E-WAter
Official Publication of the European Water Association (EWA)
 ISSN 1994-8549

Durban and Porvoo
- Governing Water Supply in South Africa and Finland

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ABSTRACT

Main focus in this study is in governance of water supply and sanitation development in South Africa and Finland in two towns during the period of late 19th century – early 20th century. Points examined are the development of water supply, water use and sanitation services, patterns of governance, access to clean water and proper sanitation in different areas of cities and technical solutions used.

Case Porvoo shows a case of somewhat problematic growth of a city at a time of the emergence of the water issue, when traditional water sources, i.e. wells, were polluted and their yield was inadequate. The systems were established quite early compared to other parts of Finland and were also extraordinary in some respects.
In case Durban there was a similar situation at the beginning, there was not enough good water in wells. Based on different geographical surroundings the solution was, however, not the same as in Porvoo.

Based on two case studies very far away from each others examples of successful and durable solutions in water supply are available. In this sense, water knows no limits— neither in place nor time. It is noteworthy how similar the problems in many developing countries are at the beginning of the 21st century compared to those faced earlier by developed countries. The underlying factors are the same in both cases: lack of good governance, rapid growth of cities and inadequate resources.

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INTRODUCTION

This article discusses water supply and sanitation development in South Africa and Finland during the period of late 19th century – early 20th century. Main focus in study is in one South African town, Durban, and in one Finnish town, Porvoo. Points examined will be the development of water supply, water use and sanitation services, patterns of governance, access to clean water and proper sanitation in different areas of cities and technical solutions used. It is assumed that if you can find similarities in development paths in two towns in so different environments than Porvoo and Durban, then you can make wider generalisations based on those development paths.

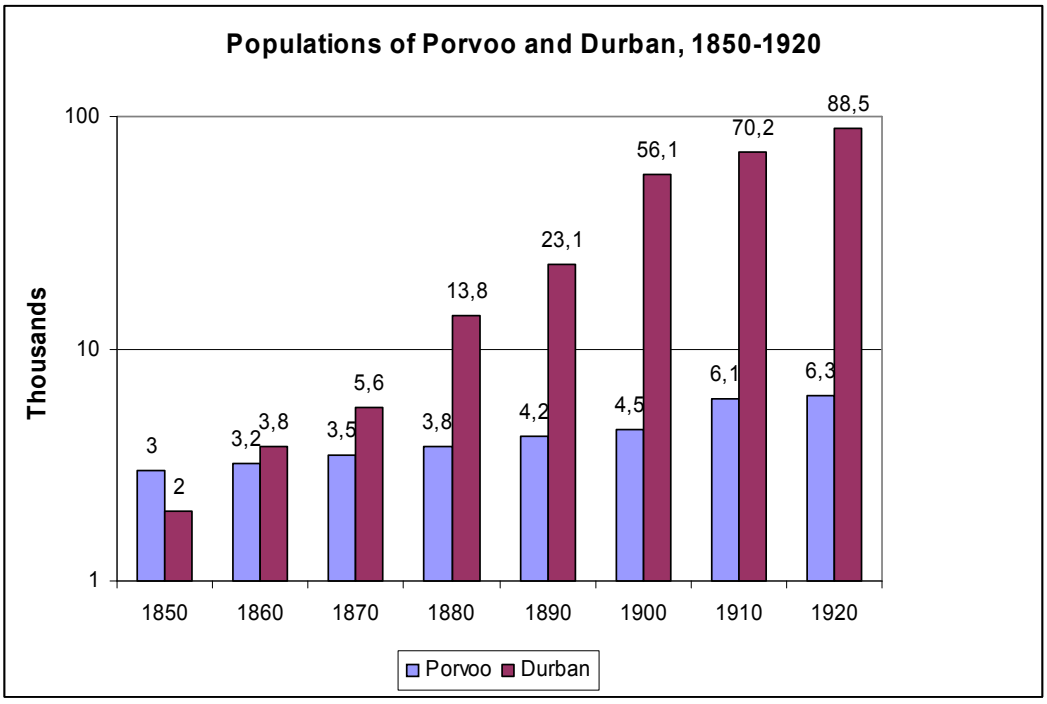

Table 1. Population of Porvoo and Durban in 1850–1920 in a logarithmic scale.

South African towns were not so developed compared with Great Britain or Germany as only the 24.7 percent of her inhabitants lived in towns in 1911. In Finland figures were in same year shows that total population in tows was 429,937 and total population in the country was 2,943,000: only 14.6 percent of inhabitants lived in towns. [1] Except in some cases in South Africa and Finland water supply was a major problem for these settlements but the above mentioned rapid economic development and urbanization allowed of and made the necessity of the introduction of modern

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water supply and sanitation systems. In Finland lack of good water may sound odd, because there are 188,000 lakes and thousands of rivers.

All cases are compared with D. Okun´s principles of sustainable water supply. [2] The term *governance* [3] deals with the processes and systems by which an organization or society operates; the word comes from Latin and suggests the notion of steering. This steering of society can be compared with the traditional approach of the governments driving society. The term ***good governance*** defines an ideal, which is very difficult to achieve. There are some principles that should be included in good governance.

1. Institutions should work in an open and transparent manner.
2. Institutions should be inclusive and communicative.
3. Policies and action must be coherent.
4. Governance systems must be equitable.
5. Accountability is critical to good governance.
6. Governance systems must be efficient.
7. Governance systems must be responsive and sustainable.

