Governance in Water Sector – Comparing development in Kenya, Nepal, South Africa and Finland

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Water Matters
– Preface

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Water really does matter: presently some 1.2 billion people do not have access to clean water and more than 2.6 billion lack access to proper sanitation. Water-borne diseases cause the death of five to six million people in developing countries each year – some fifteen thousand a day! Enormous efforts will be needed to meet the set goal of wider access to water and sanitation. In the last 10 years more children have died from diarrhoea than all the people lost in armed conflicts since WWII.

Improved water and sanitation services have many positive direct and indirect effects on public health and the national economy. Healthier people living to adulthood increase human resources and ultimately the productivity and well-being of nations. Besides, as regards the various water use purposes, a recent study showed that community water supply should be the first priority in all societies. The current view on poverty eradication- and alleviation-related challenges and their linkage to the elements of well-being is depicted by Fig 1.

The United Nations General Assembly declared the period of 2005-2015 as the International Water Decade to raise awareness and to galvanise people into action for better management and protection of our most crucial resource.

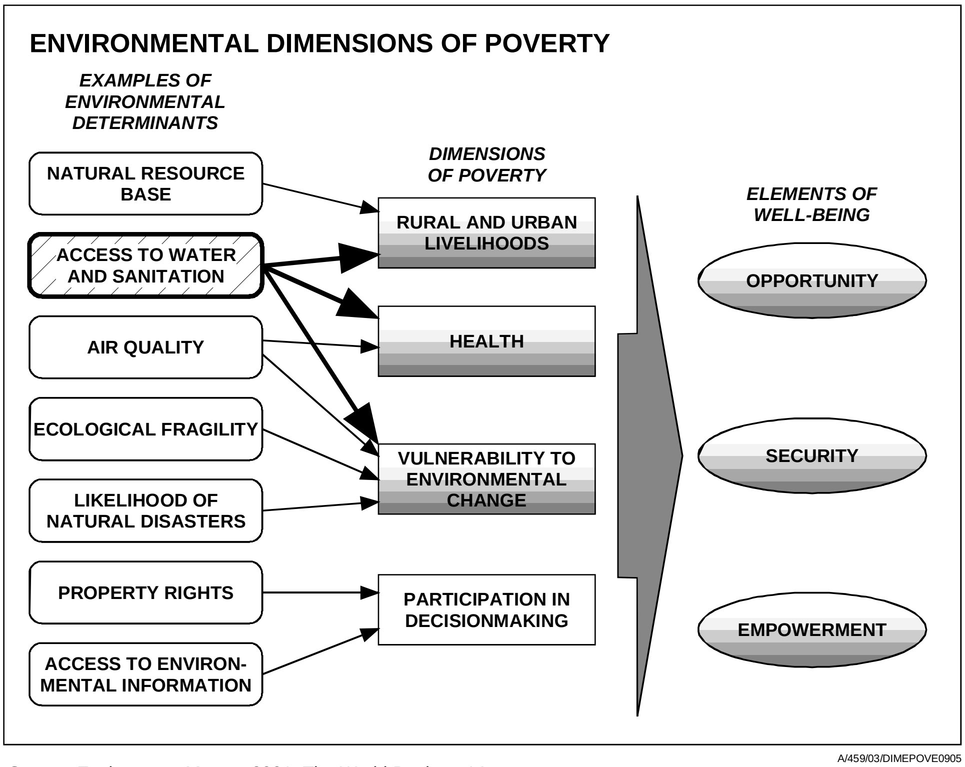
"Water matters" is what the UN said in 2002. Through the Johannesburg Plan of Implementation, countries have committed themselves to the millennium target – to halve the proportion of people lacking access to clean water and proper sanitation by 2015. Enormous efforts will be needed to meet the goal. How can it be achieved? Lessons learned from earlier industrialised and urbanised societies might help us understand the present crisis.

This book is based on the multidisciplinary research project "Governance of water and environmental services in long-term perspectives (GOWLOP) – A Comparative Study" funded by the Academy of Finland (project number 210816). The study explores the long-term development of the relationships between water supply and sanitation, environmental health, and social change in a global context with a special focus on Kenya, Nepal, South Africa and Finland.

The general objective of the project was to enhance our knowledge and understanding of the development of water use, water supply, water pollution control and sanitation services, and their overall long-term political, economic, social, cultural, technological, environmental and health impacts. The study aimed to explain the strategic decisions made over the years and to identify the key drivers –- strategies, principles and practices – which have resulted in historically significant changes in public health and overall development of community water supply and sanitation services, their governance, social importance and impacts during two urbanisation periods in Africa (Kenya, South Africa), Asia (Nepal) and Europe (Finland).

Some key findings of the GOWLOP project are presented in this book.

Figure 1. Water supply and sanitation as an environmental determinant of poverty.



Source: Environment Matters 2001, The World Bank, p. 14

1. Governance in Environmental Services – Introduction

Dr. Petri Juuti and M.A. Harri Mäki, Department of History, University of Tampere, and Dr. Tapio Katko, Institute of Environmental Engineering and Biotechnology, Tampere University of Technology, Finland

"When the well is dry, we know the worth of water"

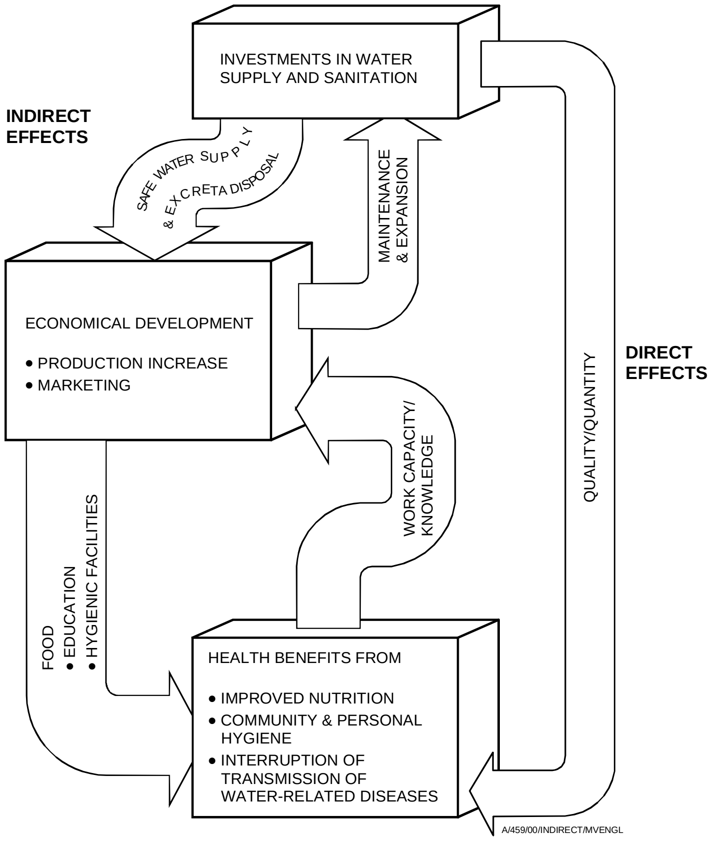
Benjamin Franklin

In many studies, such as the Millennium project (Glenn & Gordon 2000. UNU Millennium project), water management and related issues have been recognised *as one of the biggest future challenges* for mankind. Rapid population growth and expanding cities, especially in developing countries, set enormous challenges for the construction and management of infrastructure systems for water resources and for public water and sanitation services, and contribute to increasing societal complexity and interdependence.

If the current trend continues, *two thirds* of the world's population will be living with *chronic water shortages* and polluted water environments by the year 2050. (Cetron and Davies 2003) This scarcity is worsened by the fact that water *quality* has deteriorated since most nations lack even basic pollution control – and some of them are in Europe and the EU. "Water is likely to become a growing source *of tension and fierce competition* between nations*, if present trends continue, but it can also be a catalyst for cooperation"*. (http://www.un.org/works/sustainable/freshwater.html)

Figure 1. shows the basic justification of water and sanitation services – their direct and indirect effects. In addition to the several direct effects, such as health benefits, there have been indirect ones in the form of various types of economic benefits. Healthier people l increase human resources and the productivity and well-being of nations.

Figure 1. Benefits gained through improved water supply and sanitation.



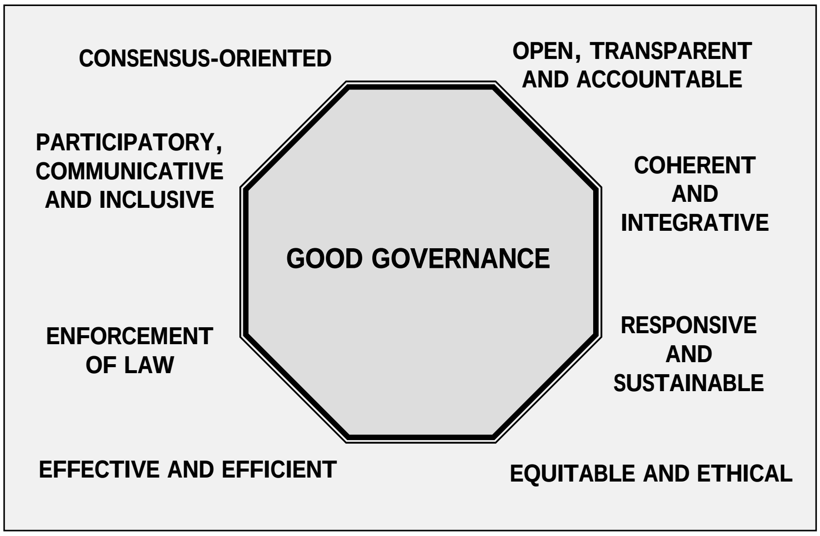
In several international water and the environment related comparisons, Finland has been placed among the best nations: 1st in Water Quality (2003: www.unesco.org/water/wwap), 1st by the Water Poverty Index (2002: www.nwl.ac.uk/research/WPI), 1st by the Transparency Index (2001:

www.gwdg.de/~uwvw/icr.htm), and one of the best by several environment-related indices. (www.ciesin.columbia.edu/indicators/ESI) This provides a challenging starting point for this study. Lessons learned from earlier industrialised (urbanised) societies might help us understand the present crisis. (Juuti 2001, Katko 1997; Juuti & Katko 2004) Could Finland's historical, internationally highly ranked experience, possibly be applied on a global scale to some extent? This question is raised with full recognition and understanding that replicability is by no means a straightforward issue and that water management – if anything – is largely dependent on local political, economic, social, technological, environmental and legislative circumstances.

The World Water Development Report 2003 noted the major problem: "Sadly, the tragedy of the water crisis is not simply a result of lack of water but is, *essentially, one of poor water governance*." (UNESCO 2003)

As pointed out by UNESCAP, the solving of the constraints on water and sanitation service production and the inefficiency of sector organisations are essentially a *governance problem* in many countries. (UNESCAP 2003) 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 minimised, 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 (Fig. 2).

Figure 2. Characteristics of good governance (modified from UNESCAP, 2003).



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. (UNESCO 2003) 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 (UNESCO 2003). In its recent White Paper on Good Governance the *European Union* recognises five key principles: *(i) openness (ii) participation (iii) accountability (iv) effectiveness, and (v) coherence*. Even in "conventional hydrology" we can *see reconsideration* of focuses and expansion of conventional water management towards wider institutional and management issues, and further to governance questions.

As for our research, cross-sectional and historical intra- and international comparisons have been recognised as a valuable method of study of different sectors of human life, including technologies and governance.

Objectives and methods

The general objective of the project was to *enhance our knowledge and understanding of the development of water use, water supply, water pollution control and sanitation services, and their overall long-term political, economic, social, cultural, technological, environmental and health impacts*. The study particularly aimed at explaining *the strategic decisions* that have taken place in this overall institutional framework over the years.

The project aimed to find out which key drivers – strategies, principles and practices – have resulted in historically significant changes in public health and overall development of community water supply and sanitation services. This required an analysis of the environment, water supply and sanitation, and mental perceptions over the long-term perspective. (eg. Melosi 2000)

The aim of the study was to compare in an inter- and multidisciplinary context the development of community water supply and sanitation, their governance, social importance and impacts in two urbanisation periods (circa 1800-1910 and since c. 1910) in Africa (Kenya, South Africa), Asia (Nepal) and Europe (Finland). The project had two more **specific research objectives**:

(i) To study the development of water use, water supply, water pollution control, and sanitation in different periods as well as at the turning points, and the reasons of development

(ii) To explore the institutional development of water supply and sanitation services and related water governance in the historical and futures context.

When residents of Finnish cities spoke about water and sanitation in the early urbanisation phase, they generally referred to the "water question". The water supply problem was solved only after prolonged planning and transitional periods. The transition from the so-called bucket system, based on wells and carrying water by bucket, through the protosystem to modern water supply (Juuti 2001; Juuti & Katko 2004) was a demanding process for the municipal administration: many decisions demanding special knowledge had to be made. Was the situation the same in all the case countries?

The main research question was: How did different countries attempt to solve the water question over time, and what key lessons have been learned? First the long history of the issue and its emergence among some water supply and sewerage systems and services is described. Then, the study examines how the water question turned into a social and governance problem and how the view that something had to be done formed within the administrative system. What kinds of major technological options were chosen or abandoned? What were the success factors? Why did so many attempts fail to provide safe water and access to sanitation facilities? It is essential to clarify the role of formal and informal institutions to find the answer.

Comparative study of long-term development requires careful historical and inter/multidisciplinary analysis. The project combined different approaches: *development studies, environmental management, environmental history, historical epidemiology, history of medicine, history of technology, new institutional economics, and social history*. Together they contribute to a more holistic view of the development.

Potential future development paths were analysed based on historical data and cases. This study utilises the *analogy* between Historical Research (HR) and Futures Research (FR). It is important to know how past decisions limit potential future development paths. FR is typically based on formulating a joint vision. From this vision alternative scenarios are derived. After selecting the most preferable scenario, various strategies for meeting the goal are explored. HR studies the past presents: how various options and strategies were selected to solve the challenges of urbanisation.

A recent study indicates *discontinuity* between the presents, recent pasts and near futures in water-related historical (HR) and futures research (FR) (Fig. 3). It could be that due to the tradition of HR, it is more difficult to assess the effects of strategic decisions on the recent pasts. These decisions have various levels of *path dependence* – known and accepted, known and rejected, and unrecognised. Therefore, if more convergence is wanted, the gap should be filled somehow.

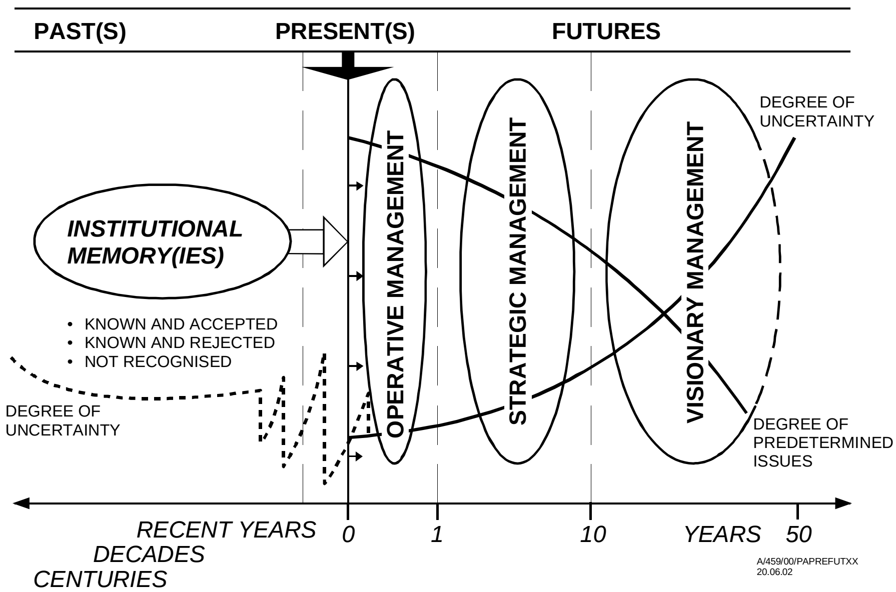


Figure 3. An overall framework for strategic management in relation to past(s), present(s) and futures (Kaivo-oja et al. 2004).

One of the key theoretical starting points of the study was the *path dependence theory*. North (North 1990, vii), one of the pioneers of New Institutional Economics, points out how history matters as "time and context". His understanding of history, however, is seriously deficient in two closely related respects. On the one hand, despite their allowance for path dependence, the models and concepts used are ahistorical, asocial, timeless, and universal. History, time and context are confined to the random shocks or whatever leads to one rather than another pre-determined, if stochastic, path to be taken. According to Margolis and Liebowitz (Margolis and Liebowitz 1997), technological lock-in is a lock-in to something bad, or at least a lock-out of something better. They further point out that these lock-ins, bad economic outcomes, are avoidable by small but prudent interventions. In a way, they are analogical to the *weak signals* that futures researchers commonly try to identify.

The division of the development stages of water supply and sanitation services into *three systems and three stages* is used in the comparative analysis. (Juuti 2001) When making comparisons, we should not be bound too much by time periods. We should explore the various levels of technological systems and services, such as:

1) Bucket systems	involving carrying
2) Protosystems	temporary and second best solutions
3) Modern systems	best available technology of the day.

Besides conventional research methods, the study also *utilises interactive research methods* – experience gained shows that such an arrangement is a necessity including research workshops held twice a year. In addition, two international workshops will be held in connection with other related research activities.

Hypothesis. It was hypothesised that dissimilar and differently timed city-infrastructure solutions may have worked well in their time. That also helps dispel the predestined, technologically deterministic view according to which water supply progresses unstoppably towards the modern, "right" solution. It also carries important implications for the current situation in developing economies. There are no colonial ties between the case countries. Still, it is hypothesised that the problems have been the same: poor governance, rapid population growth, and poor sanitation in the study period. It is also hypothesised that comparative, inter/multidisciplinary study could contribute much information to serve as a basis for policy development and good water governance.

Finland is *ideal* for studying the long-term development between the environment, technological change, health, and social change because the country underwent a radical change in all these areas at a relatively late stage. There is also *plenty of source material*, archival and published, covering and illustrating these changes. In addition to the general development in Finland, the project concentrates on local environmental conditions and public health policies of the first Finnish cities that founded water and sewage works. These Finnish cases are also research material; they illustrate how Finland became a “model country of sound water policy”. The main sources of historical research were official documents and minutes of the meetings of public health authorities, technical boards and other municipal authorities. Early networking of professional organisations and neighbouring countries is important for the understanding of the spread of ideas and technical models. Since the latter part of the 19th century the press has also been highly important.

Medical literature from different time periods was used to construct a joint historical view on the relationship between health and water. The importance of water for people’s health was widely realised by ancient writers, and the story of John Snow and the Broad Street pump from 1854 is famous in the history of cholera and epidemiology. Water-borne diseases are considered to have played a crucial role in shaping human history. (e.g. Grmek 1989; McKeown 1979)

Performers of the research, the GOWLOP team

The project consisted of four separate, interlinked case studies from Kenya, South Africa, Nepal and Finland.

The Kenya study: by Dr. Ezekiel Nyangeri Nyanchaga

So far no studies have been carried out on the long-term development of water supply and sanitation (WSS) services in Kenya, although the first projects date back to the pre-colonial period of the 1800s. There have been a lot of development projects over the years – the accumulated knowledge should now be collected and analysed. In several connections it has been noted that institutional and management issues together with the proper policy environment are the most critical factors in providing and producing operative water and sanitation services. Research-based historical knowledge is of utmost importance for understanding and developing such institutional frameworks. The suggested study is of very high social relevance. Development of WSS services is generally accepted as one of the cornerstones in poverty eradication. Lessons from past patterns in WSS are significant to present-day policy makers and implementers. (See chapter 2.)

The Nepal study: by M.Sc., Civ. Eng., doctoral student Sanna-Leena Rautanen

This case study contributes to the study on governance of water and environmental services in long-term perspectives by studying the period of 1956 to 2005 in Nepal. Prior to 1951, the end of the highly centralised Rana rule, very little interest was paid to the overall development of the country. The First Five Year Development Year was formulated for 1956-1961, this study following the time periods from then on until August 2006 when Nepal was stepping into a new era having gone through a prolonged period of internal conflict and serious political instability. In February 2005 the King assumed direct power, escalating the violence and making many development actors stay in standstill. At the time of writing this paper in October 2006 Nepal is stepping into a new era with the Government of Nepal, instead of *His Majesty's* Government of Nepal, and at the time of revising this paper in April 2007, the Maoist are in the Government, and there is a discussion about *Republic* of Nepal. Both national and international development actors have been resuming their development activities with a fresh confidence, including Finland which is a long term development partner of Nepal. This is truly the right time to learn from the past. (See chapter 3.)

The South Africa study: by M.A, doctoral student Harri Mäki

The main focus of the study will be the emergence of water management in four South African cities: Cape Town, Johannesburg, Durban and Grahamstown. The areas 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 city sectors and used technical solutions. Access to water services, possibly limited on the basis of race by colonial and local governments, will be also examined.

Four cities are selected for their different backgrounds. Cape Town is the oldest European-style city in South Africa. It was established by the Dutch in the 17th century; it is situated by the sea and is still the biggest city in South Africa. It got its first taps and iron pipes already in 1811, a year before Grahamstown was established. Grahamstown was established as a military camp and grew into an administrative and educational centre of the Eastern Cape. As it is situated inland, its problems with water management differed from those of Cape Town. Durban was established in 1824 by mostly British settlers in the middle of Nguni territory. Later on, Indian immigrants arrived in large numbers. Johannesburg is the youngest of the cities. It sprung up suddenly in the middle of the South African Republic in 1886 after gold was found in the area, and it soon became a multinational city. However, its location 60 kilometres from the nearest major river meant problems in water supply. As early as in 1887 the state established the Johannesburg Waterworks, Estates and Exploration Company to solve the problems. The geographical locations of these four cities are different, their ethnographic structures are different, and, initially, they belonged to different political units. A comparative study of how they solved problems related to water supply could illuminate the working of colonial governments and their tending to interracial relations. (See chapters 4–5 and 7–8.)

The Finland study: by Dr. Petri Juuti

The research carried out so far in Finland implies that there is wider variety and diversity in water supply and sanitation development than earlier research would suggest. In this study, further archival materials of many Finnish towns like Hämeenlinna, Porvoo, and Vaasa were studied. This material was the basis for analysing general development patterns and diversity. Moreover, focussed site visits to selected utilities and facilities in Finland were also organised for compiling data and verifying the results. Particularly long-term strategic decisions and key principles were looked into. Which factors are country-specific and which wider principles and practices could be potentially replicable also in other conditions, particularly in developing economies? (See Chapters 5–9.)

All cases were analysed and final comparative, inter/multidisciplinary analyses were made by the GOWLOP team in this comparative study which allow the researchers to distinguish between results and observations that are specific to the historical development of one country and ones that may apply to all countries. Some results are presented in the following eight chapters; some results were already presented in a book titled Environmental History of Water – Global views on community water supply and sanitation (IWA Publishing, 2007, London) by Juuti, Katko and Vuorinen (editors). Other results are presented in several peer review articles while some findings will be presented later on in doctoral dissertations by Mäki and Rautanen.

Members of the GOWLOP team in alphabetical order

Petri S. Juuti

Head of the IEHG group (www.envhist.org), Dr. Juuti (petri.juuti@uta.fi) is a historian and Docent/Adjunct Professor in Environmental History (at University of Tampere) and in History of Technology (at University of Oulu). He is currently working as a Senior researcher at University of Tampere. Previously he has worked as a Senior researcher for the WaterTime project funded by the European Commission, as an Assistant Professor (2002-2004) and as a researcher at University of Tampere and the Ministry of the Interior as well as for the business world. His major area of interest is environmental history, especially the urban environment, city-service development, water supply and sanitation, urban technology, pollution, and public policy. His interests also cover development studies, social and economic history and political history. He is the author of over a dozen books, the three latest ones are Brief History of Wells and Toilets (2005), Water, Time and European Cities (2005, with Tapio Katko), and Environmental History of Water - Global views on community water supply and sanitation. IWA Publishing, London, 2007 (eds. Juuti P.S., Katko T.S. & Vuorinen H.S.).

Tapio S. Katko

Dr. Tapio S. Katko (tapio.katko@tut.fi) is a Docent /Adjunct Professor in water services development at Tampere University of Technology where he heads the CADWES (Capacity Development in Water and Environmental Services) research group. He also holds a docentship in Environmental Policy at University of Tampere and in Environmental Sciences at University of Jyväskylä. He has several years of practical, teaching, and research experience in and for Finland; earlier in his career he also worked in Eastern and Central Africa. Dr. Katko's current research deals with institutional, management and policy issues and long-term development and strategies of water and sanitation services. He has written over a dozen books and monographs and some 50 peer review papers. In 1998 he received the Abel Wolman Award of the Public Works Historical Society, and in 2006 jointly with Petri Juuti the "Highly commended" Marketing and Communications Award of IWA in the category "Best popular presentation of water science ". In 1998-99 he was an International scholar of the Society for the History of Technology and he has also received three national writers' awards.

Harri Mäki

Harri Mäki (harri.r.maki@uta.fi) has a Master's degree in history from the University of Tampere. He is currently making his PhD work about the history of water supply in four South African towns around 1850 to 1920. He has been working as a researcher in various projects in the Department of History in the University of Tampere. His major area of interest is environmental history, especially urban environment, water supply and sanitation.

Ezekiel Nyangeri Nyanchaga

Dr. Ezekiel Nyangeri Nyanchaga (samez@wananchi.com), University of Nairobi, Department of Civil Engineering, Kenya, has more than 24 years of experience from planning, design and implementation of both rural and urban water supply and wastewater, irrigation and drainage, infrastructure engineering, urban water demand management, preparation of contract documentation and contract implementation, environmental impact assessment and audit, and preparation of operation and maintenance manuals for water supply and sewerage works. In particular, Dr. Nyangeri has been involved in the development of monitoring and evaluation systems and procedures for water supply and sewerage works. He has experience from performance evaluation for water supply projects. He is a registered engineer and licensed water and wastewater engineer and EIA lead expert registered by the National Environmental Management Authority. He is a senior lecturer, Department of Civil Engineering, University of Nairobi. He has a network of scholarly peers in Kenya and Finland who have been involved in similar assignments.

Sanna-Leena Rautanen

Ms. Sanna-Leena Rautanen (sannaleenar@gmail.com) has a MSc in Civil Engineering from Tampere University of Technology, Finland, where she is a post-graduate student and researcher. In Nepal she was the Field Specialist of the Rural Water Supply and Sanitation Support Programme. Her special areas of interest in the water and sanitation sector are poverty, gender and ethnic equity, good governance and democratic local development. Currently she is working as a Sanitation Specialist for the World Bank.

Heikki S. Vuorinen

MD Heikki S. Vuorinen (heikki.vuorinen@helsinki.fi) is an Adjunct Professor (docent) of History of Medicine at University of Tampere and University of Helsinki. He specialises in the history of public health and has written numerous articles on different aspects of the history of public health, a textbook about the history of diseases (2002) and a monograph about public health in Finland in the mid-19th century (2006). Dr. Vuorinen has for years lectured on different aspects of medical history, especially the history of diseases, at the universities of Tampere and Helsinki. Currently he is writing a textbook on medical history.

Other contributors to this book are Dr. **Henry Nygård** from Åbo Academy, Finland and Dr., Professor **Johannes Haarhoff** from University of Johannesburg, South Africa.

Now, in the new millennium, we face enormous environmental problems all over the world. At the Johannesburg Summit countries committed themselves to halving the proportion of people lacking access to clean water and proper sanitation by 2015. Is this possible? Historical study can provide solutions and even some evidence: Finland faced the same problems about 100 years ago and managed to solve them. Nowadays crises are more urgent because millions of people are moving into the major cities of the world's poorest countries. In the case countries, the City of Johannesburg, South Africa, had about 15,000 people in the 1880s while in 1970 its population exceeded 1.4 million. Today it has more than 2.4 million people. The City of Tampere, Finland, grew rapidly along with industrialisation; during the period 1835-1921 its population rose from about 1,600 to over 40,000. The problems faced by both cities were the same: rapid population growth and poor sanitation. In each case, the city was a cesspool, a kind of septic tank, and the urban poor had no sanitation facilities whatsoever. Especially children and women were in a great danger.

Cultures and traditional practices are rooted deeper in humans than organisational structures. For an organisational change to be sustainable in the long run, it has to reflect cultural and traditional practices. Efforts in water and sanitation sector development are not likely to be sustainable without attention to both formal and informal institutions. The roles and responsibilities, together with the underlying cultural assumptions, should be identified early enough to be able to plan and focus capacity building efforts properly. From field operations to the national and global level, circumstances seem to be in a constant state of change, for better or worse. Thus, water is a local issue is many respects. We hope that the following articles will further illuminate that fact.

Acknowledgements

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2. Historical Timeline on Water Governance in Kenya (1895-2002)

Dr. Ezekiel Nyangeri Nyanchaga, Department of Civil and Construction Engineering, University of Nairobi, Kenya

Introduction

This historical timeline article examines on the Kenyan context the water governance through determination who got what water, when and how and scrutiny of who had the right to water and related services. The analyses included review of the processes of interaction based on accommodation rather than domination. The paper covers a range of issues intimately connected to water from health to security, economic development, land use and the preservation of the natural ecosystems on which water resources depend.

The paper examines how good governance was enshrined in coherent and integrative nature, equitable and ethical use of the water resource, participatory, communicative and inclusive, enforcement of law and order, consensus oriented, open, transparency and accountability practices. Further, availability of quality water was pegged on the direct water governance.

Hence, the paper examines governance of water under different timeline administrative regimes in Kenya in the period between 1895 and 2002 as illustrated in Table 1.

Table 1: Historical Timeline on water Governance in Kenya

Year	Event
1088-1895	Advent of Europeans and the conquest by Imperial British East Africa (IBEA)
1895 to 1920	British East Africa Protectorate (BEAP), Uganda Railways as the main services provider
1920 to 1963	Kenya as Protectorate and Colony, state controlled water services
1963 to 1974	Independence, Water sector under the Ministry of Agriculture
1974 to1990	Post Independence; Water Act Cap 372 enacted, Water Sector under Ministry of Water Development.
1990 to 2002	Cost sharing, privatization and commercialization of water services and Water Act 2002 enacted.

Imperial British East Africa Company (Before 1895)

By 1880s, the inland areas of the present Kenya comprised a web of domestic economies of complementary nomadic and sedentary pastoral forms of production. Access to natural resources was secured through complex institutional arrangements based on geographical territories, a social-political age grade system and kinship (Jacobs, 1963). Although the first written water legislation in Kenya was put in place in the 1920s, it is clear that indigenous cultures erected institutions to control and manage water long before that (Sutton, 2004). Construction and management of these systems could not have been achieved without social organization and an informal institutional framework (Huggins, 2000). As time went on the Arabs, Swahili caravans and, from 1888, the Imperial British East Africa Company (IBEAC) penetrated the inland from the coast, all primarily interested in the export of ivory.

Despite this universal right to domestic water, certain water rights were allocated to groups or individuals for specific uses through a social negotiation process (Meinzen and Nkonya, 2005). Water was treated as a common good, but certain water rights could be acquired (Carlson, 2003). In times of water scarcity, tougher restrictions could be imposed on water uses and earlier rights hence revoked (Orindi and Huggins, 2005).

What sometimes could be perceived as an insecurity of tenure in customary water law could was a rational response to manage uncertainty in the physical environment. It's through flexible water rights, that the society was able to sustain and ensure effective and efficient water use. No cases of offenders or thereof punishment have been recorded, therefore it is assumed that enforcement of law and order was effective whether through kinship, socio-political age grade system or geographical territories.

British East Africa Protectorate (1895 – 1920)

Kenya was declared the British East Africa Protectorate (BEAP) in 1895, after the British Government bought out the (IBEA). After this, the construction of the Uganda railway began in Mombasa in 1896 and reached Nairobi in 1899 and later Port Victoria present day Kisumu City, in 1901 (Marsh and Kingsnorth, 1965). The Uganda Railways became the pioneer for the development of water supplies in Kenya. The first piped water supplies were developed and managed by the Railway to serve major towns (Colony and Protectorate of Kenya, 1913-1923).

From the beginning, the general water supply administration was undertaken by the Hydraulic Branch (HB) of the Public Works Department (PWD) under the Director of Public Works (DPW). The general remit of the DPW, with regard to water, was the administration of the Water Law in the Colony and undertaking hydro-graphic survey. In 1902 and 1903, HB opened offices in the colonial capital, Nairobi and Kisumu on Lake Victoria respectively. By 1910, HB had offices in the Rift Valley towns of Naivasha and Eldoret and in the Mount Kenya region in Nyeri (Nyanchaga and Ombongi, 2007).

When the Uganda Railway reached Nairobi, the population of the European raised drastically from 559 to 10,400 leading to sewerage disposal problems (Thorton, et al, 1948). Disease epidemics, such as 1902 and 1907 plaque in Nairobi played a major role in accelerating the need and consequent response to improve sanitation (Williams, 1907). In an attempt to cub the spread of diseases, propaganda/campaigns and sometimes coercion were used to ensure natives built and used latrines (Thomson, 1917).

The bucket latrine system was introduced to Kenya by the colonial administration around 1900/04. It was the earliest and remained widely used as mode of conservancy in Kenya in major townships by 1907. A lot of water was required for cleansing the buckets, which called for improvement of existing supplies (Williams, 1907).

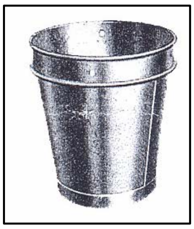


Figure 1: A handless sanitary pail (bucket). Measurements; 38 cm height by 33 cm top diameter (Reiners, 1960).

During this period, the African institutions were systematically eroded and the customary role they played was heavily circumscribed by its integration into the market economy. The controls of natural resources by customary authority, for example in the Maasai community, were weakened under colonial administration by land expropriation for the settler economy. In 1904-05, the British forcibly moved certain sections of the Maasai out of their grazing grounds to areas without water The Maasai chiefs were against the move as they argued that the proposed territory was not large enough and with limited water resources that sprang from European allocated areas (Lotte, 2006).

Private Sector Participation: In 1898, the first attempts to license a private water provider were made. However the private developer was not successful. By 1914, the large-scale European farmers played a key role in development of private water services mostly in their farms. In September 1914, the Government went into agreement with Captain James Archibald Morrison of the Upper Nairobi Township and Estate Company Limited for the supply of water to the up-market areas of Nairobi such as Muthaiga. The company operated until around 1923 when Muthaiga water supply was taken over by the Nairobi Municipal Corporation (Colony and Protectorate of Kenya, 1913-1923). In the 1920s, Mr. Sheikh Ali bin Salim a private operator, was contracted to supply the Kilifi town with water that served the public including Government employees in the station (British East Africa Protectorate, 1898).

Legislation*:* The Crown acquired, through Indian Land Acquisition Act 1894 and an Order in Council 1898, all land in BEA apart from some coastal areas (Lotte, 2006). The power to alienate land (waste or uninhabited land) was legalized by the East African (Lands) Order in Council of 1901 and passed by an Executive Council (Karuiki, 2005). This was replaced with Crown Lands Ordinance of 1902, which contained the first water legislation enactment that only covered the issuance of water permits (Sikes, 1926, and Nyanchaga and Ombongi, 2007).

The Crown Lands Ordinance of 1902 was repealed and re-enacted as the Crown Lands Ordinance of 1915 (Karuiki, 2005). It was under this provision that the Crown Lands Water Permit Rules of 1919 were enacted, giving the Director of Public Works Department the power to consent or refute to permit the abstraction of water from spring, river, lake or stream (British East Africa Protectorate, 1916). However, the legislation proved very inadequate and efforts were made towards comprehensive water Legislation (Nyanchaga and Ombongi, 2007). The imposition of governance principles that suited the few, colonial administration, was not ethical, led to inequity in distribution of resources and was not sustainable.

The immigration of the Imperial British East Africa Company brought about the assumption that there existed no water legislation, simply because there existed no written rules. Rather than through kinship, socio-political age grade system or geographical territories (common water law), the responsibility of water supply was vested in one institution, the Hydraulic branch. This disorganized and made the socially accepted water controls and informal institutional structures insignificant.

Kenya as a Colony (1920-1963)

Towards the end of 1920s, the state had taken over from the Railways as the main service provider of water in urban areas (Colony and Protectorate of Kenya, 1930). As the Public Works Department developed new township water supplies, some railway water supplies were abandoned and the Railways connected to the new supplies (Nyanchaga and Ombongi, 2007).

Use of bucket latrines dominated conservancy works in 1920's and 1930s with the development of townships, labour camps, schools etc. The pit latrines were prominent in native reserve areas and bucket latrines common in townships/urban areas and in labour camps (Sanitary Inspector, 1928). By 1934, approximately 3,350 buckets were attended to daily in the colony. This meant that more water was required than before particularly in urban areas. Ox-drawn carts were used exclusively for night soil collection (Commissioner for Local government, 1935).

On the other hand, in the native reserves various modes of sanitation were deployed. Bush, pit latrines, cat method, and compost latrines were the most widely used.

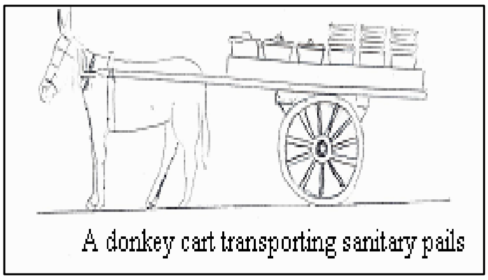


Figure 2: A donkey cart with buckets (Waddicar, 1959)

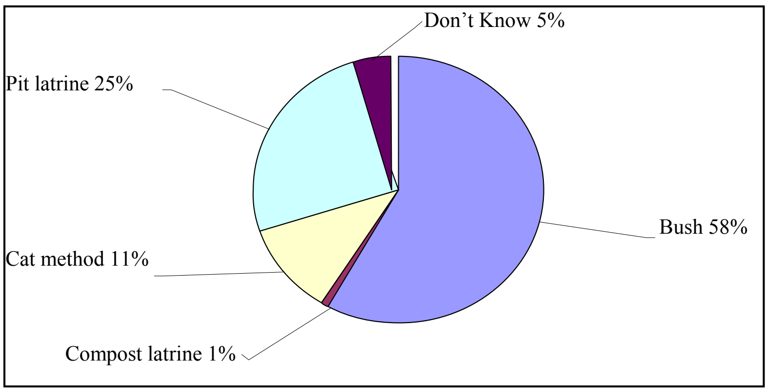


Figure 3: Traditional excreta disposal methods (BG Associates, 2001)

Largely, development of sanitation depended on availability of water and there was a need for institutional coordination. However, this was not always the case, for instance in 1934, the health committee of Mombasa recommended provision of free water to public latrines from the public works water supply. However, the public works refused and Medical Department stopped further public latrine constructions (Town

Clerk, 1934). Thus lack of clear separation of roles and responsibilities and lack of coordination among the departments retrogressed water and sanitation development.

Dixey scheme was put forward in 1943 and covered the water scarce areas of the Northern Frontier Districts (Dixey, 1950). After a pilot project, the Water Resources Authority recommended that water development in the Northern Province should be restricted to the exploitation of surface catchments and construction of pans, dams and tanks (Provincial Commissioner, 1951).

After the Second World War, the British government, under the Colonial Development and Welfare Act, invested in the British colonies to boost economic and social development (Fielhouse, 1999). Consequently, the colonial government, in 1946, launched an ambitious investment programme under the Development and Reconstruction Authority (DARA), which sparked off a rapid development of urban water supplies (Colonial Office, 1950) and African Land Development Board (ALDEV). It emerged with policies specifically aimed at intensifying arid and semi arid lands (ASAL) production (Provincial Commissioner, 1946).

The development of water supplies brought about high demand for proper sanitation. However, despite the demand, sewerage section under PWD was not introduced until 1950 (Member for Education, Health and Local Government, 1951).

In 1954, the colonial administration yielded to political pressure that had started in 1940 due to economic hardships in the reserves and introduced the third formal water development plan known as "the Swynnerton Plan" under the Ministry of Agriculture. The plan was aimed at intensifying African agriculture through mixed farming featuring improved cattle for dairying and increased cultivation of cash crops (Swynnerton, 1957).

Abuse of law by the white farmers on one hand and inability to enforce the law at the detriment of the natives on the other, were demonstrated by colonel Grogon's unconcealed disregard of the Provincial Commissioner protests at Jipe farm in 1950s. The PC was unable to enforce the Wayleave License and Water permit rules against Col Grogon who built and abstracted water from Lumi River before the Water Sanction and the Wayleave license were granted. This was even before the concerns raised by other riparian holders had been satisfactorily addressed, leaving the natives bitter and angry (Provincial Commissioner, 1952)

By 1955, there were no formal standards of water quality laid down in Kenya and the ones which were generally adhered to were those equivalent standards applied in the United Kingdom. This was a major omission on the part of the administration that led to complaints from private individuals regarding quality (Permanent Secretary, 1959).

The East Africa Royal Commission, 1953-1955, was established to guide the three East Africa territories into integrated development. The commission recommended creation of a single department in each territory to administer all aspects of water supplies, apart from urban supplies (Royal East Africa Commission, 1955).

By 1956, the Public Works Department faced problems of organization, management and finances; the minister responsible for water policy had no control over the Hydraulic Branch and the hydraulic engineer was not in complete control of the staffing in public works department divisions. The hydraulic branch faced acute shortage of staff, which led to delays and uneconomic and unsound water development. For this purpose Herbert Manzoni was appointed to enquire into reorganization of Public Works Department (Cabinet Office, 1957).

Among other recommendations, Manzoni recommended the transfer of the HB to the Department of Agriculture. Consequently, the government decided that all supplies in large towns be taken over by the Local Authorities and that the Ministry of Agriculture (MoA) should operate supplies in smaller towns (Colony and Protectorate of Kenya, 1957). The proposed organizational model outlived the colonial government by 25 years.

In the early 1960s, the ‘variegated’ nature of the water administration in Kenya continued just like in the decades before (Nyanchaga and Ombongi, 2007). At this time, three sections were involved in water supplies provision, The Ministry of Works (MoW), Water Development Department and the Local Authorities. This led to duplication of duties hence inefficiency in provision of services.

In August 1960, the Environmental Sanitation Programme commenced with the main objective to develop water supplies for the smaller rural communities. In addition to promoting awareness in the community of the benefits of adequate and safe water supplies, this integrated programme was concerned with improved methods of waste disposal in schools, health centres, markets and public meeting places (Wignot, 1974 and Nyanchaga and Ombongi, 2007).

Water Policy: Until 1940s, water development continued mainly in townships although there was no written national plan on how to mobilize the country’s water resources (Nyanchaga and Ombongi, 2007). Each township had its own water development plan.

In 1953, the colonial administration introduced emergency policy to control the mounting political pressure from the Africans (Campbell, 1956). This policy negatively affected the seemingly progressing water sector since the priorities of the administration shifted to containing political pressure rather than water development. This policy led to coercion of people to live secluded areas, the detention camps where overcrowding and lack of water and proper sanitation prevailed. The role of the three authorities that provided water was rendered redundant and drainage ditches, swamps and muddy boreholes became the water sources (Caroline, 2005). Based on the Principles of good governance, the colonial administration in all areas, failed.

Water Legislation: After the First World War, the process of introducing water legislation resumed. In 1922, Sikes presented a report called “Modern Water Legislation” (Nyanchaga and Ombongi, 2007, British East Africa Protectorate, 1923). However, the draft water legislation was not drafted into bill until 1928 due to economic recession of 1920s and fierce resistance from the white settlers. Her Majesty assented to the bill in December 1934 (Secretary of State for the Colonies, 1934) and it became the first Water legislation on July 1, 1935 (Colony and Protectorate of Kenya, 1935).

The bill vested all surface waters in the state and gave the authority for managing and enforcing the water law to a new government body - the Water Board. All water use- except for minor, domestic uses had to be granted through a permit from the water Board and riparian rights were protected. In order to satisfy the white settlers, the control and ownership of groundwater was left out completely (Colony and Protectorate of Kenya, 1929).

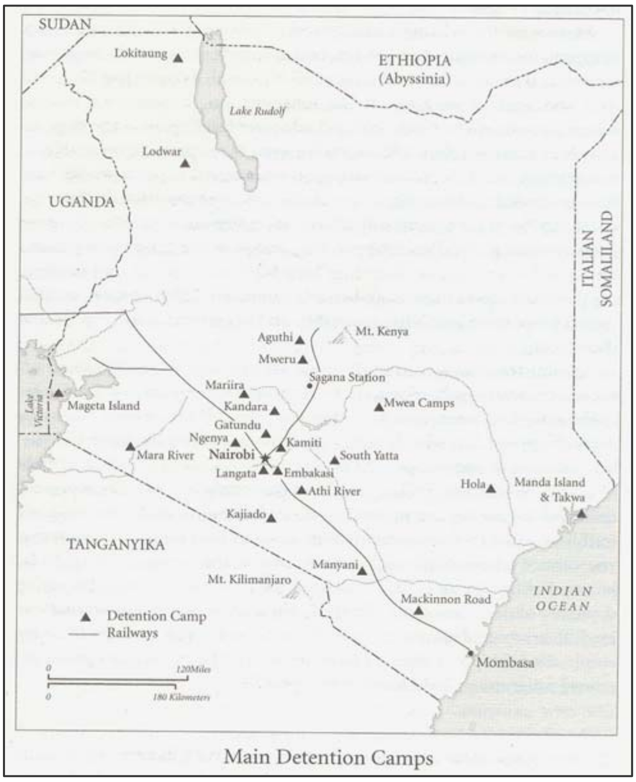


Figure 4: The map of Kenya showing the locations of the main detention camps (Caroline, 2005)

The concentrated efforts to develop water legislation focused on the quantity and neglected the quality. By 1930, pollution control rules contained in the Port Ordinance Cap 107 (East Africa Colony and Protectorate, 1904), Public Health Ordinance, 1921 (Colony and Protectorate of Kenya, 1921), and Water Ordinance, 1929 (Colony and Protectorate of Kenya, 1929a) had no clear mechanisms of evaluation, monitoring or prosecution. The control of pollution was described in form of a nuisance or health hazard only in cases where humans were affected (East Africa Colony and Protectorate, 1904).

The Water Ordinance of 1929 was revised in 1951 and the Minister for Agriculture was given the overall mandate over water development policy. The Minister in charge of water resources was mandated to appoint a Water Undertaker and select an advisory body to assist with policy and the implementation of the legislation (Colony and Protectorate of Kenya, 1929b). This was a bold step towards entrenching the principle of participation in water provision.

The rules controlling pollution of river by 1953 were the Water Undertakers Rules and the Pollution (Water General) rules enforceable by the Water Resources Authority, Public Health Authorities and the Water Apportionment Board. Standards were crucial since without them it was difficult to ascertain cases of pollution or institute prosecution (Colony and Protectorate of Kenya, 1931 - 1970).

The governance of water sector in Kenya appeared to have passed through two stages. The first stage was characterized by imposition of colonial rule, confiscation of land and water resources and impartial application of water and land laws, common in the period between 1920 and 1940s. The second stage involved concentrated efforts towards legislations that are more inclusive and extending water development to the African population. This period beginning late 1940 saw the revision of Water Ordinance, 1929 in 1951, and the implementation of Dixey scheme, Manzoni Report and Swynnerton plan among other major developments.

Independent Kenya (1963 – 1980)

After independence in 1963, the new government used five-year development plans to harness the rapid development of the republic. The first development plan from 1964-70 was mainly a carry-over from the colonial period whose focus was economic growth (Ochieng, 1995). Water development was declared important for the economy, and priority was given to schemes that were expected to be financially self-sustaining, such as water services for the municipalities (Government of Kenya, 1964).

Manzoni's recommendations were implemented in 1964 during which the Water Development Department was formed under the Ministry of Agriculture, Animal Husbandry and Natural Resources to deal with both rural and small towns. Post independent changes were crucial due to increased water demand spurred by the population growth, urbanization and industrialisation, and other factors that led to the expanded use of water (Tempelhoff, 2005). Developing marginalized and neglected areas was a step to integrate the African population in the development and bring about equity in resources distribution.

Until 1964, the Hydraulic Branch of the Ministry of Works (MoW) was responsible for water and sewerage development in urban areas. Rural water development was under ALDEV of the Ministry of Agriculture (MoA). The two organizations were amalgamated under the Ministry of Natural Resources (MoNR) in 1964 and later transferred to the MoA in 1968 when the Water Development Division was established. However, the responsibility for provincial setups of the division was divided between the Director of Water Development (DWD) and the Provincial Director of Agriculture. The distribution of authority and responsibility was vaguely defined leading to persistent weakness in management of water supplies (WHO, 1973).

By 1972, Kenya had seen an improvement in the coverage of sewerage system as shown in the figure 5.

