Mistra InfraMaint

Research report and excerpts on the history of municipal streets, water, and sanitation in Sweden

2.6 Historisk studie av regimer och dominerande modeller för byggande och förvaltning av kommunalt VA respektive gata / väg

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Foto: Nilsson, Severin (1846-1918), Stockholms stadsmuseum, Bildnr SMD005935

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MISTRA
Stiftelsen för miljöstrategisk forskning

Research report and excerpts on the history of municipal streets, water, and sanitation in Sweden.

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Foreword

This is a research report within the project *InfraMaint* funded by Mistra (The Swedish foundation for strategic environmental research) and hosted by RISE (Research Institutes of Sweden): Mistra InfraMaint – Mistra / 2.6 Historic study of regimes and dominating models for building and management municipal WS and streets - Mistra InfraMaint EN. It is published in this digital form to function as a compilation of knowledge and a reservoir for further publications. As such, the report presents lots of raw data in the form of excerpts and quotes from literature and primary sources, the analysis is not fully completed, and the text is not coherently edited. Furthermore, the report is not finalized, it represents work in progress, In the autumn of 2023 the text will be revised and published as a book at International Water Association Publishing (IWAP) under the title: *Articulating publicness in infrastructure. The history of municipal streets, water, and sanitation in Sweden*. The report will also be the foundation for a popularized book in Swedish and future peer reviewed articles. Because of its character as a draft and work in progress, I would like to be consulted before the report is cited or used as a reference.

Abstract

The first contribution of this report lies in the historical comparison of infrastructural systems that normally are dealt with separately. The synthesis has been achieved mainly by an extensive literature review of research from a wide range of various fields and by using prime sources to some extent. I have reinterpreted earlier results and brought together research areas that not so often communicate. The comparative and long-term perspective allows me to discover similarities and differences in the development of arrangements around streets, water, and sanitation. By using the analytical lens of *publicness* I can challenge the common belief that these three areas have always been public concerns or obligations. An assumption that relies on the fact that presently they indeed are *public* infrastructural systems. The second contribution is that I connect the historical development of these three sectors with research in medical, social, cultural, economic, and political history highlighting the most important contextual factors in society at large that has profoundly affected streets, water, and sanitation. I show how their respective evolution into public infrastructural systems has been strongly influenced by the strong Swedish tradition of local independence, by urbanization, demography, and industrialization, the municipal reform of 1862, and specifically for water and sanitation, the conflict between the private and the public; the social issue (concern for, and fear of, the working class and the poor); high mortality, Cholera epidemics and new perceptions of health and sickness; the Sanitary movement; the national health act of 1874. Finally, using theoretical concepts from the research traditions of Large Technical Systems (LTS, Hughes) I show how the evolution in municipal streets, water, and sanitation has left a historical *legacy* still affecting the way these infrasystems are managed today.

Acknowledgements

This project was generously funded by Mistra InfraMaint, hosted by RISE (Research Institutes of Sweden): Mistra InfraMaint – Mistra under the name: 2.6 Historic study of regimes and dominating models for building and management municipal WS and streets - Mistra InfraMaint EN. Thanks to Magnus Arnell and Lars Marklund, program leaders, for all the support I could have wished for. I also want to acknowledge the help from participants in InfraMaint that has commented on my work at seminars and meetings.

The report has been peer reviewed by many. I have had the pleasure to discuss my work and received a lot of help from the following experts in infrastructure and historical studies and most of them have at various stages of completion read and commented my drafts: Uno Jakobsson, Erik Winnfors, Ove Pettersson, Hans Bäckman and Erik Karlsson, Svenskt vatten; Jonas Hallström, LiU; Erik Lindberg, UU; Lars Nilsson and Håkan Forsell, SU; Jesper Larsson, SLU; Martin Emanuel and David Nilsson, KTH. David Nilsson has shared his deep knowledge on water and sanitation issues and been a valued discussion partner in this endeavor. I thank Jonas Christensen, Peter Ridderstolpe and Björn Eriksson who generously shared their knowledge on small scale sanitation at a special seminar in Uppsala, April 2023. Moreover, Christensen, Juris. dr. in environmental law, has also shared his deep knowledge in the complex area of WS legislation.

A special thanks goes to Mats Hallenberg, SU who commented extensively and helped me to understand the concept of *publicness*. Thanks also to Fredrik Petersson, SU who gave me a copy of Wilhelm Leijonankers plan (1853) of the piped water system in Stockholm and to Henrik Kant, Stadsbyggnadsförvaltningen, Göteborg and Ulf Thysell, NSVA, Helsingborg who helped me to see outside a narrow Stockholm perspective. I am also grateful for the help from Albin Blomkvist in revising the footnotes and the reference list.

Water and sanitation were relatively new topics for me before this project. My foremost inspiration in WS comes from David Nilsson who introduced me to the subject in the first place, from Jonas Hallström, who has written the most comprehensive Swedish historical case study of the introduction of piped water and sanitation, and from American and Swedish doyens in WS history Martin Melosi and Jan-Olof Drangert.

All remaining mistakes and misunderstandings are my own.

Kärrtorp, Stockholm in May 2023

Pär Blomkvist

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Chapter 1: Introduction, purpose, theory, and method.

Introduction

In this report I write a comparative history of municipal provision of streets, drinking water, and sanitation. My interest lies in how these fundamental service arrangements have become publicly managed infrastructural systems. As will be described below, I investigate how streets, water, and sanitation has been historically transformed into public responsibilities i.e. the *articulation of publicness*.

Since the dawn of civilization some sorts of arrangements has been made to provide for these three essential resources and the field is huge with a very long history. I will only be able to cover some aspects. My focus is on the creation of modern municipal infrastructural systems – *infrasystems*[1] – in Sweden from roughly the beginning of the nineteenth century. However I will account for some parts of their respective pre-modern history, which I believe still influence the systems today. Generally I investigate how these service *arrangements*, as I like to call early provisions of streets, water, and sanitation turned into public infrastructural *systems*. Concerning water and sanitation (WS) this development can be described as the evolution from WS *arrangements* into WS *Systems* (WSS).

Although I concentrate on *municipal* infrasystems the investigation is mainly centered around towns. The countryside gets less attention, except concerning road and street history, simply because the development towards modern infrasystems started in these densely populated places. Towns has also been much more discussed in earlier research. Of the same reasons the report is mostly focusing on Stockholm, especially when it comes to water and sanitation, because the capital of Sweden was a forerunner in WS development, and most cities followed Stockholm's example in the construction of piped water and sanitation. I will use the terms *town* and *city* interchangeable.[2]

Roads, which are called *streets* in towns, has been vital for society as long as historical (and archeological) records can tell and has always been closely related to societal matters such as trade, warfare, and the national territory. Road and street history is a quite straightforward, but slow and sometimes erratic, movement towards a unified national (and even transnational) infrastructural system.

The history of drinking water is not as straightforward though. This is partly because water is such an, and I apologize for the pun, fluid concept. It has many meanings and is used in many types of situations. When we talk about water and investigate its history in relation to humankind, we can for example mean the ocean (salt water), rivers, lakes, or ground water (fresh water) and focus on potable water provision, irrigation, sea transport, fishing, waterpower, industrial use, or pollution of water recipients. From a natural scientific perspective we can investigate the so-called *global water cycle* and follow its journey from evaporation to its return to water bodies or ground water aquifers. In sanitation, as will be discussed below, water is used for sewage, i.e. the transport of excrements in

[1] The term coined by Kaijser, A. (1994). *I fädrens spår: den svenska infrastrukturens historiska utveckling och framtida utmaningar.* Carlsson. Stockholm, Sverige.

[2] Drangert, J-O., Nelson, M. C., & Nilsson, H. (2002*).* Why Did They become Pipe-Bound Cities? Early Water and Sewerage Alternatives in Swedish Cities, *Public works management and policy*, **6**(3), 172-185: "The use of the term *city* or *town* in Sweden demands some explanation. Cities and towns were administrative units, and the designation as such was not always related to size. Of old, charters had been issued to towns for economic, strategic, or political reasons. The consideration of the urban and rural division, especially for the 19th century, is clouded by the fact that some rather large market towns and so-called municipalities were actually larger population-wise than a number of towns, a situation that was remedied, to some extent, in the decades around the turn of the century, 1900."

piped sewars, for street cleaning and of course for household hygiene, cooking and washing, etcetera. I am sure that there are many more examples. The provision of drinking water (and sewage services) is often called the *local water cycle*.

In this report I investigate water in this narrower sense. I turn to water provision, of fresh drinking, so-called potable, water, and investigate the history leading up to the introduction of modern water systems in underground pipes at the end of the nineteenth century. Thus, when writing about water in the following, if nothing else is specified, I mean drinking water.

Fresh water is vital for humankind. We simply die if we don't get it and water quality is essential for health, at least we know that today. Fresh water has furthermore almost always been associated with positive qualities, and at the present water is often seen as a *human right*.[3] However there are historical indications that drinking water was not always appreciated. Some researchers, for example, claim that the Roman elite saw water as "...the characteristic drink of the subaltern masses, the cheapest and most easily available drink, fit for children, slaves and the women that had been forbidden from drinking wine very early in the Republic…" and that the aversion to water was carried into the Middle Ages and the pre-modern era: "…Drinking water – any water – was a sign of desperation, am admission of abject poverty, a last resort. Like all Europeans of the seventeenth century, the Pilgrims (in New England) disliked, distrusted, and despised drinking water. Only truly poor people, who had absolutely no choice, drank water. There is one thing Europeans agreed on: drinking water was bad –very bad – for your health."[4] This argument is not common in a Swedish context, but perhaps the anecdotical evidence of a very high beer consumption in the seventeenth and eighteenth century could point to the same aversion. Everyone just knew that water could make you sick to the stomach.[5]

Dealing with sanitation has of course also been a vital concern, especially in densely populated dwellings. However, especially the handling of excrements, has mostly been seen as a strictly private concern and a necessary evil surrounded by all sorts of taboos.[6]

The term *sanitation* has had a lot of meanings in the course of history, and I will discuss these later under the headline "Early sanitation: inner and outer sanitation". It is worth noting that *sanitation* often is used when discussing all sorts of waste removal in historic times, which can be a bit confusing. In modern day language, referring to piped waterborne sewers, the terms *sanitary sewer* is used for wastewater and feces and *storm sewer* for the removal of excess rain (storm) water. But the confusing and complex vocabulary and complex institutional framework is not only a historical

[3] UN: GA resolution 64/292, 2010; THE 17 GOALS | Sustainable Development (un.org); Karlsson, A. (2021). *Vatten: En historia om människor och civilisationer*. Svenska Historiska Media Förlag. p.203.
[4] Salzman, J. (2012). *Drinking water: a history*. London, Duckworth Overlook. pp.79
[5] Beer was also of course a way to process and preserve grain and an important source of carbohydrates (Jesper Larsson, personal communication). This negative attitude seems to have changed in the nineteenth century when water from wells and springs were seen as healthy and invigorating. One example can be found on Gotland in October 1876 when the island was hit by a typhoid fever epidemic. One city doctor realized that more children than the elderly had fallen ill, especially among the poor, which was probably due to the fact that, according to the habit of the area, the adults drank beer (svagdricka) instead of water: *Rent vatten – en livsnödvändighet (Ett historiskt perspektiv) - Region Gotland*. (2023). Region Gotland. https://www.gotland.se/73858, accessed 23/4 2023; *Innan kranvattnet kom (drack svenskarna öl) - Swedac*. (2022). Swedac. https://www.swedac.se/swedac_magasin/innan-kranvattnet-kom-drack-svenskarna-ol/, accessed 23/4 2023.
[6] Black, M. & Fawcett, B. (2008). *The last taboo: opening the door on the global sanitation crisis.* London: Earthscan.

phenomenon. As will be discussed the "patchwork" in legislation and the many organizations around water and sanitation is exceedingly topical in current WSS.[7]

It is evident that roads/streets, water, and sanitation/sewage, presently managed as public infrastructural systems, are fundamental for modern life. They are in fact so basic that we most often take them for granted. Our roads and streets have turned into publicly managed paved corridors för automobiles, drinking water pours out of the tap, and the handling of excrements has been moved away from us by piped sewers. We don't think about these basic services, we don't have to work to maintain them in our daily lives, and the only time we notice the infrastructure is when it breaks down or malfunction. This *invisibility* is described like this I a recent study of municipal streets and WSS: "…because infrastructure networks like road and sewers are so essential to our daily life, they are prone to fade away from conscious awareness. Constant flows of water and traffic produce a deep taken-for-grantedness and, in some form, make the immobile infrastructures enabling the mobile flows invisible. In turn, a sudden absence of, or a dramatic change in, the flows render the underlaying infrastructures visible and the everyday functional aspects of infrastructure become apparent."[8]

However, it must be noted that this picture is only true in some parts of the world. In many places the service provided to us by modern infrastructural systems, is still a hardship needing manual labor. Roads are not kept by public organizations; excrement is not transported in underground pipes and water certainly don't just pour out from a tap.

It is easy to forget the novelty of piped water and sanitation. These words of August Strindberg could be a reminder of the fascination in the end of the nineteenth century:

"I met the most brilliant invention in Hamburg. There one crapped in something resembling a soup bowl, and when you looked around there was nothing to see, although you could swear that you had laid down a few meters, the dish was so clean after the service that you could eat genuine turtle soup out of it." [9]

Almost sixty years later, in 1941, when infrastructural systems had become an integral part of city life, another author showed a similar admiration for these "brilliant" inventions. It was Ludwig Nordström, journalist well-known for a radio reportage during the 1930: s highlighting the poor hygienic standard in Sweden where he coined the all but flattering term "Dirt-Sweden" (Lortsverige). However in this quote he is more optimistic when it comes to the benefits of infrasystems:

"Stockholm, like every modern city, is a wonderful creation of the soul, of imagination, calculation, inventiveness, dedication, sense of duty to help all people in the city to a reasonably human-worthy life. I see before me this wonderful creation of the human spirit in its entirety: first, the whole invisible city under the ground in the form of passages, drums, halls, machine halls, in which conduits of various kinds, silent and unknown to the general public, work and enable, for example, that it can quench its thirst with clean, bacteria-free water, can wash itself, shower, bathe, maintain a standard of cleanliness that makes it a small group in the great world of culture. I see the brilliant electricity plants, where the turbines whir as softly as cats purr, I see the coking out at Värtan, where

[7] Christensen, J. (2015). *Juridiken kring vatten och avlopp. En översiktlig genomgång av juridiken kring dricksvattenförsörjning samt avledning och rening av spillvatten och dagvatten*. Havs- och vattenmyndighetens rapport 2015, 15, Chapter 1.3

[8] Alm, J., Paulsson, A., & Jonsson, R. (2021). Capacity in municipalities: Infrastructures, maintenance debts and ways of overcoming a run-to-failure mentality*, Local Economy*, **36**(2), 81–97

[9] Jakobsson, E. (1999). Introduktion av WC i Stockholm: ett vattensystemperspektiv på staden. *Polhem*. **17**(2-4), 118-139

the gas is produced, the telephone switchboard's serpentine tangle of cables, which allow all these Stockholmers to get in touch with each other in a second." [10]

In everyday life, we normally think of two infrastructural systems, roads and WSS (the Water and Sanitation System), respectively. But, as indicated above, in a historical investigation, this line of thought is misleading. In fact, we have *three* modes of service *arrangements* turning into *systems*.

Thus I distinguish between the terms *arrangements* and *systems* to highlight the evolutionary process of transformation from older modes of *off-grid* service *arrangements* into modern *on-grid* infrastructural *systems*. Although not used in earlier research, this distinction is fundamental for the argumentation in this report. Historian Joel Tarr, for example, talks about the old (off-grid) "cesspool-privy vault *system*" and the modern (on-grid) "water-carriage *system* of waste removal". In this book the term *system* refers only to service arrangements that has taken the form of modern infrastructure.[11]

The main question is how service *arrangements* of streets, water, and sanitation turned into public infrastructural *systems*, and how they gradually were *articulated* as public responsibilities. Thus, by *articulating publicness* I mean a process whereby an area in society which earlier has been defined as being part of the private sphere, a task for the individual citizen or the household, is transformed into a task where public bodies such as the state or the municipality carry the responsibility. This does not automatically mean that a public organization must implement the tasks by establishing a special business organization. It is possible to have for example public gasworks run by commercial private companies, and as will be discussed later, it is also possible to have private individuals such as property owners and farmers performing the public tasks of road and street maintenance. In conclusion, the level of publicness is not a given based on intrinsic properties in the resource or service in question. Publicness is politically constructed and dependent on the actual historical context.

However infrasystems are not built over night and the threshold between off-grid service arrangements and on-grid systems is more of an analytical tool than something that can be exactly dated in time. What we see in a gradual transformation of these three areas with different paces, motivations, ownership forms and technical and institutional design. It is important to take a step back and recognize the character of these arrangements/infrasystems and what type of recourse or service they provide. As mentioned, it is only quite recently that arrangements for water and sanitation (WS) were merged into a unified WSS.

Another important distinction is that what we see is not a complete and total transformation of off-grid arrangements into on-grid systems. In the road sector we still have a local level of civic roads managed by the nearby property owners. Although I argue that these roads are relatively well aligned with the roads and street system, they are not entirely turned into a part of a modern infrasystem. Regarding water and sanitation we do not even see this grade of alignment between the local level and the system. In WSS the local level still has off-grid and pre-modern service arrangements which are not well aligned with the system. I will return to these aspects later.

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[10] Nordström, L. (1941). *En dag i mitt liv*, cited in Blomkvist, P. & Kaiser, A. (1998). *Den konstruerade världen: Tekniska system i historiskt perspektiv.* Brutus Östlings Bokförlag Symposium. Stockholm, Sverige, pp. 7

[11] Joel Tarr for example talks about the replacement of the old "cesspool-privy vault *system*" (off-grid) with the modern "water-carriage *system* of waste removal" (i.e. modern on-grid sewerage). Tarr, J. et al. (1984). Water and Wastes: A Retrospective Assessment of Wastewater Technology in the United States 1800-1932, *Technology and Culture*, **25**, 226-263; see also Tarr, J. A. (1996). *The search for the ultimate sink: urban pollution in historical perspective*. 1. ed. Akron, Ohio: Univ. of Akron press.

Present day challenges in municipal streets and WSS

The research presented in this report shares the same starting points as the research project MISTRA InfraMaint:

"Swedish infrastructure faces major challenges. Many water and sewer installations, roads and railways are ageing, and in many areas extensive maintenance is needed. Infrastructure in poor condition has significant adverse repercussions on the economy and environment alike.

Today, municipalities and water and sewerage (WS) services lack support for strategic priorities and decisions. What is more, owing to inadequate financial and human resources there is a growing list of much-needed maintenance projects. At the same time, recruiting qualified personnel is difficult for the municipalities."[12]

On a global scale water issues are getting increased attention. This is a summary of the water situation in the world by the Swedish newspaper SvD, in connection with the UN water conference in March 2023:[13]

"Too little, too much and too dirty"

- A quarter of the world's population does not have access to safe water.
- Half of all people, 3.6 billion, live in unsanitary conditions.
- One in three lacks the opportunity to wash their hands at home. About half of the world's schools lack opportunities to wash hands with soap and water.
- Every day, more than 700 children under the age of five die because of diarrhea caused by contaminated water.
- Almost 75 percent of the environmental and natural disasters that have occurred in the last 20 years are related to water. The costs of these are around 700 billion dollars.
- Water-related hazards have increased in the last 20 years. Since 2000, disasters linked to floods have increased by 134 percent. Periods of drought have become more frequent and more persistent.
- In the last 300 years, around 85 percent of the planet's wetlands have disappeared, leading to the loss of several sensitive ecosystems and species."

This global situation strongly affects all sorts of infrastructure where for example urban systems for piped water, sanitation, roads, and streets have begun to see decline and disrepair even in high-income countries. These infrastructure sectors face large investment needs, especially in the face of the global warming effects described above. To put it bluntly, innovation driven transformations of infrasystems are crucial to mitigate the upcoming climate crisis.

The upcoming water crisis, partly because of a global over extraction and pollution, is described like this by Charles Fishman (2011) blaming our reluctance to act on the "brilliant invisibility" of water systems:

[12] Mistra – Mistra; Malm, A., Löfdahl, G-M. (2020) Engaging stakeholders for improved IAM implementation, *Water Practice and Technology*, **15**(2), 350–355; More on this in Juuti, P., Katko, T., & Vuorinen, H. (2007). *Conclusions: does history matter?: present water governance challenges and future implications*. In *2007. Environmental History of Water-Global views on community water supply and sanitation. IWA Publishing*, pp. 589-590.

[13] https://www.svd.se/a/3Ex1V9/historiskt-mote-om-varldens-hotade-vatten Source: United Nations, (access: 23-03-23); See also: https://sdgs.un.org/conferences/water2023; https://siwi.org/latest/5-messages-from-siwi-to-the-un-2023-water-conference/; https://www.havochvatten.se/arkiv/aktuellt/2023-03-21-halla-dar-jakob-granit.html

"Perhaps the most unsettling attitude we've begun to develop about water is a kind of disdain for the era we've just lived through. The very universal access to water that has been the core of our water philosophy for the last hundred years – the provision of clean, dependable tap water that created the golden age of water – that very principle has turned on its head. The brilliant invisibility of our water system has become its most significant vulnerability. That invisibility makes it difficult for people to understand the effort and money required to sustain a system that has been in place for decades but has in fact been quietly corroding from decades of neglect."[14]

Moreover, infrastructural systems often suffer from innovation deficit, and is hampered by inconsistent and complex institutional frameworks. Furthermore, large-scale infrastructures are hard to change and typically exhibit technical and institutional path dependency and inertia, making uptake of innovations slow. Earlier research clearly shows that innovations must be aligned with organizational as well as socio-technical contexts to have an impact.[15] This points to more fundamental, structural, and even historically grounded problems in infrastructure that needs to be understood to fast-track a transformation towards sustainability.

I hope that this report will shed light on the historical legacy in infrastructure and reveal factors that needs to be considered to reach an innovative and sustainable management of streets, water, and sanitation.

The alluring legacy of Rome and the rhetoric of Bonum Commune

When dealing with the history of municipal infrastructure it is impossible to avoid the highly praised Ancient and especially Roman achievements. For good reasons Rome has a certain allurement to historians of infrasystems. First, as indicated above, roads, water provision, and sanitation, in one form or the other, has been around since the dawn of mankind. In historical accounts researchers often start by a recapitulation of their Ancient and Roman history, giving the impression that we see an unbroken system evolution over several millennia. But in this report, I claim that this ancient history does not matter very much in the development of Swedish or western municipal infrastructures. Even if the technology in these systems were ancient, well known and the envy of every municipal engineer, very little speaks for the existence of a technical (or institutional) trajectory stretching over thousands of years, at least in water and sanitation. Concerning roads though, I make an exception, and claim that the medieval history matters in a more direct sense.[16]

The second allurement of Rome, apart from a belief in the existence of a technical trajectory, lies in the perceived connection between ancient infrastructure building, especially in water and sanitation, and *Bonum commune*, the common good (Det allmänna bästa).[17] One example of this allurement is Bjur (1988) who start his, in many ways excellent historical investigation of "the art of water building in Gothenburg during 200 years", by directly connecting the efforts in WS-building in Gothenburg to Roman perceptions of the communal good. In the first sentence of the book Bjur asks the rhetorical question why the acronym *S.P.Q.R.* is engraved on every manhole lid in the streets of

[14] Fishman, C. (2011). *The big thirst: the secret life and turbulent future of water*. New York, Free press, pp. 24
[15] Blomkvist P., Nilsson D., Joma B. & Sitoki L. (2019). Bridging the critical interface: Ambidextrous innovation for water provision in Nairobi's informal settlements. *Technology in Society,* **60**.
[16] It's even possible to claim, but probably not for Sweden, that the Roman road network still has and influence today: Dalgaard, C. J., Kaarsen, N., Olsson, O., & Selaya, P. (2022). Roman roads to prosperity: Persistence and non-persistence of public infrastructure. *Journal of Comparative Economics*, **50**(4), 896-916.
[17] *Bonum Commune Communitatis*: Common good of the community or "general welfare". Refers to what benefits a society, as opposed to *Bonum Commune Hominis*, which refers to what is good for an individual. *bonum commune communitatis - Latin is Simple Online Dictionary*. (2023). Latin Is Simple. https://www.latin-is-simple.com/en/vocabulary/phrase/245/, accessed 23/4 2023.

Rome and on the front official buildings. The acronym stands for *Senatus PopulesQue Romanun,* meaning *The Roman Senate and People* or *The Senate and People of Rome*, and is an emblematic phrase referring to the government of the ancient Roman Republic. Bjur states that the engraving on the lids to the underground WS systems shows that they were built for the *Bonum Commune Communitatis*: "The art of water building showed early on its quality of serving the common good."[18] Bjur is of course not wrong. The Roman art of water building was surely in many ways connected to *Bonum Comune Communitatis* and served the senate and the people of the city (*S.P.Q.R.*). Furthermore, Bjur further builds his claim that water provision is a communal good by citing a letter from the Swedish king Gustav II Adolf in 1630: "A water main in a city is a publicum bonum."[19]

However, the referral to the acronym *S.P.Q.R.* and to an ideology of *Bonum Comune Communitatis* is still a bit misleading. First it seems that the many references to these concepts appeared at a time in the Roman empire when the old republic had been replaced by autocratic rule under the emperor Augustus (27 BC to 14 AD). For example coins with the inscription SPQR begin to appear at the same time as Augustus attempts to legitimate his claims to have "restored" the republic. Ancient historian and classical numismatist Liv Yarrow claims that the usage of the acronym served to justify autocracy by connecting Augustus rule to an earlier age in order to preserve the myth that the Republic still lived on. Since the time of Augustus, SPQR and this biased vision of Rome has repeatedly been used to connect various ideologies to the mythological power of the Roman republic. This rhetorical connection was for example apparent in the Italian Fascist movement under Mussolini. After the proclamation of the dictatorship in 1925 Mussolini's appropriation of Roman symbols was evident and functioned as a strategy to build legitimacy. Ancient Rome was portrayed as a model for political and military organization and as a symbol of Italian unity. Furthermore, and to reconnect to water and sanitation it was in fact Mussolini that popularized the use of the SPQR-inscription on the manhole lids which has been interpreted as an ancient and true Roman symbol of *Bonum Comune Communitatis.*[20]

To sum up, and as will be elaborated later, the many references to the Roman era and its alleged publicness in the history of Swedish and European pre-modern and modern WS were mostly rhetorical ornaments. By appropriating the grandeur of Roman WS technology and its reputation as a true communal good, advocates of public water and sanitation could motivate their proposals and tap into the glory of ancient Rome.

Common versus private goods

Having said the above on the rhetoric's of a Roman legacy, it is still important to note that the history of public involvement in streets, water, and sanitation, in a very concrete sense is related to the debate on *Common Goods* among economists and political philosophers (also called *public* goods, but I use *common* to not mix up the terminology).

The discussion on what constitutes a common or a private good has been ongoing since Aristoteles and was an important part of Roman political life. The terms *Res publica* vs. Res *Privata* (public vs,

[18] Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg, Göteborgs VA-verk, pp. 11
[19] Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg, Göteborgs VA-verk, pp. 15
[20] https://hyperallergic.com/457510/the-misuse-of-an-ancient-roman-acronym-by-white-nationalist-groups/; Publications – Liv Mariah Yarrow (livyarrow.org); SPQR in the hands of Racists – Liv Mariah Yarrow (livyarrow.org); This interpretation is corroborated by: Benes, C. (2009) "Whose SPQR? Sovereignty and Semiotics in Medieval Rome" in *Speculum* 84 (2009), p. 874-904, and Hardwick, L. (2003). *Reception Studies.* Greece and Rome: New Surveys in the Classics (33). Oxford, U.K.: Oxford University Press.

private property/affair) is a part of our Roman legacy, and as alluring as the belief in a technical trajectory stretching over millennia.

A private good is something that a single individual can consume and by doing so prevents consumption of other individuals (*rivalrous* goods) or a good which is *excludable*, meaning that it is possible to prevent others to consume it, to "draw a fence around it". Food that we eat are considered a rivalrous good while listening to radio music normally is non-rivalrous. Landownership is considered excludable while streetlight and the air we breathe is non-excludable.[21]

Thus, common goods are, as opposed to private, what is shared by all, or many, members in a community and it is easy to see that an infrastructural system most often fits in this category. Furthermore, common goods, as infrastructure, is difficult for an individual or a small group to realize. The investments to build a road network or a system for water and sanitation are huge and there are big financial risks associated with getting return on the investment. The services delivered are not easy to price and the market is often uncertain before the infrasystems is fully operational.[22]

These characteristics of common goods (and infrasystems) has led to a debate on *economies of scale* and whether they should be provided by the market or by the state and if they are so-called *natural monopolies* or not. This discussion leads to far for this report. It is sufficient to ascertain that the general, mid- 19th to 20th century, "Swedish model" for provision of common goods and infrastructural services most often included high state involvement by authorities or state-controlled monopolistic companies. As will be discussed below, state involvement was stronger in roads and streets than in water and sanitation which became municipal systems. Nevertheless, WSS surely has similar characteristics of economies of scale and natural monopolies as other infrasystems.

Discussions about common goods are also closely related to questions on whether they should be considered a *human right*. That is if they are so important for societal well-being that they ought to be provided for free or for a minimum cost giving everyone the right to a share the common resource. This issue is also related to deliberations on financing through individual tariffs or a general tax shared by all. Swedish roads and streets have traditionally been paid for by taxation while water and sanitation most often has been financed by user fees.[23]

Without going deeper into theories on common goods, for this report it is sufficient to say that modern infrastructure for streets/roads, water, and sanitation bears a strong *resemblance* to common goods. But this has not always been the case for all three of them. I will return to the question on common and private goods and the issue of publicness in the conclusion of this report.

Furthermore, the discussions touched upon above by philosophers and economists are quite normative and include an ambition to define intrinsic characteristics of common and private goods and methods on how to manage them. In my investigation I rather look at how these areas of essential human needs has been historically defined over time. I do not stipulate their nature, but instead investigate the *articulation* of publicness, how streets, water, and sanitation has gradually

[21] *Public Goods (Stanford Encyclopedia of Philosophy)*. (2021, July 21). https://plato.stanford.edu/entries/public-goods/; Boccaletti, G. (2021). *Water: a biography*. First edition New York, Pantheon Books, pp. 66-79

[22] These "peculiarities" in infrasystems will be elaborated later.

[23] For an interesting discussion on WSS and theories on public goods, see Nilsson, D. (2005), *The Evolution of Urban Water and Sanitation in East Africa from a public goods perspective* in Tempelhoff, J. (2005). *African water histories: transdisciplinary discourses*, Northwest University, South Africa. pp. 317-345

evolved into our present-day publicly managed infrastructural systems and thereby, as an end-result, turned into common goods-like resources. [24]

General purpose and theoretical inspiration

As mentioned there has always been some sort of service arrangement to provide for roads/streets, drinking water, and sanitation. The general purpose of this report is to analyze how these arrangements have changed over time focusing on the tension between public and private responsibilities from the nineteenth century up until today to understand how history affects present-day management of municipal infrastructure.

For a service arrangement to become a public responsibility it needs to be *articulated* as such. Thus, the creation of publicness is dependent on this articulation process. As touched upon above, *articulating publicness* is a process whereby an area in society which earlier has been defined as being part of the private sphere, a task for the individual citizen or the household, is transformed into a task where public bodies such as the state or the municipality carry the responsibility. Furthermore, the level of publicness is not a given based on intrinsic properties in the resource or service in question, whether it is a public or private good in any definitive sense. Publicness is politically constructed and dependent on the actual historical context. To use the Latin phrases introduced earlier the articulation of publicness means that areas considered *Res Privata* are turned in to *Res Publica*.

Following from the this, I argue that the articulation of publicness includes two interconnected elements. First a discussion on whether a certain area belongs to the private or the public domain. Second, after a declaration of public responsibility, follows a discussion on what type of actor that should be the performer of the tasks now declared public. However, the articulation process is not static, and it is not decided once and for all that an area belongs to the public sphere. In the following historical account it is evident that one area can exhibit a strong articulation of publicness while we see a weaker articulation in another. I follow historians Hallenberg and Linnarsson (2016) in their discussion of a "…successive articulation of the public sphere… (they investigate) …the role of political discourse in articulating a stronger sense of publicness." [25]

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[24] In a general sense, I am also inspired by Gunn et.al (2022) when they coin the term *Infrastructuring of citizenship*, in a discussion of how modern citizenship was co-created in relation to modern infrastructural systems in European towns: "…urban infrastructures and citizenship have been mutually constitutive…" Without going deep into this research area, it is fair to say that my report in some ways can be seen as part of the *infrastructuring of publicness:* Gunn, S., et.al (2022) Cities, infrastructure and the making of modern citizenship: The view from north-west Europe since c. 1870, *Urban History*, 1-19, p. 18. For a discussion of "infrastructuring" in Circular Economy (CE) se also Nogueira, A,, et.al (2020), Infrastructuring the Circular Economy, *Energies* 2020, **13**(7), 1805, p. 4: "The concept of "infrastructuring", from participatory design, suggests an expansion from focusing on the hard dimensions of interventions (outputs), and to also consider people's activities and organizational practices (processes)…Thus, "infrastructuring" CE presents a means to democratize the processes of determining how resources should be allocated and mobilized. It requires the participation of individuals and organizations to be involved in and impacted by new infrastructural interventions during the processes of creating them, not only in the implementation phase." Another inspiration in the background of this report is research on infrasystems and their relation to nature. Terje Tvedt and Eva Jakobsson (2010) use the words of Karl Marx in a discussion how infrastructure such as water and sanitation has "liberated" us from nature: "Karl Marx's statement: 'Capitalism liberated man from the traditional, localized dependency of nature, and with it the "nature idolatry" (worship) this relationship was associated with. It was no longer "nature" that fettered the human being; it was capitalism that did that.' In *Grundrisse* he wrote: For the first time, nature becomes purely an object for humankind, purely a matter of utility; ceases to be recognized as a power for itself, and the theoretical discovery of its autonomous laws appears merely as a ruse so as to subjugate it under human needs, whether as an object of consumption or as a means of production.": Tvedt, T. & Jakobsson, E. (2010) *Introduction: Water History is World HistorY,* in Tvedt, T. and Østigård, T. (eds.) (2010). *Ideas of water from ancient societies to the modern world*. London: I. B. Tauris

[25] Linnarsson, M. & Hallenberg, M. (2016). *Urban space, private business and the common good. The Politics of the street in early 20th century Stockholm*, Abstract from conference presentation**:** Reinterpreting Cities: European Association for

To avoid misunderstandings it must be noted that I use the term *private* in a different way than Hallenberg and Linnarsson. They analyze the political debate on which actors that were best suited to execute public tasks: public bodies such as municipalities or *private* actors such as commercial companies. This debate is very much alive today in Sweden and in Europe, where for example public domains such as health care and schools are run by commercial companies. In this book *private* refers to private individuals and citizens (or groups) without commercial interests because in the history of streets, drinking water and sanitation, the presence of commercial companies has not been so prominent (but there are exceptions), and because I am interested in the process where these areas were articulated as public in the first place.

To analyze the articulation of publicness in streets, water, and sanitation I relate their transformation into infrastructural systems to several important contextual factors in Swedish history. But it must be noted that although I focus on Sweden these contextual factors were in many ways also present in most European and North American municipalities at the time. The history of municipal infrastructure in Sweden is part of a general development in the whole Western world.

I propose that current management in municipal streets, water and sewage is strongly influenced by the historical development of whether these service arrangements should be articulated as public or private.

The concept of publicness

Regarding *publicness*, as mentioned, I have used the same inspiration as Linnarson and Hallenberg in their research and my investigation also draws on the work of Janet Newman and John Clarke in their analysis of publicness in contemporary politics. According to Newman and Clarke, "…publicness is the combination of ideas, people, and practices that have been made public, comprising a process in which matters of collective concern have been made visible…" They argue that "…the organization as well as the performance of public services affects the perception of common interest in any given society, and this consciousness makes up a notion of publicness." [26]

Mats Hallenberg and Magnus Linnarsson describe the concept of *publicness* as a multifaceted phenomenon: "ideas about the public/common good". The concept includes several different components:

1. Who constitutes the public/community: included "citizens" and excluded "others" respectively?
2. What resources, tasks, activities are considered public, and must be carried out to ensure the continued existence of the entire community?
3. Who shall carry out the above tasks: who may act in the name of the public?

