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Evolution of water and sewerage services in Hämeenlinna, Finland, 1800-2000

ABSTRACT

This paper aims at discussing key long-term strategic decisions and changes concerning the evolution of water and sanitation services in Hämeenlinna, Southern Finland. After a debate of three decades the construction of the water and sewage works was completed in 1910. In the early 19th century the hygienic conditions in Hämeenlinna were poor since the city was densely built-up and “half marshland, half surrounded by lakes with muddy shores where water flowed so slowly that it appeared to stand still”.

Groundwater from the Ahvenisto esker area instead of a lake was selected as the raw water source. Water consumption increased rapidly in the 1950s and a surface water plant on Lake Katuma was constructed in 1955, doubled in 1960 but taken out of use 1980. Since 1976 artificial groundwater has been used. The Paroinen wastewater treatment plant began its operations in 1966 as an activated sludge plant. In addition to Hämeenlinna’s own wastewaters, the Paroinen plant has also purified the wastewaters of Hattula, the neighbouring municipality, since 1974.

A supra-municipal water and wastewater services joint-stock company owned by Hämeenlinna Town and neighbouring municipalities, Hämeenlinna Region Water Supply and Sewerage Ltd., was established in 2001. In 2007 the company takes care of water services in the Hämeenlinna region. Water supply is fully based on groundwater or artificial groundwater.

KEY WORDS

Water supply, sewerage, evolution, services, environmental history, Hämeenlinna, Finland

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TIIVISTELMÄ

Hämeenlinnassa olosuhteet 1800-luvun alkupuolella olivat hyvin huonot. Kaupunki oli rakennettu hyvin taajaan ja se oli lisäksi puoliksi liejurantaisen veden ympäröimä. Vuoden 1831 suuri tulipalo hävitti yli puolet kaupungin rakennuksista. Suurtuhon jälkeen tontteja laajennettiin ja taaja rakennuskanta poistui. Ensimmäisen toteutetun vesilaitos- ja viemärintisuunnitelman teki insinööri Hugo Lilius vuonna 1908. Vedenotto paikaksi valittiin Ahveniston järven eteläpuolella oleva Ämmänsuo-niminen notko, jonka alla oli todettu olevan riittävästi pohjavettä. Yhdessä vesilaitoksen kanssa valmistui myös viemärlaitos vuonna 1910. Valmistuessaan Hämeenlinnan vesi- ja viemärlaitos oli järjestyksessään kahdeksas Suomen kaupunkien vesihuoltolaitoksista.

Vedentarpeen lisääntyessä Ahvenistolle rakennettiin kaksi kuilukaivoa vuonna 1942. Vuonna 1953 veden kulutus nousi lähes 20 prosenttia. Tällöin päätettiin rakentaa Katuman pintavesilaitos, joka otettiin käyttöön vuonna 1955. Ahvenistolle rakennettiin kolme uutta kaivoa 1966, mutta pohjaveden otto harjasta oli vähitellen laskenut pohjaveden pintaa. Asiaa tutkittiin ja 1976 rakennettiin Alajärven tekopohjavedenotto. Tällä tavoin saatiin harjualueen pohjaveden pinta kohoamaan ja vedenottoa Ahvenistolla voitiin lisätä. Katuman pintavesilaitos jäi varalaitokseksi vuonna 1980. Paroisten jätevedenpuhdistamo aloitti toimintansa vuonna 1966 biologisena aktiivilietelaitoksena, jonne ryhdyttiin johtamaan jätevesiä Hattulasta vuonna 1974.

Kehitystyö ja tutkimus jatkuvat Hämeenlinnan seudulla edelleen. Tekopohjaveden valmistuksessa esiintyneiden ongelmien vuoksi on Hämeenlinnassa ryhdytty tutkimaan ns. sadetusta, jossa vesi johdetaan harjunrinteille sadetusputkistojen kautta. Hämeenlinnan seutukuntaan kuuluu kahdeksan kuntaa. Vuonna 2001 perustettiin Hämeenlinnan Seudun Vesi Oy, joka huolehtii alueen vesihuollosta Janakkalaa lukuun ottamatta.

1. INTRODUCTION, OBJECTIVE AND SCOPE

Finland is a country with rich water resources. There are some 56 000 lakes with minimum diameter of 200 meters, and the landscape is largely dominated by lakes, especially in the central and eastern parts. Until the year 1809 Finland was part of the kingdom of Sweden and then attached to the Russian empire as an autonomous Grand Duchy. The country became an independent republic in 1917.

Häme castle was founded at the end of the 13th century and it is one of Finland's medieval royal castles. Its first well -12 metres deep lined with stones - was built at the same time as the castle. However, waste and rain water leaked into it, polluting the water that could be used only for firefighting purposes. Häme castle started as a fortified camp, but gradually it was built to be a residential castle for its commandant. Curtain wall buildings and a third storey

were added at the end of the 18th century. Related to the water supply of the castles, water was rarely drunk as is. It was used to brew beer and boiled. Thus, drinking the water in this form was much safer; several litres of beer per person were consumed each day. Water was also used for defensive purposes. For example, the safety of the Häme castle was increased in the 1770–80's by digging massive moats around the castle.[1]

The City of Hämeenlinna was founded in 1639. At the turn of the 19th and 20th centuries, Hämeenlinna had severe problems concerning wells. Many were placed too close to the cattle yard muck pit, sometimes just 3.5–5 meters away. Since keeping the cattle was still common and sanitation was almost non-existent, domestic waters were polluted. [2]

Nowadays Hämeenlinna Region includes eight municipalities: Hämeenlinna Town, Hattula, Hauho, Janakkala, Kalvola, Lammi, Renko and Tuulos municipalities (Fig.1). Hämeenlinna Region Water Supply and Sewerage Ltd. was founded in 2001 and in May 2006 it took care of water services in the region except for Janakkala.