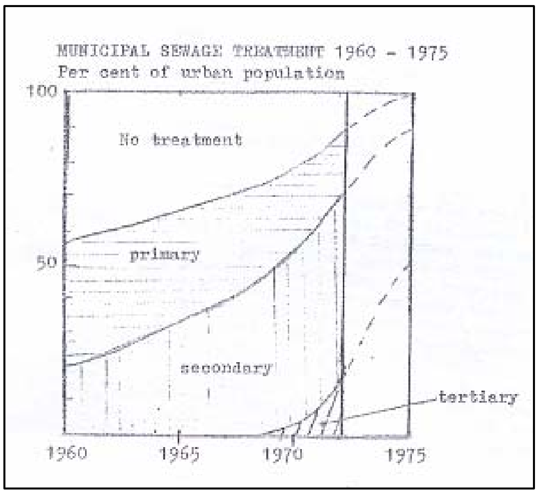


Figure 5: Municipal Sewage Treatment 1960 -1975 (Ligale, 1972).

Inter-Ministerial Committee for Rural Water Supply, was established in February 1969, a decision that was made by the Cabinet in order to accelerate the rate of community development. The committee had mandate to make recommendations and report to the Minister for Agriculture on financial policy, water charges, rate collection, scheme selection criteria and evaluation of rural water development among others (WHO, 1971).

In 1972, the Water Development Division was elevated to a Department and the Director of Water Development became directly responsible for the provincial organizations. The Water Department was given the overall responsibility for water development in the country (WHO, 1972). The Ministry of Local Government (MoLG) was in charge of water supplies in major municipalities (WHO, 1973).

Water Policy and Legislation

By 1965, the policy of cost recovery continued and all supplies were assessed from an economic viability point of view (Ministry of Natural Resources and Wildlife, 1965). Even the doctrinal Sessional Paper No 10 of 1965, which directed Government policy towards priority concerns for Africans prioritized alongside such services as transport, telecommunications and electricity (Republic of Kenya, 1965).

In 1969, due to widespread pollution and lack of any legislation or regulations that could sue and impose a sufficiently stringent penalty to an offender, the Ministry of Health drafted the Natural Waters Pollution Control Act. The intent of the proposed Act was to place the responsibility of pollution control squarely on the polluters back (Republic of Kenya, 1963-1972).

Around 1970, government policy shifted and water development became a prioritised area for intervention. Backed by a strong economy, the government developed an ambitious programme for a state-led expansion of water development in the Development Plan 1970-74. The programme had the objective of “bringing acceptable water supplies to all the rural population before 2000” (Nyanchaga and Ombongi, 2007). Consequently, the total government water expenditure increased more than six-fold (WHO, 1973a).

The Water Act (Cap 372) was deficient in providing an objective statement on what could constitute violation of law in so far as pollution was concerned. As a result, pollution problems in Kenya were normally handled on an ad hoc basis and only the most flagrant cases of pollution could be effectively controlled (WHO, 1973a). Due to this predisposition it was deemed that any new legislation on control of pollution should be made under the Water Act either by introducing a new part or formulation of pollution rules within the Act (Republic of Kenya, 1963-72). Therefore, in 1972, the Water Department released the Interim Report on the water Pollution Policy for Kenya which stated that the national goal to provide water for all in Kenya by the year 2000 need to go hand in hand with sewerage so as not to destroy the water sources through pollution. The report noted that 85% of the population at the time depended on untreated water (Ministry of Agriculture, 1972).

The succeeding years after formation of Water Pollution Control and Monitoring Unit in Water Department of the Ministry of Agriculture in 1973 saw intensive concerted effort towards pollution control. However, enforcement was affected by lack of the seriousness on pollution, multiplicity of regulations, cumbersome legal procedures, and lack of trained enforcement personnel. At the same time, there was no single organization fully responsible in administration and enforcement of law (Ministry of Agriculture, 1972).

In this period, commitment towards the advancement of the citizens was discernible. Efforts were made in order to control and maintain high quantity and quality of water for all. The government and international organization collaborated towards this.

Post Independence (1974 - 1980)

In November 1974, a fully-fledged Ministry in Charge of Water affairs was created. The Government's decision to create such a Ministry was due to the increasing awareness that water supply and environmental sanitation were the biggest contributors to acceptable health standards. One of the Ministry's first decisions was to take over the management of not only government operated water schemes but also self-help and County Council operated schemes. Within its first decade of creation, major development programmes to provide improved water supplies to the people in rural areas and improvement and extension of services in the urban areas were undertaken (WHO, 1973).

The first attempt to coordinate and streamline planning in the water and sanitation sector came as early as 1974 when the First National Water Master Plan, developed with assistance from the government of Sweden was launched. Implementation of the master plan was not effective because government development activities were then based on project approach, perceived to have several weaknesses that included, piecemeal planning, donor-driven investments, little incentive to minimize costs compromised technical standards and gradual undermining of government systems especially at local level (Ministry of Water and Irrigation and Water and Sanitation Program-Africa, 2007).

By 1979, it was obvious that the government's goal of "water for all by year 2000" was not achievable. The government accordingly reformulated its goal in the Development Plan for 1979-83: "to have an adequate water supply available to the entire population soon after the year 2000" (Republic of Kenya, 1979).

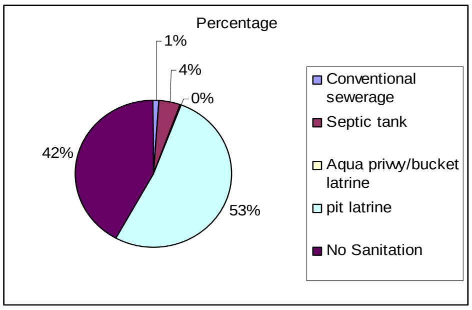
This period witnessed a very high level of participatory development through emergence of self-help water projects, environmental sanitation projects, interministerial committee for rural water supply, among other initiatives. Ministry of Water Development saw conservation of environment prioritized and a secretariat established. There was a deliberate effort toward achieving equity in distribution of water supply as the government collaborated with international organizations and other governments in rural water development. However, pollution was not adequately addressed despite the formation of Water Pollution and Monitoring Unit.

Post Independent Kenya (1980 – 2002)

At the start of this period, the water sector was characterised by very poor financial performance to expand services as planned (Nyanchaga and Ombongi, 2007).

A survey conducted in 1983 and reported in the sanitation filed manual for Kenya by Mathenge et al showed the percentage of Kenyans (millions) served by the most common sanitation technologies:

Figure 6: The population percentage served by various waste disposal techniques, (Samez Consultants, 2004)



In the late 80s, there was a break with past policies with more emphasis on participation for progress and resource mobilization to attain sustainable development. After 1988, rural development was no longer of central focus in policy circles, instead, there was movement towards cost sharing, retrenchment, sale of parastatals and privatisation etc of some government functions, price and import decontrols, removal of government subsidies, and budget rationalisation away from social programmes (Republic of Kenya, 1994).

On June 24, 1988, through Legal Notice No. 270, the President ordered that the National Water Conservation and Pipeline Corporation (NWCPC) be established, under the State Corporations Act. NWCPC supposed to operate those water supplies placed under its care on commercial basis (Nyangeri, 2003). The main objectives were to commercialise water sector operations by determining the charges for water supplied by the Corporation and establishing water tariff structure for any particular consumer. (Nyanchaga and Ombongi, 2007).

The First National Water Master Plan (NWMP) remained the main guiding plan for water development until 1992 when Japan International Corporation Agency (JICA) in conjunction with Kenya Government formulated the second NWMP (Japan International Corporation Agency, 1992).

By 1990s, it emerged that the government lacked sufficient resources to match communities' water needs. In response to unmatched resources to provide water for all by the year 2000, the government developed the National Policy on Water Resources Management as Development Sessional Paper No. 1 of 1999, which was first drafted in 1992.

Up to early 1990s, the implementation of rural water supplies were based on supply-driven approach (SDA) development strategy with high construction targets that left little opportunity for community involvement. The SDA strategy was found to be non-viable and thus a demand-driven approach (DDA) strategy was introduced (Skytta, et al, 2001).

Due to economic recession in this period, Non-Governmental Organizations became increasingly the key players in the development process. Non-governmental organisations (NGOs) participated in the development of community water supply and sanitation both in rural and urban areas. They entered into partnership with national and international agents and pioneered new techniques and approaches in participatory methods at the grass-roots level (Ministry of Water Development, 1992). SIDA, NORAD, Finland Government, German Government development Agency and Japanese International Agency were among the major participants.

The 2002-2008 National Development plan indicated that out of the 142-gazetted urban areas in Kenya, only 30% had sewerage systems (Republic of Kenya, 2002a). The governance of water was in the year 2002 held back by lack of coherence and integration in its services.

Privatisation and Commercialization of Water Sector

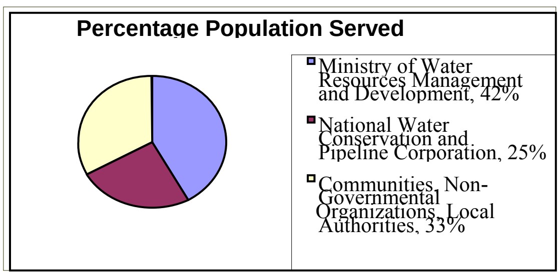
In Kenya, privatization first became a major policy tool in the 1980s with the IMF-World Bank imposition of Structural Adjustment Programs (SAPS) which forced the governments to free markets and pull of out of loss making state enterprises (Anyang, et al, 2000). By the year 2002, public institutions, which after independence held water more as a social good, were unable to render effective service hence paving way for the private sector to inject commercial values to water supply in the country (Nyanchaga and Ombongi, 2007).

Through commercialization, the Water Act required Local Authorities to form autonomous water and sewerage companies with independent boards of directors to provide water services and re-invest water revenues in service delivery improvement. The boards were also vested with powers to license private water companies which could be a potential source of conflict with Local Authorities (Wambua, 2004).

To carry out the commercialization of the services, the Ministry of Local Government with the support of the Germany Agency for Technical Corporation (GTZ) established the Urban Water and Sanitation Management (UWASAM) project aimed at assisting local authority in self-sustainability for their water and sanitation services through commercialization and privatization. It was recognized that if the financial viability was to be attained, financial autonomy from the urban councils was required. However, this could not solve those problems due to political expediency, inefficient bureaucratic procedures; diversion of water revenue to unrelated expenditures, and difficulty in the recruitment and retention of competent staff at all levels (Urban Water and Sanitation Management Project, 2001).

Figure 7 represents the number of water supply systems in Kenya by the year 2000 managed by various agencies. These systems supply water services to about 14.7 million people, which meant average service coverage of 46.5 per cent of the estimated total population of 31.6 million people (Aide M'emoire, 2000).

Figure 7: Number of water supply systems in Kenya by service provider and population served



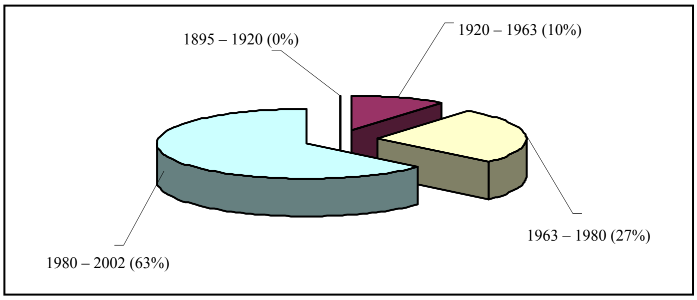


Figure 8: Number of sewerage treatment works constructed between 1895–2002 (BG Associates, 2001).

Water policy and legislation

The Presidential directive of April 1981, revised the then existing rural tariffs. The directive abolished temporary metered rural tariffs and unified official rural tariffs throughout the Country in place of the then existing geographically different tariffs. This directive started the direct influence of politicians on the policy in the water sector (Republic of Kenya, 1975). The directive lacked relevant consultation, coherence or accountability.

Under the District Focus for Rural Development introduced in 1983, people were directly involved in the identification, design, implementation, and management of projects and programmes. This made the development more consistent with the needs and aspirations of the citizenry. The decision-making structure centred on the districts minimized the delays that often characterised centralised decision-making systems. Resources were consequently equitably direct resources to areas of most need (Alila, 1988, Nyanchaga and Ombongi, 2007).

In 1992, the Ministry of Water Development released two important documents that continued to guide the sector up to the end of the decade. One was the Delineation Report whose main outcome was a defined and improved definition of roles, functions and responsibilities of the principal actors in the sector, the MOWD and NWCPC. On the other hand, the National Water Master Plan set out long-term plans for the much-needed reforms in the management and development of the water sector. One of the most important recommendations to come from the two reports was that the Ministry should develop a water policy (Nyanchaga and Ombongi, 2007).

Subsequently, between 1995 and 1999, the ministry was involved in a policy development process for the sector. This was published as Sessional Paper No. 1 of 1999 under the title "National Policy on Water Resources Management and Development". The policy spelt out the need to decentralize the decision-making in the water sector, but failed to explain clearly, where the services would be decentralized (Republic of Kenya, 1999a). It underscored the need to place water and sanitation services under single utilities in view of the close linkages in operations, maintenance and commercial aspects. Increased role for the Private Sector in service delivery and the role of communities in service provision were emphasized (Ministry of Environment and Natural Resources, 2001, and Nyanchaga and Ombongi, 2007).

Environmental Management and Coordination Act 1999 law was enacted to provide for environmental protection through coordination of the diverse sectoral laws (Republic of

Kenya, 2003). The law made provisions for the establishment of the National Environment Management Authority (NEMA), which has the statutory mandate to supervise and co-ordinate all environmental activities (Republic of Kenya, 1999b).

The National Policy on Water Resources Management Development sought to enhance systematic development of water facilities in all sectors for promotion of country's socio-economic development progress while recognizing the by-products of this process as wastewater. In this regard industries, business development were required to develop waste management systems to handle wastewater and other wastes emanating there from. As a follow-up, EMCA requires annual environmental audit to ensure continuous improvement on the recommendation from the previous audits. In addition, the policy provided for charging levies on wastewater based on quantity and quality of effluent. Further, the policy required those contaminating water to meet the appropriate cost of remediation. The policy provided for establishment of standards to protect waters-receiving wastewater (Republic of Kenya, 2003).

The National Water Policy recommended the revision of Water Act, Cap 372. This Act held up until 2002 when a new act known as Water Act 2002 was enacted in response to increasingly complex administration of the water sector. The Water Act 2002 was enacted with new institutions specified in the new decentralized setting (Nyanchaga and Ombongi, 2007). Decentralization leading to accountability and efficiency was the cornerstone of the Act and called for a clear separation of functions within the sector (Republic of Kenya, 2002b). The Act sought to address all the shortcomings that resulted in wastage, manipulation and abuse of water sources and services. The Act still had its weaknesses, but a bigger problem than inadequate legislation and regulations was poor enforcement and compliance (Nyanchaga and Ombongi, 2007).

A scrutiny of the study on establishment of public sewerage system database in Kenya shows that there are various undertakers of water and sewerage facilities in Kenya. However, there lacks coordination and duplication of duties. Only public companies provide both water and sanitation in various townships. The Ministry of Water provides water in some towns such as Kiambu and Homa Bay yet provide both water and sewerage in others such as Limuru. Entangled in such position are the Local Authorities who provide sewerage services only in some townships but both water and sewerage services in others. Both the ministry of water and the National Water Conservation and Pipeline Corporation provide water in Kiambu yet none provided sewerage services (Samez Consultants, 2004).

Conclusions:

The analyses of water governance along different regimes present a diverse overview of the growth of water sector in Kenya as each period had its unique governance implications. Through simple and all-inclusive institutional set ups, traditional societies effectively sustained water resources. The assumedly social order disintegrated through superimposition of skewed statutory law brought about by the advent of the IBEA and BEA.

However, incessant agitation for equity in distribution of resources led to gradual inclusion of Africans in decision the development and decision-making process. With time polices directed towards the marginalized majorities were formulated and implemented. Proliferation of NGOs, privatization and commercialization were responses towards dynamic economic trends in the post independent Kenya. As a result, some of the goals have not been reached due to limiting financial capacity among other hindrances.

Way Forward

Kenya's water sector faces many challenges principally, the need to improve efficiency in service delivery. The experiences of some Kenyan towns indicate the window of opportunity that well thought out commercialisation can create in service provision. The ability to pay must be fully considered and differentiated tariffs developed to ensure an adequate supply of clean, safe water across the board. As water is a human right, it should therefore be treated carefully compared to any other commodity

Political environment in the country affects the water sector. A number of 'policy' issues affected decisions on the description of responsibilities within the water sector. The long-term cooperation commitment in water sector, say 20-30 years subject to in-depth dialogue every five years, between GOK and donor agencies would allow the formulation of policies and procedures more appropriately.

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3. Past Drivers for the Future – Case Nepal

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Introduction, Objectives and Methodology

This case study contributes to the study on governance of water and environmental services in long-term perspectives by studying the period of 1956 to 2005 in Nepal. Prior to 1951, the end of the highly centralised Rana rule, very little interest was paid to the overall development of the country. The First Five Year Development Year was formulated for 1956-1961, this study following the time periods from then on until August 2006 when Nepal was stepping into a new era having gone through a prolonged period of internal conflict and serious political instability. In February 2005 the King assumed direct power, escalating the violence and making many development actors stay in standstill. At the time of writing this paper in October 2006 Nepal is stepping into a new era with the Government of Nepal, instead of *His Majesty's* Government of Nepal, and at the time of revising this paper in April 2007, the Maoist are in the Government, and there is a discussion about *Republic* of Nepal. Both national and international development actors have been resuming their development activities with a fresh confidence, including Finland which is a long term development partner of Nepal. This is truly the right time to learn from the past.

The general objective of this case study is to enhance our understanding of the development of water use, water supply, water pollution control and sanitation services, and their overall long-term political, economic, social, cultural, technological, environmental and health impacts in Nepal. This paper focuses in local governance issues as they relate to water and sanitation sector in rural Nepal. It focuses on the local institutional development and local governance from the perspective of the local governments and the Water (and Sanitation) Users Committees (UCs).

The methodology comprises various qualitative approaches. Literature review formed the basis which was further supported by the research material collected during the 2002-2004 in the Rural Water Supply and Sanitation Support Programme Phase III, a Nepal-Finland cooperation project which run for nearly 14 years in the Western Development Region in Nepal. A number of case smaller case studies within the broader "GOWLOP" framework have been presented in various articles and conferences. This paper presents background research for these cases, including such as PESTE-analysis as a framework contributing to a holistic view of various development phases. Some of the leading questions for all cases have included such as what is effective, what really entails local water governance, what makes or breaks the sustainability, and what is sustainable after all in this country of natural and man-made instability? The research questions included: How did Nepal attempt to solve its water and sanitation challenges, and what were the key lessons learned?

Nepal at Glance

The Kingdom of Nepal is a landlocked Himalayan country bordered with China in the North and India in the South. Ancient Indian cultures from the South and Tibeto-Burmese cultures from the North have influenced Nepal, and the impact is seen in the cultural, ethnic and linguistic diversity. This mountainous country of 23.5 million people has more than hundred caste/ethnic groups and some 60 distinct languages or dialects. The climate ranges from tropical Terai at Southern belt to Himalayan mountain range in the Northern Region, the lowest point being 70 m at Kanchan Kalan and the highest at 8,848 m at Mount Everest. Geographically and economically Nepal belongs to Indo-Gangetic plain, the Himalaya-Ganga representing a complex highland-lowland interactive system with diverse biophysical and human built environments.

Water has many deep ritualistic meanings in various traditions, Hindu, Buddhist or animistic alike. Many sacred rivers of the Hindu religion have their origin in the Himalayan range, particularly in Nepal. Water shapes and touches all aspects of life, from worship to location of the settlements, from agricultural practices to logistics. Nepal is rich in water resources and one of the Asian countries with the highest level of water resources per inhabitant. (FAO 2002)

Nepal was controlled by a hereditary and highly centralised Rana primeministership between 1846 and 1951. Until 1950s the majority of the people lived in medieval conditions with a very little attempt to develop anything. The first party in Nepal was established only in 1946, and the first constitution of Nepal was done in 1948. Nepal joined the United Nations in 1955. During the late 1950s the diplomatic missions were established, marking the beginning of the foreign aid and development projects to Nepal. The Development Board Act 1956 facilitated the entry of multilateral lending agencies, although it was only in the 1970s when the World Bank and the Asian Development Bank got involved. (Sharma 2004, 48)

Nepal is still today a predominantly rural society with more than 80 percent of the population living in the rural areas. Extreme slopes, high snow blocked passes, flooding rivers and land slides, as well as tropical lowlands with tropical hazards have historically led to the evolution of strongly localised cultural and religious patterns, and persistent poverty. However, there has been some encouraging progress since Nepal started to modernize its public administration and infrastructure over 50 years ago. Since the 1970s foreign aid has played a significant role in the economy of Nepal and access to many basic services such as primary education, health care, electricity and water supply, have improved steadily. (World Resources centre 2005) Human Development Index as defined by the United Nations Development Programme (UNDP) has improved steadily in Nepal. Yet, measured by this index, Nepal remains behind other South Asian countries except Pakistan. (Nepal Human Development Report 2004, 17)

The state involvement and humanitarian interest in well-being of all people in Nepal, including the remote rural areas, is fairly recent. The regional disparities within Nepal are still drastic, and despite the development efforts over the past decade and economic growth due to opening up a previously closed economy, Nepal remains one of the poorest countries in the world with the per capita income of USD 230 per year. According to the World Development Report 2005, 42 percent of the total population and 44 percent of the rural population live below the national poverty line. Assessed against the international poverty line, 37.7 percent of population live below 1 USD per day, and 82.5 percent below 2 USD. (World Bank 2004) A poverty assessment made in 2006 concluded that the incidence of poverty had declined from 42 percent in 1995-96 to 31 percent in 2003-2004, and identified that household income changed substantially with income from remittances. It was estimated that more than 1 million Nepalese were working abroad in 2003-2004, the worsening security situation encouraging more young people to seek opportunities elsewhere. (World Bank 2006)

The prolonged political instability, human rights violations and such governance problems as corruption, lack of transparency and missing democratically elected local governments clearly undermine many efforts. Peace and security are truly prerequisites for achieving sustainable development anywhere. The main threat to sustainable development in Nepal was the present conflict which is yet to be fully resolved. According to a European Commission report:

> The conflict emerges from a complex matrix of interacting factors. The most visible of these are the Maoist insurgency and poverty but, though the latter is frequently given as the single root cause of the insurgency, in fact it is the result of an intricate web of political and social factors at the national and local levels, which is much less visible. These factors are those which sustain and reproduce the inequalities and poverty fuelling the Maoist conflict. Successful conflict reduction initiatives must take into account and address these underlying factors as well as poverty alleviation, economic development and political mediation. (Hollants van Loocke & Philipson 2002)

These are certainly words to bear in mind now when stepping into a new era.

Population and Health

The main constraints for any development effort include illiteracy, difficult terrain, lack of trained manpower, and limited resources. (Ministry of Population and Environment 2002) The current estimated population growth of 2.3 percent per annum is considered yet another reason for persistent poverty and a reason why the economic growth has not improved noticeably over the years. The population growth in urban areas is even higher at 5.5 percent. (Nepal in Figures 2001) (Figure 1) Population growth has not helped the poverty alleviation efforts. Instead, among the other things, it has led to fragmented land holdings and depletion of forest products, the ratio of population to arable land being one of the highest in the world. (Nepal in Figures 2001) Numerous young Nepali have migrated to other countries in seek of better livelihoods and to support their families left in the villages, many also due to the security problems in the remote areas.

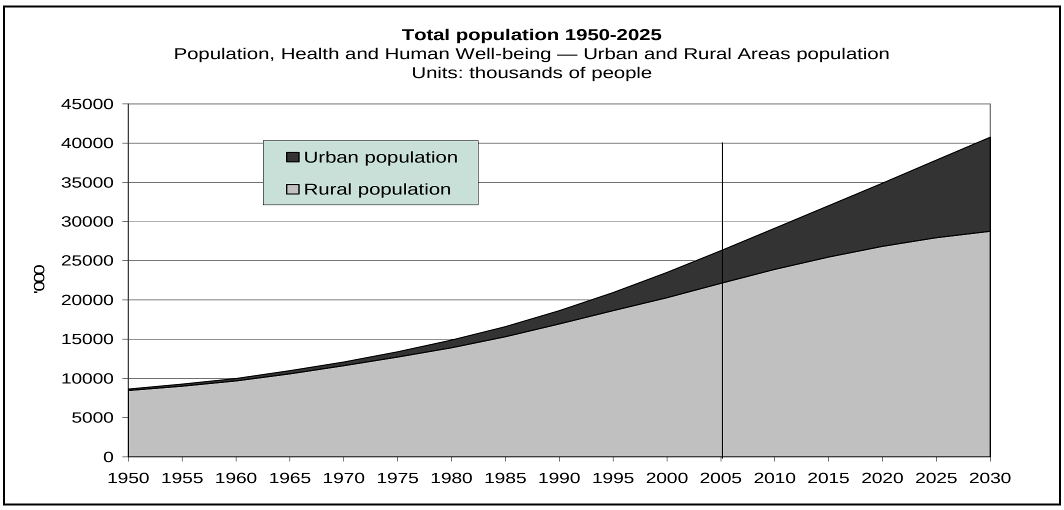


Figure 1. Population growth in Nepal.

Average total fertility rate has changed from six (1975-1980) to four (2000-2005), being still higher than in Asian countries in average. Life expectancy in Nepal has gradually increased faster than in the World in general. Yet, at 60 years, it is still lower than neighbouring South Asian countries. Fast changes are evident during the recent years as the life expectancy at birth has increased from 55 years for males and 53.5 for females in 1995 to 58.9 years (both male and female) in 2001/2002. (WHO 2004) The Ministry of Population and Environment (2002) notes that in 1954 the life expectancy of males was only 27.1 years and for females 28.5 years.

The reduction in infant mortality rate has been a major contributory factor to increased life expectancy: the infant mortality rate has dropped from 101 (per 1,000 live births) in 1990, to about 62 in 2002. (World Resources Centre 2005) Yet, it is still among the highest in the region. Due to high maternal mortality, life expectancy for women has been lower than for men. (Ministry of Population and Environment 2002) Note that there are no reliable statistics as many births and deaths go unreported, and the population census does not reach all. (Figure 2)

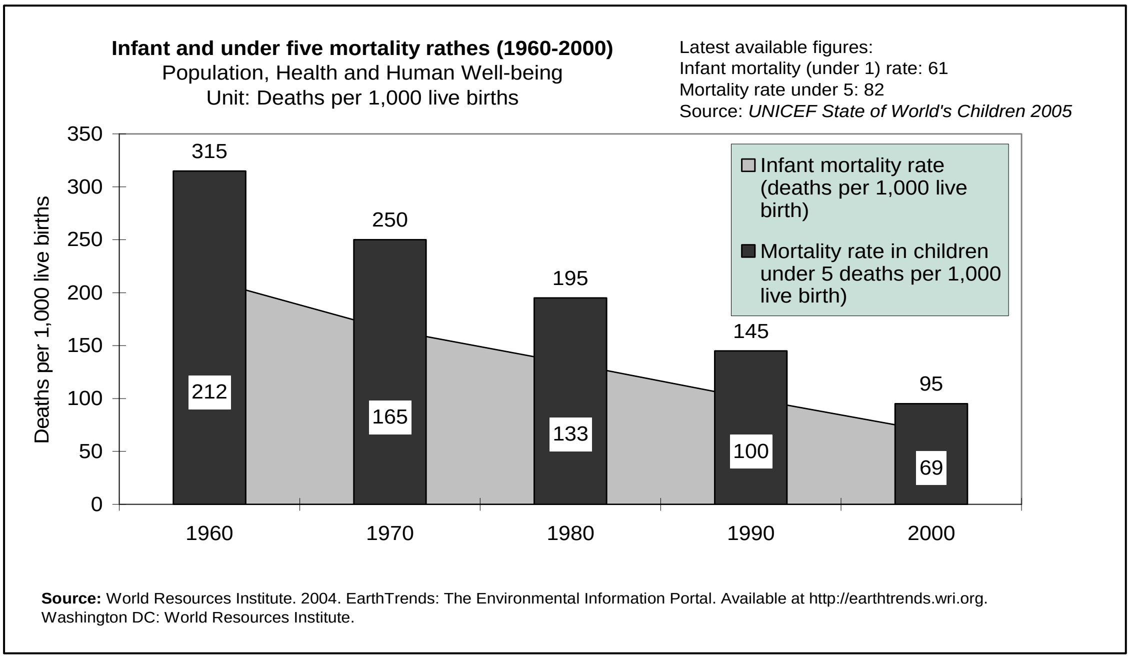


Figure 2. Infant and under five mortality rates (World Resources Institute, 2004).

Health is about human well-being and in many ways linked to water and sanitation. Until the mid 1900s there were a high mortality in Kathmandu Valley due to cholera, typhoid and smallpox. Poor sanitation, lack of education, poor nutrition and absence of health care services added to the high morbidity of the general public. Physical access to health services in Nepal has improved over the last ten years. This is due to sub-health posts in each VDC. (Nepal Human Development Report 2001, 40) Yet, the health care system reaches only 15 percent of the population. (Nepal Human Development Report 2004, 54) Even in those areas where the access to health services has improved, quality of service remains poor and because of the recent turmoil, the situation is likely to be even worse. Especially in rural areas the health services are either very poor, or unavailable because of the lack of medical supplies, supporting facilities and/or trained health personnel. (Nepal Human Development Report 2001, 41-42) In the management of the health services the Local Self-Governance Act 1999 envisaged a significant role for the elected local bodies. It is also recognised that the community management of local health services is essential in delivery of primary health care. (Nepal Human Development Report 2001) Assistance from international donor agencies still continues to play an important role in the provision of health care.

A typical water and sanitation related health indicator is diarrhoea which in Nepal accounted for 16-25 percent of childhood deaths in early 1990s. (Nepal Human Development Report 1998, Table 4.3, 59) Skin diseases, worms, diarrhoea, dysentery, and gastritis can all be linked to water supply and/or sanitation, Figure 3 below giving an overview of significance of these ailments in Nepal during an example year. Note that majority of childhood diarrhoea, skin diseases and other common illnesses are not even reported, or are such a regular work at a health post that the health personnel are not keeping records of all cases. However, diarrhoea is listed in official hospital records as one of the five leading causes in both mortality and morbidity. (WHO 2004) The health problems of poor water supply have been recognized since the First Five Year Plan.

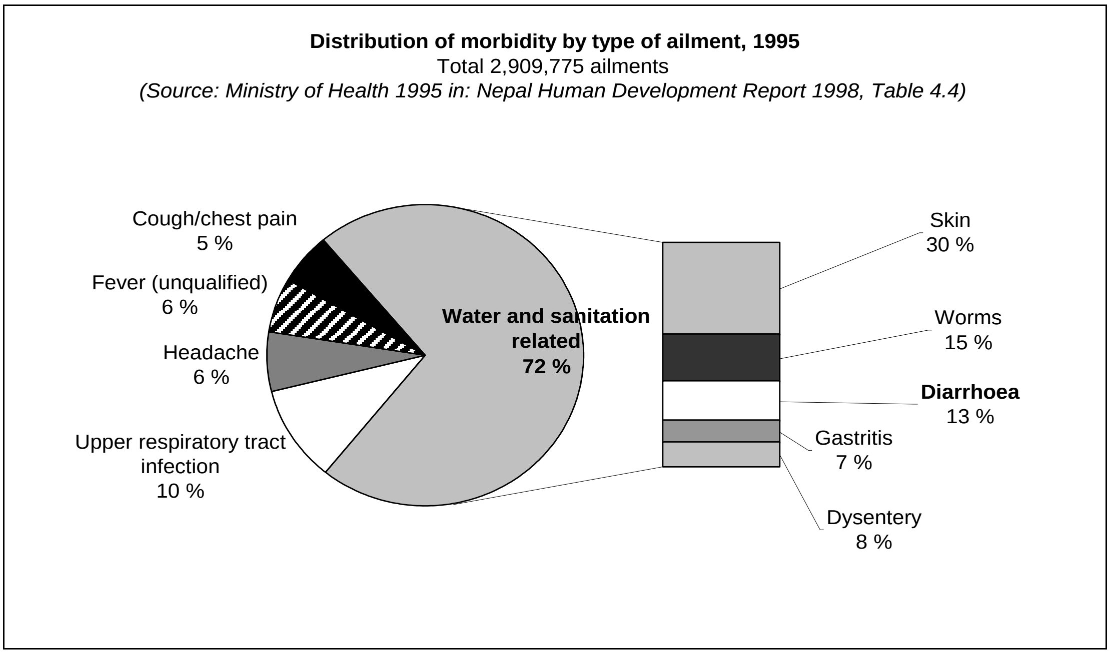


Figure 3. Distribution of morbidity by type of ailments 1995 (Ministry of Health 1995, in Nepal Human Development Report 1998)

A National Health Policy in Nepal was formulated in 1991 to address service delivery and the administrative structure of the health system. The Eight Health Plan (1992-1997), the Ninth Health Plan (1997-2002) and Second Long Term Health Plan (1997-2017) were developed in keeping with the policy. They aimed at development of integrated and essential health care services at the district level. An active community participation and mobilization of the private sector to develop general as well as specialized health services was emphasized in a very similar manner to rural water sector. The following were identified as the main constraints: *frequent changes of government, limited national resources, centralized administration, ineffective management and supervision, difficult geographic conditions and slow economic* *growth.* (WHO 2004) These are relevant constraints to many other sectors as well, including rural water supply and sanitation.

Nepal, Local Governance and Water

Many consider governance as relating to formal institutions and, more specifically, to the management of the state and its people by governments. Yet, private institutions, such as community-based and non-governmental organisations (CBOs and NGOs), are part of this equation and have roles to play in governance. They include the water users groups that represent local governance and grass-roots democracy. Their members are local people with local interests, and they often share indigenous knowledge of the local environment and changes in it. They are the key actors locally who build sustainable futures. Yet, translating the concept of sustainability into practice is difficult as the communities often struggle to meet the needs of the *present* – for many communities future is now.

The concept of *local governance* in this paper is defined as “the formulation and execution of collective action at the local level”. (Shah 2006) It encompasses the direct and indirect roles of both formal and informal institutions, the formal ones being presented by the local governments and other government functionaries active at district level as well as other institutions formally registered and therefore, legally acknowledged, and the informal institutions constituted by the local communities, various interest or ‘users’ groups, and traditional practices of decision making which may not be “formal” but yet, clearly significant in the local context.

Some form of local governance is an ancient practice in Nepal due to geographical realities and the fact that until 1768, what is now known as “Nepal” was made of a large number of small kingdoms and city-states. Over these years, the definition of “local government” has evolved from centrally appointed “*Panchayats*” to elected representatives. Decentralisation as a concept and a process has evolved as well, and its functional application to democratic local development is yet to be fully realised. As a theme decentralisation continues to be a key driver in various political agendas. One of the most recent formal attempt to institutionalise the practice was the Local Self-Governance Act 2055 (1999) (Local Self-Governance Act, 2055 (1999)) was meant to, in accordance with the Constitution of the Kingdom of Nepal 1990, to:

> Institutionalise the process of development by enhancing the participation of all the people including the ethnic communities, indigenous people and down-trodden as well as socially and economically backward groups in bringing out social equality in mobilizing and allocating means for the development of their own region and in the balanced and equal distribution of the fruits of development (…) (Local Self-Governance Act, 2055 (1999), premeable)

The present day Nepal is administratively divided into five development regions and 75 administrative districts (District Development Committees, DDCs). Districts are further divided into smaller units, whether Village Development Committees (VDC) or municipalities. Currently, there are 3914 VDCs and 58 municipalities in the country. Each VDC is composed of nine wards, and in a municipality there are 9 to 35 wards. Each VDC, DDC and municipality should have their democratically elected representatives. Kathmandu is the capital city and since ancient times the centre of power and wealth. Kathmandu Valley was already the centre of power, culture and development in the early Kingdom of Licchavis.

Local water governance is an ancient practice. Irrigation management appear in the earliest known Licchavi record from 464 AD. Local village-based decision making and communal irrigation management have roots here. Agriculture-based economy was already based on rice and other grains at that time, the local matters being managed by the village assembly of leaders (*panchalika, grama pancha)*. Among the additional labour works *(Vishti)* allocated for the peasants was the maintenance of irrigation works. (Nepal Country Studies)

Still today some 99 percent of the total water withdrawal is for agriculture, *i.e.* for irrigation. The figures are estimated as no irrigation system as such actually measures the volume of water. There are numerous small canals *(raj kulos)* from the seventeenth and eighteenth centuries, constructed by the government sector in and around Kathmandu Valley. The first large public sector irrigation canal system *(the Chandra Canal System)* with a net command area of 10 000 ha was constructed in 1922 and is still in operation. Irrigation remains an important issue as it contributed 40 percent of GDP in 1996 and majority of the people work at the agricultural sector. In mid-1990s it was found that of the total estimated irrigated land, 25 percent were public systems and the rest farmer managed systems. Of the public systems, 91 percent of total water withdrawal was from surface water. Non-formal associations have existed for a long time in almost all farmer managed irrigation systems. Water Users Associations received legal status after the promulgation of the 1992 Water Resources Act, and have since become a prerequisite for the transfer of public schemes to users, similar to drinking water users associations. (FAO 2002)

The first piped water was brought to Kathmandu in 1891 in the form of the *Bir Dhara Works*. Direct connections were provided for the Rana palaces and homes of ruling elite, and access to piped water supply was a status symbol, an indication of a close link to the ruling class. Some stand posts were provided for general public as “a gift from the rulers,” one cinema was served and many fountains supplied. New systems were built as the population grew, and *Bir Dhara Works* was followed by *Tri Bhim Dhara* system in 1928. The first water works office was established during the following year, 1929. (Dixit 2002, 252–25)

Until the 1970s the water supply development focused on urban centres, and in the 1970s the interest was expanded to the district headquarters (small towns), and drinking water was included under the social services together with health and education. (Sharma 2004) In the 1980s during the International Drinking Water Supply and Sanitation Decade the scope further broadened to outlying areas, and participatory approaches to community involvement were introduced to most rural water projects. The Dublin Principles (1990) emphasized management of the water resources at the lowest appropriate level. This matched well with decentralization efforts in Nepal at the time. In the 1990s water sector became one of the priority sectors of government investment as a part of the poverty reduction strategy. Towards the end of the 1990s several documents paid attention also to financial sustainability and financial viability of Water Users Committees (WUCs) through cost sharing by His Majesty’s

Government of Nepal (HMGN), donor agencies and project beneficiaries with proper management of community cash and in-kind contributions, enabling appropriate water tariff structures, efficient tariff collection and utilization. This was expected to lead to improved system maintenance and repair, and consequently high quality services to customers. (Tenth Plan 2003)

Today water withdrawal for the domestic sector accounts only for one percent of the total estimated annual water withdrawal. This one percent also includes industrial use in urban areas. Data on domestic water withdrawal exists only for public piped systems developed after 1974. This excludes majority of the rural water supply sources, including such as springs, wells (open and tube), rivers/streams, and traditional stone taps.(FAO 2002) The Millennium Development Goal target relating to water supply coverage is the most likely target to be achieved in Nepal. However, access to water supply and sanitation are not simple to measure. The figures vary between the various sources, depending on the definition. For instance, certain figures count only *piped* water, some count also other water sources. In sanitation some count pit-latrines, some only water-flush toilets. The other sources give +/- 10 percent of these. (WHO 2003; World resource Center 2005)

Sanitation is an essential service closely linked to health and overall quality of life. The sanitation policy of the His Majesty's Government of Nepal (HMGN) adopted the key elements of guiding principles of international initiatives, statements and declarations relevant to the sanitation sub-sector. The policy objectives emphasize the links between sanitation and public health, the integration of investments in sanitation into wider awareness and behavioural change programmes, and the need to ensure that all water supply programmes include sanitation as an integral component and vice versa.

The sanitation strategies comprise general elements as well as specific topics. The specific topics include: involvement of women, appropriate technology, knowledge and awareness creation, community participation, resource mobilization, legislation, co-ordination and integration, and institutional arrangements. National Sanitation Action Steering Committee in Nepal recognised that in its broader context national sanitation policy should aim at improving, ensuring and sustaining that there is *political commitment at all levels*, appropriate sanitation-related legislation and enforcement, sufficient funding and resource mobilisation, and well functioning sanitation technologies, together with further research and development. Participatory approaches for the problem identification, analysis, promotion, implementation, and monitoring and evaluation of the sanitation programs have to be utilised. (National Sanitation Action Steering Committee 2000)

Pollution control is still not taken seriously even if many organisations and actors have acknowledged the presence of worsening environmental conditions. WHO states that the main problems includes rapid urbanization, diminishing spring water sources due to deforestation, and pollution of surface water sources by industrial waste and sewer lines fed into rivers. (WHO 2003)

Past Drivers for the Future

Box 1. Summary of development phases (summarised from Sharma, 2004)

Summary Phase I (1951-1970)

- Decentralisation, village development and cooperative societies already in agenda. Water supply and hygiene education -> health sector. Malaria the most important.
- The focus: urban areas. Master plans for water supply. A vague plan for some villages "to be selected later".
- International actors are already visible in the water sector: UNICEF and World Health Organisation are active in Kathmandu Valley.
- The attention is still on surface waters, mainly river sources. The Third Plan plans to survey the possibility of using groundwater in Kathmandu Valley and Terai region (plain areas). There are also plans to test quality of water.
- A key driver for sewerage systems in Kathmandu Valley is health.

Summary Phase II (1971-1980)

- Increasing number of drinking water supply projects also in rural areas.
- Coverage targets set for both water supply and sanitation, clear goals set for the water supply sector for the first time. Health targets the main motive.
- Increasing number of external actors in water sector. The UNICEF continues as an active actor in the sector, A Swiss NGO gets involved, and the World Bank provides the first loan for water and sewerage.
- Institutional development is evident as Department for Water Supply and Sewerage (DWSS) is established. UNICEF works for smaller settlements through Ministry of Panchayat and Local Development.

Summary Phase III (1981-1990)

- International Water Supply and Sanitation Decade and the final period of Panchayat system.
- Drinking water supply as a basic need and included into social services together with health and education.
- Health sector paid attention to the environmental health, including drinking water, solid waste management and food hygiene.
- District level water supply projects re: decentralisation plan, including pipe water projects, shallow, tube wells, sanitation programme, supervision and maintenance.

Summary Phase IV (1991-2005)

- This is the phase of young democracy, a period of changes, raised expectations, progress in terms of human development but also raise of conflict and increasing political instability.
- Poverty the key focus of development plans
- Water sector reform (also serious attention to rural areas)
- Many development indicators improve in early 1990s.
- Increasing insecurity & number of human rights violations ….

Drivers and past development

Driving forces or "drivers" are the underlying factors influencing decision making and a change in a society, result of the dynamic interplay of socio-economic, institutional and political, and technological activities. Where-by trends and mega-trends have certain continuity and direction, the drivers may not have a direction at all. The *drivers are often less evident, intentional or unintentional everyday paradigms*, taken for given in a way that they may not be questioned at all. Drivers could be classified under such main headings as demography, economic development, human development, technology, governance, culture and environment. The Box 1 summarises some key issues from the various development phases as identified by Sharma (2004). The following PESTE-analysis takes a closer look at the various factors and drivers involved.

Political and institutional factors

Ultimately a water and sanitation question is a local question and a very practical matter: without water life is not possible. Water demand exists regardless of how high water ranks in political agenda. Thus, the water interest groups and various institutional networks connecting the water users from various dimensions range from local to national and international (regional) levels. These networks have both formal and informal functionaries, and in case of Nepal these included also the insurgents. Political instability has influenced also the water sector development, yet, water is a shared concern and remains in the political agenda.

Non-state actors have provided governance, including traditional formal or non-formal village-level institutions, NGOs and CBOs, at the times of absence of formal governance structures. Local leaders play an important role, whether formally in office or informally, out office. Many elected chairpersons of the District Development Committees continue to be influential and respected local characters. Their role cannot be overlooked even when the local elected bodies were dissolved. Politicization of local development is evident. Every action has its political side, whether party political or simply political. Various users groups or Users Committees tend to have local leaders and political activists in key posts, bringing in the party politics into a common interest local development politics. ***Water sectors actors have to accept this and be aware of the political economy of water.***

Decentralisation continues to be a strong political driving force. Geographical realities have not changed and local issues have to be managed locally. In the 1990s there were serious efforts, supported by several donors, for decentralisation of local government. According to the Tenth Five Year Plan:

> Decentralization is an important mechanism for improving service delivery to local communities and enhancing effectiveness of public spending. The decentralization process will be strengthen by: (i) promoting transparency, accountability, and responsiveness in the local institutions, (ii) improving the capacity of local bodies to identify their needs, mobilize resources, plan, prepare and implement projects and programs, and report accounting and expenditures, (iii) clarifying the responsibilities of both local bodies and line ministries and transforming the authority from central to local and (iv) fiscal decentralization. (The Tenth Plan 2003, para 146 and 147)

Many capacity building efforts have been lost recently as elected bodies have been dissolved for over two years, and the government nominated equivalents having failed to convince people and especially the insurgents. The unpredictable security situation made the ordinary local government work impossible in many districts, and the civil servants were continuously or periodically, depending on the location, absent from the districts and the villages.

Political instability influences also administrative stability. Decentralisation process as an act of democratisation is ceased and the more time passes without democratically elected *and functional* local bodies, the more institutional memory from past experiences and various capacity building efforts will be lost. NGOs, CBOs, local leaders and many informal institutions built on age old traditions carry on the institutional memory as it has been applied in their own locality.

Position of the Palace and the King, relationships between the Palace and the government, the palace and the people, and the democratically elected bodies and the people, continue to be critical issues which influence all sectors. At the time of revising this paper in April 2007, the discussion about *Republic* of Nepal adds a new flavour into debate. Unpredictable and sometimes violent incidents, human rights abuses, political meddling in the palace, and failed plans continue to be a reality and unfortunately are nothing new. These are negative drivers to any development process.

Attitudes and commitment towards water sector development continue to be positive at many levels, from the villages to the central level. This attitude is a strong positive driver. Irrigation and hydro-power have always been high in agenda and will continue to be as there is vast economic potential yet to be utilised. The drinking water supply is very high in agenda and is the one Millennium Development Goal target in Nepal which is likely to be achieved. Drinking water and sanitation is strongly recognised as a factor in poverty alleviation. Sanitation is yet to gain popular support.

Economic factors

Economic development encompasses many factors. Such economic factors as production, finance and the distribution of resources both between regions and across sections of society influence also water sector. In Nepal economic decision making has traditionally been strongly centralized, the agricultural past building strongly on feudal system. This is evident even after decades of discussion on decentralization and local decision making. The disparities between the regions, districts and villages are tremendous, the market and road side areas operating completely in a different plane of action as the remote poor areas.

Corruption and generally the transparency of economic decision making is critical and sensitive issue. Tradition of a highly centralised governance system has facilitated the temptation of being unaccountable to public and institutionalising corruption into public service. Dahal et.al. states that corruption in Nepal "is said to originate at the top and is said to be rampant in the bureaucracy which receives total protection from the political leaders in power". (Dahal et al. 2004, 24) They also cite a study made for the World Bank which found between 40 to 50 percent of the project funds being siphoned out by politicians, bureaucrats, and even project staff. (Meagher et al. 1998, 82) In water sector typical cases include side payments to authorities, bribes to win contracts for supply of materials and construction works, and falsified receipts and records. Weak monitoring system has further encouraged mismanagement and short cutting, resulting in water supply schemes which were never completed or even started, or which were completed with very poor workmanship or sub-standard materials.

Agriculture is the backbone of Nepalese economy. Majority of the people depend on it, many on subsistence level. Agriculture is one of the key drivers for development. Agriculture sector has many common interests with water sector, including irrigation, hydro-power (for milling and other agricultural purposes), livelihoods and income generation, and soil management. Changes in agricultural sector have directly visible impacts on water sector, also from the demographic and socio-economic point of view. Thus, agricultural interests are amongst the key drivers also in water sector.

Agriculture is also closely linked to land tenure and landlessness, which continue to be the root causes of persistent poverty and the stagnant agricultural development. Chapagain notes that:

> Land and land-based resources have been the principal source of economic surplus generated by the ruling classes. Concentration of land in the hands of a few elite classes and severe exploitation of the peasantry through excessive expropriation of labour and land revenue have been the principal policy adopted by the rulers through much of the nations' history. (Chapagain 2001)

Chapagain further suggests that against this historical background it not surprising that the governments have not been effective in any genuine reform. Land fragmentation is considered as one of the structural problems inhibiting agricultural modernisation.

Foreign employment is an important source of foreign currency. In remote areas this may be the only opportunity to pay for proper education for children, improved housing and for many other household matters which require cash. These impacts of foreign employment reflect to water sector as well in terms of increased education and knowledge and thus, increased expectations regarding water and sanitation, as well as in terms of increased resources in cash and kind to take action.

