innovation

Research & Innovation

2017 Annual Report

waternet
regional public water authority
amstel gooi en vecht
city of amsterdam

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Foreword

Waternet is preparing for the future, with a powerful Research and Innovation programme. We are introducing new technologies, improving our operations, and responding to societal challenges. At the same time, the programme offers excellent opportunities to establish contacts with water cycle companies abroad. This way, we can tackle the same challenges together.

In 2017 we strengthened our contacts with our foreign partners: Berliner Wasserbetriebe, PUB in Singapore, HOFOR in Copenhagen, and the City of New York. We signed collaboration agreements, with innovation as an important component, with these partners during the Amsterdam International Water Week 2017. Closer to home, links with the Amsterdam Institute of Advanced Metropolitan Solutions (AMS) were also reaffirmed. Waternet and AMS are working together in the Topsector Water project, New Urban Water Transport Systems. This involves the establishing of design principles for urban infrastructure for water transport. The aim is to reclaim as many raw materials as possible from the urban water cycle. The removal of pharmaceuticals from waste water is one of Waternet's top priorities. Together with Witteveen+Bos, Cabot, Nijhuis Industries, STOWA, and Delft University of Technology (TU Delft), we are investigating how the proven 1-STEP®filter can be extended with ozonisation. Together with STOWA, KWR Watercycle Research Institute, TU Delft, and the Topsector Water, Waternet is taking part in the experimental AdOx project. We are developing a sustainable, inexpensive technique for removing pharmaceuticals from wastewater.

Jan Peter van der Hoek, Director of Innovation, Waternet

The researchers from the Massachusetts Institute of Technology (MIT) were in the Netherlands for an AMS project

The MIT (Massachusetts Institute of Technology) and Waternet jointly carrying out measurements in the canals

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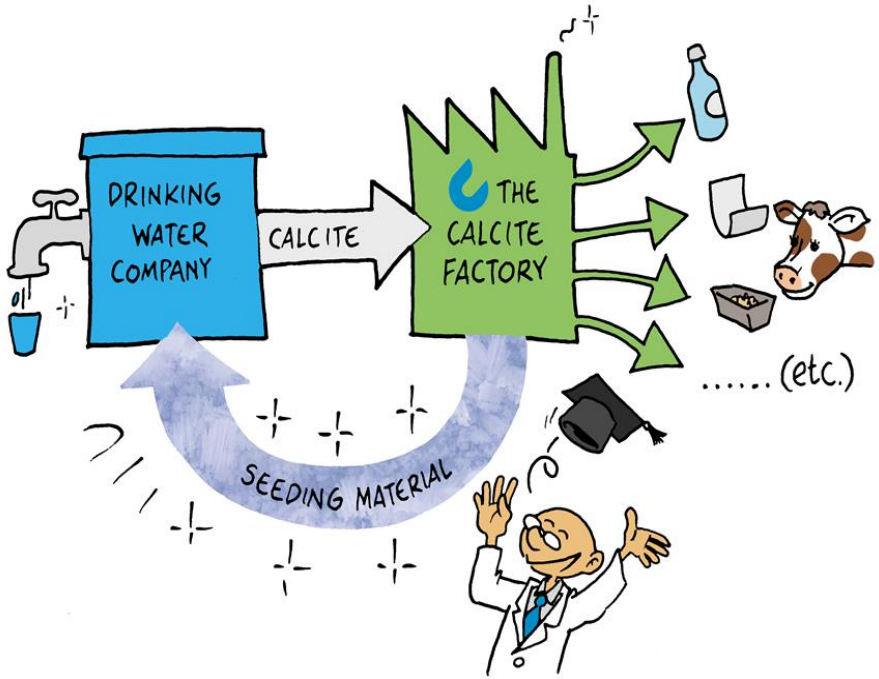
The Calcite Factory

In Amsterdam's Westelijk Havengebied, Waternet and Advanced Minerals have launched a pilot-scheme factory, The Calcite Factory, which makes high-quality products from the calcium (calcite) from Waternet's drinking water. Around 10% of the calcite produced there is re-used by Waternet when softening the drinking water for Amsterdam. The remaining 90% is sold by AquaMinerals (the former Reststoffenunie) to other drinking water companies, and to industries such as the carpet, paper and glass industries.

Three-year pilot

We will know within three years whether this scheme is viable. With a professional partner like Advanced Minerals that specialises in calcite pellets, Waternet has found a good balance between doing things itself and leaving it to the market.



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Softening water

Because too much calcium in water is bad for items like washing machines, kettles, and irons, calcium is removed from Amsterdam's drinking water. We add material (seeding pellets), to which the calcium can attach itself. These seeding pellets grow into larger pellets which are then filtered out of the water. To begin with, we used garnet sand from Australia as the seeding material. Since 2012 we have been adding calcite from Italy. The year 2015 saw a successful experiment by Advanced Minerals involving the recycling of our own calcite pellets, after being dried, ground, and hygienised.

Participation by other drinking water companies

This means that calcium from limestone quarries (a finite raw material) is no longer needed and eliminates the associated transport. The processed calcium is also much purer. It means we can recycle our raw materials and save tens of thousands of euros a year. Other drinking water companies are welcome to participate. They can supply sand-free calcite pellets and take seeding material with them for their own water softening.

Het Parool

Calcite is ground into a raw material in the port of Amsterdam

Want to take a look behind the scenes at the Calcite Factory? Click here

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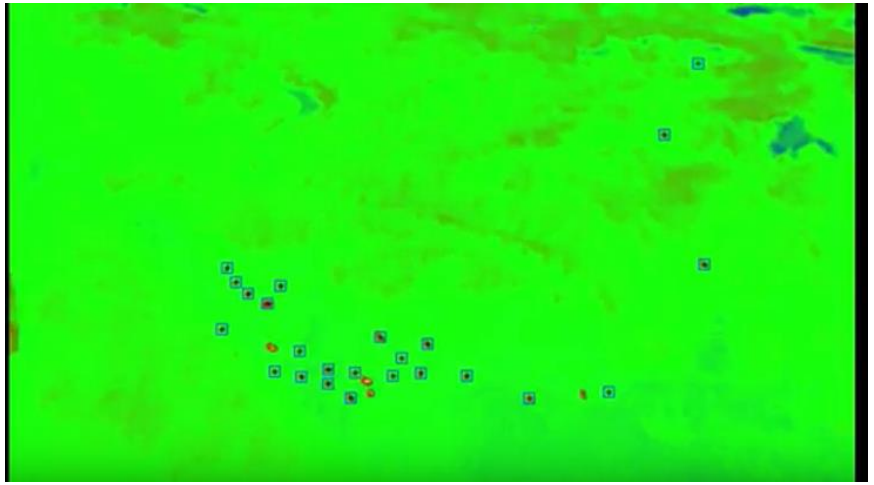
Datalab

The Datalab was launched in 2017. This is the breeding ground where data use, machine learning and artificial intelligence (also referred to as data science), gives a boost to innovation and the optimisation of our processes.

The Datalab at Waternet

Presentations, workshops, and pilot projects generated a great deal of attention in 2017. This led to many positive responses and a huge range of ideas, varying from the far-fetched to practical solutions that could be implemented straight away. Examples include predicting employee workloads, the automated reading of analogue meters, predictive maintenance of machinery, and route planning for autonomous ships. A whole range of data science was deployed for this, from simple regression techniques to complicated deep-learning models. The Waternet Datalab is now well-known in the data science world, and links have been established with the datalab of the City of Amsterdam.



DroneDeer: infrared images from the Amsterdamse Waterleidingduinen, collected by drones

In 2018, data science will be further professionalised. Bottlenecks, such as data supply, version management and central development environment, will be tackled in 2018, so that data science will gain a clear and prominent position in Waternet. Data is the future, and we are ready!