Urban History Conference, Helsinki, Finland, August 24-27 2016**,** pp. 11-12; Hallenberg, M., & Linnarsson, M. (2016). Vem tar bäst hand om det allmänna? Politiska konflikter om privata och offentliga utförare 1720–1860. *Historisk tidskrift*, **136**(1), 32–63, pp. 39; Building on: Melkersson, M. (1997). *Staten, ordningen och friheten: En studie av den styrande elitens syn på statens roll mellan stormaktstiden och 1800-talet: a study of ideals of state and state regulation among the ruling elite in Sweden c. 1660-1860* (Doctoral dissertation, Acta Universitatis Upsaliensis). pp. 207–225.

[26] Linnarsson, M & Hallenberg, M (2020) The Shifting Politics of Public Services: Discourses, Arguments, and Institutional Change in Sweden, c. 1620–2000. *Journal of Policy History*, **32**(4), Donald Critchlow and Cambridge University Press, pp. 445-446; Hallenberg, M. & Linnarsson, M. (2017). The quest for publicness political conflict about the organisation of tramways and telecommunication in Sweden, c. 1900–1920. *Scandinavian Economic History Review*. **65**(1), 70-87; Clarke, J. H., & Newman, J. E. (2009). Publics, politics and power. *Publics, Politics and Power*, 1-232.

4. What purposes, values, ideological goals do the community identify with in connection to the common good in question (order, health, equal distribution, etc.)?

Hallenberg and Linnarsson has mainly focused on point no. 3 in the list above. They analyze a central component in the articulation of publicness, namely the ownership of different service arrangements and infrasystems: Who were the actors: private (commercial companies) or municipal bodies? In my analysis of publicness in streets, water, and sanitation the question of ownership is included, but it is not in the center of investigation.

To avoid misunderstandings it must be noted that I use the term *private* in a slightly different meaning than Hallenberg and Linnarsson. They analyze the political debate on which actors that are best suited to take care of public affairs: public bodies such as municipalities or private, commercial companies. In this report *private* refers to private individuals/citizens (or groups) without commercial interests.

Analytical framework and research questions

The analytical framework of this report is divided in two parts: "the articulation of publicness" and "resource and systemic characteristics".

First, in the analysis of roads/streets, water, and sanitation respectively, I discuss how three *general contextual* factors has affected the articulation of publicness in these sectors. The first factor relates to a long history in Sweden stretching back to at least Medieval times. The rest of the contextual factors are mainly related to the nineteenth century. The general factors are:

- The strong tradition of local/municipal self-governance.
- Urbanization, changing demography and the industrialization process.
- The municipal reform of 1862.

I will also analyze the articulation of publicness in water and sanitation in relation to some *specific* contextual factors exclusively affecting the development in WS/WSS. These specific factors are:

- The conflict between the private and the public.
- The "social issue": concern for, and fear of, the working class and the poor.
- High mortality, Cholera epidemics and new perceptions of health and sickness.
- The Sanitary movement and the health act of 1874 (which was part of the municipal reform).

In the chapter on water and sanitation in the twentieth century two additional contextual factors are highlighted, which of course to some degree also influenced roads and streets:

- Environmental issues and pollution
- Sustainability, reuse, and the circular society

Thus, publicness is articulated by various actors influenced by different time dependent contextual factors. At any given time the community under investigation can be for example the village (with its village council), the town, the municipality, or the state (1.). Furthermore, different resources, tasks, and activities are considered public in different historical settings (2.) and various actors are assigned the responsibility to carry out these public matters (3.). The areas considered public are motivated and justified by reference to certain purposes, values, and ideological goals connected to the prevailing historical context (4.). In the final part, when comparing publicness in these three sectors, I return to the issue of ownership in municipal infrastructure and how the building and operations has been financed.

Second, to deepen the analysis the institutional and technical *legacy* of present-day infrasystems, I discuss how *resource* and *systemic characteristics* has influenced the shaping of municipal infrastructure. It is quite clear that streets, water, and sanitation are different in these aspects. As pointed out by for example Elinor Ostrom (1990) in her research on Common Pool Resources (CPR) the *character* of the resource or the service provided is important when analyzing its management. Important issues in my cases are if *cooperation* among appropriators/users is needed to utilize the resource/service, whether the resource/service has a *local* or non-local character and if people benefiting from the resource lived in densely populated towns or in the countryside. Furthermore, I combine the analysis of resource characteristics, with a discussion of *systemic* characteristics and use theoretical inspiration from the field of Large Technical Systems (LTS).[27] Important themes will be system characteristics such as *positive network externalities* (if the system works better when many users are connected and if the system is inherently gridded), if we can find centrally placed *system builders* and a certain systems *culture* (i.e. shared values on the best way to design and manage the system). Finally I discuss whether the system components, technical and institutional, are *tightly coupled*, meaning that systems are built only for their basic task and are difficult to use in any other way making access to the networks limited. Closely connected to the coupling of system components is the degree of *vertical integration*. In a tightly coupled system, all parts are adapted to each other, and interchangeability is low which creates a need for central coordination, i.e. vertical integration, to guarantee the system's reliability. In a vertically integrated system the same organization often acts as both system builder and network manager/system operator.[28]

Methods used and layout of the report

This report is based on a traditional combination of an extensive literature review of research from a wide range of various fields and a reading of historical prime sources. My findings and conclusions have continuously been validated in discussions with actors in the fields and historical experts (above in acknowledgements).

The literature review, which is the biggest part, has resulted in a synthetization of previous research and my main contribution lies in the historical comparison of infrastructural systems that normally are dealt with separately. I have reinterpreted earlier results and brought together research areas that not so often communicate. The comparative and long-term perspective allows me to discover similarities and differences in the development of arrangements around streets, water, and sanitation. Of these reasons, I argue that my literature review represents more than a regular state of the art in these fields.

The use of prime sources is centered on official documents, reports, and state lead investigations. I have not been able to go deep into political debates in for example various city councils or parliamentary disputes on infrastructural issues. This limitation in my research makes it difficult to present a fine-grained analysis of how publicness has been articulated trough an investigation of political debates in various municipal authorities and organizations. I strongly advice for further research in this direction due to the strong local character of municipal infrastructure.

Parts of the report concerning public and civic road keeping, are based on my earlier research and in this report, I occasionally use revisions of my own texts originally written in Swedish. I have adapted

[27] Kaijser A. (1994). *I fädrens spår: den svenska infrastrukturens historiska utveckling och framtida utmaningar.* Carlsson. Stockholm, Sverige; Ostrom E. (1990) *Governing the Commons. The Evolution of Institutions for Collective Action*, Cambridge University Press. Cambridge, United Kingdom.
[28] Kaiserfeld, T. & Kaijser, A. (2021). Changing the System Culture: Mobilizing the Social Sciences in the Swedish Nuclear Waste System. *Nuclear Technology*, **207**, 1456-1468. Taylor and Francis.

them to fit in this project and translated them. The same goes for quotes from other researchers: all translations of earlier research in Swedish are made by me.

The method also includes what can be called an *historical contextualization* where I investigate the most important contextual factors that influenced the development towards public infrastructure in streets, water, and sanitation in the beginning of the nineteenth century. I have used research in medical, social, economic, technological, and political history highlighting the most important contextual factors in society at large that has affected streets, water, and sanitation. I show how their respective evolution into public infrastructural systems has been strongly influenced by the strong Swedish tradition of local independence, by urbanization, demography, and industrialization, the municipal reform of 1862, and specifically for water and sanitation, the conflict between the private and the public; the social issue; high mortality, Cholera epidemics and new perceptions of health and sickness; the Sanitary movement and the national health act of 1874; by environmental issues and pollution; by debates on sustainability, reuse, and the circular society

Finally, using theoretical concepts from the research traditions of Large Technical Systems (LTS, Hughes) and Common Pool Resources (CPR, Ostrom) I show how the evolution in municipal streets, water, and sanitation has left a historical *legacy* still affecting the way these infrasystems are managed today.

Chapter layout:

After this introduction, chapter 2 deals with three general contextual factors that affected the articulation of publicness in municipal infrastructure. Chapter 3 is about pre-modern and modern road and street history, and chapter 4 includes thematic discussion of roads and streets followed by a summary and analysis in chapter 5. Chapter 6 deals with pre-modern water and sanitation. Chapter 7 contains the specific contextual factors mainly influencing modern water and sanitation. In chapter 8 the history modern water and sanitation is presented, followed by twentieth century WSS in chapter 9, including two additional contextual factors (environmental issues and sustainability). Chapter 10 is a thematic discussion of WS/WSS and followed by a summary and analysis in chapter 11. Chapter 12 is a summative comparative analysis of streets, water, and sanitation and a discussion on what can be learnt from history.

Chapter 2: General contextual factors for roads/streets and WS

To understand the articulation of publicness in municipal infrastructure of streets, water, and sanitation it is important to be aware of some important *general contextual* factors in Swedish society at the time. Below I account for the strong tradition of local/municipal self-governance, urbanization, the changing demography, the industrialization process, and the municipal reform of 1862 (the act was accepted in Mars 1862 and came into force 1st January 1863)[29]. They all affected the service provisions/infrasystems investigated. Later I will account for some *specific* contextual factors which mainly affected water and sanitation.

Local/municipal self-governance

One fundamental factor in the history of these three modes of service arrangements/infrastructures is *municipal independence*. Even if the term is a bit anachronistic before the municipal reform of 1862, local self-government was very strong and had been so for a long time, in both towns and in the countryside:

[29] In the literature there are different ways to name the municipal reform/act. I have chosen 1862

"…local self-government and municipal activities are nothing new. It is a living tradition in Sweden that can be traced back in time at least to the Christianization of the country and the formation of parishes in the Middle Ages. The parish is said to have originally included the people who applied to the same church. From these gatherings developed gradually a local self-government arising from the need to on best way to arrange the common affairs of people living together in the same place. The local self-government has thus, according to this view, emerged from below and not through government order. The local community is older than the nation and the state…The parish formation has also been understood as a mixture of own local affairs and those imposed by the state tasks."[30]

Historian Eva Österberg has been leading in the discussion of how conditions in early modern Sweden were influenced by old structures of the local community. She argues that the foundation of local self-governance was based in an "…independent parish assembly, where the peasants met and where the demands of the state power were discussed in a distinct negotiation procedure. This political culture with long-term objectives based on peaceful negotiated solutions to conflicts and contradictions presupposes the acceptance by the state of a developed democracy at the local level..." To this picture, however, may also have belonged a delegated *communalistic* principle which, in exchange for the support of the population, gave a certain degree of self-determination and forced the central power into responsiveness. [31]

This view is put forward by the German historian Peter Blickle coining the concept of *communalism* in his research on what room for political action that ordinary people had in medieval and early modern Europe and within what sort of political framework they acted: "The term 'communalism' assumes - let me anticipate this - that common institutional, social, and normative structures existed in villages and valleys, towns, and markets…Communalism is a 'concept', a 'model', a 'type'…Communalism is not an abstract term for just any form of commune, but rather for politically constituted communes equipped with such basics as legislative, jurisdictional, and penal authority. In this sense not only cities but also villages are an expression of the *societas civilis cum imperio* (civil society with government), to use the terminology of Old Europe."[32]

I dare to say that the history of roads/streets, water and sanitation show a high level of local independence and negotiating power in relation to the state and municipal authorities.

Urbanization, demography, and industrialization

Urbanization was a relatively late phenomenon in Sweden. Around 1840 only about 10% of the population lived in towns and densely populated places. In the 1890.s 25% lived in towns and by the

[30] Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting, pp. 23

[31] Persson, S. (2008) Gerhard Oestreich, den tidigmoderna staten och det svenska forskningsläget, *Scandia*, **73**(1), 70-71; Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting; Kilander, S. (1991). *Den nya staten och den gamla. En studie i ideologisk förvandling* (Acta Universitatis Upsaliensis, Studia Historica Upsaliensia, 164)

[32]Bengtsson, E. (n.d.). *Bönders kommunalism i förindustriella Europa*. http://erikbengtsson.blogspot.com/2022/03/bonders-kommunalism-i-forindustriella.html, accessed 23/4 2023 ; Aronsson, P. (1993). *Bönder gör politik: Det lokala självstyret som social arena i tre smålandssocknar, 1680-1850*. Lund university press, 1992. Communalism might be understood as an early form of articulated publicness, motivating communal organization of common-pool resources.

turn of the century this figure was 32%, but it was not until the 1940s that half the population lived in (still small) cities.[33]

However, even though urbanization was quite slow compared to the European continent, Stockholm's population, for example, more than tripled, from 90,000 inhabitants to 300,000 between 1850-1900.[34]

In the first half of the 19th century, about three quarters of the population worked in agriculture. While the population increased from 2.3 million in 1800 to 3.5 million in 1850, the urban share was almost constant, it increased from 9.8% in 1800 to 10.1% in 1850. At that time, 70% of the towns had less than 3,000 inhabitants and only five had more than 10,000. Stockholm was by far the largest with its 93,000 inhabitants; Gothenburg had 26,000; Norrkoping, 17,000; Karlskrona, 14,000 and Malmö had 13,000 inhabitants. Most towns had a distinct rural character well into the 1830s and the urban population produced around half of the food they consumed. [35]

The urbanization process affected water provision and sanitation profoundly. With higher population density the problems with sewage and excrement management obviously worsened and the need for water, both for street cleaning, fire protection and for drinking was accentuated.[36]

Industrialization was a latecomer in Sweden compared to forerunners like England and Germany. Nevertheless, from the beginning of the nineteenth century, and especially from mid-century, the economic structure changed radically in Sweden. Sweden was transformed from a poor country based on agriculture to an industrial nation. The first half of the century saw an early industrialization in agriculture, reforms in land ownership and new crops and continued export driven trade in areas such as timber and iron. Thus the industrial revolution was accompanied by an *agrarian revolution* which included new methods for more efficient farming such as the iron plough pulled by a horse instead of oxen, crop rotation, a focus on exports of oats and butter and better and larger livestock through conscious breeding and better fodder. “Several researchers maintain that radical enclosures were the decisive motivating force behind the agricultural revolution. But this thesis has been able to show that neither land reclamation, the introduction of new crops, new cultivation systems nor new tools were inhibited by the open field system that existed before the radical enclosures. Consequently radical enclosures were not a motivating force, but rather a part of the great agricultural transformation.”[37]

By 1850 and onwards Sweden went from being a raw material exporter to a substantial industrial producer of sawn timber and refined workshop products. Between 1890-1930 the modern industrial society took off. The gross national product (GDP) grew by 1,4% per year 1800-1850; 2,4% between 1850- 1890 and by 2,8% per year 1890-1930. This translates into an increase of GDP growth per

[33] Drangert, J-O., Nelson, M. C., & Nilsson, H. (2002). Why Did They become Pipe-Bound Cities? Early Water and Sewerage Alternatives in Swedish Cities, *Public works management and policy*, **6**(3), 172-185, pp. 173 ff; Lundgren, L. (1974). *Vattenförorening. Debatten i Sverige 1890-1921*, Bibliotheca historica Lundensis Nr 30, Lunds universitet, pp. 20-22; Today around 85-90% live in urban areas: Drangert, J. O., & Hallström, J. (2002). Den urbana renhållningen i Stockholm och Norrköping:–från svin till avfallskvarn?. *Bebyggelsehistorisk tidskrift*, **44**, 7-24., pp.10 ; Statistikskolan: Urbanisering – från land till stad (scb.se); Hallenberg, M. (2018). *Kampen om det allmänna bästa: konflikter om privat och offentlig drift i Stockholms stad under 400 år*. Lund: Nordic Academic Press

[34] Urbanisering - Stockholmskällan - Redaktion, S. (2022, March 23). *Urbanisering - Stockholmskällan*. Stockholmskällan. https://stockholmskallan.stockholm.se/teman/industrialisering/urbanisering-och-emigration/

[35] Kaijser, A. (1986). *Stadens ljus: etableringen av de första svenska gasverken*. Diss. Linköping : Univ.

[36] Hallenberg, M. (2018). *Kampen om det allmänna bästa: konflikter om privat och offentlig drift i Stockholms stad under 400 år*. Lund: Nordic Academic Press, pp. 104-106

[37] Wiking-Faria, P. (2009). *Freden, friköpen och järnplogarna: drivkrafter och förändringsprocesser under den agrara revolutionen i Halland 1700-1900*. Diss. Göteborg: Göteborgs universitet, 2010. Göteborg.

capita from 1,4% per year to 2,8%, even though the population increased substantially, which indicates a strong productivity development.

From the very beginning Sweden got most of its income from exports and the trade surplus has been around 4% per year (mean value) since the middle of the century up to modern times. However, export-pull is not the only explanation. Sweden also had a substantial "middle class" of self-supporting farmers forming a basis for a strong home market, a relatively even distribution of wealth, a population that could read and creative industrialist starting innovation-based industries such as Alfa Laval and ASEA (1883) and Ericson in the 1880s (when Stockholm became the most telephone dense city in the world). Between1840-1870 political reforms aiming at liberalization of the economy lifted trade tariffs promoting free trade: the establishment of a new law on joint-stock companies, the abolishment of guilds (1846) and the freedom for business (1846). The following period, 1890-1910, is often referred to as the era of "Organized capitalism" when workers as well as industrialists started to organize themselves in trade unions and employer organizations and the Social democratic party was formed in 1889. This period was the origin of the famous "Swedish model" for organizing economic life and the labor market.[38]

There is one important area in this general industrialization process which I will come back to later in the report: the development of technology and technical expertise. Technology advances were of course pivotal for the development of these areas into infrastructural systems. Watt's steam engine and later Diesel engines and electricity were used in road construction, in digging for water and sewage pipes and for pumps transporting both drinking water and excrements in the pipes. Other examples are cast iron pipes with socket joints that were sealed with cast lead, in 1827, the use of iron for water mains was made compulsory in England,[39] and new technology to filter water with slow sand filters, originating in England around 1830.[40] Technological aspects also include the training of civil engineers specializing in Roads and WS and the establishment of private consultancy companies and engineering associations (and lobby groups) such as the Swedish Association of Municipal Engineers (1902), The Royal Automobile Club (1903) and the Swedish Road Federation (1914). They all became influential in propaganda and in setting standards and developing technology for roads and WS.[41]

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[38] Schön, L. (2014). *En modern svensk ekonomisk historia: tillväxt och omvandling under två sekel*, Lund: Studentlitteratur; *Unik tillväxt när Sverige gick från jordbruk till tjänster*. (n.d.). Statistiska Centralbyrån. https://www.scb.se/hitta-statistik/artiklar/2017/Unik-tillvaxt-nar-Sverige-gick-fran-jordbruk-till-tjanster/, accessed 23/4 2023 ; Blomkvist, P., and Kaiser, A. (red.) (1998) *Den konstruerade världen: Tekniska system i historiskt perspektiv* Brutus Östlings Bokförlag Symposium

[39] On early technology development in England see Rosen (2015): "Steam pumps and iron pipes were applied but, up to the first decade of the nineteenth the mains continued to be made chiefly of wood. The growing iron industry made possible a more extensive use and iron pipes and mains began to be introduced. This was particularly true in the poorer sections. Generally, a standpipe was the source of supply for several houses. Water quality improvement also came slowly. In many cases water came from polluted rivers and lakes." Rosen, G. (2015). *A history of public health. Rev., expanded ed*. Baltimore, Md.: Johns Hopkins University Press, pp. 82; See also Isgård, E. (1998). *I Vattumannens tecken: svensk VA-teknik från trärör till kväverening*. Örebro: Ohlson and Winnfors

[40] Anderberg, S. (1986). *Stockholms vattenförsörjning genom tiderna*. Stockholm

[41] This list includes some of the literature covering technical issues: Andersson, J. (2013). *Karlskrona vattenverk 150 år: stadens och kommunens VA-historia 1862-2013.* Karlskrona: Karlskrona kommun; Bjur, H., & Malbert, B., (1988). *Under staden: perspektiv på kommunal infrastruktur*. Stockholm: Statens råd för byggnadsforskning; Bjur, H., (1988). *Vattenbyggnadskonst i Göteborg under 200 år*. Göteborgs VA-verk, Göteborg; Björkman, B. (1967) Väg- och vattenbyggaren i ett föränderligt samhälle, *Jubileumsskrift 125 år Väg- och vattenbyggaren*; Blomkvist, P., (2001). *Den goda vägens vänner: väg- och billobbyn och framväxten av det svenska bilsamhället 1914-1959*. Diss. Stockholm: Univ., 2001, Brutus Östlings Bokförlag Symposium; Bäckman, H. (1984). *Avloppsledningar i svenska tätorter i ett historiskt perspektiv.* Göteborg: Chalmers tekniska högskola. Meddelande nr 74; Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag; Dufwa, A. & Pehrson, M. (1989) *Avfallshantering och återvinning.*

Industrialization also meant that more people moved into towns and problems with bad housing increased with veritable slums in the bigger cities. The situation for the urban working class and for the poor, worsened and the sanitary conditions, especially in towns, became truly appalling för many people. The so called “social question” was put high on the agenda which led to a strong public interest in water and sanitation (more on these issues later).

Roads and streets were of course also affected by the industrialization process which will be discussed further below. The effect can, with an expression taken from Eva Jakobsson, be characterized as the “industrialization of roads”. Jakobsson study how the natural water flows in Swedish rivers were transformed into a flow directed and controlled by an industrial rationality – the “industrialization of rivers”. The roads were not "natural" in the same broad sense as the Swedish rivers. But after all, they had been there for a very long time and were an integrated part of the landscape and social structure. For modern road engineers, the old road network was the same problematic entity as the rivers. It was all about taming, redirecting, controlling, and strengthening to make roads a part of the industrialized (and motorized) future.[42]

Stockholm, Sweden; Dufwa, A. (red.) (1985). *Stockholms tekniska historia 1 Trafik, broar, tunnelbanor, gator*. Stockholm: LiberFörlag; Fröman, O., (1897) Stockholms gator, afloppstrummor och planteringar, *Stockholm: Sveriges hufvudstad skildrad med anledning af Allmänna konst- och industriutställningen 1897,* enligt beslut af Stockholms stadsfullmäktige, **1897**(2), 247-294; Hamlin, C., (1992) Edwin Chadwick and the engineers, 1842–1854: systems and anti-systems in the pipe-and-brick sewers war. *Technology and Culture 33/1992,* ***4****,* 680–709; Hansen, F. V. (1897). Stockholms vattenledning, *Stockholm: Sveriges hufvudstad skildrad med anledning af Allmänna konst- och industriutställningen 1897,* enligt beslut af Stockholms stadsfullmäktige, **1897**(2), 323-352; Hollsten, B., (1897) Stockholms brandväsen, *Stockholm: Sveriges hufvudstad skildrad med anledning af Allmänna konst- och industriutställningen 1897,* enligt beslut af Stockholms stadsfullmäktige, **1897**(2), 405-420; Isgård, E., (1998). *I Vattumannens tecken: svensk VA-teknik från trärör till kväverening*. Örebro: Ohlson and Winnfors; Isgård, E., Mjöberg, H., Rundgren, L., (1987). *VBB-perspektiv 1987: teknik med perspektiv. Vattenbyggnadsbyrån (VBB)*, Stockholm; Jakobsson, E. (1999). Introduktion av WC i Stockholm: ett vattensystemperspektiv på staden, *Polhem*. Tidskrift för teknikhistoria, **17**(2-4), 118-139; Johansson, B., (1997) *Stadens tekniska system. Naturresurser i kretslopp* Stockholm, Byggforskningsrådet; Jönsson, B-G., (1991) *Vägen till bättre vägar*. Vägverket och Bertil Heddelin (red.) *VÄGAR. Dåtid, nutid, framtid.* Stockholm; Löfsten, H. (1992). *Underhåll av kommunal infrastruktur: principer för planering, prissättning och finansiering*. Diss. Göteborg : Univ.; Montelius, J-O., (1991) *Vägunderhåll och vägbygge vid 1800-talets mitt. Ett bidrag till väghållningens historia*, Daedalus; Pitkä-Kangas, L. (1996) *Framväxten av en miljöinfrastruktur: avloppstekniska system i Sverige omkring sekelskiftet 1900*, Miljöhistoria på väg*:* artiklar presenterade vid Miljöhistoriskt möte 199*5*, Linnér, B-O. & Svidén, J. (red.), Linköping: Tema Vatten i natur och samhälle, Univ. ; Rubenson, M., (1897), Gaturegleringen, *Stockholm: Sveriges hufvudstad skildrad med anledning af Allmänna konst- och industriutställningen 1897 enligt beslut af Stockholms stadsfullmäktige*, **1897**(2), 217-246; Svedinger, B., (1989), *Stadens tekniska infrastruktur: en kunskapsöversikt*, Statens råd för byggnadsforskning, Stockholm; Stockholm Waterworks. (1961). Stockholm waterworks 100 years 1861-1961. Stockholm, Sweden: Stockholms gas och vattenverk; Tarr, J. (1999). The separate vs. Combined sewer problem: a case study in urban technology and design choice. In Smith, D. (ed.), *Water-Supply and Public Health Engineering*. Ashgate Variorum, cop. Aldershot, United Kingdom.; Thelle, M., (2019) Stofskifte under tryk: Vandets infrastruktur og rum i København, TEMP - *tidsskrift for historie,* **9**(18); Tullgren, E. (red.) (2002). *Svenska kommunal-tekniska föreningen 100 år: [1902-2002]*. Stockholm: Fören.; VVK ”Väg- och vattenbyggarutbildningen 125 år, Jubileumsskrift” *Väg- och vattenbyggaren* 1967; *Vägfrågans ståndpunkt i Sverige* 1915; *Vägfrågans utveckling i Sverige. Samlade uppsatser ur Teknisk tidskrift 1911-1913*, Teknologföreningens förlag 1913; Wallander, F.G.F. (1897), Stockholms renhållningsväsen, *Stockholm - Sveriges hufvudstad skildrad med anledning af Allmänna konst- och industriutställningen 1897*, **2**, ed. E. W. Dahlgren (Stockholm, 1897), Vol. IL; Wedin, R., Björlund, K., (2002). *Vatten i Stockholm, 750 år med vatten i en huvudstad*. Stockholm: Stockholms Miljöcenter; Westlund, H., (1998). *Infrastruktur i Sverige under tusen år*. 1. [uppl.] Stockholm: Riksantikvarieämbetet; Winnfors, E. (2008). *Sundsvall - vattenstaden*. Örebro: Ohlson and Winnfors; Winnfors Wannberg, E. (2017). *Jakten på Gävles vatten*. 1. uppl. Örebro: Ohlson and Winnfors; Åström, T. R., (1967) Kungl. Väg- och vattenbyggnadskåren, VVK. Då och nu – utvecklingen av VVK. *Jubileumsskrift 125 år Väg- och vattenbyggaren*, 1967; Österberg, D., (1967) Väg- och vattenbyggarutbildningen 1842-1967. *Jubileumsskrift 125 år Väg- och vattenbyggaren.*

[42] Jakobsson, E. (1996), *Industrialisering av älvar. Studier kring svensk vattenkraftutbyggnad 1900 - 1918*, diss. Historiska institutionen i Göteborg, 13; See also: Schivelbusch, W., (1984) *The History of Rail Travel*. About the industrialization of space and time during the nineteenth century, Malmö.

The municipal reform of 1862

The municipal reform of 1862 and its following statues must be seen in the light of the emergence of a more pro-active state in the second half of the nineteenth century. Kilander (1991) analyzes the new role played by the state from the end of the nineteenth century when state interventions became the more frequent than before. Earlier liberals during the 1800.s could combine a belief in the night watchman state and a minimum of state interventions, with an open mind towards state involvement in for example state-owned railway lines. The division in responsibilities was not between the *state and the private* but between the *public and the private interest*. The state had the right and duty to regulate what concerned the public interest but could not intervene in what was regarded as a private sphere. If the issue at hand only affected the lives of individuals or groups, nonintervention applied. Interestingly, from a state perspective, the municipalities were also considered to be part of the individual sphere. But this perception changed and the state, though the municipal act of 1862, gave the municipalities the obligation and the tools to intervene in the private spere. However, the municipal independence was still intact, and as will be discussed later, the state at the same time gave the municipalities a lot of freedom to decide on how much and in what areas to intervene.[43]

Before the middle of the nineteenth century the government in Swedish towns was upheld by the Burghers, and to some extent the property owners. The Burghers were citizens in towns that had the monopoly to carry on business, trade, and crafts (Burghership) and were organized in guilds (skrån). The Burghers had the right to participate in city decisions and they paid tax. During the Middle Ages and formally up to the 1866 the Burghers were part of the so-called Estate society where power was shared between the king and the four estates: Nobility, Priests, Burghers, and Farmers. Earlier the Burghers made up around 22% of the city population but this number fell to approximately 14% in the 1830.s. The most important town authority was the Magistrate which functioned as the city court and as an administrative body dealing with the day-to-day management of city affairs. The Magistrate was led by the mayor and several magistrates (varying according to town size) appointed by the Burghers and the property owners. The other important authority in the towns were the Elders Council of the Burghers which represented the interests of tradesmen and craftsmen. A special body, which eventually became the most powerful authority, was the Economic commission (Drästelkommission) dealing with the town budget, income, expenditures, and tax collection, a city department of finance, of sorts. The Burghers most often controlled this organization by their majority of representatives.[44] The third power center were the Church parishes (församlingar) which had their own parish meetings to decide on town affairs. In practice these three had to agree on all important, and costly, matters which made the town hard to manage effectively.[45]

Furthermore, the political leadership and the administration in Swedish towns were scattered before the municipal reform in 1862. Basically each town decided on their own, and it is hard to talk about a general governance model. However, the low level of unity was basically due to a conflict between two logics. The first was the medieval praxis building on the estate-society with the magistrates and the Burghers, in which the latter held most of the power. The other logic was built on the local ecclesiastical organization building on the parishes and their parish meetings deciding on taxes and expenditures. In Stockholm for example, with its eight parishes, all projects had to be approved by

[43] Kilander, S., (1991), Den nya staten och den gamla. En studie i ideologisk förvandling *(Acta Universitatis Upsaliensis, Studia Historica Upsaliensia,* **164**.
[44] Kaijser, A., (1986). *Stadens ljus: etableringen av de första svenska gasverken*. Diss. Linköping: Univ.
[45] Nilsson, L., & Forsell, H., (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Stockholm: Sveriges kommuner och landsting, pp. 23

all. To deal with these problems a special parish board was established to work out compromises between different interests. It seems clear that the hardships of getting unanimous decisions in for example infrastructural projects were a strong reason for the municipal reform. After 1862 the power was concentrated to one central body, the new mandatory Municipal council.[46]

The many stakeholders spurred administrative innovations. Already in 1811, the Burghers of Stockholm petitioned that the town finances should be transferred to a special commission jointly managed by the magistrates and the Burghers. The suggestion resulted in the establishment of the already mentioned *Drätselkommissionen*, a department of finance at town level, in which the Burghers secured a majority of seats.[47] This move was of course aimed at breaking the frequent paralyzing power struggles between Burghers, magistrates, and the parishes that often-made decisions on infrastructure investments and similar projects extremely difficult and unwieldy. The reason for these problems is quite easy to understand. When building an infrastructure in for example gas or water provision it is impossible to connect all inhabitants in a town momentarily. Thus people in the peripheral parts were forced to wait some time, often years, before they could be connected to the grid. Nevertheless they were still obliged to pay for the project. This typical feature in infrastructure development caused envy and suspicion – why should we pay for services benefiting others? Furthermore, these problems often got worse because the people first connected to the grid were wealthy property owners in the city centers.[48]

The demise of the estate society and the more liberal trade legislations from the middle of the nineteenth century and onwards meant that the original idea behind town privileges, the exclusive commerce rights (trade monopoly) of the Burghers, faded away. The estate society was formally abolished in 1866 (see below). [49]

According to a simplistic picture of classical liberalism, the state (and the city) should have a completely passive role, but that was seldom the case. Even Adam Smith in 1776 admitted three legitimate state functions:[50]

1. protect society against violence and invasion

2. protect the members of society from injustice and oppression

3. the duty to establish and maintain certain public works and certain public institutions that no individual or small group can manage.

The number of parishes, which in 1862 basically were transformed into municipalities, was almost 2 500. The following municipal reforms of the late nineteenth century and in the 20th century, has greatly reduced this number. As mentioned, Sweden now has 290 municipalities. [51]

[46] Gullberg, A. (1998). *Nätmakt och maktnät: Den nya kommunaltekniken i Stockholm 1850-1920* in *Den konstruerade världen: Tekniska system i historiskt perspektiv*, Blomkvist, P., & Kaiser, A. (red.), Brutus Östlings Bokförlag Symposium, pp. 107-116; Svensk författningssamling, SFS:14, 1862 Förordning om kommunalstyrelse i stad
[47] Höjer, T., (1953). *Stockholms stads drätselkommission 1814-1864 och Börs-, bro- och hamnbyggnadskommitterade 1815-1846,* Diss., Stockholms högskola, pp. 8-10
[48] Kaijser, A., (1986). *Stadens ljus: etableringen av de första svenska gasverken*. Diss. Linköping : Univ.; Gullberg, A. (1998). *Nätmakt och maktnät: Den nya kommunaltekniken i Stockholm 1850-1920* in *Den konstruerade världen: Tekniska system i historiskt perspektiv*, Blomkvist, P., & Kaiser, A. (red.), Brutus Östlings Bokförlag Symposium.
[49] Bokholm, R., (1995). *Städernas handlingsfrihet: en studie av expansionsskedet 1900-1930,* Diss. Lund: Univ. pp. 28-32
[50] Bokholm, R., (1995). *Städernas handlingsfrihet: en studie av expansionsskedet 1900-1930,* Diss. Lund: Univ. pp. 34
[51] Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting, pp. 23

In May 1862, Stockholm received its own municipal ordinance. It was common that capitals got a special position because the government (and the King) wanted to control the capital towns, where the national political power was concentrated.[52] But already in 1817, the parishes had received the right of taxation in certain matters, while in 1862 taxation rights was extended to all the areas that did not belong to the state's obligations. Thanks to the municipal tax, the municipalities were able to take responsibility for the infrastructure that came with industrialization and increased population. The municipality was regarded roughly as a joint-stock company where the shareholders' degree of decision-making was determined according to each one's share.[53] For most of the municipalities, taxation became the most important source of income. During the 1870s, cities and towns together received on average just over a third of their total income via tax funds. That percentage rose to over 40 percent in the early 1910s. The second most important income soon became fees charged for gaslight, water, and electricity and the third income source was fees for selling and dispensing spirits and profits from municipal spirits companies (in the 1870s, an average of 15 percent of municipal income came from alcohol). [54]

Through the municipal reform of 1862, new principles for municipal administration had been created and municipal self-government had been strengthened. The Municipal Act gave each municipality the right to take care of its own common order and household affairs.

In the preparatory work for the new municipal law, it was said that municipalities were not allowed to run companies with speculative elements. However, fees for the operation could be charged. The public undertakings that were run as companies were the gasworks, electricity works, tramways, bathhouses, theaters and in some cases hotels.[55]

Following Kaijser (1986) one can see a clear connection between public infrastructure building and the municipal reform. In the beginning of the 1860s there is a culmination of municipal gas works and the beginning of municipal piped water systems. In 1870, 18 out of 20 of the largest towns in Sweden had built a gas plant (12 them were owned by the municipalities). As mentioned, starting in Stockholm 1861, water works were built, followed by Karlskrona 1864, Jönköping 1865, Malmö 1866.