To summarise, the economic factors include 1) agriculture which continues to be significant factor in development. Irrigation and other water uses in agriculture including livestock and processing of any agricultural products will continue to increase the water demand and at the same time, influence water quality; 2) Land tenure and land fragmentation, as well as landlessness, which are difficult issues to solve and which have a direct impact for improving water and sanitation services. These are a challenge for good governance with regards to equity, social inclusion and poverty-sensitive development. 3) Foreign employment as a source of new ideas and resources, inspiring also water sector and encouraging to mainstream proper sanitation practices. It can also be viewed as a negative driver in terms of draining skilled and usually young people abroad; and 4) Corruption, which is deep rooted and overly sensitive issue. There could be a chance to tackle this parallel to conflict, as corruption, injustice, lack of transparency and accountability, and abuse of authority are some of the underlying factors that were causing the conflict, and therefore, will continue to be drivers for the future development. These issues can be deep rooted and will not disappear simply with a new constitution and new government.

Socio-cultural factors

Population size, rate of change, distribution, age structure and migration are all critical aspects of demography and as such, a driving force. Population size to a great extent has an impact on demand for many resources and services, including water and other public services. Such basic needs and services as housing, water and sanitation, food security, health, education, employment and security are influenced by demographic changes. Population growth increases the challenges for poverty alleviation and improvement of human well-being. As explained in the earlier chapters, population growth and its changes in Nepal are varied within and between the regions and between urban and rural areas. Some of the main reasons that have caused uncontrolled growth of urban areas and Tarai plains include unpredictable security situation and economic reasons. The population growth in urban areas now being 5.5 percent. Conflict has resulted in a large number of internally displaced people. The impact of the changes to both natural and socio-economic environment has been a subject of study to many development actors.

Culture embraces the set of values and institutions that enables a society to develop and maintain its identity. Justice and fairness, values and worth, are all culture-specific with differing beliefs about the relationship between people and the natural and spiritual world. (UNEP 2002) Cultural signatures differ. Not all cultures, for instance, see technology and technological change as springboards for human development. Development in Nepal is strongly rooted in local traditions and culture, the age-old practices and technologies which have created resilience in the villages since the early days of small Kingdoms.

Socio-cultural factors are highly diverse in Nepal. Every caste and ethnic group, varying from family to family, village to village, have their own system of culture and values, and a way of being resilient to external shocks. Ethnic or caste background has a great significance in Nepali life. Many Nepali agree with an external observer that the more homogenous ethnically or caste-wise, the more unity and community effort there is, and the easier the local leadership role for who ever is or are the locally respected leaders. Nepali culture is witnessing a rapid change as globalisation is reaching the urban areas and many people have been displaced due to poverty, insecurity or just in search of better education and work. Work in foreign lands always brings home a seed of change, to better or worse.

Culture and religions are strong drivers in Nepali society. Water is an important element in Hindu religion and caste system, the Buddhist, animist and Muslim groups having equally relevant meanings for water. Thus, any water action should be sensitive to local traditions, values and religions as these can be strong positive drivers. Traditional caste/ethnic system cannot be easily changed or even manipulated. In urban areas the opportunities are possibly more equal, but its impact will continue to be felt in the region. Nepali life style is also changing, more evident in urban areas but also in rural market areas. This has evident impact on water use, and at the end of the pipe, water pollution.

Social networks are of great importance in Nepal in many ways. For communities living from subsistence farming with very poor or non-existent social security, these social networks are the key life savers during the difficult times. Networking is built into social fabric, closely connected to ethnic/caste traditions and strong extended family ties. For water management this provides many opportunities. Networking users groups is one the promising initiatives, already utilised by irrigation users groups, and recently started also by the Water Users Committees. These Water Users Committee networks could be developed as supportive formal local institutions in absence of the functional local authorities or other government institutions.

The more close the question "whether there is water in the tap or not", the more interest the stakeholders do have. The sense of ownership is crucial for sustainability. Water users associations have proven their ability to manage small and medium scale water supply systems, irrigation systems and micro hydro power schemes. Rural Nepali culture still has strong tradition in working together for a common cause, and it is claimed that the more homogenous community ethnically, the more functional the system is.

Technological factors

Technology is not only about technological knowledge and how it is used. It is also a question about its benefits and costs, and how these are shared by various stakeholders. Technology transfer is coupled with social, economic and environmental issues and the question of sustainability both in terms of environmental impacts, and the socio-economic impacts, now and in the future, should be considered. Rapid changes may be driven by other forces than those driving slow changes. Sustainability of rapidly transferred technology is often questionable unless the necessary institutional change is equally rapid. Operation and maintenance are notoriously difficult in rural water supplies. Decision making relating to traditional technical options, such as protection of springs or improved local water sources (*Kuwa, Dhara), or* construction of rain fed ponds (*Pokharis)* mainly for agricultural purposes and to certain extent, also for religious ones, are built into the institutional memory of a community. The maintenance of these has been a question of life and consequently there used to be strong systems for the maintenance of these. There are numerous examples of communities which have benefited from several water programmes, and may have several parallel and always damaged old systems. Sometimes there are "good" reasons for damaged facilities, such as lime encrustation in pipe lines, or flooding and land slides damaging the structures. There are also numerous cases where the reason for damaged facilities is that there was no sense of ownership, and consequently no proper operation and maintenance systems in place.

Decision making relating to the more modern technical options, such as gravity flow water supply, over head tanks, and deep bore hole pumps have been dominated by those in charge of the programme. For instance, an engineer sent to a community to survey for a gravity scheme, will do a survey for a gravity scheme. The community will support the person as he or she is The Engineer sent to solve the water problem and probably means well. The participatory methods can reach as far as discussion on potential water sources, alignment of pipelines, locations of reservoir tanks and tap stands, although in many cases the engineer will point out where exactly these should be anyway. There will most likely be no discussion on other options, such as improvement and maintenance of existing traditional sources, rainwater harvesting, or the reasons for the failure of the previous gravity system. Engineers tend to focus on technical question at hand, also in Nepal.

Technological factors can be negative drivers when the new technology generates excessive dependence on outside resources, whether in terms of technical know-how or access to spare parts, fuel, and other material resources, or finances for the O&M. In a geographically demanding country with difficult logistics, locally available resources, both human, financial and material, should guide the technology transfer.

To summarise, technological factors include 1) Difficult logistics and terrain set clear physical limits to technology transfer and eventually its operation and maintenance. Such as access to spare parts and fuel is difficult in many parts of the country; 2) Natural elements can be destructive to many technological options. Young mountains and monsoon season result in regular landslides, flooding and generally drastically changing physical environment which can be demanding for any permanent structure; and 3) Low educational level makes such appropriate but high tech options as solar pumping only hypothetical options. Furthermore, high capital costs and unavailability of spare parts do not still support advanced technological choices.

Environmental factors

Environmental factors and environmental change as such are potent driving forces. Acute environmental problems have immediate human impacts, necessitating equally rapid change. Changes in environment have strong impacts on social and economic systems. Nepal has large topographical, vertical dissimilarities, and climatic variations. The environment is truly diverse, bringing both threats and opportunities to human settlements and life. Nepal's environmental challenges cover a wide range of complex issues. These are related to poverty, health, livelihoods, gender and ethnic/caste equity, and also water resources.

The high population growth and persistent poverty are considered as primary contributing factors to most of the Nepal's environmental problems. According to WHO (2003), the main environmental issues are water pollution due to poor sewerage and sanitation, industrial discharge and wastes, and pesticides from agricultural sources. Air pollution is due to combustion of fossil fuels, vehicular emissions, industrial emissions and combustion of bio-mass. WHO further argues that "the rapid urbanization has exceeded the capacity of municipal services to provide basic services and the concept of healthy cities is limited to discussion only."

The environmental or conservation plans have been adapted fairly recently, as the Nepal Environment Policy and Action Plan was adopted in 1993 and an Environmental Protection Council established in the same year. Ministry of Population and Environment was established only in 1995. Again the challenges are similar to water and health sector: "the main constraints in the implementation of environmental measures have been lack of resources and trained manpower, weak infrastructure and coordination, and lack of awareness on environmental issues." (WHO 2003)

Sustainable Development Agenda for Nepal (SDAN) was prepared to be compatible with the Ninth Plan (1997-2002), the Tenth Plan (2002-2007), the Poverty Reduction Strategy Paper, the Millennium Development Goals, and commitments made by the country in various international forums. Accepting and building upon Nepal's status as a largely mountainous country beset by poverty but holding tremendous future potentials, the SDAN notes that reaching the goals set in the Agenda “is challenging but plausible”. The goal of sustainable development in Nepal is:

> To expedite a process that reduces poverty and provides to its citizens and successive generations not just the basic means of livelihood, but also the broadest of opportunities in the social, economic, political, cultural, and ecological aspects of their lives.” Furthermore, “a corollary inherent in viewing sustainable development in Nepal (…) is a national resolve to pursue happy, healthy, and secure lives as citizens who lead a life of honour and dignity in a tolerant, just and democratic nation. (National Planning Commission with Ministry of Population and Environment / HMGN 2003)

The objectives of the SDAN include providing all people living in Nepal with access to safe drinking water and to adequate sanitary facilities within and around their homes.

Practices related to agriculture and forestry can have strong impacts on water resources and water infrastructure. Forest resources have declined sharply due to growing population and increased demand for both forest products and land. This has resulted in increased landslides, soil erosion, floods, depletion of soil fertility, migration of people, and diminishing crop yields. Jodha introduces a classification of negative changes as indicators of the unsustainability of mountain agriculture. (Jodha 1995) Many of these are relevant for water sector as agricultural practices, including irrigation, soil management and use of agro-chemicals, have impacts on both water quality and quantity. Furthermore, such issues as introducing new policies, technologies or practices without proper consideration of local realities and effective monitoring, focus on short term gains, high centralisation, can result negatively in any development activity, including water sector. Jodha lists the following as mountain specificity: inaccessibility, fragility, marginality, diversity, niches and adaptation mechanisms. (Jodha 1995, 10)

The largest water resource related conflict is between Nepal and India. This is also a key driver in development of overall water resource strategies in Nepal as India’s interests cannot be ignored. There are no severe local conflicts although a number of small local disputes over the use of a certain water source can be common. Gravity flow water system have made it feasible to bring water from tens of kilometres away to a village, thus possibly compromising the water use of some more nearby village or settlement. ICIMOD; a mountain development programme active in the Himalayan range, has identified the following, also water-related, environmental problems: reduced water flows for irrigation, domestic uses, and grinding mills; increased landslides and other forms of land degradation; increased time and distance involved in food fodder; indifference of programme policies to mountain specificities; focus on short-term gains; high centralization; excessive, crucial dependence on external advice, ignoring wisdom; technology, trade geared to over extraction; replacement of social sanctions for resource use by legal measures; high intensity of input use.

Ministry of Population and Environment suggests that:

> Expansion of agricultural land in sloping areas, encroachment upon forests should be minimised with people's participation, and land use should be regulated through integrated environment management (IEM) approach. The IEM approach should focus promoting ecosystem-based participatory management of natural resources, particularly forests, soil, water and biodiversity. This will help the government in meeting national and international commitments for the management and conservation of environment and natural resources. The IEM approach should also focus on promoting non-regulatory measures to empower local people for." (Ministry of Population and Environment, 2001)

Many of the suggested measures have similarities with those proposed in water sector: community participation, encouragement of private sector, NGOs and CBOs to be involved, public awareness and advocacy and promotion of technology development and transfer.

To summarise, the environmental factors include 1) Population pressure and increased demand for land and natural resources have resulted in rapid changes in natural environment. Poverty and continuing conflict have pushed many people to live on subsistence level. Daily survival counts and environmental or conservation values are not amongst the immediate priorities; 2) Majority of the land coverage in Nepal are hills or mountains. The following environmental factors characterise these environments and locations: inaccessibility, fragility, marginality, diversity, niches and traditional adaptation mechanisms; 3) Landslides, erosion and flooding are natural events, their severity being influenced by human activities. Examples of human activities having sometimes irreversible results include road cutting, deforestation, farming on marginal areas and overgrazing livestock on sensitive hill sides. All these are negative drivers which have both direct and indirect effects on water resources and their use; and 4) Critical environmental factors in Terai plains relate to tropical low lands, including flooding, high water table and certain water quality problems.

Conclusions and Recommendations

Good governance has been and still is a real challenge in Nepal. Similarly to many other countries, also in Nepal it can be claimed that failures in water and sanitation sector have been often more attributable to profound failures in water governance rather than to the natural limitations of the water supply or lack of financing and appropriate technologies. Over the past decades, Nepal has not lacked in development initiatives, programmes and related funding, and a number of appropriate technology options have been successfully applied albeit not always in a sustainable way.

Many consider governance as relating to formal institutions and more specifically, to the management of the state and its people by the governments. Yet, informal and private institutions, such as community-based and non-governmental organizations, as well private entrepreneurs, innovative Champions and local companies and contractors, are part of this equation and have roles to play in governance. Local governments position should be made clear with adequate resources to act according to the expectations. Governance is more than a management practice; rather, it refers to actions, processes, traditions and institutions by which authority is exercised. Participation, accountability, transparency, corruption and civil conflict have an important influence on the shape of the future of all these stakeholders and makers of good governance, not only that of the government bodies. In Nepal the informal sector and community-specific cultural issues have always had a very important role to play and must not be left out from the larger picture. However, conceptualising good governance in the context of rural water sector in Nepal is a challenging task because of the wide range of dimensions and uncertainties involved.

Yet, whether Nepal will continue as a Kingdom or as a Republic, due attention and respect should be granted to local capacity, indigenous knowledge and creativity. These should be encouraged as pillars of resilience to recover from both human and natural shocks, backed up by appropriate and locally feasible technological options and institutional support structures. While recognising traditions as strongholds, there must also be a strong commitment to change whenever weak points are identified. Change, in turn, is rooted both in traditions and time. Many things about systems change over time, their environments change as well as the relations between them. The Water Users Committees and other local institutions, formal and informal alike, exist in time. All systems change over time.

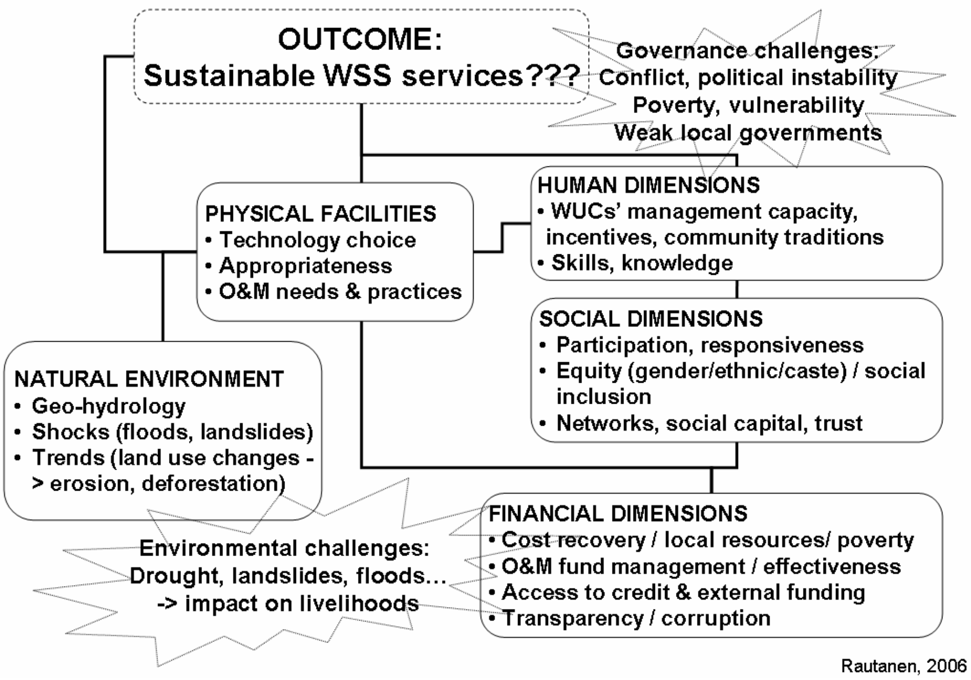
Good governance would require fair legal frameworks that are enforced impartially. It requires full protection of human rights, particularly those of minorities. Impartial enforcement of laws requires an independent judiciary and an impartial and incorruptible police force. Institutionalized corruption, human rights abuses, partial enforcement and weak enforcement of law have been undermining accountability practically "from the very beginning" of the history of Nepal. Rana rule stands out as an example of bad governance. Yet, what are the true incentives to change the system?

Accountable governance stands close to transparency and the rule of law. Requirement for accountability should apply to all actors, including governmental institutions, the private sector and civil society organizations. In practice for many development programmes it is easier to advocate and monitor the accountability of civil actors, such as the CBOs and the NGOs, including Water Users Committees, than interfere with the governmental system. All should be accountable to the public and to their institutional stakeholders, depending on the type of issue. Accountability calls for transparency and the rule of law, both of which against the highly centralised feudal systems appear to be problems in Nepal.

Participation by both men and women is one of the cornerstones of good governance. Since the 1990s practically all development programmes have addressed participation at some level, whether directly or through legitimate intermediate institutions or representatives, such as local governments, users groups, and CBOs. Theoretically some of these institutions, such as local governments and WUCs, are democratically elected representatives of the people, advocating local democratization. Yet, this is not necessarily the case as local traditions and politics together with caste/ethnic hierarchies often dictate the members. These people may not act for the benefit of the most vulnerable in society although these are very location specific issues, nested in dynamics of local culture and history. The participation of especially women and marginalized groups is further hampered by low educational levels and illiteracy/innumeracy, as participation needs to be informed and organized.

Sustainability is a future-oriented concept and calls for a long-term vision. There are a number of visions and strategies for sustainability including those of the various parties to the present conflict in Nepal. These same visions and strategies undermine long term thinking and hamper overall development in various ways. Yet, in the villages life goes on, and water and sanitation facilities are needed everyday. Regardless of the conflict, skilled local human resources are needed to construct, operate and maintain water supply facilities. However, maintenance tends to be more complicated than construction both for the WUCs and governmental actors. Successful maintenance is invisible as it does not produce new figures to report: there are no new water systems installed or more people covered, no significant investments made. Once a village is covered by a water supply facility, it usually remains covered on paper for a number of years whether the water system works or not. Furthermore, the more remote the structure, the more invisible the maintenance worker! The same applies to a WUC: the more remote, the more invisible. The majority of the WUCs of the related case study merely "existed."

Complexity is a given when multiple factors, multiple actors, and multiple perspectives on a situation exist, and the situation itself is unstable. The sustainability of a water scheme and its WUC requires identifying the significant factors or variables that can be addressed by existing resources: the pillars of resilience, the strong points which help a WUC to carry on regardless of external shocks and unpredictable changes. This is where complexity and system dynamics have to be recognised and the relative strengths of a WUC in a given location identified. Strengthening the resilience of a community becomes the key, rather than attempting to construct technical facilities alone or establish structured WUCs that "last forever." They will not.



Recommendations for further study:

- What are the incentives for the local governments and other local, also informal, actors, to apply the principles of good governance and good water governance? What are the motives for being accountable and transparent? What has motivated outstanding local governments to become outstanding local governments? What internal and community-specific factors have made certain WUCs to stand out as truly sustainable managers and Champions? What aspects of good governance can be identified from the practices of successful WUCs? Is there a “magic formula” which could b replicated in other areas? What would motivate the others to replicate it?

- How to address human and social dimensions more effectively, given that all situations are so very different? How could a water and sanitation sector activities truly apply a pro-poor agenda, considering the diverse face of poverty, traditions and a range of livelihoods issues? How these issues could be included in the National water and sanitation sector policies and action plans to encourage the local actors to take them forward and come out with tangible, equitable results?
- How to address the financial dimensions to ensure the most efficient and equitable use of local resources and to guarantee future sustainability in O&M? How to seek synergies with other sectors for the most effective use of the limited local financial resources? Would a holistic water master plan, covering not only water supply and sanitation, but also small hydro power, local irrigation initiatives and such as hygiene education, result in a more effective use of the resources, or would it spread it thin?
- What kind of system dynamics is there between the various dimensions of sustainability? Is it possible to identify certain pillars of resilience which could be used as a strong holds against the likely shocks in other dimensions? For instance, which factors in human dimensions should be strengthened to ensure that there is a system in place to recover from the natural shocks?

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4. Durban
– From wells to Vernon Hooper

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Introduction

Durban was established in 1824 as Port Natal in the south-eastern coast of the South Africa, where there was plenty of water, problem was the condition of it. The pre-urban trading post settlement of 1831 gave rise to scattered grass hut and “wattle and daub” encampments around the bay. (Figure 2) Congella, a secondary Boer settlement, on the western shores of the bay near a strong spring, was established in 1838. (Davies 1963, 30)

The south-eastern coast of the South Africa is one of the most watered areas of the country. In the neighbourhood of the newly established settlement there were many rivers where to get water. The augmentation of water supply became a problem after 1850s when the population started to outgrow the wells and pumps in the town area. Immediately eyes were turned towards the big rivers, which were harnessed one by one during the late 19th century. From the 1870s onward urban growth was dramatic; Durban's population doubled each decade. (Figure 1) By the 1890s the city alone contained nearly a third of Natal's White inhabitants. (Swanson 1976, 161)

Good governance 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 covers the sustainable use of natural resources and the protection of the environment. Participation by all stakeholders is one of the cornerstones of good governance. Transparency is also a key element for good governance.

How was this development kept under control? In what grounds where the decisions made when the most feasible plans where selected? What role different ethnic groups had in this development? Can you see good governance in this development?

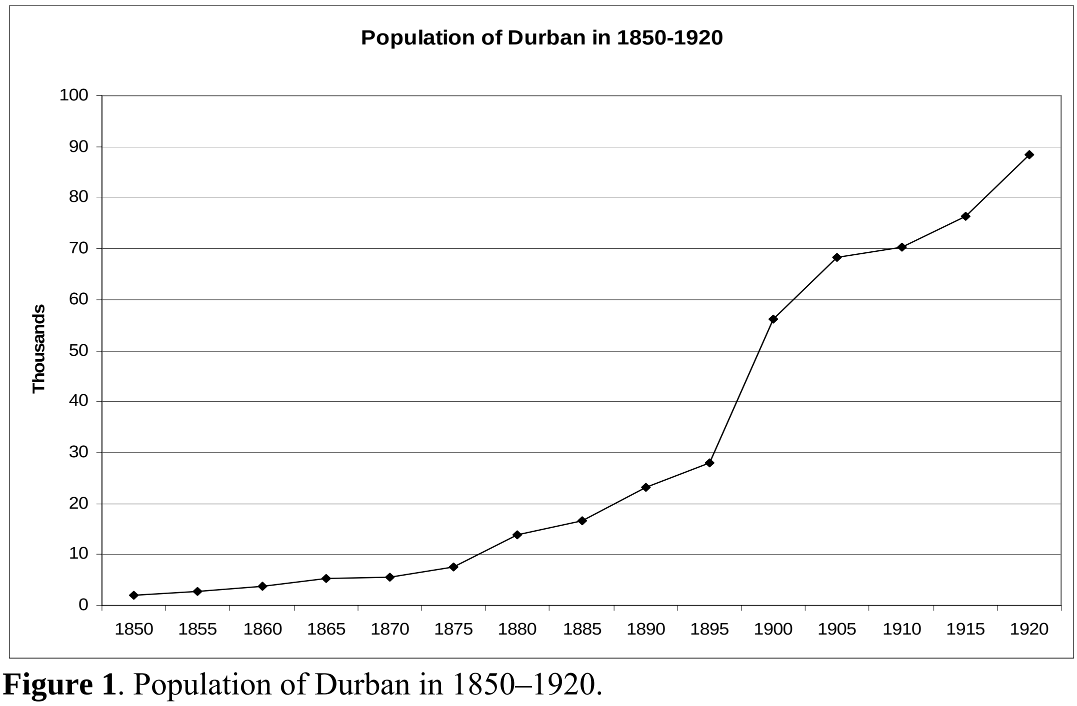

Figure 1. Population of Durban in 1850–1920.

Early Durban

The water of old Durban hadn't a very agreeable taste but was better than rainwater off dusty tarred or thatched roofs which was collected in wine or spirit hogsheads or barrels used as water-butts. As can be imagined an unpleasant spirit flavour from the wood tainted the drinking water. When the water butts or casks had given in or become cesspools, brick wells were constructed in the backyard, two to two and half meters deep. Into these wells casks without heads were inserted, one on top of the other, the top one being protected by a lid. The water was lifted by hand by means of a cord and bucket. (Tait s.a., 120)

Newly arrived Bishop John William Colenso described Durban:

> 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 effect is by no means favourable to the health of the residents, more especially that of the children, who have no refuge, I suppose, as their parents have, in stronger beverages. Some wells have been sunk deeper, and the water has been found to be brackish. Deeper still, no doubt, it would be pure enough. At present, the remedy is to drink rain water, or the water of the Umgeni River, which is brought by carriers a distance of four miles [6.4 kilometres], and is excellent. Indeed, had the Dutch founded the town of Durban, as they did that of Maritzburg, they would long ago have had the Umgeni pouring its beneficent streams through every street, and bringing health and cleanliness to every door. How long will it be before the public spirit of Englishmen will achieve this? (Colenso 1855, 14)

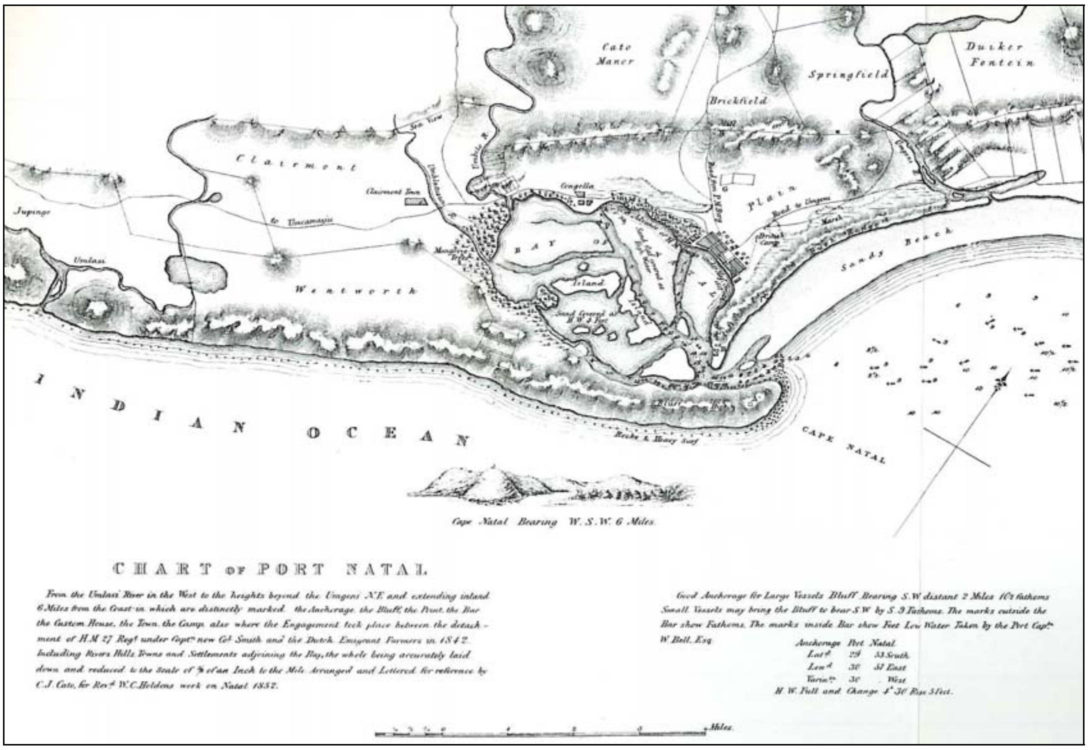

Figure 2. Port Natal (Holden 1855)

Durban after Municipal Ordinance

In the Municipal Ordinance of 1854 Commissioners were replaced by the government by a Mayor and Councillors. Consequently two boroughs, Durban and Pietermaritzburg, were proclaimed on 15th May 1854. On November 14th, 1854, the Town Clerk was directed "to report upon the state and requirements of the town pump in order that the same may be made available for the use of the public." The “parish pump" was situated in Old Well Court, in Smith Street and this pump continued in use until long after the Umbilo Waterworks were opened. Similar pumps were installed in other parts of the Borough. This form of water supply provided about 215 m^3 per day. In August 1855, the Public Works Department was inaugurated by a resolution authorising the Town Committee to appoint one or more labourers as from time to time required. (Green 1957, 33–36; Henderson 1904, 12, 225; Stark s.a., 124)

During April 1856, as the result of repeated thunderstorms and heavy rain, Durban was flooded by the Umgeni River overflowing its banks and opening up a new course through the Eastern Vlei into the Bay. During the four days April 12th to 16th the rainfall was 68 cm, and the effect of this, conjointly with the overflow of the Umgeni, was to entirely wash away all the Corporation roads, drains, and footpaths. (Russell s.a., 269–72) In 1868 destructive rainfall occurred again. This time only embankment built after previous disaster prevented water pouring into the town centre. (Brown 1875, 234–36)

From letters published in the Natal Mercury, it appears that the sanitary condition of the town at this time was unquestionably bad. The various correspondents refer to swamps, quagmires, fever and death traps, pigs allowed to roam over all parts of the Borough, and other nuisances. The Council had restricted its endeavours in the way of public improvements to drainage works of a primitive nature, but on a motion that tenders be called for the construction of a road crossing the Western Vlei, the following amendment was proposed by one Councillor: "That whilst admitting the necessity of providing good roads as a means of transit, it is conceived that the sanitary condition of the town is of primary importance, and therefore no new road be now proceeded with, but that the amount in question be carried to the estimates for drainage." This amendment, however, was not carried, the resolution in favour of the new road being adopted. (Henderson 1904, 29)

Wells and Pumps

In April 1858, the Natal Mercury reported on the state of the town pumps and footpaths, stating that some of these useful works are out of order or unfinished, and need attention of out municipal administrators. In November of the same year the ladies of the West End wrote a letter to the Town Council reporting the state of the wells in that quarter. Their letter was referred to the Town Committee “to report on the best position for the pumps imported with a view to their equal distribution throughout the town.” (Tait s.a., 120) 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. Motion for a new town hall was carried by 3 votes to 2. (Russell s.a., 348)

In April Mercury wrote about the Town council meeting where Mr. Hartley had brought forward a scheme for bettering the sanitary condition of the town, by requiring for every house to remove the night soil every day to a place appointed outside the town. Mercury thought the scheme impracticable and unnecessary. And, as the paper wrote, “it would also involve a serious interference with the liberty of the subject in transacting his private business in his own way”. (Russell s.a., 351)

W. James described Durban in 1858:

> In order to give a true picture of what Durban was like in 1858, I can best describe it as just a sandy flat. The Town gardens were an open piece of waste ground, the wind having full play on the fine sand, creating sand drifts. An open drain extended from vacant land, then called ‘the Flat’, across central West Street and emptying itself into the Bay. This was Milne’s Drain. (Quated in Houghton 1972, 81)

‘The sanitary condition of the town’, thundered the Natal Mercury in 1860, ‘has been disgracefully neglected of late […] our drains are mostly choked up, fallen in and utterly useless, or worse than useless, for they have become cesspools of stagnant filth, and hot-beds of disease. The inhabitants are allowed to throw garbage of all sorts on unoccupied plots; and these, even in dry weather, have emitted horrible stenches. We may mention particularly the low, central part of West Street, especially on the south side […] pig sties, manure heaps, and open surface privies are allowed without check.’ (Morrison 1987, 21)

The Sanitary Department of the Borough was inaugurated in January 1861, when W. H. Stonell was appointed "Town Constable, Street Keeper, and Inspector of Nuisances, and more especially for the purpose of enforcing the Bye-laws". Extensive drainage works were carried out during 1861-2, notably of the Eastern Vlei, Field Street, Pine Terrace, and West Street. In connection with these works it was decided to utilise the sub-soil removed in opening up drains for the purpose of temporarily hardening the streets. (Henderson 1904, 46, 48)

Figure 3. Durban 1860 (De Kock 1952, 178)

First Umgeni Schemes

In December 1861, Mr. Abernethy was requested to furnish the Council with a report as to the feasibility of supplying the Borough with water from the Umgeni River. The report was duly received, but the Council could not see its way to finance the scheme as submitted by him. In reference to this matter, the Mayor stated in his annual Minute that he hoped the scheme would be carried out by private enterprise, either by the Corporation giving the monopoly of the sale of water to some private company for a term of years, or by the council guaranteeing a certain percentage on the capital laid out. In July 1862, the borough was presented the drinking fountain at the corner of the Town Gardens facing West Street and Gardiner Street. (Henderson 1904, 50; Lynsky 1982, 11–12)

The news was welcomed in 1862 that "Pure Umgeni Water – for the invalid and the healthy" was to be brought daily to town, and dispensed at the corner of Pine Terrace and Field Street. (Malherbe 1965, 154)

Natal Almanac and Yearly Register 1863 described sanitary condition of Durban in 1862:

> The sanitary condition of the town has also been much improved, by the extensive drainage operations under direction of the Municipality, which have had the effect of rendering available many portions of land contiguous to the town, formerly considered valueless, and also much improving the health of the town. (Quoted in Houghton 1972, 82)

First wells in Durban were probably private, but earliest public well was in all likelihood from year 1864. Its wall was made of alternate double rows of brick and single rows of slate and it was a typical dug well. It was situated in Berea Road near Old Dutch Road intersection. Well was found in 1968 during the excavations. (Bjorvig 1994, 321–322)

New Investments

During Richard Vause's second Mayoralty considerable progress was made in the laying of brick and pipe drains. At that time a large open drain from the Eastern Vlei passed through what is now known as mark lane, running from there to the Bay. This drain, known as "Adlam's Drain", was a constant source of nuisance, and in order to cover it in the strip of land now used as a thoroughfare was purchased. The drain was not completed until 1877, considerable difficulty being experienced in coming terms with the owners of the properties through which the drain passed in an oblique direction from the West Street end of Mark Lane towards the Bay. (Henderson 1904, 87)

The origin of the Town Health Department could be assumed to be the appointment of Dr. Julius Schulz as Medical Officer to the Corporation in 1874. He advised the Corporation on health matters for 17 years. (Stark s.a., 314)

In 1873 the Council apologized for any inconveniences to burgesses because droughts had affected well supplies. 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. This seems to have received little support. In 1875 a public meeting was called to consider water requirements, when it was agreed to set up a special committee to consider a variety of schemes, which had been proposed. Those included: Messrs. O'Meara and Flintoff for a supply from the Umhlatuzana River; H. Ramsay Collins for a supply from the Umhlatuzana River with a supply pipe laid adjacent to the railway under construction to Pietermaritzburg; and finally H.W. Currie for the development of an artesian source of water within the Borough. The outcome was that the Borough authorised an expenditure of £500 on investigation into Currie's option. (Francis 1991, 43; Lynsky 1982, 12)

Sanitary matters were considerably improved during 1875-6 by the use of 1,000 galvanised iron pails imported from England in place of the wooden boxes previously used. A site was purchased on the Eastern Vlei for use as a night-soil depot, and permission obtained from the War Department authorities to lay a line of tram-trails from the town to the Depot over Ordnance Land. H. E. Ellis was appointed Inspector of Nuisances in 1875, and under his supervision many improvements were effected as regards the control of slaughterhouses, the removal of dust and refuse from the streets, and sanitary matters generally. (Henderson 1904, 88)

In 1876 the conversion of night soil, which up to that time had been treated as a waste product, into fertilising matter was commenced. The night soil was converted into a dry powder, and was believed to possess valuable manorial properties. This treatment of the night soil continued until 1883, when owing to various reasons it was discontinued. The works had been for some time, owing to their situation, proving a discomfort to the Burgesses, while the demand for the article did not exceed one-half the production. In 1882, 500 tons had been manufactured, only one-half of which had been sold, although at the time of stoppage of the works the fertiliser was declared to be fifteen times stronger than that originally manufactured. (Henderson 1904, 303–304)

In 1860s and 1870s the government of Natal was not conceived as a provider of social services or an instrument of social construction. And because of the nature of the urban poor, problems of public health, sanitation, overcrowding and slum clearance, public order and security, were usually perceived in terms of racial or ethnic differences. (Swanson 1968, 33–34)

Water Supply in the late 1870s

Although considerable sums of money had been spent during the preceding fifteen years in drainage works, no comprehensive scheme for carrying off surface water from the Vleis and centre of the town was adopted until 1876, when the Council accepted plans and specifications prepared by C.E. Gooch. He was unable to personally superintend the carrying out of the work, so the Council entrusted it to H. Ramsay Collins. The scheme consisted of two drains, each commencing in Commercial Road – one an egg shaped drain, built of brick and cement, passing under Pine Terrace, mark Lane, across West and Smith Streets, down Field Street to the Bay; the other taking the route of what was known as "Moodie's Drain" until it reached Milne's Drain, continuing at right angles and discharging itself into the Eastern Vlei. The work was satisfactorily completed in

1877. In 1878 Collins submitted valuable reports and recommendations in regard to the drainage of the Eastern Vlei, embracing the deepening and improvement of Milne's Drain; also on the drainage of the town generally and disposal of sewage. (Henderson 1904, 95)

In January 1878 the Water Supply Committee decided to ask a report on the proposed water supply from the Colonial Engineer and the Resident Engineer of the Government Railways. (Water Supply Committee Meeting, held 9th January 1878. CSO, 642, 1878/357. Pietermaritzburg Archives Depository) In their report they recommended that from the seven inspected schemes the one from O'Meara should be adopted with modifications, considering drainage they recommended that water closets be forbidden and that the municipality not entertain water carriage of sewage. (Report upon the Proposed water Supply for the Borough of Durban. CSO, 642, 1878/1781. Pietermaritxburg Archives Depository) The public improvement works carried out during 1878-9 were of slight importance; principally owing to want of funds to undertake other drainage works than that of the Central Drain. (Henderson 1904, 105)

The water supply of the Borough still continued to be obtained from tanks and wells sunk in various parts of the town until the end of 1879. It was one of the duties of the Superintendent of Police to take soundings of the 18 hand-pumped public wells, and according to Superintendent Alexander's report of soundings taken in July 1877; these wells yielded approximately 214 m^3 per diem, when the population of the town was over 5,000. The unsatisfactory quality and sparse quantity of the water from these pumps had been the source of discussion by the councillors already for years.[1] Durban still existed on public wells and private rainwater tanks. Several experiments had been tried with artesian wells but without success. With the increasing population and repeated dry seasons, the necessity for providing some other source of supply became imperative, and several schemes were submitted for bringing in water from the Umgeni, the Umhlatuzana, and the Umbilo, but the large amount of capital required to carry out one or other of these schemes rendered it impossible for the Council to do anything until borrowing powers had been obtained and a loan floated for this and other public works of importance. In 1879 the possibility of a shortfall in the water supply became so serious that the Mayor made arrangements with the Railway Department for the supply of water in tanks from the Umgeni River. A special siding was laid down for the trucks in Pine Street, and water was laid down for the trucks in pine Street, and water was sold to the Burgesses at the rate of one penny per bucketful. (Lynsky 1982, 12; Henderson 1904, 107–108)

Councillor Currie had in 1875 advocated the sinking of an artesian well, and boring operations had been carried on during 1876-77 with but partial success. However, in 1878 the Council placed the boring operations entirely under Currie's control, and he eventually succeeded in sinking a well at the foot of the Botanic Gardens, which yielded 227 m^3 per day in July 1879. Storage tanks were erected on the Flat and water pipes were led from "Currie's Fountain", as well was named, into town and along West Street, hydrants being fixed at convenient sites. An additional well was sunk in 1883 and steam pump erected to increase the supply. Storage reservoir with a capacity of 227 m^3 was

[1] There is some conflict in the sources as Bjorvig says that the Berea Road well was the first public well and Henderson says that these discussions have been going from 1861. So, where those public pumps were installed if there were no public wells until 1864?

erected in the Botanic gardens in 1884. Position of the reservoir was selected so that the supply could be utilised in any later gravitation scheme. This way a serious water famine was averted; the rainfall during the three succeeding years falling far short of requirements. This reservoir also made Botanic Gardens more attractive by giving a permanent water supply to it. "Currie's Fountain" continued to be the principal source of supply until the Umbilo Waterworks was opened in 1887. (Henderson 1904, 108, 225–226; McCracken 1987, 72; Francis 1991, 43, 45)

J.F.E. Barnes and the Umbilo Scheme

On January 17, 1882 J.F.E. Barnes was appointed as a first Borough Engineer and Government Surveyor. He urged that the Currie's Fountain supply and extension be seen only as a temporary measure especially since it was not able to supply Addington and the Berea. In addition it necessitated heavy pumping machines and accompanying expenditure and would not meet the requirements of an active fire brigade. Added to this was a warning that the water was not the purest available. Samples were "forwarded home for analysis" in 1879–80 to a Dr. Edward Frankland of London. His report concluded that the water was not suitable for "dietetic purposes", although this was at variance with subsequent analyses. (Lynsky 1982, 16, 18)

Letters to newspapers during 1882 were critical at sanitary arrangements. One reader of the Natal Mercury asked if it would be expecting too much of the Durban Corporation to fence Currie's Fountain, "stagnant water, with filth of every description, and coolie dwellings, are permitted on a spot which ought to be kept specially free from all taint." (Natal Mercury 18.8.1882)

Soon after his appointment Barnes submitted two reports urging the Council to adopt the Shone's Pneumatic System.[2] In his report appended to the mayor's Minute of 1883, he recommended, "a combination of the pneumatic with the pail system appears to be its latest and most successful application." In 1888 the Council again examined the system this time with the assurance that it was proving perfectly suitable in "Eastbourne, Henley, Warrington, Southampton and other important English towns." (Lynsky 1982, 24)

In September 1883, Barnes, submitted reports and estimates on the schemes to supply water from the Umlaas, the Umhlatuzana and the Umbilo Rivers. In December the Council decided that under existing conditions the Umbilo River was the most suitable source. Barnes was instructed to proceed with the surveys and the preparation of documents in connection with the enactments required to authorise the Council to proceed with the scheme. The "Durban Corporation Waterworks Law of 1884" authorizing the Council to construct waterworks, acquire lands, levy a water rate, and frame Bye-laws in connection with water supply, was promulgated on 8th November, 1884. The Council was authorized to borrow £50,000 for waterworks and other public works. The site selected for the Umbilo Headworks lay on a bend of the Umbilo River just above Umbilo Falls, in an area now known as Paradise Valley. An earthern dam,

[2] Isaac Shone's Pneumatic Sewerage System was a "separate" system, with sewage and rainwater disposed of by separated systems. Gravity delivers sewage to district collectors, and then pneumatic ejectors raise sewage and deliver it to disposal points.

which could conserve 169,000 m^3 of water when full, was built across the valley, complete with spillway and control valve structure. Downstream a 27,000 m^3 settling basin, discharging into two sand circular storage reservoirs, was provided. 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. An 18 cm diameter cast iron pipe carried the filtered water via a halfway break pressure tank to two small covered reservoirs adjacent to South Ridge Road and on the site on which was subsequently built South Ridge Road Reservoir next to Entabeni Hospital. These two reservoirs had a capacity of 227.5 m^3. Later a large open service reservoir near St. Thomas' Churchyard in Ridge Road was built with a capacity of 1,400 m^3. (Henderson 1904, 226–227; Lynsky 1982, 18–20)

In 1885 the Mayor's Minute recorded that tendering for the pipes to carry the water from the Umbilo Head Works to the Berea was very competitive. "After careful consideration of the question in committee, the pipe contract was awarded to Messrs. Cochrane & Grove, Middlesboro-on-Tees, not that they were as low as some Glasgow firms by about two percent, but that in the first place they accepted the contract on the terms of specifications that stood […] secondly it was the same firm who furnished us with the water pipes laid throughout the town in 1882–3." (Mayor's Minute 1885, 9)

Turning on the Queen Victoria Jubilee Fountain in the Town Gardens formally opened these Pinetown Waterworks, as they were usually described, on 21st July 1887. They were constructed at the band of Umbilo River some 14 kilometres from Durban. Water was conveyed from there to an open service reservoir on the Berea. (Twentieth-Century Impressions 1906, 439; Lynsky 1982, 22; McIntyre 1957, 109)

When considering the vital necessity of a water supply for the Borough in 1883, the Town Council had to take into consideration primarily the estimated initial cost of the scheme. In conjunction with the question of cost, another point to be considered was that at the time the Umbilo scheme was inaugurated the Corporation could not possibly have incurred the expenditure necessary for a scheme which would have given a greater quantity of water, but at a lower level, by tapping one of the other sources of supply. It was a sine qua non that the whole Borough, including the high levels of the Berea, should be supplied from the one source, and the Umbilo River alone afforded facilities for a such supply by reason of its high elevation, while the cost of the Umbilo scheme was far lower than either of the alternative schemes, viz., the Umlaas or the Umhlatuzana Rivers. (Henderson 1904, 231)

The sufficiency of the Umbilo scheme to meet Durban's needs was based on consumption of water per head of population being 91 litres per day when existing consumption was judged to have been 23 litres. The Umbilo scheme allowed Durban homes to have private connections and eliminated the use of wells – or rooms from which in 1882, as reported in the Natal mercantile Advertiser, "mischievous pigeons" were banned – undoubtedly helping towards raising public and private health standards. (Lynsky 1982, 22)

John Fletcher and the Umlaas Scheme

Within months of the appointment of John Fletcher as a Borough Engineer in May 1889 his experience was put to the test. Barnes' Umbilo 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 Umhlatuzana River, near Mariannhill Monastery Estate, to the Umbilo River above the Head Works. In January 1890, five months after arriving in Durban, Fletcher tabled a report detailing various schemes for supplementing the existing supply. He advocated the tapping of the Umlaas River to supply the lower levels of the town. Council approved this during 1890. Fletcher estimated that the resulting flow from this source would be sufficient for 50,000 people. Fletcher recommended a gravitational scheme. The new Waterworks were completed in the following year, and formally opened by the Council on the 30th July 1891, in the presence of a representative gathering of burgesses. (Lynsky 1982, 26–27; Henderson 1904, 140–141)

This was only a supplementary supply carried out to precede a permanent gravitation scheme. It consisted of a pumping plant erected on the Umlaas River at some 13 kilometres distance from Durban. This pumped water to the Neck reservoir in present day Lamontville, from where gravity took it in water pipes to the Florida Road Reservoir. This pumping plant was capable of raising 1,100 (3,200 says Lynsky) m^3 per day, and proved sufficient until the gravitation scheme was completed. Until 1894 the Umbilo supply of 910 m^3 per day and the Umlaas temporary pumping plant of 1,100 m^3 capacity per day proved to be sufficient to supply Durban's requirements. The permanent mains were laid from town to the temporary pumping station through which the water was pumped, and from the temporary pumping site the new gravitation works were connected up, whereupon the pumping plant was superseded. (Henderson 1904, 235)

This was realized in 1894 when the Umlaas gravitation scheme was built. Fletcher originally designed it to supply 9,000 m^3 per day, but as the details were worked out it was found economical to incur an increased expenditure to considerably augment the delivery of water. In it the distance between the water intake and the filter beds were shortened and the delivery of water augmented by the construction of tunnels and conduits. It was still necessary in 1898 for the Medical Officer to recommend the people of Durban to boil their drinking water. (Bjorvig 1994, 324; Henderson 1904, 235; MOR. In Mayor's Minute 1898, 46)

By 1895 Fletcher could point to the successful completion of the scheme. The Umlaas and Umbilo projects combined gave Durban a cheaper and more plentiful supply than either Port Elizabeth or Cape Town, both with bigger populations. 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 is Durban's good fortune that in such close proximity a source of supply has been made available, from a river which is so greatly in excess of the town's future needs, as to place it beyond the risk of scarcity even from a recurrence of the severest drought ever recorded." (Lynsky 1982, 27)

In 1899 Fletcher wrote the memorandum about the increasing water consumption, which he even called excessive. He didn't saw the recent dry weather as an excuse to the growing difficulty in maintaining a constant supply for promiscuous use and thoughtless waste of water. He blamed rapid increase in consumption for the causes and abuses which in his opinion should be more rigidly regulated and prevented. He wanted restrictions in use of water for watering grass "and what in many cases amounts practically to land irrigation, and the careless waste of water which serves no purpose whatever". These abuses affected the supply, reduced the pressure, and interfered with the constant supply of the inhabitants of the more elevated areas, which in turn charged the Water Department with having cut off their supply. He saw three ways how to restrict these abuses; the use of water meters, using same dribble system as in Cape Town and giving the Council more powers to punish consumers who wilfully waste or use water for unauthorised purposes. (John Fletcher to the Mayor and Councillors of the Borough of Durban, 6th March, 1899. In Mayor's Minute 1899, 28–31)

Water-borne Sewerage

The municipal area was not sewered during most of the nineteenth century. The conditions under which first night soil boxes for solid waste were introduced in 1864, followed by night soil buckets in 1875, both collected and emptied in the Western and Eastern Vleis, gave ample opportunity for the spread of diseases. The Medical Officer attributed enteric fever in 1890 to soil becoming saturated with organic matter. Such contaminated soil offered a suitable breeding ground for many of the diseases producing genes. Liquid sewage was also still carried away in huge open drains connected with the underground sewers in the town. Stench from such overflowing drains and connections of drains, despite being flushed every day, still overwhelmed the nostrils. (Bjorvig 1994, 326–27)

While developing sources on water supply Fletcher had been far from inactive in improving internal water distribution and sewerage system. In his official report for 1894–1895 Fletcher records with reference to progress of various public works: "These three most important undertakings are Water Supply, Sewerage and Electric lighting […] because they are so dependent upon each other I regard them for many reasons as inseparable undertakings. The Water Works are remunerative in the sense that the supply of water is a necessity, and a valuable commodity; but without water there could be no Sewerage Works." (BER. In Mayor's Minute 1895, 21)

On assuming office in 1889, Fletcher had immediately called for the adoption of a sewage disposal system incorporating Shone's pneumatic ejectors and sea discharge. Fletcher's report presented to Council was published in the Natal Mercury of March 3, 1891 across two and a half pages of newspaper. Remembering that the newspaper was usually only four pages long the importance of the scheme can be appreciated. Subsequent editions were to carry numerous readers' letters criticising sea disposal. (Fletcher, J., Report on the Sewerage of the Borough of Durban, Natal, January 1891. CSO, 1296, 1891/2422. Pietermaritzburg Archives Depot; Lynsky 1982, 28)

In the end of his report Fletcher wrote:

> Man is born to thrive with pure air to breathe, pure water to drink, and a pure soil to live on. The impurities which tend to render air, water, and soil unfavourable for his best development are the product of his own life. The removal of the source of this impurity must be effected by his own act.
>
> Certain diseases to which he is subject, and which tend to spread through the race by contagion or infection, it is within his power to control.
>
> Some ailments which are not fatal and which are not communicable are also due to conditions which he may change. (Fletcher, J., Report on the Sewerage of the Borough of Durban, Natal, January 1891. CSO, 1296, 1891/2422, 62–63. Pietermaritzburg Archives Depot)

It is easy to agree with these words.

