TECHNEAU NEWSLETTER
January 2008

Welcome to the fourth issue of the TECHNEAU Newsletter. The newsletter is designed to disseminate news, scientific results and developments to stakeholders. Newsletters are issued every six months, with Newsletter 5 scheduled for June 2008.

TECHNEAU challenges the ability of traditional drinking water supply systems to cope with present and future global threats and opportunities. TECHNEAU will rethink options for water supply and - through innovation, research and development – will provide and demonstrate new and improved technologies for the whole water supply chain.

Newsletter 4 highlights recent activities and outputs from TECHNEAU. The Newsletter can be downloaded from the TECHNEAU website (www.techneau.eu / www.techneau.org) where comments on the Newsletter or on any project-related issue are welcome.

TECHNEAU publications are issued on the TECHNEAU website and can be downloaded free-of-charge. A list of available publications is shown on Page 7.

RTP: Technology for Safe Drinking Water in Southern Africa

Regional Technology Platforms (RTPs) are the main vehicle for consultation and dissemination in TECHNEAU. RTPs are held twice per year to promote face-to-face consultation and knowledge transfer between local stakeholders and the TECHNEAU consortium.

The third RTP, supported by the European Commission, the Water Research Commission (RSA) and Swartz Water Utilization Engineers (RSA) was held in Cape Town, South Africa on 29 November 2007. The RTP - the first to be held outside Europe - focused on 'Technology for Safe Drinking Water in Southern Africa'.

The RTP was linked to a regional workshop of the EU-project 'Reclaim Water' (www.reclaim-water.org) which was held the following day and focused on "Water Reclamation and Reuse Technologies in Southern Africa".

An Integrated Project Funded by the European Commission under the Sustainable Development, Global Change and Ecosystems Thematic Priority Area.

Contract Number: 018320
Project Coordinator: Dr. Theo van den Hoven KIWA Water Research
Project Duration: 1st January 2006 to 31st December 2010

Delegates at the third RTP in Cape Town, South Africa

More than 70 delegates from South Africa, Namibia and Botswana listened and contributed to RTP presentations from a wide range of national and international water experts. The presentations highlighted the drinking water situation in the developing countries of Southern African and were interspersed with presentations from TECHNEAU that described relevant research and results.

All Southern African countries suffer to a certain extent from water scarcity, posing enormous challenges in ensuring a sustainable supply of safe drinking water. The standard of the water supply and the quality of the drinking water varies significantly throughout the region.

(Continued on Page 2)

In Issue No.4:

In the larger metropolitan areas, the technologies and water quality are comparable with the developed world. However, nearly half of the region's population live in rural areas where villages are widely scattered making the supply of drinking water difficult and expensive. Treatment plants in these areas frequently suffer from inadequate operating systems and deteriorating infrastructure due to inadequate maintenance. As a result, people in rural areas often lack a piped supply and water quality is often poor.

Other serious challenges to the water sector in Southern African include access to water - possibly as important as water quality and sustainability - a shortage of skilled personnel at all levels, a lack of training and education, and insufficient funding.

To manage this situation and to ensure a potable water supply in remote areas, a range of "High Technologies" (e.g. robust ultrafiltration membrane systems, solar or wave powered reverse osmosis (RO) systems) and "Low Technologies" (e.g. sand filtration, inexpensive point-of-use (POU) solar stills, simple ozonation systems) have been developed. To enable these decentralised technologies to function adequately under the most demanding rural conditions requires a simple and robust approach to operation and maintenance. For example, the South African government pursues two approaches: firstly, the treatment plants are monitored remotely and any problems are resolved by a "roving technician", and secondly, a national Technical Assistance Centre will support small water suppliers with information and practical, hands-on assistance. In addition, a number of initiatives are being implemented that should improve water quality, such as a municipal electronic drinking water quality management (DWQM) tool, a municipal DWQM Strategic Gap Analysis tool, Water Safety Plans, etc.

Countries in the region are also exploring opportunities to reduce water demand, such as water reclamation and re-use (e.g. utilisation of grey-water) and dry, on-site sanitation in Botswana, and the well-known example of direct reclamation of potable water from wastewater at the Goreangab Water Treatment Plant in Windhoek, Namibia.