It is evident that the arguments in favor for municipal gas and water were supported by a report which outlined the principles for the municipal reform. In the report from 1859, the municipal area of competence was defined like this:

"Any other or closer determination of the special concerns, which should become formal for the municipalities' self-operation and decision-making rights, than the one contained in the three words: "common order and housekeeping concerns", the committee members have not found it appropriate to include among the general statutes . . . the issues within the municipality, with which

[52] Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting, pp. 16

[53] *De svenska skatternas historia*. (2023). Skatteverket. https://www.skatteverket.se/omoss/varverksamhet/statistikochhistorik/skatternasochfolkbokforingenshistoria/desvenskaskatternashistoria.4.22501d9e166a8cb399f1f7d.html, accessed 23/4 2023 ; Gunnar Wetterberg: *Rätten att beskatta är självstyrelsens salt*. (2020, August 19). https://www.dagenssamhalle.se/alla-nyheter/kommentar/ratten-att-beskatta-ar-sjalvstyrelsens-salt/, accessed 23/4 2023

[54] Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting, pp. 139-140

[55] Bokholm, R. (1995). *Städernas handlingsfrihet: en studie av expansionsskedet 1900-1930,* Diss. Lund: Univ. pp. 105-107

it acts to take responsibility, shall have their root and their origin in and from the common interests, which the municipality as a personality acts."[56]

Thus the old principles of self-governance and independence were reinforced but also the obligation for every municipality to take care of common order and housekeeping concerns. Every municipality had to deal with these issues, but they could do so in a way that they saw fit.

Again, the most important factor concerning infrastructure was the expanded possibility for the municipalities to levy tax from all citizens. Earlier it was the Burghers and the property owners, in towns and the farmers on the countryside, that paid for most of infrastructure expenditures. Furthermore, given the new income from taxation the municipalities were able to put up a stronger security towards banks and other financial institutions.[57]

The cities borrowed money to a greater extent than the rural municipalities which can be seen in expenses for interest which increased from 9-10% to 14–15% from mid-1870s to 1920 and it was often the second largest item of expenditure after infrastructure, comparable to schools and more than poor services. Borrowing, in turn, was largely the result of infrastructural investments.[58] Between 1880 and 1910, the towns' borrowing increased sevenfold.[59]

The municipal act of 1862 was soon followed by four so-called city statues detailing the obligations of towns. They were the statue of Order (1868); the Fire statutes (1874); the Building statutes (1874) and the Health care statutes (1874). All the statutes applied compulsorily in cities. The City Planning Act of 1907 is also often included in this list.

Concerning building and city planning the cities had responsibility for their own urban planning, which included street management, since the 17th century but in 1874 consequently, these areas were regulated in national legislations.[60] A new building law was issued in 1931 and came into force in 1932 at the same time as the 1931 Town Planning Act.[61]

Already at the beginning of the 20th century, the need for cooperation between the municipalities increased, and in 1908 the Swedish City Association was formed and in 1920 the Swedish Association of Municipalities. In 1968 they were merged under the name Association of Municipalities (Kommunförbundet). The need to cooperate was a consequence the strong expansion of the public sector, most often managed by the municipalities. From the 1970s, the municipalities came to have a growing influence over physical national planning, and up to today environmental issues have also developed to become a central concern for the municipalities.

The post-war period was marked by two major municipal reforms. The municipality reform in 1952 was the most important as the number of municipalities was reduced from 2 281 to 816. The municipal block-reform of 1964–1974 further reduced the number.[62]

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[56] Kaijser, A. (1986). *Stadens ljus: etableringen av de första svenska gasverken*. Diss. Linköping: Univ., pp. 176; Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting

[57] Bokholm, R. (1995). *Städernas handlingsfrihet: en studie av expansionsskedet 1900-1930,* Diss. Lund: Univ. pp. 41

[58]Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting, pp. 96

[59] Bokholm, R. (1995). *Städernas handlingsfrihet: en studie av expansionsskedet 1900-1930,* Diss. Lund: Univ.pp. 129

[60] Bokholm, R. (1995). *Städernas handlingsfrihet: en studie av expansionsskedet 1900-1930,* Diss. Lund: Univ. pp. 84-87

[61] Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting

[62] Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting; Berglund, B., (2009) review of Mats Hayen: *Ett sekel i självstyrelsens tjänst: Sveriges kommuner och landsting 100 år* (Stockholm: Kommentus förlag 2008). *Historisk tidskrift,* **129**(4), 184

Around the same time as the municipal reform of 1862 Sweden also decided to change its principles for parliamentary representation. This led to the abolishment of the former estate representation and that the 1810 parliamentary order was replaced by the new parliamentary order of 1866. The new order meant the creation two separate chambers of parliament (Riksdag), the First Chamber, elected by the county councils and the Second Chamber, elected in direct popular elections (but not yet universal and equal suffrage). [63]

This new parliamentary order of course had a propound effect on all aspects of political life in Sweden. It also affected infrastructure building and the role of municipalities in these projects. I will briefly come back to these issues later. However the complicated interplay between the new parliament, the government, and the municipalities, is an area too large to cover in this report.[64]

Gullberg (1998) argues that municipal construction and management of various infrastructural systems helped in pushing for democracy in the towns and eventually gave rise to equal and universal suffrage on both the local and national level. The large investments needed and the slow spread of the networks, where wealthy people in the city centers got their connection before more peripheral users, which still had to pay, fueled an intense dissatisfaction which became a strong force in political mobilization for democracy. [65]

Turning back to the he municipal reform of 1862 it is perfectly clear that it had an enormous impact on the articulating of publicness in water and sanitation as will be outlined later. Especially the new Health care statute (1874) was important and of course the ability to levy taxes, and the extended possibility to take loans. Now began the era of public WS infrastructure. The impact on roads and streets was not that straightforward because in this area the state road authority already played the first fiddle. The municipalities and the reform of 1862 did not influence publicness in road and street keeping as much as in WS. The reason was also, which will be discussed later, the presence of institutional inertia and path dependence. The traditional structure of the road sector was hard to change.

Chapter 3: Pre-modern and modern roads and streets

The road traffic system in Sweden has three administrative levels. It is not possible to write about municipal *streets* without mentioning the other two categories public (state) *roads* and *civic* (local) *roads*. Their history is intertwined and stretches back into medieval times. As already indicated, in the following I will use the terms *road* when talking about the local and state level and *street* when talking about the municipal level.[66]

[63] Lindberg, E. (2022). *Välfärdens vägar: organiseringen av vägunderhållet i Sverige 1850-1944*. Lund: Nordic Academic Press; Nilsson, L., & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Sveriges kommuner och landsting; Berglund, B., (2009) review of Mats Hayen: *Ett sekel i självstyrelsens tjänst: Sveriges kommuner och landsting 100 år* (Stockholm: Kommentus förlag 2008). *Historisk tidskrift,* **129**(4), 184

[64] See for example Lindberg (2022) on how national politics slowed down the reformation of Swedish road keeping: Lindberg, E.,(2022). *Välfärdens vägar: organiseringen av vägunderhållet i Sverige 1850-1944*. Lund: Nordic Academic Press

[65] Gullberg A. (1998). *Nätmakt och maktnät: Den nya kommunaltekniken i Stockholm 1850-1920* in *Den konstruerade världen: Tekniska system i historiskt perspektiv*, Blomkvist P. and Kaiser A., Brutus Östlings Bokförlag Symposium; Söderholm, K., (2007) *Uppbyggnaden av Luleås VA-system vid sekelskiftet 1900. En djärv "miljö"-satsning i en tid av teknisk och vetenskaplig omdaning*, Research report, Luleå tekniska universitet, 2007:13, pp. 18.

[66] Some parts of the pre-modern and modern road history have been published earlier by me (Blomkvist 2001, 2010). I have adapted the texts for purpose of this report and translated them from Swedish. Some references from these texts have been kept.

Public roads

All roads lead to Rome, as the saying goes. It illustrates the importance of roads for the emperor, or the sovereign's ability to control the territory. Julius Caesar held the prestigious position of "curator", that is, responsible for the roads, before he became the Roman emperor.[67]

Since the days of Rome, the road's legal status has been governed by the principle of the public's right to free passage (Right of Way). In Great Britain, road peace and free use of the public roads were legislated early in the Middle Ages but as shown in the legend of Robin Hood, the peace of the road was not always upheld. Nevertheless, "The King's Highway" was supposed to be a place where travellers had the right to stay during movement protected by the Crown which replaced the landowner's rights of the road space.

Maintenance "in kind" by the farmers was the usual form of road tax throughout the world, although varying degrees of coercion occurred through day labour and work done by convicts (especially in the USA, so-called "chain gangs").[68]

Road building has often been closely linked to military motives. The Roman roads are perhaps the most famous example from antiquity. More recent examples are Napoleon´s upgrading of the French road network, by the establishment of a national network of main roads ("les routes nationales") and legislation of the state's right of expropriation for road construction. Also, the Italian "Autostrada" and Nazi Germany's "Autobahn" had clear military strategic motives as advance corridors for motorized infantry.[69]

In Sweden, and since very long, we see clear connections between road management and the emergence of some form of centralized power apparatus. Road building has always been in the interest of the chief, the king, or the state. From the Viking Age, we have runestones testify of a rudimentary form of organized road building.[70]

Seen from legal historical perspective road laws carry a significant historical legacy and an institutional inertia that is perhaps unique compared to other areas of law. Rules for road maintenance that were already codified in the Medieval national laws survived for a very long time and still today influence how the state views road building and maintenance.

In towns as well as in the countryside public roads were managed as a public undertaking by the property owners as a tax payment in kind. This praxis was established during the Middle Ages and each farmer was given responsibility based on the agricultural land and share in the village.[71] Rules for public road management was formally established in Magnus Eriksson's national law from the 1350s. Road maintenance was based on value and carrying capacity of the plot of land in the countryside, and for the city it was calculated in the same way, that's to say (roughly) what we today

[67]Kaijser, A., (1994) *I fädrens spår… Den svenska infrastrukturens historiska utveckling och framtida utmaningar,* Stockholm 1994, pp. 29
[68] Lay, M. G. (1999). *Ways of the World: A History of the World's Roads and of the Vehicles that Used Them*. Rutgers university press. pp 100 ff
[69] Lay, M. G. (1999). *Ways of the World: A History of the World's Roads and of the Vehicles that Used Them*. Rutgers university press, pp 113
[70] Heddelin, B., (red.) (1991). *VÄGAR. Dåtid, nutid, framtid.* Stockholm; Gustavsson, H., (1991) *Runstenar och Vikingaleder*, in Vägverket och Bertil Heddelin (red.) *VÄGAR. Dåtid, nutid, framtid.* Stockholm, p. 57
[71] Heddelin, B., (red.) (1991). *VÄGAR. Dåtid, nutid, framtid.* Stockholm, (Södermannalagen fortsätter: "Dör en fri man på en bro, skall för honom gäldas i böter sju marker, för en ofri man tre marker."); Schalling, E. (1932) *Utredning angående väghållningsbesväret i städerna, Stockholm*. Bilaga till Betänkande med förslag till lag om allmänna vägar och lag vägdistrikt, m.m. Avgivet av 1929 års vägsakkunniga, Stockholm 1932 (SOU 1932:21), s 5

call a property tax.[72] This way of managing public roads as a “communion imposition” or “inconvenience” (menighetsbesvär) was based on the principle of “utility and interest”, meaning that land owners living nearby were to manage the road because they were seen as the beneficiaries of the service delivered.

Thus, public road regulations in Magnus Eriksson's national law, were also applied in the cities and later transferred to the City Act, which also bore his name. Both laws formed the basis for Swedish legal administration in the road area, until they were replaced by the 1734 law.[73]

It is always tricky to "write history according to regulations" When it comes to the road history of older times, we know very little about the concrete process of road building and maintenance. [74] However, it seems clear that the state tried to manage the road sector with a gentle hand and that the goal was to reach amicable agreements. Without some “communalism” and the goodwill of the farmers and property owners, no roads were built or maintained.

The state's interest in public roads during the Middle Ages and up to the 18th century was essentially based on the central power's need to control the territory which was gradually complemented with a desire to promote trade and manufacture, both in the nation and in towns.

King Gustav Vasa, in the sixteenth century, wanted to create a coherent network of roads adapted for wagons. The public roads which were called country roads, main roads, or royal roads, certainly had a status as nationally important but were up until the middle of the 17th century not suitable for anything other than horse riding.[75]

During the 17th century, however, national roads became increasingly important for the crown and the state. Under Gustav II Adolf, the road network was significantly upgraded, mainly for military reasons. In 1649, his daughter Queen Kristina introduced rules to maintain passable roads between the inns and set up the so-called shuttle service. In the same year, she established a position as the kingdom's road master - "who can keep the governors in check..." Road construction and road maintenance were carried out by the king's officials out in the counties. Still, this practice was based on amicable agreements between the state and the land-owning congregation.[76]

But even though the road system was expanded and even though the roads became increasingly important, not much happened around basic legislation. The medieval organization was stable throughout the period and the principle of utility and interest prevailed.

In the famous 1734 law, which was upheld, albeit with many additions, until the end of the 19th century, the state's interpretation of the interest and utility principle was kept in the legal text. But the 1734 law quickly became outdated. It came under severe pressure from the political reforms

[72] Schalling, E., (1932) Utredning angående väghållningsbesväret i städerna, Stockholm 1932. Bilaga till Betänkande med förslag till lag om allmänna vägar och lag vägdistrikt, m.m. Avgivet av 1929 års vägsakkunniga, Stockholm, 1932:21, pp. 3
[73] Som ett sorts mellanled kan man säga att den så kallade Kristofers landslag fungerade. Den instiftades under Kristofer av Bayerns regeringstid och är från år 1442. Det var en omarbetad version av Magnus Erikssons landslag. Kristofers landslag stadfästes med tillägg av Karl IX 1608 och var i bruk fram till dess att 1734 års lag utfärdades.
[74] Svenonius, O. (1937) *Drag ur det Uppländska vägväsendets rätts- och förvalningshistoria*, En vägbok för Uppsala län, Uppsala. Quote from Pettersson, O. (1988) *Byråkratisering eller avbyråkratisering. Administrativ och samhällsorganisatorisk strukturomvandling inom svenskt vägväsende 1885-1985* Uppsala, pp. 27-28.
[75] Pettersson, O. (1988) *Byråkratisering eller avbyråkratisering. Administrativ och samhällsorganisatorisk strukturomvandling inom svenskt vägväsende 1885-1985* Uppsala, pp. 24
[76] Jönsson, B-G., (1991) *Vägen till bättre vägar*, Vägverket och Bertil Heddelin (red.) *VÄGAR. Dåtid, nutid, framtid.* Stockholm, pp. 36-37

such as the Municipal Law 1862 and the Constitutional reform 1866 and, also the gradual industrialization process.[77]

The state's interest in the roads became even greater during the 19th century and more and more roads were defined as public/state roads. An example was a royal decree from 19 February 1824 regarding additions to the Building Code (BG 25:1) where several new public roads are enumerated, to staple cities, harbors, and so on. These towns relied on trade and the increasing importance of industry. Furthermore, the issue of expropriation of land for road purposes was also raised. Several regulations on expropriation were drawn up from the middle of the 19th century, which led to the Expropriation Ordinance in 1866 and the Expropriation Act from 1917. In 1930, the concept of "right of way" was introduced, which was also applied in the cities. The right of way meant that the state or city was allowed to build a road over private land if required.[78]

During the 19th century, the road system was increasingly centralized and professionalized. But it should be noted that everything happened under the 1734 legislation. In 1813, the Royal Committee for Road Construction in the Northern Provinces was established and in 1841 the Road and Water Works Board (VoV) was formed, and the country was divided into five cross-county road and water construction districts. Through VoV, state subsidies began to be paid out for building of new roads as well as strengthening and straightening of old roads. With this development, the articulation of publicness in roads was strengthened and public roads became a common good to an even greater extent. In 1851, the Road and Water Works Board appointed road engineers in every district in the country. To get government funding VoV's participation was required, and the technical experts therefore gained an ever-increasing influence over the road system:

"Thus began the professionalization of road construction and maintenance that would not only raise the quality of the roads, but also fully transfer them into the hands of (public) specialists a bit into the next century." [79]

In 1891 a new law on public road keeping was introduced. The organization of the public road system had as been shown, medieval origins. It was based on an agrarian logic where small self-sufficient units were the starting point. As industrialization gained momentum at the end of the 19th century, this logic was perceived as overplayed and out of date.

First, agriculture became more market-oriented and the need for transport outside the absolute immediate area increased. Second, industries grew that required roads for its raw materials and products. The farmers who were obliged to maintain the roads came to see the road burden as unfair because the new industries did not have to pay for the roads they used.[80] Third, the building of the railway network meant that the need for roads increased as goods and passengers had to

[77] Schalling, E. (1932) Utredning angående väghållningsbesväret i städerna, Stockholm. Bilaga till Betänkande med förslag till lag om allmänna vägar och lag vägdistrikt, m.m. Avgivet av 1929 års vägsakkunniga, Stockholm (SOU 1932:21), pp. 15
[78] Schalling, E. (1932) Utredning angående väghållningsbesväret i städerna, Stockholm. Bilaga till Betänkande med förslag till lag om allmänna vägar och lag vägdistrikt, m.m. Avgivet av 1929 års vägsakkunniga, Stockholm (SOU 1932:21), pp. 14 and pp. 25-29.
[79] Pettersson, O. (1988) *Byråkratisering eller avbyråkratisering. Administrativ och samhällsorganisatorisk strukturomvandling inom svenskt vägväsende 1885-1985* Uppsala, pp. 26
[80] The modern industrial concept of “Just in time” means that many companies use the road network as their only warehouse and keep their stock in lorries on the roads which has spurred a renewed debate on industry’s contribution to road keeping.

travel to and from the stations. Fourth, the route of the railway meant that population and business were concentrated in connection with the nodes of the railway network.[81]

The Road Act of 1891 is usually said to have transferred road maintenance to the public domain, and what was new in this Sweden's first proper road law was that the responsibility for road maintenance passed from the agricultural property to a new legal entity, the so-called road districts. The road districts, or the road municipalities as they were also called, were based on the county or part of the county and the number was 379. A road board was appointed to lead each road district/road municipality. Furthermore, a road tax was introduced to be paid in cash for groups that were previously excluded from road maintenance. Now industry could be made to pay for the roads.

But even though the road district was now in charge of road maintenance, in-kind maintenance was not abolished. The farmers were not given the opportunity to pay the road tax in cash but would continue to maintain the roads according to the old way. It is striking how the law tried to balance two different logics – the agrarian, local with maintenance according to the utility and interest principle, interpreted as agriculture still having the greatest benefit from the roads, respectively the industrial and regional/national logic, where the benefit of roads for industry was recognized. Many of the old problems in the road system were brought into the 20th century. [82]

In retrospect, it is easy to agree with historian Ove Pettersson when he writes:

"In principle, the road fund could have taken over at once…Admittedly, road maintenance had probably initially become somewhat more expensive and the tasks of the road boards more numerous, but the roads had been better maintained and that had undoubtedly simplified things considerably. As early as 1895, there was the apparatus required to take over all maintenance of the public roads through the road fund and road board, the problem was that they were also forced to keep the old methods.[83]

Criticism of the Road Act was strong. When the legislature in 1921 opened the possibility for the road board to take over the entire operation under its own auspices, there was room for a thorough structural change without the law needing to be rewritten. By the mid-1920s more than half of all road districts had taken over, in 1928 72 remained and in 1930 only 12 districts still followed the old in-kind principle (more on this later).[84]

In 1934, yet a new Road Act was introduced, the most important change was the formal abolition of road keeping in-kind. Something that de facto had already happened. The road districts under the leadership of the Swedish Road and Water Administration became responsible for public roads in the countryside, and the towns were to cater for public roads within its borders. Streets were still their responsibility.

In 1944, the public roads in Sweden were nationalized and the utility and interest principle moved up to a societal level. Now it was the entire kingdom's joint obligation to keep roads. The Road and Water Works Board (named the National Road Administration from 1967) were put in charge for the

[81] Se Westlund, H., (1992) *Kommunikationer, tillgänglighet, omvandling. En studie av samspelet mellan kommunikationsnät och näringsstruktur i Sveriges mellanstora städer 1850-1970* Umeå.
[82] Se Blomkvist, P., *(2001) Den goda vägens vänner*
[83] Pettersson, O. (1988) *Byråkratisering eller avbyråkratisering. Administrativ och samhällsorganisatorisk strukturomvandling inom svenskt vägväsende 1885-1985* Uppsala, pp. 37
[84] Gustavsson, B., (1987) *Hur vägarna blev en kollektiv nyttighet*, pp. 93.

whole road (and motor traffic) system. From 1944 each county had its own road administration, but from 1992 several counties were merged into regional districts.[85]

In 1959, the Road Plan for Sweden was presented and adopted by a unanimous Parliament and the ground was paved for the entry of mass motorization. With the so-called Road Plan 70, the cities were also drawn into road planning adapted to the car.[86]

Civic roads

Internationally, civic roads are a unique Swedish (and Finish) road category which are managed directly by the actual road users living nearby.[87] The laws regulating civic roads have a direct and unbroken heritage from the way they were managed in medieval villages by the landowning farmers During a period of 500 years, civic roads were the responsibility of the village council and the landowners using the road.

The earlier national road regulations had, as noted, their center of gravity in public roads. The legislature wanted to regulate the construction and maintenance of the roads that were considered important to the state.

But the laws also contained some statutes on smaller roads in the villages. From the thirteenth century (Upplandslagen and Västgötalagen) stated: "If village men want to build roads, other than those that belong to the state, then one wants to build and the other doesn't, then the one who wants to build is given the right to do so and is backed up by the King´s military and pledge" ("våld och vitsord"). Magnus Eriksson's national law, from around 1350 (and similarly in Kristoffer's national law in the 1450s) contained similar provisions: "Now if farmers want to lay a road through the village, they may do so, if they themselves agree." [88]

As mentioned, regulations of public road keeping also applied as the farmers in the villages were required to build and maintain public roads and to provide ferries and bridges. For civic roads the basic rule was that roadbuilding should be on uncultivated land, and the those who had utility and interest in the road participated in its maintenance. The laws also established the right of a farmer to use someone else's land for an exit route if needed if compensation in land was given. [89] Thus, since a very long time, farmers have had the right to build a road if they could demonstrate the benefit of the road. No property would risk ending up without the possibility of connection to rest of the road network. In these early laws there was nothing stipulated about road width or technical quality. This was left to those involved to decide.

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[85] Losman, B. *Förvaltningshistorik* (no year), Riksarkivet, Stockholm, https://forvaltningshistorik.riksarkivet.se/15_Vagar.htm; + Blomkvist, P. (2001). *Den goda vägens vänner: väg-och billobbyn och framväxten av det svenska bilsamhället 1914-1959* (Doctoral dissertation, Symposion Brutus Östlings bokförlag).

[86] Blomkvist, P. (2001). *Den goda vägens vänner: väg-och billobbyn och framväxten av det svenska bilsamhället 1914-1959* (Doctoral dissertation, Symposion Brutus Östlings bokförlag).

[87] The section on civic roads builds on Blomkvist 2001, 2010; Blomkvist and Larsson, 2013; Tällberg, E. (2018). *Statligt och kommunalt väghållaransvar : En studie kring allmän väghållning och kommunala väghållningsområden* (Master thesis, KTH, School of Architecture and the Built Environment (ABE), Real Estate and Construction Management, Stockholm)

[88] Schalling, E., (1932) *Utredning angående väghållningsbesväret i städerna, Stockholm.* Bilaga till Betänkande med förslag till lag om allmänna vägar och lag vägdistrikt, m.m. Avgivet av 1929 års vägsakkunniga, Stockholm 1932 SOU 1932:21, kap. VII, Enskilda vägar, pp. 79-82

[89] Schalling, E. (1932) *Utredning angående väghållningsbesväret i städerna, Stockholm 1932*. Bilaga till Betänkande med förslag till lag om allmänna vägar och lag vägdistrikt, m.m. Avgivet av 1929 års vägsakkunniga, Stockholm 1932 SOU 1932:21, pp. 79-82

Already in the medieval laws, a very important difference between civic and public roads can be seen in terms of the relationship between the property's carrying capacity/assessed value and the road's utility. For the public roads, the individual landowner's obligations in road keeping were related to the agricultural capacity in a direct way and the assessed value (like in today's property tax) was used as a proxy in the calculation of the road burden. It did not matter if the property had any real benefit from the road. If a road was designated as public and classified as a parish, district or county road, each landowner was automatically assigned a road lot to be responsible for.

This was not the case for civic roads. Here, a more direct and user-oriented utility concept applied, which did not have as strong a connection to property value. Whoever could demonstrate the benefit of the road was allowed to build it and those who benefited from the road should be involved in the project, each according to the actual benefit the road gave to each. However, there is no information on exactly how these share numbers/road lots were determined in the medieval sources, although it is likely that the agricultural capacity and share in the village were important here as well. This medieval variant of the utility and interest principle, exclusive to the civic roads, has survived in today's legislation.

As will be discussed later, in the section dealing with pre-modern drinking water, a clear inspiration for the legislations on civic roads came from early water legislation. But these water laws did not target drinking water provision at all. The water laws were all about dikes, i.e. drainage of farming land, and later focusing on so-called lucrative water issues such as hydropower.[90]

In the law of 1734, the division between civic and public roads became explicit for the first time in legal history. It regulated how civic and public road keeping were to be carried out through "communion impositions" (allmänna besvär). [91] Furthermore, in the 1734 law, civic roads were not only linked only to the ownership of agricultural land. Even local mills and other common facilities such as summer farms (fäbodar) could be responsible for civic road keeping.

But even though the state wanted civic roads to be managed only by those with the most clearly expressed interest, it seems to have been difficult to draw boundaries. As late as 1828, the state had to clarify in a royal letter that disputes about civic roads would be settled in courts as disputes between private individuals, not as administrative cases in the county court, according to the rules for public roads. A conclusion regarding the distribution of road responsibility between the civic and public roads in the 1734 law is that the legislator wanted to keep civic roads within the sphere of private law as far as possible. The state did indeed issue some regulations on road maintenance, but it was up to the local road managers to regulate the finer details in some form of joint agreement.

In principle not much changed regarding legislation for civic roads. The law of 1734 was complemented in new statues 1907, 1926, 1939 and finally in 1974. As mentioned, the utility and interest principle has survived and property owners living in proximity of the road has basically the same rights and obligations today.

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[90] Blomkvist P. (2010). *Om förvaltning av gemensamma resurser: Enskild väghållning och allmänningens dilemma i svensk historia 1200–2010* (Managing Common Pool Resources: Road Keeping and the Dilemma of the Commons in Swedish History 1200–2010), Division of Industrial Dynamics, KTH (Royal institute of Technology), Stockholm, Sverige. TRITA-IEO 2010:06, pp. 54-56

[91] Kuylenstierna, C., (1934) *Samhällsuppgifter och väghållningsbesvär*, Minnesskrift ägnad 1734 års lag. (Av jurister i Sverige och Finland den 13 december 1934, 200-årsdagen av Riksens ständers beslut), del II, Stockholm, pp. 376-377; Blomkvist P. (2010). Om förvaltning av gemensamma resurser: Enskild väghållning och allmänningens dilemma i svensk historia 1200–2010 (Managing Common Pool Resources: Road Keeping and the Dilemma of the Commons in Swedish History 1200–2010), Division of Industrial Dynamics, KTH (Royal institute of Technology), Stockholm, Sverige. TRITA-IEO 2010:06

However, after WW2 and the beginning of mass motorization, civic roads were more tightly aligned with public road keeping. The state road administration appointed special road engineers to manage the interface between public and civic roads and took the initiative to form a special organization for civic road keepers, the The Civic Roads Federation (Riksförbundet Enskilda Vägar, REV) founded in 1949 to coordinate the various local road associations. Today REV organize around 13 000 of the 34 000 civic road organizations.[92]

Another interesting interface can be found between municipal street keeping and civic roads. Municipalities often own land and properties, and thus become members of civic road associations. The municipality is obliged to participate and contribute to road maintenance of these civic roads to the same extent as other property owners. It is also common for municipalities to contribute to civic road keeping by financial contributions or by taking over the road management. A reason why the municipalities step in is an ambition to improve the standard of a certain road or to even out injustices when civic road keepers are double-taxed (as they already pay for municipal streets).[93]

Municipal streets

Municipal street management has evolved in close relation to public and civic road keeping.[94] As mentioned for a long-time street keeping was based on the same principles guiding public roads on the countryside and civic roads within the villages. The utility and interest principle meant that property owners living close to the street, were responsible for both building and maintenance (and cleaning) for the street outside the property border stretching to half the width of the street. These rules were laid down in the 1350s, Magnus Eriksson's national and city law and repeated in the law of 1734.

This meant that, since the Middle Ages, property owners, both Burghers and others, were obliged to cater for street building and maintenance, while public roads and traffic routes were a concern for the Burghers exclusively. A distinction was thus made between streets in densely populated areas and roads. Public *roads* passing through the town as well as parks and town squares were the responsibility of the city authorities and the Burghers. Outside the town border the County and its property owners (the farmers) managed public roads.[95]

With the increasing public road expansion during the 19th century and when towns grew bigger and traffic, internal and passing through, increased, public roads within the city limits were often included in municipal duties. However, according to Schalling (1932) before the municipal building statute in 1864, special legislation for towns were largely missing in national laws and the legislation on municipal streets were basically unchanged and based on older customs and can been found in rules for building and property development such as the various building and planning acts that were issued. Towns basically had the freedom to manage streets as they saw fit and between different cities the distribution of street responsibilities came to differ where some cities had started to take over the road and street maintenance from the middle of the nineteenth century and financed this with general taxation. In some towns the magistrates or the Burghers decided to

[92] More on REV and civic road history in Blomkvist, P. (2010)
[93] Tällberg, E. (2018). *Statligt och kommunalt väghållaransvar: En studie kring allmän väghållning och kommunala väghållningsområden* (Master thesis, KTH, School of Architecture and the Built Environment (ABE), Real Estate and Construction Management, Stockholm), pp. 21 ff
[94] This section mostly builds on Blomkvist 2001, 2010 and Tällberg, E. (2018). *Statligt och kommunalt väghållaransvar : En studie kring allmän väghållning och kommunala väghållningsområden* (Master thesis, KTH, School of Architecture and the Built Environment (ABE), Real Estate and Construction Management, Stockholm), pp. 38-44
[95] Losman, B., *Förvaltningshistorik* (no year), Riksarkivet, Stockholm, https://forvaltningshistorik.riksarkivet.se/15_Vagar.htm; 221102 J-O Montelius, Road historian (personal Communication)

manage both roads and streets as a public undertaking even earlier. In Gothenburg, the Burghers in 1811, appointed a Shuttle and Haulage board, which would construct and maintain roads. And in 1845, a special committee began to distribute the costs of street maintenance between house owners and the city's other residents. In Stockholm, a special administration was established for streets in 1845 and for gas lighting in 1850. In 1861 they were merged into the streets and lighting management board. It must be noted that these arrangements were introduced before the Municipal act of 1862.

However, the municipal act, with its stronger power to levy taxes, gradually changed both road and street keeping in the cities. It seems probable that most towns had taken over both street and road management as a public undertaking in the beginning of the 1920s which is described in a referral by the Swedish Road Federation on how the road legislation of 1891 should be improved: "A simple and natural way to achieve improved road maintenance seemed to be that the road districts were given the right to take over road maintenance themselves. The completion of the maintenance could then be done either by road districts, like almost all our urban communities, already carrying out the maintenance themselves and acquiring expert assistants and mechanical equipment or outsourced to entrepreneurs.[96]

After the municipal reform of 1862, the principle of utility and interest was loosened and with the Town Planning Act in 1907, and stronger in the Town Planning Acts of 1931 and 1947, cities and city-like communities were obliged to provide for streets in areas with an established city plan.[97]

The legislation for urban planning legislation further stated that public roads included as a street in the city plan should belong to the city and thus towns took over the road maintenance for part of the public road network, an obligation which was kept in the 1934 General Road Act (SOU 1932:21).

Thus, the road legislation of 1934 codified a reality already existing praxis when it stated that the new road district, and each town was its own road district, were responsible to, apart from managing city streets, maintain and in some instances build, public roads that passed through the town/district.[98]

When the public roads were nationalized with the 1944 Road Act (SOU 1941:12), public roads in the countryside belonged to the state while the public roads in the cities belonged to the cities. State road keeping was managed by the Swedish Roads and Waterworks Board and smaller communities were included in these rural areas. Also in 1944 a state subsidy was introduced to even out municipal costs due to increasing traffic demands in more densely populated areas. These rules were somewhat revised in the new Road Act of 1971 but the division of responsibility between the state and municipalities did not change much compared to prior the nationalization of public roads.

In connection with municipal reforms the 1960s and 70s and because of changed settlement structures and travel patterns the issue of increasing municipal responsibility for public roads was

[96] The Royal Majesty's Proposition No. 157 (1921). To the Riksdag with a proposal for a law amending the wording of §§ 12, 52 and 60 of the law of 23 October 1891 regarding the nature of the road burden in the countryside; given to Stockholm Palace on 4 March 1921. (Ur: Kungl. Maj:ts Proposition Nr 157. Till riksdagen med förslag till lag om ändrad lydelse av 12, 52 och 60 §§ i lagen den 23 oktober 1891 angående väghållningsbesvärets utgörande på landet; given Stockholms slott den 4 mars 1921.)

[97] Gren, E. (2011). *Planutvecklingens följder: En studie av enboendet och utvecklingen av planpraxis för bostadsbebyggelse* (Bachelor thesis), Blekinge Institute of Technology, School of Planning and Media Design; See also: *Äldre lagar om planering och byggande*. (2022, November 2). Boverket. https://www.boverket.se/sv/lag--ratt/aldre-lagar-regler--handbocker/aldre-lagar-om-planering-och-byggande/, accessed 23/4 2023

[98] SOU 1934:21 https://lagen.nu/sou/1932:21, § 13, 14, 24; On road issues and road taxation see Nilsson, L. & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring*. Stockholm: Sveriges kommuner och landsting

brought up. The idea was to harmonize legislation around public roads and municipal streets and that more cities should be involved in public road management which led to several investigations into the municipalities' obligations during 1970 and the 80s. For example a state investigation in 1977 suggested that a new road category should be established: "municipal public roads".[99] However special national regulations on municipal public roads and streets never became a reality. Instead street regulations were incorporated into the Planning and Construction Act of 1987 (PBL). In short municipal self-determination and responsibility won over state control.

Around 1980, 110 municipalities were road managers for public roads and since 1987, the number of municipal road managers for public roads has gradually increased to include 206 in 2018. In 1992 the state took over road responsibility for the most important thoroughfares in cities and larger urban areas.