In the Hämeenlinna region groundwater sources are good and there are also quite many lakes; among others Lake Vanajavesi, Ahvenistonjärvi, Katuma, Alajärvi and many more. So, in the early history of water supply issue was not the lack of water, issue was how to utilize these water resources.



Figure 1. Location of Hämeenlinna town and its neighbouring municipalities (<http://www.hameenlinna.fi/english/>) (viewed on 3.3.2006).

The objective of this paper is to describe the evolution of water supply and sewerage services in Hämeenlinna town from the first initiatives from the 1880s to 2005 and analyse the key strategic episodes and decisions over the years.

This multidisciplinary paper combines the views of historian and water engineering scientists represented by the authors. It uses various types of sources: archives, literature, and project documents. A systematic analysis of the city and waterworks archives and the literature was made. Articles in local newspapers, and available histories of the city were also reviewed. Open-ended theme interviews of 26, present or past, staff members of the waterworks were conducted, representing all levels of the utility. Besides, visits to the works were an essential component of the project. [3]

First, the article describes the early developments in water supply and sewerage in Hämeenlinna before the founding of the actual water and sewage works. To that extent the text is based on historical accounts of the general development of the Town of Hämeenlinna. Thereafter, the needs of fire-fighting water and hygiene as well as the decision of using ground water and far-sighted planning of wastewaters are presented. Early cooperation and even resistance of the system are then presented, followed by rising water consumption and new intakes based first on surface water and later artificial recharge. Gradually the Water and Sewerage Works started cooperation in water buying and selling and sewage receiving, and finally, the recent establishment of a regional water and sewerage company, owned by Hämeenlinna town and its five neighbouring municipalities will be discussed.

2. SELECTED ISSUES AND PHENOMENA

2.1 Fire-fighting water and hygiene boosted the public system

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. For instance, a fire that started in December 1876 burned almost out of control as a result of an inadequate supply of fire-fighting water. After the fire, Governor von Ammondt demanded an explanation for the poor outcome of the fire-fighting efforts. It was discovered that in addition to the inadequate water supply, the fire alarm had been given too late.[4]

In the 1880s city fathers started to regard the shortage of water as an increasingly serious problem which resulted in a number of initiatives. The first extensive proposal was prepared by the agronomist Bremer in 1889 commissioned by the town council. He 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.[5]

In August 1880 a Public Health Decree came into force in Finland which required establishing special boards for overseeing public health. The first documented meeting of such a board in Hämeenlinna took place in 1882, while the first authority to oversee sector ordinances, a health officer, assumed office at the beginning of 1890. The poor drinking water

situation in the city kept the board busy. Consequently, it suggested to the council already in 1901 that the latter set up a water-works-construction fund that could be enlarged gradually. Yet, the proposal did not receive enough support at the time.[6] The map of the city of Hämeenlinna in 1909 is presented in Figure 2 including the proposed location of water intake (no 18).

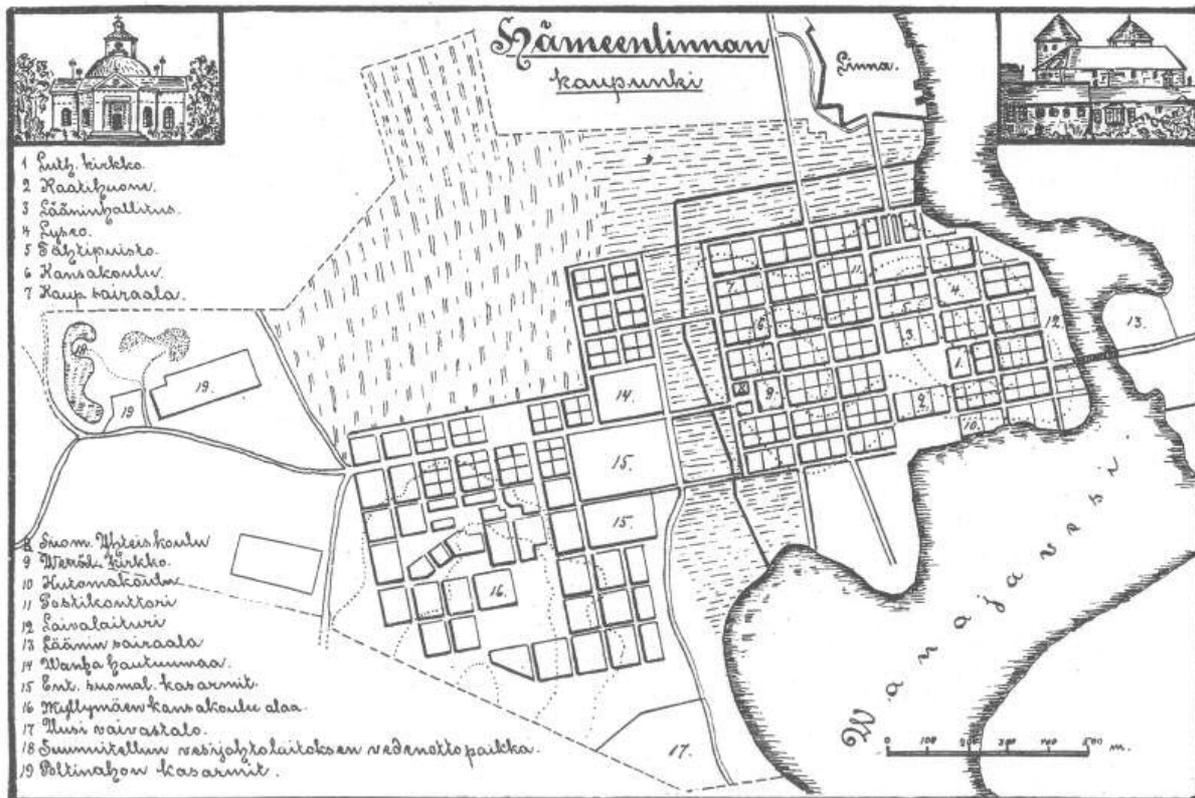


Figure 2. Hämeenlinna in 1909. 1 Lutheran Church, 2 Town House, 3 Provincial Government, 7 Town Hospital, 9 Russian Church, 11 Post Office, 13 Provincial Hospital, 14 Old Graveyard, 16 Myllymäki, 18 Water intake for planned water works, 19 Military barracks, Linna = Castle. (Manner 1909)

