Profile of the Professor of Urban Water Infrastructure

1 Key characteristics of the position

1.1 Appointment and responsibilities

The potential for visionary urban water infrastructure research is huge and the worldwide interest very high. Apart from prevailing obsolete infrastructure in Western countries, the majority of the world population is still deprived from adequate urban water infrastructure services. Sustainable and cost-efficient innovations brought forward by research in the envisaged field may contribute to leapfrog conventional developments. Therefore, TU Delft gives the new professor the opportunity to build on an excellent research group, playing a world-leading role in urban water infrastructure research and education.

The position concerns a full time position (1.0 FTE) for a full professor of urban water infrastructure, within the department of Water Management, Faculty of Civil Engineering and Geosciences (CEG), TU Delft. Scientific quality of the candidate, as witnessed through publications, funding acquisitions, community leadership, and teaching excellence, is the main selection criterion. The key responsibilities include research, education, services and valorisation and management – as further elaborated below.

Research

The envisaged professor encompasses long-term visionary research, changing paradigms in the urban water sector. The professor is expected to do research in his/her own field of specialization, and initiate, together with the research group, new areas of research within the broader domain of urban water infrastructure.

Research projects may include:

- Increased resilience towards climate change (e.g. how to handle peak discharge and/or long periods of dryness).
- Infrastructure flexibility towards demographic developments.
- Novel collection and conveyance systems (gravity, vacuum, pressure).
- Use of novel materials in distribution and conveyance.
- Aging processes and life time extension of current assets.
- Advanced sensor technology for network control.
- Increased ‘sustainability’ in urban water infrastructure (resources, materials, energy, CO₂ footprint, etc.).
- Advanced public and environmental health protection.
- Urban hydrology in relation to the water infrastructure.
- Transition processes in urban water infrastructures (main drivers): technical, technological, societal, economical, organizational, planning, managerial.
- Water-energy nexus: energy source (wastewater), energy transport (district heating), energy storage (aquifer thermal energy storage, ATES).
- Relation between urban water infrastructure and urban planning.

Considering the worldwide demand on sustainable and cost-efficient urban water infrastructure, ample finance opportunities are available through NWO, EU research and network programs, and foreign PhD subsidiary programs from e.g. China and Latin America. The TU Delft Global program provides opportunities to link to recipients in developing countries.
**Education**

The professor of urban water infrastructure has a joint responsibility for the 2-year Master track Water Management within an educational programme that leads to the title of Civil Engineer (MSc. degree). Teaching activities of the new professor include lecturing to students in various courses of the curriculum of Civil Engineering at both bachelor and master level. In addition to oral lecturing, the professor will contribute to the management and supervision of students in individual exercises, group projects, Master theses and PhD theses. The Water Management department is actively working on the development of an online education portfolio, e.g. the MOOCs ‘Water & Climate’, ‘Introduction to Drinking Water Treatment’, ‘Introduction to Urban Sewage Treatment’. Web-based online education and blended learning is becoming an integral part of the educational portfolio.

Current BSc and MSc courses in the urban water infrastructure application field include Urban Drainage and Water Management, Computational Modelling of Flow and Transport, Urban Drainage Monitoring and Modelling, Water Management in Urban Areas, Pumping Stations and Transport Pipelines. The generic aspects of conveyance and transport of drinking water and wastewater/sewage will be clustered in upgraded or new master courses. Online education making use of the EdX and/or ProfEd platform, particularly on the basics of (waste)water transport, will be prepared. The professor is expected to play a major role in the development of online and blended education strategies related to urban water infrastructure engineering.

**Services and valorisation**

Because of the large impact of urban water infrastructure on society it is expected that the professor will play an important role in the cooperation of the university with engineering practice and other academic institutions in the Netherlands and in the world. New developments in the field of urban water infrastructure are often found in actual real-life projects. Therefore the professor is expected to be involved in innovative developments in projects in the Netherlands and abroad through positions in boards and (review) committees.

The new professor will represent the university in external expertise groups and networks (such as the International Water Association), and national initiatives (such as the Top Sector Water), and new national research programs (such as Water and Climate).

**Management**

The department follows the PI (principal investigator) model, meaning that each scientific staff member is expected to build and maintain a research group of PhDs and Post-Docs. Next, each staff member is stimulated in interdisciplinary cooperation inside and outside the department. Quality assessment and overall research coherence of the department is organised through continuous review and development of scientific staff members through a well-defined R&D cycle. The successful candidate will be responsible for the management and coaching of a group of about 5 scientific staff members, as well as the general financial health of this group. In addition, the professor can be asked to participate in the management of the department, and may be asked to take management tasks at the level of the faculty or university.
1.2 Profile of the candidate
The successful candidate has a PhD in Civil Engineering or a closely related field, has a high level of expertise in a science/engineering field relevant to urban water infrastructure, has a drive to innovate through research, and has the capacity to communicate effectively.