During the Mayoralty of Robert Jameson the Sewerage Outfall Works were put into full working operation. Outfall station became operative in July, 1896. Jameson had for many years held the position of Chairman of the Sanitary Committee of the Town Council, and it was a happy coincidence that this most important scheme should be completed during his occupancy of the mayoral Chair. Authority having been obtained for the borrowing money in connection with Waterworks and Sewerage Scheme, the Council was persuaded by the Mayor to offer the loan locally instead of on the London Market. (Henderson 1904, 170; Stark s.a., 126)

There was an outfall sewer along the side of the North Pier for waterborne household sewage, which was discharged into the sea during the first few hours of the ebb tide. The discharge of raw sewage into the sea via this pipeline continued until 1969. (Murray 1987, 27; Bjorvig 1994, 327–28)

Public Health and Sanitation

Drought and the rapid increase in population during the South African War put further pressure on Durban's water supply. Water from the Umlaas had to be pumped to the Berea, as the Umbilo River Scheme could not cope. The Corporation started relief works and a number of men were employed by the Borough Engineer's department on the construction of the Clear Water Reservoir near the Umlaas Filters. (Figure 4) A site straddling a valley was chosen and an earth embankment with a clay core was built. The reservoir was completed in 1903 and increased the Umlaas scheme's storage capacity by 523,000 m^3. (BER 1901–1902. In Mayor's Minute 1902, 29–30; Mayor's Minute 1903, 3; Lynsky 1982, 30)

The Public Health Act of 1901 was a comprehensive and consolidating measure introducing new principles into the relations between the central and local authorities. It authorized the Governor-in-Council for instance to issue detailed regulations concerning sanitation, nuisances and public health. The colonial health officer was empowered to inspect local health services. (Green 1957, 40)

During 1901–02, the works carried out by the Public Works Department exceeded in magnitude those of any previous year, five kilometres of new roads were hardened, 9.43 kilometres re-coated, eight kilometres of new footpaths kerbed and channelled, 13 kilometres of storm-water channels laid, and 7 kilometres of sewerage mains laid in the suburbs. (Henderson 1904, 200)

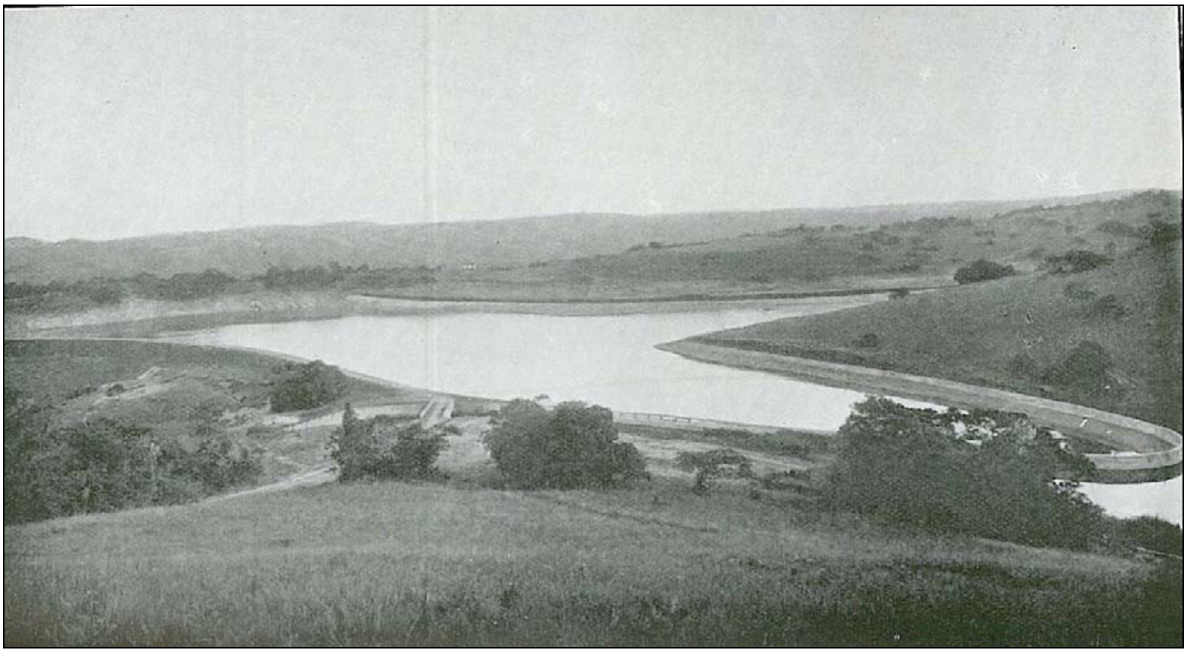

Figure 4. Clear water reservoir on the Umlaas River. (Photo by Mr. Stanley Fletcher in Henderson 1904.)

Bubonic plague visited the city in 1902 and for several years thereafter, rejuvenating past fears of African and Indian-borne pestilence, and hastening the emergence of the legal apparatus of compulsory segregation in urban locations or compounds. Although the plague had been traced to ships from Argentine it was seen to emanate from the Indian and Black slums of Durban. The White residents clamoured for containment of the Black regarding them as a public health hazard. The authorities responded by passing the Native Location Act in 1904. Locations were not created for neither the government nor the Durban municipality was able to provide the necessary finance. Just as Cape Town has passed on the innovation of a 'sanitary syndrome' as a basis for containment, so too did Durban pass on to Johannesburg a further dubious concept, namely a beer monopoly known as the 'Durban System' and the basis for financing Locations for Blacks. (Swanson 1968, 37; Beavon 1982, 8)

In 1902–03 in the outer or suburban zone, including one half of the houses of Berea, no slop or bath water was collected – these were disposed of on the premises. In some 293 houses garden burial of night-soil was resorted to. For this purpose the Council employed 10 coolies supervised by a sirdar. Each man was said to be able to deal with the pail contents of 30 houses per day. The procedure adopted was to dig a hole in a secluded part of the grounds, to mix the pail contents with earth and to cover them with at least 30 cm of earth. (Murray 1987, 23)

In 1903 Medical Officer of Health was complaining about the presence of Natives and Indians in the town. He said that they made the constant supervision of public health and sanitary matters a matter of prime necessity. According to him the Coolies seemed to be wholly ignorant of the simplest laws of sanitation and domestic cleanliness. He was also putting some blame on European employers who did not educate these people on sanitary matters. (MOR. In Mayor's Minute 1903, 57) In 1909 he was still complaining about the disheartening nature of the work because of the natural predisposition, especially Indians, of preferring insanitary to sanitary conditions. (MOR. In Mayor's Minute 1909, 93)

Camperdown Dam

The spectre of recurring droughts, like those of 1887, 1891 and 1900, had led Fletcher to seek Council's authority for additional storage in the Umlaas catchment. Work commenced in 1901 on a "temporary" dam on the farm "Killarney Isles", eight kilometres downstream from the Eston/Umlaas road. Fletcher and his team of Indian labourers completed the concrete and earthen embankment for the Camperdown temporary dam in a record time of 5 months. On completion the 128 metres wide and 12 metres high wall impounded more than 2.275 million m^3 of water in a reservoir stretching back three kilometres. (Figure 5) Even before the temporary dam was finished Fletcher was contemplating a permanent dam with a 30 meters wall and capable of storing 36.4 million m^3 of raw water. The foundation stone for the proposed permanent dam was laid but six months of preliminary work was to prove that the site was unsuitable and work was abandoned. (BER 1901–1902. In Mayor's Minute 1902, 29; Lynsky 1982, 30)

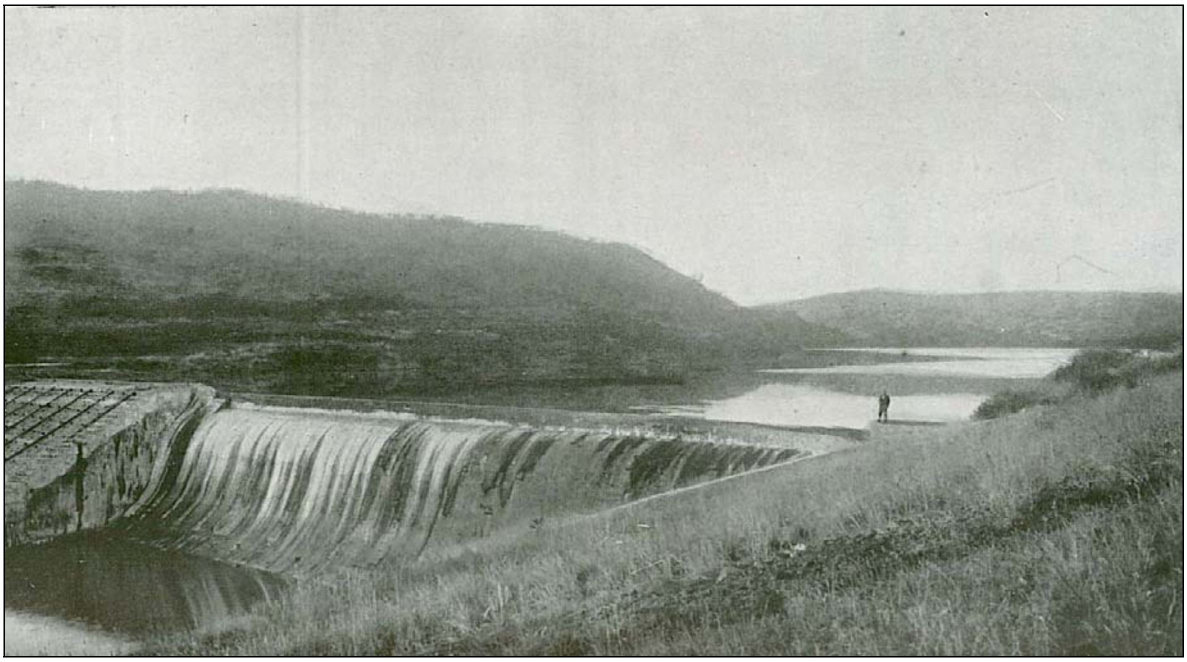

Figure 5. The Camperdown Dam. (Photo by Mr. Stanley Fletcher in Henderson 1904.)

Summer of 1902–03 was one of the most notable as the serious drought extended until to April. During this time the Camperdown dam proved its value, and helped to avoid a water famine. (BER 1902–1903. In Mayor's Minute 1903, 26) In his Minutes Mayor was giving his thanks to the foresight and engineering skill of the Borough Engineer without which there would have been a water famine with terrible consequences. (Mayor's Minute 1903, 4)

The Camperdown temporary dam stood its first test in December 1903 when a heavy flood, which damaged the Umlaas Intake downstream, left Camperdown Dam untouched. (BER 1903–1904. In Mayor's Minute 1904, 28–29) This "temporary" structure was to remain until floods destroyed the wall in 1943. 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. (Lynsky 1982, 30–32)

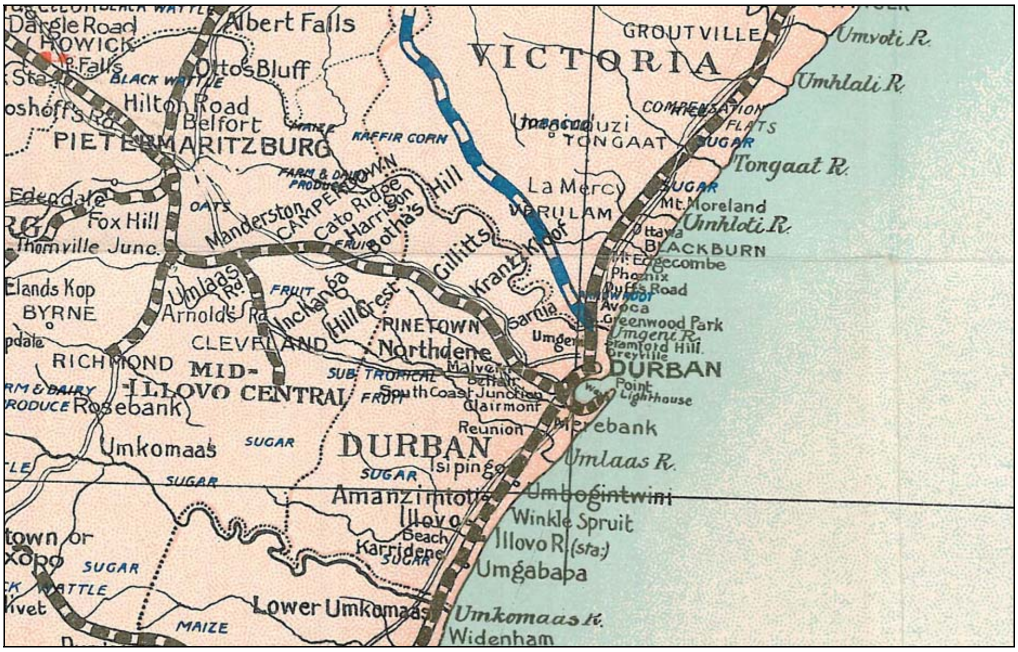

Figure 6. Surroundings of Durban in 1911 (Clip from the map in Tatlow 1911)

Flood of 1905

In the early hours of Thursday, June 1, 1905 a caretaker of the Umbilo Waterworks, watched in horror as a wall of water roared down the narrow valley, washed away the bridge crossing the dam bypass, overflowed the embankment, cut away the earthworks and rushed downstream. The storm had broken out in the Umbilo/Umlaas/Umhlatuzana catchments earlier in the night with 40 cm of rain falling in 15 hours. Debris had collected under a Pinetown bridge, which gave away and resulted in a large volume of water striking the waterworks. At the Umlaas works the floodwaters broke the main pipes below the filter beds. Three 45 cm cast-iron pipes, each weighing a ton, were washed away and Durban was without water. Fletcher and his staff worked for 26 hours, waist deep in water, diverting the stream and then replacing the 12 meters lengths of pipes. Durban's water supply was reconnected without too lengthy a break, by Sunday midday. The Umbilo Water Scheme, which had served Durban for 18 years, was abandoned and water was pumped from the Umlaas Water Scheme to the higher levels of the Berea, previously supplied by gravity from Umbilo. (BER. In Mayor's Minute 1905, 35–38; Mayor's Minute 1906, 7)

In 1905 it was decided that Camperdown temporary dam would be changed into a permanent. Work was started next year and in 1908 the retaining wall was laid.

Resulting body of fresh water was the largest in Natal; the lake was three kilometres long, and at some points over 700 meters wide. (BER. In Mayor’s Minute 1906, 34; BER. In Mayor’s Minute 1908, 42)

Conditions in the early 1910s

In January 1906 there were problems with European-style water closets in Durban harbour. One of the disposal pipes was blocked and the plumber found two bottles, one shirt and two pair of socks inside. This lead to investigations that involved the Fort Captain, harbour engineer, wharf master and even water police. It is not known whether the offenders were found. (NHD, II/1/96, 106/1906, Pietermaritzburg Archives Depot) After only one month the same closet was under discussion once more; the mechanical engineer proposed on February the 5th that the wooden seats should replace the iron ones. (Mechanical Engineer G. Thomson to General Foreman of Engineers 5.2.1906, NHD, II/1/95, 28/1906, Pietermaritzburg Archives Depot)

In 1908 there were eleven public conveniences for Europeans, and 24 for coloured people. All but three for the coloureds were connected to the sewerage system. (Sanitary Department. In Mayor’s Minute 1908, 171) In 1910 there was one more for Europeans and 7 more for coloured, and they were all connected to sewerage system. (Sanitary Department. In Mayor’s Minute 1910, 173)

In 1910 the European birth rate in Durban was 28.3 per thousand, and the death rate 8.5 per thousand. The death rate was lower than any other town in South Africa, and it is interesting to record that the death rate in England and Wales in 1908 was 14.7 per thousand. According to Tatlow the public health and sanitary conditions were unsurpassed in any town of South Africa. The incidence of infectious diseases was vigilantly watched, and the remarkable diminution was proof of the satisfactory methods employed. (Tatlow 1911, 57) The Mayor was praising the work of Councillor Robert Jameson for this:

> It is given to but few mortals to inaugurate great works and see their fruition, but Mr. Jameson is a striking exception. When he first interested himself in the sanitary work of this Borough, he found the condition of things to deplorable. He has inaugurated and piloted through the Town Council and the Natal Parliament many schemes having for their object the improvement of the sanitation of Durban and now he has the extreme satisfaction of seeing the Borough equipped with the most up-to-date public health facilities in the way of pure water, perfect sewerage scheme, and excellently conducted Public Health Department, with the corresponding result of phenomenally low death rate. (Mayor’s Minute 1910, 14–15)

The water rate in 1909 was 1/2d. in the pound, at which figure the rate had stood unaltered since 1897. The sum of £538,534 (c. 56 million euros) had been spent in thoroughly sewering and draining the borough, and £540,000 upon the excellent water service system. (Tatlow 1911, 59–60) By 1911 most of the developed areas within the Borough were connected to the waterborne sewerage system, whilst extensions were undertaken as new areas were opened up. (Stark s.a., 126) A limited slop water removal service was still in use at certain premises at Brickhill Road. (Sanitary Department. In Mayor's Minute 1911, 206)

At the same year Borough Engineer Fletcher again paid attention to the increasing use of water other than domestic purposes. He was not so worry about the cost of augmenting the daily supply but the increasing cost of distribution. It was necessary to get larger distributory mains and increase service storage to maintain a constant supply. He said that the maximum hourly consumption was nearly five times greater than the minimum. He was blaming this largely for garden watering, which was "too often wasted by the careless way in which it is applied". (BER. In Mayor's Minute 1911, 58)

The Town Council of Durban emphasized in 1914 the industrial and commercial advantages of Durban, which enabled 'private enterprise to develop on terms and conditions such as no other South African town can offer'. More specifically, the council drew attention to the ample supply of coal; the plentiful supply of skilled and unskilled labour; the abundant and cheap water supply; the efficient municipal telephone service; the abundant electric power supply offered at very attractive rates to industry; and the low municipal rates. (Maharaj 1996, 589)

Flood of 1917

On Thursday, October 25, 1917, it started raining heavily in the Durban area. This culminated in a severe storm on Saturday, October 27, with more than 30 cm of rain falling in 24 hours in the Pinetown area. The Umbilo River flooded again, carrying away the 75 cm pipeline bringing water from the Coedmore Filters to the Stella reservoir. On the Umhlatuzana River a 38 cm and two 30 cm mains from the Umlaas Works were also destroyed. Even before emergency repairs were underway the Borough Engineer and his staff received news that the concrete weir at the Intake had collapsed under the floodwaters, which also carried away portions of the 60 cm and 45 cm mains at the Intake. The mains had to be repaired and a temporary dam built to replace the destroyed weir. For five weeks the Resident Engineer at the Umlaas Works and labour gangs worked under exceptional weather conditions – four floods occurring while the work was in progress. While repairs were being carried out between October and December Durban depended entirely upon a small stream, which was led into the Clear Water Reservoir. As this was not considered safe for drinking, a temporary treatment scheme was started. (Lynsky 1982, 39–40)

'Floods caused great damage, especially on the coast where the Umgeni railway bridge was swept away, along with many others. The pipeline carrying the Durban water supply form the Umlaas was carried away in five different places, and for four days not a drop could be got in the town except what came off the roofs.' For weeks afterwards the townspeople had to depend on unfiltered water from the rivers – a hazard to health – until a safe supply could be restored. (Child 1973, 251)

The 1917 floods resulted in Durban's existing water supply coming under critical examination. By January 1918 it had been resolved by Council that a new dam was required and that the town needed the services of an experienced "Water Works" Engineer. The man would have to be a specialist with "a working knowledge of chemistry, biology and bacteriology”. The appointment of a waterworks engineer would relieve the Borough Engineer of “a large amount of detail which under the present arrangement he has to deal with personally, the bigger and more important issues suffering accordingly”. Although there was a body of opinion that the waterworks Engineer should be subordinate to the Borough Engineer, it was decided by Council that he would be responsible direct to Council. The Water Engineer’s Department was to be completely separate from the Borough Engineer’s department for the 16 years following its establishment in January 1919. Main concern for the new Water Engineer, Walter Campbell, 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 Council deciding to continue developing the Umlaas River and to proceed with the Shongweni Scheme, with nucleus being a proposed dam to be called the Vernon Hooper Reservoir, 16 kilometres upstream of Fletcher’s Umlaas Intake. Construction started in 1923 and was finished in 1927. (Lynsky 1982, 42–45)

Results

In Durban the augmentation of the water supply and the development of the sanitation systems was mostly depending of the economics; what were the costs of the project compared with benefits obtained. All the big rivers in the neighbourhood where harnessed one by one and the reservoirs were built farther and farther away from the actual town. Rapidly growing population, especially after the South African War, forced the hand of the town council in this matter. Consequently the augmentation of water supply was never a political issue in Durban, there was no fights about should they build something or not like there was in for instance Cape Town.

Durban also had a good luck with their selection of two first Borough Engineers. In J.F.E. Barnes and John Fletcher they got innovative, unbiased and hard working engineers who were leading engineering department in Durban for 36 years. Especially solutions Fletcher did for the water-borne sewerage system in Durban were example for many other towns in South Africa.

There was also an other matter where Durban was used as an example. The way how Durban’s officials handled the natives and Indians living in the area especially in sanitary matters was used as an example how to segregate different ethnicities from each others. It has been said that it was one of the roots of the later apartheid-policy in South Africa.

Conclusions

You could say that good governance was not probably even thought in this time period in Durban. The participatory democracy was the matter of future in the minds of some idealists and transparency something unheard of. Most people living in the Durban didn’t have anything to say about which way and when they got water supply or sewerage. Natural resources were taken into use without any thought about sustainability or what where the effects for the environment.

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5. Development of the Governance – Municipal politics and water supply in Cape Town, Grahamstown and Hämeenlinna

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Introduction

Augmentation of the water supply and the sanitary reform were amongst the most important municipal issues in 1850-1920 in South Africa and Finland. The term ***governance*** deals with the processes and systems by which an organization or society operates. It was also one of the key problems in the selected three cases. The word ***governance*** comes from Latin and suggests the notion of steering. This steering of a society can be compared with the traditional approach of governments driving a society. Term ***good governance*** defines an ideal which is always very difficult to achieve. Some of the key elements of good governance are participatory democracy and transparency among other things. Also traditional top-down approach is considered to be out-dated phenomena. In South Africa, case towns are Cape Town and Grahamstown and in Finland, Hämeenlinna. These cases are selected because role of working class was important in this time period and all towns were in the middle of many municipal reforms. Two of the case towns are even established in the same year, but the historical development was quite different. The development of water supply and sanitation (wss) impacted on the development of municipalities and interacted in the process of the transformation of their economy and society. What was the role of the working class in this development? There were clashes amongst the dominant class for instance about the amount the degree of municipal power and the costs of projects. Especially rentier classes seek the support of the working classes against the water schemes. And most of the time these two classes were in close political association.

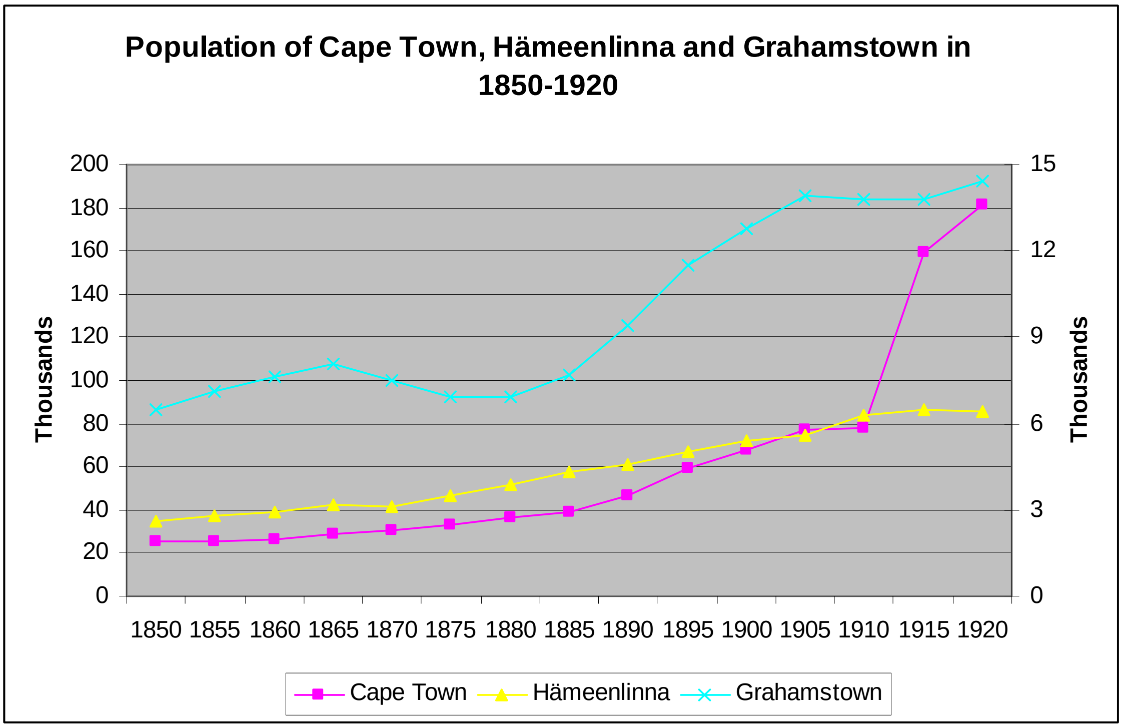

Figure 1. Population of Cape Town, Hämeenlinna and Grahamstown in 1850–1920.

What were the reasons why the working class was against these improvements that were suppose to better also their living conditions? Why didn't they see it to be in their interests to get drains and sewers working properly? Even the appealing to the improvements in health situation didn't change the attitude of the working class. It is assumed that working class was not involved properly in these reforms and a top-down approach was used. If this was the case, the municipal administration was not working well. Now we would say that it was not good governance.

Early history of Cape Town and Hämeenlinna

These two towns are established in the very same year, 1652. Cape Town is the oldest European-style city in South Africa and first iron water pipes and taps, were installed along Orange, Long and Strand Streets in 1811. (Barlow, Chas. R., Report on Cape Town's Water Supply, October 1914, 3/CT, 4/1/4/298, F134/4, Cape Archives Depot, 2) All these new pipes and the provision of water involved considerable expense. As a result, in 1814 the Government had no money to spare. As time went on, more fountains were erected, and by 1834 there were 36 of them in the city. (Shorten 1963, 97; Picard 1968, 82; Burman 1969, 98)

The Municipality of Cape Town, established on 3 March 1840 inherited the responsibility for water supply. The old reservoir was dilapidated, the mains corroded, and the supply quite inadequate in dry weather. At the same year it was reported that the water supply consisted of public fountains or the 63 pumps in town. Inspectors reported several cases of rotting fish and human excrement in the very sleeping apartment. Such examples may have been extreme, but it was in general difficult for people to keep clean. (Morris 1970, 4; Wall 1998, 1; Burman 1969, 98-99; Worden et al 1998, 120)

In 1846 The Good Hope Mill Estate was purchased to obtain the water rights, which rendered an increased supply available for the Town's requirements. The older houses possessed their own wells, but the water in them was brak. Water became so scarce that a proclamation was published offering rewards for the discovery of springs on Government land. In 1849 only about one-fifth of the houses in town had water on the premises. (Barlow, 4/1/4/298, F134/4, 3/CT, 3; Shorten 1963, 122, 240; Laidler 1952, 179; Hattersley 1973, 179)

Meanwhile, in the opposite side of the globe, in Hämeenlinna in southern Finland, there were in the 1660s probably around 300 people living in town. In 1690 there were only 250 people left. The early years of the town were not very successful. The town was established as market place for the surrounding area but it couldn't compete with older coastal towns, like Turku and Helsinki. Besides the place of town was not very good; it was so narrow that the inhabitants could not cultivate the land. (Moilanen 1996) The town was "half swamp, it was partly surrounded by low and muddy bank, where flow was so slow that you could say that it didn't move at all". (Manner 1902)

In the 1740s the town was under threat of loosing it rights because it has declined so badly. For instance Abraham Hulpers who visited town in 1760 said that he have never visited so small a town. The threat, however, vanished and the town started to grow. In 1780 there were already 878 inhabitants in Hämeenlinna. (Moilanen 1996)

Also in Hämeenlinna military had important role. Häme Castle was built there already at the end of the 13th century, following Sweden's crusade to Häme. It was fortified camp for a long time and later was built into a residential castle for its commandant and his staff. Castle has its own big water well; it is still there to be seen. (Juuti & Wallenius 2005)

Establishment of Grahamstown

Grahamstown was established in 1812 as a military camp. Its commanding position and the availability of water from streams determined the location. (Scott 1987, 139) Situated inland its problems with the water management differed from those in for instance Cape Town; it was unfortunately situated on a high watershed with all rivers flowing away from it. Unlike most other inland towns it was besides market and administrative centre also a major educational and ecclesiastical centre. (Figure 2)

At first sluices were built across the neighbouring watercourses. From these water was lead in a wooden through into a stone watercourse and a tank near the Drostdy gate. (Hunt 1976, 9) According to Sheffield there were also at least two wells. They were landmarks in the town and were always referred when old Grahamstown was spoken of. (Sheffield 1884, 220)

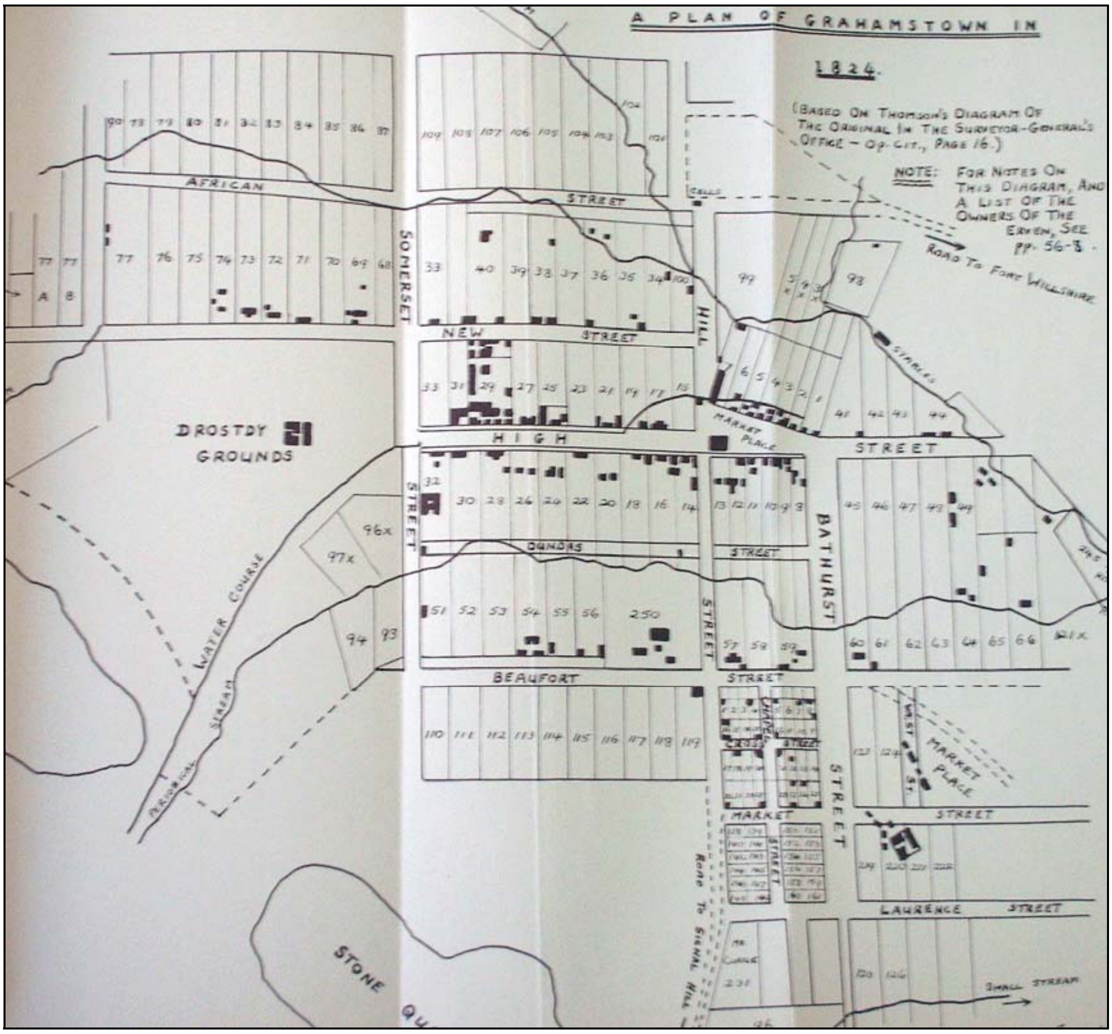

Figure 2. Grahamstown in 1824. (Watts 1957, 55)

When the General Municipal Ordinance was passed in August 1836, Grahamstown was a town with many problems. Developing slum conditions in the non-European Village increased the chances of disease. In addition to this an insufficient water supply, and unhygienic butcheries, were a threat to public health. Wells appear to have been sunk wherever there was a probability of finding water. (Hunt 1961, 155; Hunt 1976, 9)

First reservoirs

In Cape Town the Council decided to build a reservoir with a capacity of 11 Ml. This first reservoir was completed in 1852, and proved highly successful. Greatly encouraged, the Council in 1856 embarked on a larger No. 2 reservoir. (Burman 1969, 99; Shorten 1963, 131)

Worst affected by water shortages were the town's poor and the working classes, who relied on the public pump's and fountains, which were shut off at night to conserve water. The consequence of this was described by Dr. Laing:

> […] many [of the working class] being employed until late every day, have no time for carrying it. They used to carry water at night when they came back from their work, but the pumps are now locked up at night. (CCP, A1-1859, 10)

Consequently those who could afford it had to employ others to do so, paying up to 3 pence for two buckets. Alternatively, they could rush to the pumps after work where:

> Sometimes twenty or thirty buckets [are] waiting to be filled. There is also often a row there, through the people quarrelling about the water. (CCP, A1-1859, 28)

In 1861 the Cape Argus criticised both the unsanitary state of the town and the attitude of the Commissioners to municipal reform. The paper advised that the first priority was the provision of water. Furthermore it suggested, "when we have as much water as we can use, we can carry out a proper system of underground sewerage …provide drinking fountains, and public benefits for the working class". (Cape Argus, 26.1.1861) The paper warned that 'underground drainage' without water would represent "the greatest curse to befall this city". (Cape Argus, 31.1.1861) It went on to caution:

> Instead of scores of children dying in our back streets, we would have hundreds and hundreds of adults into the bargain[…] the only thing that has saved the city from typhus and cholera hitherto, has been the absence of underground sewerage[…] [because] we have never had water sufficient to flush such drains if we had them. (Cape Argus, 31.1.1861)

Although two reservoirs provided a welcome addition to Cape Town's water supply, they did not solve the problem. In the 1860s the Council bought various water rights and in 1869 a filter-bed was built. Water pipes could be spread over the whole town through these purchases. (Burman 1969, 99; Picard 1969, 85)

However, in 1872 water supply was not equal to demand and shutting off the supply at night had to be resorted to. Average daily consumption was about 6 l/person/day with the population of c. 30,000. Storage facilities were unequal to this, and the city lived on the edge of disaster. The task of reporting on the water supply was given to John G. Gamble, the Hydraulic Engineer to the Colony. He researched Table Mountain and pressed for the construction of a tunnel from there to the town reservoir. He also saw that Cape Town would have to look further for its supplies of water. (Barlow, 4/1/4/298, F134/4, 3/CT, 4; Hodson 1980, 349; Burman 1969, 99-100; Shorten 1963, 336)

In 1875 there was a series of articles in the Cape Monthly Magazine that spoke of the need for street improvement and an increased water supply. This started a campaign to improve the sanitation and infrastructure of the city; this campaign was also a part of the promotion of Englishness in town. English press stigmatised opponents of reform as obstructionist, often in the most virulently racist terms. (Bickford-Smith 1995, 45; Worden et al. 1998, 223)

As a result of council's conservative policy towards improvements, by the 1870's the position of Cape Town's water supply had deteriorated from 1840's. While the daily average minimum had risen, the population had doubled in the same period, which reduced water consumption from 52 to 41 litres per head. (CCP A15-1879, 59) Once again the underclass was worst affected and bore the real cost in terms of their high mortality rates. Most of the town, and especially the poor were still dependent on the public fountains for water. During periods of drought or in the summer months, water was shut off at night, and sometimes the water pumps were chained up during the day. (Cape Times, 28.1.1881) The effect of the water restrictions on the city's poor was described by Cape Times:

> …the suffering from want of water is intense among the poorer class of people[…] when the pump handles are free so fierce is the competition for the use of them that weak folks have no chance in the struggle, and are compelled to go away empty. (Cape Times, 28.1.1881)

It was decided to build a storage reservoir big enough to cope with the problem, and in 1877 work commenced on the Molteno reservoir. It took four years to build. When finished in 1881 it could hold 186 Ml. Though Molteno reservoir gave the town sufficient storage space, the drought of 1880 focussed attention on another problem. It was useless having storage if there was an insufficient flow of water to fill it. (Burman 1969, 100-101)

In Grahamstown Municipal Commissioners ordered construction of open furrows for the town centre in 1838; they thought that iron pipes would have been too expensive. Furrows, however, proved to be irksome and from 1844 onwards they were replaced by pipes. This installation was coupled with the building of dams and reservoirs to meet an increased demand for water. From the beginning there were problems; water pipes were not dug deep enough to endure wagon traffic in the streets, dams were badly constructed, there were mischief against the pipes etc. To help with these matters a "Superintendent of Water" was appointed in April 1850. (Hunt 1961, 171, 189–96)

Most significant problem created for the Municipal Commissioners by the iron water pipes was the inadequacy of water storage capacity to meet the demand of an increased supply of water. The already serious water position in Grahamstown was aggravated by a drought in the summer of 1858–59. The Graham's Town Journal reported that the shortage of water was a great inconvenience to the city. "Some localities have not had a drop from the municipal leadings, for which they pay rates, for nearly a month," complained the Graham's Town Journal. The position was gloomy. Those rate-payers who did not possess large tanks or bore-holes were “reduced to the utmost straits.” The poor who had no leadings and the non-European population who lived in the locations were “in a most miserable plight, begging water from house to house.” (Graham’s Town Journal, 18.1.1859) Personal wants were not being met, cleanliness was neglected, and the general health of the whole community was threatened. A large dam was urgently needed.

In April 1859 a City Engineer was appointed to supervise all the public works of the town. One of his first tasks was to supervise the erection of the new reservoir, which was opened on the 25th January 1861 by Governor Grey and named after him the “Grey Reservoir”. Reservoir was an important milestone in the development of Grahamstown’s water supply. Yet this solution of the problem of water storage only emphasized the inadequacy of the piping. (Hunt 1961, 196–98)

Time of building of Grey Reservoir was fortunate for the 1860’s were years of serious drought. The need to augment the water supply became obvious by 1865. (Hunt 1976, 14) The Board of Works presented a plan for a new reservoir situated in the gorge above Fort England. The plan was adopted after two lengthy sessions of debate which rejected a suggestion to raise the level of the Grey Reservoir. (Grahamstown Journal 9.8.1865) But the delays exacerbated the water problem to such extent that in December the military made serious complains. Military threatened that if better supply was not provided they would be removed from Grahamstown. The military had just previous year returned to Grahamstown after two years in King William’s Town. (Gibbens 1982, 139)

The Council had made a contract for building a dam in Water Kloof. Unfortunately the contractor stated in July 1866 that he was unable to proceed with the work. After this the military was given a permission to assist in building of the dam. The supervision of the work was taken over by Colonel R.G. Hamilton of the Royal Engineers. In gratitude the Town Council decided to name the reservoir as Douglas Reservoir after Sir Percy Douglas, commandeer of the troops in Grahamstown. The reservoir was completed at the end of February 1867. The construction of another reservoir was begun before the Douglas Reservoir was completed, on the other side of Signal Hill. The gratitude of the Council was marked by their decision to call the northern reservoir the Hamilton Reservoir. This reservoir was completed in October 1868. (Hunt 1976, 14–15; Gibbens 1982, 139–40)

The problem of water supply became acute once again with the severe drought of 1877–78 and Council efforts to improve the water supply were redoubled. The necessity of additional reservoir was impressed upon the Council in 1874, after this Council attempted various avenues to ensure an adequate water supply. The old plan for a reservoir at Fort England was revived in 1878, but once again came to nothing. In the drought crisis of 1878 all inhabitants were called upon to observe the strictest economy in their use of water. The drought led to excavation, repair and enlargement of the Grey Reservoir in 1877–1881 and repuddling of the Hamilton Reservoir in 1878. (Gibbens 1982, 144–45)

Council’s hopes focussed on the West Hill Reservoir most of all during the years after 1877. This Reservoir sparked off conflict not only between Town Council and

Divisional Council, but among the Councillors themselves and especially between the railway authorities and the Town Council. The original proposal in 1876 was to ask if the Government would consent to the bank and bridge to be constructed across the gully at West Hill, being used as a dam by the Council. Apparently there had been a small dam named Graham's Dam next to the site of this proposed railway embankment, used by authority of the Divisional Council. The final arrangement was that the Railway Engineer and workers would construct the West Hill Reservoir at the Town Council expense. At the later stage during the lengthy construction of this Reservoir, which was later known as the Cradock Road Reservoir, railway authorities proposed that they take over the Reservoir. The terms of the Council proved unacceptable and the Reservoir remained Council property. The most significant aspect of the construct of this Reservoir was the internal conflict within the Council. The quarrel was about whether this Reservoir would benefit all the ratepayers or not. A powerful minority urged to proceed with the construction of the Reservoir at Fort England as more beneficial for the general body of ratepayers; West Hill area was populated mostly by wealthy merchant families and the Settler's Hill area near Fort England was mostly small businessmen and shopkeepers. (Gibbens 1982, 145–46)

Around same time in Finland there was also same kind of problems. City fires, and the water required to put them out, were crucial in making Finnish towns realize that they must develop water supply systems. This was the case also in Hämeenlinna. A fire in December 1876 burned almost out of control as a result of an inadequate supply of water. After the fire, Governor demanded an explanation for the poor outcome of the fire-fighting efforts. (Koskimies 1966, 273; Juuti & Rajala & Katko 2000, 19–22)

Conditions in the 1880s

In the 1880s Cape Town was not in a very good condition. Winter torrents gouged out the roads and flooded homes, while the sand raised by the summer winds enveloped the town in dust. Waste accumulated in the covered grachts and the resultant gases were released through 'stink traps'. Human ordure was frequently poured into the streets. Refuse and night-soil collection was inefficient. Slaughtering was still carried on at the shambles and fish was cured at Roggebaai: the result was nauseating. Animals roamed the streets and the superintendent of public works claimed scavenging pigs were being bred 'by hundreds'. Even street watering contributed to the aroma, for polluted seawater was carried to the upper parts of the town. To all this was added a chronic shortage of water. Most neglected were the back streets. District Six was an instant slum where houses were uncontrolled by building regulations. (Worden et al. 1998, 223-35)

In 1886 W. Clark Russell wrote about his visit in Cape Town (Russell 1886, 210):

> Why should such a town as this suffer from such conditions of uncleanliness, from such complications of evil odours, from such gutters of black and creeping filth as would be utterly impossible in the very poorest village you can point at home? […] why, then, not deal determinedly with this question of drainage, and with the aboriginal notions of the Malays and the bovine indifference of the Dutch, and so rescue a charming town […] from the most disgraceful charge which, in these days of science, of soap, and of drainpipes, can be brought against a community?

There were same kind of problems in both Grahamstown and Hämeenlinna in 1880s. In Grahamstown the general sanitary living conditions presented a variety of nuisances. Apart from the discomfort of dust and rubbish in the streets, there were rubbish heaps and manure dungs, dead animals in the streets, washing in public streams, overflowing cesspools which would impregnate wells and streams, and the stench of offal from the slaughter houses. (Gibbens 1982, 187)

In 1882 there was an article entitled "Thoughts about Grahamstown" in The Grahamstown Journal. (Grahamstown Journal 5.10.1882) Visitor, as the writer signed himself, criticised the conditions in the town and probably gave more realistic picture than some other writers. The entry from the interior was marred not only by the stench of the slaughter houses, but by the sight of the tin hovels and ragged huts of the Hottentot Location, whose filth and human inhabitants "in the lowest grade of existence would be a disgrace to the most lawless community". The writer's opinion was that this was a result from Municipal negligence. Criticism was levelled at the Municipality for doing so little to encourage the erection of buildings and provide a water supply for the locations.

In Hämäläinen newspaper the pseudonym "Interested about health" (terveyttä harrastava) wrote an article entitled "One point about public health" (eras terveydenhoito seikka). (Hämäläinen 11.9.1889) In this article he was referring the local slaughterhouses and them being situated too close to the town centre. He wrote about the disgusting stench coming from them when the wind was blowing from their direction and was wondering why the health board is not paying any attention to this stench. Besides, he said, slaughterhouses are spoiling the town water. He described the water as "greasy and meaty" but at the same time "too strong for public health". At the end of the article writer was demanding the removal of the slaughterhouses further away from the centre before they "poison the whole town".

In every one of these three towns conditions were demanding improvements in the 1880s and in every one of them the blame for condition was but on the negligence of the municipal government.

New legislation of 1880's

Although the reformists' call for water and sanitation reforms was grounded in concerns over health and trade, the earlier philanthropic attitude over the effect on the town's underclass was almost entirely absent by this time. The working class was now seen as an obstacle to reform, as it was perceived that it was they who underpinned rentier class control of the Town House. The issue of class thus became important factor in the battle over the Town House for the implementation of water and sanitation reforms. (Grant 1991, 70)

The Cape Times saw the greatest threat to reform being this relationship between the representatives of property, the 'Dirty Party', and their working class tenants. It was suggested that while landlords did not want to augment water supply because of the impact it would have on property rates, the coloured working class did not need it:

> How moderate must be the requirements of Abdol, whose washings are chiefly of a ceremonial kind, and whose house is guiltless of the trace of the scrubbing brush. There are thousands of inhabitants in this city who could put up, without any sense of discomfort or want, with considerably less quantity of water than the present supply, and we may be sure that their voices will be heard[…] why should they be taxed for a commodity which they have never felt the need, and which they would not[…] use more freely than the present time? (Cape Times, 29.9.1876)

Despite these conditions demanding of attention, reform was slow. The main features of town government in the 1880s were lethargy and conflict. The press ranted ineffectually about the 'grave-like torpor, a mouldering stagnation, a dream-like unsubstantiality about us that is stamped on all our corporate life'. Underlying the reluctance of the councillors to invest in improvements were several interrelated issues. Costly reforms would have to be paid for by the ratepayers, hitting the property owners on the council particularly hard. Many of them were Dutch. But they also represented an earlier generation of business in the town, ousted by entrepreneurial immigrants. Their attitude to sanitation was old-fashioned, a view shared by English-speaking residents of the same vintage, like R.H. Arderne:

> I believe that any dirt is comparatively innocuous, and I believe it is the waste of water in all the little houses and alleys that has been the source of more annoyance than anything else can possibly be. When these people had to go to the public pumps they did not waste water. (CCP, A13-1881, 68)

Merchants resident in the suburbs led opposition to the 'Dirty Party'. The interest of the 'Clean Party' lay in a thriving town, which could be successfully promoted on the London bond markets. ‘The neglected state of the town' as the Clean Party complained in 1881, threatened residents with an epidemic and prevented 'Strangers and Visitors remaining in this Town to the detriment of its Trade and prosperity'. In the 1882 election the Clean Party sent a spanking-clean 'Van of Progress' round the town with a band inside playing 'lively airs' in an attempt to garner votes.