The road and street system today

As been discussed, the present-day Swedish road system is divided into three parts. State (public) *roads*, including so called National roads, are managed by the state (The Traffic authority). Municipal streets are managed by the 290 municipalities (including towns). However, the municipalities' street administrations are obliged to follow standards and specifications given by the Traffic authority which are published and updated regularly.[100] The third level consists of *Civic roads* which are managed directly by the actual road users living near the road, organized in around 34 000 local road associations. This part of the road system is run by individual property owners, but the state road administration oversees and control technical specifications, and distribute state subsidies to these often small, but important *capillaries* of the grid. The present road network in Sweden includes approximately 100 000 km state roads, 40 000 km municipal streets, and 150 000 km civic roads.[101]

Public roads are primarily regulated by the Roads Act (SFS 1971:948) and the implementing regulations in the Roads Ordinance (SFS 2012:707). The current Road Act has been reworked in parts but has the same foundation as the Road Act from 1944 (when public roads were nationalized). Since 1971, the law has been adapted to the Environmental Code and the new Planning and Building Act and to regulations for the national plan for transport infrastructure (SFS 2009:236) and county plans for regional transport infrastructure (SFS 1997:263). Technical requirements for roads and streets are issued by the Swedish Transport Administration in cooperation with the Swedish association for municipalities and counties (SKL). These requirements and advice for the design of roads and streets are binding for the state, while they are advisory for the municipalities.[102]

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[99] SOU 1977:12: Kommunal och enskild väghållning: lagförslag och motivuttalanden

[100] Krav - VGU, Vägars och gators utformning Trafikverkets dokumentbeteckning: Krav - VGU, Vägars och gators utformning Publikationsnummer: 2022:001; https://bransch.trafikverket.se/for-dig-i-branschen/vag/Utformning-av-vagar-och-gator/vagar-och-gators-utformning-vgu/

[101] Blomkvist, P. (2010) *Om förvaltning av gemensamma resurser: Enskild väghållning och allmänningens dilemma i svensk historia 1200–2010* (*Managing Common Pool Resources: Road Keeping and the Dilemma of the Commons in Swedish History 1200–2010*), Division of Industrial Dynamics, Royal Institute of Technology, Stockholm (Stockholm 2010), TRITA-IEO 2010:06: Pettersson, O. (1988) *Byråkratisering eller avbyråkratisering. Administrativ och samhällsorganisatorisk strukturomvandling inom svenskt vägväsende 1885-1985* Uppsala. Se också Sveriges Nationalatlas "Infrastrukturen" 1992, pp. 34-36 och Vägverkets jubileumsbok *Vägar - Dåtid Nutid Framtid* 1991, pp. 231-238 där Reinhold Castensson diskuterar statistiken över vägnätets och bilismens utveckling under 1900-talet. Se även SOU 2001:67 *Enskild eller allmän väg?*, pp. 9-10 samt REV-bulletinen nr 1, 2009, pp. 8-9. There are also approximately 15 000 km of strictly private roads, not open for public use, owned by various industries (mostly the forest industry)

[102] Blomkvist, P. (2001). *Den goda vägens vänner: väg-och billobbyn och framväxten av det svenska bilsamhället 1914-1959* (Doctoral dissertation, Symposion Brutus Östlings bokförlag).; Pettersson, O. (1988) *Byråkratisering eller avbyråkratisering. Administrativ och samhällsorganisatorisk strukturomvandling inom svenskt vägväsende 1885-1985* Uppsala; Tällberg, E. (2018). *Statligt och kommunalt väghållaransvar : En studie kring allmän väghållning och kommunala*

Municipal streets are regulated in the PBL (Planning and Building Act, SFS 2010:900) which broadly regulates the planning and construction of property trough so called "detailed plans" which is a planning instrument with legal effect which is the basis for a municipalities' planning monopoly. The PBL replaced previous city and building plans.[103]

Rules for civic roads is regulated since 1997 in the Construction Act (Anläggningslagen, SFS 1973:1149) when the law on civic roads from 1939 was changed. The purpose of the change was to achieve a more modern and uniform legislation with simpler rules and added regulations on *community facilities* (GA, Gemensamhetsanläggningar) with special rules for civic roads.

As related above the three categories, public roads, streets, and civic roads, are based in different types of legislation. The road act with its rules for the right to build roads on private land (Right of way) is the strongest law of them all. But despite this, the road network is a relatively well aligned and cohesive infrastructural system with its three integrated levels (strong vertical integration) and a distinct state system builder controlling each level. . In other words, and using a term from earlier research, the road and street sector exhibit a strong *vertical integration* with a distinct system builder controlling each level. (Blomkvist and Larsson, 2013; Blomkvist and Nilsson, 2017) As will be discussed later, this strong vertical integration is different from WSS where we, at the present, can see a development towards *horizontal integration*. ((Alm, et.al, 2021; Alm and Paulsson, 2023)

Chapter 4: Thematic discussion on roads and streets

System builders and technical development in roads and streets

As ben discussed several times, the state had a clearly pronounced ambition to articulate *publicness* in the road sector for hundreds of years. Through the State Road administration, gradually from the beginning of the nineteenth century public roads, streets, and civic roads were transformed into a well aligned infrastructure, a modern infrasystem and the state had become a system builder.[104]

For a very long time, road building and maintenance had been performed by landowning farmers using ordinary tools and equipment such as shovels, crowbars, and iron skewers. Material for the roadbed, gravel, stones, and sand, was taken near the road and transported with the farmers own horses and wagons. Road keeping was not seen as a prioritized task compared to actual farming. It was often executed by farmworkers when there was room in the schedule which resulted in irregular and uncoordinated efforts. There are many accounts from road travelers describing that one part of a road could be well kept while the next stretch was in a terrible state and not yet maintained by the farmer assigned that part of the road. Road networks, and similar gridded infrastructural systems, is a concrete illustration of the old proverb "a chain is only as strong as its weakest link".

väghållningsområden (Master thesis, KTH, School of Architecture and the Built Environment (ABE), Real Estate and Construction Management, Stockholm)

[103] Tällberg, E. (2018). *Statligt och kommunalt väghållaransvar : En studie kring allmän väghållning och kommunala väghållningsområden* (Master thesis, KTH, School of Architecture and the Built Environment (ABE), Real Estate and Construction Management, Stockholm)

[104] The section on technology and the Swedish road federation as a system builder is a revision of a text published in Blomkvist, P. (2001). *Den goda vägens vänner: väg-och billobbyn och framväxten av det svenska bilsamhället 1914-1959* (Doctoral dissertation, Symposion Brutus Östlings bokförlag). The section covers the development up until roughly the mid-twentieth century. The full impact of the car society after WW2 is only briefly discussed.

Road keeping as a tax payment in kind was perhaps sufficient until the industrial revolution picked up speed in the end of the nineteenth century and road transport became increasingly important. The new demands put on the road network changed the perception of the old methods and technologies. Old style road work was increasingly seen as an obstacle, or in the words of historian Tom Huges (1987), as a “reverse salient” for systems development and expansion. When the private automobile appeared at the turn of the century the critique was multiplied.

Swedish motorists were early to realize the importance of organization. The Royal Automobile Club (RAC) was founded in 1903, when only a handful of cars existed in Sweden. Car ownership was, and still were for many years to come, a privilege for the very rich, and the automobile was mainly a sports and recreation vehicle. The most important outward objective of the RAC was to change the deeply rooted view in the public mind of the car as a toy for rich boys and a menace to society, a definition of the car that was quite accurate, at least up until the mid-twenties. Directly inspired by the so-called Good Roads Movement in the US, the Automobile Club took the initiative to form the Swedish Road Federation (SRF) in 1914. Joining the motorists were commercial interests in road building, local and regional road keepers and, most important, staff from the state road administration, county governors and members of the Royal Corps of civil engineers, all educated in road- and water engineering and members of the Swedish Technology Association. The road federation was a truly *corporativist* organization where State and county officials joined forces with commercial interests and expert members. This mix-up of actors from all areas in society was not uncommon in Sweden at that time. Currently however, a stronger emphasis is put on separating public and commercial interests and state officials can no longer be members of commercial lobby groups.

Already in its first year, in 1914, the Swedish Road Federation launched its first course in “rational road keeping” in Enebyberg, Danderyd outside Stockholm. The audience were traditional road keepers, farmers, and property owners, under the prevailing mode of road management in kind, following the utility and interest principle. These courses were seen as the best means of agitation for the Road federation and over the years many were held all over Sweden.

Expectations were high and an ambitious lecture program was planned: "The need for and advantage of good roads", "Rational Road construction", "Rational Road maintenance", "Road construction and road maintenance abroad", "The importance of wider wheel rims" and "Reforms in road legislation” were titles agreed upon.

The main trust in the argumentation during these courses were against the reluctance from both the state and the farmers to accept rational and industrial road keeping using modern machines.

Firstly, the farmer must be made to understand that rational road maintenance brought more money into his own chest through increased freight capacity - "...the shortening of commercial distances."

Second, the farmers had the wrong valuation of time itself. They thoughtlessly made several trips, with little cargo in their cart each time, because they had a wrong concept of time. This relationship would be resolved "...to the same extent that time gains more value."

The shrinking space and the value of time in the society of industrialism paved the way for the new and modern man who realized the importance of roads in this process. The automobile that was first acquired for "purely practical reasons" would later help shaping this new attitude to time and become the force that ultimately forced the improvement of the roads.

The fear of labor-saving road equipment was seen as a sign of backward-looking hostility to technology. The old way of road keeping would never survive "...for it will only be economical when it is done in an industrial fashion...Therefore get rid of this expensive, uninteresting and deficient approach to roads as quickly as possible...It is in road management as in manufacturing in general: the craftsmen are replaced by big industry...What good does it do for the road federation to waste time and work and try to encourage a method in road management that has outlived itself." The conclusion was that the only way was to acquire the most modern machines and tools.

"The Swedish Road federation is on the right track, as it does not waste work on kneading the old, outdated sourdough, which is called in-kind road management…" with its "...absurdly driven parceling of road maintenance."

To build rail- and waterways was considered an artwork of scientific status by the civil engineering community of the day, road building was not. Road keeping was not a job for the technical expert but of the ordinary peasant. Thus, the road engineers had a strong incentive to expand their professional field of expertise and to drive the traditional road keepers out of the market.

The Swedish Road Federation became the key professional organization for the road engineers in their struggle to gain society's acceptance of their claim on expertise and monopoly in the road sector. To join up with the engineering community was a perfect strategy, from the motorists and the commercial interest's point of view. Through the Swedish Road Federation, they could argue for better roads adjusted to the automobile using the politically neutral and scientifically objective arguments of the civil engineers. By *technifying* the debate, the controversial character of the automobile was avoided by reference to the much more common road question.

To make a long story short, the Swedish Road Federation managed to, metaphorically speaking, *industrialize* road keeping – the old tradition of work in kind was abandoned in the end of the twenties, the engineers became uncontested experts, technical rationality was applied, industrial methods and machinery was adopted and the revenues from the introduced car and fuel tax (1922 and 1924 – an initiative of the Road Federation) went directly to the roads. This process also helped to redefine the car towards a socially accepted technology. In Sweden, as opposed to Norway and many other European countries, the process of domesticating the automobile was nearly completed around 1950.

By the Second World War the Swedish Road Federation had gained the position of a politically neutral provider of technical knowledge and expertise. The Federation was deeply embedded in the personal and professional network of the state's road administration and had become a respected and influential actor. The Swedish Road Federation was reorganized in 1947 with economic support from chiefly the car and oil industries. The Federation's role as an umbrella organization for the wider car lobby was thereby reinforced. It was in fact its reputation as an apolitical mediator of technology that afforded the Federation its main resource as well as the principal reason for the participation of the other bodies. After the war, the central interests of the car industry crystallized around a common strategy based on maintaining a united front publicly. The "sound development" of mass motorization was to a large extent the objective the industry could build upon. Lobbyists felt that the wisest path was to tone down internal divisions, for instance between commercial and private traffic, so as not to damage their common interest. And despite its apparent character as a commercial lobby group the strategy of *technifying* the road question paid off once again and served as a sign of legitimacy which enabled SRF to initiate and heavily influence *Road Plan for Sweden* in 1958. Having said this about the influence of the roads and automobile lobby, it must be noted that

they were certainly not alone in their efforts to turn Sweden into a car society in the post-war period. Many other influential groups such as experts in traffic and town planning, representatives from a united industry and not the least, almost every politician, both on state and municipal level, endorsed the vision of a motorized future.[105]

In the towns, originally the material used for street construction was logs of wood and to build streets was called "to bridge" (broa) which is why street and road keeping in older laws often are referred to as "bridge building".[106] But already in the fourteenth century cobble stones (kullersten, fältsten) were being used, at least in larger towns and in the most important streets. These streets had a width of 4,8 meters while smaller alleys had a width of 1,8 meters according to the City law of Magnus Eriksson (1350). During the sixteenth century stone pawing became more common and stone lined gutters were requested by the authorities. However, it was not until the middle of the nineteenth century that the use of cut granite (huggen sten) was established as the norm for streets with high traffic intensity. At that time the innovation of special areas, footways, or sidewalks (trottoarer), finally were realized after many years of debate. Before this time pedestrians in the streets had to share the space with horses, carriages, and carts, which of course made a stroll through the city quite adventurous and nothing at all like a walk in the park.

From the beginning of the twentieth century, the most important system builder for city streets was the Swedish Association of Municipal Engineers, founded in 1902 by high-ranking engineers in municipal administrations in Stockholm, Gothenburg and Gävle. Very soon other municipal engineers from Sweden's larger towns joined the ranks. Membership grew from 97 members in 1902, to 330 in 1925, and to 675 in 1950.[107]

The association engaged in street building technology from the start.[108] One of the first issue was how street and curb stones could be manufactured. At the annual meeting in 1913 in Västerås, Malmö city's building manager, raised the question of how stone that would be used for paving and footpaths and as edging and guttering. He noticed that both dimension and processing varied and if a Swedish standard could be established, it would be cheaper for the municipalities. A committee was appointed, and the results were reported two years later, at the annual meeting, 1915 in Gävle. In 1932 a new proposal was presented in cooperation with the association's Danish, Finnish, and Norwegian equivalents. In 1961, the standardization work was moved to SIS, the State Standardization Commission. Also other paving materials, such as asphalt, was discussed and at in 1924 the issue of street and road paving economics was introduced. The purpose was partly to reduce maintenance costs and partly to increase traffic capacity to meet the expected boost in automobile transportation. These questions were closely related to the Swedish Road Association´s efforts to in traffic counting and prognosis. The municipal engineers presented their own car traffic calculations for Swedish towns in 1930.

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[105] There is a rich literature on the postwar car society which would lead to far to go into in this report. Examples are: Lundin, P.,(2008). Bilsamhället: ideologi, expertis och regelskapande i efterkrigstidens Sverige. Diss. Stockholm : Kungliga tekniska högskolan; Emanuel, M., (2012). *Trafikslag på undantag: cykeltrafiken i Stockholm 1930-1980*. Diss. Stockholm : Kungl. tekniska högskolan; Wikman, P., (2019). *Kulturgeografin tar plats i välfärdsstaten: vetenskapliga modeller och politiska reformer under efterkrigstidens första decennier*. Diss. Uppsala: Uppsala universitet.

[106] This part builds on Dufwa, A., (red.) (1985). *Trafik, broar, tunnelbanor, gator*. Stockholms tekniska historia 1 Stockholm: Liber Förlag, pp. 10-14

[107] Tjulin, R., (2002). *I kommunalteknikens intresse: svenska kommunal-tekniska föreningens verksamhet under 100 år*. Master thesis, KTH, Stockholm, supervisor Pär Blomkvist Stockholm, 2002; Tullgren, E., (red.) (2002). *Svenska kommunal-tekniska föreningen 100 år: [1902-2002]*. Stockholm; Cettner, A., Söderholm, K., & Viklander , M.,(2012) An Adaptive Stormwater Culture? Historical Perspectives on the Status of Stormwater within the Swedish Urban Water System, *Journal of Urban Technology*, **19**(3), 25-40, pp. 31

[108] This section is based on Tjulin, R., (2002). *I kommunalteknikens intresse: svenska kommunal-tekniska föreningens verksamhet under 100 år*. Master thesis, KTH, Stockholm, supervisor Pär Blomkvist Stockholm, 2002, pp. 39-42

A handbook for street building and maintenance for the new car society was published in 1953 and in 1969. It basically covered everything from geotechnics to signal facilities and community planning. Another influential handbook published by the association in 1973 was "Guidelines for the geometric design of streets" (RIGU 73) in collaboration with the National Road Administration, the Swedish Association of Municipalities, and the National Planning Agency. The content described how streets, intersections, cycle paths, etcetera should be designed to cope with traffic loads and safety requirements.

Although street building and maintenance were at the center for the association, a variety of traffic issues were also important. Traffic noise, traffic flows, parking facilities, traffic rules, signs and signals were areas covered. The municipal engineers often worked in close cooperation with members of the automobile lobby such as the Royal Automobile Club. The general direction of the efforts was how the streets and public places, and the whole town, should adapted to different traffic needs, especially to the private automobile. In 1960, a whole conference week was devoted to the car question. The question was what should be done and who should pay for the car society. Many speakers at the conference were from organizations within the car lobby and the municipal engineers thus showed that they were at the forefront of motoring and the construction of cities around the car. Also, in 1967, when Sweden switched to right-hand driving, the association was deeply involved. For example, they took the lead in the right-hand traffic investigation in Stockholm where 25 interchanges and more 200 street intersections had to be changed, 176 traffic signal facilities were moved, and 35 000 road markings were repainted.

Institutional path dependence in roads and streets

Road maintenance carried out by the farmers remained for a long time, despite attempts to make road management a public task performed by the authorities. As mentioned, this arrangement for public road keeping was since the Middle Ages until the 1920s, a tax payment in kind. Historian Erik Lindberg (2022) shows that this extremely decentralized way of managing roads was unconventional in an international perspective. Only Sweden had an arrangement where both the financing and the execution of road management laid in the hands of the same local authority, the road district, and thus outside the regular parish or municipal administration. This way of handling road issues gave the local road districts a very strong position. Furthermore, he successfully argues that despite state initiatives to build new roads during the nineteenth century, the Achilles heel of public road keeping was road maintenance in kind according to the utility and interest principle. Lindberg convincingly show that traditional road keeping was tightly inwrought with other institutional arrangements in Swedish society and therefore extremely hard to change.

"What is known in the literature as the interest principle did not create good roads but functioned as a brake on institutional changes regarding the continuous maintenance of the public road network in the country."[109]

The Road Act of 1891 strengthened, despite contrary intentions, local self-government in the road sector. The newly formed road districts became an independent form of municipal administration, where voting rights remained graded according to income and wealth, and where companies also had voting rights. The problem was that within a road district, actors with many votes could control and block the decisions in the road district board.

[109] Lindberg, E., (2022). *Välfärdens vägar: organiseringen av vägunderhållet i Sverige 1850-1944*. Lund: Nordic Academic Press, pp. 128

Lindberg claims that municipal self-government in the road sector prevented fiscal justice between the municipalities through municipal tax equalization. During the latter part of the 19th century, the municipal tax pressure rose significantly and the question of an equalization of the tax burden between municipalities became a burning domestic political issue, since a large part of the municipalities' cost increases were due to government decisions that applied to all the country's municipalities, for example infrastructure, hospitals, schools, etc. Between the years 1900 and 1925, the municipalities' expenses rose seven times and the debts increased fivefold. And these increases were far from evenly distributed among municipalities.[110]

It was thus the reluctance to contribute to municipal tax equalization that caused a reform of the road sector to be delayed, although most people realized that in-kind maintenance had played out its part. It was difficult to reform road maintenance due to far-reaching individual and local self-determination, where many changes could be blocked by individuals or by local communities. The strong position of the municipal self-government basically prevented all attempts to improve road quality. The nationalization of the road network in 1944 was thus a drastic way to completely disconnect road maintenance from local interests to achieve tax equalization.

Following Lindberg, I would argue that it was *institutional* inertia and path dependence that slowed down the modernization of the Swedish public road sector. On the other hand, *technical* inertia and path dependence was not as important in preserving the historical legacy of road keeping.

Although I agree with Lindberg it is possible that this institutional inertia and path dependence were not as strong in municipal street management, especially in the larger towns. As I have shown both city streets and public roads passing through the town, were in many cases incorporated in the obligations of the municipality since the first half of the nineteenth century. This expansion of municipal engagement in streets and roads was realized before the municipal reform of 1862 and the new road legislation of 1891.

It is quite clear that towns had a high level of freedom in dealing with street and road issues and some cities had started to take over the road and street maintenance from the middle of the nineteenth century and financed this with taxation. Furthermore, as mentioned, in the larger towns such as Gothenburg and Stockholm the magistrates or the Burghers decided to manage both roads and streets as a public undertaking even earlier.

When, the municipal act was introduced, with its stronger power to levy taxes, it gradually moved both road and street keeping in the cities, towards even stronger public engagement. Furthermore, this increased articulation of publicness was most certainly strengthened by the adoption of the new Building statutes in 1874 and it seems probable that most towns had taken over both street and road management as public undertakings in the beginning of the 1920s.

These last remarks are based on a synthesis of secondary sources and therefor preliminary. More research on primary sources is needed. Nevertheless, I claim that my results on road and street keeping in the Swedish towns complements Lindberg's results. It seems to me that the conservatism he finds in public roads in smaller municipalities on the countryside, is not found in the larger cities. The old habits of street and roads management faded away faster in the towns, and they were able to modernize the sector earlier. In the towns, the strong municipal independence did not cripple

[110] Lindberg, E., (2022). *Välfärdens vägar: organiseringen av vägunderhållet i Sverige 1850-1944*. Lund: Nordic Academic Press, pp. 112

road and street keeping as it did in the countryside. The city authorities used their strong and immemorial self-governance to adapt the sector to modern demands.

Systems culture in roads and streets

In research on the history of and infrastructure and large technical systems (LTS) there is an idea that a special *system culture* develops within each system.[111] According to Kaijser (1994) this culture among the dominant actors is characterized by uniform education, common and overlapping career paths, and common views on what is right or wrong. The systems culture fosters a certain "system rationality" or "inner logic" which guides the thoughts and leads the actors to see solutions in line with the system rationality and logic. The system culture thus contributes to the system's inertia and creates path dependance. We can discover such a systems culture, or system builder culture, both in roads and streets and in WSS.

In the road/street sector, after the demise in the 1920.s of the institutional conservatism discussed above, this culture grew strong and was shared by both state and private actors. Common educational background and cross-border career paths were factors that have created a sense of belonging within the "guild", regardless of whether one worked in the commercial or state/municipal side of the road system. It must be emphasized that the system builder culture, even though it is community-creating, does not exclude fierce conflicts. System builder culture should be seen as a collection of informal rules for how conflicts are expressed, which opinions are considered grounded in science and facts, and which are defined as not. It maintains an "inside" and an "outside" within the road system. The sociologist of science Bruno Latour puts it this way about the "exclusive network" of technicians and scientists and their privilege to specify what is rational and what is not rational:

"In this way, a scientific/technical discourse is created within the network that defines what is knowledge and what is belief, while at the same time an asymmetry arises between those inside the network and those outside...(which can lead to)... that the critics are either redefined as irrational and representatives of extreme views or they are convinced to accept the network's discourse and thus become allies." (Latour, 1987)

The most important components of the road system building culture have been a technical, scientific view of the field of road traffic and a common value base created by a similar educational background. Both are based on the professionalization project of the road-engineers. As been discussed, the *technification* of the road system was intimately connected with the road-engineers' desire to expand their professional field. This applies both to the "industrialization" of the roads in the 20s and the adjustment to mass motorization in the post war years. The Swedish Road Association became one of the most important organizations for this endeavor, and its commercial members thereby gained access to an important political resource: the reputation of engineering science as politically neutral. The system builder culture is relevant because it contributes to a system's inertia, path dependence and creates a reluctance to change.

After WWII the system builder culture was heavily influenced by the demands put on society by automobility and Sweden decided early in the 1950s to become a *Car Society*. This decision was a

[111] The section on systems culture is a revision of a text published in Blomkvist, P., (2004) *Transfering Technology - Shaping Ideology. American Traffic Engineering, Experts and Commercial Interests in the Establishment of a Swedish, and European, Car Society in the Post War Period*, Comparative Technology Transfer and Society; and Blomkvist, P. (2001). *Den goda vägens vänner: väg-och billobbyn och framväxten av det svenska bilsamhället 1914-1959* (Doctoral dissertation, Symposion Brutus Östlings bokförlag).

product of internal developments, a growing motor sector in the economy and demands from below, the Swedish people really wanted to have a car of their own. But it was also apparent that to implement the desired Car Society, Swedish planners and road engineers had to draw upon knowledge from outside the nation. The inspiration and knowledge to adjust the Swedish motor road system to meet the demands posted by mass motorization came from "American Traffic Engineering" which at the time was a new way to handle traffic. The goal of traffic engineering was to create free and unrestricted traffic flows and to meet the demands of mass motorization by increasing road capacity. Its core message was the often-quoted phrase: "All traffic demands should be met." Traffic engineering can be said to be the transport sector equivalent of Scientific Management or Taylorism and it became the foundation in the so-called "predict and provide ideology". Traffic engineering identified the critical problem in the motor road system as lack of flow and gave the solution: expanded road capacity. The carriers of this new car orientated culture were the interest groups mentioned above, SRF and the municipal engineers, commercial interests and state and municipal authorities. It is fair to say that all important actors, including politicians, embraced this invigorated automobile-based road and street systems culture.

Chapter 5: Summary and analysis of roads and streets

This is a brief list of the most important laws and regulations for roads and streets:

- National, Landscape (County), and City laws (12th-18th centuries)
- The law of 1734: Clear articulation of state utility in public roads and rules on civic roads
- 1866: Expropriation Ordinance of 1866 (followed by the Expropriation Act of 1917)
- 1874: Building statute of 1874 (regulated, among other things, land rights for streets)
- 1907: Town Planning Act (the municipality was given the right and obligation to redeem street land and land for public places)
- 1907, 1926 and 1939: Civic roads acts
- 1930: the concept of "right of way" was introduced, which was also applied in the cities. The right of way means that the state or city was allowed to build a road over private land if required. Land ownership was intact. The right of way was (and is) only a right of use.
- 1934: Public Roads Act and Road Districts Act (the towns are from now formally managing roads and streets)
- 1944: Nationalization of the public roads
- 1947: Building Act (municipal planning monopoly)
- 1960: Building code (uniform rules throughout Sweden)
- 1974: The Construction Act and the Act on the management of communities
- 2011: Plan and building act, PBL 2011 (replaced the Planning and Building Act from 1987)

Articulating publicness in pre-modern and modern roads and streets

Roads and streets have, as indicated, been articulated as a public domain for a long time. The Swedish state and the towns/municipalities has strived to create laws, and institutions promoting road building and maintenance, at least from the middle-ages. I would argue that the road/street network was a public concern long before it became an infrastructural *system* in our modern meaning and that the authorities showed a clear public ambition long before they really became system builders.

The publicness of roads and streets were for a long time implemented based on the so-called principle of "utility and interest", meaning that landowners, in towns and in the countryside, living in

proximity were to manage the road/street because they were seen as the beneficiaries of the service delivered.

However, the strong tradition of local self-governance meant that street and road management was exercised with a gentle hand and that the goal was to reach amicable agreements. Without some "communalism" and the goodwill of the farmers and property owners, no roads or streets were built or maintained.

The state's interest in public roads during the Middle Ages and up to the 18th century was essentially based on the central power's need to control the territory, mainly for military reasons, which was gradually complemented with a desire to promote trade and manufacture, both in the nation and in towns.

Industrialism affected the sector and road and street keeping was articulated in new ways: First, agriculture became more market-oriented and the need for transport outside the absolute immediate area increased. Second, industries grew that required roads for its raw materials and products. The farmers who were obliged to maintain the roads came to see the road burden as unfair because the new industries did not have to pay for the roads they used. Third, the building of the railway network meant that the need for roads increased as goods and passengers had to travel to and from the stations. Fourth, the route of the railway meant that population and business were concentrated in connection with the nodes of the railway network. This development can be characterized as the "industrialization of roads".

Moreover, adding to these general trends in the industrialization process affecting the articulation of publicness, technical advances were of course pivotal for the development of these areas into infrastructural systems. Industrialization also meant that more people moved into towns and industry´s need for better transport facilities affected road and street construction, pavements, but the real challenge to streets came with the automobile.

Eventually in the 1930.s efficiency became more important and central control was strengthened in 1934 when yet a new Road Act was introduced, the most important change was the formal abolition of road keeping in-kind. Something that de facto had already happened. In 1944, the public roads in Sweden were nationalized and the utility and interest principle moved up to a societal level. Now it was the entire kingdom's joint obligation to keep roads and streets.

Also, from the 1930s and especially after WW2, publicness in the road and street sector was foremost articulated trough the automobile. The national road plan for Sweden in 1958 was an ambitious effort to remodel the public road network to fit the demands of mass motorization. In towns the municipal engineers worked hard to adapt streets and public places, and the whole town, to motorized traffic, especially the private automobile. A spectacular effort of public engagement was the decision to switch to right-hand driving in 1967. Towns, municipalities, and the whole country, showed an unprecedented will to embrace publicness in the traffic sector.

Roads were from the very beginning connected to the values and ideological goals of movement, of both people and commodities. *Movement* was seen as something inherently beneficial for the country and its inhabitants and thus an obvious common good. Roads were also instruments for the

highly valued concept of "connectivity", which of course also applies for all modern transport and communication systems.[112]

The most important contextual factor influencing the articulation of publicness in roads and streets was undoubtedly the strong tradition of municipal independence and self-governance. The history of roads/streets show a high level of local independence and negotiating power in relation to the state and municipal authorities. It is quite clear that towns had a high level of freedom in dealing with street and road issues and some cities had started to take over road and street maintenance from the middle of the nineteenth century and financed this with taxation. Furthermore, as mentioned, in the larger towns such as Gothenburg and Stockholm the magistrates or the Burghers decided to manage both roads and streets as a public undertaking even earlier. The municipal act of 1862 gradually changed both road and street keeping in the cities, towards more public engagement and it seems probable that most towns had taken over both street and road management as public undertakings in the beginning of the 1920s.

But municipal independence also caused a reform of the road sector. It was difficult to reform road maintenance due to far-reaching individual and local self-determination, where many changes could be blocked by individuals or by local communities. The nationalization of the road network in 1944 was a drastic move to completely disconnect road maintenance from local interests.

Nevertheless the conservatism found in public road keeping in smaller municipalities on the countryside, was not present in larger cities. The old habits of street and roads management faded away faster in the towns, and they were able to modernize the sector earlier on. In the towns, the strong municipal independence did not cripple road and street keeping as it did in the countryside. The city authorities used their strong and immemorial self-governance to adapt the sector to modern demands.

The historical legacy in roads and streets: resource and systemic characteristics

Roads/streets is a *communicative* inherently networked/gridded arrangement/system with clear *positive network externalities*. This means that it would not be rational for and individual to build a road that only serves personal transport needs. Roads are not *local*, in a narrow sense. To be of real value, they need to connect point A to point B, to attach to other roads and cross a geographical space larger than the private domain. These characteristics has been apparent in Swedish road history for many hundred years, perhaps millennia. In a quite recent example, the Swedish prime minister Tage Erlander realized this in a debate 1956 with the right-wing leader Hjalmarsson discussing proposed state expenditures in the extensive national road plan mentioned above:

[112] In English, the word "Path" indicates soil that has been trodden by the foot. "Way" comes from the concept of movement, from Sanskrit (vah) and reappears in Vehicle and Wagon. "Street" comes from the Latin strata and means "constructed" - a place-bound word. "Road" began to be used at the end of the 16th century and probably comes from the verb "to ride". Road thus refers to "movement" instead of "place". The Old Norse word for street was Gate (from Gait – horse gait), which is associated with movement, and we have the same origin in Sanskrit for our "Väg" (road - vah – way – väg). Thus, in Swedish, both street (gata) and road (väg) come from concepts that have to do with movement. In Japanese the word for road is *michi*, which gives a certain poetic touch to the mundane road. The initial *mi* is used to give beauty to a word. *Chi* is a word stem that expresses movement or direction. "Beautiful place for movement" or just "beautiful direction" could be a Swedish translation. From the middle of the 19th century, the meaning of the road and the street finally changed from indicating something tied to a place to meaning a channel intended for vehicles in motion. "Artery" was the word that came into use: Gunn, S., et.al (2022). Cities, infrastructure and the making of modern citizenship: The view from north-west Europe since c. 1870. *Urban History*, 1-19, p. 12; Lay, M. G. (1992). *Ways of the World: A History of the World's Roads and of the Vehicles that Used Them*. Rutgers university press., pp. 7-8, 59 and 66; Yamada, M. (1981) *Roads, An Essential Aspect of Human Life*, The wheel extended, A Toyota Quarterly Review Special 10th Anniversary Issue, April-June, pp. 69

"Not even Mr. Hjalmarsson wants to go back and forth in his own courtyard, he wants to go out with his car on the roads. As citizens acquire a car, the demands on society's efforts are increased".[113]

Roads/streets, due to their inherent character as *communicative* networks is a common good by definition, at least in most cases although there are modern exceptions such as motorways or toll roads which are *excludable* or when congestion turns the road into a *rivalrous* good. Nevertheless, historically roads and streets are clearly perceived as common goods. This perception is evident in the fact that roads and streets almost always have been financed by taxation. Attempts to introduce user fees, like in most other infrastructural systems, has met fierce resistance. The recent introduction of road pricing in Stockholm and Gothenburg was, and still is controversial, to say the least.[114] It seems to me that the public character of Swedish roads and streets is firmly rooted.

From a systemic perspective, public and civic roads and streets has gradually become a well-aligned and cohesive infrastructural system with three integrated levels (strong vertical integration) and a distinct state-controlled system builder controlling each level. Thus roads and streets are not tightly coupled in a technical sense, but they are tightly coupled from an institutional perspective. Sweden has a distinct state system builder in the National traffic authority who controls technical and institutional design on all three system levels. Finally, I would argue that the road/street network was articulated as a public concern long before it became an infrastructural *system* in our modern meaning and that the authorities showed a clear public ambition long before they really became system builders.

Chapter 6: Pre-modern water and sanitation

In this section I discuss and analyze the pre-modern history of water and sanitation. The field is of course huge, and I can only touch on the most important aspects for this report. I briefly discuss the ancient legacy of water and sanitation before turning to pre-modern WS. I discuss to what extent the pre-modern history has affected modern service arrangements in Sweden and my focus is on the question whether water provision and sanitation has been seen as a public or private responsibility.

One area which is only briefly discussed is the question of whether water scarcity has affected various service arrangements for drinking water provision in Swedish towns. I have not found any clear indications of this and in a general sense fresh water has not been a scarce resource in Sweden. Possible exceptions could be Malmö and Karlskrona where geographical and geological conditions made it difficult to obtain fresh water. [115]

Another interesting area outside my scope is the contested theories by historian Karl August Wittfogel who coined the term *hydraulic civilization* for early state power residing on the control of water resources like advanced irrigation schemes. Even though the term does not fit in pre-modern

[113] Erlander 1956 – Blomkvist, P. (2001). *Den goda vägens vänner: väg-och billobbyn och framväxten av det svenska bilsamhället 1914-1959* (Doctoral dissertation, Symposion Brutus Östlings bokförlag); Blomkvist P. (2010). Om förvaltning av gemensamma resurser: Enskild väghållning och allmänningens dilemma i svensk historia 1200–2010 (Managing Common Pool Resources: Road Keeping and the Dilemma of the Commons in Swedish History 1200–2010), Division of Industrial Dynamics, KTH (Royal institute of Technology), Stockholm, Sverige. TRITA-IEO 2010:06
[114] Isaksson, K., (red.) (2008). *Stockholmsförsöket: en osannolik historia*. Stockholm: Stockholmia
[115] Person, K, M. (1999). *Några tankar om Malmös vattenförsörjning under medeltid och renässans*, Elbogen, Malmö Fornminnesförenings årsskrift. Person stresses the fact that water scarcity due to geographical circumstances could be a motivational factor for publicly organized water provision; Andersson, J. (2013). *Karlskrona vattenverk 150 år: stadens och kommunens VA-historia 1863-2013.* Karlskrona: Karlskrona kommun.

or modern European history the impressive water systems discussed by Wittfogel surely points to an interesting trait in modern WSS: the fancy for large-scale, centralized, and piped solutions.[116]

Pre-modern drinking water provision: proto systems and wells

The most famous constructions for water provision are the Roman aqueducts, although there are older examples of impressive water systems.[117] In 33 BC, over 500,000 cubic meters per day were transported into Rome by the aqueducts. The water was mainly collected from wells and springs and not from surface water like rivers as one might believe. Furthermore, contrary to common imagination, most aqueducts were not elevated structures but ground level canals or underground tunnels. The water was led in a self-falling system according to the flow-through principle, without the possibility to turning of the flow. With the great amount of water coming in, the diversion and drainage needs were of course huge (see below on Cloaca Maxima). Around 60 percent went to public facilities like fountains, 20 percent to the emperor's palace and 20 percent to private house. What is clear is that only wealthy families in ancient Rome could have running water and their own baths. The famous fountains like Fontana di Trevi, still in use today, had a double function. They provided water for the populace, and they were also leveling reservoirs or safety-valves to even out water pressure. Each of the aqueducts ended with a large final fountain and smaller fountains were scattered along the water course of the aqueduct. Some of the ancient fountains are still part of Rome's WS system.[118]

However, as many researchers claim, the aqueducts were not only providing drinking water. The copious amount of water transported by the aqueducts were mainly used for the Roman baths:

"At all periods of Antiquity, wells were a prime, if not *the* prime resource. Aqueducts, which we often think of as an essential feature of any ancient city – certainly of any Roman one – were often very late in arriving on the scene, for it was usually the opening of large bath complexes, voracious consumers of water, that spurred their construction. Previously, all water supplies had to come from cisterns and wells, and even after the advent of the aqueduct would remain in service. Indeed, in most cities it is a good question whether one should think of domestic wells as supplementing the aqueducts or the other way around. And of course some cities, such as Ampurias and London, never had an aqueduct at all, and relied on cisterns and well-water all through their history… (when an aqueduct was built) … some of its water might be diverted for drinking and domestic use, (but) its major purpose was normally to supply the baths. Seen in this light, the Roman aqueducts become largely a social and recreational facility rather than a public utility." [119]

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[116] Wittfogel, K. A. (1957) *Oriental despotism; a comparative study of total power*. New York: Random House; See also: Boccaletti, G. (2022). *Water - A Biography*. Random House USA

[117] The history of water and sanitation in Roman times and earlier is a fascinating field. See for example: Nilsson, D. (2014), *Reflections on past approaches and policies for water and sanitation in cities: transformative shifts and future perspectives*, Background Paper for UN Habitat Global WSS Report 2014; Deming, D. (2020). The Aqueducts and Water Supply of Ancient Rome. *Ground water*, **58**(1), 152–161; Bruun, C. (2013). Water supply, drainage and watermills. In P. Erdkamp (Ed.), *The Cambridge Companion to Ancient Rome (Cambridge Companions to the Ancient World*), (pp. 297-314). Cambridge: Cambridge University Press; Scheidel, W. (2013). *Disease and death*. In P. Erdkamp (Ed.), *The Cambridge Companion to Ancient Rome (Cambridge Companions to the Ancient World)*, (pp. 45-59). Cambridge: Cambridge University Press; https://engineeringrome.org/water-and-the-development-of-ancient-rome/

[118] Erik Winnfors Wannberg: Personal e-mail conversation (220602); Deming D. (2020). The Aqueducts and Water Supply of Ancient Rome. *Ground water*, **58**(1), 152–161; Bruun C. (2013). *Water supply, drainage and watermills.* in Erdkamp, P. (2013) *The Cambridge Companion to Ancient Rome (*Cambridge Companions to the Ancient World, pp. 297-314*).* Cambridge University Press.