2.2 Groundwater from Ahvenisto esker area

The first implemented plan for a water supply and sewerage system was prepared by engineer Hugo Lilius in 1908. Accordingly, a depression south of Lake Ahvenisto was selected as the location of a water intake plant since a sufficient amount of groundwater, "a layer of at least 20 metres", had been discovered there. The water was under enough pressure to rise through pipes into a concrete reservoir from which it was pumped to a water tower. The tower, again, provided sufficient pressure to serve the entire network. The water supply committee asked the City Engineer of Vyborg, B. Gagneur, for his opinion about the plan. He supported it. Actual construction started in April 1910. The work was supervised by B. Gagneur and building engineer Otto Tolonen was the site foreman.[7]

The decisions made at the founding stage of the water works have proven quite forward-looking. The selection of groundwater from the Ahvenisto esker area instead of lake water was a sustainable solution, although it was criticized during planning. The rest of the technology, such as pipe materials, also represented the best available then. The positioning of fire hydrants in the middle of streets was, however, a mistake. They caused problems especially in winter times due to snow. Starting in 1926 they were gradually repositioned on the sides of streets.[8]

2.3 Far-sighted planning for wastewaters

Concurrently with the water works a sewerage system was completed in 1910. This system was planned with a possible wastewater treatment plant in mind, since all the main sewer lines were led to the northern side of the city. A sewage pumping station and a pressurized sewer were also built. The city was also levelled to allow determining the proper routing of the gravity sewer lines. On its completion, the Hämeenlinna water and sewerage works was the eighth such a facility in Finland.[9]

2.4 Early cooperation networks

The city medical officer, Viktor Manner, was a key actor in the public health board and the water pipe committee, an expert organ which dealt with plans concerning the water works. Undauntingly he pushed for the establishment of a water works stressing its health benefits. Alongside Manner and other municipal actors, several Finnish key water-sector experts such as Huber, Gagneur and Wasenius - other leading water “champions” in Finland that time - were involved in the establishment of the water works. Thus, the project was carried out with the help of a wide network of experts.

However, the local newspaper, Hämeen Sanomat, opposed vehemently the water works promoted by Manner. The critique maintained by the paper was valuable in that the networks were later extended also to the working-class quarter of Myllymäki. Such strong opposition was, however, exceptional in Finland as a whole—it was party-political to some extent.[10] The water and sewerage works was completed in November 1910. After the inauguration ceremony Hämeen Sanomat changed its mind and wrote in positive tone about the water facility.[11] In any case, this episode shows how neglecting proper participation and involvement of all the key stakeholders or considering their interests may raise resistance and unnecessary delays.

In 1921 the Vuorentaa water supply association was established in the Hämeenlinna rural district. A special feature of that association was that the municipality was also a stakeholder. The association served an elementary school and a few farmhouses. The rural district was abolished in 1948 whereby Vanaja municipality became the association’s new home. As the

latter was abolished in 1967, the association became part of the City of Hämeenlinna. Finally in 1973 the city's water works assumed responsibility for the association's system. [12]

2.5 Rising water consumption and new intakes

As the need for water increased (Fig. 3), two new shaft wells were constructed in Ahvenisto esker in 1942, while the original tube wells became backups. Obviously due to the reconstruction after WW II, in 1953 water consumption suddenly increased by nearly 20 per cent which called for a review of the existing master plan for water supply. At that time, the decision to build a surface water plant on Lake Katuma was made. Why a surface water plant? Most probably it was a question of following the prevailing trend of utilizing surface water and a treatment technology called "pulsator"⁵. On the other hand, if the choice had been groundwater, the city would have had to pipe it from a neighbouring municipality. This might have caused some problems or at least challenging negotiations. In any case, change from groundwater to surface water was a clear strategic change. Accordingly, the length of water and sewerage networks constantly increased and the number of water meters doubled from 1940s to 1950 and doubled again in ten years (Fig. 3 and 4). Since 1975 the per capita consumption started to decline following the general pattern in the country. This was largely influenced by the energy crisis and the introduction of wastewater surcharge act enacted in 1974, followed by various actions by the utility, related industry and consumers. One strategic choice has been water metering: from the beginning water billing has based on metering (Fig. 5).

⁵ Technology developed in Finland by a leading sector contractor, YIT.