The key elements of good governance are participatory democracy and transparency. The traditional top-down approach where initiatives come from up and go down in organizations is outdated; now the goal is a bottom-up approach where people and groups at “grass roots” level have a say in decision making. It means that results produced by institutions meet the needs of society while making the best use of available resources. The concept of efficiency in the context of good governance also encompasses the sustainable use of natural resources and the protection of the environment. Participation by all the stakeholders is the one of the cornerstones of good governance. Recent developments in the field of water supply and sanitation (WSS) management have had a profound impact on the development of the local government strategies in municipalities. It also had a marked effect on the transformation of the economy and society on the local, regional, and national levels. [4]

SOUTH AFRICAN CASE

One of the most obvious processes during the 19th century in South Africa was the growth of towns around the area. When the British took over the Cape there were only fourteen urban centres and ten of them within eighty kilometres of Cape Town. By 1870 the number of urban centres in the Cape Colony had increased to 103. In Natal there were twenty-two towns, villages and hamlets. This growth is mostly attributed to the establishment of service and administrative centres in the areas

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annexed. In the Orange Free State and the South African Republic, however, only Pretoria and Potchefstroom could be labelled as towns, as most of the other administrative centres contained only half a dozen houses. [5] In 1870 there were probably only three towns with population over 10,000. By 1911 the number of such towns had increased to twenty-one and southern Transvaal contained ten of them. In 1870 there were 231 towns in South Africa; by 1911 the number had risen to 336. These towns housed a population of 1.5 million out of c. 6 million living in the area in 1911.[6]

Figure 1. South Africa.

Today, there are several pressing environmental issues in South Africa: a lack of natural water resources which requires extensive water conservation and control measures; the growth in water usage outpacing supply; pollution of rivers from agricultural runoff and urban discharge; air pollution resulting in acid rain; erosion caused by water and wind; desertification expanding in the semi-arid areas. With water situation one of the biggest problems is that most urban and industrial development, as well as some dense rural settlements have been established in locations that are far away from large watercourses. As a result, the requirements for water far exceed its availability in several river basins.

DURBAN [7]

Durban was established in 1824 on the eastern coast of the South Africa, where there was plenty of water for household purposes, but not of the best quality. The water of old Durban did not have a very agreeable taste but was better than rainwater. The town pump was situated in Old Well Court, in Smith Street and continued in use until long after the Umbilo Waterworks were opened.

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Similar pumps were later installed in the other parts of the Borough. This form of water supply provided about 215 m^3 per day. [8]

Newly arrived Bishop John William Colenso described Durban in the early 1850s [9]:

> A greater evil in Durban is the water, which is taken usually from wells that are not sunk deep enough, and, consequently, abounds with decaying vegetable, if not animal, matter, and innumerable animalcules and worms.

The Local newspaper, the Natal Mercury reported in April 1858 that some of the town pumps were out of order or unfinished and needed attention. In the same year there was a discussion in the Town Council about which was more important for the municipality: a new town hall or paved roads and pure water. A motion for a new town hall was carried by three votes to two. [10] In December 1861, the Council requested a report on the feasibility of supplying the Borough with water from the Mgeni River. The Council could not, however, agree to finance the scheme as submitted. In 1873, the Council apologized for any inconveniences to citizens because the droughts had affected supplies from the wells. Still dreaming about its future water supply, the Council in 1874 considered a proposal that private tenders be invited to provide Durban with the best water supply. In 1875, it was agreed in a public meeting to set up a special committee to consider a variety of schemes proposed. The outcome was that the Borough authorized an expenditure of £500 on an investigation of an artesian source of water. [11]

Until the end of 1879, the water supply continued to be obtained from tanks and wells sunk in the various parts of the city. In July 1877, these wells yielded approximately 214 m^3 per day, when the population of the town was over 5,000. With the increasing population and repeated dry seasons, the necessity for providing some other source of supply became imperative. In 1879, the possibility of a shortfall in the water supply became so serious that the Mayor arranged with the Railway Department for the supply of water in tanks from the Mgeni River. [12]

Drilling operations for artesian wells were conducted in the course of 1876–77 but only with a partial success. However, in 1878, the Council placed the drilling operations entirely under H.W. Currie's control, and he eventually succeeded in sinking a well yielding 227 m^3 per day at the foot of the Botanic Gardens in July 1879. Storage tanks were erected and water pipes were led into town. An additional well was sunk in 1883 and a steam pump erected to increase the supply. A storage reservoir was erected in the Botanic gardens in 1884. This way a serious water famine was averted; the rainfall during the three succeeding years falling far short of requirements.

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"Currie's Fountain" continued to be the principal source of supply until the Mbilo Waterworks was opened in 1887.[13]

The Borough Engineer urged that the Currie's Fountain supply be seen only as a temporary measure. In September 1883, he submitted reports and estimates on schemes to supply water from the Mlazi, the Mhlatuzana, and the Mbilo Rivers. In December, the Council decided that under the existing conditions the Mbilo River was the most suitable source. The site selected for the Headworks lay on a bend of the Mbilo River just above Mbilo Falls. An earthen dam was built across the valley. The attraction of the scheme was two-fold. Firstly, it was within the borough's financial means and, secondly, it was designed to provide a gravity supply to the growing Berea residential area. The Pinetown Waterworks, as they were usually called, were formally opened on 21st July 1887. [14] In 1889, Mbilo scheme was already overtaxed by drought and population growth. As a temporary measure, Council voted to allow the construction of a plant to pump water from the Mhlatuzana River to the Mbilo River. In January 1890, new Borough Engineer John Fletcher tabled a report detailing various schemes for supplementing the existing supply. He advocated the tapping of the Mlazi River. The council approved this during the year. The new Waterworks were completed in the following year, and formally opened by the Council on the 30th July 1891. [15]

Figure 2.
Queen Victoria Jubilee Fountain erected at the inauguration of Mbilo Waterworks in 1887. (Photo: Old House Museum, Durban)