In summary, the RTP provided a unique insight into the problems and challenges facing the drinking water sector in Southern Africa and enabled an intensive exchange between water experts from the developing countries in Southern Africa and the industrialised EU countries. TECHNEAU will continue to co-operate in the region on several levels. The link between the region and the TECHNEAU team will be strengthened as a result of studies such as the risk assessment of the Goreangeab WTP in Windhoek, as well as training courses and training materials. Gerhard Offringa (WRC) and Chris Swartz (Swartz Water Utilization Engineers) will continue to serve as regional contact persons.

The dissemination of TECHNEAU results will be further promoted by distribution of the TECHNEAU Newsletter via the Water Institute of South Africa website (www.wisa.org.za).

For further information, contact Ronald Wielinga, WA8 Leader, or visit the TECHNEAU website (www.techneau.eu).

Work Area Highlights

Risk Assessment and Risk Management (WA4)

The principal objective of WA4 is to integrate the risk assessments of the separate parts of water supply, e.g. source water, treatment and distribution, in the preparation of Water Safety Plans (WSPs).

WA4 is developing methods for risk assessment and risk management (RA/RM) for use by water companies. The aim is to prepare a decision-support tool for cost-efficient and sustainable risk management from-source-to-tap.

Two articles are presented. The first presents an overview of RA/RM, while the second provides an example of its application at a small water treatment plant in South Africa.

- **Integrated Risk Management for Water Supply**

In their Guidelines for Drinking-Water Quality, the World Health Organization (WHO) emphasises the importance of preparing ‘from-source-to-tap’ WSPs for managing risks to drinking water consumers. The WHO guidelines facilitate a much-needed increase in awareness and understanding of risk issues for providing safe drinking water.

A generic framework for risk management, in accordance with WSPs, has been developed[1]. The framework describes a work structure based on internationally recognised principles for risk management. It stresses the importance of integrated assessments from-source-to-tap and considers risks to both water quality and quantity. It also stresses the importance of communication and a continuous iterative approach to make risk management more effective. An overview of the framework is shown in Figure 1.

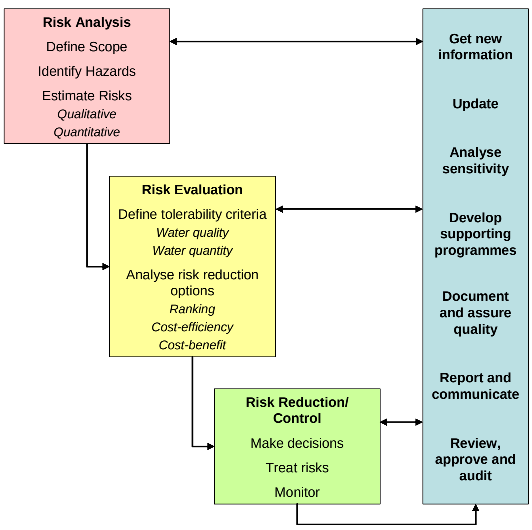

Figure 1 Generic Framework for Risk Management (GFRM)

The first tool developed under WA4 for identification of hazards in drinking water systems was the TECHNEAU Hazard DataBase (THDB)[2]. The database contains a comprehensive checklist of hazards in source waters, treatment and distribution. The database is currently being prepared in Excel format.

To estimate the risks, three main categories of methods are currently being developed as there is no single method of risk estimation that will meet all requirements:

(1) Relative ranking of risks using risk matrices.
(2) Quantitative estimation of risk using a fault tree model.
(3) Spatial mapping of risks in catchment areas using Geographical Information Systems (GIS).

The categories represent different degrees of sophistication, meeting the requirements for operational, programme and strategic levels of risk estimation. For example, relative ranking of risks is often relevant for operational decisions, whereas quantitative and more detailed methods are more relevant for the programme and strategic levels. For these levels, cost-benefit and cost-efficiency analysis methods will be developed in the later stages of the project.

In order to assist water companies to improve water safety, a database on risk reduction options is being developed. The TECHNEAU Risk Reduction Options DataBase comprises risk reduction options for source waters, treatment plants and distribution networks. The database is currently being prepared in Excel format.

To test and revise the RA/RM methods, case studies are being carried out in five different European countries (Norway, Sweden, The Netherlands, Germany and the Czech Republic) and in South Africa.