WATER SUPPLY IN HÄMEENLINNA, FINLAND, 1910-1998

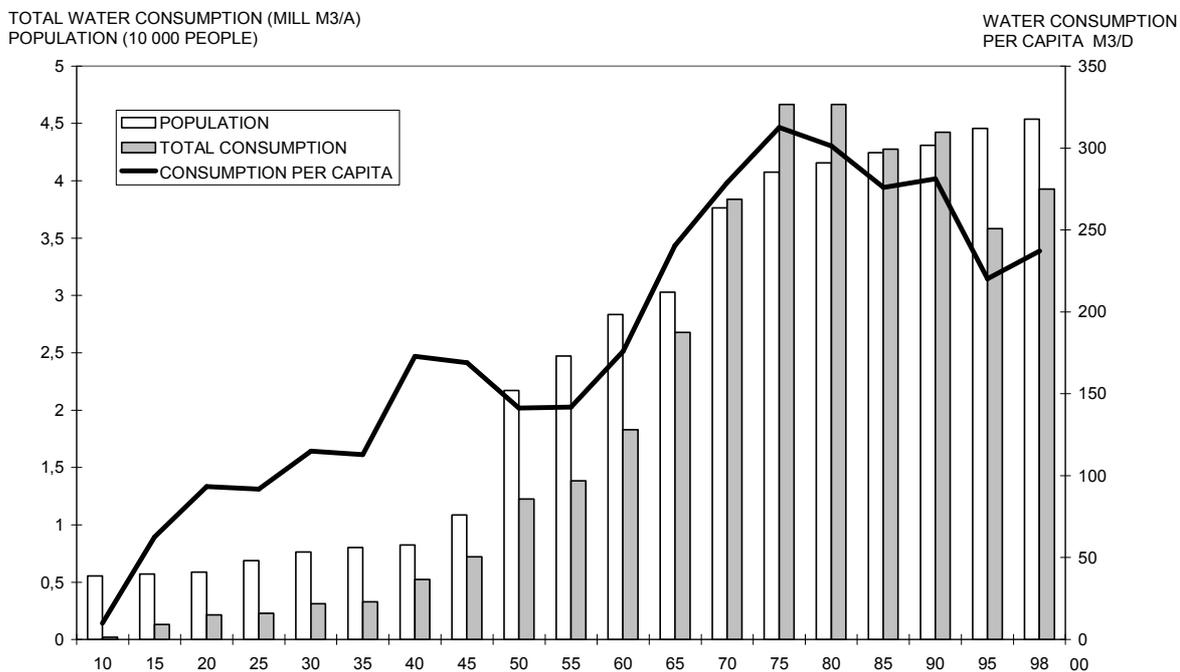


Figure 3. Water supply (total water consumption and water consumption per capita) and population in Hämeenlinna, Finland, 1910-1988.

WATER METERS, WATER AND SEWERAGE NETWORKS IN HÄMEENLINNA, 1910-1998

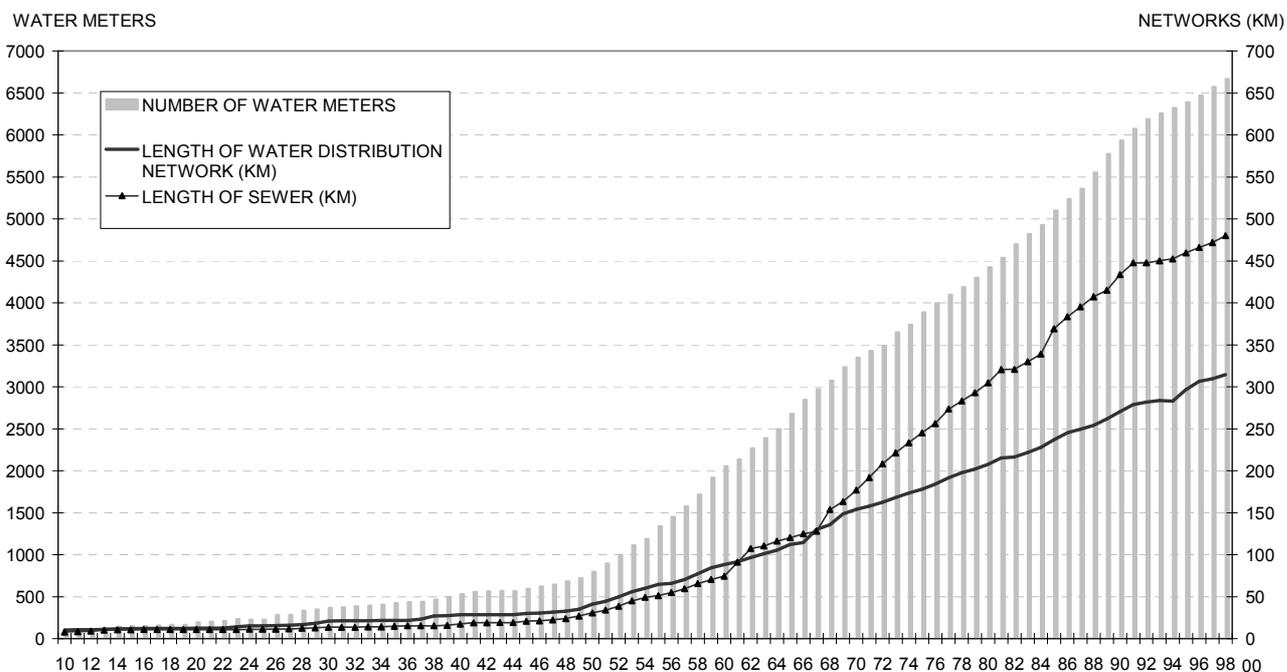


Figure 4. Water meters, water and sewerage networks in Hämeenlinna, Finland, 1910-1998.