Until 1894, the Mbilo supply of 910 m^3 per day and the Mlazi temporary pumping plants capacity of 1,100 m^3 per day proved to be sufficient. The Mlazi gravitation scheme was built in 1894. By 1895, Fletcher could point to the successful completion of the scheme. The Mlazi and Mbilo projects,

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combined, gave Durban a cheaper and more plentiful supply than either Port Elizabeth or Cape Town had. Fletcher estimated that to consume the daily delivery of over 9,000 m^3, Durban's population would have to double from its then 28,000. It was, however, still necessary in 1898 for the Medical Officer to recommend the people of Durban to boil their drinking water. [16]

During the South African War 1899–1902, drought and the rapid increase in population put further pressure on Durban's water supply. The Corporation started relief works and a number of men were employed on the construction of the Clear Water Reservoir. The reservoir was completed in 1903 and it increased the Mlazi scheme's storage capacity by 523,000 m^3. The spectre of recurring droughts had already led Fletcher to seek Council's authority for additional storage in the Mlazi catchment. Work commenced in 1901 on a Camperdown temporary dam, which was constructed in a record time of five months. Even before the temporary dam was finished Fletcher was contemplating a permanent dam. [17]

During the serious drought of the summer of 1902–03, the Camperdown dam helped to avoid a water famine. The dam stood its first test in December 1903 when a heavy flood, which damaged the Mlazi Intake downstream, left the dam untouched. The Camperdown Dam was of incalculable value in maintaining water supplies to Durban between 1901 and 1904 during periods when the normal river flow at the Intake Works would have been less than Durban's consumption unless augmented from Camperdown. In 1905 it was decided that Camperdown temporary dam would be changed into a permanent one. Work was started the following year and in 1908, the retaining wall was laid. [18]

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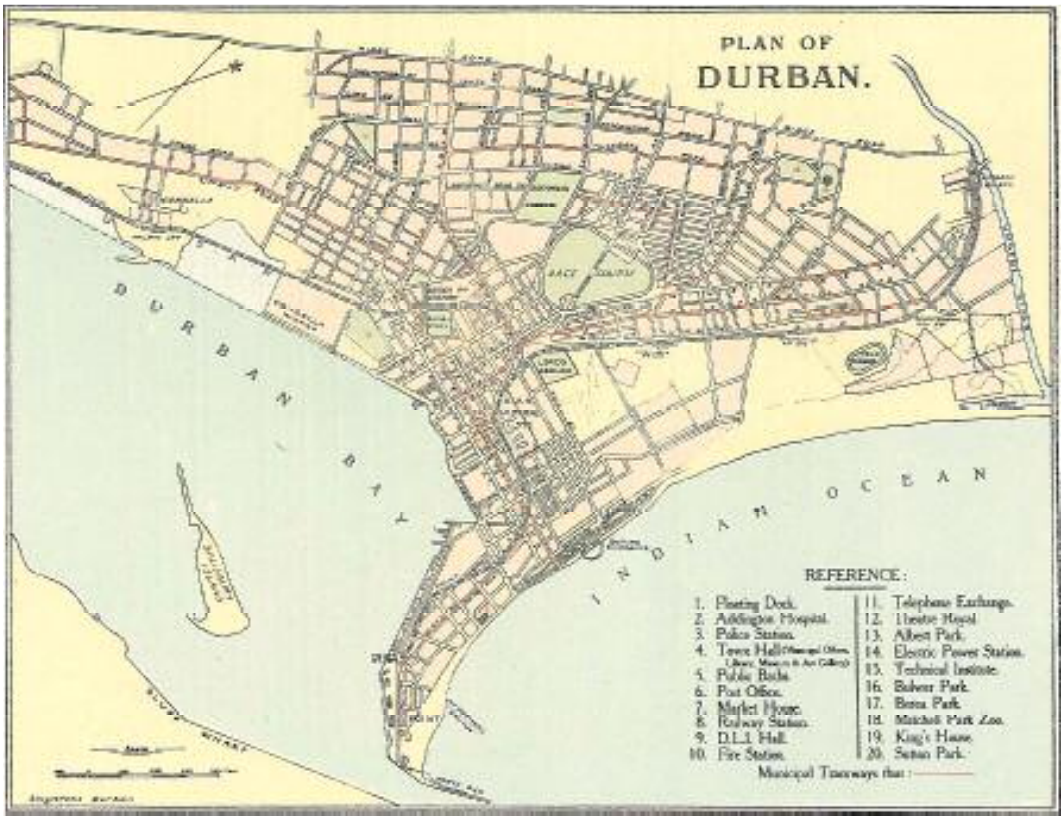

Figure 3. Durban 1911. (A.H. Tatlow (ed.), *Natal Province: descriptive guide and official hand-book*, (Durban: South African Railways Printing Works, 1911).