[119] Hodge, A. Trevor: "Part 1, "Water supply"; chapter 3 "Wells" (p 29-34) and chapter 5 "Aqueducts" (p. 39-66) in Wikander, Örjan (red.) (2000). *Handbook of ancient water technology*. Leiden: Brill (p. 29 and 47)

Nevertheless, it is important to note that Roman law had many regulations on water issues, including drinking water, and Rome also had a quite impressive administrative apparatus managing water provision. As in the Roman road administration the highest-ranking water officer was the Curator, "*Curator Aquarium",* who oversaw the upkeep of the aqueducts. A central task for the Curator was to guarantee the flow of water day and night and to manage the constant need for maintenance.[120] The curator also had an extensive workforce at hand which included occupational groups specialized in various parts of the Roman water system. [121]

But despite all this and although Rome had left us with an impressive heritage of water provision, the general view among researchers is that, although famous and celebrated, "…it is not correct to talk about a technical or institutional trajectory stretching from Roman times to the early nineteenth century, the arc was broken for 500 hundred years or so." [122] However, references to Roman water and sewage technology were often used in the rhetoric's of advocates of gridded systems such as Wilhelm Lejonancker who designed the piped water system in Stockholm (see below). French historian Goubert (1989) notes this admiration for Rome was based on a superficial knowledge of the Roman water system: "With their smattering of Greek and Latin culture. Mayors, members of parliament, doctors, architects, and engineers, whether in France, Western Europe, and North America, were often inspired by the Roman model."[123]

Having said the above, it must be noted that references to Rom was not only empty rhetoric. The role model borrowed from Roman water systems played a substantial role in for example the construction of the Paris sewage system in the 19th century. Its rhetorical or symbolic meaning was probably instrumental in mobilizing actors and capital. [124]

Although Roman technology and organization lay dormant until European state and municipal governments had the will and the resources to do anything about water provision and sanitation, a substantial institutional and legal legacy survived, in the form of Roman water legislation. The laws in Europe which regard water more as a public resource with ownership only of its products (usufruct) derive from the Roman tradition, while those emphasizing land ownership bordering to the water curse as the guiding principle, derive from British common law. During colonialism, the European, and thus partly Roman, water law was exported to all corners of the earth. [125] Nevertheless, it is my impression, that these Roman laws mainly targeted water issues other than those related to drinking water. As will be discussed later, early water legislation in Sweden did not mention drinking water at all but instead were directed towards so-called *defensive* (land drainage)

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[120] Deming D. (2020). The Aqueducts and Water Supply of Ancient Rome. *Ground water*, **58**(1), 152–161; Bruun, C. (2013). *Water supply, drainage and watermills*. In Erdkamp, P. (2013), *The Cambridge Companion to Ancient Rome* (Cambridge Companions to the Ancient World, pp. 297-314). Cambridge: Cambridge University Press, Bruun is quoting the famous water Curator Sextius Julius Frontinus (around AD 100) who wrote the most important source on Roman water management: *De aquaeductu urbis Romae,* pp. 304.

[121] Mays, L. W. (2010), Ancient Water Technologies, Springer, London; Crow, J. (2012) Ruling the waters: managing the water supply of Constantinople, AD 330–1204, *Water History* (2012) 4:35–55.

[122] Goubert, J-P. (1989). *The conquest of water: the advent of health in the industrial age*. Cambridge: Polity, pp. 208; Rosen, G. (2015). *A history of public health*. Rev., expanded ed. Baltimore, Md.: Johns Hopkins University Press, pp. 12

[123] Goubert, J-P. (1989). *The conquest of water: the advent of health in the industrial age*. Cambridge: Polity, pp. 208

[124] Reid D (1991), Paris Sewers and Sewermen. Realities and representations. Harvard University Press, Cambridge Mass. and London

[125] Dellapenna, J. W. & Gupta, J. (eds.) (2009). *The Evolution of the Law and Politics of Water,* Dordrecht: Springer Netherlands

and *lucrative* (waterpower) projects and focused on ownership and the right to manage water resources for farming and industry. It seems to me that literature on water legislation often blur the lines between drinking water and other uses where water is included.

One important legal legacy concerning drinking water that has survived though, is the right to draw a water pipe over land owned by another. These rules have been a fundament in drinking water (and sewage) legislation since at least Roman times where it was called "Aquae ductus" (the right in law to carry water by means of pipes or conduits over or through the estate of another). [126]

In the period following the fall of the empire, Europe saw few attempts to systematically tackle water provision and the achievements of Greeks and Romans were largely forgotten. However, Moslem Spain was unusual with its twelfth century system in Seville which is considered as a remarkably complex system for the collection and inhouse-distribution of water. But most European towns relied on springs and wells for drinking water. Concerning water quality and pollution, Denis Smith (1999) states that the "…desire for clean drinking water manifested itself here and there in large cities through legislation to prevent the dumping of refuse and sewage in rivers. But there are few examples of technological solutions being employed.".[127] In a French context historian Goubert echoes this opinion, giving an illustration of the ideology of the *night-watchman state:* "In the early nineteenth century, the state did not bother to intervene in the area of prevention. The welfare state was still a long way of…It would doubtless be a fine thing if there were more water purifying stations; however, the government will play no part in this: it is up to private individuals to establish them; the government can only protect them."[128]

In Sweden, the situation concerning provision of drinking water and sanitation is much the same as in the rest of pre-modern Europe and very different from WS in ancient Rome. As touched upon, in the countryside and in the villages many public matters such as roads, land drainage, grazing, fishing, hunting and common forestry, were managed as CPRs and regulated in the Village by-laws (Byordningar). However, drinking water were not mentioned at all (the same goes for sanitation). I have investigated approximately 400 Village by-laws published by Ehn (1982) and searched the web for other Village ordinances and found no sign of drinking water being a public or common issues.[129]

The Villages by-laws were codified and standardized in the so-called Model Village by-law in 1742 and included the most important stipulations needed for the Village council and the Village eldest to manage Common Pool Resources. The purpose of the Model Village by-law was to make sure that

[126] Aquaeductus Definition & Meaning - Merriam-Webster; Aquae Ductus – Free Online Dictionary of Law Terms and Legal Definitions (lawin.org)

[127] Smith, D. (red.) (1999) *Introduction*, Water-supply and public health engineering. Aldershot: Ashgate Variorum; Karlsson, A. (2021): *Vatten en historia om människor och civilisationer*, pp. 175-177; Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag: Cronström mentions the Roman aqueducts and the famous Cloaca Maxima but does not go so deep into the matter. With the fall of Rome their water works also fell and the Middle Ages is described as a long period of decay and nonexistent "communal technology". Following did centuries of filth. Water became a private matter. Cronström writes: "Attempts was made to solve the water issue through some form of joint property unit ("samfällighet)" – but he does not give any evidence to this claim. London, Paris and Hamburg are mentioned as examples of attempts on water distribution and sewage pipes during 1200-1400. However, it is not until the middle of 1800, that modern systems for water and sewage saw the light of day. (pp. 3-6)

[128] Goubert, J-P. (1989). *The conquest of water: the advent of health in the industrial age*. Cambridge: Polity, pp. 40

[129] Ehn, W. (1982). *Byordningar från mälarlänen: Stockholms, Södermanlands, Uppsala och Västmanlands län*. Lundequistska bokhandeln.

conflicts within the village around these types of common resources, were solved within the village community and not referred to the County court.[130]

Water issues were only mentioned in §5, 6 and 7 where drainage of land using ditches are mentioned, in §26 public water for fire protection is dealt with, in §33 regulations for public management of wells, springs or "other common water reservoirs" are listed, but, and this is important, only for cattle, as shown in this example:[131]

"All villages should be well supplied with water, and to that end all wells, springs, or other common watering-places for the cattle, shall be constantly kept under control, and when it is necessary that they should be cleaned or dug up, no one may escape from them at (?) silver coin's fine, if someone does it, the village eldest and the village council have the power to let the reluctant hire workers then collect the wages and fines from him."[132]

But § 33 is included in only a few of the Village by-laws related by Ehn. This, or similar wordings on water for cattle, can only be found in around 5-10% of the approximately 400 individual village ordinances. To conclude. there is nothing in the older history of rural areas, such as village ordinances or by-laws, legislation, or court proceedings, that treats drinking water as a public concern.[133] Drinking water provision in the countryside of Sweden was simply not regarded as a Common Pool Resource in the meaning of Elinor Ostrom, at least not in any formal sense in written laws and regulations. [134]

In contrast, two interesting case studies of elaborated and advanced CPR-management of both drinking water and water for irrigation can be found in Yemen dating back to the fifteenth century and in Tashkent, Uzbekistan, from the eighteenth century.[135] Another interesting case comes from Mexico where Indigenous people in the Meseta region since a very long time, at least before the sixteenth century, has managed to cope with harsh conditions and limited amount of water by developing sociocultural strategies for water management based on the following three components:[136]

- The emergence of what we may call a "culture of water scarcity", that utilizes modest volumes of water due to the lack of adequate sources of supply.

[130] Ehn, W. (1982). *Byordningar från mälarlänen: Stockholms, Södermanlands, Uppsala och Västmanlands län*. Lundequistska bokhandeln, pp. 2-4
[131] Ehn, W. (1982). *Byordningar från mälarlänen: Stockholms, Södermanlands, Uppsala och Västmanlands län*. Lundequistska bokhandeln, pp. 24
[132] https://tingvastbo.se/onewebmedia/dokument/Byordning%20f%C3%B6r%20Tingvastbo%20%20by.pdf
[133] Corroborated in an interview (210325) with Jesper Larsson, agrarian historian and expert on Common Pool Resources in Swedish early modern history.
[134] I have not made any systematic attempt to find out if drinking water has been regarded a Common Pool Resource internationally. Shiva, (2003) writes interestingly about water as a common pool resource in India. However, this applies to water for irrigation. No CPR organizations specifically for drinking water or sewage have existed (pp.42-56). However if there is a CPR-managed irrigation system, drinking water is also included as a side effect, but no special arrangements were made to handle this part of the resource. Shiva, V. (2003). *Krig om vattnet: plundring och profit*. Stockholm: Ordfront
[135] Hehmeyer, I. (2007) *Water, lifeline of the city of ghayl ba wazir, yemen* (pp. 197-212) in Juuti, P, Katko, T, Vuorinen, H (eds.) (2007). *Environmental history of water: global views on community water supply and sanitation*. London: IWA Publishing; Bazarov, D., Kazbekov, J., & Rakhmatullaev, S. (2007). History and present condition of urban water supply system of Tashkent city, Uzbekistan. *Environmental History of Water-Global views on community water supply and sanitation. IWA Publishing, Alliance House, London, UK*, 213-221, in Juuti, P, Katko, T, Vuorinen, H (eds.) (2007). *Environmental history of water: global views on community water supply and sanitation*. London: IWA Publishing
[136] Citation from García, P. A. (2007) Water and environment in one indigenous region of mexico (chapter 27: pp. 411-428) in Juuti, P, Katko, T, Vuorinen, H (eds.) (2007). *Environmental history of water: global views on community water supply and sanitation*. London: IWA Publishing; See also chapter 31 on Māori water ideology in New Zeeland where water is seen as divine: Dixon, N. (2007) *Healthy water from an indigenous maori perspective* (pp. 475-488)

- A form of social organization that permits "community control of water", where this resource is seen as a collective good to which the entire population must be assured access. In addition, all members of the community share the responsibility of conserving and maintaining the sources of supply and for capturing, transporting, and distributing water.
- The emergence of a "culture of ecological water use and management" associated with the Purepecha people's cosmovision (worldview), where water is highly valued and must be cared for because it is a "fruit" bestowed by "mother nature" (Cuerauahperi). This attitude is reflected in the practices of water use and management, whose basic ecological principles are low consumption patterns (little waste), the diversification of sources of supply (utilization of rainwater, springs, watering holes), multiple applications (productive and domestic uses) and recycling (minimal discharge).

In a very interesting investigation on household water provision in the countryside in Sakumaland, Tanzania, Drangert (1993) shows that even if drinking water/household water is considered a common pool resource, this fact does not mean that it is actually managed as a CPR in the meaning of Ostrom: "Household water remains a common-pool resource which means that everyone is entitled to draw household water from any water source and that it is monitored by all residents in the area." Even if this norm was supported by most, many other factors, such as fear of "free riding" often prevented communal/cooperative solutions from becoming a reality.[137] Drangert concludes by stating that these norms could well be general: "The pronounced Sukuma norm that water is a common-pool resource from which to draw household water is believed to be the general pattern in rural areas in most of Africa." [138]

The most nearby explanation for the difference between Sweden the cases related above is water scarcity. In regions where water has been a scarce resource it is possible to find elaborate schemes for communal, CPR-like, water management. In most locations in Sweden, water was not a scarce resource and there was no need for cooperation and public/common management of WS. This notion is corroborated by Drangert (1993): "Norms about water rights do not make themselves manifest as long as water is abundant, but their sustainability is put to the test when water gets scarce." [139]

Despite the statements above and although it is quite clear that drinking water was not a formal public concern in the Swedish countryside, this picture is nuanced by evidence from research using ethnographic and oral history sources. Even though formal rules were missing in the Village bylaws, like those regulating roads, pasture and such, there seems to have been informal rules concerning water as a common pool resource. Many informants testify that it was seen as rude and breaking social norms to deny others to use water from a private well or spring. People in the villages were expected to share.[140]

Interestingly these social norms of water sharing seem to be universal and historically stable trough different cultures. Almost the same widely accepted expectations were present in, for example, traditional rural communities of East Africa where you had to share the water with other people, but

[137] Drangert, J. O. (1993). *Who cares about water?: A study of household water development in Sukumaland, Tanzania*. Linköping: Linköping University, p. 249
[138] Drangert, J. O. (1993). *Who cares about water?: A study of household water development in Sukumaland, Tanzania*. Linköping: Linköping University, p. 254
[139] Drangert, J. O. (1993). *Who cares about water?: A study of household water development in Sukumaland, Tanzania*. Linköping: Linköping University, p. 175
[140] Drangert, J-O. (1991). *Svensk vattenhistoria*. Linköping: Universitetet, Tema Vatten

you didn't have to share with other people's livestock.[141] In Sweden though, even if not so common, livestock seemed to be included in these norms.

In towns however, due to higher population density, the situation was somewhat different. Trough the 17th and 18th centuries in Europe, water provision in towns sometimes relied on *proto systems*, which was rudimentary technological solutions using water pipes made of wood (drilled logs). [142] Thus, in some Swedish towns, at least in the larger one's attempts were made using various types of proto systems for piped water during the Middle Ages and the following centuries (Göteborg, 1780.s; Uppsala, 1640s). In Malmö an impressive stretch of wooden water pipes has been found, dating back to around early sixteenth century.[143] In Stockholm in the beginning of the seventeenth century, a few attempts were made by private citizens to construct small water distribution systems by wooden pipes and to build water pipes supplying the Royal castle and other important buildings. However, these attempts were not successful.[144] In Uppsala, in 1642, a water main with iron pipes was built, supposedly the first in Sweden which led water to the castle. Due to lack of interest on the part of the residents, the piped were forgotten. The naval town Landskrona, on the east coast had a rudimentary water main of during the late 17th century which were replaced when the first modern water system was built in 1869-74.

The most famous and well researched proto system is the so-called *Kallebäcksledningen* in Gothenburg.[145] *Kallebäcksledningen* is interesting because it shows an attempt to provide water for all citizens in a town before the municipal authorities really had the ability or will to provide public drinking water in our present day understanding of the concept.[146] The spring that became the water source is mentioned for the first time in 1692, and in 1714 came the first proposal to transport the spring's water in pipes to the town. However, this project never materialized. From the middle of the 18th century private water peddlers delivered the spring water and sold it in the city. In 1785 a group of the cities wealthier residents turned directly to the King for permission to build a water main, which was granted in a royal letter. A water directorate was formed which was given the right to expropriate the land that was required to lay out the water main because landowners at the stretch of the pipeline refused to give up their proprietorship. Bjur (1988) makes a strong point of this expropriation right. In the Royal resolution the water main was seen as an equally common good (Bonum Commune) as a public road and therefore the right of the town should override the right of the property owners. Bjur´s hypothesis is that the Royal decree can be seen as a forerunner to the so called "line right" (ledningsrätt) which is the present-day legal foundation for municipalities to build

[141] 221103: Personal mail conversation with historian and water expert David Nilsson. See his and other contributions in Dellapenna, J. W. & Gupta, J. (eds.) (2009). *The Evolution of the Law and Politics of Water,* Dordrecht: Springer Netherlands https://link.springer.com/book/10.1007/978-1-4020-9867-3; See also Finnish water researchers Juuti, K.; Similar expectations in Jewish water norms: https://swedishwaterhouse.se/wp-content/uploads/Water-in-Judaism_ENG.pdf

[142] Hallström, J.and Melosi, M. V. (2022*). History of technological change in urban wastewater management, 1830–2010*. Routledge handbook of urban water governance. pp. 163-172, pp.164

[143] Person, K. M. (1999). *Några tankar om Malmös vattenförsörjning under medeltid och renässans*, Elbogen 1999, Malmö Fornminnesförenings årsskrift. Person stresses the fact that water scarcity due to geographical circumstances could be a motivational factor for publicly organized water provision. See also: Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag

[144] Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber, pp. 15-16; Anderberg, S. (1986). *Stockholms vattenförsörjning genom tiderna*. Stockholm; Söderholm, K. (2007) *Uppbyggnaden av Luleås VA-system vid sekelskiftet 1900. En djärv "miljö"-satsning i en tid av teknisk och vetenskaplig omdaning*, Research report, Luleå tekniska universitet, 2007:13, pp. 10.

[145] Andersson, A. (1971). *Svenska vattenledningar och vattenreservoarer 1869-1910*, C-uppsats i konstvetenskap, Lunds universitet, Lund, Sverige; Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg: Göteborgs VA-verk.

[146] This part builds on Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg: Göteborgs VA-verk, pp. 24-36

water pipes on private land (similar to the "right of way" in public roads legislated in 1930).[147] The financing of the project came partly through grants from the city with a third, partly through collection from the city's more affluent residents. In November 1787, the king Gustav III inaugurated the water pipeline. It was built of hollowed and buried logs of aspen, pine, and oak and stretched for 4.8 kilometers to a water cistern with a fountain at city center where the citizens could collect their drinking water. Quite soon though, the project ran out of money and after some initiatives to privately finance the operations, the king decided that the water pipe should be paid by taxation in 1804. However, the obligation to pay tax in cities in this time, before the Municipal reform of 1862, were not on all citizens but rested on the Burghers and the property owners.

Kallebäcksledningen is surely an interesting and quite unusual example of public involvement in the history of piped water. The ambitions of wealthy people and city authorities in Gothenburg to provide for piped water and the expropriation rights given by the Crown points to legislation that came to be enforced in both roads/streets and WS some hundred years later, surely show an early articulation of publicness. It is not possible for me to ascertain if the Gothenburg case really is a forerunner to public water provision or if it is an isolated example. I recommend further research. Still, I believe it is fair to say that this proto system can be seen as a something in between older forms of service arrangements in water provision and modern infrastructure. It is perhaps the *missing link* in the evolution of municipal infrastructure.

As been indicated these proto systems were financed and managed by private individuals of some wealth in cooperation with city authorities. Perhaps one can say that they were early examples of what we today call Public Private Partnerships (PPP). However, I believe that it is not correct to describe them as public infrasystems anywhere near our modern meaning. The water delivered by these early piped proto systems were certainly for all to use but the service arrangement was still not fully publicly financed and managed. Regarding the discussion on *publicness*, it is important to note that the proto systems discussed above, and the communal wells described below, were public in a weaker sense than the modern water systems being realized later. Hallström (2003) summarizes the history of drinking water like this: "Before the 1860s, the primary ways of obtaining fresh water in urban areas was from wells, springs, and waterways. There were a few smaller water pipes in certain cities, the most famous one being *Kallebäcksledningen* in Göteborg, but modern piped systems were wholly missing, and urban residents had mainly to resort to manual, decentralized water supply." [148]

Water peddlers were probably common in Swedish towns although I have only found some examples mentioned, most often in passing, in the literature on water history. One "water delivery man with his horse and barrel" (Vattuköraren) is mentioned in a famous song by Carl Michael Bellman (1740-1795), *Fredman's epistle no. 48: Ulla Winblad's journey home from Hessingen in Mälaren one summer morning in 1769* (verse 18). Water delivery men were also enrolled in the firefighting brigades in Stockholm and as mentioned water was sold in Gothenburg from the spring that later was the source for *Kallebäcksledningen*. Water stores serving bottled and sometimes sparkling water was set up from the middle of the nineteenth century. One example was the water store in Kungsträdgården, in the center of Stockholm. The shop started in 1850 and ended in October 1933. In this very store a literary murder takes place when the reverend Gregorius is

[147] Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg: Göteborgs VA-verk, pp. 67
[148] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 61-61

poisoned in the novel *Doctor Glas* by Hjalmar Söderberg (1905).[149] It must be noted that the proto systems and the possibility to buy water from water peddlers, in stores or to use a private well, was a prerogative for the rich. Poor people had to rely on the water in springs, lakes, and common wells.[150]

On Stockholm Cronström (1986) presents some facts on common wells around 1600. They were spread over the town for fire defense reasons. Nevertheless, people were free to fetch water, although some evidence points to the fact that the water was "hard" (rich in minerals) and not liked very much. In the middle of 1700 J E Carlberg, the town architect, listed around 20 wells and other water catchments that were to be used for fire protection. [151] At the end of the 17th century, there were nearly 300 wells in Stockholm, most of them private. In addition to private wells, there were around 25 common wells in the city, which supplied the population with water and whose locations were decided upon with fire protection in mind. This number increased significantly during the 19th century and even in the 1860s, i.e. at the same time as the city's piped water supply system was built, new wells were dug or drilled. Thus, Stockholm had, during the entire period before the middle of the 19th century, several common wells, which in terms of drinking water, supplemented private wells and water collection from Lake Mälaren. In 1858, when the piped water system already had been decided on, there were approximately 50 common wells in Stockholm where private citizens could fetch drinking water.[152]

Furthermore, there are evidence that the authorities did take some responsibility even before the 1800s. In 1739, for example, in a Royal decree to the city magistrates is stated that the so-called "building and civil service college" were to oversee the quality of wells and drinking water.[153] Another even older example can be found in Pettersson (2008) who relates a "city council protocol" from 1640 referring to discussions on how to deal with provision of drinking water in Stockholm. According to the protocol the council made a monetary contribution to build four additional common wells.[154]

Some researchers interpret the attempts by the municipal authorities related above, as an indication that "…water supply was the first *necessity of life* (my italics) that became the subject of common solutions for "the public good" when already in the 18th century they started distributing well water to collection points in Stockholm through wooden pipes."[155] *Kallebäcksledningen* discussed above, is interesting, but again, it seems to me being a quite unusual example of public involvement in the history of piped water.

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[149] Okänd. (2021, December 2). *Vattenbutiken i Kungsträdgården mellan Jakobs kyrka och Lantmäteribacken.* Stockholmskällan. https://stockholmskallan.stockholm.se/post/30824, accessed 25/4 2023; *Carl Michael Bellman - låttexter av Fredmans epistel n:o 48 – Solen glimmar bl.* (n.d.). https://lyricstranslate.com/sv/fredmans-epistel-no-48-%E2%80%93-solen-glimmar-blank-och-trind-fredmans-epistle-no-48-suns-s.html, accessed 25/4 2023; Hollsten, B. (1897) *Stockholms brandväsen*, Stockholm: Sveriges hufvudstad skildrad med anledning af Allmänna konst- och industriutställningen 1897, enligt beslut af Stockholms stadsfullmäktige, 1897:2, 405-420, pp. 414; Holmbäck, B. (red.) (1990). *Huvudstadens hästar: bilder och berättelser om hästkulturen i Stockholm under fem sekler*. Stockholm: Höjering, pp. 45-56; http://runeberg.org/drglas/0822.html

[150] Anderberg, S. (1986). *Stockholms vattenförsörjning genom tiderna*. Stockholm

[151] Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber, pp. 10-14

[152] Pettersson, R. (2008). *Bekvämlighetsrevolutionen: Stockholmshushållen och miljön under 150 år och i framtiden*. Stockholm: Stockholmia, pp. 26

[153] Dufwa, A. (red.) (1985). *Trafik, broar, tunnelbanor, gator*. Stockholms tekniska historia 1 Stockholm: Liber, pp. 11

[154] Pettersson, R. (2008). *Bekvämlighetsrevolutionen: Stockholmshushållen och miljön under 150 år och i framtiden*. Stockholm: Stockholmia, pp. 24

[155] Svedinger, B. (1989), *Stadens tekniska infrastruktur: en kunskapsöversikt*, Statens råd för byggnadsforskning, Stockholm, pp. 38; Bjur, H. & Malbert, B. (1988). *Under staden: perspektiv på kommunal infrastruktur*.: Statens råd för byggnadsforskning om vattentillförsel under 16-1700 tal för att öka dricksvattnet i Stockholm, pp. 36.

The proto systems and common wells for water supply were certainly existing but they were not designed solely to provide water as a *necessity of life*. Drinking water was not the only, or even the main, reason for building and maintaining proto systems and public wells. Rather, public drinking water could be seen as a welcome side effect of the basic motives for public water provision: fire protection and street cleaning.[156] Thus, with a possible exception from the situation in Gothenburg, in the articulation of publicness concerning water in its many meanings and forms, fire security and tidiness were articulated more strongly than provisioning of drinking water for the people.

In conclusion, it is difficult to find evidence for a strong public ambition on behalf of city authorities to provide arrangements for drinking water before the beginning of the nineteenth century. There were attempts made but compared to street cleaning and fire protection, water provision was not a priority. Furthermore, the articulation of publicness in drinking water was much weaker than in other sectors such as roads and streets and even compared to sanitation, which will be discussed below. I have found no evidence for the existence of a serious obligation from state or city authorities to provide for drinking water and there was not really an expressed public desire to provide. Public drinking water was not mentioned neither in the medieval city-laws or in the law of 1734, although both roads, streets, and sanitation (outer) was directly targeted as public concerns. Furthermore, water provision is not mentioned as a formal public obligation in research on the role of city magistrates and councils of Burghers, the century old authorities of the towns, in urban history literature or in contemporaneous reports and literature.[157] I am aware that it is dangerous to draw conclusion based on silent sources, but in this case, it seems to me that the sound of silence is loud and clear.

To sum up: in towns, the early and scattered attempts on proto systems were rarely successful in the longer run and common wells were not only for drinking water provision. It is hard to interpret their existence as signs of high public engagement in drinking water and they certainly did not transcend into the modern piped system of the late nineteenth century.

That drinking water was not formally regulated in the written laws, but instead followed informal and older established customs, becomes clear in this historiography of Swedish water legislation by the Swedish Environmental Protection Agency (2008, my italics and underline):

"Swedish water law is based on a private law system, i.e. that the control over the water in lakes and waterways is linked to the ownership of individual land. The perception of the right to water according to private legislation, is very old in Sweden. It is already clearly expressed in *Hälsingelagen* from the 14th century. There you find the well-known regulation that "the one that owns land also owns water". The regulation of the Hälsingelagen was also supplemented with a provision which allowed the beach owner to sell his right in the water. A similar view can be traced in the

[156] Anderberg, S. (1986). *Stockholms vattenförsörjning genom tiderna*. Stockholm, pp. 22.
[157] See for example: Forsell, H. (2003). *Hus och hyra: fastighetsägande och stadstillväxt i Berlin och Stockholm 1860-1920.* Diss. Stockholm : Univ., 2003: Gullberg, A. (1998). *Nätmakt och maktnät: Den nya kommunaltekniken i Stockholm 1850-1920,* in *Den konstruerade världen: Tekniska system i historiskt perspektiv*, Blomkvist, P., and Kaiser, A. (red.), Brutus Östlings Bokförlag Symposium; Nilsson, L. & Forsell, H. (2013). 150 år av självstyrelse: kommuner och landsting i förändring. Stockholm: Sveriges kommuner och landsting; Sheiban, H. (2002). *Den ekonomiska staden: stadsplanering i Stockholm under senare hälften av 1800-talet*. PhD thesis. Stockholm University, Stockholm, Sweden; Hansen, F. V. (1897). - Stockholms vattenledning - Stockholm : Sveriges hufvudstad skildrad med anledning af Allmänna konst- och industriutställningen 1897 enligt beslut af Stockholms stadsfullmäktige. ; 1897:2, 323-352; Kuylenstierna, C. W. U. (1934) *Samhällsuppgifter och väghållningsbesvär*, Minnesskrift ägnad 1734 års lag. (Av jurister i Sverige och Finland den 13 december 1934, 200-årsdagen av Riksens ständers beslut), del II, Stockholm; Bokholm, R. (1995). *Städernas handlingsfrihet: en studie av expansionsskedet 1900-1930,* Diss. Lund : Univ.; Höjer, T. (1967), *Sockenstämmor och kommunalförvaltning i Stockholm fram till 1864*, Stadsarkivet, Stockholm.; Höjer, T. (1953). *Stockholms stads drätselkommission 1814-1864 och Börs-, bro- och hamnbyggnadskommitterade 1815-1846,* Diss., Stockholms högskola

Västgötalagen from the latter part of the 13th century and is reflected in the national law of 1734. The concept of availability is the same for groundwater. The availability right does not prevent the water, *according to old customary law, being used by others for washing, fetching water, watering livestock and the like*." [158]

It is my belief, although it is not explicitly mentioned in the sources or the literature, that drinking water, in both towns and in the countryside, was regulated by informal rules based on old customs and it was not until the first half of the nineteenth century that drinking water provision was articulated as a public undertaking. Perhaps, but this is a speculation, drinking water was mainly seen as *foodstuff* and thus per definition belonging to the private sphere.[159] Public authorities did not engage in the food habits of the people. This notion is corroborated by Drangert (1993): "Water is part of the diet, but the informants treated the provision of water separately and differently from other food items The Wasukuma do not expect the district council to provide food unless there is a serious famine." [160] Today drinking water is certainly seen as food and therefore falls under the Food Act (SFS 1971:511). Since the act does not apply to the handling of food in individual households, it does not apply to water from individual wells.[161] And as mentioned, another possible explanation for this surprising finding, at least from a modern perspective, is that water in Sweden was considered and everlasting resource. Drinking water could be found almost everywhere and was far from scarce.

Finally, and to end this section, I want to highlight that my conclusions on a relative low level of public engagement in drinking water provision are based on the specific, mainly secondary sources used in this project. It would certainly be very interesting to test this thesis on primary sources from various municipal archives around Sweden. I strongly encourage further research along these lines.

Pre-modern sanitation: inner and outer sanitation

To understand the modern water and sanitation system (WSS) based on water and sewerage in underground pipes, it is important to note the varying meaning of the term *sanitation* in different historical periods. First, we must separate between *inner* and *outer* sanitation. Inner sanitation was the handing of human refuse, such as dirty excess water, household leftovers, and human and livestock excrement. These practices were for a very long time seen as an exclusively private matter. Inner sanitation and excrement handling relied on latrine pits or cesspools and was dealt with inside the confinement of the private property. [162]

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[158] Naturvårdsverket (Handbok 2008:5) *Vattenverksamheter: Handbok för tillämpningen av 11 kapitlet miljöbalken*, Kapitel 12.1 "Rådighet över vatten", pp. 109

[159] Interestingly the industrial organization of Sweden's municipal water works, Swedish water, presently market themselves as member of the food industry: "Svenskt Vatten is the industry organisation for Sweden's most important food producers and environmental companies - the water and wastewater providers."
https://www.svensktvatten.se/globalassets/om-oss/in-english/svenskt-vatten-sustainable-water-services-2050.pdf

[160] Drangert, J. O. (1993). *Who cares about water?: A study of household water development in Sukumaland, Tanzania*. Linköping: Linköping University, p. 178

[161] Christensen J. (2015). *Juridiken kring vatten och avlopp. En översiktlig genomgång av juridiken kring dricksvattenförsörjning samt avledning och rening av spillvatten och dagvatten*. Havs- och vattenmyndighetens rapport 2015:15. Stockholm, Sverige.

[162] "Cesspits and cesspools should not be confused. A cesspit was a modified form of a traditional latrine pit in the ground, mainly for excreta disposal, and it was often lined with cement to make it less leaky. A cesspool was an earthenware tank underground, which in Linköping and Norrköping collected storm- and wastewater from buildings, yards, and streets. The liquid part continued to the sewers, while the solid part at least in theory remained in the cesspool. The sewered cesspit was connected to the sewers via the cesspool, just as all other connections from the yard." Hallström, J. (2003). *Constructing a Pipe-Bound City: A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping; footnote 108, pp. 155; Also in

According to Wetterberg and Axelsson (1995), hygiene, cleanliness and handling of feces was an exclusively private matter right up until the sanitary revolution from the middle of the 19th century. This applies to both rural and urban areas. The basic rule in cities and more densely built-up areas was that property owners were required to "keep their front door clean". These rules can be derived via the so called Bjrkörätten and as far back as in Birka of the Viking Age. In Magnus Eriksson's city law (1350s) and in the cities' own regulations ("Burspråk") these rules were repeated.