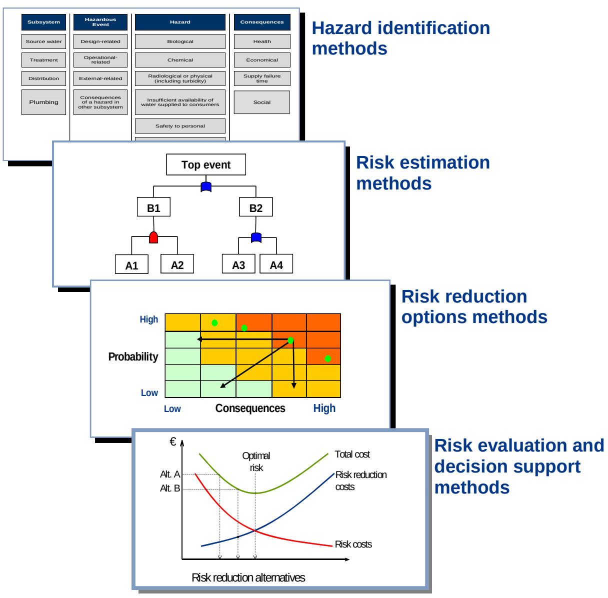

Figure 2 Risk Management Methods

The final outcome of WA4 will be a series of methods and tools for use by water companies in the preparation and implementation of WSPs. All parts of the risk management framework, from hazard identification to risk reduction options, are being covered, as shown in Figure 2. The aim is to provide end-users with practical methods and tools to increase safety in the supply of drinking water.

[1] Rosén, L., Hokstad, P., Lindhe, A., Sklet, S. och Rostum, J., 2007: Generic Framework and Methods for Integrated Risk Management in Water Safety Plans. TECHNEAU Deliverables D 4.1.3, D 4.2.1, D 4.2.2, D 4.2.3. (www.techneau.eu).

[2] Beuken, R., S. Sturm, J. Kiefer, M. Bondelind, J. Åström, A. Lindhe, I. Machenbach, E. Melin, T. Thorsen, B. Eikebrokk, C. Niewersch, D. Kirchner, F. Kozisek, D. Weyessa Gari, and C. Swartz (2007). Identification and description of hazards for water supply systems – A catalogue of today's hazards and possible future hazards. TECHNEAU (in preparation).

- **Risk Assessment of the Mnyameni Water Supply**

TECHNEAU Partners Swartz Water Utilization Engineers and Chalmers University have carried out a risk assessment of the Mnyameni Water Supply in South Africa (Figure 1).

Figure 1 Upper Mnyameni (Treatment Plant in Foreground Enclosure)

The water supply, situated in the Amatola Mountains in the province of Eastern Cape, provides drinking water to two villages, Upper and Lower Mnyameni, with a total population of about 2500 people. Good-quality raw water is abstracted from the Mnyameni Dam, situated approximately 1 km from the treatment plant. The catchment area is very isolated - surrounded by precipitous mountains - and unaffected by industrial or farming activities. The water treatment process includes pre-chlorination, polymer dosing, flocculation, rapid sand filtration and chlorination. Treated water production is approximately 240 cubic meters per day, distributed to consumers via household connections and stand pipes.

As part of the case study, risks were evaluated using a risk matrix with ALARP (As Low As Reasonably Practicable) zones according to WHO's Water Safety Plan approach and the Generic Framework for Risk Management (GFRM). Twelve risk scenarios covering both water quality and water quantity were identified through brainstorming sessions and use of the TECHNEAU Hazard DataBase (THDB). Likelihood and consequence for each scenario were then discussed and ranked in collaboration with experts from Amatola Water who are responsible for the local water supply (see Figure 2).

	Limited public exposure, little or no	Limited public exposure, minor	Public at risk, minor discomfort	Public at risk, potential for major	Multible deaths or widespread major
Frequent			2, 5		
Occasional	6	7			
Possible					
Rare				3	
Has not occurred	1, 4, 10	8, 9	11, 12		

Figure 2 Health Risk Matrix for the Mnyameni Water Supply

Three of the principal risk scenarios are described below:

Risk Scenario 2: Risk 2 identified in the red area of the matrix is due to contamination caused by animals leaning against - or licking - standing taps. Taps are not covered or protected from animals (cattle or dogs). Microbial contaminants may spread when people, especially children, drink from the taps.