The existing water supply system of Durban came under critical examination after the 1917 floods. By January 1918, it had been resolved by the Council that a new dam was required and that the town needed the services of an experienced “Water Works” Engineer. It was decided by the Council that the waterworks Engineer would be responsible directly to the Council. The main concern of the new Water Engineer was the new water scheme. In 1918, investigations had been carried out as to the possibility of using various rivers along the Natal coast. The pilot survey resulted in the Council deciding to continue developing the Mlazi River and to proceed with the Shongweni Scheme. Construction of the Vernon Hooper Reservoir started in 1923 and was finished in 1927. [19]

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FINNISH CASE

FIRST WATERWORKS IN FINLAND

The first municipal "water pumping installation" in Finland was most likely founded in Tampere 1835 although there were small private systems already earlier. The high-pressure facility of Tampere was completed on 1898, but not on the scale of the original plan. Since slow sand filtration was rejected and the outlets of the sewers were too close to intake pipes, the efficiency of the new facility was also its weakness: later typhoid fever spread fast over a wide area aided by the water pipe network. In 1916 the death of hundreds of people finally prompted the necessary decisions to be made. [20]

Figure 4.
(Source: http://www.porvoo.fi/index.php?mid=44, read 16 April 2007)

It is interesting that Tampere initially chose to use surface water while many other cities such as Hanko, Hämeenlinna, Lahti, Turku and Viipuri (Vyborg) went for groundwater. In some cities, the establishment of a waterworks was postponed far into the 20th century—in Savonlinna until 1951.[21] The new high-pressure waterworks in Finnish towns provided safety and comfort. However, since the suggested slow sand filtration was rejected and the outlets of the sewers were too close to intake pipes, the efficiency of the new facility was also its weakness: later typhoid fever spread fast over a wide area aided by the water pipe network. [22]

In cities sufficient water for fire fighting became available only after the emergence of high-pressure waterworks and professional fire-brigades. This was the case both in Tampere and Oulu,

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since both cities had initially low-pressure waterworks. It is probable that the decisions in Tampere were known well in Oulu as the two cities followed closely developments in each other's water supply and sewerage. In addition, Tampere and Oulu used same external experts, like Hausen from Helsinki. [23] Networking of experts in the Finnish water sector was quite advanced already in the last years of the 19th century. Besides, Finnish experts and civil servants went on numerous fact-finding tours abroad (Sweden, England and Central Europe) to familiarize themselves with the foreign solutions. [24]

Problems with water quality were also largely solved only after the introduction of high-pressure waterworks. There had been knowledge of proper equipment and the dangers of not having it for years as a result of the domestic expert network and the active foreign connections. [25] In Helsinki, Hämeenlinna and Lahti related problems were not as great as in Tampere, because they did not use untreated surface water. Lahti was using good quality groundwater from the Laune spring, Hämeenlinna used groundwater from Ahvenisto and Helsinki used from the beginning surface water treated with slow sand filters. These modern systems were thus safer than the one in Tampere. In addition, the other cities were taking care of their wastewaters in a modern way compared to the Tampere: in Lahti the wastewaters from the entire planned city area were treated already in 1910. [26] Apparently economic interests also stirred up dispute since some people were afraid that the costs were going to be shared by everyone while only a few could enjoy the advantages. [27]

The other side of the water question, i.e., sewerage also had to be solved. The public health decree of 1879 obliged cities to do so since the act required that levelling of the city areas was to be carried out. [28] Although the wettest areas of the cities were drained and hygiene improved, lakes were still being polluted since wastewater was not treated. The bucket was replaced by a drainpipe, and the problems were flushed out of sight untreated to the nearest water systems. Luckily wastewaters were not used for irrigation like in Germany and France at that time. This kept the groundwater unpolluted. In 1917, the year of Finland's independence there was sixteen waterworks in the country. [29]

The waterworks was excellently suited for the needs of fire fighting. There were no great fires in the city after the founding of waterworks and fire department. On the national scale, the health situation improved after the founding of the waterworks, especially typhoid fever cases decreased with the exception of a few epidemics and the civil war period in 1918. In 1919 infant mortality was

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lower in the cities than in the countryside; earlier the situation was the reverse. At least in this respect, the cities had become healthier places to live than the countryside. [30]

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PORVOO

Porvoo was founded in 1346, although the exact year is not certain. What is known with certainty is that Porvoo is Finland's second oldest city. The Porvoo River got its name in the 14th century from the ground fortress built on Linnamäki; it later became the name of the city as well. [31]

For centuries the townspeople got along using traditional water sources: wells, springs and surface waters. As the population, and population density, increased and water became scarce and the environment started showing symptoms of deterioration, new measures were called for. One such measure was municipal water supply. First, gradual construction of a sewerage system was launched already at the end of the 19th century. A waterworks was founded in 1913 following a long period of discussion and planning. Since its establishment Porvoo City Water Works has been a municipal utility operating in accordance with the economic and operational goals laid down by the City Council. In keeping with the general Finnish practice, a sewerage system was built alongside the waterworks. The first wastewater treatment plants came into being in the 1970s. Porvoo originally grew up as a trading centre, and it continues to be an attractive hub of business and commerce. The volume of retail trade in Porvoo makes it one of the country's bigger municipal centres. [32]

For hundreds of years the city extracted water from wells, springs and the Porvoo River. Although great fires did not occur in Porvoo as often as in other Finnish cities, the founding of a waterworks was facilitated by the fear of fires and the scarcity and poor quality of well water. The environment also became polluted as habitation spread; the problems came to a head especially in the poor sections of the city such as Pappilanmäki. Before the establishment of the waterworks most houses had a well in the yard. Several public wells also existed – the first mention of one dates back to 1622, but it is likely that there were some already earlier. Water was also drawn from the river. The best known public well was a so-called Laska well. The Headmaster's spring was considered the only source of good water in town in the 18th century. [33]

After well-water quality deteriorated and water levels fell, new ways of satisfying water needs had to be invented. The risk of fires also speeded up the organizing of water supply. Despite various reforms, the bucket remained the key implement in water supply, latrines and waste disposal until the end of the 19th century. Sewers were laid to get rid of rain waters that flowed into basements and also hindered movement of people. At that time, people still believed in the so-called miasma