Drones in the Amsterdamse Waterleidingduinen

The Datalab Waternet has carried out its first explorations using OpenCV on the infrared images from drones that have gathered images from the Amsterdamse Waterleidingduinen. It turned out that images can be recognised using very few codes.

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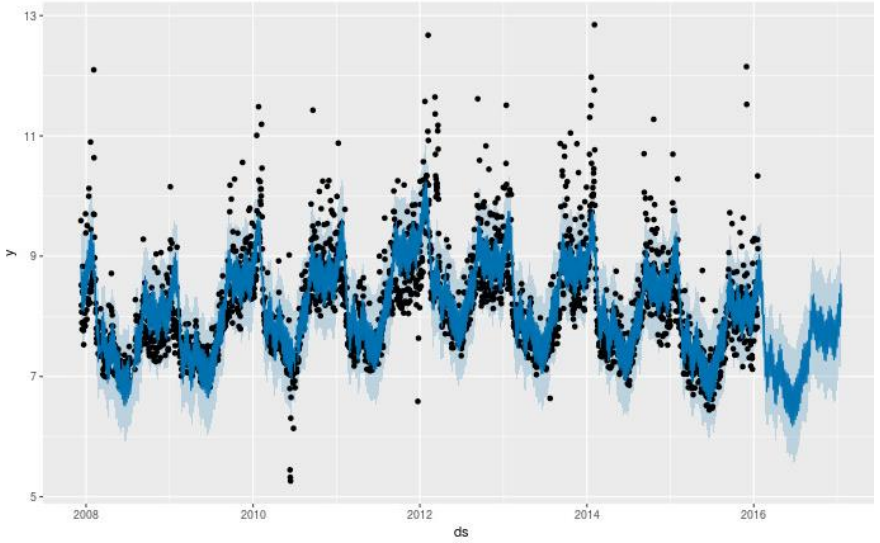
The Time Series Prophet

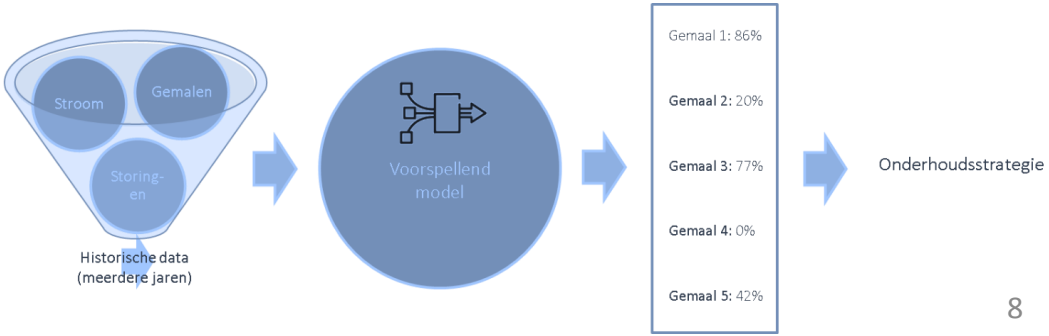
Prophet is a powerful module used in data science for analysing time series. This time series prediction module is an excellent tool that makes rapid time-related predictions possible. We carried out a test in the Datalab simulating historic data and their subsequent development. The results are very promising. We are now going to see whether we can use machine learning to make accurate predictions regarding the water temperature at the intake points for raw water for treatment for Amsterdam's drinking water supply.



Prophet predictions and calibrating readings

Data science and pumping stations

For pumping stations, we are looking at whether we can use historic data to predict which are the most likely to malfunction. An initial test shows that power consumption can provide some indication, but that this is limited as a predictor variable. We will now include the pump's on/off data, rainfall readings, and pressure readings. This will enable us to make further improvements to our maintenance strategy.



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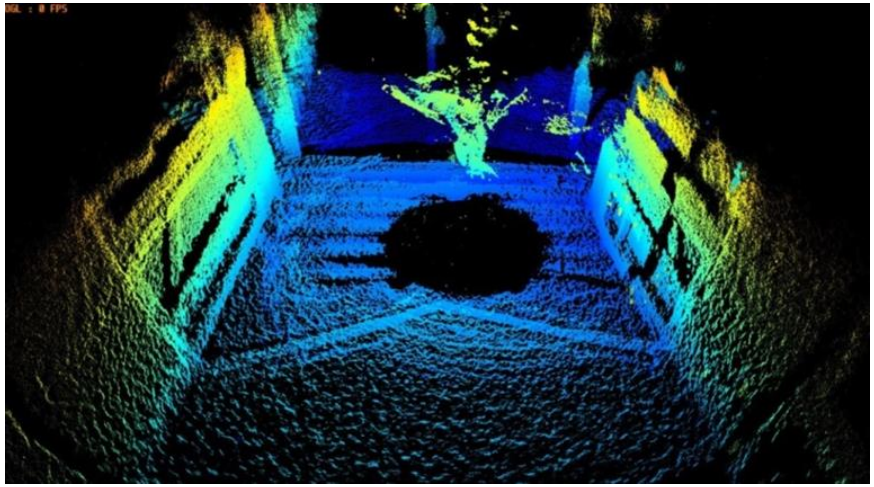
The digital canal

Waternet is developing the digital canal. More and more information regarding Waternet's operations on and in the canals is being acquired digitally. This allows Waternet to carry out its nautical monitoring activities, for example, more efficiently.



Sonar image of a lock

Combining data

An example of this is the acquisition of shipping data from the Automatic Identification System (AIS). Analysing real-time information of navigation movements gives us a clearer idea of where things are busy or are going to be, where vessels are sailing too fast, and where vessels are moored up. By combining this information with other sensor data, such as leisure craft detection, and administrative data, and by adding employees' knowledge, we hope to use more carefully targeted measures for dealing with speeding vessels and to proactively inform commercial shipping and leisure craft users.

Wrecks and water quality

Another example of the digital canal is the use of sonar on the wreck detector boat, SB24, to 'see' under water; this makes it easier to recover objects such as bicycles, car tyres, and larger items, without overly disturbing the canal bed. There are many aspects to the digital canal. For example, we are carrying out research into new online readings to gain a clearer idea of water quality and to improve water quality models.


Haarlemmerweg
Haarlemmerweg
Van Hallstraat
Nassaukade
Rozengracht
AMSTERDAM
Nassaukade
Kinkerstraat
Overtoom
Overtoom
Mauritskade
Mauritskade
Vondelpark
Oosterpark

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Innovating together

Waternet and the Regional Public Water Authority Amstel, Gooi en Vecht are working on the city of the future. For example by actively collaborating with Pakhuis de Zwijger in the ‘Steden in Transitie’ (cities in transition) network. This is a network of urban planners and innovators. The aim is a sustainable city and a green society.

More greenery in and around Reguliersdwarsstraat in Amsterdam

Waterbank neighbourhood communities, Neighbourhood garden

Urban issues

The platform uses a creative and innovative approach to work with urban planners and public and private-sector organisation exploring solutions to complex urban issues. We are taking part in new initiatives, research, and projects. In 2017, we worked in a range of programmes such as the ‘De Tafel van 10’, ‘Gebiedsontwikkeling’, ‘Buurtcommunities’, and Water Republic to actively share our knowledge about our innovation programme and to acquire information.

Together, we are working on the city of the future!

samen vernieuwend organiseren

Kennisactie programma Water

Results

- What water projects will be completed between now and 2025? Read more about ‘Amsterdam Waterstad’ (Amsterdam, city of water).
- How are we democratically designing the transition to a circular city? Read more about democracy in the circular city.
- We want to convert knowledge directly into action. Every update from the ‘Kennisactieprogramma Water’ (water knowledge action programme) will be posted on the kennisactiewater.nl website.