- *Option*: The best action would be to provide household connections for all the consumers in the villages.

Risk Scenario 5: Risk 5 identified in the red area of the matrix is due to poor storage of water. Storage of water in open buckets or dirty bottles presents an obvious risk for contamination, whether water is stored inside or outside. Prolonged storage of water also results in reduced levels of chlorine increasing the risk of contamination before consumption. Most villagers are at least aware of this risk and many boil their water before using it.

- *Option*: This risk would be minimised if all consumers were provided with household connections.

Risk Scenario 7: Risk 7 identified in the yellow area of the matrix is due to prolonged power failures or other incidents leading to potential shortages or total lack of water. In these circumstances, villagers might use untreated water taken directly from the Mnyameni River or from the Dam. This water might be of poor quality, particularly as power failures often coincide with thunderstorms and heavy rainfall resulting in water of very high turbidity.

- *Option*: A power generator at the WTP is the only reasonable option in order to ensure sufficient drinking water.

Identification and analysis of all possible risk reduction options will help to provide a safe and sustainable water supply to the villagers of Upper and Lower Mnyameni.

For further information, contact Thomas Pettersson, WA4 Leader, or visit the TECHNEAU website (www.techneau.eu).

Decentralised Water Supply and Membrane Processes Workshop (WA2)

Interest in decentralised water supply has been growing and technological breakthroughs are expected in the coming years. TECHNEAU aims to significantly contribute to these developments and Partners EAWAG and Opalium are developing solutions that should find wide application.

The TECHNEAU 3S (Small-Scale Systems) Task Force was created to promote effective integration and planning of activities related to small-scale systems and decentralised water supply. It currently involves more than 60 members, including representatives from TECHNEAU, WHO and the IWA. On 7 September 2007, around 30 scientists and professionals from Europe and South Africa attended the first workshop of the 3S Task Force, dedicated to the topic "Decentralised Water Supply and Membrane Processes" (Figure 1).

Figure 1 Participants at the First 3S (Small-Scale Systems) Workshop

An overview of decentralised water supply in Europe and worldwide was given in the first session of the workshop. Roger

Aertgeers (WHO) referred to strong disparities regarding water coverage and considered rural water supply as a major issue in Europe, while Adriana Hulsmann (KIWA) called for an appropriate Water Safety Plan (WSP) as at least 10% of the EU population depends on (very) small supplies. Relevant case studies in Vietnam, Uzbekistan and Germany were presented with epidemiological data support from the University of Bonn. A need for fast and easy water analysis was emphasized, such as the low cost water test currently being developed by the University of Southampton ("Aquatest").

The second session focused on the application of membranes to small water supplies including the current work of Work Package 2.5 (WP2.5):

- Eric Hoa (KWB) opened the session with a review of commercially available membrane-based products including point-of-use (POU) technologies - which treat water at the household level (up to 200 L/d) - and small-scale systems (SSSs) - which provide drinking water at the community level (up to 1000 m^3/d). As few simple POU ultrafiltration systems were identified in the review, the on-going development within WP2.5 should prove valuable.
- Maryna Peters (EAWAG) presented results from research work on the long-term operation of a POU ultrafiltration system with substantial NOM/biofouling under low pressure. Although no crossflow, backflush or cleaning was carried out, the flux seemed to stabilise at 7-10 $l/h.m^2$ over several weeks. This system is to be implemented in South Africa in a scaled-up prototype (up to 5 m^3/d) to be built by TECHNEAU Partner Opalium.

Besides the TECHNEAU-related activities described above, presentations were given on emergency membrane systems and current projects including cleaning-out-of-place (COP) membranes and a desalination unit combined with a windmill.

Chemical-free operation and low energy requirements were identified by all workshop participants as key issues for decentralised water supply with membrane-based processes.

In the third session, participants discussed the relevance of membrane technology for small water supplies generally and within the context of TECHNEAU. Membrane processes offer effective pathogen removal and costs have decreased over recent years. In the short term, simple solutions at reasonable cost were considered essential, although membrane integrity or extra-treatment would usually be ensured. However, as both factors lead to increased cost, would it be acceptable to design a system intended for developing countries with a lower level of control and performance in order to maintain affordable prices? It was observed that membrane-based systems were not a universal solution as water contamination differs from region to region, requiring different pre-/post-treatment options.