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theory according to which humidity and dirty air spread disease. Yet, this belief for its part also facilitated the introduction of sewerage. [34]
House owners had an economic incentive to have public sewerage in town – before they were responsible for the maintenance of ditches and sewers on their section of the street. The organization of water supply was speeded up by the poor quality and shortage of well water and the need for fire-fighting water. [35] The *know-how* to solve the water problem was acquired at least from Stockholm and Helsinki. However, the first initiative came from within the town: professor Strömborg, involved in town administration, suggested as early as 1889 that a water-works be established to solve the problems. House owners also supported the idea. A waterworks utilizing groundwater was completed a quarter of a century later in 1913. [36]

The Porvoo Water Works was designed by the director of Helsinki Water Works, Albin Skog, who designed the first waterworks of several other Finnish towns. The contractor was Yleinen Insinööritoimisto, YIT – Allmänna Ingeniörsbyrå, AIB. The headquarters of that company was in Stockholm; it established a branch office in Finland in 1912. The Porvoo Water Tower was the company's first actual project in Finland and the beginning of its later growth into a leading sector contractor in this country. Construction of sewers had started already at the end of the 19th century. [37] The total project budget stayed quite well within the planned framework. The financing arrangements were also skilful and advantageous to the city. However, the initial estimates on the sufficiency of water appear too optimistic in hindsight due to population growth. During the first few years it was noticed that the water was not sufficient for the growing needs. City newspaper *Borgobladet* reported often about this development. [38]

When an owner of the house wanted to connect to the city's water supply, he had to submit a written application. This system started already in 1913. A written contract was always required for water supply; the term of notice was three months. The regulations governing the water pipe of the City of Porvoo from 1913 said that each plot to which water is led is to have its own pipe extending from the street pipe to the water meter. The regulations also read as follows: "The waterworks shall procure and lay said pipe at the expense of the house owner, charging the fee confirmed by the council, in the order applications are submitted and performance of the city's own works allows; the city also undertakes to put right without charge any possible defects in the pipes due to poor workmanship or materials for a period of one year." [39]

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Figure 5.
Public well from
Porvoo, late 1800s.

The measures undertaken made the built environment safer and eliminated the immediate problems. Reforms in fire services also increased safety. The evolution of the sewerage system started from open ditches. As the city grew the ditches were straightened, dug open and covered. However, this was not enough, and the growing problems made the city's decision makers plan an underground sewerage system following the English example. Development of a sewerage system was well on its way even though a wastewater plant was not yet built along with the waterworks. [40] The Kaupunginhaka Water Works proved to be an interim solution in hindsight. Yet, its performance improved, and since 1921 the utility turned a profit. Despite the large investments early on, it continued to grow. Thanks to the selection of the groundwater alternative, Porvoo avoided major problems such as epidemics which occurred in cities using surface water. The new facility completed in Linnanmäki in 1923 ended the water shortage but quality problems, such as excessive iron content, remained unsolved. [41]

Since the beginning water fees were charged based on the readings of the city's meters. *[42]* When a house owner doubted the accuracy of his water meter, he could ask the waterworks to check it. If the reading error was more than five per cent, the waterworks repaired or replaced the meter, if it was less than five per cent, the house owner had to pay all the costs of inspection. This very same rule is still in force over ninety years later. It was not always possible for house owners to connect to the city's water supply network. For instance, in the old town the bedrock lying close to the surface prevented the laying of a water pipe. *Public standposts* were provided for these consumers; the key required to use them could only be given to the occupants of the house. Care

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had to be exercised in the use of the standposts also in other respects. Persons on poor relief could use water free of charge. In 1914 there were a total of 159 water connections and consumption was around seven cubic meters per inhabitant. In 1952 connections numbered 520 and consumption was up to 38 cubic meters per inhabitant annually. In 1940, during the Winter War, water consumption dropped significantly since a major portion of the city's population had been evacuated. [43]

The new Linnanmäki water intake plant was finished in 1923. A concrete well 8 meters deep was dug there, and the water was pumped by two large centrifugal pumps to the city through a six-inch cast iron pipe 610 meters long. Originally the water was treated only by adding soda lye to increase pH. The water intake plant operated satisfactorily for the first years. In 1923 about 70 percent, and the next year 87 %, of the water need was covered by it. The rest came from the Kaupunginhaka pumping station. But the water was quite rich in iron and carbon dioxide. Especially water that sat in the pipe overnight produced thick layers of iron deposits. When the water started to flow again, these "rust specks" worked loose and consumers got "beer-coloured" water. The engineer Skog was asked to help, and he designed an iron removal plant incorporating aeration of raw water, iron precipitation by adding lime water, filtration and storage of clean water in a tank. [44]

The original water supply network was built using steel piping. Later cast iron pipes were introduced as they are more durable. Plastic piping became prevalent in Finland in the 1960s, first as water pipes in the countryside and later also as sewer pipes. Construction of the city's sewer system began already in the late 1800s. At the time, larger conduits were made of natural stone and smaller ones of glazed clay pipes. The pipe network was built as a combined sewer – a separate sewer system was adopted only in the 1960s. Prior to the establishment of the waterworks, the state of the environment in Porvoo had deteriorated quickly endangering the health of the population. The waterworks and the sewerage system improved the condition of the built environment. Domestic wastewaters loaded the environment, because a wastewater treatment plant was not built initially. Since the city started treating wastewaters in 1973, and the new Hermanninsaari wastewater treatment plant was completed in 2001, the pollution load on water bodies from domestic wastewater has decreased significantly.

The majority of the people were no longer faced with a water shortage after the completion of the first waterworks in 1914, but the needs of the growing population and increasing demand could not be satisfied until 1924. Water quality problems came to a head in the 1960s and '70s as the

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network reached the age when rehabilitation became necessary. For consumers this meant an extra drawback: e.g. the service life of hot water boilers was very short. These problems were eliminated by the new Sannainen plant in 1982.