Outer sanitation included street cleaning and storm water management (and solid waste management which will be left out of this report). Outer sanitation has always been a more distinct public concern and national and city authorities has since the Middle Ages worked hard to make people take care of these matters.[163]

In this report I concentrate on sanitation defined first as street cleaning and storm water management using open sewers and gutters and second on the establishment of underground piped sewers for excrement management, I will also briefly touch upon the period when excrements were managed by bucket collection. However, there is a problem with the delimitation of outer sanitation as street cleaning and storm water management. Both areas are of course also connected to street management in a general sense. Street (and road) keeping involves building and maintenance. The latter has two parts namely *technical* maintenance meaning keeping the street in a functional condition such as repairing pavements and *general* maintenance such as street cleaning and snow removal. In the following I refer to the technical side of maintenance when I discuss street keeping. This distinction is valid also today. Municipal street management, building and technical maintenance, is regulated in the Planning and Building Act (PBL), but not street cleaning which is handled in the Street and Cleaning Act which gives the municipality responsibility for street cleaning in public places. It was preceded by the order and cleanliness legislation, including the General Order Statute from 1956. In the Environmental Code from 1999, the legislation was moved The Act with special regulations on street maintenance and signage (1998:814), usually called the Street and Cleanliness Act.[164]

On early sanitation the most famous ancient example is again Roman, the Cloaca Maxima (600 BC), which was an underground sewage tunnel used for stormwater drainage of the Forum Romanun. It was not primarily used for the handling of water borne excrement, even though some public privies were in fact connected. After the fall of Rome some of the Roman water and wastewater networks were used in southern Europe during the Early Middle Ages and old Greek and Persian systems were still functioning in Spain, Malta, and southern Italy. In northern Europe, ancient systems were operational in for example Paris, London and in Visby, Sweden. Visby, with its peripheral position in

Nygård, H. (2004). *Bara ett ringa obehag?: avfall och renhållning i de finländska städernas profylaktiska strategier 1830-1930*. Diss. Åbo: Åbo Akademi, 2004; Sjöstrand, Y. S. (2014). *Stadens sopor: Tillvaratagande, förbränning och tippning i Stockholm 1900-1975* (PhD dissertation). Lund; Wetterberg, O. & Axelsson, G. (1995). *Smutsguld and dödligt hot*. Göteborg: Göteborgs renhållningsverk; Dufwa A, Pehrson, M. (1989) Stockholms renhållning under de första 600 åren i Dufwa, Arne, Snöröjning, renhållning, återvinning. Stockholms stadsbibliotek, pp. 1-23.

[163] The old expression “keep clean in front of your own door” (sopa framför egen dörr) surely originates in this arrangement. In fact even house owners today still have this responsibility to clean the street and the pavement outside their property

[164] Tällberg, E. (2018). *Statligt och kommunalt väghållaransvar: En studie kring allmän väghållning och kommunala väghållningsområden* (Master thesis, KTH, School of Architecture and the Built Environment (ABE), Real Estate and Construction Management, Stockholm), pp. 19; Personal communication by email 22-09-30, Jarina Edlund jarina.edlund@stockholm.se and Fanny Flyborg, Trafikkontoret, Stockholm

Europe, is interesting as it shows that advanced ancient technology for water cisterns, cesspools and some rudimentary sewers for excrement were transferred and used far up north.[165]

However, just as in early water provision, I agree with Hallström and Melosi (2022) in their general conclusion: "All in all, however, the inhabitants of Europe had to rely on off-grid systems of wastewater management during the Middle Ages and well into the early pre-modern and modern eras. The same also can be said about colonial and post-colonial America. In cities and towns, there were gutters for managing stormwater and household wastewater, and privy vaults, cesspools, and outhouses for human excrement, the latter of which were also employed as the primary means of sanitation in the countryside."[166]

The period after the fall of Rome was pretty much a long stretch of stagnation. Sewers before the mid-19th century were generally built for land drainage and stormwater and we would not call them "systems" in any modern sense of the word, and to conclude I turn once again to Hallström and Melosi (2022):

"The premodern attitude about the disposal of wastewater was thus mostly to drain liquid waste from wherever it was deemed unnecessary, which meant manual discharge in a street, cesspool, ditch, or pipe to the nearest watercourse. Before the mid-19th century, the sewerage of ancient civilizations, notably Rome, remained unmatched. The sewers of the early modern period were street gutters or drains rather than real underground sewers and the discharge of waste in the sewers was forbidden, although a great deal ended up there anyway."[167]

In France, for example, historian Goubert concludes that some villages ha a common water supply, but drainage and sewers were unknown. From around 1860, cooperation on water supply was increasing, catering both for cattle and human needs. These installations were typically a fountain or a communal well, maintained in kind by the villagers.: "On the other hand, drainage and sewers systems were unknown. The removal, transport and disposal of feces remained the prerogative of several larger market towns which had adopted city habits…Leak-proof tanks and cesspits designed for the storage of human and animal waste and excrement were few and far between."[168]

However, even if sanitation technology was at a level we hardly or would accept today, as mentioned some parts of sanitation was still a public concern at least from the Middle Ages, i.e. outer sanitation such as storm water management and street cleaning. In line with the prevailing ideology of *Politi*, state and city authorities tried, but rarely succeeded, to uphold order, tidiness, and cleanliness in towns. It must be noted that the regulations on public sanitation were only issued for the cities. In the countryside village by-laws and other sources are silent on sanitation.

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[165] Hallström, J. & Melosi, M. V. (2022). *History of technological change in urban wastewater management, 1830–2010*. Routledge handbook of urban water governance. pp. 163-172; Rosen, G.(2015). *A history of public health*. Rev., expanded ed. Baltimore, Md.: Johns Hopkins University Press, pp.12-13; On Visby: Westholm, G. (1995). Gaturenhållning, avfallshantering och stadsplanering. Medeltida teknik belyst av visbyfynd. *Nordisk arkitekturforskning*, **8**(1), 7–18. I am aware that there are numerous examples of even older water and sewage technology in for example the Indus valley and the ancient Mediterranean cultures: Nilsson, D. (2014), *Reflections on past approaches and policies for water and sanitation in cities: transformative shifts and future perspectives*, Background Paper for UN Habitat Global WSS Report.

[166] Hallström, J. & Melosi, M. V. (2022). *History of technological change in urban wastewater management, 1830–2010*. Routledge handbook of urban water governance. (pp. 163-172), pp. 164. See also Katko and Juuti, 2014; Melosi, 2008; Tarr, 1996

[167] Hallström, J. & Melosi, M. V. (2022). *History of technological change in urban wastewater management, 1830–2010*. Routledge handbook of urban water governance. (pp. 163-172), pp. 164

[168] Goubert, J-P. (1989). *The conquest of water: the advent of health in the industrial age*. Cambridge: Polity, pp. 209

The public ambition on outer sanitation was hard to implement. The situation is described like this by Finish historian Henry Nygård (2004): "The fact that the executioner – as in Stockholm at least as far back as the 17th century – had the supervision of street cleaning and excrement collection shows how low the status was. It was also one of the most heinous punishments to be condemned to go with the city cart collecting waste…" Finland, being a part of Sweden up until 1809, had similar rules…" The principles of street cleaning were formed at the latest in the Middle Ages. Already Magnus Eriksson's city law in the 14th century codified the principle that cleanliness was the obligation of the property owner. Gustav Vasa's charter from 1557 and several later privileges repeats this provision." In Turku, for example, the magistrate ruled that the property owners had to cut up the gutters in the winter so that storm and wastewater had free flow in the streets.[169]

In Stockholm the state and the city authorities tried to organize outer sanitation, but they were not very successful and not always in agreement. In the Middle Ages the building code of Magnus Erikssons city law stated that rules for the towns are to be given in the Burghers written ordinances for the city, so-called "Burspråk", which included regulations about the cleanliness of streets, bridges, and yards. On latrine management nothing else was stated than rules for the building of privies in section two of the law: "No one shall build a secret house next to his neighbor or on a public street, unless he leaves open three feet of drip space between his house and his own yard or house". [170] According to the customs of the Middle Ages, in Stockholm, and probably also in other towns, it was considered completely out of the question that an ordinary citizen could empty his latrine himself. It was probably the executioner with helpers who had to take care of this part of the cleaning.[171]

The authorities did not manage to implement efficient outer sanitation for many hundred years. For example in 1711, when the plague ravaged Stockholm several regulations on improved street cleaning were issued. According to Dufwa (1989) the fear of the plague seems to have resulted in only a temporary improvement. In 1723 city authorities launched a new plan to organize outer sanitation motivated like this: "Since human health is generally maintained most of all by the purity of the air and water, the squares and streets, together with the bridges and harbors, must be kept in proper condition, the impurity must be removed early in the morning from the road and nothing from the windows, whereby the walls are greatly stained. The organization envisioned concerned not only cleanliness, but also the function of the police in various branches of activity, the supervision of trade, crafts, servants, poor relief, the fire service, paving the streets and much else. The proposal aroused violent opposition from the bourgeoisie, which would bear the costs and the was never realized. The Building Code in the law of 1734, contained quite detailed provisions on public engagement but the legislators apparently considered that these problems were so complicated and varied in the cities that they could not be solved generally in the law. Instead it was

[169] Nygård, H. (2004). *Bara ett ringa obehag?: avfall och renhållning i de finländska städernas profylaktiska strategier 1830-1930*. Diss. Åbo: Åbo Akademi, 2004, pp.82; Sjöstrand, Y. S. (2014). *Stadens sopor: Tillvaratagande, förbränning och tippning i Stockholm 1900-1975* (PhD dissertation). Lund.; Wetterberg, O. & Axelsson, G. (1995). *Smutsguld and dödligt hot*. Göteborg: Göteborgs renhållningsverk; Dufwa A, Pehrson, M. (1989) Stockholms renhållning under de första 600 åren i Dufwa, Arne, Snöröjning, renhållning, återvinning. Stockholms stadsbibliotek, pp. 1-23

[170] *Magnus Erikssons stadslag*. I nusvensk tolkning av Åke Holmbäck och Elias Wessén. (1966). Stockholm: Nord. bokh. Om byggningabalken: Det talas om "Burspråk" med omfattande ordningsföreskrifter för staden där "…föreskrifter om renhållning, av gator, broar och gårdar, som utgöra en så väsentlig del av burspråkens innehåll." (s. 101) Reglerar "Huru hemlighus skall byggas" (Avdelning II) "Ingen får bygga hemlighus bredvid sin grann eller vid allmän gata, om han icke lämnar öppet tre fots dropprum mellan hans hus och sin egen gård eller sitt hus" (s. 87)

[171] Dufwa A, Pehrson, M. (1989) *Stockholms renhållning under de första 600 åren* i Dufwa, Arne, Snöröjning, renhållning, återvinning. Stockholms stadsbibliotek, pp. 10

left to each town to decide on these matters, including sanitation. It was not until in the Building Act of 1736 (see below), that these matters were regulated in national legislation. [172]

In the 18th and early 19th centuries, Stockholm had a bad reputation for its dirty streets and smelly waterways. Already Carl von Linné (1707-1778) complained that he was sickened by the smell of cesspools and privies during the summer season. The wretched sanitary conditions were described very vividly in 1815 by Johan Olof Wallin, the priest of Adolf Fredrik's parish, when speaking of the many waterways that received the city's waste. "Day by day, year by year, the masses grow which, united by street filth, garbage, rubbish and all kinds of impurity, will turn these lakes into hideous, swamps".[173]

To sum up: Concerning outer, external sanitation and street cleanliness, had early on been regulated in various building and order statutes but until the middle of the 19th century, the internal cleanliness in Stockholm, the household waste, and the latrine, was essentially an individual matter and the city did not intervene. As in many other cities, the disposal of internal refuse was arranged with latrines and waste pits within the private properties, which were periodically covered over and replaced with new ones. Waste was also used as fertilizer in gardens in the city or dumped in or near water. Since the 18th century, Stockholm, and many other tows, with the help of contractors, had made sporadic attempts to systematically use the waste as fertilizer, including by collecting it in special storage areas in the city and then taking it out of the city on barges.[174]

Chapter 7: Specific contextual factors for modern water and sanitation

Apart from the already mentioned *general contextual* factors discussed above (Local independence/ Urbanization, demography, and industrialization/The municipal reform of 1862), in this section I discuss some of the most important *specific* contextual factors that affected water and sanitation: The conflict between the private and the public/ The “social issue”: concern for, and fear of, the working class and the poor/ High mortality, Cholera epidemics and new perceptions of health and sickness/ The Sanitary movement and the health act of 1874. [175]

The importance of these factors grew over time and mainly influenced the development in modern WS from the beginning of the nineteenth century and onwards. The specific contextual factors in water and sanitation are connected to each other and it is fair to say that they all lead up to the health act of 1847 which can be seen as the final articulation of publicness in the sector. The health

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[172] Dufwa A, Pehrson, M. (1989) *Stockholms renhållning under de första 600 åren* i Dufwa, Arne, Snöröjning, renhållning, återvinning. Stockholms stadsbibliotek, pp. 13-14

[173] Bäckman, H. (1984). *Avloppsledningar i svenska tätorter i ett historiskt perspektiv*. Göteborg: Chalmers tekniska högskola. Meddelande nr 74, pp. 7

[174] Sjöstrand, Y. S. (2014). *Stadens sopor: Tillvaratagande, förbränning och tippning i Stockholm 1900-1975* (PhD dissertation). Lund, pp. 40-41; See also: Dufwa, A. & Pehrson, M. (1989) *Avfallshantering och återvinning.* Stockholm, Sweden; Nygård, H. (2004). *Bara ett ringa obehag?: avfall och renhållning i de finländska städernas profylaktiska strategier 1830-1930.* Diss. Åbo: Åbo Akademi, 2004; Wetterberg, O. & Axelsson, G. (1995) *Smutsguld and dödligt hot: Renhållning och återvinning i Göteborg 1864-1930*, Göteborg; Drangert, J-O. & Hallström, J. (2003). Den urbana renhållningen i Stockholm och Norrköping: från svin till avfallskvarn?, *Bebyggelsehistorisk tidskrift*. **44**, 7-24; Hallenberg, M. (2018). *Kampen om det allmänna bästa: konflikter om privat och offentlig drift i Stockholms stad under 400 år*. Lund: Nordic Academic Press; Pettersson, R. (2008). *Bekvämlighetsrevolutionen: Stockholmshushållen och miljön under 150 år och i framtiden*. Stockholm: Stockholmia, pp. 76-85

[175] More on these in: Granberg, B., (2008) *Stockholm i mitten av 1800-talet, en ursprunglig röra* och *Stockholms hushåll kring år 1900* (kap. 1and2) in Pettersson, R., (2008). *Bekvämlighetsrevolutionen: Stockholmshushållen och miljön under 150 år och i framtiden*. Stockholm: Stockholmia

act operationalized all the preceding contextual factors and suggested legislative and institutional solutions to the problems under debate. Furthermore, and as mentioned, in the following chapter on water and sanitation in the twentieth century, I include two additional contextual factors affecting the articulation of publicness: environmental concerns due to pollution and the rising focus on sustainability.

The conflict between the private and the public in WS

As mentioned, the municipal reform of 1862 and its following statues developed alongside the emergence of a more pro-active state in the second half of the nineteenth century which gave the municipalities the obligation and the tools to intervene in the private spere. In this new political landscape the issue of "intervening vs. not intervening", was replaced with the question: "Intervene, but in what?" According to (Kilander, 1991) the result was a changed relationship between public and individual spheres of society, which now merged into a common sphere, which gave a changed mandate for the stat, and the municipalities, to intervene in various areas. The debates on public intervention starting from the second half of the nineteenth century follows a common pattern according to Nydahl and Harvard (2026) where certain actors start lifting a problematic societal issue: "A debate is held where the central dividing line concerns whether this is a societal problem, or whether it concerns individual perspectives and interests. In cases where the debate culminates in the fact that it is certainly a general problem, plans are raised for interventions, in the form of support or regulation. Interventions or proposals for such in various sectors…are consistently justified by the fact that the solution of the issue constitutes a public interest, which justifies that the freedom or decision-making rights of the actors concerned can be affected or restricted." [176]

Concerning water and sanitation the municipal act of 1862 gave local government extended power to intervene in previously private areas. The borders between the public and the private domains were challenged. Issues such as inner sanitation, that had been strictly private for hundreds of years became an issue for local government. Following Drangert et.al. (2002) questions like how far the authorities could go "...in determining how water pipes could be drawn, what kinds of gutters were required, and who had access to what kind of water…" and other earlier responsibilities of the individual property owners, came up on the agenda.[177]

Using the words of Svenbjörn Kilander (1991), changes occurred in "…the dividing line between what were considered the public and private spheres. The former was the only one to which the state could have access, whereas the latter was considered to consist of private groups that were defined as individuals, families, and the local community…This "private sphere" was one in which the state could act as mediator but should not interfere."[178]

This divide becomes even sharper in the passing of the public health act in 1874. When the new act was designed, the committee crafting its text investigated the conflict between private property and communal collection of garbage and latrines and concluded: "Property owners have become accustomed to thinking of their properties as protected areas, where authorities have no business

[176] Nydahl, E., Harvard, J. (2016) Den nya statens ansikten. In Nydahl, E. & Harvard. J. (eds.), *Den nya staten: Ideologi och samhällsförändring kring sekelskiftet 1900* (pp. 9-23). Lund: Nordic Academic Press, p. 21

[177] Drangert, J-O., Nelson, M. C., & Nilsson, H. (2002). Why Did They become Pipe-Bound Cities? Early Water and Sewerage Alternatives in Swedish Cities, *Public works management and policy*, **6**(3), 172-185, pp. 173 ff

[178] Drangert, J-O., Nelson, M. C., & Nilsson, H. (2002). Why Did They become Pipe-Bound Cities? Early Water and Sewerage Alternatives in Swedish Cities, *Public works management and policy*, **6**(3), 172-185 (p. 173 ff; Kilander, S., (1991), Den nya staten och den gamla. En studie i ideologisk förvandling *(Acta Universitatis Upsaliensis, Studia Historica Upsaliensia,* **164**, 118-121.

interfering with internal daily affairs, but the committee is convinced that all, after closer consideration of this important question, will recognize the necessity of giving the public authorities the right to regulate and control, in detail, the manner in which cleanliness is to be maintained in towns and other densely populated areas…(public actions) if limited only to outside areas, would continue to be fruitless, as the worst sources of sickness and miasma are most often found inside the house and its adjoining property, because of poverty."[179] However, even if the committee saw the connection between health problems and poverty, they argued that poverty elevating measures were outside their mandate and beyond their competence. According to Kilander the distinction between the public and the private "…disappears, or perhaps, more accurately, it becomes legitimate for the state to interfere directly in areas previously considered the sole province of the private sphere."[180] And the same was true for the municipalities.

The "social issue": concern for, and fear of, the working class and the poor

The interest and the will to provide for public water and sanitation was motivated by a mix of both genuine concern for the living conditions of the lower classes, a true desire to improve their livelihoods and simultaneously by a fear of uprising, chaos, and revolution.

It is easy to agree with Nelson and Rogers (1994) when they state that the work and the ambition to create the first comprehensive Swedish public health law in 1874 shows that the authorities had a genuine concern for the working class and for the poor.[181]

Another example of concern can be found in the investigation of urban sanitation in Stockholm and Norrköping by Drangert and Hallström (2002). The health board in Norrköping complained about the large number of pigs in the city in a letter to the governor in June 1885, and argued that "...one could rather think that the three hundred people keeping pigs are violating the rights of the other twenty-seven thousand residents, because they do not to enjoy the privilege of inhaling air, which is not been plagued...In a few words: the workers and their families may well enjoy the smell from the pig pens, but only exceptionally the smell from the pork that is produced."[182]

The concern for, and the fear of, the poor and the working classes is often labeled "the social issue" in historical accounts of the first half of the nineteenth century. The focus on the connection between a sound lifestyle and good health grew out of older views associated with the so-called "patriarchal care": "…the social policy that emerged during the second half of the 19th century can be seen as a further development and modernization of the patriarchal care. The successive shift from the mill patron's and mill management's responsibility for the employees to the municipality's responsibility then gradually came to include the entire population."[183] Another view on the "social issue" is that the interest can be "…interpreted from a perspective of normalization and moralization where the various regulations and laws had an essential role in the upper class's endeavor to steer the lifestyle of the lower classes in the desired direction."[184] Nevertheless, there seems to be a

[179] Nelson, M. C., & Rogers, J. (1994). Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History,* **19**(1), 17-39, pp. 24-26
[180] Nelson, M. C., & Rogers, J. (1994). Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History,* **19**(1), 17-39, pp. 27
[181] Nelson, M. C., & Rogers, J. (1994). Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History,* **19**(1), 17-39
[182] Drangert, J. O., & Hallström, J. (2002). Den urbana renhållningen i Stockholm och Norrköping:–från svin till avfallskvarn?. *Bebyggelsehistorisk tidskrift*, **44**, 7-24, pp. 16
[183] Wiell, K., (2018). *Bad mot lort och sjukdom: den privathygieniska utvecklingen i Sverige 1880–1949.* Diss. Uppsala : Uppsala universitet, pp. 140 + REF, Hossein Sheiban + more
[184] Wiell, K., (2018). *Bad mot lort och sjukdom: den privathygieniska utvecklingen i Sverige 1880–1949.* Diss. Uppsala : Uppsala universitet, pp. 50

consensus in that gradually, from the middle of the nineteenth century "…responsibility for the population was shifted from the individual to society…" This change also meant that people in power, economically and politically, started to see a connection between the health of the workforce and production capacity which in turn affected the nation's general income and welfare.[185]

The fear of revolution and an uprise of the working class is a distinct feature in the motives behind the articulation of publicness in water and sanitation. George Rosen describes these sentiments like this:

"…fears of the revolutionary movements brewing in Europe in 1848, as much as the dread of cholera, prompted public health reforms. Each nation had intellectuals who pointed out the connections between ill health and poverty and demanded radical or revolutionary change as an answer to the problems of endemic and epidemic diseases. Friedrich Engels in England and Rudolf Virchow in Germany, for example, used public health as a focal point for demonstrating exploitation, dramatizing unhealthy social conditions, and demanding more democratic solutions." [186]

The revolutions of 1848 occurred in several European countries, starting in France in February. The wave spread all over Europe, more than 50 countries were affected, and it is probably the largest wave of revolts in European history.

Three main factors explain the revolutions: widespread dissatisfaction with the political leadership; demands for a higher degree of democracy and working-class discontent. Tens of thousands of people were killed and not much was won. From a Swedish perspective the most important effects probably were the ending of absolute monarchy in Denmark and of the Capetian dynasty in France.

In March 1848, Stockholm got a taste of the unrest. Anti-authority posters were put up demanding reforms and suffrage. The same day an angry crowd gathered in one of the town squares, protesting and smashing windows, and in the evening a crowd had gathered around the Royal castle. The following days riots continued, and the king finally gave the order to fire. In total 18 people were killed and many wounded.[187] At the same time as the riots in Stockholm, Milan, Munich, Copenhagen, and many other European cities were affected by similar violence. Regular upheavals were taking place in Vienna and Berlin. The newspapers wrote about a great revolutionary fire that was gaining momentum and that could well consume all the continent's old regimes."[188]

However, the revolutionary wave of 1840 was not the only reason behind the fear of the Bourgeois class: "In Sweden of the 1830s, keen observers everywhere began to see signs of an ever-deepening social crisis: rampant poverty of a previously unknown level, epidemic crime, broad sections of the population drifting freely, dabbling in odd jobs and begging, household ties dissolving, unbridled immorality, filth, and crudeness. In the turbulent revolutionary years of the late 1840s, these

[185] Wiell, K., (2018). *Bad mot lort och sjukdom: den privathygieniska utvecklingen i Sverige 1880–1949.* Diss. Uppsala : Uppsala universitet, pp. 51-52
[186] Rosen, G., (2015). *A history of public health. Rev., expanded ed*. Baltimore, Md.: Johns Hopkins University Press, Introduction, pp. xxv
[187] Björkman, J., (2020). *"Må de herrskande klasserna darra": radikal retorik och reaktion i Stockholms press, 1848-1851*. [Möklinta]: Gidlunds förlag, pp. 119; For a concise account of the mayor events see: Bidragsgivare till Wikimedia-projekten. (2023). Februarirevolutionen 1848. *sv.wikipedia.org*. https://sv.wikipedia.org/wiki/Februarirevolutionen_1848, accessed 23/4 2023
[188] Björkman, J. (2020). " *Må de herrskande klasserna darra": Radikal retorik och reaktion i Stockholms press, 1848-1851* (Doctoral dissertation, Gidlunds förlag), pp. 119

impressions were reinforced and, according to more overt alarmists, the whole society balanced on the brink of disaster."[189]

According to John Björkman (2020) it is a bit paradoxical the "social question" mostly centered around urban life considering that Sweden, Stockholm being the only exception, really did not have any large urban centers at the time: "Without any dramatic change in terms of population taking place, however, the cities and above all Stockholm during the period came to be perceived as particularly vulnerable focal points of disorder and decay...Notorious were the slums around the tuberculosis hotspots Fatburssjön on Söder and the so-called Träsket on the outskirts of Norrmalm. But Stockholm allowed itself to be characterized with essentially the same words already at the beginning of the 19th century, without this coming to the fore and being interpreted as a sign that the whole society was in crisis." [190]

However, it is true that street riots and riots were common in Stockholm, "…and during the 1830-1840.s these began to be more and more clearly directed upwards towards society's elites and sometimes carried conscious political agendas." The lower classes rioted several times protesting against, for example, employers' wage-pressing tactics of calling in cheap labor from the countryside. Also the earlier July Revolution in France, 1830 and the Chartist movement in England fueled the fear of the working class. Many started to discuss negative sides of industrialization and began to picture images "…of large-scale acts of violence directed at the government and the wealthy." These new fears of the workers were alloyed with "…century-old images of the rebellious and unbridled "mob" – images of the lower classes as irrational, easily manipulated and explosive, rather than as politically self-aware and organized."[191]

Thus, the treat of the working class focused on Stockholm as a place of destructive activities portraying workers as "…socially and morally corrosive – immoral, disobedient, drinking, silly, impulsive, thieving..." although without a clear political agenda or self-awareness. Workers were dangerous and at the same time compared to "…faithful children…. (or) …an inferior species".[192]

The social issue also had effects outside the field of water and sanitation. During the second half of the century several laws targeted the less well-off classes aimed to strengthen and facilitate, but also to prevent and control undesirable behavior. Examples of laws and regulations that were added in the wake of the social issue were the 1833 lease charter, the 1842 folk school charter, the 1846 defenselessness statute, the poor welfare ordinance from 1847, the abolition of house chastise in 1858 and the 1885 vagrancy law.[193]

It is of course hard to tell if the fear of the poor and the lower classes was real or imagined. Nevertheless it is quite clear that these emotions strongly influenced the motives behind the "sanitary movement" and the growing public interest in water and sanitation in Sweden. According to Hallström (2003), in his investigation of water and sanitation in Norrköping and Linköping, the

[189] Björkman, J. (2020). *" Må de herrskande klasserna darra": Radikal retorik och reaktion i Stockholms press, 1848-1851* (Doctoral dissertation, Gidlunds förlag), pp. 55
[190] Björkman, J. (2020). *" Må de herrskande klasserna darra": Radikal retorik och reaktion i Stockholms press, 1848-1851* (Doctoral dissertation, Gidlunds förlag), pp. 55-57
[191] Björkman, J. (2020). *" Må de herrskande klasserna darra": Radikal retorik och reaktion i Stockholms press, 1848-1851* (Doctoral dissertation, Gidlunds förlag), pp. 60-61
[192] Björkman, J. (2020). *" Må de herrskande klasserna darra": Radikal retorik och reaktion i Stockholms press, 1848-1851* (Doctoral dissertation, Gidlunds förlag), pp. 75-76
[193] Wiell, K. (2018). *Bad mot lort och sjukdom: den privathygieniska utvecklingen i Sverige 1880–1949*. Diss. Uppsala: Uppsala universitet.

"social issue" also rested on British experiences and rhetoric around the importance sanitary reforms where the fear of a working-class revolution was evident (more on this later).[194]

High mortality, Cholera epidemics and new perceptions of health and sickness

From the beginning of the nineteenth century the "social issue" was blended and invigorated by concerns for high mortality rates, dramatic outbreaks of cholera and a gradually evolving new perception of the causes of health and sickness, which culminated int the so-called *Sanitary Movement* originating in England around 1830.

Many died in Sweden, and they died young. Especially Swedish towns had a high level of mortality compared to European figures, despite their relatively small size. At mid-century, two thirds of Swedish towns had crude death rates exceeding 23 per 1,000, a rate used as the cutoff point for "excessive" mortality in British urban areas. The committee preparing the health act of 1874 argued that Sweden's high mortality rate was not due to climate, physical geography, economic or social structure, but of unsanitary conditions in towns: "In a study of Swedish urban mortality the Committee found that the situation in the towns was worsening. During the period 1846-1851 mortality in the countryside was 19%o and in the towns 29%o. During the next five years the mortality gap increased, 20%o in the countryside and 33%o in urban Sweden. There was a considerable amount of variation among Swedish towns: four cities had deathrates exceeding 40%o, 15 between 30 and 40%o, 43 between 23 and 30%o, with only 25, mainly small towns, with crude deathrates of less than 23%o. Stockholm topped the list with a crude death-rate exceeding 45%o and a life expectancy at birth of less than 17 years. With indications that urbanization was on the increase the Committee clearly made its point. It summarized the result of its study: "…the comparison (with other European countries) is disheartening, yes even degrading, for Sweden cannot nor should not be denied. It is with sorrow that one must admit that at least part of the race, originally so strong and hardy, stands, as far as sanitary conditions are concerned, on the bottom ring among the civilized nations of the world."[195]

The focus on health and sanitation was of course due to these terrible statistics. However, as will be elaborated on later in the report, the campaign to combat excess mortality was not aimed at all citizens: "Its concern was with *some aspects* of the health of *some* people: working-class men of working age."[196]

Cholera is often mentioned as an important cause for the establishment of water and sanitation in European cities during the nineteenth century. This terrible disease indeed played a part and often was the trigger for public interest in water and sanitation. Cholera outbreaks hit Sweden several times eleven times between 1834 – 1874 and around 37,000 people died. The worst epidemics occurred in 1834, 1853 and 1866 and after each outbreak the debate on sanitary issues became fierce.[197]

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[194] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping.
[195] Nelson, M. C. & Rogers, J. (1994) Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History*, **19**(1), 17-39
p. 22-23; See also Drangert, J-O., Nelson, M. C., & Nilsson, H. (2002). Why Did They become Pipe-Bound Cities? Early Water and Sewerage Alternatives in Swedish Cities, *Public works management and policy*, **6**(3), 172-185.
[196] Hallström, J. (2003) *Constructing a pipe-bound city: A history of water supply, sewerage, and excreta removal in Norrköping and Linköping, Sweden, 1860-1910*. PhD thesis. University of Linköping, Linköping, Sweden, pp. 73; quoting Hamlin, C (1998), *Public Health and Social Justice in the Age of Chadwick. Britain, 1800– 1854.* Cambridge.
[197] Karolina Wiell (2018) argue, based on research by historian Daniel Larsson's research on cholera in Sweden during the 19th century, that after each cholera epidemic, public hygiene decisions were made even if cities prior to the outbreak had

But the concrete fear of cholera is perhaps not the only explanation. Cristopher Hamlin (2009) criticizes a simplified cause and effect relationship between Cholera and public water and sanitation efforts. Hamlin claims that it is more fruitful to investigate the financial, political, and administrative foundations of these endeavors: ""Cholera forcing"—the idea that cholera "forces" beneficial changes in public health—is probably the best-known case of the myth of the good epidemic: public health infrastructure is inadequate; sooner or later an epidemic arrives and flourishes in these foul conditions; then, technological changes that had not seemed possible, become imperative. "No more!" people say, "We have erred, but we learn." Thus, the arrival of epidemic cholera in 19th-century Europe and North America has been seen as responsible—at least in some senses—for public sanitation systems: public supplies of pure water, water-closeting, sewers, and sewage treatment, and, more broadly, a sanitary revolution in which the environmental causes of epidemic disease are appreciated as a public responsibility. Cholera teaches "hard lessons" …" [198]

I would claim that this report acknowledges Cholera as an important cause behind WS and complements it with other causes as called for by Hamlin: "…the financial, political, and administrative foundations of these endeavors."

Another fundamental factor that influenced the movement towards public water and sanitation was a new perception of health and sickness from the beginning of the nineteenth century and maturing in the 1830.s, the *prophylactic* view, the insight that sickness could be prevented, and that good health, fresh water and sound sanitary conditions were tools preventing disease.

Going back in time, historian George Rosen relates the medieval Cristian view on sickness as the result of individual sinfulness: "…health problems were for the most part considered and dealt with in magical and religious terms…Old pagan customs and rites survived and were used for individual and community health problems. At the same time, Christianity held that there was a fundamental connection between disease and sin. Disease was punishment for sin. Possession by the devil or witchcraft were also recognized as causes of disease. Consequently, prayer, penitence, and invocation of saints were the means employed to deal with health problems."[199] This interpretation is corroborated by Nelson and Rogers (1994) adding that during the Middle Ages the "…care of the sick, the infirm and the elderly was a familial affair."[200]

Without going too far into medical history it must be noted that the scientific basis for water and sewerage problems were based on the so-called *miasma* theory on infectious diseases. The theory held that odors and vapors emitted from contaminated sources were the roots of sickness. When the first large European cholera epidemic reached Sweden in 1834, the miasma theories dominated. It was not until the 1880.s that modern bacteriology had its breakthrough. Thus the arguments used in the discussions water and sanitation were most often based in the miasma theory.[201] The aim of "hygienism" was abolition of dirt and filth, a standpoint that found no real poof the scientific

considered water pipes and sewage systems too expensive: Wiell, K. (2018). *Bad mot lort och sjukdom: den privathygieniska utvecklingen i Sverige 1880–1949*. Diss. Uppsala: Uppsala universitet

[198] Hamlin, C. (2009) Cholera forcing: The Myth of the Good Epidemic and the Coming of Good Water, *Public Health*, **99**(11), 1946–1954. See also: Hamlin, C. (2009). *Cholera: The Biography (Biographies of disease)*. Oxford University Press; Hamlin, C. (1998). *Public health and social justice in the age of Chadwick: Britain, 1800-1854*. Cambridge: Cambridge Univ. Press

[199] Rosen, G. (2015). *A history of public health*. Rev., expanded ed. Baltimore, Md.: Johns Hopkins University Press, pp. 19-20

[200] Nelson, M. C. & Rogers J. (1994) Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History*, **19**(1), 17-39, pp. 18.

[201] Drangert, J-O., Nelson, M. C., & Nilsson, H. (2002). Why Did They become Pipe-Bound Cities? Early Water and Sewerage Alternatives in Swedish Cities, *Public works management and policy*, **6**(3), 172-185 (p. 173 ff).

findings of bacteriology, but still an effective strategy in combating infectious diseases. Thus the sanitary movement, by identifying causes for disease, such as water, sewage, and housing, paved the way for bacteriology. [202]

In a recent investigation of provisional doctors in Sweden during the nineteenth century, historian Annelie Drakman (2018) convincingly show that the miasma theory lingered on until the end of the century while the doctors' perceptions of dirtiness, impurity, and causes to illness changed radically between 1865-1900. During an earlier period 1820–1865, the doctors explained morbidity with the geographical, climatological, and meteorological conditions of the district, he health of the local population was determined by the place they lived: "But in the years 1865–1900, people's morbidity was rather linked to the cabin they lived in than the landscape where they grew up. The focus shifted to the filth and crowding that the provincial doctor saw around the patient's bed. The provincial doctor's attention narrowed. At the beginning of the century, human-borne contagion was explained by the arrival of strangers, but by its end it was no longer travel that was a medical problem, but people living too close together." However, it is difficult assess this change in focus towards dirtiness in the private homes since the living conditions of the local population did not change during the 19th century: "It seems rather as if the living conditions of the common people remained the same but were now reinterpreted by the doctors: the assessment changed, not the cleanliness habits."[203] Drakman claims that from the middle of the century everyday dirt came to be regarded as miasmic and disease-causing and the human refuse and overcrowding gradually became causes of disease. This was not at all the case in the early 1800s, common dirt had not been identified as smelly miasma, but related to lack of orderliness and neatness (often termed "Politi"). Illness was reinterpreted as something that came from within bodies and disease transmission took place inside the home."[204]

From 1874, the health care charter obliged municipal committees to deliver an annual report to the provincial doctor with information about the common people's dirtiness, overcrowding and if they lived too close to livestock. Also how people handled feces, saliva and other bodily secretions became central to disease transmission.[205]

The Sanitary movement and the health act of 1874

It is obvious that the contextual factors related above influenced the so-called sanitary movement which had a huge direct impact on the management of municipal water and sanitation.