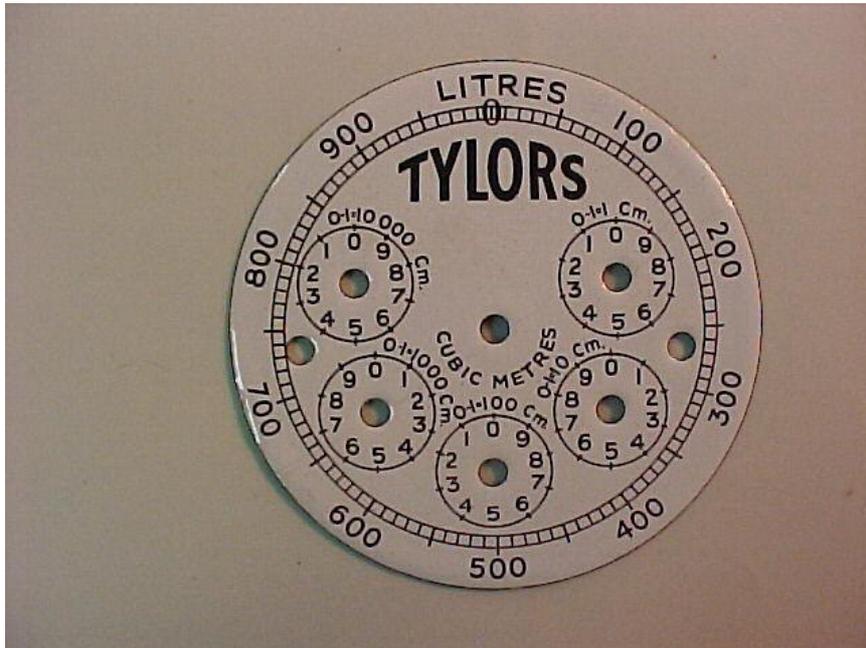


Figure 5. The display of an old water meter. It was very important to check which way the scale run - clockwise or anticlockwise. (Hämeenlinna Region Water Supply and Sewerage Ltd)

The Katuma surface water treatment plant was inaugurated in 1955, and its capacity was doubled by an expansion in 1960. Three new tube wells were built in Ahvenisto in 1966, and another groundwater intake plant at Kylvälähti - that had been part of the original water intake expansion plans - was taken into use in 1969.[13]

The drawing of groundwater from Ahvenisto esker had gradually lowered the water table. Lake Ahvenisto, which lies on an esker, was also losing its significance as a recreational area. The descent of ground water level was explored, and in 1976 an artificial recharge system was built. In this system water from Lake Alajärvi was pumped into a recharging basin constructed on the esker. This made the water table under the esker area rise, and additional water could be drawn from there. New tube wells were built in the Ahvenisto area in 1976 and 1978 which allowed decommissioning the Katuma surface water intake plant and turning it into a backup facility in 1980.[14] Thus 1980 the city had turned back fully to groundwater.

Since 1976 artificial groundwater has been used in Hämeenlinna, and in 2007 water supply is fully based on groundwater or artificial groundwater. There are sixteen water intakes: three water intakes in Hämeenlinna, Hattula, Renko and Lammi each, two intakes in Kalvola and one in Hauho and Tuulos municipalities respectively. Fourteen of them use natural groundwater and two artificial recharge.[15]

In 1985 a new two-part recharging basin was built on the Ahvenisto esker to increase the volume. In the new basins, the vertical infiltration distance was, however, too short and the

quality of the recharged water did not meet expectations. As a result, research on surface irrigation was started. It involves conveying water to the sides of an esker via irrigation pipelines (Fig. 6). With irrigation, there is no need to disturb the topsoil which cannot be avoided when building recharging basins. The places of irrigation pipelines are changed once a year to avoid excess siltation of the surface. The studies on Ahvenisto showed that the quality of groundwater remained very good with the irrigation method. Development and research still continue, and irrigation is likely to be used also in the future. One problem related to water provision in Hämeenlinna has been the high iron-content of well water. An effort has been made to distribute water abstraction from intakes over a wider area by building new wells while also attempting to limit the output of individual wells and the iron-content of their water.[16]