1912 – 1913	Construction committee or water pipe committee water distribution started in February 1913
1914	Utilities board - electric utility & water works
1965	Municipal water and sewage works started operating in Porvoo rural district - Until 1975 water was purchased from the City of Porvoo. Throughout that period the business was transacted under a technical board and the technical department. A technical board was established in the early 1960s.
1966	Technical board - electric utility & water works - construction bureau which became a technical office with its sub-divisions
1975	From water works to water and sewage works - sewer issues came earlier under the construction bureau
1976	From electric utility to energy department
1985	Town planning and real estate board established Technical board supervised: - fire department - water and sewage works - planning, construction, forest and parks divisions of technical office
1991	Technical board supervised: - energy department - water and sewage works - technical service and construction division of technical office
1992	From energy department to Porvoon Energia Oy
1993	The technical and fire board supervised: - fire department - water and sewage works - technical service and construction division of technical office
1994	Board for water works (rules and regulations on 1.11.1994) Technical board acts as works' board - water and sewage works to waterworks (name changes)
1997	Merger of municipalities - waterworks and its board (rules and regulations on 27.1.1997) - technical board acts as works' board
2001	Board of public corporations (separate body with five members) - waterworks and waste processing plant
2003	Board of waterworks waste processing plant becomes regional starting on 1.1.2003

Table 2. Key organizational changes related to Porvoo water and sewage works, 1912–2003

CONCLUSIONS:

Professor D. Okun, a grand old man of water management, mentions five principles of sustainable water supply: (1) The uniqueness of water projects, (2) Efficiencies and economies of scale, (3) Integration of water supply, sewerage and pollution control services, (4) Sound financial policies, and (5) A preference for pure rather than polluted sources of potable water. [45]

Compared to Okun´s principles of sustainable water supply with the development in cases, at least the Principles 1. and 2. had been applied successfully. Local expert knowledge was used amply and the adaptation was tailored for the conditions of Tampere—even too much considering the elimination of slow sand filtration. The dimensioning of the 1898 waterworks was a success, even if there was some criticism during the planning period. The estimates of the planners and specialists about the growth of the city and the capacity and extension possibilities of the waterworks needed proved to be correct. Okun's first principle was applied successfully in Hämeenlinna and in Porvoo. The expertise of the several Finnish key water-sector experts such as Huber, Gagneur and Wasenius were involved in the establishment of the Hämeenlinna water works. Thus, the project was carried out with the help of a wide network of experts. In Porvoo the expertise of the director of Helsinki Water Works, the engineer Albin Skog, was utilized and adapted to the local conditions. However, the dimensioning of the first water intake plant in Kaupunginhaka was off. The estimates of designers and experts about the growth of the city and the related capacity and expansion needs of the waterworks were too low, and the planning of an expansion had to start almost immediately. In South Africa experts had to be called outside. In Durban both first and second town engineer had earlier worked in England and had a needed experience for solving the local problems. The second principle applies to the several *water cooperatives* that have cropped up in the rural district of Porvoo since the late 1990s, to which the works sells water. A joint water and sewage works for the entire area would, however, be too expensive at today's population density.

Environmental monitoring mentioned in connection with the third principle began in its earliest form in Finnish cities with the enactment of the 1879 Public Health Decree. It required, for instance, the city to measure the relative elevations of different city areas which was a precondition for sewerage planning. Health and environmental issues were the responsibility of a board of health which also saw to it that good quality water was provided for the inhabitants. *Water charging*, according to Okun's fourth principle, was based on metered consumption from the beginning. This allowed rational development of the works which, in the light of examples, would likely have failed with different charging principles. Exceptions were public standposts, which had been in use for tens of

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years, and gave water against payment of a fixed water fee. For example, the Porvoo waterworks operated this service at a loss, but it introduced equality into the distribution of water for citizens before the piped network reached the working class neighbourhoods.

The combining of water acquisition, sewerage and environmental protection in Tampere started on the threshold of the crisis of 1909. Ever since that year, the food inspection office of the city supervised the quality of water in Tampere. It was decided to finance the activity on the basis of metered consumption (cf. Okun's principle 4.) following the failed system of lot- based charging with the low-pressure solution. This has made possible the sensible development of the utility, which probably would not have been possible in light of the examples with other charging principles.

What comes to the fifth principle, utilization of groundwater, in Porvoo the later problems with iron and salt showed that solutions that appear indisputable are not necessarily sustainable on the long term, but one must be prepared for surprises. The Linnanmäki water works built in 1924 eliminated the old water shortage problem, but quality problems remained a nuisance for decades. It can be said that perpetual quality problems were solved only by the completion of the Sannainen artificial groundwater plant in 1982 which did away with the "beer-coloured" water. The so-called VYR equipment installed in Linnanmäki plant in 1971 also turned out to be a temporary solution – it saw daily use for only about three years. Principle 5. is the most delicate issue in the history of the water supply in Tampere: preference was not given to better quality groundwater in spite of various warning signs, but the decision makers stuck with untreated surface water which contained unclean wastewater. The result was a catastrophe, from which it took the city a long time to recover. And even then better quality groundwater was not used—mainly because of the quarrels among specialists. Treated surface water and a better protected intake area were chosen instead of groundwater. Only decades later did groundwater become part of the water supply of Tampere. In Durban they have from the beginning taken surface waters from the local rivers.

The removal of the constraints to water and sanitation service production and the inefficiency of sector organizations are essentially a *governance problem* in many countries. Lack of *good governance* principles is one of the root causes of all major constraints within our societies. Good governance is participatory, consensus-oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law. It also ensures that corruption is minimal, the views of minorities are taken into account and that the most vulnerable members of society are listened to in decision making. It is also responsive to the future needs of society.