Within the global context, decentralised water supply faces the same issues as centralised water supply although solutions may differ. Thus, along with the technological requirements, risk assessments, monitoring, operation, maintenance and cultural acceptance should be considered and this will be achieved through close co-operation between the TECHNEAU work areas. For example, the WP2.5 demonstration programme will benefit from the WA4 risk assessment studies being carried out in South Africa and the Czech Republic, while the WA6 case study on customer acceptance should include aspects of POU systems. Co-ordination with external projects will also be valuable, for example co-operation with the Aquatest project will be assessed with regard to monitoring.

The second workshop of the Task Force will be held in Trondheim in June 2008, dedicated to the topic "Monitoring Techniques, Risk Assessment and Epidemiological Studies for Decentralized Water Supply". Any persons interested in the activities of the 3S Task Force are invited to contact Eric Hoa (eric.hoa@kompetenz-wasser.de).

For further information, contact Marie-Renee de Roubin, WA2 Leader, or visit the TECHNEAU website (www.techneau.eu).

TECHNEAU Delivers New Monitoring Technology (WA3)

A new, modular monitoring station has been designed and built for monitoring water quality (Figure 1). The design of the monitoring station has been based on information on source water monitoring collated in TECHNEAU Work Package 3.1 (WP3.1) as well as the results obtained during the source water monitoring trial at the Vienna Waterworks.

Figure 1 s::can Water Quality Monitoring Station

The monitoring station combines the multiparameter spectro::lyser™ UV/Vis probe, which measures turbidity, TOC, DOC and NO_3, with probes for measuring dissolved oxygen, pH, ammonium and conductivity. Parameters important for monitoring drinking water (as distinct from source water) such as free and residual chlorine have been incorporated into the design of the monitoring station and it is possible to integrate further parameters if required. For example, the existing ammonium probe can be equipped with an electrode for fluoride measurement.

The rapid design and development of the monitoring station was due, in part, to the implementation of well proven instruments. The monitoring station is now available as a commercial product.

For further information, contact Frank Sacher, WA3 Leader, or visit the TECHNEAU website (www.techneau.eu)

Membrane Biofouling Investigated (WA3)

Biofouling is a big problem in membrane processes used in drinking water treatment. It leads to higher operating pressures, a frequent need for chemical cleaning, membrane deterioration and compromised water quality. Biofouling is more complicated than other fouling types, e.g. non-microbial colloidal and particulate fouling, which can be controlled by effective pre-treatment. Even if numbers of micro-organisms in water are reduced by pre-treatment, they can still reproduce on the membrane.

The conventional approach for monitoring membrane fouling is the use of normalised pressure development (NPD). However, NPD is neither sensitive nor specific for biofouling.

TECHNEAU Partner NTNU (Norwegian University of Science and Technology) is developing a toolbox of methods for characterising biofouling. The toolbox can be used to understand and predict the behaviour of membrane filtration reactors when exposed to different operating conditions, i.e. how measured variables are related to controlled variables, in order to control biofouling processes.

For the development of the toolbox, an on-line/by-pass test unit with sacrificial hollow fibre membranes was constructed. The unit is fed with water produced by ozonation / biofiltration - part of the oxidation / biofiltration / membrane filtration (OBM) process (Figure 1) being investigated in WA2. A protocol for the toolbox methods has recently been reported within TECHNEAU (D3.3.4). The protocol allows characterisation of important biofouling components such as microbial cells and extracellular polymeric substances (EPS) by confocal laser scanning microscopy (CLSM) analysis of sacrificed hollow fibre membranes. Fluorometric enzyme activity assays are used to assess active biomass. Combination of these techniques will give additional information on biofouling and can potentially be developed into an on-line monitoring tool for measuring biofouling.