> It was a smartly painted conveyance, with the panels and wheels tastefully picked out with gilding. A bright white canvas awning protected the bandsmen, in their trim, new uniforms and freshly scrubbed faces, from the sun and rain. Not a speck of dirt defiled this smart turn-out; and the pair of well-groomed animals in front pranced proudly along as if they knew that they were chasing away from Cape Town the demons of Slovenliness, Meanness and Dirt. (CCP, A8-1897, 4-5)

The result was to put the Clean Party into power.

In 1882, the Cape Parliament enacted legislation that gave municipalities control of water supplies and sewage disposal. Cape Town was allowed to abandon the free supply of water to every dwelling house. In 1883 further legislation empowered the Town Council to levy a special rate to cover the health services and to control epidemics. These provisions and the appointments, in 1885, of the first medical officer of health and sanitation officials constituted the beginning of the City Health Department of later years. (Wall 1998, 1; Bickford-Smith 1995, 58; Shorten 1963, 144)

In the 1880’s and early 1890’s the reformers sought to increase municipal borrowing powers as well as to narrow the municipal franchise by excluding the working class. A series of three municipal amendment acts passed in 1885, 1890 and 1893 restricted the municipal franchise by narrowing the definition of occupiers to those who were liable for tenant's rate, by raising the property qualification for the franchise, and by introducing a system of plural voting designed to favour businessmen and property owners.[1]

The most serious latent threat to public health in Grahamstown was the cesspool nuisance. The problem with the cesspools was that many had not been constructed properly nor cleaned out periodically as they should have been. Most unhealthy conditions resulted when seepage from cesspools drained into wells, streams and drains. The cesspool nuisance gradually increased until in 1879 a full scale investigation into the Sanitary Condition of the town was made. In the report of this investigation the only suitable system for the situation was felt to be the introduction of the "pail system" after abolition of cesspools by 1 January 1881. All the doctors in Grahamstown approved the proposal. Unfortunately when the report was debated by the Council, it was accepted only partly because of the financial reasons. The Council accepted the principle of the abolition of cesspools and the medical evidence for the abolition but the majority just could not permit the financial outlay necessary for the introduction of an entirely new system. (Gibbens 1982, 217–22)

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Despite all the Council activity 1882 posed the necessity for yet further extension of the water supply. In April the town's water supply had to be restricted in availability to one day a week. (Grahamstown Journal 20.4.1882) In August the Council resolved to apply a loan for government and to obtain the services of the Colonial Hydraulic Engineer for a survey and advice. When the Report was presented in October, prudent financial considerations won the day. The motion of surveying the "pipe track" with a view of obtaining additional water supply from "Green Hills" and to furnish an overall estimate was defeated. (Gibbens 1982, 147)

The drought that accompanied the economic depression of 1882–1886 provoked debate on water augmentation proposals. In April 1884, H.L. Spindler, independent civil engineer, selected Slaai Kraal and Howison's Poort as being the only water schemes worth developing, the former for a minor, economical supply, and the latter as a major supply. At a public meeting on 15 April 1885, the Council recommended that the Slaai Kraal Scheme should be adopted. The additional expenses of constructing the filter bed,

[1] Those owning property valued between £500 and £999 qualified for two votes, those with a value of more than £1000 got a maximum of three votes.

acquiring the water rights and the rearranging city pipe service, however delayed the implementation until 1897. Meanwhile the Council resorted to increasing the supply through boreholes which were not really effective. (Sellick 1983, 94–95; Hunt 1976, 15)

In 1887 water from springs and hills were conserved in five reservoirs holding about 230 Ml. Water was distributed in 1000 pipelines to the 1500 houses and stores. The sanitation of the town was fairly good. The old cesspool system was replaced by the pail system; the sewage was removed nightly and covered up with earth in rectangular pits three kilometres leeward of the city which when filled were planted with eucalyptus trees. Parliament had made a grant of 2.8 km^2 of land on the New Year's River with riparian rights, for an increased water supply for the city. Reliable surveys and estimates for pipe track and storage reservoir showed that the water could be led out by gravitation over the railway neck, thus keeping reservoirs filled with running water all the year round. (Souvenir of Grahamstown 1887, 35, 39–41)

Meanwhile in Finland city fathers in Hämeenlinna started to regard the shortage of water as an increasingly serious problem which resulted in a number of initiatives for settling the issue. The first extensive proposal was prepared in 1889. It was suggested that water be drawn from Lake Ahvenisto, but no action followed. The detailed proposal by the merchant F. Kiuttu for the construction of a water pipe at the end of 1890 had a similar fate. (Hämeenlinna town council, record of arrived documents 1887-1889, 47/1889, 14.5.1899; record of arrived documents 1890-1892,104/1890; Minutes of counsellors, 21.6.1889 §9, 19.7.1889 §9, 6.9.1889 §10, 8.11.1889 §25, 21.3.1890 §4)

In 1879 first Public health Act said that towns must provide good water to city dwellers. The first meeting of a public health board in Hämeenlinna took place in 1882; the first medical officer of health, Doctor C.H. Bartram, was elected already in 1877. The poor drinking water situation in the city kept the board busy. Consequently, it suggested to the council in 1901 that the latter set up a water-works-construction fund that could be enlarged gradually. The proposal did not receive enough support at the time. (Manner 1902; Juuti & Rajala & Katko 2000, 17–19, 25)

Water from Table Mountain and Slaai Kraal

The construction of the pipe track to Table Mountain provided employment for the migrant workers entering the town. (Figure 3) When the tunnel constructed through the Apostles range and a pipeline laid to the Molteno Reservoir became operative in 1891 it was evident that the scheme was overcommitted and not viable without major storage. In 1892 a start was made to building of a reservoir on the Table Mountain. (Worden et al. 1998, 227; Hodson 1980, 349)

After a further year’s delay excavation for a new dam started in January 1893. Even so, the short-sighted ratepayers limited the engineer to a total expenditure not exceeding £50,000 and this was sufficient only for a 21 m high short dam impounding about 137 Ml. Fortunately there was a severe drought at the beginning of 1894 and this apparently stimulated the Council into deciding to build the dam 3 m above the originally proposed 34 m height, affording storage for 955 Ml. (Hodson 1980, 349)

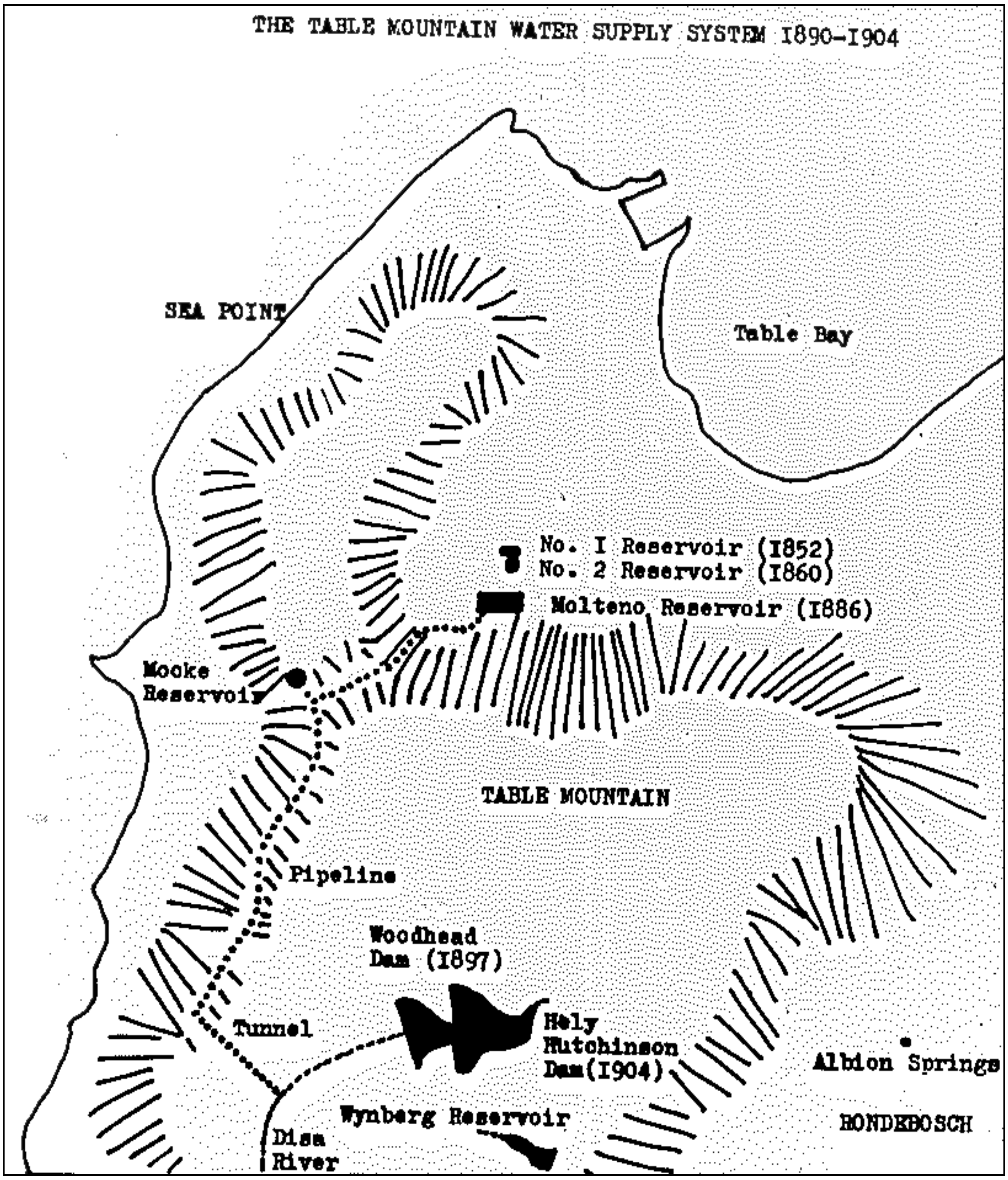

Figure 3. The Table Mountain water supply system 1890–1904. (Grant 1991)

In the 1890s the reforming party acquired a fresh countenance. It included two Afrikaner Bond members, D.P. Graaff and D.C. de Waal, both 'new' urban Afrikaners. Another active member of the revamped council was the department-store retailer and property developer John Garlick. A changing power base and improved prosperity contributed to the emergence of a sense of civic responsibility in the 1890s. The members of the Clean Party were not only more willing to spend large sums on improvements, but were also in a better position to do so. This is not to say that the lot of the poor was improved. On the contrary, what did occur was that the differential between whites and other residents of the city increased as the former began to benefit from the improvements created. (Worden et al. 1998, 226)

Waterborne sanitation was introduced only in 1895. The scheme for Cape Town was costly for those days as it evolved the laying down of nearly ninety miles of sewer leading. The pipe installation was laid in tunnels hewn through rock and a sea outfall was lead to Green Point and was completed in 1905. (Slinger 1968, 13; Shorten 1963, 150, 336)

On the 1st May 1897, the last stone of the dam for the Table Mountain Water reservoir was laid. The reservoir lay across a catchment area of 2.5 km^2, capable of yielding over 2000 Ml. Work on the next reservoir started in 1898. The Governor, Sir Walter Hely-Hutchinson, opened this reservoir, named after him, on 5th March 1904. The water surface covered 0.16 km^2, and the reservoir had a capacity of 1050 Ml. (Picard 1969, 100; Burman 1969, 106)

The dissension that arose in 1897 in some aspects echoed the earlier conflicts of 1861 and 1882, as it represented a division of interests between the reformist businessmen and the old rentier classes and their tenants. The influence of this latter group had diminished considerably, not only due to change to the municipal franchise, but also because of their declining economic position. The increasing importance of commerce and the growth of the suburbs saw a decline of investment in cheap housing and rent based income. Nevertheless, those opposed to further expenditure continued to draw on the support of the working classes and small householders who perceived these reforms as serving the interests of the city's dominant class. Indeed charges of corruption formed a large part in the mobilisation of ratepayers against the Council. (Cape Times, 13.2.1897) Similarly, reformists continued to label their opponents as 'dirty' and used racial criteria to explain the conflict. (Grant 1991, 96-97)

There were two polls in 1897 about taking a municipal loan for improvements in water supply. In the second the reformers managed to gain support for the loan. Those opposing were seemed to resemble the Dirty Party of the 1850's and 1880's, although now dubbed the "wreckers". (Cape Times, 29.7.1897) The 'clean party' of the 'progressives' as they were sometimes called, were perceived by their opponents to represent the interests of the city's businessmen. (Cape Times, 29.1.1897) The 'wreckers' on the other hand were a group of householders, large property owners and the working classes, united by the issue of municipal debt, who questioned the necessity of a further reservoir, who feared a rise in property rates, and were concerned about allegations of corruption. The Cape Times had feared that this combination had the potential to defeat the reformers, particularly the "voting Malay's" which it continued to stereotype as a:

> large class of small householders and occupiers which loves filth and cannot be expected to pay willingly for cleanliness. (Cape Times, 21.7.1897)

Furthermore the working class householders were seen to be deceived and influenced by the 'wreckers':

> …the language habitually used by Mr Hofmeyer and those who sort with him is calculated to convey to those small property owners, slum owners many of them, that a raising of the rates is really at issue; and the waving of that red flag suffices to send them headlong to the poll to vote "Nay" to anything and every thing[…] (Cape Times, 21.7.1897)

An outbreak of typhoid in 1898, which killed the incumbent mayor, Herman Boalch encouraged reform. Thus by 1899 Cape Town had many of the amenities of a modern city, including a professional bureaucracy, an adequate water supply, water-borne sanitation and efficient drainage. (Worden et al. 1998, 226-27)

While whites were moving out of the city into the suburbs, the growing Coloured population was crowded into the decaying buildings still close to the centres of work. Even when the houses were relatively new, as in District Six, the lack of regulations and overcrowding ensured that they were death traps. Although water was laid on and a sewerage system existed, neither was adequate to cope with a situation. The poor quality of urban housing was demonstrated by the turn of the century in the rising incidence of tuberculosis. Bubonic plague also hit Cape Town in 1901. The outcome of the plague was the call for an African location by Medical Officer of Health, Dr. Jasper Anderson. There they could be housed in sanitary conditions without flooding into already overcrowded central area. Ndabeni location was constructed rapidly and soon there were 7000 Africans living there. Notwithstanding that there were eventually fewer deaths among the Black than among the Whites and considerably fewer than among the Coloureds, it was only the Black who were forcibly removed and contained in the Location. Nor were they allowed to return to Cape Town once the plague had abated. (Simkins & van Heyningen 1898, 91; Maylam 1990, 61; Slinger 1968, 14; Beavon 1982, 6-7)

By the 1890's the political power of the rentier classes had been broken by a combination of their decline within Cape Town's economy and the narrowing of the municipal franchise. The alliance of interest between working class tenants, small householders and landlords, was gradually replaced with the emergence of ratepayer's associations which shared a common concern of keeping municipal rates to a minimum. The ratepayers' association that emerged at the turn of the century coincided more closely with class lines rather than the ethnic basis of the clean and dirty parties. The ratepayers' association included sections of the middle and professional classes as well as a number of smaller businessmen. The merchant interest associated with the clean party in the 1880's was superseded by a rising class of businessmen who controlled the council by the turn of the century. The ratepayers' association drew on the support of the city's working classes, particularly where the issue of water supply was concerned, as the water schemes had become to be perceived as the prerogative of the business interest. (Grant 1991, 128-29)

In the 1880's and early 1890's there were efforts in Grahamstown to find cheap alternatives to the already accepted Slaai Kraal Scheme. Proposals for the construction of new reservoirs at Fort England and Pinnock's Toll were considered. (Grahamstown Journal 28.2., 1.3., 12.4. and 20.4.1883) In 1893 motion in favour of the construction of a reservoir at Goodwin's Kloof was withdrawn in response to local opposition. (Grahamstown Journal 23.9.1893) The devastating drought of the 1890's prompted the town council's renewed search for the best source available. In April 1896, the piped water supply was reduced to a three hour service fortnightly. In June, a contractor began supplying water from Slaai Kraal. (Grahamstown Journal 4.6.1896) The report submitted by engineer Thomas Stewart in 1896 favoured Slaai Kraal as the best available source at moderate cost. (Grahamstown Journal 28.2.1896) There were however resistance against the scheme from the local working class citizens. This resistance led to the rejection of the proposed scheme by a public meeting in August 1897. This woke up the middle class ratepayers whose pressure resulted to a poll in September. In this poll only those ratepayers who had met all their payments could vote and the result was victory for the supporters of Slaai Kraal scheme. (Sellick 1983, 98–99)

Stage one of the Slaai Kraal project comprised the construction of a 364 Ml storage reservoir, a high pressure tank for screening and gauging the supply, and the enclosure of the property to eliminate pollution. Water was supplied for the first time on 12 November 1898, in time to fill the empty Grey Reservoir for the Exhibition visitors. (Grahamstown Journal 15.11.1898) In 1901 the new reservoir was named "Milner" in honour of the High Commissioner. Between November 1898 and April 1900, Slaai Kraal was the sole water supply as the other sources had all run dry.

Unification and hinterland schemes

By 1902 Cape Town and other Peninsula municipalities had developed to such an extent that the water supplies were giving a cause for alarm. In that year the Suburban Municipal Waterworks Board approached Cape Town with a proposal of a central body for solving the problem. A joint committee was set up, but by 1904 Cape Town was so short of water that in summer supplies had to be cut off for certain periods during the day. The Government was asked to appoint a commission of inquiry into the water supply position of all the municipalities in the Peninsula, and the scope of this commission was widened later to include the whole question of local government in the area. The other commission had recommended already in 1903 that the eight municipalities of 'greater Cape Town' be amalgamated into 'one unified body'. The issues identified as requiring attention at this nascent metropolitan scale included sanitation, water supply and other services and 'all other municipal matters'. (Shorten 1963, 152; Parnell & Mabin 1995, 50)

City engineer of Cape Town submitted in 1904 a report on various water supply schemes, of which the Cape Town Council favoured the Franschhoek reservoir on the headwaters of the Berg River. (Figure 4) The council proposed building a dam capable of supplying 180 Ml per day. The municipality bought most of the ground and then with the support of the southern municipalities (Woodstock, Mowbray, Rondebosch and Claremont) introduced a bill into Parliament. The bill was, however, delayed for a next session, and the support of southern suburbs faded away. (Wall 1998, 5; Burman 1969, 111)

In 1905 Cape Town received its next shock, when it was discovered that the daily water consumption had risen to between 10.5 and 13.5 Ml per day and the Table Mountain reservoirs could only provide 13.5 Ml. Several Table Mountain schemes were put forward which, however, had their limitations because the bulk of water in Table Mountain was already being utilized. A Peninsula Water Commission considered the problem, and recommended that no large additional works should be constructed on Table Mountain; instead the peninsula authorities should amalgamate, and embark on a scheme giving at least 45.5 Ml per day, for which it would be necessary to go a distance of up to 80 kilometres from Cape Town. The passing of the Southern Suburbs of Cape

Town Water Supply Act in 1907 finally killed the Franschhoek scheme. The act authorized the municipalities of Claremont, Mowbray, Rondebosch and Woodstock to continue with a scheme on the Wemmershoek. (Burman 1969, 108-9; Barlow, 3/CT, 4/1/4/298, F134/4, 4; Wall 1998, 5; Shorten 1963, 152)

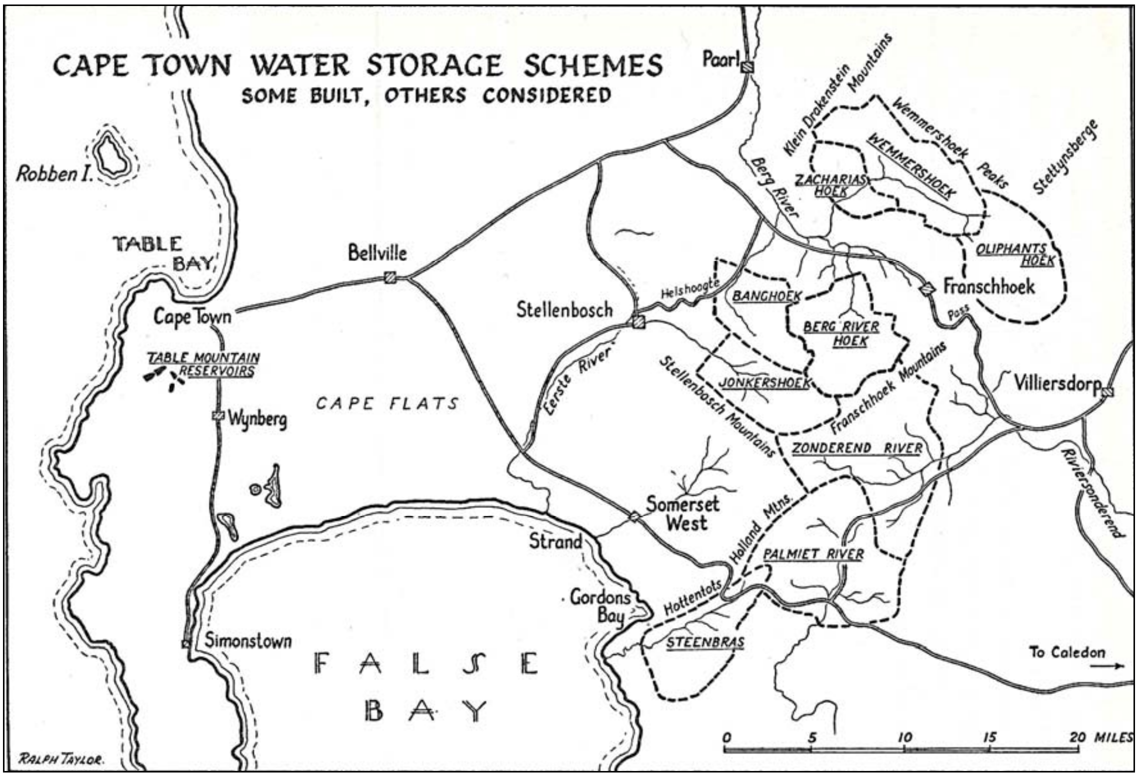

Figure 4. Cape Town water storage schemes (Burman 1969)

During the municipal elections in 1904-1906 distinctions may be made between the water and anti-water parties on the basis of the composition of their supporters. The support of the parties was generally drawn from different groups of ratepayers. Support for the water party tended to come from businessmen and professional classes, broadly coinciding with the upper and middle class ratepayers, while the following of the anti-water party was strongest amongst middle and lower middle class householders, artisans and the working class. It was this latter group that had been hardest hit by the municipal debt through the increase in rates and rents. Although the representatives of the anti-water party were hardly typical of the working class, they attracted the latter's support with their accusations of extravagance and rhetoric denouncing of corruption. (Grant 1991, 133, 135)

Much of the anti-water party's campaign was popularist, particularly with regard to water supply, and the Berg River Scheme represented a convenient symbol of extravagance. The working classes needed little reminding, they had been casualties of the rivalry between landlords and merchants over sanitation and municipal reform during the nineteenth century. The poll in September 1904 resulted in a decisive defeat of the water party; only two of its candidates managed to return to the city hall. The Cape Times lamented: "we had hoped that the municipal elections would result in a triumph for water. As a matter of fact, the poll is …a victory for mud." (Cape Times, 14.9.1904)

From 1910 the crusaders for unification formed a 'Peninsula Municipal Union Society'. Its chairman John Parker noted that the 1904 census had counted a population of 170,000 of all races in the area, of which 78,000 were citizens of the Cape Town. Wynberg and Cape Town had 'barely sufficient' water reserves for their populations. The Suburban Municipal Waterworks Board was able to provide a supply 'totally inadequate for existing needs'. Cape Town and Wynberg both possessed dams on Table Mountain, but the other municipalities depended upon wells, springs and small streams. (Wall 1998, 2)

The suburban municipalities had constantly to buy water from Cape Town. Although a parliamentary commission of inquiry in 1902 had made it clear that unification was the only way to go, the municipalities clung fiercely to their independence. It was clear that Cape Town would have to look beyond the Peninsula for future water supplies but only Cape Town could actually afford to bring its water so far. This realisation was gradually and reluctantly forced upon the suburbs. Cape Town was not entirely in favour of such an expensive undertaking. In a division similar to the Clean and Dirty Party conflicts of the 1880s, councillors representing smaller local interests opposed the larger merchants and businessmen. It took all Parker's negotiating skills combined with the multiple vote of the merchants to carry the day. In the face of critical water shortages in the dry months of 1913, Cape Town was finally united with the suburbs. Only Wynberg stood out until 1927. (Bickford-Smith et al. 1999, 46-49)

The municipal unification poll in 1913 reflects a general class division over the issue of water supply. It would seem that working class ratepayers, and to a lesser extent the middle classes, considered the issue of water as the prerogative of the wealthy suburban classes and business elite. The issue of water supply, which had been inextricably linked to municipal reform and improvement in the 19th century, and now to unification, was once again perceived to be in the interests of the city's elite in the eyes of these classes. (Grant 1991, 176)

Grahamstown at the beginning of the 20th century

In Grahamstown a heavy downpour filled the Milner dam overnight in November 1901. This provoked plans to increase the storage capacity at Slaai Kraal. In May 1904, tenders were accepted for the construction of a 590 Ml reservoir. This was brought into use in June 1906. It was called Jameson Reservoir after Dr. Leander Starr Jameson, the Prime Minister of the Cape. (Sellick 1983, 100–101; Hunt 1976, 15–16) In 1905 Grey and Hamilton reservoirs were still in use; Douglas was no longer used because of leakages. (Rough notes made by Dr. J.A. Mitchell, Assistant Medical Officer of Health for the Cape Colony in Grahamstown in 1.9.1905, MOH, 77, 286, Cape Archives Depot) After 1907 older reservoirs were used only as standbys for emergencies. (Figure 5)

While the quantity of water able to be stored in the reservoirs seemed impressive, there were in practice large problems to be faced. The difficulties with the flow of water to the town were experienced almost immediately. (Grahamstown Journal 5.4. and 19.4.1906) In May 1906 two leaks were found in the main pipe leading to the town.

(Grahamstown Journal 10.5.1906) The other major problem was the cleanliness of the water. Medical officer of health, Dr. James T. Bruce-Bays provoked some controversy when he stated that the water supplied was in such an unsatisfactory condition as to be not suitable for drinking by infants and children. (Grahamstown Journal 18.7.1906)

Figure 5. Grahamstown in 1909. (Southey 1984, 371)

In June 1908, the Board of Works recommended that a new water scheme be adopted, which involved the construction of filters, and also laid out recommendations for better metering of water and charges to be levied. (Grahamstown Journal 11.6.1908) The scheme was adopted in February 1910. (Grahamstown Journal 17.2.1910) A system of filtration was the first priority; a high level distribution pipe was to be provided to meet the needs of the higher levels of the town. It was also proposed to introduce gradually a system of payment according to meters instead of the rate that was levied. (Grahamstown Journal 19.2.1910) Problems with the condition of the Milner Reservoir, however, prevented immediate implementation of this scheme. In December 1910, during investigations on the cleanliness of the water, a serious leak was discovered. (Grahamstown Journal 22.12. and 24.12.1910) Detailed investigations revealed that the dam was cracked in various places, and there was a break in a portion of water pipe which passed through the reservoir wall. (Grahamstown Journal 21.1.1911) Immediate repairs were started and completed by November 1911. (Grahamstown Journal 21.11.1911)

Purity of the water from Slaai Kraal provoked a bitter debate in 1912. George E. Cory, Professor of Chemistry at Rhodes University College, reported in August that the construction of filter beds was vital, but that he found water generally acceptable. (grhamstown Journal 29.8.1912) Dr Saunders, the Medical Officer of health, challenged this report and quoted the analyses which had found the water to be of very doubtful purity, and advised against its use for human consumption. In the following City Council meeting Saunders was accused of vindictiveness and unprofessional behaviour, and of blackening the name of Grahamstown. Motion was passed unanimously demanding his resignation within seven days. (Grahamstown Journal 5.9.1912) Chemical and bacteriological analyses made in the Government bacteriological laboratory, however, showed that the water was dirty and seriously contaminated vindicating so Dr Saunders. (Grahamstown Journal 12.9.1912)

After this the City Council decided to take steps to rectify the situation. Two experts, Dr Porter from Johannesburg and Dr. D.W. Tomory, Medical of Officer of health of Bloemfontein, were consulted about the filtration. (Grahamstown Journal 12.9.1912) As a temporary measure, the Council authorised the Board of Works to scrape and clean mains from Slaai Kraal to the town. (Grahamstown Journal 24.10.1912) The scraping was completed in January 1913, and an improvement was reported. (Grahamstown Journal 23.1.1913) Dr Tomory recommended the Candy method of filtration, and that the position of filters be ascertained by engineers. (Grahamstown Journal 16.1.1913) At the end of the year joint special committee accepted one of the tenders for filters. (Grahamstown Journal 30.10.1913) The entire installation was imported from England and was reported to be the first of its kind in South Africa. (Grahamstown Journal 21.3.1914) It was installed at the west end of the town, and was officially opened at the beginning of the September 1914. (Invitation to the opening ceremony of the water filtration plant in Grahamstown, 1.9.1914, 3/KWT, 4/1/167, M7/17, Cape Archives Depot)

Water problems were far from ended. In October 1914, scarcity of water forced the City Council to curtail the water supply to once a week, as it was reported that only two months supply of water remained in Slaai Kraal. The sudden shortage was questioned and criticised in the town’s newspapers. An examination of the use of water revealed that many citizens had been using water extravagantly. The regulations that had previously been passed, but never implemented, were adopted, and a meter system introduced in November. (Southey 1984, 122)

By 1916 the resources of Slaai Kraal were overtaxed and the searching for a new scheme started again. This was not because the Slaai Kraal dams were inefficient nor because of any extraordinary growth in the size of the town, but because leading citizens saw the need for modern sanitary arrangements. Water-borne sanitation required substantially more water than the old reservoirs could provide. The heads of the academic institutions in Grahamstown took the lead in urging the City Council to consider the water-borne sewerage. (Hunt 1976, 17–18)

In June 1916, a separate water committee was formed. The Committee immediately set about obtaining the services of a consulting engineer. It also accepted tenders for boring operations at the Slaai Kraal. These borings, however, all failed. P.W. Menmuir was in November 1916 hired to research various possibilities to augment the water supply. In January 1917 he submitted an interim report in which advised that no further major expenditure should be undertaken at Slaai Kraal, and recommended that new schemes should be inaugurated. He singled out Green Hills, Howieson's Poort and Featherstone's Kloof as prime sites. Water Committee decided to continue examination of the first two. The water crisis meanwhile worsened; the supply was reduced to a fortnightly service in April 1917. By the beginning of June 1917, both the Jameson and the Milner Reservoirs contained less than 2.5 meters of water. Unseasonal rainfall in July relieved the critical situation, and resulted in the restoration of a weekly service. (Southey 1984, 125–28)

Menmuir's report was eventually published at the end of July 1918. He favoured a site on Botha's River, but qualified this by emphasizing the need for further investigations. The Council adopted the report, and spent the remainder of the year in exploring methods to raise enough money, and examining alternative schemes. The Menmuir scheme was, however, soon discredited; it was based on the high rainfall figures of 1917 and Botha's River was established to be an unrealistic site. After various proposals the Howison's Poort was in 1926 confirmed as the most economical. (Southey 1984, 128; Hunt 1976, 18)

Steenbras –scheme

The report of the Board of Engineers in 1915 recommended the damming up of the Steenbras River and the construction of a reservoir to contain 2,730 Ml of water. The proposal was not accepted without considerable argument. There was an alternative plan for a dam at Wemmershoek. (Shorten 1963, 170, 339)

While the issues of cost and water quality were relatively clear, the inclusion of working class on the side of the more costly Wemmershoek scheme is difficult to explain. The majority of its leadership was drawn from the professional and middle classes. An examination of the rhetoric of the working class leadership reveals that they opposed Steenbras because they suspected the motives of the business classes. Thus in the words of one of the leaders of the anti-Steenbras campaign, the issue came to represent one of "Gold vs. the People". Another claim was that they "had wealth against them". (Cape Times, 18.7.1917)

In spite of fears that the Steenbras Scheme would be lost because of massive working class mobilisation against it, the referendum resulted in a narrow victory for the Steenbras. (Cape Times, 24.7.1917) But because a plural voting system skewed the result, on a straight vote, Steenbras would have lost. (South African Review, 27.7.1917) Furthermore the results showed that the four predominantly working class wards of East Central City, Castle, Woodstock and Salt River voted overwhelmingly against Steenbras. (Cape Times, 24.7.1917)

Establishment of the water works in Hämeenlinna

The first implemented plan for a water supply and sewer system was prepared in 1908. Accordingly, a depression south of Lake Ahvenisto was selected as the location of a water intake plant because the amount of groundwater there. The construction started in April 1910. (Figure 6) A sewerage system was completed concurrently with the water works. The system was planned with a possible wastewater treatment plant in mind. A sewage pumping station and a pressurized sewer were also built. (Lilius 5.2.1908; Hämeen Sanomat 13.3.1908; Manner 1910)

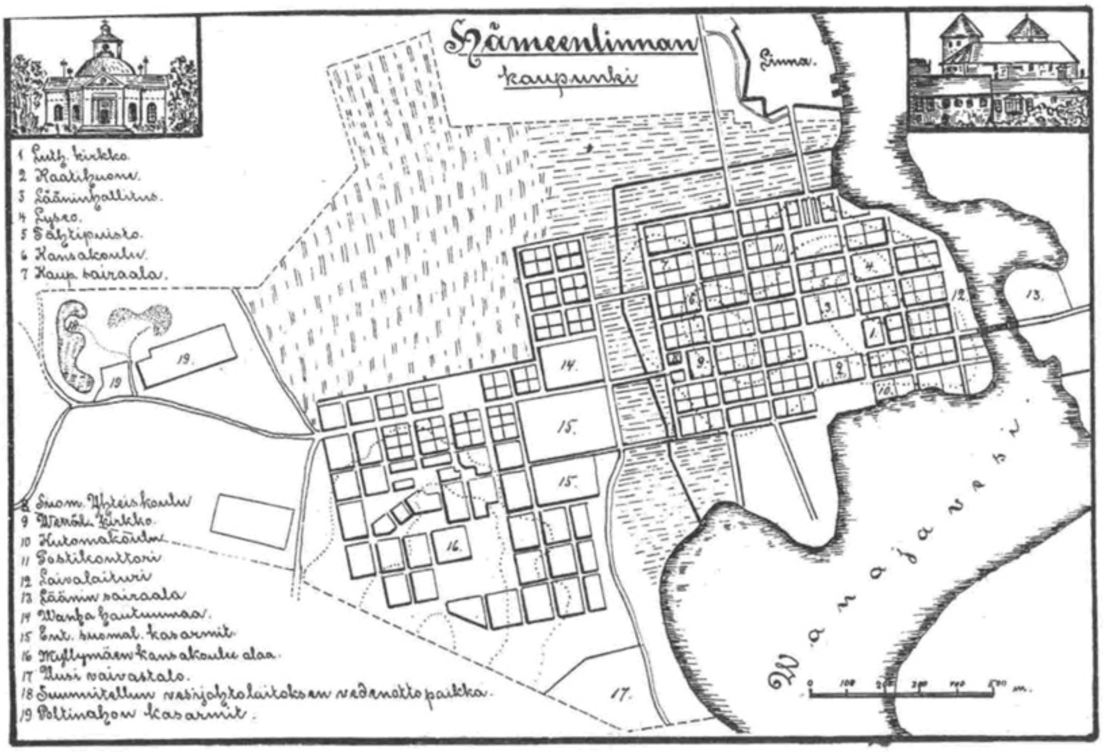

Figure 6. Hämeenlinna in 1909. 1 Lutheran Church, 2 Town House, 3 Provincial Government, 7 Town Hospital, 9 Russian Church, 11 Post Office, 13 Provincial Hospital, 14 Old Graveyard, 16 Myllymäki, 18 Water intake for planned water works, 19 Military barracks, Linna = Castle (Manner 1909)

The establishment of the water works needed a great amount of money. The water pipe committee thought that they should not press the water works for public. The committee was on the opinion that the importance and the necessity of the works was so well known that the question itself was speaking for itself. (Manner 1910) This decision was nearly fatal for whole project. You could say afterwards that mere rational reasons – necessity and importance – and the familiarity of the subject were not enough for the acceptance of the matter, at least for the local newspaper, Hämeen Sanomat. In Hämeenlinna there were also barracks of the former Häme battalion, which were immediately connected to network and were one of the biggest water consumers. (Kunnalliskertomus 1911) There were also problems with the military during the construction works; the commander of the Russian troops in Hämeenlinna refused to remove one army shed, which was in the area planned for an intake plant. The land was owned by municipality so the commander has no legal right to hinder construction works like this. (Koskimies 1966, 378)

Former inadequate health conditions have soiled the ground in Hämeenlinna and that way spoiled the waters of the wells in inhabited areas. Poor health conditions and the lack of water were familiar so you could presume that the opinion about the water works would have been unanimously positive. That was not the case. Hämeen Sanomat opposed vehemently the water works at the beginning of the 20th century.

There were other big investments to be made at the same time, too. Most important was the renovation of the electricity works. In addition, the extensions of the poor house and the hospital as well as the building of a new school were in hand. Because of these it would have been better if the publicity campaign for the water works would have been done. This way some of the disputes might have been avoided. In nowhere else in Finland was the critique in media against the water works this great. For example in cities like Tampere, Porvoo, and Vaasa there were mainly positive reactions towards waterworks schemes. (See for example http://www.waterhistory.org/html/finland.php; Juuti & Rajala & Katko 2003; Juuti & Katko 2004)

Hämeen Sanomat attacked against the plans in its editorial in 22.4.1908:

> …In the plans there is no thought about leading the water to our workers part of town, Myllymäki, where most of the labourers are living. And we can be sure that if we ask people living there if they are ready to block their wells and start to buy a pipe water for their needs, you could hardly find a half dozen families, even if the town laid the mainpipes, who would without a strong pressure pay for expensive pipes for their small houses.
>
> In our opinion the reasons for the haste in which the governing party is pressing this matter are wholly others, and they are those which are haunting in the putting into effect of the new municipal decree. It is clear that then current totally one-sided municipal government based on money and liquorpower will wholly loose its exclusive authority in municipal matters. So before that they should burden the taxpayers so heavily that in the future this more democratic municipal government could not start any measures needing funds. (Hämeen Sanomat 22.4.1908)

One of the reasons Hämeen Sanomat was against the water works was that Myllymäki part of the town was not included in the first plan:

> […] There is now compelling reason for throwing hundreds of thousand of Marks to water, even less because it is not even meant to include the whole town. It is too indecent when they have the impudence even to think let alone suggest that the municipality should build with enormous costs an expensive water works that would be only for convenience of a few masters and mistresses and very few house owners. (Hämeen Sanomat 1.5.1908)

Perhaps partly because of this critique Myllymäki was included in the realised plan. There was at first installed one water post.

Besides editorials there was a campaign against water works also in "Letter from Hämeenlinna" column in Hämeen Sanomat, especially pseudonym Tiitus was active. He was concerned about the position of the labourers:

> […] It is true that our “fathers” have not brought our town at the brink of bankruptcy. Not yet. But nowadays it seems that they wanting also that. I mean of course the waterpipe question started by this village kagaal. It is clear that everyone who had find out the great costs of this work will realise that it goes over the means of our little town and that only an actual compulsion, inevitable necessity could cause such an entertainment. But now there is no such pressing necessity. There is no lack of water here, neither drink nor washing water. There is a river bending the town and the wells, if even some care is taken to clean them, offer healthy water enough and to spare. Of course it would be quite nice to get a water pipe if there was enough money, and if, like now would happen, the water from the pipes would be only a delicacy for a few wealthy person, an amusement that would be paid by the majority who could not enjoy from it, unless maybe sometimes take a sip in a kitchen of some whole or half-Swedish rich man. (Hämeen Sanomat 22.5.1908)

Politically the opposition against the water works consisted of conservatives and socialists. Municipal council and the water pipe committee were led by liberals. Working class believed for long that they would be left without the water pipe although all the ratepayers would pay the expenses. Later the opposition was mostly because of the lack of information and the fear of tax raises. The motives of the conservatives are harder to understand. Koskimies thinks that the only reason was party fanaticism; you should oppose the plans of liberals whatever they were. This attitude was shown in the writings of Hämeen Sanomat, which had a demagogic tendency. (Koskimies 1966, 376-378)

The city medical officer of health, Viktor Manner, was a key actor in the public health board and the water pipe committee. Undauntingly he pushed for the establishment of a water works stressing its health benefits. (Manner 1910) His time in Hämeenlinna (1904–1913) is called “the era of Manner”. The water and sewage works was completed in November 1910 as the eighth such facility in Finland. After the inauguration ceremony *Hämeen Sanomat* changed its mind and wrote in positive tone about water facility. (Hämeen Sanomat 24.11.1910)

Results

The working class’s perception of water supply as the prerogative of the dominant class may at first appear to be a contradiction, given that the lack of an adequate water supply was a major reason for diseases and high mortality rates amongst the population. It could be expected that the working classes would have benefited from regular supplies. This assumption must be questioned as the link between health and water supply had only begun to be fully appreciated by medical doctors. (Buirski 1984, 125-132)

Another reason for the working class’s opposition to water schemes arises from their political association with the rentier classes in the latter half of the nineteenth century. During this period expenditure on water was rejected because it would result in an increase in municipal rates, which would in turn be reflected in rising rents.

By the late 1870's working class support for the property owners was seen to underpin the dirty party's control of the Town House. The 1880's saw the breaking of this dirty party. Once the reformers or Clean Party had gained control over the Town House in 1882, they sought to reduce the influence of the working class by narrowing the municipal franchise. Furthermore, opposition to excessive spending on water and sanitation schemes in the 1890's and early twentieth century was met by similar attempts to isolate working class ratepayers through use of racial stereotypes which fed on middle class fears of disease and disorder. (Bickford-Smith 1984, 29-65)

The reaction against reform in the 1890's has its roots in these earlier conflicts. Although the 'wreckers' were related to the 'dirty party' interests, they should be seen as the beginning of the emergence of the smaller working and middle class ratepayers associations. By the end of the nineteenth century the issue of water supply had begun to move beyond the alliance of large property owners and working class tenants and householders. Instead the mid-1890s saw the development which placed an emphasis on economy and efficiency of the city.

In the early 20th century water was rejected not only because of increased supply, but because it was perceived to be in the interest of business. The fact that an increased water supply would have benefited the working classes seems to have escaped their attention. The link between municipal politics and water supply is clearly illustrated, as the early years of the 20th century represent the culmination of a process against the merchant interest in the council that had its origins in the late 1890's. To an extent, it afforded an alliance of interests between the ratepayers' association, certain businessmen and the working classes. The reaction against extravagance and corruption was symbolised in the council's perceived obsession with water. This found its expression between 1904 and 1906 when businessmen who proposed economy in spending, gained control of the town council by mobilising householders and the working classes against the proposed water schemes. Similarly, opposition was expressed against cooperation with the suburbs and later to municipal unification.

After unification in 1913, working class opposition to a water scheme in the hinterland once again became the focus of a conflict within the council. Working class opposition to the cheaper Steenbras water scheme in the 1917 municipal referendum can be explained in terms of their long-standing perception of the dominant class's self-interest.

In Grahamstown the water supply was not as political subject as in Cape Town. Most of the time there were a consensus that the town just couldn't afford to improve the situation. When the town council, however, decided to do something there was a competition between West Hill and Market Square –groups, of which the best example is the debacle around Craddock Dam in 1870s. Still this was never at the same level than in Cape Town; water was not an issue in local elections in Grahamstown.

The development of Cape Town's water supply between 1850's and 1920 was not only the product of a struggle within the dominant class, but was also shaped by the reaction of the working classes against a process of reform that was not seen to be in their interest. The Table Mountain dams and hinterland schemes symbolised yet another aspect of the self concern of the dominant classes, which was made more poignant by the fact that many houses in District Six remained without running water until the early twentieth century.

You can find interesting similarities when you compare this with what happened in Hämeenlinna. Both were actually established at the same year, 1652, and both developed around the castle. In both cases you could say that in water issue there was an alliance of ‘conservative’ property owners and householders with underclasses against ‘liberal’ commercial interests. The ‘conservatives’ resisted major reforms because they realised they would have to pay for them; the underclasses rejected water schemes because they feared an increase in rents, and similarly saw water schemes to be in the benefit only of the merchant and commercial interests. In both cases there were allegations that municipal leaders were just thinking about their own interests. Besides in both places local newspapers were calling the issue of water as “the water question”. In Grahamstown situation was different in this sense, there really was not very clear political or social distinctions between different groups. Municipal conflicts were mostly based on personal and religious grounds.

Common nominator between Grahamstown and Hämeenlinna was that they were garrison towns, at least until military was moved away from Grahamstown in 1870s. In both towns military needs had to be taken into account when they were discussing about the water supply. In Hämeenlinna military was one of the biggest consumers of water after the establishment of the water works.

But even if there were similarities between the case towns, there were also many differences. There was a huge difference in size; Hämeenlinna and Grahamstown were very small compared to Cape Town. The geographical location of them is different; Cape Town is situated on the coast whereas Hämeenlinna and Grahamstown are inland towns. In Hämeenlinna there was no racial issue like in South Africa; most you can say about Hämeenlinna in this sense is that there was a language issue. And if you consider the water, there was – and still is – plenty of good groundwater and even good quality surface water in Hämeenlinna while in Cape Town and Grahamstown there had been constant lack of water.

Conclusions

Based on all this, it could be said, that ***good governance*** was not yet used in municipal governments in case towns in the era of reforms. The participatory democracy and transparency were only distant ideas in the minds of the reformist. Also traditional top-down approach was used and all shareholders were not taken into account by local officials and politicians. But, some new ideas and criticism were introduced especially in the newspapers and also in the political debate -- it even caused actions to the better direction not only in the WSS but also in the municipal administration.

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6. Local Conditions Need Local Solutions – Water and sanitation services in Vaasa, Finland from the 1700s to 2005

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Introduction and objectives

This paper describes the evolution of water supply and sanitation in Vaasa, a small city on the western coast of Finland with some 57,200 people at the end of 2005. Since its earliest days, the city has been a major hub of commerce and shipping due to its favourable location. The sea has always offered the opportunity to communicate with overseas countries. The city's position at the narrowest point of the Merenkurkku Strait – with Umeå, Sweden just 80 km away – has enabled diverse and smooth co-operation for centuries (Fig. 1). Besides opportunities, the seaside location has also posed challenges especially to water supply and sewerage.

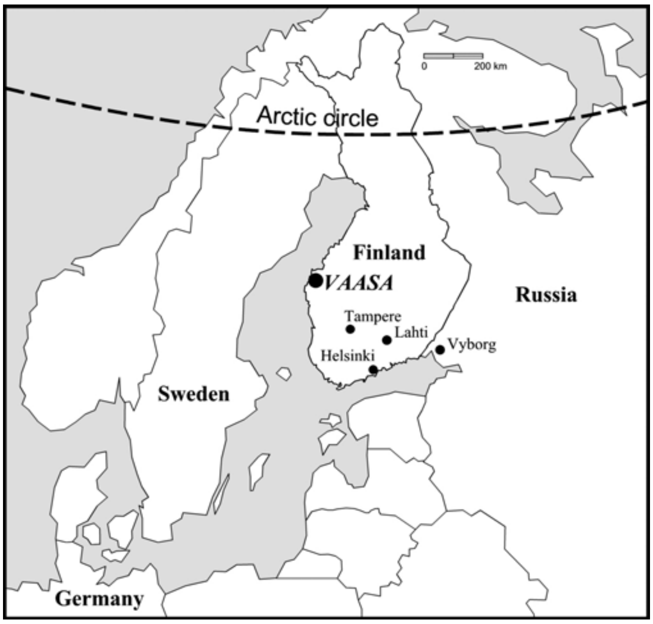

Figure 1. Location of the City of Vaasa on the western coast of Finland, with the key cities cited in the text.

In 2006 the City of Vaasa reached the age of 400 years. A King's Manor was built by order of King Gustavus Wasa already in the 16th century on a site that was later to become part of the Town of Vaasa. The town itself was founded in 1606 by King Charles IX; Finland was part of Sweden at the time (and until 1809). The present city is situated some seven kilometres nothwest of its original site. The old town was nearly completely destroyed by fire 1852 and rebuilt by decision of the Russian tsar some years later on the present site nearer to the sea. One reason for the new site was land uplift which made it impossible to use the old harbour.