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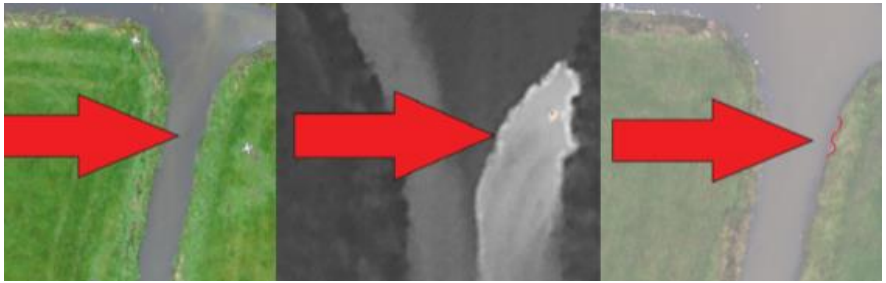
Drones in the water cycle

Robots and drones are becoming increasingly important in our work. We are using new techniques and sensors to make our work processes more efficient, more accurate, and safer. Sensors can measure heat, UV and near-infrared (NIR), for example. Using a heat camera under a drone, we can detect erosion and springs. In the future, we want to combine this with machine learning to enable us to detect springs automatically using drones.

Increasing use of drones

Demand for the use of drones has continued to rise in 2018. This varies from supporting Building Infrastructure Management (building reconstruction) to making inventories of grassland birds, breeding grounds, ecology, and many other aspects.



The erosion can be seen via a thermal infrared camera. The photo on the left shows the original situation, the one in the centre shows the embankment and outflowing warm water, and the start of the erosion. The erosion can be seen in the photo on the right.

Image of failing flood defence system

3D developments concerning our drones are moving fast as well. We have digitised an entire polder. Together with Deltares, we recently made a 3D recording of the 'Projectoverstijgende Verkenning (POV) Macrostabiliteit Eemdijk' (multi-project exploration of Eemdijk macro-stability'). This involved causing an artificial flood defence barrier to fail; drone and satellite readings gave a very accurate picture of the resulting deformed barrier. Technological advances give a very high positioning accuracy.

In the summer of 2017, the City of Amsterdam organised a Summer School during which Waternet gave a course on working with drones. For the After movie, click here.

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Internet of Things (IoT)

How can we gather information smartly and inexpensively? How does technology work? And what opportunities does IoT offer? For many of Waternet's sensor readings, there is no need to obtain high-density real-time values. For small quantities of information per hour, per day, or incidentally, LPWAN (low-power wide-area network) could prove a useful solution for readings concerning groundwater, sewage overflows, or alarm notifications.

What is LPWAN?

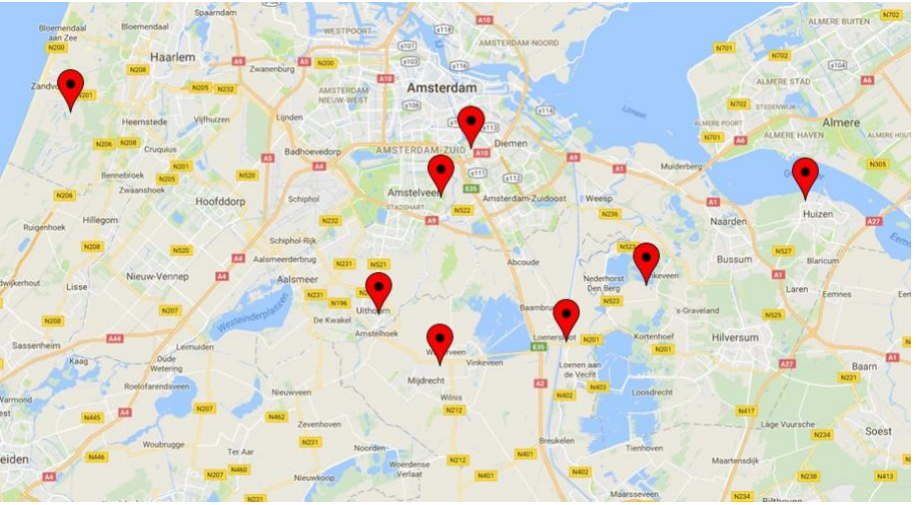
LPWAN is a new technology for wireless communications, used by the IoT and elsewhere. Because it requires much less energy than other wireless techniques such as WiFi, sensors with batteries can last for many years. Also, data is sent over a free radio frequency, which carries no costs. One limitation is that only small data packages can be sent at a low frequency - a few text messages per day or week, for example.

Testing surface water and groundwater readings via LPWAN in the Amsterdamse Waterleidingduinen.

Pros and cons

We have examined whether surface water and groundwater readings via LPWAN work well. Our field tests show that coverage initially varied over the area. We experienced the disadvantage of loss of data. Also, for distances of greater than one kilometre and when positioned underground, the range was disappointing. For future use, however, the technology does offer potential.

Installing water level sensor using LPWAN.



Surface water and groundwater LPWAN reading locations

In 2017, the IOTC365 company interviewed colleagues about how the IoT could be used at Waternet. It became very clear how Waternet would like to proceed with the IoT. The new Solution Internet of Things team has made an excellent start. The next phase consists of a strategic investigation into the flexible and scalable implementation of IoT solutions in the company's operations.

Recommendations

The conclusion and recommendations from the investigation were:

- Waternet is carrying out various pilot schemes and is aware of the opportunities that IoT brings. Waternet has sufficient numbers of technical employees who can grow with this new development.
- Because knowledge at Waternet is widely distributed, the greatest challenge lies in organising IoT.
- No specific systems have yet been chosen. Informed choices are needed in order to restrict the number of specials.

Next

In 2018, we are looking at the flexible and scalable implementation of IoT solutions in the company's operations and examining the pros and cons of LoRa, Sigfox, NBIoT.

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Better protecting vital infrastructure against flooding

The Amsterdam region is well protected against flooding, but if a dyke were to fail, the consequences would be huge. Many vital and vulnerable functions and businesses are concentrated in Westpoort, the Amsterdam port area. An adaptation strategy has been drawn up for the area, which includes changes to its spatial design and layout, and crisis management.

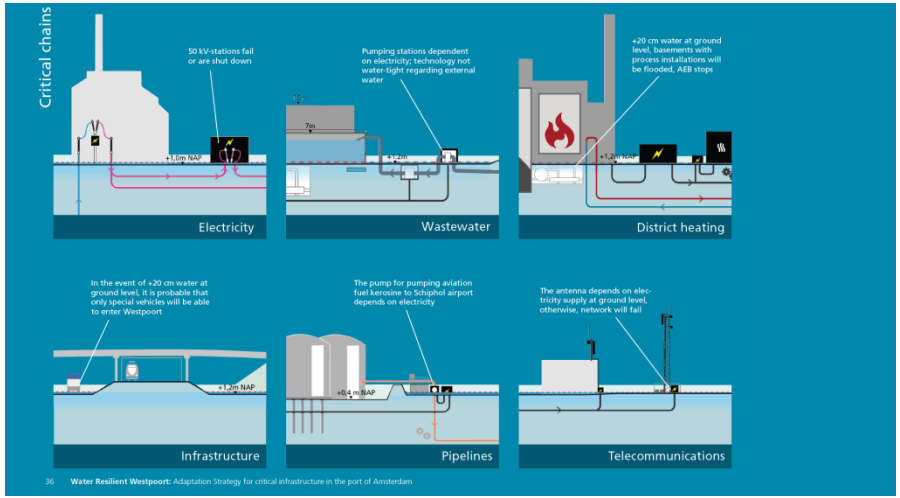
Major consequences

The likelihood of a dyke failing is very small, but if it were to happen, the consequences would be enormous. If hospitals, the electricity supply, or chemical companies were to cease operating, the result could be a whole chain of events whose effects would extend far beyond the flooded area, including power cuts, the escape of toxic substances, and the stagnation of petrol distribution.