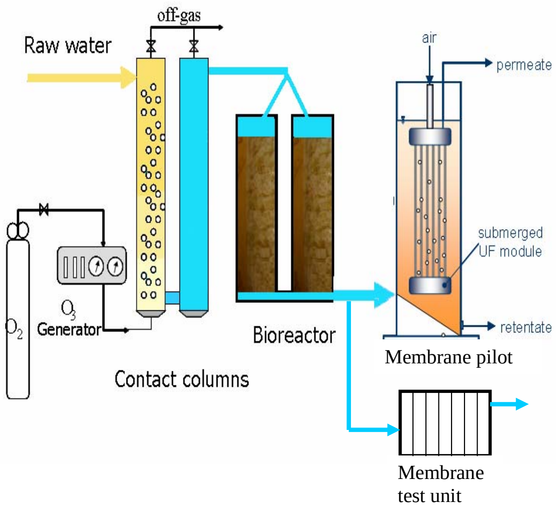

Figure 1 Schematic Presentation of the Membrane Filtration Test Unit and the OBM Process

The biofouling components and characteristics are quantified by appropriate image analysis software. While several software packages designed to analyze digital biofilm images are available commercially, these assume that the reference surface (- the surface or substratum supporting biofilm growth) is aligned horizontally at the top or the bottom of the biofilm. This is untrue for hollow fibre membranes, where the reference surface is curved. Thus to avoid errors in some of the parameter calculations (e.g. biofouling/biofilm thickness), a new software, CMem, has been developed within TECHNEAU. CMem allows for the curved reference surface and can be used for a refined analysis of different components such as microbial cells and EPS (e.g. polysaccharides) on tubular/hollow fibre membranes.

For further information, contact Frank Sacher, WA3 Leader, or visit the TECHNEAU website (www.techneau.eu)

Forthcoming Events

- **7-8 April 2008**

Water Contamination Emergencies Conference: Collective Responsibility
London, UK
Organiser: SCI Environment Group, RSC-WSF and IWO
Host: Royal Society of Medicine
Further information: Maggi Churchouse, T: +44 (0)1359 221004, E: maggi@maggichurchouseevents.co.uk

- **June 2008**

4th Regional Technology Platform, 'Technology for Safe Drinking Water in Eastern Europe'
Prague, Czech Republic
Organiser: RWTH Aachen University
Host: National Institute of Public Health, Prague
Further information: Diana Marquardt (marquardt@ivt.rwth-aachen.de) or see TECHNEAU website (www.techneau.eu)

- **June 2008**

Monitoring Techniques, Risk Assessment and Epidemiological Studies for Decentralised Water Supply
Trondheim, Norway
Organiser: 3S Task Force (WA2)
Host: NTNU
Further information: Eric Hoa (eric.hoa@kompetenz-wasser.de)

- **2-4 September 2008**

NOM2008 Conference: Natural Organic Matter from Source to Tap
Organiser: Centre for Water Science, Cranfield University
Host: Hilton Bath City, Bath, UK
Further information: Please see NOM2008 website (www.cranfield.ac.uk/sas/about us/events/nom2008)

TECHNEAU Delivered!

The TECHNEAU project has been running for 24 months and the number of available publications increases week-by-week. Publications are issued on the TECHNEAU website (www.techneau.eu) and can be downloaded free-of-charge.

The following Table lists the publications available up to December 2007.

Report Number	Title
D1.1.1	Trend Report: Report on Trends in South Africa / Sub-Sahara Africa
D1.1.2	Trend Report: Report on Trends in Water Stressed Regions
D1.1.3	Trend Report: Report on Trends in Eastern European Countries (Baltic States)
D1.1.4	Trend Report: Report on Trends in Southern European Countries (Portugal)
D1.1.5b	Trend Report: Report on Trends in Central Europe (Germany / Switzerland)
D1.1.6a	Spain - A TECHNEAU Case Study: Phase I - Climate Change
D1.1.6b	Spain - A TECHNEAU Case Study: Phase II - Climate Change
D1.1.6c	Long Term Effects of Climate Change on Europe's Water Resources (Romania)
D1.1.7	Global Trends Affecting the Water Cycle: Winds of Change in the Water World
D1.1.9	Trend Report: Report on Trends Regarding Future Risks
D1.1.11	Organisation and Financing Models of the Drinking Water Sector: Review of Available Information on Trends and Changes
D1.1.12	Report on Consumer Trends: Cross-cutting Issues Across Europe
D1.1.14	Trend Report: The Netherlands
D2.1.2	State-of-the-Art Report on Reverse Osmosis Desalination
D2.1.2b	New Prototype Pre-Filter for Seawater Reverse Osmosis: Protocol for Bench-Scale Testing
D2.3.1.1	Organic Micropollutants with Nanofiltration
D2.3.1.2	A Nanofiltration Retention Model for Trace Contaminants in Drinking Water Sources
D2.3.1.3	Influence of Electrostatic Interactions on the Rejection with NF and Assessment of the Removal Efficiency during NF/GAC Treatment of Pharmeuctically Active Compounds from Surface Water
D2.3.2	Coagulation Pre-treatment for Microfiltration with Ceramic Membranes
D2.3.3.5a	Case-Related Protocol for Optimal Operational Conditions to Treat Filter Backwash Water
D2.4.1.1	UV Disinfection and UV/H_2O_2 Oxidation: By-product Formation and Control