In the first half of the nineteenth century earlier ideas on the mercantilist virtues of population development were strengthened by the high mortality rates, the poor health of the population, especially in towns, and the many Cholera epidemics. The industrialization process required a healthy labor force because labor was one important production factor. Loss of labor productivity due to bad health became an economic problem, Thus, authorities, in Sweden and all over Europe,

[202] Wiell, K. (2018). *Bad mot lort och sjukdom: den privathygieniska utvecklingen i Sverige 1880–1949*. Diss. Uppsala: Uppsala universitet, 2018, pp. 59
[203] Drakman, A. (2018). *När kroppen slöt sig och blev fast: Varför åderlåtning, miasmateori och klimatmedicin övergavs vid 1800-talets mitt* (Doctoral dissertation, Acta Universitatis Upsaliensis), pp. 122-123
[204] Drakman, A. (2018). *När kroppen slöt sig och blev fast: Varför åderlåtning, miasmateori och klimatmedicin övergavs vid 1800-talets mitt* (Doctoral dissertation, Acta Universitatis Upsaliensis), pp. 122-123, pp. 133
[205] Drakman, A. (2018). *När kroppen slöt sig och blev fast: Varför åderlåtning, miasmateori och klimatmedicin övergavs vid 1800-talets mitt* (Doctoral dissertation, Acta Universitatis Upsaliensis), pp. 122-123, pp. 138-154

started to take a renewed interest in population development and sanitary issues became an important tool.[206]

The sanitary movement originated in England in the beginning of the nineteenth century and the new perceptions of health and sickness related above were combined with the realization that the industrial workforce was a valuable production factor, which made it important to keep the workers healthy. Added to these insights was the realization that health and modern technology had to be joined together, that true progress in public health was only to be achieved if water and sanitation was managed as a proper infrastructural system. I will not go deeper into this aspect, but it must be noted that Chadwick and the early Sanitary movement had an outspoken holistic view on the reuse of human wastewater and latrine. The piped sewage system with its connected water closets were meant to transport fecal matter and waste to farmlands outside the city where farmers would pay for them and use as fertilizers. This business model would finance the sanitary improvements in the cities, and at the same time benefit agriculture. In the words of Chadwick, using an ancient metaphor the recirculation of nutrients would complete the circle, and realize the Egyptian type of eternity by bringing "the serpent's tail into the serpent's mouth." [207]

Edwin Chadwick led the work preparing the influential *Health of Towns Enquiry* of 1844 in Britain. The report stated a clear connection between poor health and poverty and argued that sickness and epidemics like cholera "…spread via bad smells from putrefying matter. Therefore public health should be preventive in character, and the appropriate solution to these sanitary problems was technological systems such as piped water supply and sewerage, to which water closets were connected… British public health and modern water and sewerage technologies became very influential across the Western world for decades…and in Europe this led to a veritable "water-mania" in the mid- to late 19th century. What was essential here was the successful British linking of public health *and* technology." [208]

Chadwick and the Sanitary movement changed society's perceptions on disease and poverty from something that was blamed on individual character. Instead Chadwick claimed that poverty was often the consequence of disease which had its roots in sanitary conditions for which the individual could not be held responsible. He strongly argued for preventive actions and that it would in fact be economically sound to prevent disease: "Filth, disease, destitution, and the demand for a reduction in the burden of poor relief are the roots from which the movement for sanitary reform sprang."[209]

George Rosen claims that Chadwick "…proved beyond any doubt that disease, especially communicable disease, was related to filthy environmental conditions, due to lack of drainage, water supply, and means for removing refuse from houses and streets. Attention was further focused on these problems by Chadwick's adherence to the theory that epidemic fevers were due to

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[206] Nelson, M. C. & Rogers, J. (1994) Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History*, **19**(1), 17-39, 18-20; Rosen, G. (2015). *A history of public health*. Rev., expanded ed. Baltimore, Md.: Johns Hopkins University Press, introduction p. xxii and p. 55ff; Wiell, K. (2018). *Bad mot lort och sjukdom: den privathygieniska utvecklingen i Sverige 1880–1949*. Diss. Uppsala: Uppsala universitet, p 53: The population was attributed a value to the state from the second half of the 17th century onwards there was a gradual shift in the view of illness, from something private to a matter for the state.

[207] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 16-17.

[208] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 16-17.

[209] Rosen, G. (2015). *A history of public health*. Rev., expanded ed. Baltimore, Md.: Johns Hopkins University Press, pp.116-118

miasmas arising from decaying animal and vegetable matter. "The defects which are most important," wrote Chadwick, "and which come most immediately within practical legislative and administrative control, are those chiefly external to the dwellings of the population and principally arise from the neglect of drainage." Thus, the problem of public health was reoriented. It was declared to be an engineering rather than a medical problem. Thenceforth, filth was no longer simply a matter for private disgust; it was raised to the status of an important public enemy of the community health."[210]

According to Binnie (1981) it is evident that Chadwick had a clear understanding of the systemic and socio-technical nature of water projects. Chadwick insisted that proper sanitation was the most important prerequisite for improvements in living conditions and that sanitation must be based on "… applications of the science of engineering, of which the medical men know nothing..." [211]

The extension of water supply to every house and room, and even to the poor, was considered crucial and fear of a working-class revolution was evident. Chadwick's *Health of Towns Enquiry* and other studies claimed that "…since the lower classes had neither sufficient insight nor the capacity for an orderly way of living, it was necessary to start them on a better path indirectly. This path was what was called *Sanitary Economy* – that is, everything that promoted personal cleanliness, clean housing, and clean cities including introduction of water supply – and it had proved to induce much sounder ways of living among the working class." [212]

When discussing the piped water system in Norrköping 1866 arguments from the sanitary economy discourse were common and the same goes for Stockholm a decade earlier as will be shown later. Hallström (2003) quotes a newspaper article in one of the town papers. This article, in turn, quoted "one of England's most eminent engineers" (who was in fact Thomas Hawksley cowriter of the *Health of Towns Enquiry* of 1844):

"My own observations and inquiry convince me that the character and habits of a working family are more depressed and deteriorated by the defects of their habitations than by the greater pecuniary privations to which they are subject. The most cleanly and orderly female will invariably despond and relax her exertions under the influence of filth, damp, and stench, and at length ceasing to make further effort, probably sink into a dirty, noisy, discontented, and perhaps gin drinking drab – the wife of a man who has no comfort in his house, the parent of children whose home is the street or jail. The moral and physical improvements certain to result from the introduction of water and water-closets into the houses of the working classes are far beyond the pecuniary advantages …"[213]

Following this line of thought, that indoor fittings of water and sanitation was the best solution to sanitary issues, British WS engineers like Hawksley (1858) and his Swedish colleague Richert (1869) strongly argued "…against public wells and public taps since they often prevented the installation of internal water taps in the dwellings, which were the only means of sanitary and moral improvement of the poor. According to Hamlin, in mid-19th century Britain arguments were also made in favor of

[210] Rosen, George (2015). *A history of public health*. Rev., expanded ed. Baltimore, Md.: Johns Hopkins University Press, pp.120
[211] Binnie, G. M. (1981). *Early Victorian water engineers*. London: Telford, p2-3; Binnie quotes from the biography by S. E. Finer (1952) *The Life and Times of Sir Edwin Chadwick* (Barnes and Noble, New York); see also Lewis, R.A. Edwin Chadwick and the Public Health Movement (1832 – 1854)
[212] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 72
[213] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 71-73; The newspaper: *NT*, 1866-01-25 (including the quotation) and 1866-01-27. *NT* originally took this information from Leijonancker (1853) pp. 4-5,

internal fittings on the grounds that public pumps and water taps were places for inappropriate social behavior, for example, gossip, especially among women."[214] These types of gendered assumptions are quite common in the history of technology. The introduction of the telephone, for example, include lots of prejudiced statements, not at least from the telephone companies, on "improper" female use of the new infrastructure.[215]

The will to help the lower classes was not uncontroversial which the newspaper anticipated and retorted: "Against this may be said that higher mortality among the poorer class is not a great misfortune, but this would only be possible to defend as long as people unfit for work died; but . . . often men between 25- and 40-years old die . . .". It was from the poor families these men left behind that those who needed poor relief mostly came, and by improving the sanitary conditions, poor relief costs could be reduced."[216] It is obvious that hygiene and cleanliness had physical as well as moral implications.

Even though in Norrköping, Stockholm and in other towns, sanitary concerns were the most common, one must keep in mind that these were not the only motives behind piped water. Other main arguments were street cleaning, public baths, industrial needs and not the least, improvement of municipal fire protection. Fire protection was of course central to cities crammed with wooden houses that easily caught fire.[217]

To conclude, before moving on to the next section dealing with the Health act of 1874, Swedish water and sanitation initiatives were clearly based on British sanitary reforms and came to relay on the ideology of the sanitary movement. Furthermore: "Late 19th-century ideals of the *healthy city* and metaphors of society as a *sound* or *healthy* body, had their origins in the same ideas of purity and dirt, as did the consequent dichotomy health – sickness.[218]

It was against the background of Cholera epidemics, the valorization of workers health, the high mortality rates, the new perceptions of health and sickness and inspired by the British sanitary movement that the creation of Sweden's first comprehensive public health legislation began.[219] The health act can be seen as the specifically Swedish articulation of publicness responding to the challenges from the contextual factors discussed above and also as a direct operationalization of ideas from the sanitary reform on a national scale.

Advances in WS technology was of course also very important but technology is not a silver bullet, water and sewage systems were not new to the world. What was new, in Europe as well as in Sweden, was the creation of a new municipal organization with the power and resources to afford and manage these expensive undertakings. This can be seen as a successful articulation of publicness

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[214] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, (p. 71-73); Hamlin, C. (1998). *Public health and social justice in the age of Chadwick: Britain, 1800-1854*. Cambridge: Cambridge Univ. Press;

[215] Fischer, C. S. (1988). Gender and the Residential Telephone, 1890-1940: Technologies of Sociability. *Sociological Forum*, **3**(2), 211–233.

[216] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 71-73)

[217] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 74

[218] Hallström, J. (2003). *Constructing a Pipe-Bound City. A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping., pp. 49

[219] Nelson, M. C. & Rogers, J. (1994) Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History*, **19**(1), 17-39.

which gave political leverage and organizational capacity. In Sweden as a discussed, this organization was established trough the Municipal reform act of 1862, which gave the towns and municipalities the right to take loans and tax all citizens. The reform laid health care in the hands of the municipality and thus made every town responsible for sewage and water.[220]

But already in the 1830.s, when the first cholera pandemic occurred, legislation was put in place both for quarantine regulations and for the obligation for local parishes to report cases of cholera to the medical authorities. In towns special committees were established which became the foundation for the establishment of compulsory local health boards after the approval of the Public Health Act of 1874.[221]

According to Nilsson and Forsell (2013) these early health committees can be seen as a prelude to the whole reform movement which led to the municipal reform of 1862 and the following city charters. The health boards of 1874 were put up to oversee, among other things, water, sewage, cleaning, garbage disposal, burial sites, housing, disposals, food handling, animal husbandry and industries."[222]

Nelson and Rogers (1994) characterize the new act like this: "The Public Health Act of 1874 was a piece of comprehensive legislation dealing with the entire range of what we today would include in the realm of health and environmental policy, and including measures directed towards the community as well as towards the individual. It was innovative in the sense that no attempt had ever been made to pass legislation covering all aspects of preventive health care."[223]

As mentioned earlier, the health act of 1874 was heavily influenced by Chadwick and the sanitary movement and the committee that worked on drawing up the act frequently referred to studies from Chadwick and associates "…that attempted to estimate the economic benefits of a public health program by calculating the number of man-hours gained in production and the reduction in costs of medical and hospital care…(and)…that improvements in water supplies and sewerage systems and the control of other sanitary problems would lead not only to better health but to economic profits."[224]

Chapter 8: Modern water and sanitation

Before I move on in the history of modern drinking water and sanitation, which eventually led to the establishment of WSS, I will shortly account for the early nineteenth century´s history of latrine collection and street cleaning. Moreover, as a contrast to the history of modern water provision, I will also briefly discuss water legislation excepting drinking water from the first half of the same century.

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[220] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 16-17

[221] Nelson, M. C. & Rogers, J.(1994) Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History*, **19**(1), 17-39, pp. 21

[222] Nilsson, L. & Forsell, H. (2013). *150 år av självstyrelse: kommuner och landsting i förändring. Stockholm: Sveriges kommuner och landsting*, pp.131; For other legislation concerning water and sanitation: Drangert, J-O., Nelson, M. C., & Nilsson, H. (2002). Why Did They become Pipe-Bound Cities? Early Water and Sewerage Alternatives in Swedish Cities, *Public works management and policy*, **6**(3), 172-185.

[223] Nelson, M. C. & Rogers, J. (1994) Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History*, **19**(1), 17-39, pp. 27

[224] Nelson, M. C. & Rogers, J. (1994) Gleaning up the cities: Application of the first comprehensive public health law in Sweden, *Scandinavian Journal of History*, **19**(1), 17-39, pp. 23

Latrine collection and street cleaning in the early nineteenth century

As mentioned above street cleaning and gutters, outer sanitation, were seen as public concerns, and connected to street keeping, what I have called *general* road and street maintenance, since the Middle Ages, although it seems that the authorities were not very successful in enforcing the many regulations. In the first half of the eighteenth century a praxis was established meaning that property owners kept the street clean outside the plot and the city authorities managed street cleaning on open spaces and public squares.[225]

The meaning of the term sanitation changed from the beginning of the nineteenth century. Earlier sanitary measures were associated with "Politi", i.e. good order, cleanliness, and tidiness.[226] But from around 1800 sanitation was gradually associated with human health and wellbeing, a matter that increasingly became a public concern. This movement changed the motives in outer sanitation, away from Politi, and towards individual health. It also transformed inner sanitation into a public concern and responsibility in the first half of the nineteenth century. Public interest now focused on earlier private practices such as house cleaning and personal hygiene and Swedish towns tock a firmer grip on excrement handling by a gradual takeover of latrine barrel collection by publicly employed personnel (more on this change below). At the end of the nineteenth century these areas of sanitation had been firmly moved under the town authorities. It is evident that the articulation process of publicness in especially latrine collection and, somewhat later, in street cleaning predates piped water and piped sewerage in the latter half of the nineteenth century.

Later in the report, I will continue the discussion on how piped water and sewage to a higher degree than before became public responsibilities influenced by the advent of health and sanitary ideologies. However, health and sanitary discussions of course also influenced latrine collection and street cleaning in the beginning of the century. Finish historian Henry Nygård (2004) summarizes the history of waste removal like this: "Society has faced the waste problems in two main ways, partly by moving the problems, partly by using technology to reduce the inconvenience or by transforming the waste into a form that is perceived as less harmful. However, public cleanliness is a relatively modern phenomenon. The transition from private to public responsibility has been influenced by the new healthcare ideals and administrative models that emerged during the 19th century." When waste management in general became a public matter a prophylactic strategy on cleanliness was accentuated which culminated at the end of the nineteenth century. This strategy was part of what could be called a "…social purification process where dirt, infection and sin were just different expressions of the same evil principle. Expressed in social terms, it meant mastering not only uncleanliness and overcrowding, but also poverty, destitution, alcoholism, and prostitution, and all those circumstances which broke down the health of the poorest and left them susceptible to suffering and misfortune."[227]

Thus, the *prophylactic* view on health and sanitary issues first appeared in in latrine management, somewhat later in street cleaning, and gradually grew stronger in influence in the "Sanitary

[225] Hallenberg, M. (2018). *Kampen om det allmänna bästa: konflikter om privat och offentlig drift i Stockholms stad under 400 år*. Lund: Nordic Academic Press, pp. 99
[226] Nygård, H. (2004). *Bara ett ringa obehag?: avfall och renhållning i de finländska städernas profylaktiska strategier 1830-1930*. Diss. Åbo: Åbo Akademi; Sjöstrand, Y. S. (2014). *Stadens sopor: Tillvaratagande, förbränning och tippning i Stockholm 1900-1975* (PhD dissertation). Lund; Wetterberg, O. & Axelsson, G. (1995). *Smutsguld and dödligt hot*. Göteborg: Göteborgs renhållningsverk; Dufwa A, Pehrson, M. (1989) Stockholms renhållning under de första 600 åren i Dufwa, Arne, Snöröjning, renhållning, återvinning. Stockholms stadsbibliotek, pp. 1-23
[227] Nygård, H. (2004). *Bara ett ringa obehag?: avfall och renhållning i de finländska städernas profylaktiska strategier 1830-1930*. Diss. Åbo: Åbo Akademi, 2004, pp. 24-25

economy/sanitary movement" which directly affected the development of piped water and sewage.[228]

Regarding latrine management historian Eva Jakobsson (1999) summarize the development before the introduction of the WC in 1909 like this, referring to the fascination expressed by August Strindberg cited in the beginning of this report:

"In the Stockholm Strindberg left, the so-called pit system had just been abolished. Each transfer would now instead consist of an exchangeable barrel. In 1880, there were 34,801 such disposal vessels (at 2.5 cubic feet). Only 6,295 of them were located indoors. On average, 4.41 Stockholmers shared each vessel. Since 1869, it had been the owner's responsibility to ensure that the vessel was replaced and emptied by bidding. For reasons of piety, this took place at night… Although the handling of the barrels was relegated to the late hours of the night, the system had obvious inconveniences. The relatively high cost of getting the barrels picked up contributed to the fact that it took an average of six and a half weeks between changing the vessels: "that not only are the vessels overflowing, but also that some impurity has run down the ceding bay, before bidding takes place , and yet more often it happens that, where the vessels are not overflowing, they have nevertheless been used for so long that part of the contents must be removed, so that nothing will flow out during the removal". A good third of the vessels were so full that they "had to be scooped out". The wooden vessels were also leaky, difficult to clean, and the lids were so loose that the splashing made them even more smeared. To reduce inconveniences in the system, the barrels were rebuilt according to the so-called Rochdale system, which meant that the distance between the floor and the underside of the seat was not allowed to be greater than the height of the vessel. A ring was attached to the seat board which stuck a bit into the discharge vessel… "the vessel cannot be used for so long that it overflows, unless a particularly uncomfortable position is taken, and the ring prevents the excrement from coming out of the vessel during the discharge itself. In 1880, the sanitation work in collaboration with a contractor carried out 274,104 collections of barrels in Stockholm. The barrels were emptied into barges at Nybrohamnen and at Stadsgården in the city center, where they remained for another 3-10 days before the barges were fully loaded. The barges were further shipped out to Fjäderholmarna, some were taken to Huddinge by rail, where the latrines were sold to agriculture. In 1888, they managed to sell a third of the entire latrine production in this way. The system was functional in terms of circulation but hardly in terms of hygienic conditions. From the latter aspect, the WC system could of course offer better solutions. Against this background, it is understandable that Strindberg, in his first encounter with the water closet, thought he had experienced something magical." [229]

In March 1849 a committee was set up by the financial board of the city to investigate how to handle these arrangements. The committee suggested that public authorities should take a firmer grip and wanted to get rid of the traditional ways of managing latrine collection. After some turns in the

[228] Dufwa, A. & Pehrson, M. (1989) *Avfallshantering och återvinning.* Stockholm, Sweden; Nygård, H. (2004). *Bara ett ringa obehag?: avfall och renhållning i de finländska städernas profylaktiska strategier 1830-1930.* Diss. Åbo: Åbo Akademi; Wetterberg, O. and Axelsson G. (1995). *Smutsguld and dödligt hot: Renhållning och återvinning i Göteborg 1864-1930*, Göteborg; Drangert, J-O. & Hallström, J. (2003). Den urbana renhållningen i Stockholm och Norrköping: från svin till avfallskvarn?, *Bebyggelsehistorisk tidskrift*. **44**, 7-24; Hallenberg, M. (2018). *Kampen om det allmänna bästa: konflikter om privat och offentlig drift i Stockholms stad under 400 år*. Lund: Nordic Academic Press; Sjöstrand, Y. S. (2014). Stadens sopor: Tillvaratagande, förbränning och tippning i Stockholm 1900-1975 (PhD dissertation). Lund, pp. 40-41

[229] Jakobsson, E. (1999). *Introduktion av WC i Stockholm: ett vattensystemperspektiv på staden*, Polhem. Tidskrift för teknikhistoria, 1999 (2-4, årgång 17, pp.118-139), pp. 118-119

debate, where a publicly hired contractor was appointed, and very soon failed, in 1859 the municipality finale took charge by creating a municipal sanitation organization.

According to Hallenberg (2018) latrine management in Stockholm was organized like this before the 1860.s:[230]

- Up to the first half of the eighteenth century: as communal inconvenience executed by individual property owners.
- 1738: Municipally organized contracting.
- 1760: Communal inconvenience, property owners pay contractors.
- 1774: Contractors hired by the municipality.
- 1800-1850 Communal inconvenience (again), property owners pay contractors.
- 1849: Full contract for 10 years, paid by the municipality (the contractor fails).
- 1859: Municipal organization: Stockholm Sanitation Works.

As a side note it can be mentioned that like common wells, bigger towns also had common privies to some extent. In Stockholm, according to a regulation in 1792, it was stipulated that public "convenience facilities" were to be put up and to be managed by the contractor responsible for latrine collection. In the 1840s, there were around fifteen public convenience facilities in Stockholm and in the 1870s, the city increased the number of by allowing private individuals to rent privies and make them available to the public for a certain fee. Around 1885 there were 17 public commercial privies called "cabinets" and at the same time around 70 public urinals in the city.[231]

When cholera broke out in Stockholm in 1853, and claimed around 3 000 lives, an even more invigorated debate began about the city's sanitary conditions. In 1859, the financial board decided that the city should also take over street cleaning alongside latrine management.[232] However, this initiative was not very successful, and in 1875, a street cleaning company (Gaturenhållningsbolaget) owned by the city was established, billing the property owners for its service. Gradually, between 1895-1902 the city took over street cleaning in its own municipal organization. In 1902 street cleaning and latrine collection were merged in the Stockholm Sanitation Works (see above) when the street department of the municipality got the responsibility for both.[233]

- Up to the first half of the eighteenth century: as communal inconvenience executed by individual property owners. Many different forms of contractors were also tried.
- 1859 The Financial board takes over.
- 1875 The Street cleaning company
- 1895 Municipal organization established.
- 1902 Excrement handling and street cleaning merged in the Stockholm sanitation works.

To sum up: Latrine collection and street cleaning became an arena for political dispute where the articulation of publicness was evident. Since the Middle Ages the responsibility for both street

[230] Hallenberg, M. (2018). *Kampen om det allmänna bästa: konflikter om privat och offentlig drift i Stockholms stad under 400 år*. Lund: Nordic Academic Press, pp. 100
[231] Bidragsgivare till Wikipedia-projekten. (2023). Offentliga toaletter i Stockholm. *sv.wikipedia.org*. https://sv.wikipedia.org/wiki/Offentliga_toaletter_i_Stockholm, accessed 25/4 2023
[232] Dufwa, A. & Pehrson, M. (1989) *Avfallshantering och återvinning.* Stockholm, Sweden, pp. 18-21
[233] Drangert, J-O. & Hallström, J. (2003). Den urbana renhållningen i Stockholm och Norrköping: från svin till avfallskvarn?, *Bebyggelsehistorisk tidskrift*. **44**, 7-24; Personal mail conversation with the street and traffic department in Stockholm

cleaning and latrine emptying rested on individual property owners, but this arrangement often functioned poorly, and the duties were often outsourced to private contractors.

According to Hallenberg and Linnarsson (2016) the articulation of latrine collection as a public responsibility spearheaded the articulation of publicness in Stockholm and broke down the resistance towards a public, tax-funded organization. However, it still took quite a long time to introduce municipal street cleaning. Although the financial board (Drätselkommissionen) advocated public street cleaning very early it remained an individual responsibility of the property owners until 1902. It is in fact still part of the responsibilities of every houseowner in Swedish towns to clean the pavement in front of one's own plot.[234]

The difference in the articulation of publicness in street cleaning and latrine collection, where street cleaning became a public responsibility much later than latrine management, is a bit paradoxical. Street cleaning and outer sanitation had since a very long time been an area where public authorities tried to articulate publicness. Latrine management and inner sanitation, on the other hand, was seen as an area outside the realm of the public. This paradox can probably be explained by two reasons: First that the prophylactic view on sanitary and health issues, for obvious reasons, were much more prominent in latrine management. Latrine collection became an increasingly problematic area when the sanitary issues were put high on the agenda. The former private sphere of inner sanitation was opened to public intervention. Second, which was discussed earlier in the report, street cleaning was connected to established practices in road and street management where road maintenance was considered as tax payment in kind. If regulations for street cleaning were to be changed it would disrupt an important principle behind tax withdrawal. This entanglement between the road and street sector and taxation gave the road/street system an institutional path dependence and inertia which resisted change and made the field very hard to modernize.[235]

Water legislation excepting drinking water.

In the first Swedish national legislations on water the non-public character of drinking water is reviled by the fact that drinking water is not mentioned at all. In the Act on Water Rights from 1865, the damming wheel for hydropower, the flotation wheel and the ditching wheel were the only water aspects addressed. The subsequent Water Rights Ordinance of 1879 makes additions to urban water intake and fishing rights. However, nothing was mentioned about drinking water provision, groundwater extraction or domestic water from watercourses. Thus, contrary to the situation in ancient Rome, in Swedish legislation drinking water was generally treated as a private good and a productive resource rather than a common good.[236]

Swedish water legislation was, just as for civic roads, based on rules recorded in the landscape laws from the 13th century. They in turn built on ancient customary law based on the medieval village organization. In the 1734 law, water regulation was introduced into the Building Code. The rules thus applied partly to how one could appropriate water through various companies (power, mills), the so-called *lucrative* water projects, and partly to the so-called *defensive* water projects such as ditches, dams and other things that aimed to protect from the harmful effects of the water.

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[234] Hallenberg, M. & Linnarsson, M. (2016*). Vem tar bäst hand om det allmänna? Politiska konflikter om privata och offentliga utförare 1720–1860. Historisk tidskrift*, **136**(1), 32–63, pp. 55-58, 61; Based on: Hallenberg, M. (2018). *Kampen om det allmänna bästa: konflikter om privat och offentlig drift i Stockholms stad under 400 år*. Lund: Nordic Academic Press

[235] For a discussion on conservatism in the road sector: Lindberg, E. (2022). *Välfärdens vägar: organiseringen av vägunderhållet i Sverige 1850-1944*. Lund: Nordic Academic Press

[236] Drangert, J-O. (1991). *Svensk vattenhistoria*. Linköping: Universitetet, Tema Vatten

Modern water legislation had its beginnings in the Ditching Act of 1879 and concerned so-called *defensive* undertakings, i.e. removing excess water from the fields. But its purpose was anything but defensive. The state realized that the cultivation of the kingdom required vigorous measures. In the Ditching Act, there were regulations for setting up ditching companies and rules for the formation of a CPR-organization for this purpose. In this water related area inspiration clearly came from the methods used for management of common resources in the villages and both land drainage and civic roads were taken care of in the same manner. From the end of the 19th century until the 1960s, between 30 – 40,000 CPR-organizations for land drainage were set up, of which around 10,000 can be said to be active today.

In Water Act of 1918, the legislations took on the *lucrative* water projects. An obvious reason was the state's desire to appropriate hydropower for the expansion of the electricity grid.

Within both the defensive and the lucrative water rights, it is quite clear that the state, so to speak, perceived a need to steer up the regulation because the water rights had become a national concern. The expansion of agriculture, industrialization, and the project to electrify Sweden, made water a strategic resource in the building of a modern society.[237]

This is a chronological summary of the most important laws and regulations, based om (Christensen, 2003, 2015):[238]

Water legislation excepting drinking water and sanitation/sewage:

- Landscape laws (13th century ---)
- Gustav Vasa's order (16th century)
- House inspection arrangements (18th century)
- 1734: Building Code: Swedish water legislation, just as for the individual roads, built on rules recorded in the landscape laws from the 13th century. They in turn built on ancient customary law based on the medieval village organization. In the 1734 law, water regulation was introduced into the Building Code (not mentioning drinking water and sanitation).
- 1879: Ditching Act (based on 1915 Ditching Committee): Defensive water projects
- 1880: Water Rights Ordinance: Lucrative water projects
- 1918: Water Act, 1918:523 (replaced the 1880 Water Rights Ordinance). Water pollution regulations were introduced in 1942.
- 1983: Water Act, 1983:291 (soma few regulations on drinking water; replaced the 1918 Water Act)
- 1998: Act with special provisions on water activities (in power 1999; replaced the 1983 Water Act)
- 1996: Nature Conservation Act (amended land drainage in 1992)
- 1999: Environmental Code

[237] Blomkvist, P. (2010). *Om förvaltning av gemensamma resurser: Enskild väghållning och allmänningens dilemma i svensk historia 1200–2010* (Managing Common Pool Resources: Road Keeping and the Dilemma of the Commons in Swedish History 1200–2010), Division of Industrial Dynamics, KTH (Royal institure of Technology), Stockholm, Sverige. TRITA-IEO 2010:06, pp. 54-56

[238] Christensen, J. (2003). *Enskilda avlopp – miljöbalken har ändrat de rättsliga förutsättningarna*. Michanek, G. & Björkman, U. (red.) (2003). *Miljörätten i förändring: en antologi*. Uppsala: Iustus; Christensen J. (2015). *Juridiken kring vatten och avlopp. En översiktlig genomgång av juridiken kring dricksvattenförsörjning samt avledning och rening av spillvatten och dagvatten*. Havs- och vattenmyndighetens rapport 2015:15. Stockholm, Sverige

The era of building piped water systems

The first suggestions for a municipal system for piped water in Stockholm was put forward in 1851.[239] At the same time the Swedish society of physicians started a campaign for modern water provision motivated by an investigation of mortality rates. The doctors were also inspired by a committee set up in Copenhagen with the same purpose and, perhaps most importantly by the "sanitary reforms" described in Chadwick's *Health of Towns Enquiry*.[240]

In the campaign, hygienic, social, medical, and national economic advantages of piped water were pointed out, not to mention its importance for firefighting. Those who suffered the most from the current conditions were the poor, who lived far away on the wells in the city center. Women and children in poor families had to spend time and a lot of work fetching water, which they then had to save and use for a long time. In this way, much suffering had been caused in the form of back pain and leg injuries on the one hand, and stomach and intestinal diseases on the other. The rich could always hire people to carry water. The views of the Society of physicians were later cited by Wilhelm Leijonancker who later were commissioned to design the water supply system.

Even despite of a quite strong internal resistance, this opinion led the parishes, the magistrates, and the Eldest of the Burghers to pay half the cost for a study trip to England and Germany for Leijonanker. The other half was covered by the Fire insurance company of Stockholm, which shows the importance of firefighting as a motive for piped water systems. In June of 1853 Laijonanker delivered his plan including maps, design, and drawings for a piped water system.

For the future organization, it was important that Leijonancker decidedly advised against the system of private companies building and operating water mains, sometimes in competition with each other, which was most often the situation in England. His strong opinion was that profit interests should be completely kept away from such activities. In April 1854 the committee appointed to evaluate the proposition agreed with Leijonancker that a water main should be installed, and that the municipality should install and operate it. In the pro arguments, social conditions, and sanitary issues dominated the rhetoric. It must be noted that piped sewerage, just like piped water distribution, also came under municipal ownership in most towns and municipalities. In fact sewerage was considered a clear natural monopoly, more so than piped drinking water, which made municipal ownership the obvious choice. [241]

However, the project was far from secured. Some of the more peripheral parishes objected strongly. They did not want to pay for something that only rich people in the city center would be able to use and a service that they would have to wait years to get. The resistance came mostly from the lower end of the Burghers, small artisans, and traders, and from not so well of property owners.

Nevertheless, after quite a few complicated rounds of discussions voting's in the committee, the pro water system side won with 42 votes against 16 and the qualified majority needed was reached in 1854. In short social and sanitary arguments won over economic and financial misgivings. Further negotiations were needed to get the parishes on board and an investigation of the water in wells

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[239] This section builds on Höjer, T. (1967), *Sockenstämmor och kommunalförvaltning i Stockholm fram till 1864*, [Stadsarkivet], [Stockholm], pp. 270-287; 436-453; Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 2-27

[240] On Copenhagen: Thelle, M. (2019) Stofskifte under tryk: Vandets infrastruktur og rum i København, *TEMP - tidsskrift for historie*, **9**(18)

[241] Höjer, T. (1967), *Sockenstämmor och kommunalförvaltning i Stockholm fram till 1864*, [Stadsarkivet], [Stockholm], pp. 270-287; 436-453; Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 2-27

were added to the argumentation. It was claimed that a cholera outbreak in one parish, Kungsholmen, that was particularly opposed to the water system, was related to foul well water (a proposition that could not be proved though).

A special board to manage the water works was appointed in 1856 and Leijonanker's proposition was approved in September 1857, under the condition that the famous British expert Thomas Hawksley were in favor. Finally in February 1858, after Hawksley´s approval, the work could start.

Connection to the water supply network was initially slow and during the late 1860s the common wells were still widely used. But these were said to be contaminated and gradually more people connected to the network.[242]

Other tows that built water pipe systems during the same period included Karlskrona 1862-1864, Jönköping 1865, Malmö 1866, Gothenburg and Skövde 1871. During this decade, pipes were also added in Kristianstad, Lund, Landskrona, Linköping, Uppsala, Askersund, Gävle, Uddevalla and Sundsvall.[243]

The process in Gothenburg is described like this by Hallström (2003): "In Göteborg there were several proposals for piped water and sewerage during the 1850s and 1860s, but for various reasons they were never realized. In 1864, the Göteborg City Council decided to build a piped water supply, and in the spring of 1865 Leijonancker was hired to construct it. It had already been decided that the lake Delsjöarna would be the source of water, but there was nevertheless uncertainty whether it would suffice for the estimated future water needs, which led to a heated debate. J. G. Richert, who was chief construction engineer for the harbor, the streets, and the waterworks (Kallebäcksledningen, the old waterworks from the late 18th century), participated in this debate and presented a very different view of the problem than Leijonancker. Richert's proposal was at last successful, and he was appointed constructing engineer for the piped water supply instead of Leijonancker. Around 1871, the building of Richert's water system was finished. Richert also constructed the sewerage for Göteborg (1866), and as chief engineer was responsible for the whole extension of water supply and sewerage until 1888." [244]

Population size was of course an important factor, but also smaller towns built modern water systems. Jönköping built its system as early as 1864 and was the third city in Sweden. Norrköping, on the other hand, which was the third biggest town after Stockholm and Gothenburg got its piped water supply ten years later. Other larger cities which latecomers were Gävle, Helsingborg and Örebro. Furthermore, the motives behind piped water varied. In Karlskrona, the water pipeline was built by the crown to primarily meet the needs of the naval base. In 1859, the crown approved a proposal presented by Leijonancker and the work was finished in 1863. In 1897, the crown handed over the water pipeline to the city of Karlskrona. One of Sweden's earliest municipal water mains was built in Jönköping. The initiative came from the State-owned railroad company in 1863 and as the city did not want to miss out on the railway connection the construction started, and the facility was completed in 1865. The motives in Norrköping were connected to the fear of fire. The first proposal for a water supply came already in 1826 but it was not until 1872 that the actual project was launched, this time under the leadership of Josef Gabriel Richert. In Gothenburg the older proto

[242] Anderberg, S. (1986). *Stockholms vattenförsörjning genom tiderna*. Stockholm
[243] Tjulin, R. (2002). *I kommunalteknikens intresse: svenska kommunal-tekniska föreningens verksamhet under 100 år*. Master thesis, KTH, Stockholm, supervisor Pär Blomkvist.
[244] Hallström, J. (2003). *Constructing a Pipe-Bound City: A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp.84; Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg: Göteborgs va-verk.

system was replaced between 1868- 1871 primarily because of water shortage and pollution of local water sources such as the river (Göta älv.). In Linköping in 1870 a proposal was submitted to the city council for a build a water main. The motives were sanitary and economic advantages and improved fire protection. As one of the few examples the city gave a private company the task to build the piped water system and Linköpings Vattenlednings AB was formed with the governor and mayor among the board members.[245]

It must be noted that the initiative to build a piped water network in Stockholm was launched ten years before the acceptance of the Municipal act of 1862 and that the system in Stockholm was ready for operation ten years before the Health act of 1874. The same early start can be seen in a few other places which is a strong argument for the prevalence of the specific contextual factors discussed above. Publicness in drinking water was articulated stronger and stronger in the first half of the nineteenth century and the Municipal act of 1862 and the Health act of 1974 codified a changed perception that was already a fact. As mentioned, many other towns followed suit and Sweden already had functioning water works in approximately ten towns by 1874. In 1875 fourteen of Sweden's cities had water mains and in 1909 the number was 65.[246]

As will be discussed in detail later in the report, most cities constructed water mains before piped sewage. In these cases sewage came as a response to the increased amount of water needing drainage. After the 1870s though, sewerage water mains were built simultaneously to minimize excavation costs and the preferred method was the combined system (waste and storm water in one pipe). The combined system was a sign of technical path dependence as the new piped sewage system replaced the ditches and trenches earlier used for storm water.[247]

To sum up I again want to stress that the early development in piped water strongly indicates that the contextual factors discussed in this report had a profound influence on the articulation of publicness and the development of WS and that the formal legislations were codifications of a more positive attitude in society towards publicness and interventions from the state and from municipalities in domains previously seen as private.