Limiting the consequences

Many vital and vulnerable functions are concentrated in Westpoort, the Amsterdam port area, which are of great importance to the whole region. Various public sectors bodies and businesses in this area have looked at how the consequences of any floods that could occur can be limited through crisis management and modifications to its spatial design and layout. These would be in addition to the protection offered by dykes.

Vital links in 'Waterbestendig Westpoort'



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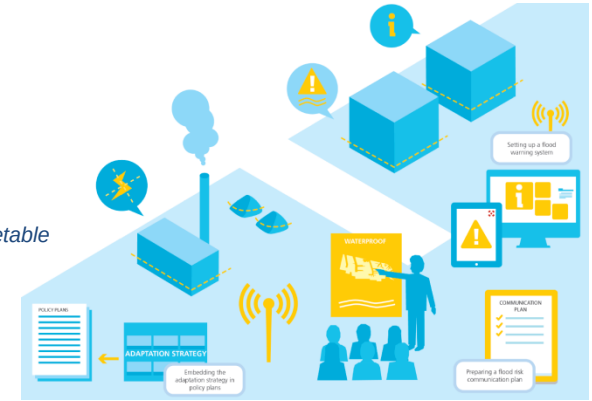
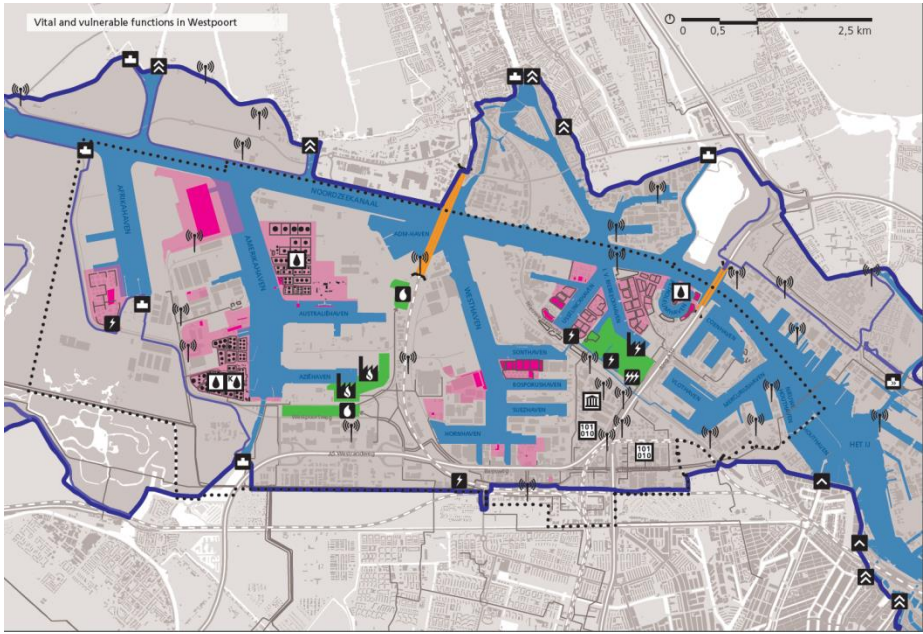
Adaptation Strategy

The adaptation strategy was drawn up following an inventory of flood risks and their effects on vital and vulnerable chains. One of the results will be that from now on flood risks and pluvial flooding will be assessed as combined phenomena. The adaptation strategy contains concrete measures and states the parties responsible. To keep costs down, there is an emphasis on smart coordination with spatial developments and major investments by businesses. This approach and strategy is also effective in other areas. Work is currently underway at upscaling the strategy to the Amsterdam Metropolitan Area.



Adaptation Strategy timetable



Vital and vulnerable functions in Westpoort

Interested in the report about the ‘Vitaal en Kwetsbaar’ (vital and vulnerable) pilot schemes?
Download the report via the spatial adaptation knowledge portal

Aerial photograph of Westpoort, the commercial and industrial area on the south side of the North Sea Canal.

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The Nautonomous: unmanned multifunctional vessel

The Nautonomous is a prototype of an electrically powered, autonomously moving ship. This year saw an improved version of the Nautonomous based on a design by students from Amsterdam University of Applied Sciences. The WN23 Nautonomous is multifunctional, so it can be deployed for a range of tasks.

Multifunctional

Because different modules can be placed on the prototype, it can be deployed for removing floating debris, but also for simultaneously measuring waterway and quayside profiles, for example; for tracing objects on the beds of waterways, or for gathering water quality data.

A range of electronic equipment

The on-board computer and other electronic equipment have been placed conveniently in a new housing, and can be stowed safe and dry in the vessel's flotation tanks.

Example of LIDAR images of Herengracht

A test voyage was carried out successfully in 2017, during which the Nautonomous covered a route autonomously, including avoiding a buoy that lay in its path. To observe objects of this kind, the software uses data from LIDAR, a laser with which the Nautonomous ‘looks around’ and detects objects. A graduate from TU Delft designed the first version of the software and will continue to work on its further development in 2018.

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A first

The WN23 Nautonomous also took part in the national Rijkswaterstaat Smart Shipping Challenge, as the first unmanned vessel in the Netherlands with an Automatic Identification System, or AIS, without a marine radio. After all, there is no-one on the ship. Thanks to the AIS, the boat can be seen by other ships and safety is enhanced. The Telecom agency has granted the licence for a year. The various sensors, technologies, and new disciplines involved, as well as safety and legal aspects, make this a complex research project.

Our partners in the project are TU Delft, Amsterdam University of Applied Sciences, the Massachusetts Institute of Technology (MIT) Roboat project, and the Amsterdam Institute for Advanced Metropolitan Solutions (AMS).

On the right, the new (in the foreground) and previous Nautonomous prototype, and on the right, the on-board control computer

WN 23 Nautonomous

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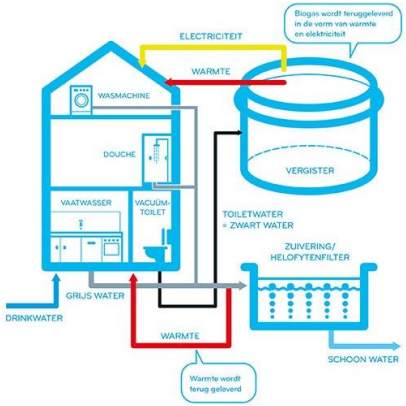
New sanitation

New sanitation saves water, energy, and recycles raw materials. We separate dirty domestic water at the source into two streams - black and grey water. Black water is water from toilets. Grey water comes from sinks, showers, washing machines, dishwashers, and other taps. From black and grey water, we extract both energy and certain substances. This animated film explains what new sanitation is and how it works. Amsterdam is seeking to introduce new sanitation at various locations.

New sanitation in Buiksloterham

In 2018, the Amsterdam district of Buiksloterham will get its own treatment station, extracting raw materials such as phosphate and biogas from human waste. A total of 600 homes will be connected to the floating station on a stationary barge. In 2017, we made the design for gathering, transporting, and treating wastewater in accordance with the concept of new sanitation. Together with the City of Amsterdam and others, we are gaining experience of new application possibilities.