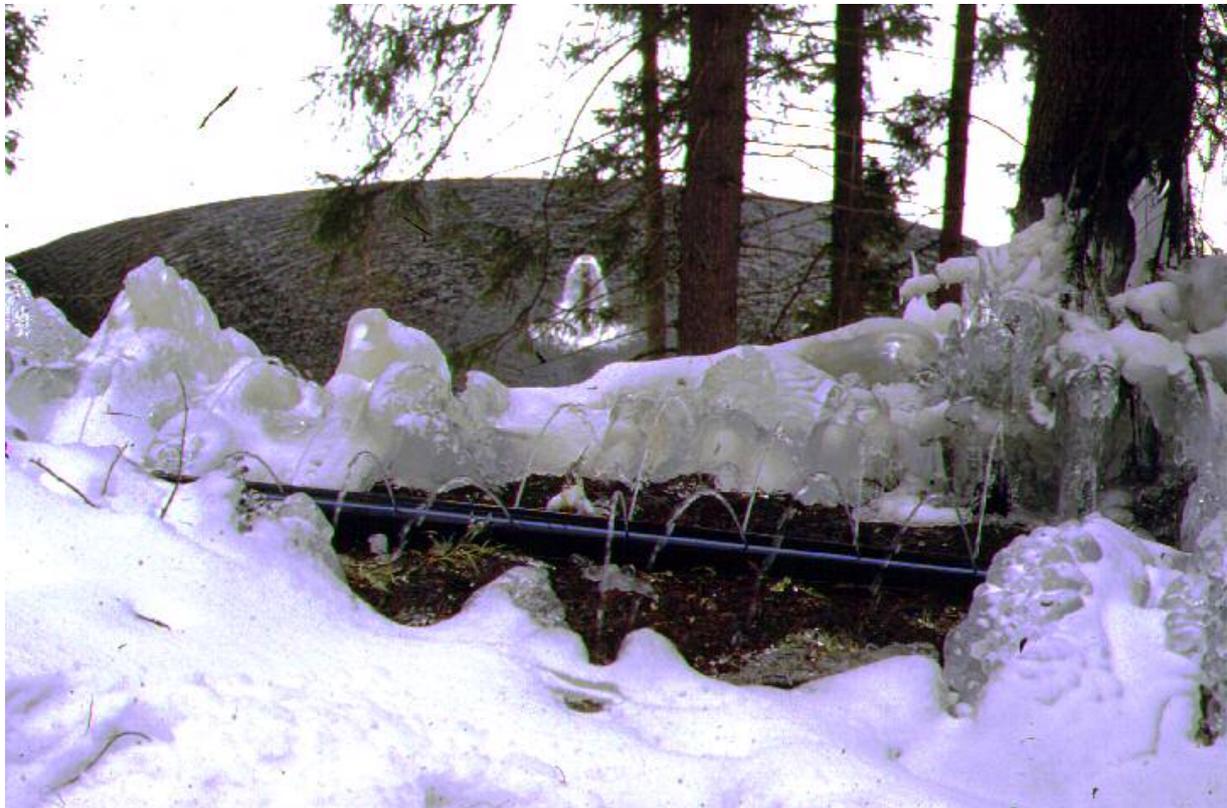


Figure 6. Water is pumped from the Lake Alajärvi to the Ahvenisto esker. Surface irrigation goes on despite of winter time. There is irrigation pipeline in front and one of recharging basins in the background. (Hämeenlinna Region Water Supply and Sewerage Ltd)

2.6 Cleaning neighbours' wastewaters

Some Finnish cities and townships introduced wastewater treatment in the early 1900s, while the actual momentum started after the Water Act of 1961 that forced to start water pollution control. Yet, in Hämeenlinna sewer network was planned already in 1910 so that wastewater treatment plant can be constructed easily later on in the end of the sewer network.

The Paroinen wastewater treatment plant began operations in October 1966 as an activated sludge plant. The rapid technological development in the sector has meant that the plant has been involved in research, construction and expansion throughout its existence. The first expansion was completed in 1974 starting phosphorus removal by simultaneous precipitation, very commonly used in Finland. This treatment, as well as the oxidation of ammonium nitrogen, began in Hämeenlinna in 1990—quite early compared to other Finnish cities.[17]

After the expansion of the sewer system, all of Hämeenlinna's wastewaters—with the exception of a few dispersed settlements—have been led to the Paroinen treatment plant since 1999. Regional cooperation in receiving wastewater for treatment also started early. Since 1974 besides Hämeenlinna's own wastewaters, the Paroinen plant has also purified the wastewaters of Hattula. The wastewaters of Renko municipality have been received since 1993 and those of Hauho Eteläinen since 1996. The municipality of Tuulos also started to convey its wastewaters to the plant in 1997.

2.7 Hämeenlinna Region Water Supply and Sewerage Ltd.

The above mentioned development, for its part, paved the way for the establishment of the supra-municipal water and waste water company for Hämeenlinna and its neighbours. A supra-municipal water and wastewater services joint-stock company owned by Hämeenlinna Town and five neighbouring municipalities, Hämeenlinna Region Water Supply and Sewerage Ltd., was established in 2001. In 2006 the company took care of water services in the Hämeenlinna region – except for Janakkala.

At first of the municipalities in Hämeenlinna Region, four joined the drinking water services system of Hämeenlinna Region Water Supply and Sewerage Ltd. (Hämeenlinna, Hattula, Kalvola and Renko), while six joined the wastewater services system (Hauho and Tuulos in addition to the previous). In Hauho and Tuulos municipalities, drinking water services were arranged through Ydin-Hämeen Vesihuolto Oy (Core Häme Water Services Ltd.). Lammi municipality joined the waste water system of Hämeenlinna Region Water Supply and Sewerage Ltd. in September 2005. In addition Hämeenlinna Region Water Supply and Sewerage Ltd bought the capital stock of Ydin-Hämeen Vesihuolto Oy in the autumn 2005 and companies were merged by the beginning of May 2006.

Over the half of the population living in Hämeenlinna Region have their homes in Hämeenlinna Town. The population of Hämeenlinna town and municipalities in Hämeenlinna

Region in 2002 are shown in Table 1. Development of population in Hämeenlinna Region from 1970 to 2005 is presented in Table 2.

Table 1. Population of municipalities in Hämeenlinna Region in 31.12.2005.[18]

Municipality	Population
Hämeenlinna Town	47,335
Hattula	9,332
Hauho	3,947
Janakkala	15,871
Kalvola	3,461
Lammi	5,612
Renko	2,352
Tuulos	1,564
Region TOTAL	89,474

Table 2. Development of population in Hämeenlinna Region from 1970 to 2005.[19]

Year	Population	Year	Population
1970	79 285	2000	87 583
1980	81 775	2002	88 187
1990	85 247	2005	89 474

The successful regional cooperation in the Hämeenlinna region in sewerage and wastewater treatment shows that also small towns and municipalities can be forerunners in wastewater treatment and water protection measures. In the case of Hämeenlinna region, the cooperation – although the development from its initiation to the establishment of the regional joint-stock company also took about a decade – progressed fairly smoothly and in a fairly good consensus between all shareholding municipalities. One explanation for this must have been the central role of Hämeenlinna City and its key “champions” in the development and negotiation process. It is obvious that all shareholding municipalities see the joint-stock company as a win-win situation, where Hämeenlinna City as the biggest shareholder foresees long-term economic gains and rationality in terms of technical and environmental benefits, and the smaller municipalities were in many cases able to “avoid” the substantial forthcoming infrastructure replacement and rehabilitation costs.

3. DISCUSSION

3.1 Key episodes and public-private cooperation

An overall summary of the development of water supply and sewerage systems in Hämeenlinna from the late 1800s to the 21st century, is shown in Table 3. The expertise of the several Finnish key water-sector experts such as Huber, Gagneur and Wasenius were

involved in the establishment of the water works. Thus, the project was carried out with the help of a wide network of experts. The expertise was utilised and adapted to the conditions of Hämeenlinna.