The Bothnian Gulf area, where Vaasa is situated, is the epicentre of the northern European crustal area with a land uplift of about one centimetre per year. This results in constantly fluctuating surface and ground water conditions. The land has risen 250 metres since the last Ice Age and is expected to rise about another 180 metres in the future (Fig. 2). In addition to land rise, the so-called acid sulphide soils pose a special challenge to the coastal region. Those deposits formed during the Litorina Sea stage (7500-1500 BC) when temperature, salt content, and nutrient levels were higher than today (Voipio & Leinonen 1984). Sulphide acid soils often affect the quality of the region's ground water negatively. Thus, the geological history of the area forms an important framework for present and future development of water services.

In 2006 the region was added to UNESCO’s World Heritage List, called as a High Coast/Kvarken Archipelago. The threshold level of the strait is about 25 metres at the writing of this history, but in the year 4600 – 2600 years from now – land uplift will have joined Sweden and Finland. The process will turn northern Gulf of Bothnia into the largest inland lake in Northern Europe that will seek a path toward the southeast and, finally, toward Lake Ladoga. This will take place on a geological time scale. The impacts of global warming prior to these events are another issue.

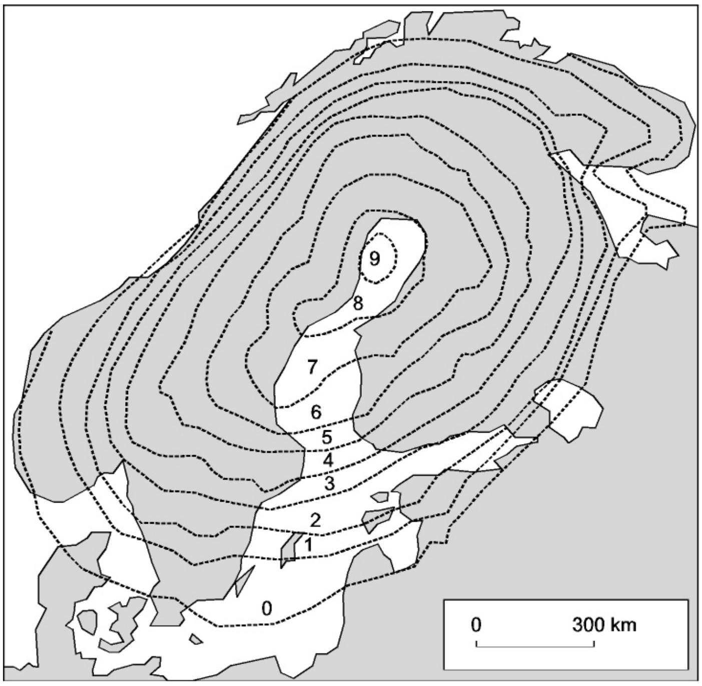

Figure 2. Current annual land rise in the Gulf of Bothnia region (mm); in Vaasa it is about 8 mm (Ekman 1992).

This paper is largely based on a recent book on the history of water supply and sewerage in Vaasa, finished aptly during the city's jubilee year. The book presents for the first time in a single volume the development phases of the city's water supply and sewerage over the 400 years of its existence. In addition to studying archives and conducting a literature review, the authors also visited the various facilities of the water company and interviewed altogether 28 persons: former or present staff of the Water Company and representatives of its collaboration partners. This made it possible to collect so-called tacit knowledge and to get a better understanding of the arguments related to key decisions over the years. The rebuilding of the city on a new site in the 1860s also provides an extraordinary opportunity to analyse the general conceptions about public water services in the 19^{th} century and the practical role of water supply in the rebuilding of the city.

The City of Vaasa has expanded – most recently due to the merger with another municipality in 1973. Only as recently as 1940, the area of the city was less than a quarter of the present. The residential areas of Vaasa have expanded especially since

WWII and the subsequent reconstruction. The development of the water and sewage works should also be viewed as part of this change.

Vaasa Water Works can be considered to have commenced operations on 1.4.1915 when the entire system was officially inaugurated and a public standpost was taken into use in the market square. The Vaasa Water Works is the 14th oldest in Finland; Vaasa got its sewage works already in 1904 as one of the first 10 Finnish cities.

The boundary conditions for water supply and sewerage in the Vaasa Region are set by the described geological history involving land uplift, land use and, naturally, the available ground and surface water resources – in the vicinity of Vaasa as well as throughout the Kyrönjoki River Valley. Significant changes have occurred in the exploitation of water resources as to emphases and uses over a few centuries.

The old town: medieval traditions in water services

Most houses in the old town appear to have had a private well already in the 1600s. For instance, Magistrate Baltzar Baltzarson, who lived "below his means", had a beautiful well in his yard. The 1658 inventory of property indicated that Chaplain Peter Jesenhausen even had a draw well in his yard. The 1695 inventory, again, showed that Niilo Maununpoika Kalm, a wealthy ¨shopkeeper, had both a well and a privy. (Luukko 1971, 536–39) Initially, each household was responsible for its own service.

In the days preceding the water works wells were not significant just as a source of water but also as meeting places and landmarks. The fact that they were marked on town maps also indicates their importance. For instance, a map drawn in 1750 by Town Surveyor Jonas Cajanus shows the public well located by the northern toll fence. Even private wells were occasionally marked on maps. (Luukko 1971, 29–52; Luukko 1979, 30–31)

It was quite common for houses in the town area to have cattle. During dry spells, when wells ran dry, people were offended by the use of the scarce water resources to water cattle. The following is an excerpt from a newspaper article which, despite having been written in the 1880s, aptly describes the problem:

> There is not a single well in town that provides truly clean and tasty water, and there is no guarantee that the water in many of them is safe for kitchen uses and drinking by townspeople. Moreover, some (perhaps most) run completely dry in the dry season. No doubt, it would be better if the amount of clay mixed into the water was much smaller, and if it contained less matter originating from animals and plants. Yet, it is presently possible for anyone in Vaasa to freely draw any amount of water from any public well for any purpose. For instance, there is a story about a householder who drew […] water from one of the best wells in a single day to water his nearby vegetable garden. Some use wells to wash their clothes, to water cattle, and for other major household needs – purposes for which other towns oblige inhabitants to fetch water from outside town limits, unless they have a well of their own [...] (Wasabladet, no. 67, 25.8.1880)

The population of the city was quite small at that time, meaning that nutrients were recycled for the most part – for instance, manure and human faeces were used as fertiliser. Minor problems must have occurred locally as when the well had been dug too close to the cattle shed (Luukko 1979, 33–34) — it was typical of the times to fear especially diseases thought to be caused by offensive odours and vapours from rotting. Unorganised waste disposal and deficient street cleaning in particular contributed to the deterioration of the quality of domestic water and contamination of ground water.

At times wastes and surface waters also flowed into wells. The wells of the day were quite typical dug wells: they were often timber-lined – the square timber cribs were made with the same timber blocking technique as residential buildings and outbuildings. The dug well is still the most common well type in the world, albeit in its round form. (Juuti & Wallenius 2005, 14)

The bucket was the basic unit of water supply and waste disposal: it was used to carry water into the house and sewage out of the house. Fire-fighting water was also transported by bucket from the water source to the scene of the fire. That's where "bucket brigade" derives from. Such a system, however, becomes inadequate when a city starts to grow and population density increases. Vaasa experienced its first painfully concrete water shortage during the 1852 Great Fire (Fig. 3) when nearly all of old Vaasa burned, partly due to the lack of fire-fighting water.

Figure 3. Ruins of old Vaasa after the Great Fire of 1852 (Photo: T. Katko).

New site poses new challenges

When a new site was surveyed for the town after the fire, special attention was given to an ample supply of water. Thus, the city plan also considered the needs of fire fighting. Especially the fire of Vaasa in 1852, but also the Pori fire the same year, contributed to the Act of 1856 which required nationwide adoption of the city plan system to prevent the spread of fire developed in the meantime. The main principle of the Act of 1856 was to divide a city into several smaller sections by planting protective zones of deciduous trees in between to make it easier to contain a fire within a zone. Fire safety was a major factor behind the division of the new Vaasa by 36 metre wide streets, lined with a minimum of two rows of deciduous trees, into smaller sections, generally no larger than one half square kilometres. Blocks within the sections were separated by streets at least 18 metres wide, and in every other block plots were separated from each other by protective zones of deciduous trees. Generally, the protective zones were to form together a 12 metre wide belt which could be even wider at the centre line of the block. The buildings in the core city were to be, at least partially, of stone, and there were to be a sufficient number of wells and other sources of water equipped with lifting devices in each city sector. Yet, there is no mention of sewerage. (Juuti & Wallenius 2005, 14)

The new city was built on the Klemetsö peninsula seven kilometres northwest of the old town in 1862. The new location on the seashore was perfect for a seaport, but even though the city plan was drawn in accordance with the ideals of the day, water supply and sanitation was based on traditions and methods dating back centuries.

The local daily gives an even better description of the construction of the new city than documents of city administration. In 1855 it wrote:

> Clearing work started on 31st May last year. Drainage to dry out existing shallows, where water from higher ground collected due to moss growth and rotting trees, was launched simultaneously. […] It was decided to build initially four public wells in locations deemed appropriate: one on the southern and northern sides of both the Market Square and the Church Square. The one on the southern edge of the Market Square is now finished and is an ample source of water […].

The primary concern was land drainage and securing the availability of drinking water from public wells. Yet, the new Nikolainkaupunki (town named after Tsar Nicholas I; Finland was an autonomous Grand Dutchy under the Russian Tsar in 1809–1917) did not have enough water for its population. Water shortage and contaminated wells started to pose a grave threat to the safety and health of the new city in the last decades of the 1800s.

The newspaper Wasabladet was a keen observer of the situation and carried an article titled "Water shortage" where it pointed out that: ”Our city has not only had a shortage of the "noble" stuff – distilled spirits – but also of another liquid in short supply, namely potable drinking water. City wells have run nearly dry, and the water drawn from those few that still yield water has been thick and ill-tasting. As a result, vending of drinking water has increased, and people have been forced to buy water from as far away as the old town. A snowy winter would solve this and many other problems [...]” (Wasabladet, no. 7, 13.2.1864)

Some years later the same local newspaper paid attention to the misuse of public wells (Wasabladet, no. 25, 19.6.1869): ”It is said that the new well at the head of Sepäkyläntie street has been built improperly. Due to defective insulation horse manure and other less pleasant substances leach into the well. The number of wells in our city with potable water is so small that they ought not to be spoiled by slipshod work." Thus, new solutions were needed desperately and urgently.

Pioneering ground water use in Finland

The first comprehensive mappings of ground water resources and field investigations in Finland were conducted in Vaasa before the end of the 19th century. In 1901 a pilot plant was built for making artificial ground water with the help of domestic and international experts – also a first in Finland. Removal of iron was also tested in the same connection.

As early as on 18.11.1885 health authorities suggested to Vaasa City Council that a water pipe be laid from the place where test drillings had been made under the engineer Robert Huber. (Vaasa City Council, 18.11.1885, § 5) The only result was that a committee was established to study the water supply and the condition of wells in Vaasa. In February 1887 the council decided that the above-mentioned committee was to continue its studies and prepare a plan and cost estimate concerning rock drillings. (Vaasa City Council, 9.2.1887, § 2)

Based on the decisions of the city council, extensive ground water inventories were made in Vaasa from 1896 to 1897, presumably for the first time in Finland, and again at the turn of the 1900s and during the first years of the 1900s.

Most knowledge and expertise was drawn from abroad, mainly from Sweden and Germany, while some domestic experts were also used. At that time there were different, partly contradictory schools of thought on how to assess the safe yield of ground water deposits. There was the German-based school of Thiem using estimates based on soil transmissivity and the geological "bird's-eye-view" school. It is obvious that a combination of these two approaches could have yielded better results (Katko 1996). On the other hand, around that time chemical treatment methods had also been introduced which made surface water treatment a realistic alternative to ground water (Vaasa Health Board 1901; Vaasa Water Committee 1918; Juuti & Katko 1998, 101-108).

Several top experts, including the Germans Thiem and Printz and the above-mentioned engineer Gagneur, had studied the ground water situation in Vaasa. The last-mentioned described in 1916 how the geological conditions in Vaasa affected water quality:

> Ground water in Vaasa has a high iron content. The iron would have to be removed by the old-fashioned open iron-removal system which provides no protection against water pollution – rather the opposite is true. On the other hand, I believe that if the water intake remains in its present location, the chlorine content of the water will reach a detrimental level. (Gagneur 1916)

The high iron content of ground water in Vaasa, which was probably the biggest problem, was known to Gagneur. It should be noted that Gagneur, who had worked for long as the city engineer of Vyborg, participated actively in the professional discussion about Vaasa's water supply although no actual plans were commissioned from him. The same well-known experts designed the water works of most Finnish citys at that stage.

Gagneur was also a pioneer of public sanitation. He had familiarised himself with city drainage systems and the operation of urban slaughterhouses, for instance, in Germany.

As engineer and consultant for several cities, he had also studied the practical sides of issues and followed the political discussions related to projects. His active involvement with Vaasa can also be viewed as part of a wider discussion which sought to solve all – even social – problems of the city by drainage, waste disposal service and a new type of water supply and sewerage system.

Planning the first water works

The first ideas and plans for organised water supply in Vaasa were based on the use of ground water. During the first decade of the 20th century, people from Vaasa toured Europe to learn about the best and most widely known solutions to water supply and sewerage as well as corresponded actively with top international professionals. Domestic experts and their experiences were also used to advantage. Although there was cooperation especially with the Swedes and Germans since the early planning phase, a Finnish top expert was selected to oversee the building of the facility and to manage its implementation.

The manager of the first water works project, the engineer Kaarlo Tavast, had prior to coming to Vaasa gained the necessary experience in cities like Vyborg and Lahti. Since the first utility in Vaasa was a pioneering undertaking as to many of its solutions, problems were faced frequently. Thanks to his valuable international and domestic networks and know-how, Tavast was able to overcome the construction-phase difficulties that at times appeared unsurpassable. On its completion in 1915, the water works incorporated the leading edge solutions of the day.

First plans for sewerage and solid waste management

As the search for a solution to the water shortage continued, the problem of what to do with solid wastes and waste water also came under scrutiny. In 1889 the city council invited the city engineer of Helsinki, O. Ehrström, to prepare a plan for a sewer system covering the entire city. That is why Ehrström visited Nikolainkaupunki in early summer. His visit resulted in a plan that suggested chanelling all streets in the city. Tenders for implementing the plan were invited from Finland as well as several European countries including Germany, England and Sweden. (Wasabladet No. 99, 11.12.1889)

A proposal for a waste disposal system had been made in Helsinki already in 1878 by the then city engineer Tallqvist. It suggested that a sewerage system be built and collection of solid wastes be organised. For the first time in Finland, the plan brought to the focus of attention the two opposing ideas in the European waste disposal debate: the barrel system and the water-flushing system. In both cases the primary question was how to handle the human excreta. The following debate regarding waste disposal highlighted all the elements included in the complex group of factors which influenced the choice of a sanitation system: the etiological motivation, the economic context, changing opinions regarding the pollution of water, waste disposal practices and technological development. All these elements came up also in the Vaasa discussions (Nygård 2004).

The lessons learned from the Helsinki sewer system were, however, utilised elsewhere in the country, and Helsinki city engineers were used as experts, for instance, in Vaasa. The key parts of the Vaasa plan prepared by Helsinki city engineer Ehrström were also published in *Wasabladet*. His plan reflects the discussion about the right shape of sewer pipes going on in Europe at that time:

> [...] clay pipes available in Germany and England as well as Sweden. [...] yet, it is worthwhile buying them [...] from Stromberga in Sweden despite their slightly higher price compared to commonly available English pipes. These pipes are round, and I have suggested using them up to the size of 18 inches, but not larger, since pipes of larger cross section are so flexible at the bottom that, in the worst case, they will do not flush themselves or accumulate sediments. In areas with greater discharge it is necessary to use egg-shaped pipes with the narrower end downward which keeps the bottom clean even with a smaller water volume – as during dry periods. Pipes like this can be laid of iron reinforced cement bricks; today concrete blocks may also be used since they cost no more, or even less, are highly durable and easier and quicker to lay as their production length is 3.5 feet. In general, they save time and labour. There is presently a factory owned by Helsingin Sementtivalimo manufacturing a wide range of sewer pipes, and it is willing to work also in other regions. At their request I have designed three different egg-shaped pipes for sewers that need piping in excess of 18 inches in diameter. (Wasabladet No. 99, 11.12.1889)

Thus, the plan did not consider the cheapest pipes, but Ehrström decided in favour of the so-called Chadwick model, that is, modern egg-shaped or oval pipes. The plan also included preparations for rain water removal.

Any city with a water main could build a water closet system. A debate about the introduction of water closets in Finland started during the 1880s, and they were accepted 20 years later. The debate in Finland was marked by the same opposition as elsewhere in Scandinavia: the people who were for the system praised its cleanliness and comfort whereas the opposing side highlighted the risk of contaminated waters and also pointed out that the farming community needed manure. However, the 1895 building by-laws of Helsinki paved the way for the water closet although the restrictions on the construction of water closets limited and postponed the introduction of the system. At the start of the 1920s water closets were still banned by a few cities (Nygård 2004).

In 1896 a committee appointed by Vaasa Technical Society submitted its report concerning the establishment of a public sanitation facility for the city. The committee considered the water closet system the best solution but noted that it would be feasible only after a water works is built. That seemed "hopelessly far in the future". Instead of the best alternative, the committee suggested a system where the wastes of different households are hauled in barrels to dumps and the barrels are disinfected after emptying. Wastewaters were to be led into a sewer where possible. The City Building Code stated that a privy or the manure shed of a stable or animal shelter, or any other outhouse emitting foul odours, must not be built along avenues, treeless streets, market places or other public places. Spouts, pipes and culverts from porches, kitchens, baking rooms, washhouses and workshops discharging dirty water onto streets or into gutters were banned altogether.

In addition, the committee stated:

> All outbuildings that include a stable and animal shelter and a privy and a waste shed, made of logs or planks, are to have a properly built and plastered foundation wall on the side of the neighbouring plot, and the walls must also be tight enough to keep any impurities from escaping to the neighbour's side. (Vaasa City Council, M Collection, Water works, report of committee established by the Technical club concerning organising of sanitation in the city, Vaasa 28.2.1896)

In theory the sewer system had no practical connection to the handling of waste. Sewers were meant only to facilitate the drying of soil and removal of surface water. Yet, in practice, excrement was being discharged into the sewers. This practice based on convenience led to abuse of the water supply and sewerage system which, in turn, led to the biggest problem related to the waste disposal system – the exclusion of the handling of human excreta from the administrative and practical functions which constitute waste disposal (Nygård 2004).

Although Ehrström's technical solutions were up to date, old attitudes and doctrines remained deep-rooted. The above quote and the understanding of the origin of diseases that can be read between its lines are consistent with the miasma theory. The bacteriological view of the origin of diseases took another few decades to win over the professionals, and considerably longer in the case of laymen.

Although the theoretical background of the problem was not the most modern possible, the solutions leave no room for complaint:

> The situation can be ameliorated by building sewers to collect most impurities. Even if liquid impurities are collected in cesspools, ground and rain water nevertheless end up in pits and leach from them into the environment, which is why they should be kept as dry as possible. Impermeable pit latrines dug into the ground are out of the question in preventing impurities from leaching into the environment and water from leaking in since they have already been generally rejected for many reasons. It is impossible to make them impermeable enough since the impurities accumulate into a substance that quickly corrodes cement and asphalt and other possible materials. The best acknowledged way to collect, transport and utilise impurities is to separate them by type: human faeces, cattle manure, trash and kitchen refuse. Appropriately planned, it does not involve especially high construction or maintenance costs, and a cheaper procedure can be followed initially if there appears to be too little time for complete overhaul [...]. This procedure would involve collecting faeces, kitchen refuse and trash into above-ground wooden boxes that could then be placed over filled up pit latrines. The boxes could be made smaller than the privies used today which have to be emptied often; then the emptying process would not be as unpleasant and costly since all liquid impurities would go directly into the sewer and the solid impurities in the boxes [...]. (Wasabladet No. 99, 11.12.1889)

Separation of different types of wastes and faeces was sensible and well grounded. The suggestion was workable also with respect to privies as it called for separation of urine and solid faeces. In this respect Ehrström's plan reflected the trends of the times in Europe and America. An entire sewer system was, however, a huge undertaking that would not come cheap according to him. Ehrström also suggested that the location of the sewer should be considered already when selling new plots to have them in the best possible position with respect to the sewer line.

Everything indicates that Ehrström was well aware of the international reform movent launched in England aimed at improving the hygienic conditions of cities. Different sections of his plan reflect the principles of the movement's spiritual father, Edwin Chadwick, for flushing filth out of the city through sewers. He also espoused the ancient concept of the origin of diseases based on the miasma theory, still dominating at the end of the 1800s. The measures suggested in the plan as such were not flawed although the theory behind it was. Construction of the sewer system began as planned in 1889. The work was considered finished in 1904 – 15 years later. Yet, the quality of well water did not improve, and the bay where wastewater was discharged also started to get polluted. Vaasa was the eight city in Finland to receive a sewer system.

The waste disposal and cleansing solutions were borrowed from Sweden since there was a long-standing close relationship between the cities and people of the two countries. Both countries had similar legislation, and their local government acts were almost identical. Through technical literature and educational visits physicians and engineers of Vaasa gathered up-to-date information on the progression of Swedish waste disposal systems. Sweden was seen as the pioneer in Scandinavia, and the waste disposal system of, for instance, Denmark was considered to be of a lower standard. Thus, it can be said that European ideas and methods for cleansing were adapted to Nordic circumstances in Sweden which is why they could also – at least theoretically – be copied almost as such in Finland.

First water works and turning to the surface waters of Kyrönjoki River

One of the conditions of the General Fire Assistance Company, when granting Vaasa a loan of half a million marks for laying a water pipe, was that a water tower of 500 cubic metres be built high enough for the top water level to be 55 metres above the mean sea water level**.** A design competition was organised for the water tower which attracted a total of 66 proposals[1]. That is Finnish, if not also a world record. The panel of judges placed first the proposal by Jussi Paatela and Toivo Paatela (Fig. 4).

Water shortages were not totally eliminated in Finland by the introduction of modern water works. For example, there were problems with water quantity in the 1920s in several cities such as Vaasa, Turku and Porvoo during dry summers. The dry summers in 1941–1942 also caused shortages (Stenroos et al. 1998, 89-98; Juuti et al. 2005; Juuti & Katko 2006.; http://www.fmi.fi/saa/tilastot_99.html#6).

[1] According to Kallio there were 64 proposals. Kallio 1914. 39-40, bilder 32-38.

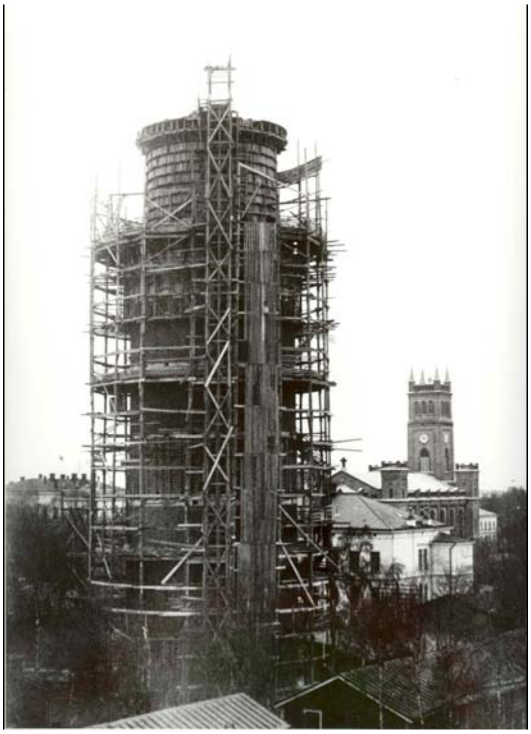

Figure 4. The water tower of the first water works under construction in 1914. It has been in operation since its completion.

Ground water conditions in Vaasa are a challenge; especially dry summers have often been problematic. For instance, in 1940 there was a severe water shortage. Water was drawn from Kyrönjoki River for the first time towards the end of 1952 to ease the situation. The quality of the water left a lot to be desired, but as consumption increased steadily, the residents were happy just to have sufficient supply. Water consumption started to decrease only after the oil crisis of the early 1970s at which time attention shifted more to quality. Kyrönjoki River was at the time a quite poor source of raw water as untreated or insufficiently treated wastewaters were discharged into it, and sludges and other loading leached from fields, in the upper reaches. The situation with Kyrönjoki River started to improve in the early 1990s. The slow-filtering unit and the pre-precipitation of raw wastewater implemented in the early 1990s as well as diversion of part of the surface runoff from the natural discharge area of the Pilvilampi Pond improved raw water quality essentially. More effective protection of the waters of Kyrönjoki River also improved the situation for Vaasa. The city's treated drinking water has ever since been as good as that of any other Finnish water works.

Mankind has impacted water bodies in several ways. In Ostrobothnia, rapids have been cleared, lake water levels lowered, structures for floating logs, mills and power plants have been built, embankments have been raised along shores, channels have been straightened, artificial lakes have been built and water flow regulated. As the needs of society and people have changed, earlier ways of doing things have been given up partly or totally. Table 1 summarises the main water uses from water mills in the 1500s to raw water source for Vaasa since the 1950s.

Table 1. Use of Kyrönjoki River waters from the 1500s to the 2000s.

Period	Main water use
1500s to1950s	Water mills
1700s	Tar production and transport
1700s to1900s	Timber floating
1800s	Lowering of lake levels
since the 1910s	Hydropower
late 1800s to 1980s	Drainage of swamps and forests
1900s to 2000s	Peat production
1953-2004	Hydraulic constructions on Kyrönjoki River
1952-	Raw water supply for Vaasa

New innovations

Water supply and sewerage networks expanded strongly in the 1950s and '60s. At the time sewer pipes were still mainly of concrete while water pipes were Mannesmann pipes. The precursor to KWH-Pipe in Vaasa, Wiik & Höglund, started to manufacture plastic piping already in the 1950s. Vaasa was among the first cities in Finland to switch rapidly to the use of plastic piping in the 1960s since it was available nearby and easy to procure. The first plastic pipe was laid in Vaasa in 1964, and already at the turn of the 1970s all service pipes were built of the material. For instance, Helsinki introduced plastic pipes only decades later in the early 1980s. Finland is a leader in the use of plastic piping, and far ahead of Sweden, which has often been quicker to adopt new practices. Renovation of networks has gradually increased in the last few decades.

The water supply network incorporates a ground-level reservoir built in 1968 that is an exceptional solution in Finland. A few years earlier plans for a new water tower intended for Palosaari were commissioned from architect Viljo Revell. Yet, the idea was abandonded and a ground reservoir built in its stead – largely due to the high level of know-how that local industry has concerning various electrical, automation and pumping technologies. The imposing 500 cubic metre water tower in the Kirkkopuistikko Park nevertheless remains in use.

Wastewaters were a problem already at the beginning of the 1900s and contaminated Onkilahti Bay quite badly. The first quite modest treatment plant erected in Hietalahti Bay in 1953 served until 1973. One of the biggest changes in the history of the works was the inauguration of the Pått central wastewater treatment plant in 1971 next to the sea shore. Subsequently, gradually increasing amounts of wastewater were led to the Pått plant while several smaller plants in Vaasa were decommissioned.

Vaasa has been known for brisk action, especially in introducing new technology, know-how and materials. For instance, Vaasa was among the first to use plastic pipes, inspect sewers with TV cameras and reline existing sewers. Technical solutions have been developed together with companies. For example, flushing with compressed air was started with the equipment of a private company – later the works purchased similar equipment. The first prototypes of the fire water stations installed on bigger distribution and transmission lines to replace conventional small fire hydrants were built in Vaasa and quite soon entered industrial business-driven production. One unique example were the pressurised multistage swirl concentrators designed for grit removal in pre-treatment of sewage (Fig. 5). The centre of Vaasa still has combined sewers which is why the amount of grit discharged with the inflow to the plant has been remarkably high.

Figure 5. Multistage pressure swirl concentrators specially designed by Seppo Ryynänen for Pått wastewater treatment plant. They were in operation from 1985 to 2001. (Häkkinen et al 1987)

The innovativeness and strive for thought-through solutions of the early days have survived until today and exist on every level of the organisation. In the late 1990s excess sludge from the wastewater treatment plant was taken to Stormossen solid waste station; it had one of the first underground anaerobic reactors in the country for solid waste treatment.

Fig. 6 shows the overall cycle of Vaasa water. Raw water is pumped from Kyrönjoki River, except during flood peaks that typically occur in spring. In Kalliolampi pond the water is pretreated chemically while it is stored and partially aerated in Pilvilammi pond, before conveying it to the actual treatment plant. The treatment process itself has developed over the years. In the early 1990s slow sand filtration was introduced for tertiary treatment and removal of tastes and odours, while more recently a modern high rate flotation system was introduced to replace the earlier upflow clarification. Water is distributed through the supply network, and pumping stations pump wastewaters to the Pått wastewater treatment plant, with the final. Several small water associations established and promoted earlier by the city have gradually been taken over by Vaasa Water. Since the late 1970s the city has also entered into bilateral agreements for buying and selling water and receiving wastewaters for treatment from her neighbouring municipalities.

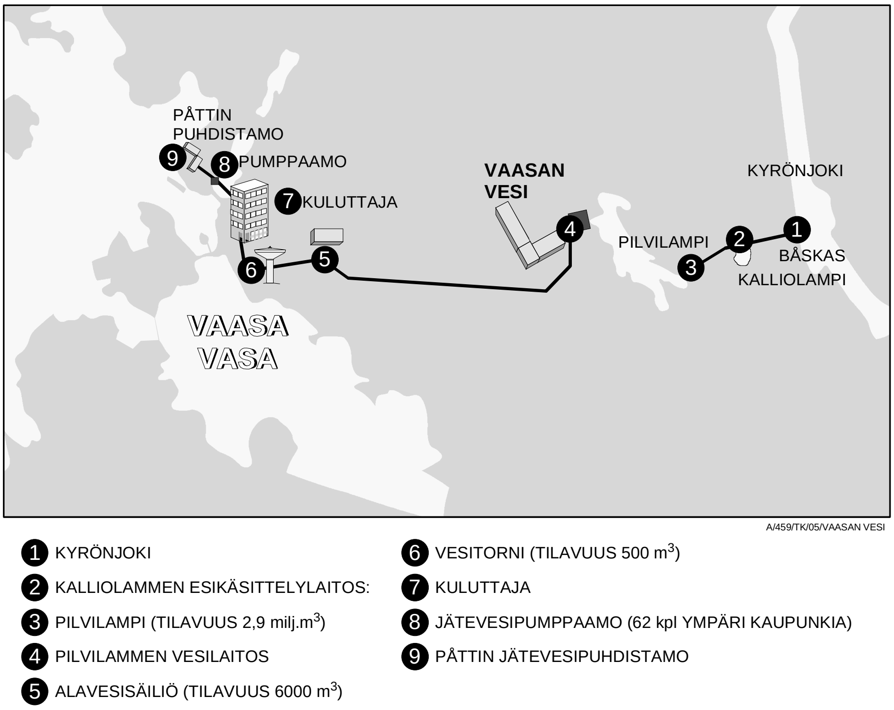

Figure 6. The overall cycle of water through the water supply and sewerage systems of Vaasa in 2005.

Discussion and concluding remarks

Past success does not eliminate future challenges. Many problems that caused headaches historically still remain. For instance, ground water and artificial recharge were debated vehemently already a hundred years ago. Yet, they remain topical issues, even nationally. Managing Director Ilkka Mikkola said it in a nutshell: ”Some think that the solution is to substitute ground water for surface water. It's not that simple. Ground water abstraction must not be an end in itself. The main thing is to supply people with water of good quality.”

The future of wastewater treatment remains a key challenge of the future. The extent of required nitrogen removal remains to be seen. The largest mass of assets owned by the water works, the network, requires constant maintenance and renovation which requires trained and motivated personnel. Yet, people fresh out of an educational institution are not able to run plants and maintain pipe networks. The same applies to management.

Vaasa is a city nearly 400 years old but still mentally alert. Its readiness for action and energy equal those of a person having just reached middle age while its experience matches that of an elder statesman. That is a good combination – the long and illustrious history is to be seen as a strength, not an impediment. Vaasa has remained dynamic through active relationships, commerce, shipping and other forms of contacts. The townspeople have also valued acquisition of knowledge and education throughout the city's history. Even water supply and sewerage have been international from the very beginning. Prior to the launching of the actual planning of the water works, the foremost experts in Europe were engaged to assess the ground water resources, reasonableness of the preliminary plans and implementation possibilities.

Local conditions have posed tough challenges for environmental services in Vaasa. Especially in the case of water supply, the city has been forced to develop new means of ensuring a sufficient supply of quality water for its inhabitants. Early artificial water surveys, utilisation of water from Kyrönjoki River and daring experimentations with new materials and methods are an indication of innovative adaptation to difficult conditions.

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7. A Short Comparative History of Wells and Toilets in South Africa and Finland

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Introduction

Although South Africa and Finland, as a result of their respective geographic localities, appear to share little in common, there are, surprisingly enough, some interesting similarities. Both are countries with climatic extremes; South Africa with its aridity and heat; and Finland with its extreme arctic conditions. In a way, these extremes are comparable in terms of human sustenance. The most arid province in South Africa (the Northern Cape) and the northernmost province of Finland (Lapland) both cover 30 per cent of the surface area of their respective countries and both have an extremely low population density of 2 persons per square kilometre (*Table 1*). However, there are significant differences between the water resources of the two countries (*Table 2*).

Province	Population (million)	Area (km2)	Density (#/km2)
Northern Cape	0.823	361830	2
Free State	2.707	129480	21
North-West	3.669	116320	32
Western Cape	4.524	129370	35
Eastern Cape	6.437	169580	38
Mpumalanga	3.123	79490	39
Limpopo	5.274	123910	43
Kwazulu-Natal	9.426	92100	102
Gauteng	8.837	17010	520
SOUTH AFRICA	44.820	1219090	37
Lapland	0.199	98946	2
Oulu	0.453	61572	7
Eastern Finland	0.604	60720	10
Western Finland	1.829	80975	23
Southern Finland	2.037	34378	59
FINLAND	5.122	336591	15

Table 1. Comparative population density for South African and Finnish provinces (www.statoids.com, accessed on May 1, 2005)[1]

A comparison of rainfall indicates how much water resources diverge. Finland has a fairly uniform annual rainfall distribution (450 mm to 650 mm) whereas the annual rainfall in South Africa varies between less than 100 mm to more than 2000 mm. A large part of South Africa is considered to be arid (21 per cent has less than 200 mm annual rainfall) or semi-arid (44 per cent receives between 200 and 500 mm/year). Therefore some 65 per cent of the country does not receive enough rainfall for successful dryland farming. In Finland a much higher percentage of rainfall (55 per cent as opposed to 7 per cent) appears as surface runoff after evaporation and infiltration,

[1] Note that there are small differences in population numbers and land areas when compared to Table 2, which do not impact on the general trends demonstrated

consequently leaving Finland richly endowed with natural lakes and streams. There are approximately 56 000 lakes larger than 1 km_2 and the total number of all water bodies, such as rivers and lakes, is approximately 188000 (Honkavirta 1998, 62; Myllyntaus 2004, 11-12; Pajula & Triipponen 2003, 9-10; Haarhoff & Tempelhoff 2004). In terms of renewable water resources, South Africa has only 45 per cent of the water of Finland, despite being four times larger. When factoring in the respective populations, Finland has 18 times more water available per capita than South Africa.

	SA	FINLAND	SA / FIN
POPULATION DENSITY			
[a] Surface area (km^2)	1 221 040	304 590	4.01
[a] Population (million)	43.309	5.172	8.37
[a] Population density (#/km^2)	35	17	2.09
WATER RESOURCES			
[h] Rainfall, including snow (mm)	475	575	0.83
[b] Runoff (mm)	35	318	0.10
[b] Percentage runoff	7%	55%	-
[a] Total water availability (km^3/a)	45	107	0.45
PER CAPITA WATER AVAILABILITY			
[h] Groundwater availability (m^3/a)	112	366	0.31
[b] Surface water availability (m^3/a)	1042	20902	0.05
[a] Total water availability (m^3/a)	1154	21268	0.05
PER CAPITA WATER USE	(2000)	(1995)	
[h] Groundwater use (m^3/a)	67	39	1.72
[b] Surface water use (m^3/a)	299	400	0.75
[c] Total water use (m^3/a)	366	439	0.83
RESOURCE EXPLOITATION	(2000)	(1995)	
[b] Groundwater exploitation	59.8%	10.7%	-
[b] Surface water exploitation	28.7%	1.9%	-
[b] Total water exploitation	31.7%	2.1%	-
WATER USE	[d] (2000)	[c] (1991)	
Percentage domestic use	[e] 14%	12%	-
Percentage industrial use	[f] 21%	85%	-
Percentage agricultural use	[g] 65%	3%	-

Table 2. Statistical comparison between South Africa and Finland.

a from Table 4.2 in *Water for People – Water for Life (*UNESCO (March 2003). Accessed on May 1, 2005, http://www.unesco.org/water/wwap/wwdr/table_contents.shtml)

b calculated

c EarthTrends environmental database (World Resources Institute. Accessed on May 1, 2005, http://earthtrends.wri.org/country_profiles/index.cfm?theme=2)

d from Table 2.3 in *National Water Resource Strategy* (Department of Water Affairs (September 2004). Accessed on May 2, 2005, http://www.dwaf.gov.za/Documents/Policies/NWRS/Sep2004/pdf/ Chapter2.pdf)

e arbitrarily taken as 50% of urban/rural consumption

f taken as consumption for mining, power generation and 50% of urban/rural

g includes forestry

h Global Groundwater Information System (International Groundwater Assessment Centre. http://igrac.nitg.tno.nl/system.html)

It is hardly surprising that South Africa is already exploiting a significant part of its total water resources. In the important Vaal River catchment area, which supplies the heartland of South Africa's manufacturing, mining and power industries, the critical limits of the natural run-off had been reached already in the 1980s and thus massive interbasin transfer schemes from other regions in South Africa, as well as from the neighbouring country of Lesotho, had to be implemented (Haarhoff & Tempelhoff 2004). While South Africa is already exploiting a massive 32 per cent of the theoretical maximum of its water resources, Finland uses only of 2.1 per cent of its theoretical maximum.

In the context of this study, it is more instructive to view groundwater resources separately from surface water resources. In both countries, the renewal rate for groundwater is much lower than for surface water, but the relative exploitation of groundwater resources is higher. In South Africa, the exploitation rates for groundwater and surface water are 60 per cent and 29 per cent of the sustainable maximum respectively, while the same rates for Finland are 11 per cent and 2 per cent. In South Africa, about 20 per cent of *all* water is derived from groundwater. In Finland, about 60 per cent of the *potable* water supplied is derived from groundwater. Wells and boreholes form the backbone of rural water supply in both countries; there are about 600000 wells in Finland serving single households or holiday homes (Salonen 2002) and more than 225000 boreholes in the national South African groundwater database, which only reflects a part of the total. Two-thirds of South Africa's surface area is depends primarily on groundwater due to the lack of perennial streams. (http://www.dwaf.gov.za/Geohydrology/Databases/databases.htm) Groundwater is therefore of indisputable importance to both countries.

The efficiency of national water management practices is measured by the *Water Poverty Index* (WPI). The WPI incorporates the following aspects:

- Water resources available to the population
- Access of the population to water supply and sanitation
- Capacity (in terms on income and development) of the population to exploit the available water resources
- Efficiency of water use
- Environmental aspects such as water quality, pollution and biodiversity (Lawrence & Co. 2003).

The WPI evaluated 147 countries, and the relative position of South Africa and Finland in the different categories is shown in *Table 3*. Finland was ranked highest in WPI, while South Africa is in the bottom third of the countries included. A closer look at the WPI components, however, reveals that in terms of their natural water availability (which they really cannot do anything about) neither score that well, but their best ranking is in the environmental category, with South Africa at position 36 and Finland in position 1. All in all, the index reveals that the level of water management in Finland is excellent and fairly good in South Africa, given geographical and developmental constraints.

	South Africa	Finland
Resources	126	34
Access	86	6
Capacity	95	13
Use	72	57
Environment	36	1
Overall WPI	103	1

Table 3. The Water Poverty Index, as calculated for South Africa and Finland. All the values reported are the ranking of the 147 countries included in the survey, with 1 being the country with the highest score and 147 the country with the lowest score.

This article focuses in particular on two aspects of water management, wells and toilets, comparing the early experiences of both countries.

Wells in the countryside

The earliest sites where a safe supply of water was found were springs and freshwater streams such as small creeks. Not just humans, but also other mammals prefer flowing water and some even dig their own water holes – for example, elephants dig quite deep well-like holes in dry areas. On average an elephant needs to drink approximately 160 litres per day (ℓp/d); therefore the need for an adequate water source is obvious. The pit well, a simple deep water hole without any fortified walls, is the forerunner of the dug well. Water was taken from this sort of well by whatever means were available, usually just using simple vessels. One possibility was to form a chain of water carriers – this enabled the drawing of water from deep underground without advanced technology. In this way it was possible to reach water lying tens of metres deep, but then it was also necessary to get air down to those who were at the lowest level lifting the water. Water has been lifted from the dug well using the means available at the time, first with a bucket or a similar vessel, or possibly with the help of a rope or other tools. Different types of wells are described in *Table 4*.

Type of well	Technical realization
I Natural spring & bottomless barrel in spring	no construction or very simple construction
II Pit well	pit in the ground, no construction or very simple construction
III Dug well	place and construction planned, built shaft, place carefully chosen by observing terrain
IV Tube well	pipe is pushed into the ground, place and construction planned, requires precise knowledge of ground water location
V Drill well	pipe is drilled on rock foundation, place and construction planned, requires precise knowledge of ground water location

Table 4. Wells by their technical realization. (Categorization P. Juuti).

By approximately 3000 BC, the draw well with a counterpoise lift was invented in Babylonia and it was for over 2000 years the common and effective means to draw water. In Egypt it was called a *shaduf* and was used to lift water from rivers.

Traditionally a draw well was built from wood, but some iron fortification might also have been used. However, the column, the counterpoise lift, the bucket pole and the bucket were wooden. If there was a need for a counterweight for the bucket, it was usually made of a heavier material. A windlass or winch was used when the well was very deep whereas the counterpoise lift was mainly used for shallower draw wells. They were followed by wind turbines, crank reels and hand pumps. The first tube wells in Finland were built at the end of the 19th century. Gradually the counterpoise lift and wind turbines were replaced by the electric pump or the drilled well. (Juuti & Wallenius 2005, 19) (See also *Table 5*)

Type of well	Method of lifting chronological order
I Natural spring & bottomless barrel in spring	Hand, scoop, bucket
II Pit well	Hand, scoop, bucket
III Dug well	well & rope, bucket pole, hand pump
VI Draw well counterpoise lift	counterweight
V Windlass well	winch or reel
VI Tube & drill well	pressure of the groundwater formation or pump
VII Wells with wind engine	wind power, rotor
VIII Wells operated with engine	combustion engine, electricity

Table 5. Wells by method of lifting water. (Categorization P. Juuti).

In the countryside, watering livestock formed the major part of the water consumption. Thus, if possible, the well was placed closer to the cowshed than the house itself – humans need only a few litres of water to drink per day. According to estimates made by the Finnish Committee for household efficiency, the distance between the cowshed and the well was nevertheless approximately 50m in the 1930s. Likewise the sauna (the Finnish washing place), was often placed close to the well to ease the burden of carrying water. A study by the Finnish Ministry of Agriculture shows that wells were the most common source of water in the countryside in the early 1950s and that only seven per cent of the households were connected to a water supply pipe. The most commonly used methods to draw water were a bucket, a hand pump and a winch (Katko 1988, 8–11; Paulaharju 1958, 32–33; 1906, 7).

The early indigenous nomads of South Africa had no need to construct elaborate water supply systems. When the very dry areas of the Northern Cape Province had good rains and vegetation the nomads moved in, and left when the drier seasons arrived. From the eighteenth century, white colonist farmers copied this practice, with a large-scale “trek” every year with their cattle and sheep to follow the available water and vegetation. Water was taken from surface depressions and streams immediately following the rains and from shallow dug wells in river-beds for the weeks following. As communities settled, the need for permanent water supplies became essential. For the very dry regions, however, the digging of a permanent well represented a large investment in time and effort, which would require land tenure and secure ownership. Where farmers could get their title to the farmland, the water supply systems were developed from the eighteenth century. In some of the very dry regions, the land stayed under government control as the so-called “crown lands” and here the water supplies were not developed until as late as the early twentieth century, when the farms were eventually sold to individual owners (Van der Merwe, 1945a, 209).

The digging of wells required much effort to get through the hard banks of stone and rock. Besides shovels, picks and chisels, heating the rock with fire and quenching with water was an early method of getting through (Van der Waal-Braaksma & Ferreira, 1986, 63). Later, some fairly ineffective home-made explosives were tried, but things only got better in the 1880s when the newly established South African mining industry, as a side effect, made it possible to procure dynamite. Digging the wells was slow, typically requiring about three months for well with a depth of 45m – equivalent to 0.5m p/d. Getting water and other supplies from far away to the well-diggers during the many months when the wells were being dug, presented a major logistical problem. Moreover, only 20-25 per cent of the attempted wells struck water and the others had to be aborted (Van der Merwe, 1945b, 44).

Illustration 1. A typical shallow pit well in South Africa, showing the platform from which the water was drawn.

Where the water was close to the surface, a typical well was a dug well, 2-3m deep and about 5-6m in diameter, encircled by a low wall to keep the animals from the water. Inside the well, a flat stone just above the water level would serve as a small platform from where a person would scoop the water with a bucket and empty it directly into a small channel leading to a drinking-trough outside the wall, where the animals would drink (see *Illustration 1*). When the well was deeper, up to about 5-10m, a lever was used, similar to the ancient Babylonian design, or a series of steps would be carved to allow the "human chain" to lift the water by progressively passing on the bucket. Deeper than this, the buckets had to be winched out with a primitive reel (see *Illustration 2*).

An interesting variation on this method was to use two to four donkeys on the surface to hoist the bucket by pulling the rope over the reel. By leading the donkeys away from the well, the bucket would be lifted. After the bucket had been emptied and dropped back into the well, the donkeys were brought closer to the well and the cycle was repeated. This use of animal-power allowed the use of much larger buckets of between 45 and 90ℓ (Van der Merwe, 1945a, 257).

Typical of South African wells in the remote rural areas, was the reliance on hand-made equipment using local materials. Home-made explosives were packed in a bottle, provided with a fuse and sealed with beeswax. Buckets were made of canvas and water-proofed with animal fat. A circular ring was fixed to the top of the bag to keep the bucket 'open', with a second ring sometimes at the bottom. To simplify the emptying of the large buckets when the donkeys were used, a canvas spout was fixed to the bottom of the bucket, long enough to be tied to the handle of the bucket while it was being filled and lifted – a very simple valve! Buckets were sometime made of more durable leather and stored in the cool, moist area immediately above the water in the well to extend their lives, but only lasted eight months at the most (Van der Merwe, 1945a, 258).

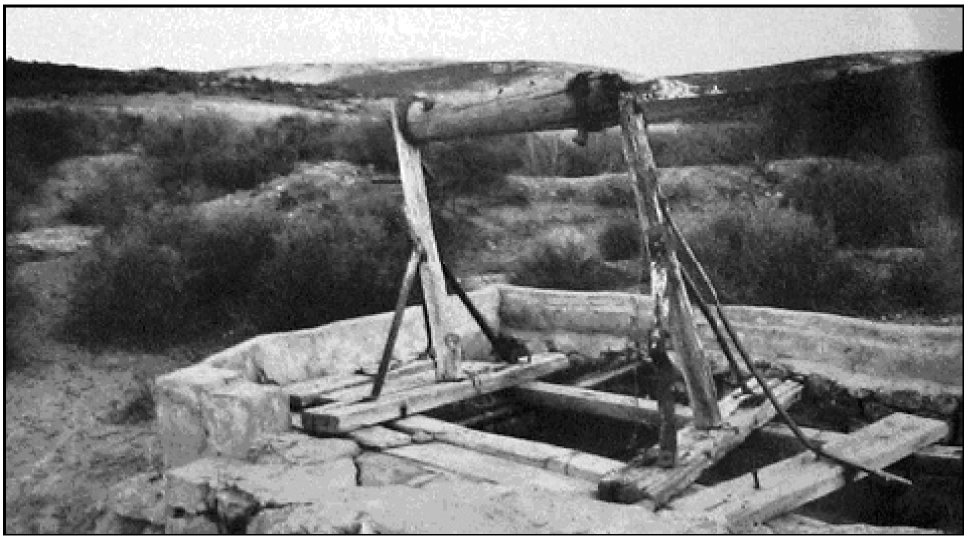

Illustration 2. A deeper well (in South Africa) with a reel, dating back to 1880.

When a well with good water was found, special measures had to be taken to ensure that different herds of sheep could be adequately watered without getting mixed up. A simple method to extend the watering capacity was to have two or more watering-troughs extending from the same well, to allow more than one herd at the well at a time. A more elaborate arrangement was to dig more than one well close to each other, thus increasing the water production rate. The importance of such watering-points are reflected in the indigenous languages of South Africa – a strong water source was known as 'the womb' and an area which allowed more than one well at the same point was known as a 'stomach' (Van der Merwe, 1945b, 105, 259).