Overall, the candidate should meet the following criteria:
1. Very strong track record in scientific research related to urban water infrastructure, as demonstrated by a PhD thesis, high quality scientific publications, and a clear vision on scientific research for future developments in the research field;
2. Strong record of acquisition and management of scientific projects;
3. Strong leadership skills and team player abilities, creating a stimulating environment, focused on cooperation with academic staff in adjacent fields as well as on the supervision of academic professionals, graduate students, and research teams and projects;
4. Excellent teaching qualities, with an enthusiasm for, and a strong interest in, teaching younger generations of engineers and scientists, as demonstrated by personal experience with knowledge transfer and dissemination;
5. A clear view on the required future developments aiming at a high degree of sustainability in the application field;
6. Experience in several application fields and/or scientific disciplinary fields of urban water infrastructure as implemented in the setting of industrialized societies. The application field includes amongst others: drinking water distribution, sewerage systems, pumping stations, asset management, storm water handling, subsoil water infrastructure, piped water networks. The scientific disciplinary fields include fluid mechanics, applied mathematical sciences (modeling: probabilistic, stochastic, CFD, etc.), material sciences, etc.;
7. The ability to interact with stakeholders in the application field such as (semi)governmental institutions, consultancy firms, and companies involved in urban water infrastructure;
8. Preferably, understands constraints in non-Western settings and has clear visions for urban water infrastructure developments in non-Western societies;
9. Great affinity for education and educational innovation. Having a clear vision on future developments in education in general and in urban water infrastructure in particular, especially the development of online education;
10. The ability to communicate fluently in English and have the willingness to learn Dutch within the first three years of the appointment, when Dutch is not the mother tongue.
2 Position of the chair of urban water infrastructure

2.1 Background
A sound urban water infrastructure is pivotal to our current and future society, as it includes safe drinking water provision, conveyance of wastewater, excess storm water, and the upcoming water-based thermal energy networks. The total value of the related infrastructural assets in the Netherlands is estimated to exceed 200 billion €, with current yearly maintenance costs of 2-3 billion €. The future urban water infrastructure demands call for innovative, climate resilient distribution and drainage systems, flexible systems, clever predictive sensor technology, automated monitoring and control, understanding urban hydrology, understanding material aging processes, advanced protection of human and environmental health, energy and resource efficient water systems that are embedded in a circular economy, etc. Transiting our current urban water infrastructure’s system into a sustainable system addressing future challenges, is regarded a major challenge for our water authorities, drinking water companies and municipalities, and requires a scientific approach and a sound education of future generations.

The current urban water infrastructure research mainly refers to asset management and lifetime extension, and is already partly addressed in our department within two consecutive research programmes, which were developed with RIONED, the Dutch umbrella organisation responsible for sewerage and urban drainage (2 times 5 years research programme of 2-2.5M €).

2.2 The section Sanitary Engineering
The section Sanitary Engineering hosts two full-time full professors covering Drinking Water/Urban Water Technology and Wastewater Treatment/Environmental Engineering. In addition, the section hosts three part-time, externally funded, full professors focussing on Drinking Water Engineering, Water and Health, and Urban Drainage. Next, eight full-time scientific staff members (assistant and associate professors) focus on research & education on drinking water, wastewater, industrial water and urban drainage. The research focuses on user functions such as buildings/urban setting (drainage, soil management, urban water management, etc.), drinking water (extraction, storage, purification and distribution), and wastewater (collection, transport, treatment, reuse or discharge).

2.3 Position within the department of Water Management
The department of Water Management focuses on quantitative (normal discharge conditions, extreme floods, droughts) and qualitative (pollution, solute transport) aspects of fresh and salt/brackish water systems and related user functions such as building (drainage, soil management, urban water management, etc.), drinking water (extraction, storage, purification and distribution), wastewater (collection, transport and treatment) and agriculture (drainage and irrigation). The department also contributes to the societal needs with respect to water management, water related economical aspects, eco-hydrology, land use management and optimisation questions with respect to water use.

The department of Water Management is organised in two sections: Water Resources Engineering and Sanitary Engineering. A distinction is made between the water cycle (the natural system and the engineering system used to control the water) covered by the Section Water Resources Engineering, and the urban water cycle (drinking water and wastewater conveyance and treatment), covered by the Section of Sanitary Engineering.

In total, there are six full-time and four part-time full professors (see Figure 1). Total permanent scientific staff of the department of Water Management comprises around 40...
persons representing 34 FTE (full-time equivalent), who work as autonomous scientists with responsibilities in research, education and management.

The new professor will be part of the section of Sanitary Engineering but will strongly collaborate with staff members of both sections. The new professor will have the opportunity to further develop the urban water infrastructure research group, including the recruitment of two new scientific staff members (Tenure Track positions).

![Diagram of WATER MANAGEMENT](image)

**Figure 1: Sections and full professors within the department of Water Management**

2.4 Position within the Faculty CEG and Delft University of Technology

The challenges in urban water infrastructure call for a close collaboration with various other research groups in- and outside the faculty of Civil Engineering and Geosciences. Urban Water Infrastructure e.g. tightly links with (Sub-surface) Infrastructure (e.g. Roads & Railways), Material Sciences and Control Strategies, as well as to Integral Design & Management, Hydraulics and Fluid Mechanics, Environmental Engineering, Remote Sensing, and Geosciences. In addition, Urban Water Infrastructure offers a clear connectivity with the Faculty Technology Policy and Management on i) institutional aspects, ii) behavioural changes, iii) transition management, iv) decision support, v) risk assessment, vi) linking technical aspects with governance, etc. A close cooperation is also pursued with mathematics at the Faculty of Electrical Engineering, Mathematics and Computer Science, regarding i) applied statistics, ii) (numerical) mathematics, probabilistic modelling, etc. Other field challenges are identified with the Faculty of Mechanical, Maritime and Materials Engineering, on material science and engineering and the Architecture Faculty on urban planning and urban metabolism.