Infographic on extracting biogas and heat from wastewater

Pharmafilter at the Academic Medical Center

Local treatment of wastewater at the Academic Medical Center

The Amsterdam Academic Medical Center (AMC) is to treat its own wastewater and reuse some of the resulting treated water. In 2019, the AMC will be installing the Pharmafilter system, which consists of grinders located in hospital departments and a treatment plant where all the wastewater will be brought together. Substances harmful to the environment, such as pharmaceutical residues and other micro pollutants from wastewater will be removed in the installation to the point where they are non-detectable. The Regional Public Water Authority Amstel, Gooi en Vecht will bear half the costs. This represents an important step in the removal of pharmaceutical residues from wastewater.

Johan van Hasseltkanaal, Buiksloterham

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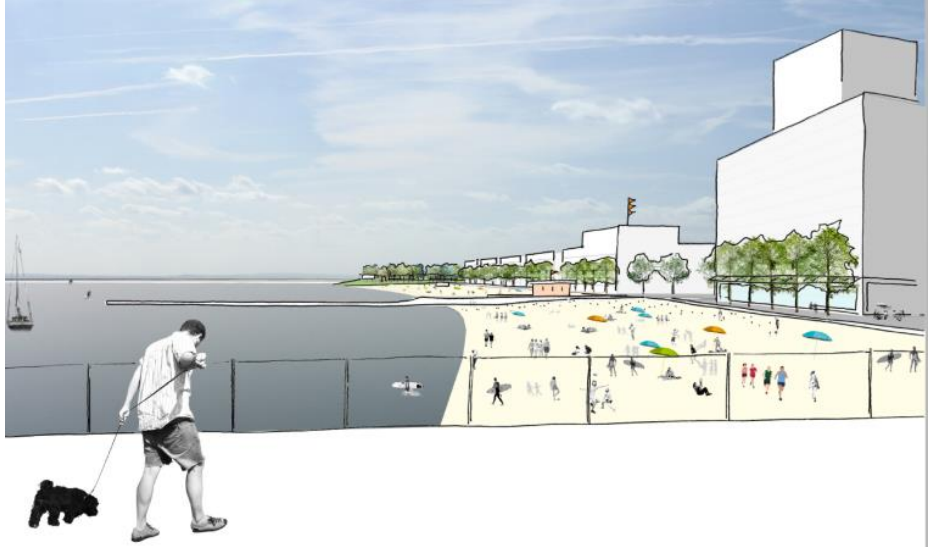
Strandeiland: innovative energy system

The City of Amsterdam and the Regional Public Water Authority Amstel, Gooi en Vecht are aiming to be energy-neutral. This requires an energy transition. Natural gas and residual heat from power stations and from the Afval Energie Bedrijf (AEB) is currently used for the water supplied to Amsterdam. Now we have to look for new heat sources so we are developing a new energy concept for the future district of Strandeiland.

Large scale

Projects with Sanquin and Eneco show that thermal energy (heat and cold) offer major energy-saving possibilities. The temperature of wastewater and surface water differs to that of their surroundings. From that difference in temperature, we can generate energy. A project has been launched on Strandeiland in IJburg in which thermal energy from wastewater and surface water is being used on a large scale.



Impression of the future Strandeiland in the IJmeer

Strandeiland in a nutshell

With this project, we are aiming to supply 8000 new households with sustainable and renewable heat. Heat is needed to warm up homes and water from the taps. We gain this heat using heat exchangers from grey wastewater and surface water. We are also using biogas from the treatment of black wastewater (see New Sanitation). Heat from surface water can only be gained during the summer. We bridge the time gap between supply and demand with the help of thermal energy storage. This supplies heat in winter and cold in summer.

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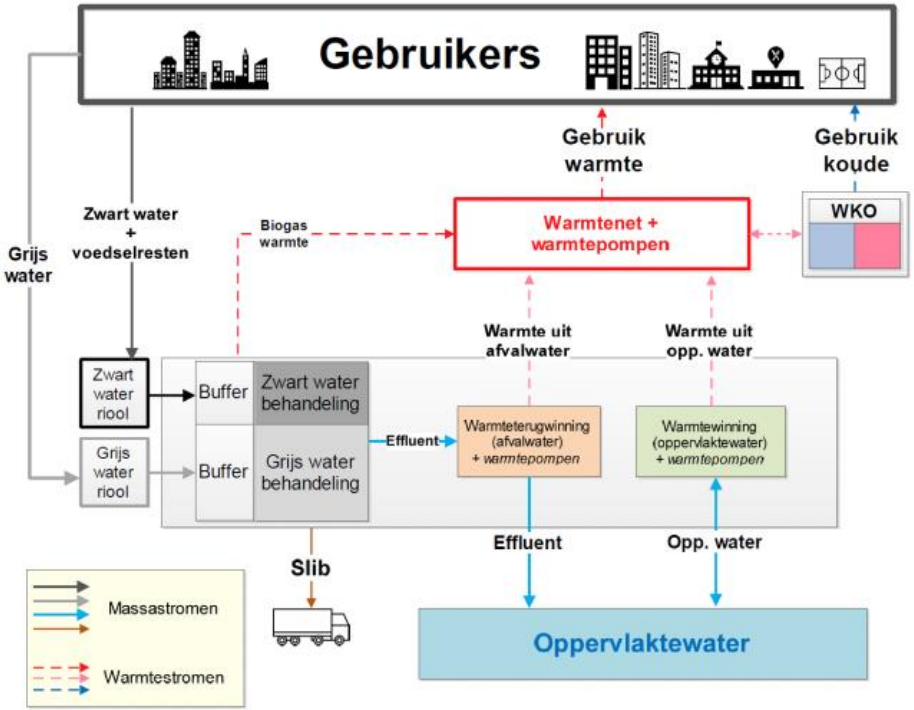

Extracting thermal energy for future households

Technology and figures

The roofs of the houses and buildings on Strandeiland will be fitted with solar panels to help meet the island's electricity needs. Heat from grey wastewater and surface water will be brought up to temperature using electric heat pumps. Excess heat in the summer will be stored in thermal energy storage facilities located across the island. A heating network will bring the heat to homes and other buildings. The ideal temperature of this heating network still needs to be determined (15 or 40°C).

Strandeiland as an example

Strandeiland is a model project where the city of the future can be heated without natural gas using natural heat from surface water and residual heat from wastewater. This means represents an important contribution to the fight against climate change.

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Removing pharmaceuticals with Ozon-GAC

The water sector is exploring cheaper and more effective ways of treating wastewater. Together with Witteveen+Bos, TU Delft, and others, we are testing how the combination of an ozone filter and an activated carbon filter (Ozon-GAC), as the fourth step in the treatment process, can remove micro pollutants such as pharmaceutical residues. If the tests are successful, we will add ozone dosing at our Horstermeer wastewater treatment plant with the 1-STEP®-filter.

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Removing nutrients with the 1-STEP® filter

The 1-STEP® filter is a post-treatment of treated effluent. It is an activated carbon filter that removes the nutrients nitrogen(N), phosphorus (P), and suspended solids as follows:

- nitrogen: biologically through denitrification, adding the extra carbon source methanol
- phosphate: physically/chemically using a metal salt
- suspended solids: through filtration.

The 1-STEP filter from above

The 1-STEP filter at the Horstermeer wastewater treatment plant

Effect of activated carbon

Because the filter contains activated carbon, it is also able to remove micro pollutants through adsorption. The 1-STEP®filter on the Horstermeer wastewater treatment plant entered into service in 2012. The removal of micro pollutants is monitored, as is the length of time during which the activated carbon removes effectively. The results show that a number of solids are removed during four to six months. After this time, the carbon has to be cleaned again. We refer to this as reactivation.