 ISSN 1994-8549

Water governance is an exercise in political, economic, administrative, and social authority, which influences the development and management of water resources and related services delivery. It comprises mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations, and mediate their differences in relation to water resources. The overview of the recent Human Development Report 2006 summarises the issue as follows: The global crisis in water consigns large segments of humanity to lives of poverty, vulnerability and insecurity. The scarcity at the heart of the global water crisis is rooted in power, poverty and inequality, not in physical availability. There is more than enough water in the world for domestic purposes, for agriculture and for industry. The problem is that some people –- notably the poor –- are systematically excluded.

This paper has concentrated on the birth and early development of community water supply and sanitation in South Africa and Finland. Out of the development the following six key conclusions can be drawn:

1. Surface water was initially taken from nearby sources, and as these became contaminated, from farther away. The utilization of groundwater started later, and artificial groundwater will likely be produced in the future.
2. Wastewaters polluted the water systems until their efficient treatment started at a relatively late. The industry began to protect waters later by increasing co-operation with the waterworks when the time was ripe.
3. When the increase in the water consumption levelled off, the emphasis shifted to water quality.
4. Mistakes have been made, but lessons have also been learned. It is better to do something than to do nothing.
5. In environmental matters the utility has played, and will continue to play, a key role in all cases.
6. Good governance was found in a quite late state and the beginning of this development was not easy.

IMPLICATIONS

The models and the knowledge in support of the various solutions were collected both from abroad and other facilities in South Africa and Finland. The perception of the determining role of capital, even the perception of it as a precursor in this sector, proved to be misleading, if not incorrect. Capital has, of course, played an important, but not necessarily the only and central role. Although many facilities of the works are hidden underground, we all come daily into contact with its key products: potable water, wastewater, cleaner water bodies and easier and safer everyday life.

The growing cities of developing countries seem to be repeating the same patterns in building their water supply as Finland and South Africa earlier. First, they build a water pipe to replace wells, then sewerage to replace ditches. At this point, diseases like cholera and, especially typhoid fever, very often plague growing cities. The excessive use of water, the assessment, the lack of maintenance, etc. also cause problems. Only after the occurrence of these problems, the systems are built to guarantee good quality of water, and only lastly—usually after yet further problems—a wastewater treatment plant is built.

1 *Suomen tilastollinen vuosikirja* 1952, 8, 10.
2 Daniel A. Okun, *Regionalization of Water Management. A Revolution in England and Wales* (London: Applied Science Publishers, 1977), 4–7.
3 For all the aspects of governance, see *Debating Governance: Authority, Steering and Democracy*, ed. by Jon Pierre (Oxford: Oxford University Press, 2000).
4 See *Governance in Water Sector – comparing development in Kenya, Nepal, South Africa and Finland*, ed. by Petri S. Juuti, Tapio S. Katko, Harri R. Mäki, Ezekiel Nyangeri Nyanchaga, Sanna-Leena Rautanen, and Heikki Vuorinen (Tampere: International Centre on Environmental Services and Governance (ICES), 2007).
5 T.J.D. Fair and J.G. Browett, The Urbanization Process in South Africa. In D.T. Herbert and R.J. Johnston (eds.), *Geography and the Urban Environment: Progress in Research and Applications*. Volume II (New York: John Wiley and Sons, 1979), 264–269.
6 A.J. Christopher, *South Africa* (London: Longman, 1982), 135–138.
7 For more thorough examination of Durban see: Harri Mäki, *Water, Sanitation and Health: The Development of Environmental Services in Four South African Cities, 1840–1920* (Tampere: KehräMedia Inc., 2008).
8 Barbara C. Tait, *The Durban Story, or, Durban cameos of yesterday and today* (Durban: Knox Printing Co., s.a.), 120; W.P.M. Henderson, *Durban: Fifty Years' Municipal History* (Durban: Robinson & Co., 1904), 225; Felix Stark (ed.), *Durban* (Johannesburg: Felstar Publishing, s.a.), 124.
9 John W. Colenso, *Ten Weeks in Natal. A Journal of a First Tour of Visitation among the Colonists and Zulu Kafirs of Natal* (Cambridge: Macmillan & Co., 1855), 14.
10 Tait, *Durban Story*, 120; George Russell, *The history of old Durban and reminiscences of an emigrant of 1850* (Durban: P. Davis & Sons., 1899), 348.
11 Henderson, *Durban*, 50; T.E. Francis, "The Influence of the Geology of Durban on the Supply of Water from Wells to Early Settlers," *Natalia* 21 (December 1991), 43; Rory Lynsky, *They Built a City: Durban City Engineer's Department 1882–1982* (Durban: Concept Communications, 1982), 12.
12 Lynsky, *They Built a City*, 12; Henderson, *Durban*, 107–108.
13 Henderson, *Durban*, 108, 225–226; Francis, *The Influence*, 43, 45.
14 Henderson, *Durban*, 108, 226–227; Lynsky, *They Built a City*, 16, 18–20, 22.
15 Lynsky, *They Built a City*, 26–27; Henderson, *Durban*, 140–141.
16 Anna C. Bjorvig, "Durban 1824–1910: The Formation of a Settler Elite And Its Role in the Development of a Colonial City," (Ph.D. diss., University of Natal, 1994), 324; Henderson, Durban, 235; Lynsky, They Built a City, 27; Borough of Durban, Medical Officer of Health, Annual Report 1898. In Borough of Durban, Mayor's Minute, 1898, 46.
17 Borough of Durban, Borough Engineer, Official Report for the Year 1901–1902. In Borough of Durban, Mayor's Minute, 1902, 29–30; Lynsky, *They Built a City*, 30.
18 Borough of Durban, Borough Engineer, Official Report for the Year 1902–1903. In Borough of Durban, Mayor's Minute, 1903, 26; Borough of Durban, Borough Engineer, Official Report for the Year 1903–1904. In Borough of Durban, Mayor's Minute, 1904, 28–29; Lynsky, *They Built a City*, 30–32; Borough of Durban, Borough Engineer, 1906. In Borough of Durban, Mayor's Minute, 1906, 34; Borough of Durban, Borough Engineer, 1908. In Borough of Durban, Mayor's Minute, 1908, 42.
19 Lynsky, *They Built a City*, 42–45.
20 Väinö Voionmaa, *Tampereen kaupungin historia II: Tampereen historia Venäjän vallan ensipuoliskon aikana*, (Tampere: Tampereen kaupunki, 1929), 481; Petri S. Juuti and Tapio S. Katko, *Ernomane*