Table 3. Key long-term decisions on Hämeenlinna water and sewerage services, 1869–2002 [20]

Year	Event	Reason	Outcome	Organisational change	Stakeholders
1869	1st City Police Order	Inadequate cleanliness	City's cleanliness improved		Various groups among local councillors
1882	1st Health Committee (board) meeting	Public Health Decree of 1879	City takes control over environmental and health matters	Health Committee (board)	Various groups among local councillors
1889 and 1890	A. Bremer and Fr. Kiuttu's proposals for waterworks	Need of fire-fighting and household water, pollution and wastes control	Proposals postponed, several committees and small improvements	Several committees	Various groups among local councillors, experts
1908	H. Lilius' plan for water and sewerage systems	Need of fire-fighting and household water, health, pollution and wastes control	Modern waterworks in 1910	1st City Waterworks in 1910	Various groups among local councillors, city council, waterworks, consumers, experts
1910	Metering based billing	Control of use	Billing based on actual use		Waterworks, customers
1910	1st phase of sewers		Pollution of surface waters in the long run, better quality of city life in the short term		City council, experts
1953	Plan for surface water plant	Inadequate quantity	1955 Katuma plant, more capacity, used until 1980		City council, waterworks, experts
1966	1st wastewater treatment plant at Paroinen	Health and environmental aspects, Water Act of '1961	Receiving WW from Hattula since 1974; from Renko municipality since 1993	Based on bilateral contracts	City council, waterworks, consumers, the state, experts, Hämeenlinna, Hattula, Renko
1976	Alajärvi artificial recharge	Inadequate quantity	More capacity		Waterworks, experts
2001	Hämeenlinna Region Water Supply and Sewerage Ltd	Foreseen benefits, favourable conditions	Supra-municipal services	Supra-municipal company	Several municipal councils, Reg. Env. Centre, Regional Council of Häme

The Vuorentaa water supply association was established in 1921 in the Hämeenlinna rural district. In 1973 the city's water works assumed responsibility for the association's system. A joint water and sewage works for the entire area would, however, be too expensive at today's population density.

The 1879 Public Health Decree required, for instance, the city to measure the relative elevations of different city areas which was a precondition for sewerage planning. Health and environmental issues were the responsibility of a board of health which also saw to it that good quality water was provided for the inhabitants. Water charging was based on metered consumption from the beginning. This allowed viable 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 fee. The works 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.

Utilisation of groundwater - though returning to surface water for a few decades - was the right solution in light of what was known then. The later problems with iron showed that solutions that appear indisputable are not necessarily sustainable over the long term and now, but one must be prepared for surprises.

Prior to the establishment of the waterworks, the state of the environment in Hämeenlinna had deteriorated 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 initially built, domestic wastewaters loaded the environment. Since the city started treating wastewaters in 1966, and improved process gradually, 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: example well water quality was often poor. The situation in the rural areas started to improve slowly, for example in Hattula after 1974 when the Paroinen plant has purified its wastewaters.

The selected organisational option in 2001 — a joint-stock company owned by the municipalities — is a common alternative in the regional cooperation of the municipalities in Finnish water services sector, though mainly for wholesale purposes. Based on the experiences elsewhere and on the majority decisions taken by the municipality organs in the Hämeenlinna Region Water Supply and Sewerage Ltd's a joint regional company was established. The management and decision making structures of the joint-stock company seem to be well accepted by all shareholding municipalities. Yet, this may be largely due to the incentive: Hämeenlinna town owns 75 per cent of the shares, while the smaller municipalities have a joint voting majority in the Board.

Table 4 presents a summary of the private sector involvement in providing major construction contracts, consultancy services, goods and equipment for Hämeenlinna City Water and Sewage Works, 1910-2002. It shows that there has been over thirty outsourced contracts in planning – general planning or design - and over sixty contracts in construction.

3.2 Future challenges

One future challenge will be to secure sufficient groundwater resources for Hämeenlinna. The risk of their contamination has been diminished by moving oil tanks from groundwater areas to protected indoor spaces or by introducing completely new heating modes. The at-risk locations in Hämeenlinna were surveyed in 1994, and a groundwater protection plan was devised in that same connection. Education and research are also used to minimize the threat posed by the de-icing salt spread on roads in winter and other threats external to the water works. A new approach to safety issues will have to be taken in a unifying Europe.

The water works has traditionally had good contacts with domestic and foreign research and educational institutions and enterprises ever since its planning started. The works has grown as part of society and has played a key role in the provision of safe water and sanitation services to inhabitants. The big basic decisions made early in the 20th century have proven sustainable: the population of Hämeenlinna can still enjoy the high quality groundwater of the Ahvenisto esker and the waterways traversing the city are also in good shape.

The regional joint-stock company, Hämeenlinna Region Water Supply and Sewerage Ltd, still has huge challenges ahead – despite the promising start and good acceptance by shareholders and majority of its customers. Challenges are mainly related to the economic and financial sustainability of the company, bearing in mind that the company has substantial nominal debts to the shareholding municipalities. The foreseen debt service costs together with inevitable high infrastructure rehabilitation costs put high pressure on future tariff structures and revenue collection levels.

Table 4. Private sector involvement in providing major construction contracts, consultancy services, goods and equipment for Hämeenlinna City Water and Sewage Works, 1910-2002.