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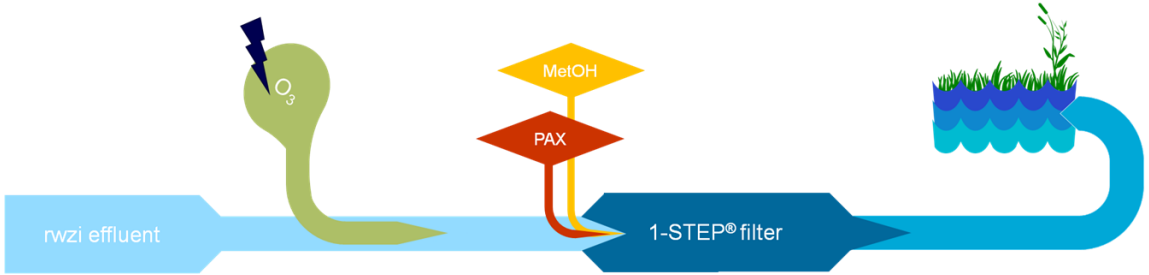
Ozone dosage

In the subsequent research project, we will be looking at the effects of removal after a dosage with ozone (O_3). Micro pollutants are partly broken down thanks to the activated ozone treatment. The remaining micro pollutants and degradation products are then adsorbed in the 1-STEP®filter. The effect is twofold - the overall removal rate of micro pollutants increases and the length of time that the activated carbon can be used is extended. The filtrate complies with European surface water standards. It is also highly suitable as a fuel for the production of cooling, process, or drinking water. This means that O_3-STEP filter forms a linking technology between the treatment of wastewater and the recycling of water. After the lab research, we will be launching a pilot scheme at the Horstermeer wastewater treatment plant. The findings will be tested in the field, with a continuous scale model of the O_3-STEP filter. The research is being carried out with STOWA, Witteveen+Bos, TU Delft, Nijhuis, and Cabot.



The Ozon-GAC project in phases

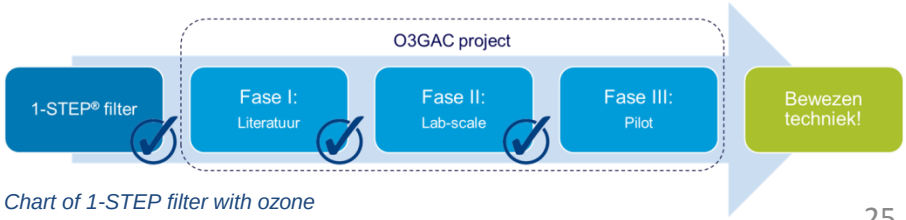


Chart of 1-STEP filter with ozone

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Rainproof

Rainproof is a network in which the city, together with residents, businesses, knowledge institutes and government bodies are taking measures aimed at better withstanding the effects of heavy showers, which are occurring more and more frequently. In 2017, Rainproof was awarded the WOW prize for Best Collaboration!

Three criteria

Of the 58 entries, Rainproof was given the best overall score by the jury for three criteria:

- the collaboration partners' diversity and/or the collaboration intensity
- the level of achievement of the project, and its effects
- the degree of sustainability and innovation.

It is great recognition for Rainproof and the 78 network partners.

Winner of 2017 WOW prize

Cloudburst on Prinsengracht

Prize for water-friendly gardens

Besides recognition, the winner is awarded a sum of €15,000 to take the collaboration a step further. Rainproof will be using this to create water-friendly gardens in April 2018, together with partners that include housing corporations, tenants, garden centres, and the 'Sociaal Tuinieren' and Present foundations. This concerns gardens which the residents are not able to look after and maintain themselves. We are making the neighbourhoods in question more water-resistant, more liveable, and greener. In 2017, Rainproof conducted a similar campaign in Betondorp in Amsterdam.

WOW platform

WOW stands for 'Water ontmoet Water' ('water meets water') and 'Wegbeheerders ontmoeten Wegbeheerders' ('road managers meet road managers'). It is a platform for collaboration between road and waterway managers, and water-related aspects of the Dutch government. The organisation awards the WOW prize for best collaboration every two years.

Rainproof Betondorp garden campaign in Amsterdam

innovation

Research on a blue-green roof

In the next few years, we will be carrying out detailed research on a ‘blue-green’ roof in Amsterdam into the cooling effects of evaporation. The roof has a drainage layer underneath the plants. This captures the rainwater, which is then recycled for irrigation. The research roof was opened on the Marineterrein in Amsterdam in September 2017, under the name Project SmartRoof 2.0.

Multifaceted role

Roofs are no longer merely the tops of buildings. They fulfil an important role in the building’s energy performance, they improve the way rainwater is managed in the city, they mitigate the urban heat island effect and they have a positive effect on people, health, and biodiversity. The research-and-demonstration roof has been made possible by the business sector, government bodies, and stakeholders, under the Dutch government Topsector Water TKI Watertechnologie programme.

Marineterrein research roof

A new polder roof on Wibautstraat

The project demonstrates and scientifically underpins the value of the *combination* of *blue* (capture and recycling of rainwater) and *green* (varied planting) for a climate-proof and liveable city.

Green oasis

The black bituminous roof of Building 002 on the former Marineterrein has been transformed into a green oasis with different types of planting in the heart of Amsterdam. It is a lightweight blue-green roof, where rainwater is captured in the drainage layer, stored, and recycled for naturally irrigating the planting. Under the management of KWR Watercycle Research Institute, a large number of sensors are used for measuring the exact levels of evaporation and the energy balance in order to gain an understanding of the cooling capacity of blue-green roofs in cities.

innovation

Test Power to Protein at the Horstermeer wastewater treatment plant

In late 2017, the Power to Protein test plant operated for two months on site at the Horstermeer wastewater treatment plant. Here, we tested whether we could produce proteins from ammonium and other substances in our wastewater. This could be a way of saving energy and of making better use of residual substances.

Power to Protein uses biosynthesis to produce high quality proteins from hydrogen, oxygen, carbon dioxide, and ammonium nitrate. Ammonium, carbon dioxide, or energy are released as residues or sources of energy during wastewater treatment. With Power to Protein, both proteins and energy are extracted from the residues. This means we can save energy for the production of fertilisers and prevent the destruction of ammonium in the water treatment process. The research is a Topsector Water project. It is being carried out by the KWR Watercycle Research Institute, together with Waterkracht, Barentz, AEB Amsterdam, Avecom, and Waternet.

Power to Protein test plant at the Horstermeer wastewater treatment plant

innovation

Cooling for Sanquin from drinking water

In early July 2017, the first heating and cooling plant was erected on Plesmanlaan in Amsterdam to cool the pharmaceutical processes of Sanquin Bloedvoorziening. The 65-ton plant was lifted into position in one go. The 13.5 by 3.5 metre space is filled with heat exchangers, pipes, and pumps.

Sanquin Amsterdam plant

Twofold benefit

Sanquin has a continuous need for cooling facilities for cooling its pharmaceutical processes. Near to Sanquin are two drinking water transport pipelines that are used by Waternet to supply a large part of Amsterdam. A heat exchanger extracts the cold from the drinking water which is then used for cooling the processes at Sanquin.

We store part of the cold in the ground, using thermal energy storage. This is subsequently used during the summer. The cold extraction raises the temperature of the mains water. This means that users using the water for showering or dishwashing, for example, don't have to heat it so much. So Sanquin and residents alike can save on their energy bills.

