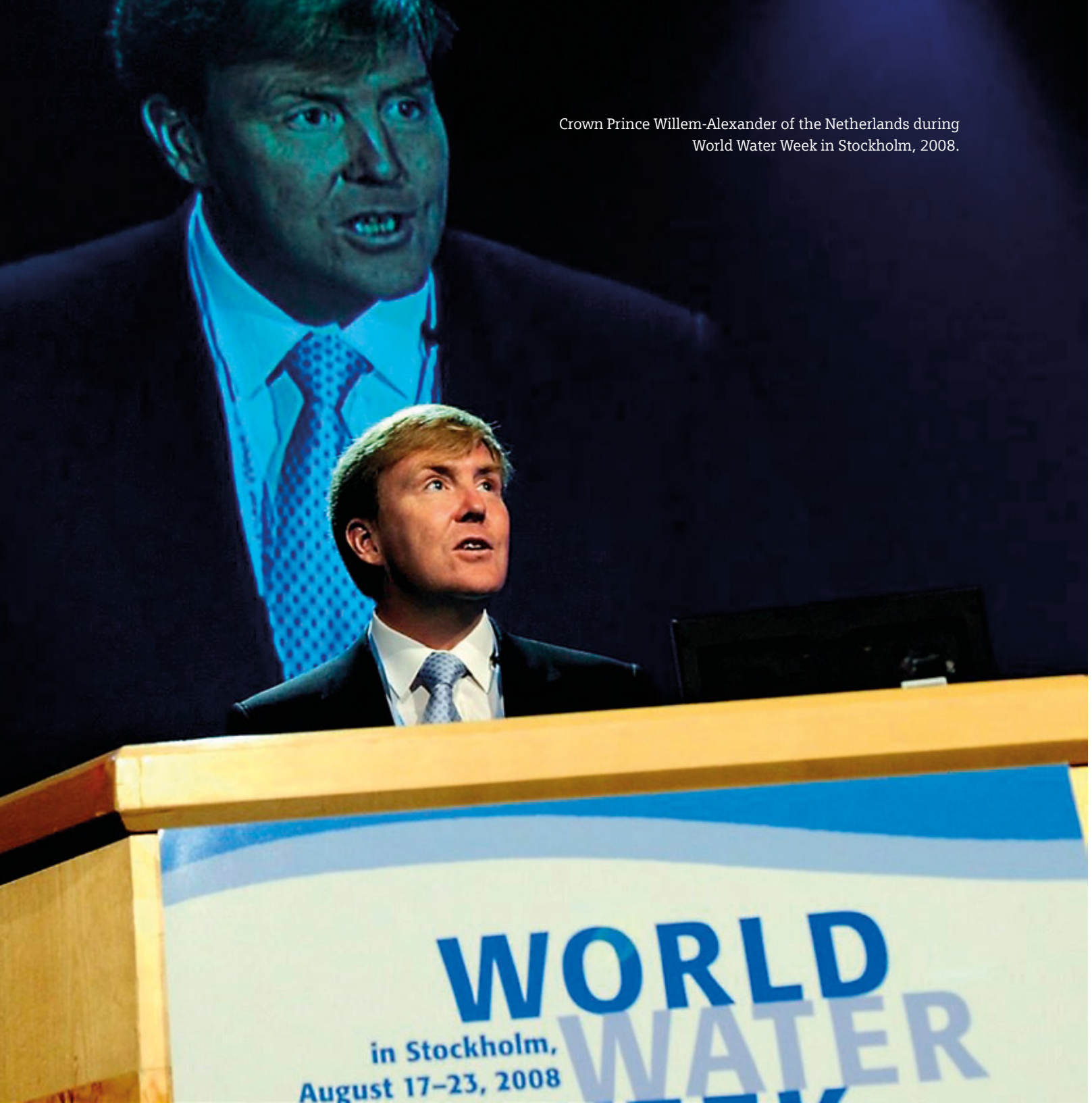
Good organisation and communication within a planning process is of great importance for the development and implementation of a spatial plan.

process



multidisciplinary approach

communication



Crown Prince Willem-Alexander of the Netherlands during World Water Week in Stockholm, 2008.

Water awareness

Under the heading - awareness and support - the memorandum on "A different relationship with water – Dutch water policy for the 21st century" (WB21, 2000) states the following: Deltas with their vast supplies of water make an attractive place in which to live, work and relax. But, there are also inherent risks to living in low-lying regions; absolute safety cannot be assured and the possibility of flooding can never be eliminated. Government needs to make citizens aware of these risks. This will allow citizens to make their own contribution, alongside that of the government, to preventing damage and flooding.