In South Africa wells with wind turbines replaced all the other types of wells outside of urban areas at the beginning of the 1870s. The first wind turbines were imported from England, America and Australia (Walton, 1954, 155). The drawn-out war between the Boer Republics and Britain, known as the Anglo Boer War (1899 and 1902) brought agricultural development to a practical standstill. In 1903, soon after the war and in the time of rebuilding the country's agricultural production capacity, a devastating drought struck South Africa. This accelerated the introduction of the wind turbine and accounted for the fact that wind turbines were recorded for the first time in 1904 by the Cape census, which reported that in the Cape Colony there were 1275 wind turbines and 364 water wheels in use. By 1914 there was, for example, one wind turbine for every 4000 ha in the Reddersburg district in the Free State Province. In the drier parts such as Bushmanland in the Northern Province, the development was slower and by 1945 a farmer with one wind turbine for every 5000 ha was considered to be fortunate. According to the South African agricultural census in 1926, the number of wind turbines on the country's farms was 44000, in 1946 101000 and in 1955 151000. In 1942 the first wind turbines were locally manufactured and the Climax company alone (there were others as well) had manufactured 150000 units by 1974. (Archer, 2000, 682; Walton, 1954, 155; Van der Merwe, 1945b, 51). In recent times, technology has evolved further and the use of submersible pumps in boreholes and solar power spread into the Karoo (a dry area in central South Africa) during the 1980s and 1990s.

A wind turbine (*Illustration 3*) is very reliable and usually requires very little maintenance. Wind power is still used on a large scale in South Africa. In 2003 there were about 300 000 wind turbines on farms across South Africa, second in number only to Australia. Nowadays even in the most desolate wastelands of the Karoo, it is hard to find a place where a wind turbine cannot be seen. These turbines make many of the most arid parts of South Africa habitable. They are primarily used for watering livestock and supplying communities with water. (http://www.africaguide.com/facts.htm, 12.5.2005; South Africa Yearbook 2003/2004, 481).

Illustration 3. A typical wind turbine in the Northwestern Cape, South Africa, on the farm Nanibees, Brandvlei District. The wind turbine, also known as a windpump in South Africa, was manufactured in the industrial city of Vereeniging in the mid-twentieth. After having fallen into disuse it was recently restored, with good effect by the owner of the farm, Mr. Francis Visagie. (Photograph: Magda Morrison (2003) with additional information by Theo Venter), Editor.

First urban wells and toilets

Compared to the rural areas with scattered settlements, castles and cities were more densely populated – the same space was sometimes shared even with a large number of livestock. Securing the water supply was of utmost importance when the layout of a castle or fortress was planned. A location near water provided a good means of transportation and on the other hand also protection against enemies. It was necessary to get water from the surroundings or preferably even inside the walls, otherwise the general safety would have been endangered significantly under siege conditions. To have a well was important also in case of fire, for it was a constant threat even in times of peace (Juuti & Wallenius 2005, 69; about sieges: see Syvänne 2004, 295-303).

The first toilets did not require much technical construction; they were just holes in the ground. In the world today, sadly, the most common type in use is still the most primitive – a hole dug in the ground. An evolved, Finnish version of this latrine hole is *riuku* – with supporting, vertical logs on both sides of the hole and horizontal log(s) attached to them. It's been used widely by the Finnish army, especially during World War II, and the *riuku* was also introduced to later generations of young Finns doing their military service (Juuti & Wallenius 2005, 29; Katko 1996, 96). *Riuku* was designed so that even several people could sit on it. A popular story from wartime Finland tells how the Soviet Red Army troops were sometimes beaten just because of the lack of good sanitation. Finns always had their *riuku* further away from their camps and sources of water. The Red Army was not as careful and at times the fighting condition of the troops was quite poor. There is a grain of truth in this story, for during military campaigns diseases spread among the troops with devastating results. A good example of successful maintenance is the army of the Roman Empire, which took good care to provide vital water supply and sanitation (Syvänne 2004, 104).

Upgrading doesn't always mean improving, for the most dangerous type of toilet is the "modern" water closet, which is *connected to a sewer without wastewater treatment facilities*. This kind of system had caused fatal epidemics and the pollution of small lakes on many occasions. An Englishman, Joseph Bramah, is usually named as the developer of the first actual water closet, in the year 1786 (Juuti 2001, 38; Wijmer 1992, 60-62).

The compost toilet is the most environmentally friendly, especially the dry compost model in which urine is collected separately. Urine diluted with water can be used as fertiliser and composted solid waste can be used for soil improvement. The amount of urine produced by one individual in a year could be used to produce 200kg of grain. This method not only recycles the nutrients in the urine but it also prevents them from getting into the groundwater and watercourses. Other advantages worth mentioning are that the whole process is quite easily managed by the users themselves and the separation of urine and faeces also reduces the offensive smell. The compost toilet can thus offer a possible solution to the problem of famine often coupled with poor hygiene. It's notable that in the nineteenth century there were already dry compost and compost toilets in cities joined with different transportation systems. Choosing the water closet for the primary system in the late nineteenth and early twentieth century effectively stalled the product development of dry compost and compost toilets for over a hundred years (Mattila 2005, 41; Juuti & Wallenius 2005, 29). (See *Table 6*)

Toilet	Method	Consequences / Results
i Pit	none or covered with soil	waste won't compost
ii Outhouse & WC, no waste treatment	none	leakage in ground or into body of water, environmental hazard, wells and watercourses endangered
iii Transportation of waste within organization	centralized collection of waste	depends on further treatment
iv WC, flush water led into watercourse	waste flushed and led into watercourse	catastrophic, watercourse and in worst case drinking water contaminated and polluted
v WC with precipitation tank	heavier matter sinks to the bottom of the precipitation tank (one or multiple piece)	refinement only partial
vi WC with closed wastewater tank	waste flushed into tank, then collected and transported to the network of sewer works	good
vii WC with filtering on the ground	often with the precipitation tank	result varies
viii WC and treatment plant	small local waste treatment plant	result varies
ix WC, connected to the sewer network	wastewater treatment plant	advantages of bigger units: better treatment result
x Compost toilet	composting	controlled recycling of units

Table 6. Toilets – method and consequences of treating the waste. (Categorization P. Juuti).

The oldest remaining wells and toilets are usually found in castles – both in Finland and South Africa. The castle of Good Hope in Cape Town in South Africa provided shelter and protection to soldiers and administrative staff, but it also provided good water from its wells. Cape Town was established by the Dutch in the seventeenth century and is the oldest European-style city in South Africa. It is situated by the sea and is the centre of the second largest metropolitan complex in South Africa. In the castle there is one big dug well, the so-called Kat well and a couple of smaller ones. The Kat well is, according to Werz, the oldest still remaining well in South Africa and dates back to the year 1682 (Werz 2002, 97). The Kat well had a reel and its walls were made of stone, which was a quite typical method of construction. Building this type of well requires quite good planning, expert builders and resources such as money or manpower (Juuti & Wallenius 2005, 12-15). Originally the Kat well was built in the centre of the castle and it was about 10m deep and 2m in diameter. In 1691, a long building was constructed across the castle courtyard and the well was left inside, but it was still accessible to the inhabitants (Werz 2002, 95-96). Later, in the early 1700s, the Kat well was operated by hand pumps. Water was lifted by the pumps to an iron water tank with a capacity of about three cubic metres and from there it was distributed through pipes around the castle. Another important well was in the kitchen, equipped with a water tank and also a heating place and tap for hot water. In Cape Town fountains were erected in different parts of the town already in 1699, for slaves to draw water for their masters (Report on Cape Town Water Supply by Chas. R Barlow, October 1914, 3/CT, 4/1/1/90, ref F134/4, in Cape Town Archives Depot).

In Finland, Turku castle was founded at the mouth of the Aurajoki River in the 1280s. Finland was a part of Sweden from early 1200s to 1809 and castles built in that era served the administrative purposes of the Swedish Crown. Turku castle was originally built in an open form of a fortified camp and the first well dates back to this era too. When the castle was extended, the kitchen was built around the well and it was kept in use. Up to this day its water is clear and of good quality and this well is considered to be the oldest remaining in Finland. In the early fourteenth century, the fortified camp was built into a closed castle and then it was divided into a main castle and a bailey. (http://www.tkukoulu.fi/tiimalasi/tl-rakennushist.html; Gardberg 1959, 7-8) In the mid-sixteenth century Turku castle was found to be old-fashioned, deteriorated and an inconvenient place in which to live. The castle was renovated into a handsome renaissance-style dwelling in 1556–1563 and extended to its current size. Water pipes made of lead and copper were installed from Kakolanmäki hill to the castle and this project took 4000 man-hours in 1561–63. Several more wells were also built to satisfy the increasing need for water. One of them, with timber frame and stone-lined walls is still to be seen in the courtyard (Stenroos & al 1989, 60; Gardberg 1959, 309-310; http://www.nba.fi/fi/turun_linna; Puhakka & Grönros 1995, 28-29; Gardberg 1961, 7–10). (*Illustration 4*)

Illustration 4. Well from Turku Castle. (Photo: P. Juuti)

Water also has a protective purpose in the castles in South Africa and Finland. The castle of the Cape of Good Hope has a moat that was finished shortly after 1720 and in Finland, for example, the safety of the Häme castle was increased in the 1770–80s by digging massive moats around the castle.

There were several toilets in Turku castle. From the fifteenth century onwards there were three: the privy in the gatekeeper's chamber (located in the corner of the gate tower), one in the prison and the third was located in the north wing. These three were connected to the same toilet drainage system and formed an independent system. The king, other noble residents and high officials had their own privies and one is still left in the medieval great hall. These privies were usually constructed on top of the corbels or supportive beams, a sort of a bay toilet, being located partially outside the wall. However, in the Turku castle, most of these privies in the quarters of the aristocracy were built completely inside the walls. The chamber of the young noblemen from the 1540s is located near the king's hall and it had access to the bay toilet (built on beams). Similar privies were attached to the castellan's chamber and the queen's hall (Puhakka & Grönros 1995, 40, 48, 57, 59, 63, 75). None of these types of privies have survived to the present day; fires and time have taken their toll, but they can be seen in the scale model of the castle. However, other types of privies have been preserved quite well in this castle.

Ordinary soldiers did not have decent outhouses – in Finland, lakes and moats were used for this purpose as was the sea in South Africa, but at least later the commandant of the castle of Good Hope had a private toilet. Elsewhere in the old city of Cape Town wealthy people relied on water carriers and slaves to empty chamber pots. Lots of complaints were made that slaves did not do their job well in this regard. They should have emptied the buckets in the sea but instead they emptied them even in front of doors and into streets. Viktor de Klock describes this practice:

> One of the most maddening habits of the slaves was that of emptying sanitary tubs into the canals, and frequently even before other people's doors, instead of into the sea" (cited in Fehr 1955, 13).

The fiscal and two burgher councillors acted twice a year as sanitary inspectors, but these inspections were only partly effective, since they were usually announced in advance and since the householder's responsibility was limited to seeing that the area immediately in front of his door was clean. (Shorten 1963, 54). It is easy to criticise such habits, but the task was not a pleasant one. It is likely that the adoption of new, improved techniques was slowed down by the fact that the owners did not have to do this duty themselves (Juuti & Wallenius 2005, 136).

Wells and toilets in the 1800s

The construction of a dug well requires planning and to some extent expertise in building. Walls are usually made of stone or wood. Wells with stone walls are typically round. Wooden walls for wells were traditionally built in a rectangular form (similar to the timber block construction for houses) and their shape was typically square. Dug wells are suitable in sand, gravel and moraine areas, where groundwater is closer to surface. The dug well is still the most common type used in the world. Its diameter varies usually between 1-5m and the depth varies from a few metres to more than 20m. The best location for a dug well is on the lower slope of a ridge somewhat higher than the base (Juuti & Wallenius 2005, 15).

At the end of 1800s the water closet (WC) was considered an improvement that saved people from unpleasant tasks – such as emptying a chamber pot in the morning. But not everybody rushed to exploit this new invention. The wealthy burghers of Turku could hire people cheaply from the countryside and when there was a servant to empty the pots in the morning, there was no hurry to get a water closet, M. Brunow-Ruola explains. In these circles the WC and other facilities that eased everyday life were not acquired until the lady of the house was alone taking care of the household or had perhaps only one servant (Brunow-Ruola 2001, 234).

The most commonly used sources of water available to the inhabitants of Cape Town, prior to 1811, were springs on the slopes of Table Mountain or a fountain on the northern side of the Grand Parade. Another fountain was at the lower end of Caledon Square and was mainly for military use. In 1811 the Governor ordered iron pipes to be laid along the principal streets (Shorten 1963, 96-97). In 1834 there were 36 public fountains in the town area and it was reported that so much water was wasted from them that it would be advisable to erect public pumps (Report on Cape Town Water Supply by Chas. R Barlow, October 1914, 3/CT, 4/1/1/90, ref F134/4, in Cape Town Archives Depot).

Durban was established in 1835 by mostly British settlers in the middle of Nguni territory on the eastern coast of South Africa. Later on, Indian immigrants formed an important part of the town's population. There was plenty of water, but its quality was questionable. In 1854 Bishop Colenso complained that the water was the greater devil in Durban, because wells were not dug deep enough to keep organic material from polluting them. The only solution was to drink rainwater or the excellent water from the Umgeni River aboput 7km away (Hattersley 1956, 96-97).

In 1856, the construction of an embankment at the head of the water above the Umgeni brickfields improved the sanitary condition of the town. (Ellis 2002, 38) The first wells in Durban were probably private; the earliest public well possibly dates from the year 1864. (*Illustration 7*) Its walls were made of alternate double rows of brick and single rows of slate. It was situated in Berea Road near the intersection with Old Dutch Road. The well was rediscovered in 1968 during excavations (Bjorvig 1994, 321-322).

Johannesburg was a sudden birth in the primarily rural South African Republic in 1886, after gold was discovered in the area. Its increasing cosmopolitan population and location of 70km from the nearest major river created water supply problems from the start. Gold diggers used shallow wells, but the quality of their water was poor. Already in 1887, the state commissioned the Johannesburg Waterworks, Estates and Exploration Company to ease the problems (Hattersley 1973, 238).

Sanitation needed to be organised as well. At first 'sanitary gangs' were formed from convicts to empty cesspits. In 1888 the Sanitary Board imposed charges for the nightly collection of sanitary pails and for the daily collection of rubbish and slop-water. It was not allowed to run dish- or bath water into the streets. Every house had a cistern in the back yard to collect such slop-water. A large wagon with several tanks came twice a week to empty these cisterns. Use of this service was compulsory and if left unpaid, it was punished by imprisonment (Hattersley 1973, 238; Leyds 1964, 32).

A British engineer, Robert Boyle, visited Johannesburg in 1890 and commented on the conditions there. He explained:

> The sanitary condition of Johannesburg, though not yet all that could be desired, has been greatly improved within the last year or so […] The pail-closet system is used. There is a splendid opening here for an improved dry-earth closet, as the system at present employed is very unsatisfactory (Sanitary Crusade, 20-21).

At the end of the 1800s and the early 1900s the refuse problem of Johannesburg was worsening. In the Transvaal Law Reports several Supreme Court cases can be found dealing with these problems. For example, in 1907 in the case of Tobiansky vs. Johannesburg Town Council, it is apparent that there really was a serious problem with refuse and overall sanitary conditions in the town and especially in the township of Sophiatown. A portion of Waterval farm was used wrongfully […] as a depositing site for night-soil, slop water and carcases of animals, and . . . consequently offensive, poisonous and unwholesome vapours and noxious matters issued and proceeded from the site and spread and were diffused […] to properties, rendering them unwholesome, dirty and uncomfortable to live in […] and seriously endangering […] health (Transvaal Law Reports 1907, Tobiansky v. Johannesburg Town Council, p. 134-156).

The Waterval area was situated near a major public road, Old Krugersdorp Main Road. It was used for this purpose obviously since 1894 and became a serious health risk by 1907. These practices and problems were common in the growing cities of the South Africa. (Transvaal Law Reports 1907…) Even on the other side of the world – in Tampere, Finland – similar cases were reported. (Juuti 2001, 66-87).

City fires were also a big problem. Before the time of waterworks, Finnish cities burned down frequently due to an insufficient amount of water and because of the dominant use of wood as a building material. In South Africa this problem was not as comprehensive as in Finland. There are however indications that Cape Town experienced numerous fires since the seventeenth century (Nikula 1972, 40-41; Worden et al 1998, 112).

First WCs in South Africa and Finland

The first reference to WCs in Cape Town is from the year 1814, when Lord Charles Somerset ordered four patented water closets for Government House at a cost of £230. They, however, did not become general, even in the larger residences, until the second half of the century (Hattersley 1973, 147).

In 1887, in Grahamstown, the old cesspool system was replaced by the pail system; at nights the sewage was emptied and removed to outside of the city, where it was covered up with soil (Souvenir of Grahamstown, 35, 39). A few years later, in 1891, Robert Boyle mentioned the use of pail-closet systems in Kimberley, Johannesburg, Pretoria and Durban. There were also plans for switching to water-borne sewerage system in Kimberley and Durban (Sanitary Crusade, 12, 20, 23 and 26).

Some progress was made in Durban in 1896, when an effective sewerage system became operational. Lavatories were provided throughout the town. There was also an outfall for waterborne household sewage, which was discharged during the first few years into the sea at the ebb tide (Bjorvig 1994, 327-328). In January 1906 there were problems with European-style water closets in Durban harbour. One of the disposal pipes was blocked and the plumber found two bottles, one shirt and two pair of socks inside. This led to investigations that involved the fort captain, harbour engineer, wharf master and even the water police. It is not known whether the offenders were found (Pietermaritzburg Archives Repository, NHD II/1/96 106/1906). A month later the same closet was under discussion again when the mechanical engineer proposed on 5 February that the iron seats should be replaced by wooden ones (Archives Repository, NHD II/1/95 28/1906).

In Finland, sanitation problems were solved along with the water question. Water closets were seen as a solution to sanitation at the end of the nineteenth century. The first legally built water closet was completed in 1883 in the house of the Bank of Finland. Stockholm, in Sweden, got its very first water toilet the same year. In Finland a few 'illegal water closets' had been constructed even before that date. There was a heated discussion concerning the necessity of water toilets in Tampere and other cities in the late nineteenth century. At the time, a WC was built in most blocks of flats in Helsinki, but still in 1906 there were instances when outhouses were preferred (Katko 1996, 57-58; Nygård 2004, 224-225). The health board of Tampere demanded in 1890 that a WC, built in one of the downtown houses, should be dismantled, since it was illegal. The owner and builder of the toilet, F. W. Gustafsson, explained:

> Closets […] are equipped so that nothing but water can go through them to the city ditches, because there's a cesspool under the closet and there's a 4-inch (10mm) diameter pipe with a filter (TKA, THL BI:1, Gustafsson 10.6.1890).

A similar incident occurred in Helsinki a decade earlier, when in 1882 a businessman, F. W. Grönqvist, had water closets put into his house. Two years later he lost a dispute with city officials, when the senate confirmed the decision of the provincial governor, which forbade the running of any impurities from closets to the sewer network (Laakkonen 2001, 48-50).

Discussion and Conclusions

Today, there are several pressing environmental issues in South Africa and Finland in respect of water issues. There is a lack of natural water resources. This requires extensive water conservation and control measures. Growth in water use is much faster than the available, and also the anticipated future supply. There is the severe pollution of rivers as a result of agricultural, industrial and domestic discharges. Air pollution is resulting in acid rain. There are many examples of soil erosion and desertification is still the order of the day. Both South Africa and Finland have to cope with these problems simultaneously.

The greatest challenge now in Finland is to find a solution for complying with new wastewater treatment regulations in areas of scattered settlements. The best choice might be the complete recycling of nutrients, which requires replacing the water toilet by the compost toilet with urine separation and a significant change of attitude. The second-best solution would be leading the wastewater to the sewerage works, but long distances make this almost impossible. Finland has plenty of water, so there's no need for two-pipe systems, where for example the flushing water is of lower quality. Rural areas without sewer networks should seriously consider abandoning the flushing toilet altogether. In urban areas, with established networks, it is not reasonable to replace the existing infrastructure with a new system. In general, the large wastewater treatment plants work well. But for new areas the system based on composting toilets should be studied and developed further.

In 2004, Transparency International (2001: www.gwdg.de/~uwvw/icr.htm) ranked Finland – again, the fifth time in a row – as having the lowest perception of corruption in the world. Also South Africa made out very well in this evaluation, it was second in Africa. It's not co-incidental that the most corrupt countries – without pointing a finger directly at them – are also the countries with the worst water governance.

Outhouses and wells remained in use in cities for some time after the establishment of central water supply systems. Water and sanitation services reached the suburban areas slowly and in some areas of scattered settlements they still are not available. So in 2004, 650000 private wells (500000 simple dug wells and 100000 artesian wells) remain in Finland and the majority – probably two-thirds – require immediate maintenance to improve the quality of the water. These figures include both the main households and the holiday homes. But a little over 90 per cent of all Finns get water of good quality from local waterworks distributed to their permanent address. In South Africa, the backlog in getting people access to safe drinking water is a national priority scheduled to be eliminated in 2008 (http://www.info.gov.za/speeches/2004/04051015151001.ht).

The conditions have not always been as good and surprises may occur. But all in all, the situation is quite good in both countries. In Finland in the early 2000s the waterworks provided 250ℓ p/d per capita for private use. For industrial purposes, the figure is 20 000ℓ, but industry gets only a small amount of its water from public waterworks. The total consumption of communities and industry is 7.5 per cent of the renewable water resources. There are even in suburban areas 40 000 people and in sparsely populated areas more than half a million people who remain outside the water supply network. Approximately 300000 people have some impurities in their domestic water and one million people living in houses have their own sewer systems, without a connection to a municipal sewer system.

The reason for this favourable situation in both countries is that the right choices were made in the past. The nineteenth century was a time of increasing environmental problems in Finnish and South African cities. Old water supply systems became inadequate when the population increased. The contemporary term for the situation was the 'water question' – nowadays it is called the 'water issue' – and the answer to the issue was sought for decades. Developing countries of our time confront this same acute problem.

Water management, i.e. water supply and sewerage and waste management, are essential elements of the development of communities. Together they are called environmental services. The environmental services are justified in themselves and by expecting direct and indirect benefits. The concrete infrastructure is the basis for economic and social systems, which can be vulnerable to environmental changes. The success of urbanization and the modernization of the rural areas are closely connected to finding solutions for environmental services. A well and an eco-toilet in areas with scattered settlements will provide in future ecological solutions. Investing in water supply and sewers is always worthwhile.

Water supply and sewerage are vital, although mainly invisible, parts of the economic-technical infrastructure of a community. Environmental services are essential for public health, hygiene, the protection of the environment and industry. Water supply and sanitation, sewerage and waste management are the basic issues of environmental history and studying them can give new ideas for surviving the problems caused by increasing standards of living and populations. The solution for environmental services is simultaneously a solution to the problem of how to live and settle successfully, as well as how to create better surroundings. Wells and toilets are an essential part of durable solutions for the future.

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8. Governance in Water Supply and Sanitation in Finland and South Africa – A case study

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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 two South African towns, Johannesburg and Durban, and in one Finnish town, Porvoo. Points examined will be the development of water supply, water use and sanitation services and patterns of governance. Use of water management in race relations by colonial and local governments will be also examined.

Water as a resource is threatened by problems of quantity and quality in a time of heavy population and industrial growth in all countries. Sustainable water use is vital to the well-being of both rural and urban dwellers, the national economy and urban water supply. Insecure access to water resources has led to conflicts in many societies throughout the centuries. Water and sanitation services are part of the urban infrastructure and are too often taken for granted; often their real importance is realized only when something goes wrong. While water management is one of the biggest challenges of mankind (UNDP 2006), in historical perspectives clean water is regarded as the most important service of mankind. In January 2007, sewage disposal and clean water supplies, among other aspects of sanitation, were chosen over 15 key medical advances named in an international poll by the British Medical Journal (BMJ).

Case study method is widely used in many disciplines and it is also used in the field of water history and environmental engineering. But what case study method really means in these specific cases? The paper will include also examples from successfully finalized case studies on long-term development of water history in all case cities.

We have to learn how earlier choices affect today's available options and development paths of the futures. We can look back to history to pin-point factors of success, turning points and strategic decisions. Thereby environmental history offers us almost laboratory-like conditions vis-à-vis historical case studies. We can understand, interpret and analyze long-term historical developments in urban infrastructures, which contribute to our understanding of the economic backwardness and social and environmental problems of the case countries, and have significant relevance globally.

In the early 1800s population of the Cape Colony was around 60 000 and in 1921 the population of whole South Africa was 6 953 000. It is quite difficult, if not impossible to estimate population of whole current South Africa in 1800; first reliable census regarding African population was done only in 1904.[1] In Finland in year 1810 population was only 863 301 and in year 1920, it was 3 147 600 so population rose about 3.6 fold in time period. (Suomen Tilastollinen vuosikirja 1952, 5, 8, 10)

Both cases were selected from the present territory of South Africa which was part of the British Empire. The country’s economy is based on mainly mining industry, agriculture and food production. Around the early 1930s economy started to develop rapidly. In the industrial area social tense was still festering because of the wide structure of the feudal society. (Houghton 1964)

[1] Information from Professor Johann Tempelhoff, 21.2.2007.

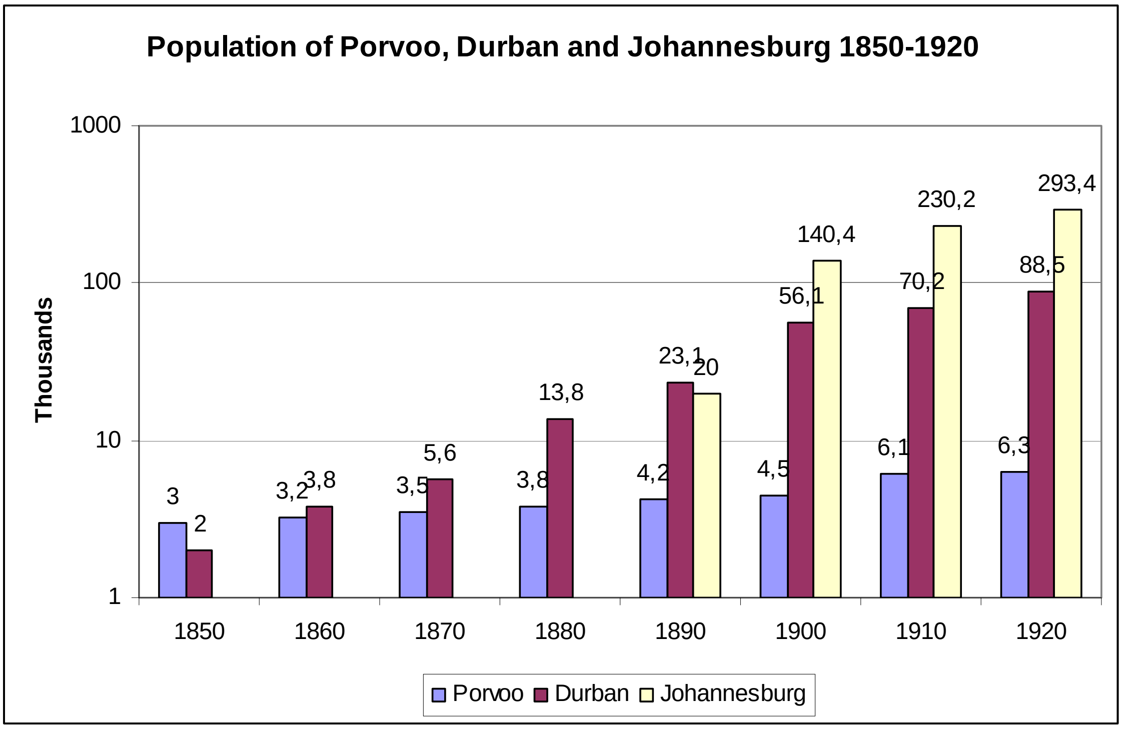


Table 1. Population of Porvoo, Durban and Johannesburg in 1850–1920 in logarithmic scale.

South African towns were not so developed compared with Great Britain or Germany as only the 24.7 per cent of her inhabitants lived in towns in 1911. In Finland figures in same year shows that total population in towns was 429 937 and total population in the country was 2,943 million: only 14.6 per cent of inhabitants lived in towns. (Suomen Tilastollinen vuosikirja 1952, 8, 10)

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

Great city fires were great problem in Finland during 19th century, even capital city Turku burned down in 1827. Main reason for big city fires was building materials (wood) and lack of pressurized water. In South Africa city fires were not so big problem because of buildings were build mostly from stone in bigger cities. Odd enough is that average rain fall is about the same in both countries.

All cases are compared with D. Okun´s principles of sustainable water supply. (Okun 1977, 4–7) Also development stages and different systems are evaluated shortly. Development stages of water supply and sewerage systems can be divided roughly into three systems. Used points of comparison must be from research subjects (water supply and sewerage) that are not only contemporary but also of similar technological level. The systems are roughly divided as follows (Juuti 2001):

1) Bucket systems	Reflects carrying;
2) Protosystems	Second best system available;
3) Modern systems	Best available system.

The purpose of this is to show that various solutions for city infrastructure, at different times, could have been feasible then. This way, we can also avoid a predestined, technologically deterministic view of water supply and sewerage advancing unavoidably towards the modern, "right" solution.

The bucket system is associated mostly with the use of buckets or similar vessels to draw, carry and hold water from wells, springs and various natural water sources like rivers, lakes and rainwater. Transportation of wastewater and refuse was also done with buckets to ditches, rubbish heaps and pits. The most characteristic feature of fire fighting during the bucket-system period was the use of untrained people to put out fires with water transported by "bucket brigades".

The period of rapid growth increased population density and demanded new constructional solutions. The densely built blocks of wooden houses, and later the first apartment houses, brought new challenges both for water supply and fire protection. Simultaneously, water acquisition, fire protection and refuse disposal demanded new solutions - otherwise the existence of the city would have been endangered.

In the middle of growing environmental problems, great fires that ravaged cities, and heaps of refuse, the *protosystems* were created to hide the problems. This solution demanded recognition of the fact that there were problems, and that the decision makers had the will for a change. They had to understand that the community should take care of these things. Drawing of water from the vicinity of the city, not from the city area, was typical for the protosystem. This meant, for instance, wells and leading untreated or mostly slow-sand-filtered water by gravity through pipes to consumers.

Other main features were the building of sewers so that untreated waste- and stormwater were led in the combined system to nearby water bodies and transportation of refuse to the immediate surroundings of the city area or dumping it in the water systems. The protosystem can be described by its operational principle: into the pipe, out of the pipe. As always with prototypes, there were defects and errors in this system.

Modern systems, on the contrary, were quite different from protosystems. They aimed at more sustainable solutions than protosystems. The central features were use of groundwater or treated surface water before leading it under high pressure to consumers, charging for water according to metered consumption, use of elevated water reservoirs, and the introduction of a separate sewer system and wastewater treatment. In this period fire fighting included the hydrant system within the city area and regular fire brigades.

Based on these classifications, the water supply systems of different cases are compared. The development of water supply and sewerage has not progressed linearly from primitive systems to more complicated, or from "bad" to "good" ones. The growth period of the city, and especially preparedness of the community to take responsibility for water supply, have been central issues. In different time periods objects of interest and methods have varied according to need, readiness and what has been considered important. (Juuti 2001)

Cases in South Africa

Figure 1. South Africa.

After the British seized the Cape of Good Hope area in 1806, many of the Dutch settlers (the Afrikaners) trekked north to found their own republics. The discovery of diamonds in Kimberley (1867) and gold in Johannesburg (1886) spurred wealth and immigration and intensified the subjugation of the native inhabitants. The Afrikaners resisted British encroachments, but were defeated in the South African War (1899-1902). The Union of South Africa established in 1910 operated under the policy of apartheid - the separate development of the races.

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 places and ten of them within 80 kilometres of Cape Town. By 1870 the number of urban places 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 annexed. In the Orange and the South African Republic, however, only Pretoria and Potchefstroom could be called as towns, most of the other administrative centres contained only half a dozen houses. (Fair & Browett 1979, 264–69)

In 1870 there were propably only three towns with population over 10 000. By 1911 the number of such towns had increased to 21 and southern Transvaal contained ten of them. In 1870 there were 231 towns in South Africa; by 1911 the number had risen to

336. And these towns housed a population of 1.5 million out of c. 6 million living in the area. (Christopher 1982, 135–38)

Nowadays there are important environmental issues in South Africa: lack of important arterial rivers or lakes requires extensive water conservation and control measures; growth in water usage is outpacing supply; agricultural runoff and urban discharge are polluting rivers; air pollution results in acid rain; country loses an estimated 500 mt of topsoil annually through erosion caused by water and wind; desertification is 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.

Selected two towns represent different kind of geographical locations, their ethnographic structures were different and at first they were part of different political units. They also ended up going different routes when trying to solve their water supply in the late 19th and early 20th centuries. Comparing the ways they solved problems around water supply illuminates from its own viewpoint the governance of water and responses of local government to the needs of fast growing population.

Durban

Durban was established in 1824 in the eastern coast of the South Africa, where there was plenty of water for household purposes, problem was the quality of it. The well water of old Durban hadn't a very agreeable taste but was better than rainwater. The town pump was situated in Old Well Court, in Smith Street and this pump continued in use until long after the Umbilo Waterworks were opened. Similar pumps were installed in other parts of the Borough. This form of water supply provided about 215 m^3 per day. (Tait s.a., 120; Henderson 1904, 225; Stark s.a., 124)

In April 1858, the Natal Mercury reported that some of pumps were out of order 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. Motion for a new town hall was carried by 3 votes to 2. (Tait s.a., 120; Russell s.a., 348)

In December 1861 the Council requested a report of the feasibility taking water from the Umgeni River. The Council could not, however, see its way to finance the scheme as submitted. In 1873 the Council apologized for any inconveniences because droughts had affected well supplies. Still dreaming about its future water supply, the Council in 1874 considered a proposal that private tenders be invited to provide Durban with water. In 1875 it was agreed in public meeting to set up a special committee to consider schemes, which had been proposed. The outcome was that the Borough authorised an expenditure of £500 on investigation of an artesian source of water. (Hendersson 1904, 50; Francis 1991, 43; Lynsky 1982, 12)

The water supply continued to be obtained from tanks and wells until the end of 1879. 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 other source of supply became imperative. In 1879 the possibility of a shortfall in the water supply became so serious that the Mayor made arrangements with the Railway Department for the supply of water in tanks from the Umgeni River. (Lynsky 1982, 12; Henderson 1904, 107–108)

Boring operations for artesian wells had been carried on during 1876-77 with no success. However, in 1878 the Council placed the boring operations entirely under H.W. Currie's control, and he eventually succeeded in sinking a well at the foot of the Botanic Gardens, which yielded 227 m^3 per day in July 1879. Storage tanks were erected and water pipes were led into town. An additional well was sunk in 1883 and steam pump erected to increase the supply. 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. "Currie's Fountain" continued to be the principal source of supply until the Umbilo Waterworks was opened in 1887. (Henderson 1904, 108, 225–26; Francis 1991, 43, 45)

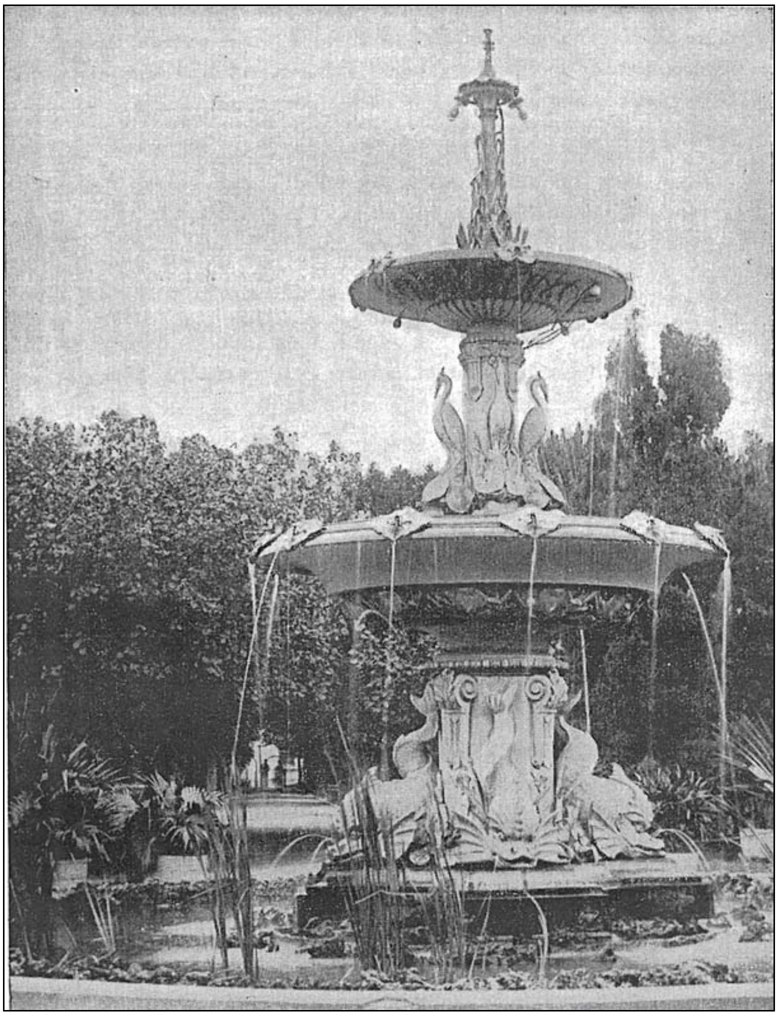


Figure 2. Queen Victoria Jubilee Fountain erected at the inauguration of Umbilo Waterworks in 1887. (Photo: Old House Museum, Durban)

Borough Engineer J.F.E. Barnes urged that the Currie’s Fountain be seen only as a temporary measure. In September 1883, Barnes reported on the schemes to supply water from the Umlaas, the Umhlatuzana and the Umbilo Rivers. In December the Council decided that the Umbilo River was the most suitable source. The site selected for the Waterworks lay on a bend of the Umbilo River just above Umbilo Falls. An earthern 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 described, were opened on 21st July 1887. (Henderson 1904, 226–27; Lynsky 1982, 16, 18–20, 22)

In 1889 Umbilo scheme was already overtaxed by drought and population growth. As a temporary measure Council allowed the construction of a plant to pump water from the Umhlatuzana River to the Umbilo River. In January 1890 new Borough Engineer John Fletcher reported of various schemes for supplementing the water supply. He advocated the tapping of the Umlaas River. This was approved in 1890. The new Waterworks were completed following year, and formally opened by the Council on the 30th July 1891. (Lynsky 1982, 26–27; Henderson 1904, 140–41)

This was only a supplementary supply to precede a permanent gravitation scheme. Until 1894 the Umbilo supply of 910 m^3 per day and the Umlaas temporary pumping plant of 1,100 m^3 per day proved to be sufficient to supply Durban. Umlaas gravitation scheme was built in 1894. By 1895 Fletcher could point to the successful completion of the scheme. The Umlaas and Umbilo projects combined gave Durban a cheaper and more plentiful supply than either Port Elizabeth or Cape Town. 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. (Bjorvig 1994, 324; Henderson 1904, 235; Lynsky 1982, 27; Medical Officer's Report 1898, 46)

Drought and the rapid increase in population during the South African War 1899–1902 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 increased the Umlaas scheme's storage capacity by 523,000 m^3. The spectre of recurring droughts led Fletcher to seek Council's authority for additional storage in the Umlaas catchment. Work commenced in 1901 on a Camperdown temporary dam, which was constructed in a record time of 5 months. Even before the temporary dam was finished Fletcher was contemplating a permanent dam. (Borough Engineers Report 1901–1902, 29–30; Lynsky 1982, 30)

In summer of 1902–03 the serious drought extended until to April. During this time the Camperdown dam helped to avoid a water famine. (Borough Engineers Report 1902–1903, 26) The Camperdown temporary dam stood its first test in December 1903 when a heavy flood, which damaged the Umlaas Intake downstream, left Camperdown Dam untouched. (Borough Engineers Report 1903–1904, 28–29) 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. (Lynsky 1982, 30–32) In 1905 it was decided that Camperdown temporary dam would be changed into a permanent. Work was started next year and in 1908 the retaining wall was laid. (Borough Engineer's Report 1906, 34; Borough Engineer's Report 1908, 42)

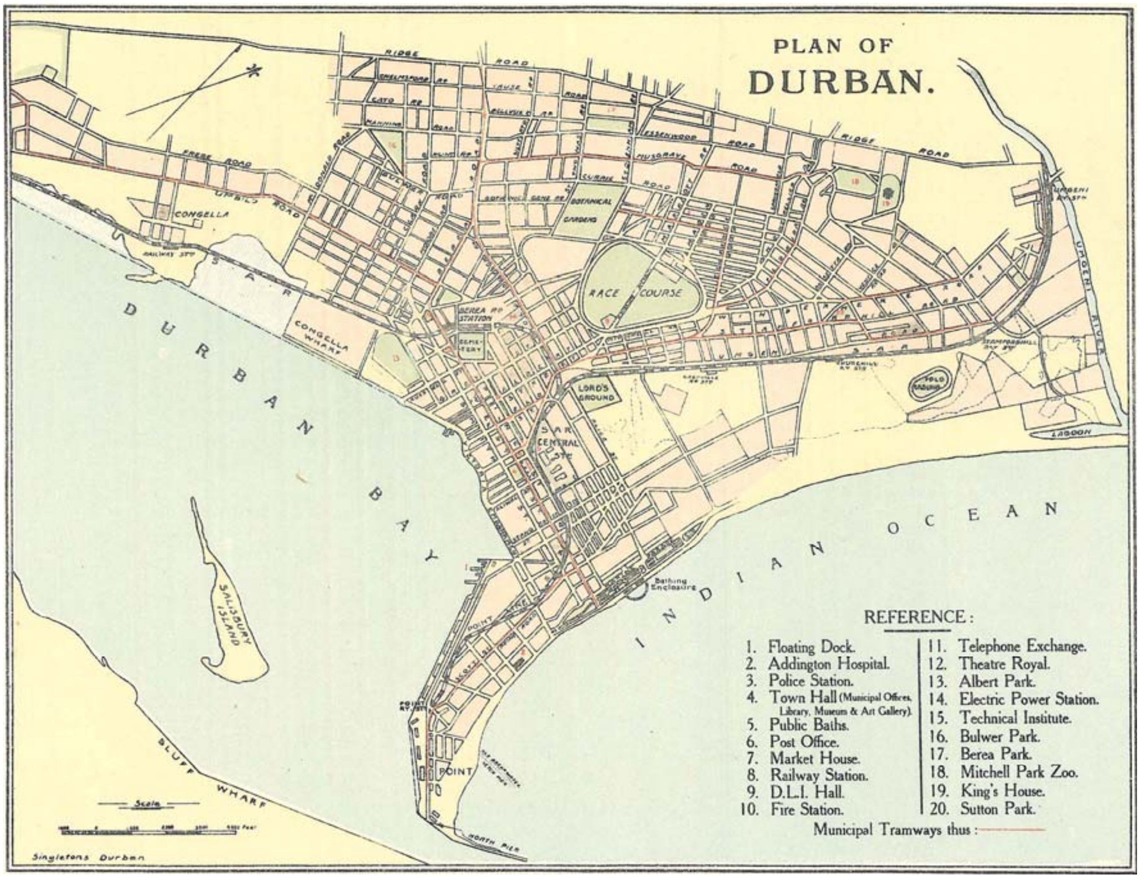


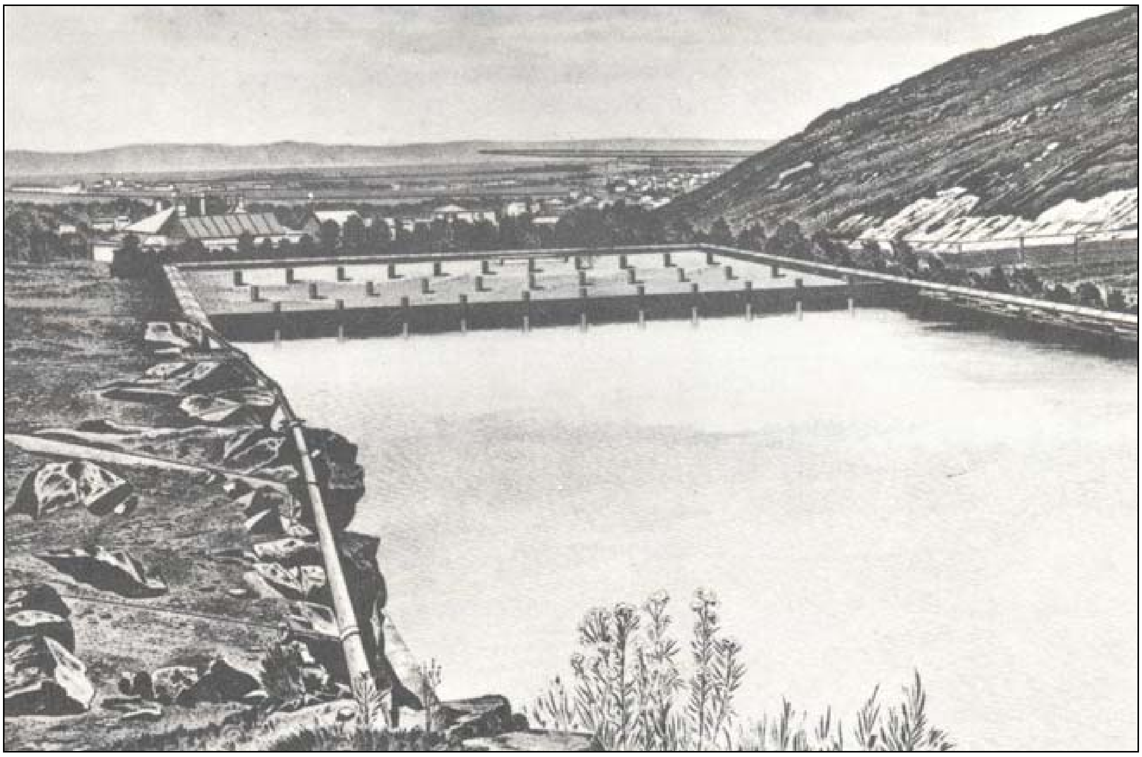
Figure 3. Durban 1911. (Tatlow 1911)

The 1917 floods resulted in Durban's existing water supply coming under critical examination. By January 1918 the Council resolved that a new dam was required and that the town needed an experienced "Water Works" Engineer. It was decided by Council that the waterworks Engineer would be responsible direct to Council. Main concern for the new Water Engineer, Walter Campbell, was the new water scheme. In 1918 investigations had been carried out as to the possibility of using various rivers along the Natal coast. These resulted in Council deciding to continue developing the Umlaas River and to proceed with the Shongweni Scheme. Construction of the Vernon Hooper Reservoir started in 1923 and was finished in 1927. (Lynsky 1982, 42–45)

Johannesburg

Johannesburg was founded in 1886 far away from good water resources. When the gold mining camps were arranged, water was drawn from streams and springs. Rainwater was also potted up. The position was worst in times of drought; the streams dried up altogether. That happened in 1886 and in early 1887. In January 1887 land was purchased on Braamfontein as commonage. The spring was then cleared and the water made available. Simultaneously a group of businessmen initiated a water supply based on Old Doornfontein. Soon after, negotiations began for the floating of a formal company, which would take over the operations of the syndicate. (Zangel 2004, 11, 44; Mandy 1984, 8; Cosser 1990, 17–18, 20; Frescura & Radford 1982, 5)

Government tried to solve problems by granting a private concession in December 1887, when James Sivewright got right to lay pipes in order to supply water. This did not impose any obligation to make the water available. It was not until June 1888 that the water was turned on. By 1888 the Waterworks Company was providing c. 3,000 m^3 of water. In September the foundation stone of storage reservoir was laid.[2] The amount of piping was, however, inadequate for the needs of the growing town. A large number of premises did not connect up with mains and wells and rainwater tanks were in use for a long time. (Gray & Gray 1937, 202–04; Leyds 1964, 52–53; Tempelhoff 2003, 28–30; Maud 1938, 126)



Figures 4. Harrow Road reservoir then. (Rosenthal 1974, 42)

The Big Slump left the Waterworks Company without; and when they had to raise money they failed and were faced with the prospect of liquidation. Plagued by drought, impatient shareholders and banks, Sivewright turned to Barnato Brothers. Barney Barnato at once advanced £30,000 (c. 3.3 million euros); soon pouring in more cash to give his firm a controlling interest. In May, 1889, the Company had 54 kilometres of water mains, while it claimed that the "number of leadings already put on exceeded one thousand". By September 1889 the company claimed that a supply of 3,400 m^3 a day was available. During the year ending June 1892 three reservoirs were built. (Jackson 1970, 106; Zangel 2004, 15; Shorten 1970, 167)