Saving

The initial energy yield from the plant equals the electricity consumption of 1800 households (20,000 gigajoules). In due course, this should double. Each year, Sanquin saves 1100 tons of CO_2 by using cold from mains water rather than mechanical cooling. The thermal energy storage installation is a pilot within the CityZen European project. Waternet and Sanquin received a contribution for the project from the European Union.

innovation

deVerdieping Trouw

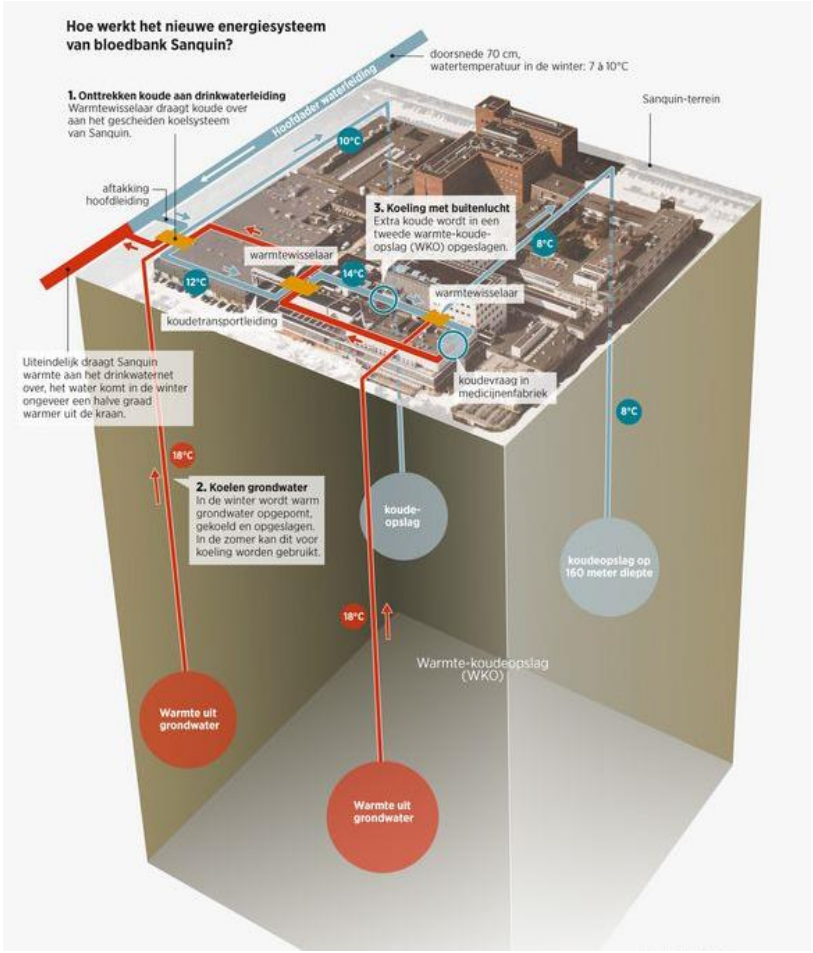
[Blood bank has a first with energy from cold drinking water]

H2O

[Amsterdam drinking water to cool blood?]

CITY-zen Near urban energy

[Sanquin and Waternet join efforts to reuse cold from drinking water infrastructure for cooling]



How the Sanquin energy system works

innovation

Clean Water Experiment: the people of Amsterdam measure water quality themselves

In the summer of 2017, some 500 Amsterdam residents set out with a Waterbox to measure water quality. This was done not just when and where Waternet usually carries out readings, but at any random moment and in any canal, ditch, or pond where the water experts wanted to test the water.

A Waterbox full of measuring instruments for the experiment

Participants and water researchers together

All of the 500 available Waterboxes were collected in mid-July, and the participants got down to work, armed with instruction films and manuals. Turbidity, temperature, taste, *E. coli,* water creatures and bird life were observed and evaluated. All the readings were added to the interactive map of Amsterdam at http://hetschonewaterexperiment.nl/, where they were immediately displayed.

The participants were informed every week about the readings and of any notable aspects. Ultimately, 250 Amsterdam residents provided 1000 readings. Together with the water researchers (Waternet, AGV, Deltares, Wageningen University & Research, KWR Watercycle Research Institute, AMS Institute, and artist Pavèl van Houten), the participants discovered how clean (or not) the water in Amsterdam is.

innovation

Clearer picture of Amsterdam water quality thanks to readings taken by residents

Children on the Amstel carry out a test with the Waterbox

Water awareness and transparency

During this project, it was not just the involvement with water among 500 Amsterdam residents that was enhanced, but a great deal of data was also obtained about the quality of water in the city. Moreover, it has become clearer how the participants use water. Half of all the water in the city was shown to be fit for swimming in. Fewer clean readings formed a useful opportunity to explain the reasons for this. Waternet is sharing the results and also using them in its own work. The project received a very positive response from the participants and a great deal of press attention. Waternet would like to carry out more citizen-science projects in the AGV area, by involving secondary schools, for example.

Want to see more? Watch the project video of the Clean Water Experiment.

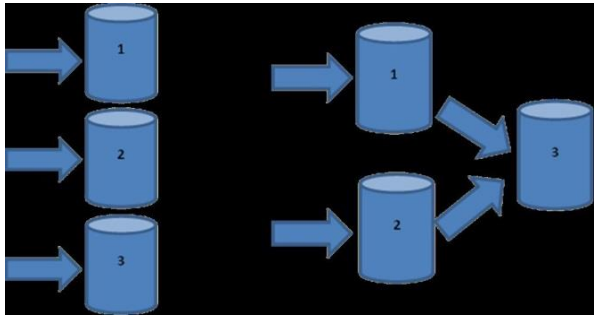
innovation

More biogas from sludge - simple and inexpensive

At the central sludge processing plant at the Amsterdam West wastewater treatment plant, the largest sludge fermentation operation of any Dutch water authority, the production of biogas has risen by 5 to 10%. Feeding the sludge fermentation tanks in succession (in series), rather than parallel, is a simple and inexpensive way of deriving more biogas from sludge. This means we are producing more biogas and, at the same time, less sludge, which reduces disposal costs.

Low investment

Water authorities are developing many initiatives for producing more energy. Often, sludge fermentation plants are being used to produce biogas. To increase production levels, various pre-treatment technologies are being deployed, such as thermal pressure hydrolysis. These technologies often require a high degree of investment. Series operations need a lower level of investment and provide a high yield.



The diagram shows a parallel operation, the current situation in the three fermentation tanks.
In the case of series operations (right), two of the three fermentation tanks are being used in parallel, and the sludge then goes to the third fermentation tank. This results in a two-stage system.

Stable process

We had assumed that series operations would reduce the stability of the treatment process, so it had not been used at wastewater treatment plants. But a model study and a practical test showed that the sludge fermentation process also remains stable during series operations. Following this, the method was introduced at the central sludge processing plant. It can be used by any water authority with multiple fermentation tanks at one site.

Sustainable project

The extra biogas production means the use of natural gas can be reduced. The decrease in sludge production also leads to fewer transport movements. So we are saving energy and reducing CO_2emissions. The analyses and studies were carried out in collaboration with Opure bv.

innovation

The taming of brackish seepage

We are investigating whether brackish groundwater in the Horstermeer Polder can be treated using reverse osmosis in order to produce drinking water. With reverse osmosis, a membrane functions as a very fine filter, through which only water can pass. All other substances, including salt, are held in the filter.

Measuring groundwater velocity in the snow

Measuring groundwater velocity in the summer

Three benefits

The fresh groundwater that seeps upwards is then no longer ‘spoiled’ by the brackish groundwater. This results in three benefits:

- Marked improvement to the quality of the surface water in the polder and the surrounding area.
- A new source of drinking water for Waternet.
- The freshwater stocks in the Markermeer are spared.