Report Number	Title
D3.1.1/2	Monitoring and control of Drinking Water Quality: Selection of Key Parameters
D3.2.1	UV-Vis Monitoring Station for Calculating 'Integrated Parameters'
D3.2.4	A Method for the Concentration of Microbes in Large Volumes of Water
D3.3.1	A Flow Cytometric Method for AOC Determination
D3.3.4	Development of a Toolbox for Identifying and Quantifying Membrane Biofouling in Drinking Water Treatment
D3.3.5	Assessing the Feasibility of Total Virus Detection with Flow Cytometry in Drinking Water
D3.3.7	A Protocol for the Determination of Total Cell Concentration of Natural Microbial Communities in Drinking Water with FCM
D3.4.6	Odour and Flavour Tests: Human Panel and Electronic Testing Compared
D3.4.10	Monitoring and Control of Drinking Water Quality by the ToxProtect Fish Monitor
D3.5.1	Development of FISH Methods for Detection of Pathogens in Biofilm
D4.1.1/2	Identification and Description of Hazards for Water Supply Systems: A Catalogue of Today's Hazards and Possible Future Hazards
D4.1.3 / D4.2.1/2/3	Generic Framework and Methods for Integrated Risk Management in Water Safety Plans
D5.2.1	Results of Background Work and Data Integration of MAR Systems for an Integrated Water Resources Management
D5.3.1a	Water Treatment by Enhanced Coagulation: Operational Status and Optimization Issues
D5.3.1b	Ozonation and Biofiltration in Water Treatment: Operational Status and Optimization Issues
D5.3.4a	Ultrafiltration with Pre-Coagulation in Drinking Water Production: Literature Review
D5.3.4b	Nanofiltration in Drinking Water Treatment: Literature Review
D5.3.6a	Ultra- and Nanofiltration in Water Treatment: Workshop
D5.3.8	Impact of Chlorination on the Formation of Odour Compounds and their Precursors in Treatment of Drinking Water
D5.3.10	Backwash Characteristics of Granular Activated Carbon (GAC) from Asia
D5.4.1	Models for Drinking Water Treatment: Review of State-of-the-Art
D5.4.1a	International Workshop on Treatment Simulators: Review
D5.4.2	Models for Drinking Water Treatment: Methodology for Integration
D5.4.3	Conceptual Design of Modelling Framework
D5.5.1	Particles in Relation to Water Quality Deterioration and Problems in the Network
D5.5.3	Database on the Formation of Sediment in Drinking Water Distribution Systems

Report Number	Title
D5.5.4	Methodology of Modelling Bacterial Growth in Drinking Water Systems
D5.5.5	Review and Selection of Monitoring Parameters and Methods
D5.5.9	Modelling Planktonic and Biofilm Growth of a Monoculture (*P. fluorescens*) in Drinking Water
D5.6.1 / D5.6.2	Report on Operational Methods and Maintenance Schemes: Applied in Praxis and Compared to Best Practice
D6.1.1	Assessing Consumer Trust and Confidence: Methods Appropriate for the Water Utilities
D6.1.2	Consumer Trust and Confidence: An Overview
D6.2.1	Consumer Preferences: An Overview
D6.2.2	Assessing Consumer Preferences for Drinking Water Services: Methods Appropriate for Water Utilities
D6.2.5	Stakeholder Interviews

An Integrated Project Funded by the European Commission under the Sustainable Development, Global Change and Ecosystems Thematic Priority Area.

Contract Number: 018320
Project Coordinator: Dr. Theo van den Hoven KIWA Water Research
Project Duration: 1st January 2006 to 31st December 2010