In January 1893 the Johannesburg sanitary board formed a special water committee. This committee made it clear that the search for water must go beyond the borders of Johannesburg. In July President Kruger told that he had held talks of a plan to transport water from the Vaal River. The constraint was the cost of the railway wagons and constructing the equipment for pumping water into the wagons. By the end of June 1894

[2] This reservoir can still be seen in Mackay Park.

three more reservoirs was constructed. However, for the most part the capacity of the reservoirs was far greater than the water available. (Cosser 1990, 53–54; Tempelhoff 2003, 59–60; Grant & Flinn 1992, 186)

Figures 5. Harrow Road reservoir now. (Photo: Harri Mäki)

In 1894 town was enduring worst drought in years. The Waterworks Company limited supply to an hour each morning. In June a commission of enquiry was appointed to find a solution to the water shortages. The commission submitted two reports in September. The first recommended Johannesburg taking over the water service. (Rapport J.M.A. Wolmarans and S. Wierda) In minority report it was said that government should be careful about taking over all the water resources. It was an investment that could be costly without bringing in profits. (Rapport A. Bock) The government instructed the sanitary board to take a poll on the Wonderfontein proposal. The waterworks company's opposition to this plan was so effective that the board dropped it. (Ramsden 1985, 129–36; Maud 1938, 127)

The Waterworks Company claimed in 1895 to have a daily supply of 6,800 m^3. But in the spring there was a severe drought and the Waterworks Company had to introduce rationing on October: mains were turned on only for an hour each morning and afternoon. Water had to be supplied by mule carts to the higher parts of the town. In most households soda water was used for cooking. Public works were stopped and factories closed down. At public meetings in February 1896, no less than 12 schemes were laid before the ratepayers. A big majority voted for the expansion programme submitted by the Waterworks Company, while Wonderfontein was the second choice. (Neame s.a., 51; Draper 1925, 1; Jacobsson 1936, 172–73; Maud 1938, 127–28)

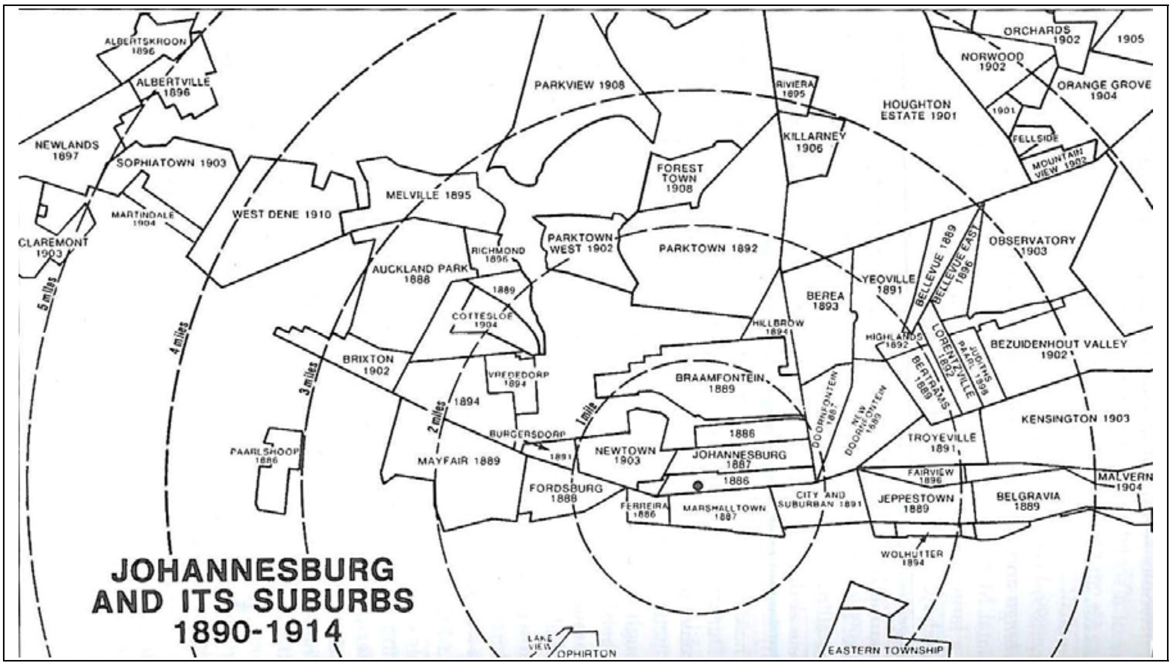


Figure 6. Johannesburg and its Suburbs. (Van Onselen 2001, 270)

In September 1897 an elected stadsraad (town council) was established for Johannesburg. The town became now a municipality and the powers of the stadsraad were wider than those of sanitary board. (Ramsden 1985, 48; Maud 1938, 44) In his first report Burgomaster mentioned a sufficient water supply as one of the most important matters. (Report of the Burgomaster 1897, 3) During 1898 the position fundamentally improved. In August the company began pumping water from Zuurbekom. From now onwards a considerably larger quantity of water was available. By 1899 when the pumping station was completed, the source could provide all the existing needs of Johannesburg. (Appelgryn 1985, 124; Laburn 1979, 3)

The town council was created in May 1901. Major O'Meara, who was controlling local affairs, observed that the company holding monopoly possessed unusual powers and used meters, which tended to record in its favour. The long-term solution would have to be bringing water for both towns and mines from the Vaal River. The water supply was important for ensuring that the mining industry could be brought into full operation as soon as possible. Special attention was given to providing the necessary infrastructure that would culminate in the establishment of a well-structured water utility. (Maud 1938, 57–58; Ramsden 1985, 48)

Consultations now took place between the Chamber of Mines and the town council; and in September 1901 a suggestion was made that a new public body should be created for a bulk supply of water. In November the government appointed the water supply commission to report on the available sources of water and make proposals on how a water supply for the towns and mines could be provided. The commission also had to consider the establishment of a public body to take responsibility of supplying the area with water. In February 1902 the commission reported in favour of the council's plan; a committee appointed later that year settled further details; and an ordinance, establishing the Rand Water Board, was passed in 1903. The board contained representatives of the municipalities and of the mines, with a chairman appointed by the government. (Maud 1938, 128–29; Tempelhoff 2003, 72–73)

In April 1905 reservoirs and distribution system were handed over to the Town Council, the Board retaining control of the pumping stations, the rising main and the wells and pumping plants. With the distribution systems the Town Council got several problems. Most important was how the extensions were to be made. This was complicated by a distance of the many townships from the centre. Only solution was to get a right to levy a special rate in districts to which the water system was to be extended. (Laburn 1970, 4–5; Mayor's Minute 1905, 11–12; Grant & Flinn 1992, 118)

When the daily consumption rose up to the 11,360 m^3 in 1905, it was still possible to cope with the demand. More boreholes were simply sunk at the Zwartkopjes pumping station. However this supply soon started dwindling. By 1909 the consumption had risen substantially. A drought of 1910 prompted the board to take steps to locate more reliable supplies. (Tempelhoff 2001, 252–53; Laburn 1970, 19) The position was temporarily saved by the Zuurbekom, which proved capable of producing some 34,000 m^3 a day. In 1913 on several occasions the supply to the town had to be curtailed. According to the Mayor there were two reasons why the supply should be secure: fire protection and the water-borne sewerage. The Council said that an additional water supply of at least 45,000 m^3 per day was necessary. (Mayor's Minute 1913, x)

By 1913 twenty-one schemes had been investigated, and in 1914 a site was selected on the Vaal River. The board was enabled to take 91.000 m^3 a day from the river. Until 1916, however, the First World War prevented even a start from being made with the construction of a barrage, and the works could not be finished before 1923. (Laburn 1979, 11–12; Laburn 1970, 21)

Cases in Finland

Finnish case is Porvoo, small medieval town in coast. In the beginning of time period country's economy was based on mainly agriculture. Finland was autonomous part of Russia in 1809-1917 and it finally won its complete independence in 1917. Nowadays there are only a few environmental issues in Finland, including water pollution from industrial wastes, agricultural chemicals and air pollution from manufacturing and power plants.

In Finnish case development of water supply and sanitation represents development in the whole country. 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.

At first the objective was to ensure the supply of fire-fighting water, then meeting the demand for domestic water supply. Thus, fires promoted indirectly the improvement of hygienic conditions along with sewerage systems. In spite of the incorrect scientific theory of miasma, the solutions made, however, advocated the right causes, i.e., improvement of the environment and safety of the case cities.

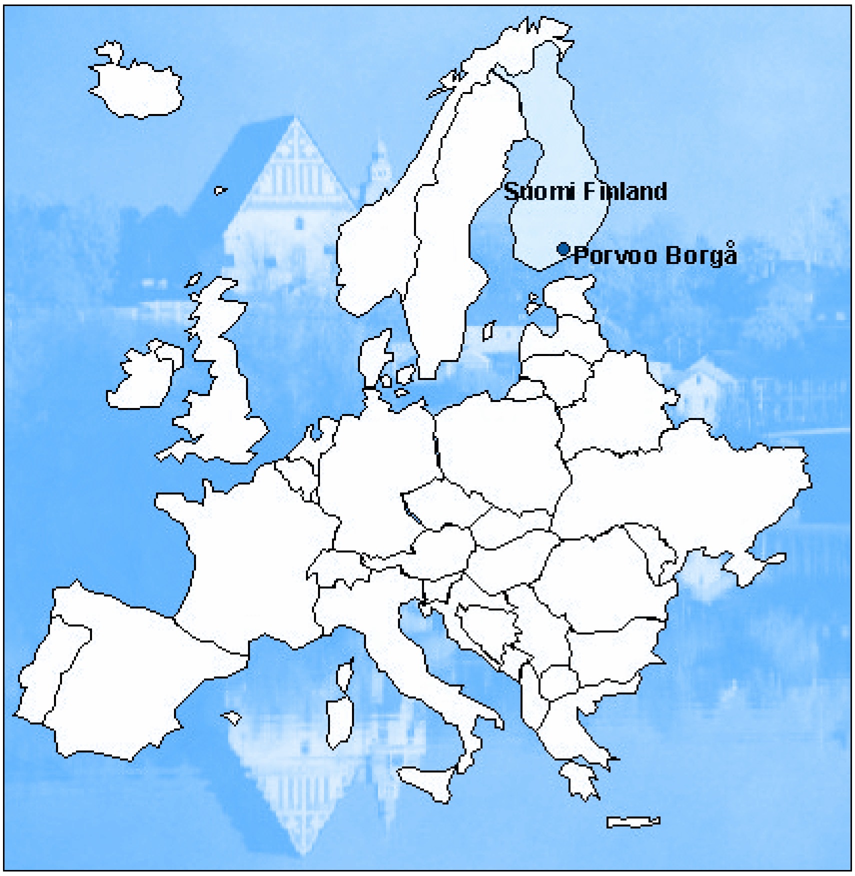


Figure 7. (http://www.porvoo.fi/index.php?mid=44)

The first municipal "water pumping installation" in Finland was founded in Tampere 1835. (Voionmaa 1929, 481) The high-pressure facility 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. (Juuti & Katko 1998, 9–72; Juuti 2001, 182–90)

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. (Katko 1996, 45, 102)

At the beginning, towns were like a farmhouse on a grand scale with pigs and cows. As the city grew, rural living habits began to disappear and the city began to lose its metabolic ties with the surroundings. Nutrients were no longer put back into circulation, for instance, to be eaten by pigs or to improve the soil. Instead, they were removed as refuse and deposited in rubbish heaps, dumps, and only later, in the water systems along the sewers. When there was no network of sewers, wells started to become polluted, and there was no longer enough pure water for people. Polluted water and unhygienic living conditions created a favourable environment for epidemics, like the typhoid fever. The same sequence of events occurred also in several other European cities.(Rasila 1984, 131)

The evolution of sewerage began with free-flowing ditches flowing through tows. As years went by the ditches were straightened, opened and covered. These measures, however, proved to be insufficient and the dirt and filth continued to spread. The exacerbated problem forced the decision makers to work out a plan for underground sewerage following the hygienic reform started in England and personified by W. Chadwick. (Hamlin 1998) A transition from the bucket system to the protosystem thus began.

When the growth of the city accelerated due to industrialisation, problems began to accumulate: there was not enough water and what little there was, was of a poor quality. A discussion about changing this bad situation started.(Juuti 2001, 67–70) The construction of sewers was a way to get rid of this. Thus, the model came directly from England, not from any other city in Finland. (Minutes of the city administrative court 30.1.1867; Porter 1999, 79–82; Juuti 2001, 70–71)

First waterworks in Finland

The 1879 public health decree obliged the city to prepare a plan for a sewer system commensurate with the estimated population within 10 years. The city administrators took seriously the deficiencies in sewerage and the demands of the government: starting in the early 1880s the municipal health board repeatedly exhorted the city to expand and upgrade their sewerage system. At the end of the 1880s, the Finnish people followed closely the development of the bacteriological revolution and hygienic reform started in England. Slowly the miasma theory began to lose ground. (K.F.M. in Duodecim 1885, number 6–7, pp. 66–73, number 8–9, pp. 92–131; Terveydenhoitolehti 1897, numbers 1, 3, 6, 8–9; Juuti 2001, 85–87) In this phase, discussion about the water question also started to become livelier. Frequent fires and the various epidemics gave city officials and inhabitants the determination needed to establish water and sewerage systems. For example in Hämeenlinna there were many big fires in 1900s.

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. Security was essentially increased when a regular fire brigade was founded in case towns. The lack of water pipe had also caused various other difficulties, extra work and trouble. After the founding of the waterworks, it was a great relief for the city’s inhabitants not to have to carry and transport water and also to get rid of the extinguishing duty after a transition period. This increased the comfort and security of the inhabitants. In Finland this quite long process also improved, after some setbacks, the sanitary situation and the appearance of the town areas.

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, 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. (Katko 1996, 52; Juuti 2001, 141–164)

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 familiarise themselves with the foreign solutions. (Hietala 1987)

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. (Koskinen 1995, 54–55, 64, 77; Juuti 2001, 140–164, 182–185)

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 protosystem in Tampere: in Lahti the wastewaters from the entire planned city area were treated already in 1910. The facility in Lahti was the most advanced in Finland then. The systems in Hämeenlinna and Turku also surpassed the one in Tampere in most areas since they were using safer groundwater. (Aamulehti 16.4.1915; Koskinen 1995, 54-55; Juuti 2001, 140-164, 182-185)

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. In Hämeenlinna the committee preparing the plan for the waterworks followed the principle of not forcing the facility on the public. It thought that the importance and necessity of the facility were so well known that no discussion was needed. This nearly destroyed the whole plan. With hindsight it can be said that the importance and necessity of the waterworks were not a big enough factor to sell it, at least, to the local newspaper *Hämeen Sanomat*. (Juuti 2001, 155–164)

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. (Minutes of the city council 25.5.1887; Juuti 2001, 90–100)

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 as is typical of protosystems. Luckily wastewaters were not used for irrigation like in Germany and France at that time. (Reid 1991) This kept the groundwater unpolluted. In 1917, the year of Finland's independence there was 16 waterworks in the country. (Juuti 2001, 182–85)[3]

[3] The inhabitants of the peripheries were not necessarily in a worse position than the inhabitants of city centre. The peripheries relied for long on wells and latrines. For instance, in the suburb of Pispala, people organised water distribution based on a clear protosystem managed by a local cooperative. They largely escaped the great

Industry needed vast amounts of water while the city water supply was still at the bucket system level. The biggest factories built their own proto-level systems. The actions, on the whole, were initiated by demand. The waterworks were born as a solution to the water question after long discussions, often after various, inadequate and temporary solutions. In terms of quantity there was enough water, and the selected technological, administrative and economical solutions were also successful. The well-being of people improved compared to the earlier situation and equality between them increased as waterworks expanded and better quality water slowly reached also working class people.

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 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. (Juuti & Katko 2007)

Porvoo

Porvoo is assumed to have been 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. The name originates from the Swedish word Borgå (borg = castle, å = river). Since 1913 Porvoo City Water Works has been operating as a municipal utility with economic autonomy. (The initial case study was Juuti, Rajala & Katko 2003)

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 19^{th} 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. Old Porvoo is famous for its narrow lanes and brick-red riverside warehouses. The low wooden houses in the Empire-style part of the

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typhoid epidemics in Tampere, mostly due to their isolation. A somewhat similar case occurred in 1892 in Altona-Hamburg, in Germany where people living in adjoining areas were saved from cholera depending on whether they drank treated or untreated water. A system does not necessarily have to be of a high technical level, if the water source is protected or isolated. But surface water must be treated. Evans 1987, 189-192, 289-299.

city were built according to the classical town plan based on blocks. The home of Finland's national poet, Johan Ludvig Runeberg, one of Porvoo's most popular tourist attractions, lies there. (http://www.porvoo.fi/en/enytporvoosta/index.html)

Documents mention *Porvoo Parish* already in the early 14th century. 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 Rehtorin lähde (Headmaster's spring) at the corner of Vuorikatu and Rihkamakauppiaankatu streets was considered the only source of good water in town in the 18th century. Another well-known public well was the Brakan luukku (a covered well). (Mäntylä 1994, 326)

Figure 8. Public well from Porvoo, late 1800s. (Photo: Petri Juuti)

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 organising 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 theory according to which humidity and dirty air spread disease. Yet, this belief for its part also facilitated the introduction of sewerage. (Juuti 2001, 67–69, 97, 138–141)

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 organisation of water supply was speeded up by the poor quality and shortage of well water and the need for fire-fighting water.(Mäkelä-Alitalo 2000, 194, 215; Juuti 2001, 62–63, 66, 70, 90)

Figure 9. Public well from Porvoo, late 1800s. (Photo: Petri Juuti)

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. (Öfversikt öfver… 1914, 77–87, 111, 116, 126, 144, 177–178)

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. (Öfversikt öfver…1914, 280–284, 293–294, 300; Juuti 2001, 151; Katko 1996, 368)

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. (Borgåbladet, 16.1.1913, 9.1.1913, 25.2.1913, 4.3.1913, 17.3.1913, 15.11.1913, 20.12.1913, 12.3.1914, 14.3.1914)

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. Thus, progress from the bucket system to a proto system began. Development of a sewerage system was well on its way even though a wastewater plant was not yet built along with the waterworks.(Juuti, Rajala & Katko 2003, 59–86)

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. (Waterworks, annual report 1913–1923; Juuti, Rajala & Katko 2003, 59–86)

If a house owner wanted to connect to the city's water supply in 1913, he had to submit a written application. 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 read as follows:

> Each plot to which water is led is to have its own pipe extending from the street pipe to the water meter. 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. (Regulations 1913; Juuti, Rajala & Katko 2003, 319-350)

Since the beginning water fees were charged based on the readings of the city's meters. The waterworks ordered the meters to be installed where

> basic and surface water cannot penetrate into the dial housing to obstruct its reading, the meter is not exposed to subzero temperatures or other harmful influences, and the meter is accessible enough to allow attaching, reading

and removing it without hindrance. (Regulations 1913; Juuti, Rajala & Katko 2003, 319-350)

If a house owner doubted the accuracy of his water meter, he could ask the waterworks to check it. If the reading error was less than five per cent, the house owner had to pay the costs of inspection. This rule is still in force over 90 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 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 metres per inhabitant. In 1952 connections numbered 520 and consumption was up to 38 cubic metres 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. (Regulations 1913; Waterworks, annual report 1913–1914, 1940–1945, 1952; Juuti, Rajala & Katko 2003, 59–86)

In the first half of the 20th century the water supply of Porvoo rural district de-pended on private wells. Alongside them the largest water consumers started to build their own modest water pipes. Water shortage encouraged cooperation between inhabitants. This led later to consumer-owned and administered water cooperatives and common wells. The rural district concentrated on supp-lying water to its own institutions and offices in the early 1900s and maintained a few public wells and latrines. (Porvoo rural district, annual report 1964–1969)

In the early part of the 20th century public health requirements gradually tightened and the importance of hygiene was stressed. Well water quality was monitored closely, for instance, at schools. Deficiencies were remedied quite promptly. Yet, the state of the environment deteriorated badly in places due to the high increase in living standards and the spread of flush toilets among other things. For instance, in 1969 the board of health noted that the water bodies were polluted to such an extent that only a few beaches had water that was safe to swim in. (Porvoo rural district, annual report 1969–1975)

The water supply and sewerage system of Porvoo rural district has made use of the expertise and services of authorities, other water utilities and the private sector from the beginning. For instance, water analyses were commissioned from Porvoo City Laboratory among others. Designs and construction work were commissioned from companies. Intermunicipal cooperation in water supply and sewerage was also practiced at one time with the City of Porvoo. At first, the rural district bought water from the city's waterworks. When the Saksanniemi waterworks of the rural district became operational in 1975 the roles switched and the district supplied water also to the city. The Päijänne Water Tunnel was among the most prominent projects of intermunicipal cooperation in the metropolitan area. The rural district took part in its financing in order to secure the raw water needs of the petrochemical industry. (Christiernin 1934; Waterworks, annual report 1913–1927)

The new Linnanmäki water intake plant was finished in January 1923. A concrete well 8 metres deep was dug in Linnanmäki, and the water was pumped by two large centrifugal pumps to the city through a six-inch cast iron pipe 610 metres 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 per cent, and the next year 87 per cent, 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. (Waterworks, annual report 1944–1966; Juuti, Rajala & Katko 2003, 203–239)

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. Because a wastewater treatment plant was not built initially, domestic wastewaters loaded the environment. 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 Increased population and a higher living standard were a danger to the environment and people's health also in the rural district: e.g. in 1968 only half of the wells contained water of good quality and the swimming waters were polluted. The situation in the rural district started to improve slowly after the first Hermanninsaari wastewater treatment plant started operating in 1974.

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 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.

Table 2. Key organisational changes related to Porvoo water and sewage works, 1912-2003

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 techical 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

Conclusions:

Okun 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. (Okun 1977, 4–7)

When we compare 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 utilised 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 in Johannesburg experts had to be called outside because of the sudden birth of town. 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. *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. An exception were public standposts, which had been in use for tens of 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, utilisation 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 Johannesburg they used at first surface water, then when the local streams were polluted or utilized underground sources like Zuurbekom were taken in use. Final solution however was to begin to take surface water from the Vaal River. Durban has used from the beginning surface waters from the local rivers.

These principles are mainly related to the city water supply and sanitation. Bigger industries have traditionally had their own systems although they used to have some connections to the city water works at certain stage.

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 seven key conclusions can be drawn:

1. Surface water was initially taken from nearby sources, and as these became contaminated, from farther away. The utilisation 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.
7. The development has not been straightforward from bucket system to modern systems. There have been several transition periods and even many systems in same time.

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.

Examples of successful and durable solutions in water supply are nevertheless 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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9. Water and Health
– From ancient civilizations to modern times

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Introduction

Water is life – and life on earth is linked to water. Our existence is dependent on water – or the lack of it – in many ways, and one could say that our whole civilization is built on the use of water.

This paper summarizes the general outline and some of the main results of two academic, multi- and cross-disciplinary projects, GOWLOP-project and Environmental History of Water –project by Petri S. Juuti, Tapio S. Katko, and Heikki S. Vuorinen. Special emphasis is given to the first urbanization of ancient civilizations focusing on ancient Greece and Rome (Vuorinen 2007).

Figure 1. Roman aqueduct in Segovia, Spain (Photo: T. Katko).

Early Innovations

Modern humans (Homo sapiens) have dwelled on this earth for some 200 000 years, most of that time as hunter-gatherers and gradually growing in number. Approximately 50 000 years ago modern man began to inhabit every corner of the world and people were constantly on the move. Occasionally people were troubled by pathogens transmitted by contaminated water, but general aversion for water that tasted revolting, stunk and looked disgusting must have developed quite early during the biological and cultural evolution of humankind. It has been postulated that the waterborne health risks of hunter-gatherers were small.

In reconstructing the history of water and sanitation of this hunter-gatherer phase, we have to rely on analogies with later societies. Modern anthropological studies and recorded mythologies of indigenous peoples play an important role in these analogies while observing primates and other more evolved mammals can also give us useful information. However, archaeological and written sources concerning water and sanitation can be found only on relatively recent times.

Humankind established permanent settlements about 10 000 years ago, when people adopted an agrarian way of life. This new type of livelihood spread everywhere and the population began to expand faster than ever before. Sedentary agricultural life made it possible to construct villages, cities and eventually states all of which were highly dependent on water. This created a brand new relation between humans and water. Pathogens transmitted by contaminated water became a very serious health risk for the sedentary agriculturists. This was a world in which guaranteeing pure water for people became a prerequisite for successful urbanization and state formation.

The earliest known permanent settlement, which can be classified as urban, is Jericho from 8000–7000 B.C., located near springs and other bodies of water. In Egypt there are traces of wells, and in Mesopotamia of stone rainwater channels, from 3000 B.C. From the early Bronze Age city of Mohenjo-Daro, located in modern Pakistan, archaeologists have found hundreds of ancient wells, water pipes and toilets. The first evidence of the purposeful construction of the water supply, bathrooms, toilets and drainage in Europe comes from Bronze Age Minoan (and Mycenaean) Crete in the second millennium B.C.

The experience of humankind from the very beginning testifies to the importance and safety of groundwater as a water source, particularly springs and wells. The way in which water supply and sanitation was organized was essential for early agricultural societies. If wells and toilets were in good shape, health problems and environmental risks could be avoided.

The realization of the importance of pure water for people is evident already from the myths of ancient cultures. Religious cleanliness and water were important in various ancient cults. The first known Greek philosophical thinkers and medical writers also recognized the importance of water for the health of people.

Water and Health in Ancient Greece and Rome

The first urbanization in Europe occurred during antiquity (500 B.C. – 500 A.D.) around the Mediterranean region. By the birth of Christ the share of urban population reached some 10–20 % and the most urbanized areas were the Eastern Mediterranean, Egypt, North Africa (modern Tunisia), the Apennine Peninsula (modern Italy), and the southern part of the Iberian Peninsula, most of which were areas of quite modest rainfall. In this period the archaeological and written sources become richer, and consequently improve our possibilities to study the relationship between water and health of people (Vuorinen 2007).

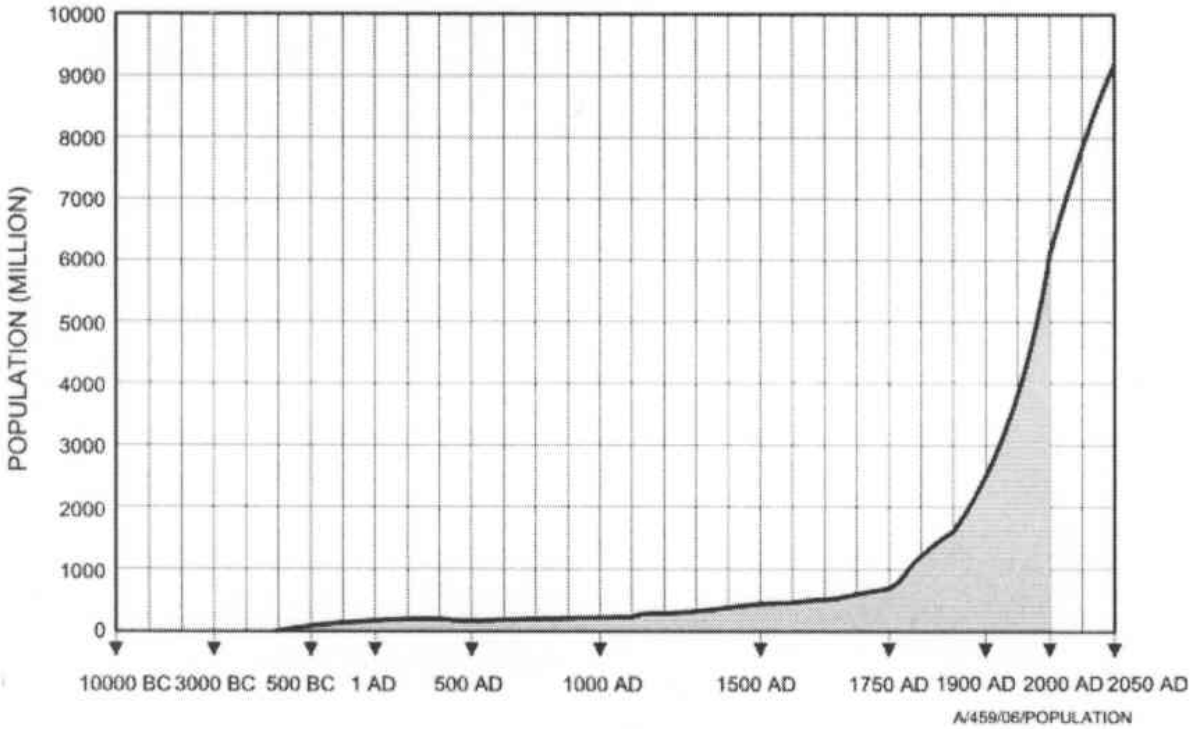

Figure 2. Estimated human population growth from 10 000 B.C. until year 2050. Population grew from around 6 millions in 10 000 B.C. up to 200–300 millions by the birth of Christ. (Juuti et al 2007, 13)

Alcmaeon of Croton (floruit ca. 470 B.C.) was the first Greek doctor to state that the quality of water may influence the health of people. Hippocratic treatise *Airs, Waters, Places* (around 400 B.C.) deals with the different sources, qualities and health effects of water in length. Various other Hippocratic treatises (mostly written around 400 B.C.) contain short comments on the influence of water on the health of people.

The quality of the water was examined by the senses: taste, smell, appearance and temperature. Also the health of the people and animals using a water source was considered. Throughout antiquity tasty or tasteless, cool, odourless and colourless water was considered the best, and stagnant, marshy water was avoided. These ideas were held until the end of antiquity. The ancient Greeks and Romans were also quite aware of the dangers of water coming from hills and mountains where mining was practiced.

The ancient authors have thus made some comments about the influence of different kinds of water on the health of people, but had these comments any influence on the health of people is hard to infer. Because of the inadequacy of sources, it is practically impossible to evaluate the health of ancient populations and the role of water in it. It is, however, quite safe to conclude that despite the impressive measures used to obtain pure potable water, urban centres had serious public health problems. The ancient Greek or Roman society did not have the interest or the means to deal adequately with matters of public health (Nutton 2005, 26).

The Greeks and Romans used different methods to improve the quality of the water if it did not satisfy their quality requirements. From written sources and archaeological excavations, we know that using settling tanks, sieves, filters and the boiling of water were methods used during antiquity. At least boiling of water, which was widely recommended by the medical authors during antiquity, would have diminished the biological risks of poor quality water. Although the boiling of water might have been feasible from a hygienic point of view, it was ecologically and economically not feasible in extensive use since firewood and other combustibles would sooner or later have become a scarce resource around the Mediterranean.

The poor level of waste management, including wastewater, most probably involved a major risk for public health during antiquity. For instance, toilet hygiene must have been quite poor. The abundance of water that was conducted to the bath could also be used to flush a public toilet. The Romans, however, lacked our toilet paper. They probably commonly used sponges or moss or something similar, which was moistened in the conduit in front of the seat and then used to rinse their bottoms. In public toilets facilities were common to all; they were cramped, without any privacy, and had no decent way to wash one's hands. The private toilets most likely usually lacked running water and they were commonly located near the kitchens. All this created an excellent opportunity for the spreading of intestinal pathogens.

Water-borne infections must have been among the main causes of death. Dysentery and different kinds of diarrhoeas must have played havoc with the populations. Although the ancient medical writers described different kinds of intestinal diseases, the retrospective diagnoses are difficult and the causative agents cannot be identified. Summer and early autumn, when water resources were meagre in the Mediterranean world, must have been a time when drinking water was easily contaminated, and intestinal diseases were rife as presented e.g. in several passages in the Hippocratic writings. The mortality of children, especially recently weaned, must have been high.

It should also be kept in mind that the salubrity of the water supply must have differed markedly in accordance with the social status of people in the Roman towns. The rich had running water in their homes; the poor had to fetch their water from public fountains. The rich had their own baths and toilets, while the poor had to use public toilets and baths. All this must have caused differences in the health of rich and poor people.

A lot of the water in a Roman town was consumed in bath(s) connected to the aqueduct(s) (Figure 1). Ideally shining marble walls and limpid water were considered a feature of a bath in Rome, the cleanliness of which was watched over by aediles. Baths were probably also beneficial for public health in towns where there was an abundance and rapid turnover of water. However, in towns where water was in short supply, cisterns had to be used and the turnover of water was slow, the role of baths was probably negative for public health.

Water supply and sanitation for military needs was a primary concern of the authorities of an imperial power like the Roman Empire needing a strong military machine. The Romans did know how to obtain adequate amounts of drinking water for their garrisons, cities and troops in the field and thus successfully planned their operations according to the availability of water. Army veterans were well accustomed to baths and to an ample water supply during their active service, and they may have been a quite important pressure group for building an aqueduct and bath in a town.

The contamination of water by lead has been a topic in the discussions concerning the health of people in Roman times. Roman authors expressed doubts concerning the use of lead pipes and recommended the use of ceramic pipes. However, in practice it seems that although ceramic pipes were used, water was in many situations routinely distributed by lead pipes, as revealed by both written sources and archaeological remains. Yet, there are two reasons to believe that exposure to lead through water was quite minimal. Firstly, as a consequence of the quality of the water, a calcium carbonate coating separated the lead and the water in most cases. Secondly, because of the constant flow, the contact time of water in the pipe was too short for contamination by lead.

The indirect public health effects of water might have been greater than the direct effects during antiquity. Agriculture depended on the proper amount of available water. Droughts and floods led to food shortages and famines. Food, people and pathogens moved most easily by water during antiquity. Maritime trade was especially vigorous around the Mediterranean in the period 200 B.C. – 200 A.D. This meant that the Mediterranean world became more or less a common pool of infectious diseases. Two important diseases caused by parasites were intimately connected with water and the ways water was managed during antiquity: malaria and schistosomiasis.

The breeding of mosquitoes depended on water and mosquitoes spread malaria, which was a serious and widespread health problem around the Mediterranean during antiquity. Malaria was well documented by Greek and Roman medical authors from the Hippocratic writings onwards.

Schistosomiasis (bilharzias) has been for millennia a scourge in Egypt. The parasite (blood-vessel inhabiting worms) has an intricate relationship between the human host and a snail intermediate host. The type of agriculture (irrigation, flooding of the Nile) must have spread the disease. Although the evidence from ancient Egyptian medical papyri remains hard to interpret, there is strong paleopathological evidence of schistosomiasis in human remains from ancient Egypt.

Romans knew well that a water system needed constant maintenance to function efficiently. For instance, calcium carbonate incrustation that formed inside the conduits needed constant removal, otherwise the flow of water would eventually stop. In Italy aqueducts and baths seem to have been maintained even after other monumental buildings in the towns, with the exception of town walls and palaces, fell into disuse in late antiquity (Ward-Perkins 1984, 31, 128). In Antioch and other Near Eastern towns, at least part of the ancient water system was maintained into the Byzantine period and possibly up to the Era of Islam (Kennedy 1992). Although there were continuities from antiquity to the Middle Ages, the water supply was more limited and the Christian water patronage replaced the classical one: it was a move from luxuria to necessitas (Ward-Perkins 1984, 152).

Second Urbanization: The Long 19th Century

After the fall of the Roman Empire, water supply and sewage systems experienced fundamental changes in Europe. Medieval cities, castles (figure 3) and monasteries had their own wells, fountains or cisterns. Usually towns built a few modest latrines for the inhabitants, but these were mostly inadequate for the size of the population. The lack of proper sanitation increased the effects of epidemics in medieval towns in Europe.

Figure 3: Privy attached to tower of Olavinlinna Castle, Finland.

Fundamental changes began to appear: science and knowledge were institutionalized for the first time when the development of modern universities started in the 13th century, and the agricultural world set out to industrialize from the 18th century onwards. Consequently, the growth of world population increased (Figure 2). All this profoundly affected water supply and sanitation.

Along with the industrialization and urbanization of the Western world, enlightened people were fascinated with the idea of progress. Ever since the 18th century, science and reason were considered to be able to lead humankind towards an ever-happier future. This was the period when the first actual water closet was developed. By 1900, the water closet became a generally accepted cultural necessity in the Western world – the same way aqueducts had been in the Roman Empire. The water closet was seen as a victory for public health without any consideration for where the human excreta went through sewer pipes.

The start of industrialization and the related growth of cities created a situation where public health and environmental problems overwhelmed city governments to a greater degree than before, and novel technology was often seen as the solution. In the 19th century, Great Britain was seen as the forerunner of modern water supply and sanitation systems, but the innovations soon spread to Germany, other parts of Europe, USA and later also elsewhere.

Sanitation in towns around Europe was one of the great achievements of the 19th century. During the century the role of water in the transmission of several important diseases – cholera, dysentery, typhoid fever and diarrhoeas – was realized. The final proof came when the microbes causing these diseases were discovered. Especially cholera served as a justification for the sanitary movement around the world in the 19th century.

Sensory evaluation of water quality was complemented with chemical and microbiological examination. During the 19th century, filtering of the entire water supply of a town was introduced and the systematic chlorination of drinking water started in the early 20th century. The discovery of microbes and the introduction of efficient ways of treating large amounts of water paved the way to an era in which the public health problems caused by polluted water seemed to belong to history.

Urban Iinfrastructure in the 1900s

The 1900s was a period of extensive population growth –the global population about quadrupled while the urban population increased 13-fold (Figure 2). By 2000 A.D., in almost every country, over half of the population lived in urban areas. During the century industrial production increased 40-fold and the consumption of energy by a factor of tens. Water and sanitation services had a definite role in this rapid socio-economic change of the entire globe.

In the early 20th century the health problems associated with water pollution seemed to have been resolved in the industrialized countries when chlorination and other water treatment techniques were developed and widely taken into use. Microbiological problems related to water were largely considered a problem of the developing world. However, in the late 20th century the biological hazards transmitted by water emerged again in the post-modern Western world. Anxiety about chemical and radioactive environmental hazards and their impacts on human health mounted in the 1960s. The overall amount of known biological and chemical health hazards transmitted by water increased manifold during the last half of the 20th century.

In today's world around 10 000 people die every day due to diseases like dysentery, cholera, and various diarrhoeal diseases, caused by a lack of safe water and adequate sanitation. Yet, since most of those who die are children and old people, whose death is considered "natural", or people who are more or less marginalized in their societies (e.g. refugees, the poor) or living outside areas that are important for the global economy, mortality due to these waterborne diseases is too often considered unavoidable.

Future Challenges

In the historical context, the growth of urban centres has been a continuous and even an escalating trend. Many of these centres are today located in developing economies, while the ensuing problems are concentrated on the poorest people – as always. The most severe constraints include poor living conditions, a lack of democracy, poor hygiene, illiteracy, corruption and a lack of proper water and sanitation services. Especially women and children suffer from these constraints.

Today there is a global shortage of potable water. When making fundamental decisions concerning water supply and sewerage, it is also necessary to be ready to make big investments. Services that are now at a high operational level were not achieved easily and without massive inputs and efforts. This is something to keep in mind when assessing future options and considering required strategies.

The level of water supply and sanitation in a society is not necessarily bound with time and place as much as the capability of that society to take responsibility for developing the living environment of its citizens and proper policies. In some cases, the situation was even better earlier than nowadays. Decisions have been made concerning water and sanitation systems – e.g. the universal acceptance of the water closet as a cultural necessity – that through path dependence have limited future options. There have also been situations where the choice of a technology has been regarded as problematic from the first beginning but has been chosen anyway. For instance, lead pipes were considered hazardous for health already in antiquity but continued to be used in house connections until recently.

Water supply and sanitation systems have always required continuous maintenance and adequate rehabilitation. This was already evident with the Roman aqueducts: calcium carbonate incrustation forming within the conduits needed to be removed constantly or it would have stopped the flow of water. The same is true for modern systems: they must be maintained to function properly.

In the historical context, we can see both a continuation and a change in the perception of good quality drinking water and waterborne health hazards, which are both highly dependent on the scientific and technological level of a society. The importance of good quality drinking water for urban populations was realized already in antiquity. Yet, the importance of proper sanitation for the health of townspeople was not understood until the 19th century. The building of “modern” urban sewerage systems started in Britain and rapidly spread all over the globe.

The availability of water in large quantities has been considered an essential part of a civilized way of life in different periods: Roman baths needed a lot of water as does the current Western way of life with water closets and showers. Particularly high rates of water use occur when it is not properly charged for. Evidence indicates that as soon as water and wastewater are charged based on real costs, wastage diminishes remarkably.

There are numerous development paths that water supply and sanitation can take. From the point of view of the wellbeing of man and the environment, it is essential that water is good and safe – regardless of whether it is from piped systems or point sources like wells. The same applies to sanitation — it is a question of being connected either to the sewer or using proper on-site sanitation solutions. Local conditions, traditions and people have to be in the core of decision making when future solutions are considered. In the long historical perspective, it is evident that regardless of the political system, good local solutions can be found based on local conditions, needs and traditions. Although water – and particularly water services – is largely dependent on local conditions, it is useful to make comparative studies between various regions and cultures, and identify possibly applicable and replicable principles and practices.

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Governance of Water and Environmental Services in Long-term Perspectives – Epilogue

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Supervisor Antti Korkeamäki, who has worked for almost 40 years for the water works in Vaasa, Finland, has a word of advice for future piping supervisors:

> ”Devote yourselves to your work; it is not a piece of cake. You must know the network and anticipate needed renovations; the city must also be familiar to you. Command of a person's mother tongue helps establish a relationship with him. Renovation of networks and personnel's coping at work are the key challenges of the future. A decision has to be made promptly when the situation so requires – contemplation is out of the question."

These words are a good guideline for the future also more generally.

South Africa was not as advanced as Great Britain or Germany since only 24.7 per cent of her inhabitants lived in towns in 1911 (Wilson & Thompson 1975, 173, Table I). At that time the total number of people living in towns was 429,937 out of a total population of 2,943 million: thus only 14.6 per cent of Finns were living in towns (Statistical Yearbook of Finland 1952, 8, 10).

Except in some cases in South Africa and Finland, water supply was a major problem for the settlements while rapid economic development and urbanisation made it possible and necessary to introduce modern water supply and sanitation systems. It may seem odd to speak about the lack of good water in the case of Finland because of the large number of lakes and rivers. The same applies to Nepal, which is rich in water resources, but water is not necessarily available where the people live. Carrying of water for long distances in a mountainous country is today's reality; the bucket system is used also in the Kathmandu Metropolitan area.

The removal of the constraints to water and sanitation service production and the inefficiency of sector organisations 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.

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. In its recent White Paper on Good Governance the *European Union* recognises five key principles: *(i) openness (ii) participation (iii) accountability (iv) effectiveness, and (v) coherence*. Even in "conventional hydrology" we can *see reconsideration* of focuses and expansion of conventional water management towards wider institutional and management issues and further to governance questions.

The overview of the recent Human Development Report 2006 (UNDP 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.

The problems of governance were also dealt with in the World Water Development Report 2006 involving 24 United Nations organisations and bodies. The report states, for instance, the following: Many of the solutions to water problems lie in better governance. Water is central to promoting socio-economic development, protecting the environment, and achieving the Millennium Development Goals (MDGs). Yet, few lower-income countries make water a key feature of their national planning and budgets. Mismanagement of water is widespread, characterised by lack of integration, sectoral approaches, and institutional resistance to change by large public agencies in a context of increasing competition. Only a minority of local authorities and water associations have the resources needed to carry out the responsibilities delegated by central governments.

D. Okun, a grand old man of water management, mentions five principles of sustainable water supply: (i) The uniqueness of water projects, (ii) Efficiencies and economies of scale, (iii) Integration of water supply, sewerage and pollution control services, (iv) Sound financial policies, and (v) A preference for pure rather than polluted sources of potable water (Okun 1977, 4–7).

At least the first and second principles of Okun seem to be applicable to the studied cases. Local expert knowledge was amply utilised, and tailored to Finnish conditions. The expertise of several Finnish key water-sector experts was used in establishing water works in various places around Finland. Thus, the projects were carried out with the help of a wide network of experts. The expertise was utilised and adapted to the conditions of cities. In Nepal, due to geographical and ethnic/caste diversity, each water project is unique, calling for dynamic approaches both in terms of technology and related institutions.

The second principle applies to several small-scale water cooperatives in Finland that are buying bulk water from a city water works. A joint water and sewage works covering a large area with a dispersed population would, however, be too expensive. Existing joint works operate only in their own areas leaving sparsely populated areas out. The other issue – economies of scale – is obviously true only in the case of high or constant population density, and therefore does not apply to wider dispersed areas.

The monitoring of the condition of the environment 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 assured that good quality water was provided to inhabitants.

Water charging, according to Okun's fourth principle, was based on metered consumption from the beginning in Finland. This allowed rational development of the works which, in the light of examples, would likely have failed with different charging principles. An exception were public stand posts, which were in use for tens of years for a fixed charge. For example, the Hämeenlinna and Porvoo waterworks operated this service at a loss, but it introduced equality into water distribution before the piped network reached the working class neighbourhoods. In Nepal pollution control is just taking its first steps as people in urban areas are becoming increasingly aware of the problems caused by both liquid and solid wastes. Latrine coverage is still among the lowest in Southeast Asia.

The fifth principle, utilisation of groundwater, was the right solution for Vaasa and Hämeenlinna in Finland in light of what was known then. The later problems with iron in Hämeenlinna showed that solutions that initially appear indisputable are not necessarily sustainable over the long term, but one must always be prepared for changing situations. In Porvoo the later problems with iron and salt proved the same point. In Nepal drinking water quality has finally attracted interest due to publicity of the arsenic problem in the plain areas. Yet, water quality laboratories remain far and few between. Another question is that any larger good quality ground water deposits in Finland lie far from cities and their use must therefore be considered case by case.

Based on the developments in all the different countries, the following six conclusions can be drawn:

1. Surface water was initially taken from nearby sources, and as these became contaminated, from farther away. The utilisation of groundwater started later, while artificial groundwater will likely be produced in the future.
2. Wastewaters polluted the nearby surface water bodies until their efficient treatment started at a relatively late date. Industries started to treat their wastewaters later by increasing co-operation with the waterworks when the time was ripe.
3. When the increase in 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 water and sewage utility has played, and will continue to play, a key role in all cases.
6. Governance was a problem in all cities to some extent in the early phase.

The models and the knowledge in support of the various solutions are based on findings from the case countries: Kenya, South Africa, Nepal and Finland, as well as other findings from abroad. The perception of the determining role of capital, even the perception of it as a precursor in this sector, seems to be misleading, if not totally incorrect. Capital has, of course, played an important, but not necessarily the only and central role.

In Nepal the strategic decisions made over the years had certain common themes which have been repeated since ancient times and included in development plans since the First Five Year Development Plan. They included decentralisation, participation in village development, importance of agriculture and irrigation, hydro-power potential and acknowledgement of the high morbidity and mortality from such water and sanitation related illnesses as diarrhoea. The health concern has been a key driver since the 1950s. Water turned into a social problem in the early 1970s when there was a new emphasis on basic needs. Decentralisation as a concept has evolved since then, and its functional application to democratic local development is yet to be proven. However, as a theme it continues to be a key driver together with various political agendas. Regional disparities remain drastic. The present conflict has its roots in the inequity and poverty.

The growing cities of developing countries seem to be, at least to some extent, repeating the same patterns in building their water systems as Finland and South Africa followed earlier. First, they build a water pipe to replace wells and the *bucket system*, then sewerage to replace ditches. The systems were and are usually *protosystems*. Earlier diseases like cholera and, especially typhoid fever, often plagued growing cities – more currently they have been replaced by other water-borne and -related diseases. The excessive use of water, the lack of maintenance, etc. also cause problems. Only after the occurrence of problems like these are systems built that guarantee good quality of water, and only thereafter – usually after yet further problems – a *modern* wastewater treatment plant. As time passes the infrastructure ages and is likely to become the biggest future challenge.

The situation was not totally the same in all case countries, but the following past key decisions, that limited future development options, were made in all countries:
1. WC or dry toilet or bucket system
2. Combined sewer system or separate system
3. Surface water or ground water
4. Low or high pressure levels of water network
5. Treating sewage or not
6. Chlorination & water treatment or not
7. Public ownership or private
8. Ambitious plans or political reality
9. Formal institutions and/or informal institutions
10. Hierarchy / networks within networks (centralised / decentralised), both in terms of technology and in terms of institutional arrangements, decision making, the roles & responsibilities of the various stakeholders at different levels.

Examples of successful and durable, or rather sustainable, solutions in water supply nevertheless exist. 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. This may even apply to a certain extent to some transition economies.

The underlying overall factors are the same in all cases: rapid growth of cities and inadequate resources. Yet, this is not in contradiction with the fact that many solutions of water and sanitation services are tailor-made and thus depend on local conditions.

Developing countries seem to face largely similar problems and challenges especially in governance. It would certainly be useful to try to learn from previous mistakes – many of them being strategic in nature – rather than to repeat them. At the same time, so-called developed countries could also remember that their own systems do not provide proper services to everyone and that water pollution control and operation, maintenance and rehabilitation of their systems is far from perfect. Besides, they should put more effort into serious cooperation in the water sector. The acute need for improved water supply and sanitation faces our entire global village today.

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