WATER	SEWERAGE
1. GENERAL PLANNING	
1920 PRIVATE EXPERT	1951 CONTRACTOR
1940-41 CONTRACTOR	1952 CONTRACTOR
1946 CONTRACTOR	
1966 CONSULTING COMPANY	1966 CONSULTING COMPANY
1974-75 CONSULTING COMPANY	
2. DETAILED PLANNING & DESIGN	
WATER INTAKES AND TREATMENT	SEWERAGE TREATMENT PLANT
1952-53 CONTRACTOR	1957 CONSTRUCTION
1952-53 CONTRACTOR	1962 CONSULTING COMPANY
1960 CONSULTING COMPANY	1962 CONSULTING COMPANY
1966 CONSULTING COMPANY	1962-63 CONSULTING COMPANY
1968 CONSULTING COMPANY	1970 CONSULTING COMPANY
1976 CONSULTING COMPANY	
1980-81 CONSULTING COMPANY	
1985 CONSULTING COMPANY	
WATER PUMPING STATIONS	SEWERAGE PUMPING STATIONS
1954 CONTRACTOR	1953 CONTRACTOR
1954 CONTRACTOR	1968 PRIVATE EXPERT
1964 PRIVATE EXPERT	
1964 CONSULTING COMPANY	
1982 CONSULTING COMPANY	
GROUNDWATER INVENTORY	OTHERS
1941 CONTRACTOR	1966 CONSULTING COMPANY
1944 CONTRACTOR	1970 CONSULTING COMPANY
1961 CONSULTING COMPANY	1978 CONSULTING COMPANY
1995 CONSULTING COMPANY	
1999 CONSULTING COMPANY	
3. CONSTRUCTION	
WATER INTAKES AND TREATMENT PLANTS	SEWERAGE TREATMENT PLANT
1954-55 CONTRACTOR	1963 CONTRACTOR
1954-55 CONTRACTOR	1965-66 CONTRACTOR
1965-66 CONTRACTOR	1965-66 CONTRACTOR
1968 CONTRACTOR	1967 CONTRACTOR
1969 CONTRACTOR	1967 CONTRACTOR
1969 CONTRACTOR	1967 CONTRACTOR
1976 CONTRACTOR	1972-73 CONTRACTOR
1980-81 CONTRACTOR	1978 CONTRACTOR
1980-81 CONTRACTOR	
1980-81 CONTRACTOR	
1999 CONTRACTOR	
WATER TOWER	
1910 CONTRACTOR	
WATER PIPES	SEWERS
1920 PRIVATE WATER PIPE	1954 CONTRACTOR
1924 PRIVATE WATER PIPE	1956 PARTLY FUNDING BY
1937-38 PARTLY FUNDING BY	INSTITUTIONAL CUSTOMER
INSTITUTIONAL CUSTOMER	1967 CONTRACTOR
1947 CONTRACTOR	1972 CONTRACTOR
1956 PARTLY FUNDING BY	1972 CONTRACTOR
INSTITUTIONAL CUSTOMER	
1970 CONTRACTOR	
1971 CONTRACTOR	
1971 CONTRACTOR	
1972 CONTRACTOR	
1973 CONTRACTOR	1972 CONTRACTOR
1976 CONTRACTOR	1973 CONTRACTOR
WATER PUMPING STATIONS	SEWERAGE PUMPING STATIONS
1929 CONTRACTOR	1970 CONTRACTOR
1959 CONTRACTOR	1972 CONTRACTOR
1960-61 CONTRACTOR	
1964 CONTRACTOR	
1965 CONTRACTOR	
1966 CONTRACTOR	
1982 CONTRACTOR	
QUALITY CONTROL OF SUPPLIED WATER	
1956 CONSULTING COMPANY	
HPAC (HEATING, PLUMBING, AIR-CONDITIONING)	HPAC (HEATING, PLUMBING, AIR-CONDITIONING)
1939 CONTRACTOR	1965-66 CONTRACTOR
1950 CONTRACTOR	1979 CONTRACTOR
1954-55 CONTRACTOR	
1955 CONTRACTOR	
1969 CONTRACTOR	
1980-81 CONTRACTOR	
ELECTRICAL WORK	ELECTRICAL WORK
1969 CONTRACTOR	1965-66 CONTRACTOR
1971 CONTRACTOR	1967 CONTRACTOR
1980-81 CONTRACTOR	1972 CONTRACTOR
	1978 CONTRACTOR
OTHERS	OTHERS
1970-71 CONTRACTOR	1970-71 CONTRACTOR
2002 CONTRACTOR	1978 CONTRACTOR
	1978-79 CONTRACTOR

4. CONCLUSIONS

The following key principles and findings of the evolution of water and sewerage services in and for Hämeenlinna have been identified:

(i) The waterworks and the sewerage system improved dramatically the condition of the constructed environment.

(ii) One reason for the working class's opposition to water schemes in the 1910s arose from their political association with the renter classes. During this period expenditure on water was probably rejected because it would result in an increase in municipal rates, which would in turn be reflected in rising rents.

(iii) Another reason to oppose water schemes was lack of information. As it is also seen today, if the scheme - whatever it is - is not well informed to all shareholders and public relations are not done properly, there is for sure, strong opposition. This was the case also in Hämeenlinna. And it seems like lack of information has been one main reason why some citizens have expressed strong opposition to the planned artificial recharge plants in Turku and Tampere regions.

(iv) There was an alliance of 'conservative' property owners and householders with working class against 'liberal' commercial interests. The 'conservatives' resisted major reforms because they realised they would have to pay for them. The working class rejected water schemes because they feared an increase in rents, and same time saw water schemes to be in the benefit only of the merchant and commercial interests.

(v) Because a wastewater treatment plant was not built initially, domestic wastewaters loaded the environment. Since the city started treating wastewaters in 1966, and improved the process gradually, the pollution load on water bodies from domestic wastewater decreased significantly.

(vi) At the beginning the selection of groundwater from the Ahvenisto esker area instead of lake water was a far-reaching and open-minded solution, though surface water was also used for a few decades.

vii) The successful regional cooperation in the Hämeenlinna region in sewerage and wastewater treatment shows that also small towns and municipalities can be forerunners in wastewater treatment and water protection measures.

viii) Future challenges are probably related to economical and financial sustainability.

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