Water problems

The Horstermeer Polder is a deep polder in the Vechtplassen area, with much brackish and freshwater seepage. If the latter mixes with the brackish water, the result is an unusable brackish mixture, which is then pumped to the River Vecht by the polder pumping station. This affects the quality of the water in the surrounding surface waters. As the higher areas dry out as a result of water draining to the low-lying Horstermeer Polder, a lot of water is transported from the Markermeer to the polder. This flushes the brackish water from the area and replenishes the water in the surrounding areas. However, this situation is far from ideal.

innovation

Experiment

Pumping and purifying brackish groundwater could provide a solution. First, we need to test whether it is possible. We will drill a single well, from which brackish groundwater can be pumped up. We will then transport this groundwater to a nearby mobile treatment plant. The experiment will run for about three years.

It was not yet clear where in the Horstermeer polder this would be. In 2017, we investigated where exactly the brackish and freshwater were to be found and applied for licences to carry out the pilot project. If the project is successful, more wells will be sunk and a water pipeline will be connected to the drinking water treatment plant in Weesperkarspel. This treatment plant provides drinking water for Amsterdam.

Want to read more about how we are aiming to tame saltwater seepage in the Horstermeer Polder? Click here

Images: Measuring water quality in the Horstermeer Polder

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Fish migration alongside weirs

Dutch waterways contain many locks, weirs, and pumping stations which form barriers. They prevent fish from reaching their spawning, juvenile, feeding and overwintering grounds. Up to now, any measures taken have only dealt with bottlenecks in the larger bodies of water. Very few weirs in our water authority area have fish ladders. A solution to this problem was requested in the Innovation Challenge. The Polderpassage 2.0 received a prize because of the limited amount of water it allows to pass through.

Few weirs with fish ladders

The fragmentation of the water systems in the Netherlands means there are too few habitats for fish and it limits the degree to which fish populations can mix. There are more than 100 polders with in excess of 500 different water-level areas, and around 1500 weirs. Very few weirs in our water authority area are equipped with fish ladders. Our area therefore has many barriers which are causing fish stocks to decline.

Only very few fish ladders have been constructed at these weirs because the extra drainage of water would have too great an impact on water levels and on the nutrient loading. Gates could mitigate this impact, but automatic gates are too costly and manually operated ones are too labour-intensive.

Eels being carried over dykes in anticipation of a definitive solution to the fish migration bottleneck. Here at the De Ruiter pumping station on the Vinkeveense Plassen

innovation

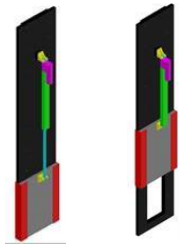
H2O

Wetskills Challenge winner:
Flushing fish for Waternet

Polderpassage 2.0

The AGV water authority issued an Innovation Challenge for an innovative fish ladder. It would have to be robust, easy for fish to pass through, have no undesirable effects on water levels or on nutrient loading, be inexpensive, and require little maintenance.

In early November 2017, seven participants presented their ideas during the Amsterdam International Water Week. Each of the entries contained good ideas that could be used in various situations. The Polderpassage 2.0 by Arcadis and Beutech was declared the winner. This is a flexible gate for existing fish ladders, and works on solar energy. It opens and closes at levels that can be adjusted, thereby preventing any negative impact on water levels and nutrient load in the polders. If the current test proves successful, it will be used at several locations.



Innovative gate in open and closed position

Polderpassage 2.0

This Meyberg floating fish ladder can be fitted with a simple and relative inexpensive gate valve that works autonomously and is operated electrically by a solar panel or battery. It has two settings - open, when there is sufficient water discharge, and closed when there is not.

innovation

From wastewater and plant clippings to products

Residual materials from nature organisations and water authorities carrying out their management tasks can be used as raw materials for biocomposite. Formulas for making biocomposite from reed already exist. Biocomposite may also be made from water plants, plant clippings, and cellulose. If we can process these residual materials in this way, savings of CO_2amounting to 42 kilotons will eventually be possible.

Biorefinery

Biorefinery (separating different components from plant-based raw materials) offers new opportunities for processing green residues from water management. Some 125,000 to 250,000 tons/year of biomass are available (wet weight). Joint research with STOWA shows that processing plant clippings through biorefinery (into proteins, fibres, phosphate fertiliser, and liquid for fermentation) is more economical than composting.

Tour of NPSP, testing biocomposite

Biocomposite

To make biocomposite, Waternet uses calcite (from The Calcite Factory), fibres (such as grass clippings or cellulose), and resin. In the research project, composite producer NPSP is testing formulas to find the right proportions. A press will be used to turn the right formula into biocomposite. Durability tests will be carried out in 2018 to see how strong the material is.

innovation

Biocomposite from reed

The research into biocomposites has produced a good formula for turning waste flows from winter-harvested reed into biocomposites. Unfortunately, Waternet is not able to harvest this quality reed itself. This is because we have to harvest before the winter and the quantity of pure reed from each location is too small to be gathered separately. However, the formula provides a very high quality use for B-quality reed from our area.Demand for biocomposites is growing which means that (if demand is sufficient) no reed has to be composted.

Pre-treatment of clippings

To make biocomposite from water plants, reed, and grasses, the clippings have to be made sand-free, dried, and chopped small. Simple pre-treatments have been tested in an experiment.

Uses for biocomposite

NPSP has made eight gauges from biocomposite. Some of these have now been placed at various locations.

Want to read more about how biocomposite can be used?Click here.

Biocomposite benches

Waternet has eleven benches made from biocomposite. Benches have been installed in the Amsterdamse Waterleidingduinen and at Fort Spion, and will also be used in completed dyke improvement programmes. In 2018, we will be developing more applications for building materials, such as for shoring banks.

Biocomposite gauge

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Large-scale rollout of solar energy

The year 2016 saw the launch of the plan to fit 100,000 solar panels on Waternet premises by 2020! Major steps were taken in 2017 to installing PV systems (photovoltaics, the technology that converts solar energy into electricity). Licences and grants have been awarded for installing large PV systems on thirteen Waternet locations, and an implementation programme has been set up. Three projects are currently underway, with another eight in preparation.

Solar array at Leiduin with 530 solar panels

384 solar panels above an aeration tank at the Huizen wastewater treatment plant

Obstacles

Various obstacles will have to be overcome:

We would prefer to use the solar energy directly for preparing drinking water, treating wastewater, and managing surface water. That would entail incorporating it into our technical infrastructure, from both an electrical point of view, and for controlling and exchanging data (process automation). However, this is quite a puzzle to solve.

The market for solar energy systems is young and turbulent which further complicates the tendering process. After two unsuccessful attempts we altered our strategy, and the first two locations have now been successfully tendered.

At one of the wastewater treatment plants, more solar power can be produced than it can sometimes process. A suitable form of energy management has to be found in order to effectively harmonise the various energy sources and consumers there.

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Tenders

We want to tender all sites in 2018. The work will take place in 2018 and 2019. If there are no major obstacles, more than 80,000 solar panels could be in place by the end of 2019. Meanwhile, work is underway on developing ideas for placing the remaining 20,000 solar panels, or for even more solar panels.

Further research

We are taking part in various other research projects on using solar energy. Together with other water authorities and drinking water companies, the possibilities for floating PV systems on water are also being examined.

Water authorities will be investigating whether dykes are suitable for using solar energy. With KWR Watercycle Research Institute and other partners, we are looking at whether solar energy can be deployed flexibly as a source of power, but also for the production of hydrogen and heat, under the name Power2X. So there are many opportunities and developments in the solar energy field.

Solar panels at Leiduin in the snow

Constructing a floating PV system

Floating solar panels

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Measuring campaign in the canals of Amsterdam on 5 September 2017, together with researchers from the Massachusetts Institute of Technology (MIT)

Publishing information

Text editors:
Aukje de Ru
Peter Beemsterboer
Layout:
Aukje de Ru
Editor-in-chief:
Alice Fermont

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