 ISSN 1994-8549

vesitehras. Tampereen kaupungin vesilaitos 1835–1998, with English summary Marvelous water factory – Tampere City Water Works 1835–1898, (Tampere: Tampereen kaupungin vesilaitos, 1998), 9–72; Petri S. Juuti, *Kaupunki ja vesi (City and Water). With English summary*, (Pieksämäki: KehräMedia Inc, 2001), 182–190.
21 Tapio S. Katko, *Vettä! – Suomen vesihuollon kehitys kaupungeissa ja maaseudulla*, (Helsinki: Vesi- ja Viemärilaitosyhdistys, 1996), 102.
22 Juuti, *Kaupunki ja vesi*, 274.
23 Katko, *Vettä!,* 52; Juuti, *Kaupunki ja vesi*, 141–164.
24 Marjatta Hietala, *Services and Urbanization at the Turn of the Century. The Diffusion of Innovations*, (Helsinki: Suomen Historiallinen Seura, 1987).
25 Mika Koskinen, ”Saastunut Näsijärvi terveydellisenä riskinä – Kulkutaudit, kuolema ja puhdasvesikysymys Tampereella 1908–1921,” (M.A. thesis, University of Tampere, 1995), 54–55, 64, 77; Juuti, *Kaupunki ja vesi*, 140–164, 182–185.
26 *Aamulehti* (Tampere), 16 April 1915; Koskinen, ”Saastunut Näsijärvi,”, 54–55; Juuti, *Kaupunki ja vesi*, 140–164, 182–185.
27 Juuti, *Kaupunki ja vesi*, 155–164.
28 City of Tampere, Minutes of the City Council, 25 May 1887, Tampere City Record Office; Juuti, *Kaupunki ja vesi*, 90–100.
29 Donald Reid, *Paris Sewers and Sewermen. Realities and Representations*, (Cambridge, Mass.: Harvard University Press, 1991); Juuti, *Kaupunki ja vesi*, 182–185.
30 Petri S. Juuti and Tapio S. Katko, ”Birth and expansion of Public Water Supply and Sanitation in Finland until World War II.” In Petri S. Juuti, Tapio S. Katko and Heikki S. Vuorinen (eds.), *Environmental History of Water – Global views on community water supply and sanitation,* (London: IWA Publishing, 2007), 117–130.
31 The initial case study was Petri S. Juuti, Riikka Rajala and Tapio S. Katko, *Aqua Borgoensis*, (Porvoo: Porvoon Vesi, 2003).
32 http://www.porvoo.fi/en/enytporvoosta/index.html, read 13 May 2003.
33 Ilkka Mäntylä, *Porvoon kaupungin historia 2: 1602–1809*, (Porvoo: Porvoon kaupunki, 1994), 326.
34 Juuti, *Kaupunki ja vesi*, 67–69, 97, 138–141.
35 Anneli Mäkelä-Alitalo, *Porvoon kaupungin historia III:1 1809–1878*, (Porvoo: Porvoon kaupunki, 2000), 194, 215; Juuti, *Kaupunki ja vesi*, 62–63, 66, 70, 90.
36 Edvard Rindell, *Öfversikt öfver den kommunala verksamheten i Borgå stad 1875–1911*, (Borgå: Stadsfullmäktige, 1914), 77–87, 111, 116, 126, 144, 177–178.
37 Rindell, *Öfversikt*, 280–284, 293–294, 300; Juuti, *Kaupunki ja vesi*, 151; Katko, *Vettä!*, 368.
38 Borgåbladet (Porvoo), 9 January 1913, 16 January 1913, 25 February 1913, 4 March 1913, 17 March 1913, 15 November 1913, 20 December 1913, 12 March 1914 and 14 March 1914.
39 City of Porvoo, Water Works, Regulations, (Porvoo 1913); Juuti, Rajala & Katko, *Aqua Borgoensis*, 319–350.
40 Juuti, Rajala & Katko, *Aqua Borgoensis*, 59–86.
41 City of Porvoo, Water Works, Annual Reports, 1913–1923; Juuti, Rajala & Katko, *Aqua Borgoensis*, 59–86.
42 City of Porvoo, Water Works, Regulations, (Porvoo 1913); Juuti, Rajala & Katko, *Aqua Borgoensis*, 319–350.
43 City of Porvoo, Water Works, Regulations, (Porvoo 1913); City of Porvoo, Water Works, Annual Reports, 1913–1914, 1940–1945, 1952; Juuti, Rajala & Katko, *Aqua Borgoensis*, 59–86.
44 City of Porvoo, Water Works, Annual Reports, 1944–1966; Juuti, Rajala & Katko, *Aqua Borgoensis*, 203–239.
45 Okun, Regionalization, 4–7.