The Dutch government is putting out the message that citizens need to be water and risk aware. The communication campaign was launched under the heading "Nederland leeft met water" [the Netherlands lives with water]. As well as producing technical solutions, we want to create a water management system that is sustainable and makes us more aware of the quality of our (living) environment.

Developing water awareness (footprint) should contribute to living in an ecologically sustainable manner. This could include a self-sufficient ecosystem or a "smart" climate city where strong social values, committed and flexible partnership and the application of (and innovation in) new technologies all have a place. In our vision of the water sensitive city the following are key, distinct aspects:

- Regulations set down in laws, policy and strategy;
- Social costs/benefits;
- The organisation and coordination of interests so that solutions can be produced.

Royal Haskoning in action during Dutch Dialogues 3 workshop – New Orleans (dutchdialogues.com, 2010).

Application
in practice

When promoting the water sensitive city, we have set ourselves the challenge of, alongside producing technical solutions, creating a water management system that is sustainable and makes us more aware of the quality of our (living) environment. The vision we are presenting is based on the building blocks that make the transition to a city in which the awareness of water, energy, nature and living environment are all connected and in which planning developments always take place in a robust and climate-proof way.

Ideas for climate adaptation and innovations in water management are being put forward in relation to development schemes, the various risks/threats and management strategies. Ensuring our environment remains a good and safe place in which to live demands creativity and that the right choices are made. Our task is to apply sustainable technology and innovations in practice and enable these to filter through to become standard practice. How do we link this task to ensuring that the best decisions are taken and to implementing sustainable solutions?

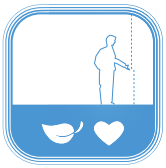
Every planning development should be evaluated for opportunities to incorporate sustainability and innovation. In the Netherlands water has gained its own place in the planning decision-making process via the mandatory “water assessment” (Wet Ruimtelijke Ordening - Spatial Planning Act). The process of the water assessment requires that when development plans are put forward the consequences and opportunities for water and/or spatial planning are considered at an early stage. The application of sustainable technology (“being aware of water in the design and organisation”) should be determined via a referencing option in the process of the water assessment (“awareness of water”). This is partly driven by the legislation, such as for adequate water storage and good water quality.

Initial phase

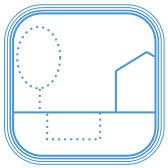
Spatial planning authority ◀▶ **Water authority**

Informs the water authority in the early stages of the plan, invites it to participate and asks for information about the water system concerned.

Informs the spatial planning authority about the water system, relevant policies, criteria and priorities.



protecting (fresh) water quality



spatial solutions - water resilient

Agreement on criteria and process

Spatial planning authority and water authority together

Agree on the assessment criteria and interactions as well as the responsibilities in the following process of spatial planning.

▶ defining ambition level

sustainable enhancement techniques:

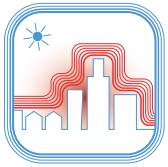
Developing phase

Spatial planning authority ◀▶ **Water authority**

Designs the draft spatial plan, taking the water criteria into account and involves the water authority in the designing process.

Is activily involved in the development of the plan.

quality of living environment



regulation urban micro climate

Water recommendation

Water authority

Checks if the agreed water criteria are met in the spatial plan and writes a Water recommendation

energy from water

sustainable (re-)use of water resources

Decisionmaking phase

Spatial planning authority

Makes final decisions about the plan and describes in a water paragraph how water has been taken account of. If water criteria will not be met, reasons and measures for compensation must be described

Water paragraph

▶ balancing on the basis of effectiveness and / or cost efficiency

Reviewing phase

Higher authority

Reviews the spatial plan including the water aspects and the process of Water Assessment.

Where the actors and parties involved come together, the joint ambition and level of involvement should also be discussed. Mutual independence between the actors and parties involved, uncertainty about final outcomes and continually changing partnerships have changed government's leading role to a shared role with stakeholders. Planning developments are no longer just about the technicalities, but also about the way decisions are taken. Defining the quality of the environment being sought and the management approach to bring this about (efficiency, costs/benefits) makes it possible to formulate joint agreements for the actual implementation of sustainable technologies and solutions. In this way, growing awareness and adaptation comes about and the reality of a water sensitive city comes ever nearer.

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