The motives in Leijonancker's plan of 1853

Before moving on I would like to take a step back and highlight a couple of points from Leijonancker's plan for the piped water system in Stockholm, which led to development accounted for above. I have already mentioned that Leijonanker used examples from glorious Roman times to advertise his message, but no ancient technical inspiration can be found in the report. It is clearly stated that modern WS technology originated in England.[248]

First, it must be noted that Leijonancker's report is an impressive piece of work. It is a complete design of a water system with very detailed technical and economic calculations, which I have no possibility to go into. As mentioned, the report was approved by Thomas Hawksley, one of the most prominent WS engineers of his time.

[245] Andersson, A. (1971). *Svenska vattenledningar och vattenreservoarer 1869-1910,* C-uppsats i konstvetenskap, Lunds universitet, Lund, Sverige.
[246] Söderholm, K. (2007) *Uppbyggnaden av Luleås VA-system vid sekelskiftet 1900. En djärv "miljö"-satsning i en tid av teknisk och vetenskaplig omdaning*, Research report, Luleå tekniska universitet, 2007:13, pp. 10.
[247] Söderholm, K. (2007) *Uppbyggnaden av Luleås VA-system vid sekelskiftet 1900. En djärv "miljö"-satsning i en tid av teknisk och vetenskaplig omdaning*, Research report, Luleå tekniska universitet, 2007:13, pp. 13-14.
[248] Leijonancker, W. (1853). *Förslag till vattenledning i Stockholm*, pp. 1; See also Petersson, F. (2005). *Vattnets vägar - från vik till innergård på Södermalm 1880-1920*. Stockholm: Center for Health Equity Studies (Chess), pp. 53-55

Second, I believe that if one wants to find a "Swedish model" of sorts for WS infrastructure Leijonancker's design plan is a good starting point.[249] It certainly influenced many of the following towns building water, and later sewage systems in the decades after Stockholm. Leijonancker's suggestion was motivated by these main points, covering all aspects that earlier research has listed as important components in water provision history:[250]

- Concern about the poor who lived far from water sources and on upper stories in houses.
- More convenience for the better off citizens.
- Alleviate sanitary conditions in the whole town including street cleaning.
- Increasing the health standard of the population.
- A resource for water consuming industries.
- Firefighting gets more effective.
- Creates opportunities for public baths and washing facilities.

As a short note on my remark on a "Swedish model" for WS infrastructure I want to emphasize that even though Leijinanker was the first to design a modern piped water system and that his ideas certainly were influential, he was not alone. As mentioned, Josef Gabriel Richert were commissioned to design the water system in Gothenburg and later his son Johan Gustaf Richert became even more influential in WSS. The correct way to attribute credit would probably be to say that the "Leijonanker-Richert model" became the norm in Swedish WSS development.[251]

Third, and lastly, I want to stress the profound influence of Chadwick's *Health of Towns Enquiry*. Leijonancker openly referred to the sanitary movement and it reports on the health situation in England, comparing and adjusting the results to Swedish a context. Most of his general motivations for the piped water systems are blueprinted on Chadwick and the sanitary movement. In the report he interestingly enough quotes the words of Thomas Hawksley, the same words that later were used in the newspaper in Norrköping that I discussed earlier: "My own observations and inquiry convince me that the character and habits of a working family are more depressed and deteriorated by the defects of their habitations than by the greater pecuniary privations to which they are subject…" [252] Later on in the report Lejonancker adds what might well be his own words, which the newspaper attributed to "one of England's most eminent engineers" (i.e. Hawksley):

"One might object that even greater mortality among the poorer class is not exactly a severe accident, a claim that can be defended if only people unable to work died, but the tables show that men between the ages of 25 and 40 often die, and from which, in poverty left families the proletarian class is mostly recruited. Now that sanitary measures undoubtedly contribute to increasing the middle age, the poor service can avoid many, perhaps most, such families."[253]

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[249] Kaijser (1994) introduce the notion of a "Swedish model" for infrastructure building with the state as the dominant system builder which applies for railroads, telephone and certainly roads. The same type of model does not really exist in WS.

[250] Leijonancker, W. (1853). *Förslag till vattenledning i Stockholm.* Stockholm; See also Anderberg, S. (1986). *Stockholms vattenförsörjning genom tiderna*. Stockholm, pp. 32

[251] Hallström, J. (2003). *Constructing a Pipe-Bound City: A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-191*0 (PhD dissertation). Linköping University Electronic Press, Linköping, pp.84; Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg: Göteborgs VA-verk.

[252] Hallström (2003) also recognize this cross referencing, or rather plagiarism: Hallström, J. (2003). *Constructing a pipe-bound city: A history of water supply, sewerage, and excreta removal in Norrköping and Linköping, Sweden, 1860-1910*. PhD thesis. University of Linköping, Linköping, Sweden, pp. 71-73

[253] Leijonancker, W. (1853). *Förslag till vattenledning i Stockholm.*. Stockholm, pp.6: "Man torde invända att en större dödlighet bland den fattigare klassen ej just är en svår olycka, en sats möjlig att försvara om blott icke arbetsföra personer dogo, men tabellerna visa att det ofta dö män mellan 25 och 40 år, uthur hvilkas, i fattigdom efterlemnade familjer

To conclude, sanitary and health issues were important, but not the only motives in Stockholm. Hallström (2003) also note the many different motives behind public water and sanitation in Norrköping. The sanitary advantages were given the most space, but the question of fire prevention was also considered "one of the most important." Piped water supply would make fire protection "…so complete that a greater fire is nearly impossible." Hamburg was mentioned as a model where the last big fire was pointed out as the motive for a large-scale water system. Fire-protection was in Norrköping, as in Stockholm, also one of the main reasons accompanied by industrial needs such as water turbines. [254] In Gothenburg these motives were echoed with an even stronger emphasis on the financial arguments to enroll property owners, industry, and tradesmen in the project of public water provision.[255]

Managing, financing and ownership of the piped water system

In this section I touch upon the central question in Linnarsson and Hallenberg´s research on publicness: private or public ownership of municipal infrastructure. During the planning process in Stockholm the managing board discussed how to design water tariffs. Individual meters were considered too expensive and technically insecure. The discussions ended up in a tariff based on the number of rooms in the property connected to the grid. Factories and commercial buildings were levied using meter though. Water for street cleaning, an important issue in the sanitary economy, was paid as a tax by the parishes in analogy with the tariffs for gas lightning. Furthermore, several standpipes were decided on where people not connected to the grid were able to fetch water for free. These public standpipes were however not very appreciated by the managing board. They argued that to many standpipes would delay the preferred inhouse connections and slow down the number of subscribers. Fire protection was of course also an important issue, and it seems that this part of the water system worked satisfactory.[256]

Initial technical problems with water meters delayed their introduction, but in 1925 Stockholm introduced mandatory metering for every service connection, private and commercial because a large share of produced water was unaccounted for. The new water meters led to a significant rise in income for the water works.[257]

Another example on tariffs is from Norrköping which in 1874 decided, inspired by Gothenburg, that the Waterworks Board should pay water and sewer service pipes up to the boundary of the private property and the landowner paid for pipes laid inside the lot and in the house (which is the same principle most municipalities use today). However, water for household use, except for horses and

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proletärklassen till största delen rekryteras. Då nu sanitära åtgärder otvifelaktigt bidraga till förökande af medeldåldern, slipper fattigvården många, måhända de flesta, sådana familjer."

[254] Hallström, J. (2003) *Constructing a pipe-bound city: A history of water supply, sewerage, and excreta removal in Norrköping and Linköping, Sweden, 1860-1910*. PhD thesis. University of Linköping, Linköping, Sweden, pp. 73; "I en kartläggning av indragning av vatten inomhus på den svenska landsbygden framgår att ungefär 17% av hushållen hade rinnande vatten inomhus vid tiden för första världskriget, vanligen via en ledning från egen brunn. Denna procentsats ökar successivt till 90% i slutet av seklet." Drangert, J.-O., Löwgren, M. (2005). *Förändring eller kontinuitet?: faktorer som påverkat va-systemens utveckling i Linköping och Norrköping under perioden 1960–1990*. Chalmers tekniska högskola, Göteborg. pp. 11.

[255] Hallström, J. (2003). *Constructing a Pipe-Bound City: A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp.84; Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg: Göteborgs VA-verk.

[256] Höjer, T.(1967), *Sockenstämmor och kommunalförvaltning i Stockholm fram till 1864*, [Stadsarkivet], [Stockholm], Stockholm: Liber Förlag, pp. 2-27

[257] Juuti, P. & Katko, T. (2005). *Water, time, and European cities: history matters for the futures*. WaterTime. Tampere, Finland, pp. 200; See also Cronström (1986).

cattle, was free of charge, as were water for firefighting, municipal baths, and the cleaning of streets. "Free" meant of course that the actual cost was paid by general taxation. Public buildings, hospitals, hotels, and factories, had to pay a fee and the fee was SEK 3 annually for a tap in a workshop and SEK 6 for a water closet. In the small municipality of Eksjö, water for a room with a fireplace cost SEK 2 annually and if you had a water meter, 1,000 liters cost 20 öre.[258]

In Sweden as a whole, the question on how to finance the operation of the water works after they had been built, was a troublesome issue in many towns. On strong argument was that if water had been extracted for public health reasons, and the most in need could not use it because of high fees, then nothing would have been gained. In Sundsvall and Gävle, for example, the municipalities decided to offer free water for personal use but took out a fee for commercial users. Eventually, partly because meters to measure individual water consumption became safer and more affordable, all waterworks implemented individual tariffs. Gävle had free household water from 1879 – 1949 and was the last bigger town in Sweden to introduce water tariffs.[259]

In the conclusions of this report I return to the financial issues which are an important difference between roads/streets and WS. Roads and streets have almost always been financed by general taxation (in one form or the other) while WS been financed by a combination of loans, taxation, and user fees.

In the table below the development of the first 30 years of piped water is summarized. The dominant source was surface water between 1860-1890. Only 7 of the 24 Water works used ground water. Household fees, based on number of rooms were used by 9 cities, one used a designated taxation (Malmö) and 13 did not charge anything, which again means that the bill was paid for by the collective of taxpayers.

Table 1: Construction of the first modern Swedish waterworks, 1860-1890[260]
Surface water (S) and/or groundwater (G). The water fee is for household consumption at the first years of service.

City/Years	***Source***	***Fee/year***
Stockholm 1858-61	S	2 kr/room
Karlskrona 1861-64	S	—
Jönköping 1864-65	S	2 kr/room
Malmö 1861-66	S	Taxation
Göteborg 1867-71	S	—
Landskrona 1869-74	G	—
Lund 1872-74	S	—
Norrköping 1872-75	S	—
Linköping 1874-76	S	3 kr/room
Uppsala 1874-75	G	—
Gävle 1874-76	S	—
Skövde 1875	G	1 kr/room
Sundsvall 1878-79	S	—
Borås 1881	S	—

[258] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, p. 99 ; See also: Andersson A. (1971). *Svenska vattenledningar och vattenreservoarer 1869-1910*, C-uppsats i konstvetenskap, Lunds universitet, Lund, Sverige.
[259] Winnfors E. (2008). *Sundsvall – vattenstaden*, p. 30-31, Ohlson & Winnfors. Örebro, Sverige; Winnfors Wannberg E. (2017). *Jakten på Gävles vatten*, p.60-61, 1. uppl. Ohlson & Winnfors. Örebro, Sverige.
[260] Adapted from Hallström (2003), pp. 336-337

Vänersborg 1882	S	—
Härnösand 1882-83	S	—
Helsingborg 1883	G	1 kr/room
Halmstad 1885-86	S	—
Örebro 1885-86	G	2 kr/room
Västerås 1887-88	G	2 kr/room
Växjö 1887	S	—
Eskilstuna 1887	S	3 kr/room
Karlstad 1888-89	S	2 kr/room
Mariestad 1889-90	S	?

Sourcing of raw water was of course important in the creation of the Swedish piped water systems. It seems to me that the water works were farsighted in their strategy to secure raw water resources. Already in the end of the 1800s, Malmö acquired land around Vombsjön, Sundsvall did the same at Sidsjön and Stockolm bought 80-90% of the land around Bornsjön. The general idea was to secure the so-called "rainfall area" surrounding the lakes to avoid pollution of the fresh water source. The same strategi has been used, and still is used, for ground water sources. Adding to this the water companies also acquired land for pipes and other installations. The land acquisition strategy is an important but under researched area.[261]

As mentioned above Leijonanker was opposed to private ownership of the Stockholm water works. He motivated his standpoint with earlier experiences in Great Britain where commercial interests in his opinion had failed miserably. Thus water works were considered public in stronger sense, including a demand on public ownership, in contrast to the earlier gasworks, that often were run by private companies in the beginning. In this respect the piped water system, although local and under the municipality, was more like the state-owned national railroad network planned and built in the same period.

Public ownership has lasted until this day and age. In the beginning of the twenty-first century, in tune with the prevailing zeitgeist, private ownership was investigated in in the plans to replace the Law on public water services (SFS 2006:412). But the investigation argued water and sanitation services was a basic need and a prerequisite for a satisfactory standard of living. WS was acknowledged as a *natural monopoly* and therefore not an area for private ownership and commercial interests. The municipal responsibility to provide for WS was placed in §6, and the law and was extended by including the environment as one criterion besides health and sanitary issues.[262]

Juuti and Hukka (2005) Juuti P., Katko T., and Hukka J. (2007) presents detailed facts about ownership in water and sanitation in an international perspective from the establishment phase up to the year 2000.[263] Their thorough historical comparison is too extensive to be fully accounted for in

[261] Persson, K. M. & Winnfors, E. (2007). *Malmö - den törstande staden*. Örebro: Ohlson and Winnfors, pp. 56-58; Winnfors, E. (2008). *Sundsvall - vattenstaden*. Örebro: Ohlson and Winnfors, pp. 48; Winnfors Wannberg, E. (2017). *Jakten på Gävles vatten*. 1. uppl. Örebro: Ohlson and Winnfors

[262] Söderholm, K., Vidal, B., Hedström, A., & Herrmann, I. (2022). *Flexible and Resource-Recovery Sanitation Solutions: What Hindered Their Implementation? A 40-Year Swedish Perspective*. Journal of Urban Technology, pp.8

[263] Juuti, P. & Katko, T. (2005). *Water, time, and European cities: history matters for the futures*. WaterTime. Tampere, Finland; Juuti P., Katko T., & Hukka J. (2007) *Privatisation of water services in historical context, mid-1800s to 2004* (pp. 235-257) in Juuti, P., Katko, T. & Vuorinen, H. (eds.) (2007). *Environmental history of water: global views on community water supply and sanitation*. London: IWA Publishing

this report. However, it can be noted that the first modern water systems often had builder-owner or concession models in European countries, and particularly in North America. In most cases, however, municipalities soon took over these water and sewerage systems. In the early 20th century, 93 per cent of the systems in German urban centers were municipal, as were all the urban WSS systems in Sweden and Finland. Thus in the 1920s municipal ownership argued by Leionanker in 1853, had become the dominating form of governance in WSS. This situation prevailed until mid-century when the Eastern bloc countries got state administrated systems after WW2. In the end of the 1980s England and Wales performed a full privatization of the systems and in Estonia, a partial privatization was made in Tallinn (2001). Since the early 2000s water and sewerage services have been managed by a single utility in most of European countries and cities.[264]

Did health improve by the introduction of piped water and sewage?

As been mentioned many times the piped water system in Stockholm, and later in other Swedish towns, was to a great extent motivated by health issues in line with arguments from the British sanitary movement. An interesting question for a historian would be if piped water, and later sewage, actually improved health. This is not as easy question to answer. It is true that Cholera never hit Stockholm after the introduction of piped water and it is also true that less children died in diarrhea, but to establish a clear causal relationship between piped water and better health is difficult. In the same period the sanitary, housing and food standard got better which also can explain improved health. Historian Fredrik Petersson has tried to clarify these issues by investigate how piped water spread over Södermalm in Stockholm during the period 1880-1920. He follows the gradual expansion of the network street by street and compare it with statistics on mortality in child diarrhea. A clear positive correlation is found. However, the improved child health is not only connected to the accessibility of larger quantities of water. Water quality, which improved greatly during the period, is of course also a decisive factor. The authorities in Stockholm realized this early on and built up an impressive chemical expertise in water testing of both chemical and bacteriological water quality.[265]

The relationship between mortality and sanitary measures was investigated in 1908 by the City District Physician in Helsingborg Med. Dr Carl Lindman. He stated that both morbidity and mortality had decreased substantially, which he attributed to the introduction of water mains, sewers, epidemic hospitals, the cleanliness statute, and food control. In Lindman's study, it was shown that mortality in the cities was about 40% higher compared to the countryside in the 1860s, and that by the beginning of the 20th century the differences were evened out. This despite the fact that mortality has also decreased in rural areas by nearly 20% (below Figure 1). Lindman stated that "had

[264] Juuti P., Katko T., & Hukka J. (2007) *Privatisation of water services in historical context, mid-1800s to 2004* (pp. 235-257) in Juuti, P., Katko, T. & Vuorinen, H. (eds.) (2007). *Environmental history of water: global views on community water supply and sanitation*. London: IWA Publishing; More on ownership and governance in an international perspective; Vinnaria, E. M. & Hukka, J. J. (2010) *An international comparison of the institutional governance of water utility asset management and its implications for Finland*, in Water Policy 12, 52–69; Dellapenna, J. W. & Gupta, J. (eds.) (2009). *The evolution of the law and politics of water*. Amsterdam: Springer verl.; Heino, O. & Anttiroiko, A-V. (2015) *Inverse infrastructures: self-organization in the water services* in Water Policy 17, 299–315; EurEau - Resources - Publications; The governance of water services in Europe, 2021: file (eureau.org); Europe's Water in Figures, 2021 edition: file (eureau.org)

[265] Petersson, F. (2005). *Vattnets vägar - från vik till innergård på Södermalm 1880-1920*. Stockholm: Center for Health Equity Studies (Chess), pp. 7-9, 62; For a general overview of the history of health measurements in WSS see: Heikki S. Vuorinen, *The medical identification of new health hazards transmitted by water* (chapter 32: pp. 489-500) in Juuti, P, Katko, T, Vuorinen, H (eds.) (2007). *Environmental history of water: global views on community water supply and sanitation*. London: IWA Publishing

the population in Sweden's cities during the years 1901-05 lived under the same hygienic conditions as during 1861-75, then during these years 60,000 people would have had to pay for the decay".[266]

Figure 1.1 Mortality, calculated as number of deaths per 10,000 and year, in towns and the countryside.[267]

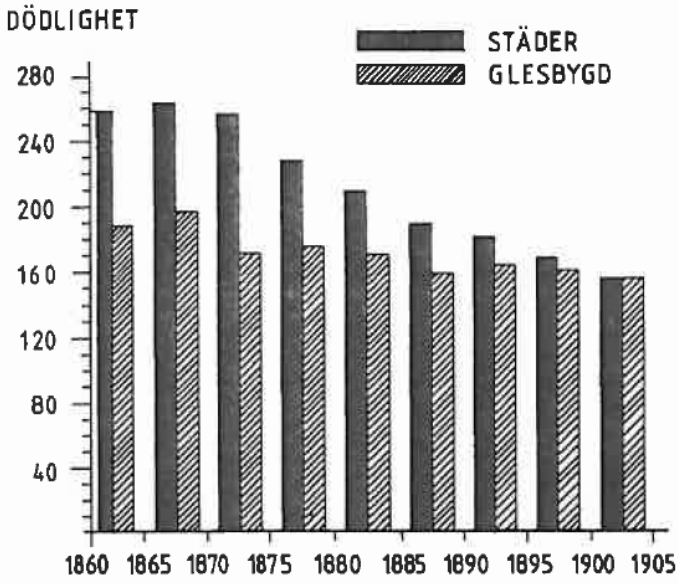

Fig 1.1 Dödlighet för befolkning i städer resp landbygd, 1860-1905.

Given these numbers it must still be noted that sanitary conditions, especially in the countryside, left a lot to which for, way up into the first half of the twentieth century. The already mentioned author and journalist, Ludvig "Lubbe" Nordström made a reportage trip for Swedish radio in collaboration with the Swedish Medicines Board in 1938. His findings were not optimistic on the hygienic situation, and he coined the term "Dirt-Sweden" (Lortsverige) to describe the filthy and unsanitary conditions people still lived under. Nordström´s description of the miserable sanitary status became very influential for the future expansion of WSS. Interestingly, the large impact of Nordström´s message was due to another infrasystem that by this time could reach most Swedes simultaneously, the wireless radio. [268]

The introduction of piped water and sewage improved health and sanitary conditions in Swedish towns and municipalities. But the control of water provision and the disposal of foul substances in underground pipes also had cultural consequences and ramifications. Historian Tobias Osvald (2002) puts the control of the "flows" in a wider perspective like this: "Finally, the flows have become so restrained and so tightly controlled that they increasingly cease to be part of the disorder, a process that is finally completed with the introduction of the public sewer from the 1860s onwards

[266] Bäckman, H. (1984). *Avloppsledningar i svenska tätorter i ett historiskt perspektiv. Göteborg: Chalmers tekniska högskola. Meddelande nr 74,* p. 1
[267] Figure 1.1 used with permission: Bäckman, H. (1984). *Avloppsledningar i svenska tätorter i ett historiskt perspektiv. Göteborg: Chalmers tekniska högskola. Meddelande nr 74,* p. 1
[268] Nordström , L. (1941) *En dag i mitt liv*, cited in Blomkvist P. & Kaiser A. (1998). *Den konstruerade världen: Tekniska system i historiskt perspektiv.* Brutus Östlings Bokförlag Symposium. Stockholm, Sverige, pp. 7; Sverker Sörlin: Ludvig Nordström i *Svenskt biografiskt lexikon* (1991): https://sok.riksarkivet.se/sbl/Presentation.aspx?id=8333

…continuous flows were regulated away and the street became more important than the yard in maintaining sanitary order. These practices had a part in shaping not only the Stockholm we know today, but generally the kind of urban space where flows of impurity have been built away in principle entirely…In the cities we move through today, flows are tightly controlled. Material ones, pure or impure, are buried or closed, while immaterial information flows are increasingly airborne and invisible. The ephemeral is generally ruled out or strictly assigned to selected occasions and places, such as outdoor dining, festivals, markets, and the like. Nor is it acceptable to mix up different forms of activity, such as business and living. For better or for worse, this is regulated by such things as detailed plans, permitting authorities and a complex of rules."[269]

Introducing piped sewage (WSS)

In hindsight it seems a bit strange the water and sewer pipes were not built at the same time. Presumably the town did not dare to venture into another large-scale undertaking. The prevailing view was that not before the moment the water main had reached its full extent, and only then, the surplus funds could be "used for the construction of pipes for receiving and discharging overflow or impurity water".[270] It would take until the middle of the 1870s, before sewer networks got any significant expansion, first in Stockholm and then spreading throughout the country. Many of the smallest towns did not introduce piped water until the 1920s and even later embarked on a sewage network. [271] However there is one interesting example of the opposite. Luleå, a small city in the far north of Sweden planned a network piped sewage before water mains. In Luleå the large river running through the town was considered sufficient for drinking water and sanitation issues were seen as more pressing.[272]

Liejonanker however, was clear about the need and realized the work was only half complete, sooner or later, sewer pipes must be laid down. In 1862 he put this argument to the board of directors of the water works and in 1864, he was hired to design a sewer system in parts of the Stockholm.[273]

In 1866 Lejonanker presented his plan, but it was rejected by the city council. The council admitted that piped sewerage would be beneficial for public health but argued that the project was to new, insecure, and unfamiliar in Sweden, the decision had to be postponed until more knowledge and experience could be obtained regarding this type of systems. [274]

It was not until 1872 that the first sewage pipes were installed in the city center and the piped system slowly started to reach the whole of Stockholm. These first pipes let out all the dirty water directly into the surrounding recipients. In the beginning the sewage was mainly used for so-called grey water. The bucket arrangement for latrine collection prevailed for a long time and was not really gone until the 1940.s and lasted longer still in smaller towns and on the countryside.

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[269] Osvald, T. (2022), *Stadens gränsplatser: Kungliga Poliskammaren och vardagens omstridda rum i Stockholm, 1776–1835*, Acta Universitatis Upsaliensis, Diss. Uppsala : Uppsala universitet,Uppsala, pp. 286-287; 294
[270] Cronström, A.(1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 94-120
[271] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 60
[272] Söderholm, K . (2007) *Uppbyggnaden av Luleås VA-system vid sekelskiftet 1900. En djärv "miljö"-satsning i en tid av teknisk och vetenskaplig omdaning*, Research report, Luleå tekniska universitet, 2007:13, pp. 26-27.
[273] Höjer, T. (1967), *Sockenstämmor och kommunalförvaltning i Stockholm fram till 1864*, [Stadsarkivet], [Stockholm], 1967, p. 270-287; 436-453; Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 2-27
[274] Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 94-120

More generally also in other Swedish towns apartments in multifamily houses began to be equipped with kitchen drains in the 1860s, and the urine from the so-called floor exits (urine sorting toilets) was collected in a porcelain pot that was emptied into the kitchen drain (later a pipe for the urine was connected directly to the drainpipe in the floor). An economic reason for separating the urine was simply that the latrine barrel filled much more slowly which reduced the need for emptying (urine makes up about 90% of the volume of a person's excrement, however the value of as a fertilizer also diminishes).[275]

Although the water closets were part of the debate and had many proponents in the 1890s, they were still unproven challengers to the more traditional service arrangements (the bucket collection). The Stockholm city council and the finance board, who were now in charge of the water works and the piped system, were opposing WC while the municipal health board approved. This made the expansion of WC very slow.[276] In 1895 Stockholm had only around 40 houses with this convenience installed, a number that had risen to around 1 500 in 1904, the year when the restrictive attitude was somewhat loosened. However, it was not until the new sewage plan of 1909 that WC was fully allowed. When the ban was lifted, WC installations spread fast and the connection to the piped sewage system took off. By the 1910s, the water closet system had become an integrated and generally accepted system for sanitation, if not yet fully realized, in Norrköping and Stockholm, as well as in the rest of Sweden." [277] The new national health care act of 1919 confirmed the development and advocated that "…to meet the said purposes public water and sewer lines be constructed."[278] Gothenburg also had its WC-debate in the 1890s. The town´s leading actor in water and sanitation J G Richert expressed a clear opinion. He stated that the water flushing toilet was a "hygienic axiom", in other words something self-evident not needing further justification, and that counter arguments, like the fear of pollution, was exaggerated. In any case the positive hygienic qualities of the WC outweighed possible negative effects.[279]

Björkman (1984) using statistics from the Swedish Association of Municipal Engineers discuss how many of the cities' built-up plots were equipped with an underground sewage line, respectively equipped with a WC. Note that latrine collection could occur for a large part of the population in smaller communities and towns right up to the 1940-1950s. The towns and communities included in the statistics in 1922 (98) had a variation of built-up plots equipped with underground sewage pipes between 55% and 100%. Corresponding figures for plots with WC varied, with a few exceptions,

[275] Drangert, J-O., Nelson, M. C., & Nilsson, H. (2002). Why Did They become Pipe-Bound Cities? Early Water and Sewerage Alternatives in Swedish Cities, *Public works management and policy*, **6**(3), 172-185

[276] The medical expert las Sondén was engaged in the matter of WC and wast water contamination of recipients: Sondén, K. (1889), Stockholms afloppsvatten och dess inflytande på vattendragen kring staden. Bihang till Stockholms stads helsovårdsnämnds årsberättelse 1888; Sondén tror inte att avloppsvatten i någon högre grad kan kontaminera recipienterna. Han ändrar sig dock senare (se Cronström, s. 133-135): J G Richert hävdar i 1909 års avloppsplan att det vore önskvärt om alla avloppsledningar byggdes så att de i framtiden kunde utrustas med reningsanordningar för kloakvattnet. Mot detta vände sig Sondén (1910): Han hävdade att det skulle komma att dröja lång tid innan avloppsvattnet skulle komma att innebära några betydande bekymmer. Sondén ändrade åsikt 1930 och förordade mekanisk rening då det var "ofrånkomligt att rena kloakvattnet från simmande orenlighet och slam.."

[277] Drangert, J-O. & Hallström, J. (2003). Den urbana renhållningen i Stockholm och Norrköping: från svin till avfallskvarn?, *Bebyggelsehistorisk tidskrift*. **44**, 7-24.

[278] Drangert, J.-O., Löwgren, M., (2005). *Förändring eller kontinuitet?: faktorer som påverkat va-systemens utveckling i Linköping och Norrköping under perioden 1960–1990*. Chalmers tekniska högskola, Göteborg, pp 10; Pettersson, R. (2008). *Bekvämlighetsrevolutionen: Stockholmshushållen och miljön under 150 år och i framtiden*. Stockholm: Stockholmia, pp. 76-85

[279] Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg, Göteborgs VA-verk, pp. 105

between 0 and 30%. In 1927, most of the communities had less than 3 meters of sewage pipes per person. Djursholm, the affluent suburb of Stockholm, on the other hand, had about 10 m/p. [280]

The 1909 sewage plan for Stockholm presented by the head of the street department, C J Gimberg, included so called “cutting lines” that took care of storm water, and the building of new sewer outlets farther out from the city and its harbor. In 1925, it was decided to draw out part of the existing outlets to even deeper water. The plan of 1909 and the following adjustments did not really solve the problem with pollution of the water recipients. After 1925, the sewers were buried deeper and the discharges ended up a below the water surface instead of directly on the surface, but this did not help much. It became gradually more obvious that one could not any longer discharge the city's sewage completely untreated.[281]

In 1930, a new plan for Stockholm’s sewerage was presented. It came to be known as the “Sewage bible” with the official title “Proposals for devices for the purification of wastewater in Stockholm”. It was the beginning of a large scale planned sewage network in Stockholm including sewage treatment plants. However, the plan only aimed at purification of the wastewater from the inner-city area and a few suburban areas. The newly built residential areas in Bromma got their and the city's first treatment plant in Åkeshov in 1934. A complete plan for the city's sewage treatment was therefore not presented in the proposal.[282]

The 1953 "General plan for the treatment of Stockholm's wastewater", approved by the city council in 1954, became the basis for the city's continued sewage planning. The plan primarily aimed to capture all the city's wastewater and release it after biological treatment. In addition, the plan presented the necessary collection lines, in the form of tunnels and pumping stations. In connection the rearrangement of collection pipes for both the inner city and the outer areas, efforts were made to divert stormwater from streets and parks directly into the waterways to thereby reduce the inflow of stormwater in the sewage collection pipes.[283]

The example of Stockholm to build underground piped sewage, was soon followed by other towns in the following decades: 1860s: Gothenburg; 1870s: Helsingborg and 8 other towns; 1880s: 21 towns; 1890s; 23 towns; and 1900: 18 towns.[284]

As will be discussed later, which can be seen in Table 2, the domination of combined sewers was almost total during the first 30 years of sewer construction in Sweden (only Karlstad built separate sewers). [285]

Table 2: Construction of the first modern Swedish sewer systems, 1860-1890
Combined (C), separate (S)

City/Years	***Sewer***
Stockholm 1866-1900	C
Göteborg 1868-88	C

[280] Bäckman, H. (1984). *Avloppsledningar i svenska tätorter i ett historiskt perspektiv. Göteborg: Chalmers tekniska högskola. Meddelande nr 74, p*p. 9-16
[281] Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 94-120
[282] Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 94-120
[283] Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 94-120
[284] Drangert, J-O., Nelson, M. C., & Nilsson, H. (2002). Why Did They become Pipe-Bound Cities? Early Water and Sewerage Alternatives in Swedish Cities, *Public works management and policy*, **6**(3), 172-185 (pp. 173 ff); Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 94-120
[285] Adapted from Hallström (2002), pp. 336-337

Norrköping 1872-74	C
Linköping 1874-75	C
Uppsala 1874-75	C
Sundsvall 1878-79	C
Borås 1881	C
Härnösand 1883	C ?
Örebro 1885-88	?
Jönköping 1885-86	?
Västerås 1887-88	C
Karlstad 1888-89	S
Mariestad 1889-90	C
Lund 1890	C

Chapter 9: Water and sanitation in the twentieth century

Two new contextual factors: Environmental concerns and the focus on sustainability

In this section I briefly discuss two additional contextual factors affecting the articulation of publicness in WS from the first half of the twentieth century: first, environmental concerns due to pollution and second, a growing focus on sustainability.

The section builds on a periodization of legislation in three *generations*, from the beginning of the 1800s until today introduced by Christensen (2015). Even though Christensen´s focus is on *environmental* legislation, his timeline fits well in my account of modern water and sanitation history and the articulation of publicness. The different generations of environmental law are characterized by their most important aspects:[286]

- *Sanitary aspect/Health Care aspect*. From the beginning of the 1800s, the culprit in the drama was not primarily emissions from treatment plants, but from individual drains that did not meet even basic purification requirements.
- *Pollution aspect/Environmental aspect*: In the beginning of 1900, attention was paid to watercourse pollution and fish death. The supply of nutrients, mainly nitrogen and phosphorus, led to what we know today as eutrophication or eutrophication. Major culprits were leather processing industries and the cellulose industry.
- *Re-cycling aspect/Sustainability aspect*: In the beginning of the 1980s, in the wake of the Brundtland report in 1987, people increasingly began to realize the extent that the availability of natural resources is not infinite. The need of recycling and reusing has been strengthened, which not least applies to society's exploitation of the element phosphorus.

Following Christensen (2015), laws and regulations in water and sanitation can be described, in more general terms, as originating in the healthcare statues of the 1860-70s, followed by a focus on environment and pollution from the 1940s. The third generation was related to the national Environmental Code of 1999 which points to sustainable management of natural resources, reuse and recycling of energy and nutrients (in the wastewater). It must be noted though that the term

[286] Christensen, J. (2003) *Enskilda avlopp – miljöbalken har ändrat de rättsliga förutsättningarna* in Michanek, G. & Björkman, U. (red.) (2003). *Miljörätten i förändring: en antologi*. Uppsala: Iustus, pp. 5-7; Christensen, J. (2015). *Juridiken kring vatten och avlopp. En översiktlig genomgång av juridiken kring dricksvattenförsörjning samt avledning och rening av spillvatten och dagvatten*. Havs- och vattenmyndighetens rapport 2015:15, chapter: 1.3

"generation" can be a bit misleading as it signals three separated historical periods; that the earlier generation dies when the new one is born. This is not the case, which is also acknowledged by Christensen, quite the contrary, the earlier factors affecting water and sanitation are still very much alive. The next generation simply adds new contextual factors and today, these three generations of legislation have merged into the environmental code's regulatory system: "Old regulations, which were based on the needs that existed in the old local community, must be combined with regulations aimed at reducing climate impact and that all water bodies in the EU must achieve good status. This means that what may look like a preconceived system of laws and regulations is in fact the result of many legislative actions over a long period of time." [287]

Following from this, the first "generation" would be equivalent to what I have described above: water and sanitation articulated as a public domain in relation to the five contextual factors culminating in the sanitary movement and the Health care act of 1874. And, as mentioned, health motives for public WS did not disappear.

Some health-related regulations for wastewater handling were in fact already visible in the 1868 Ordinance Statute (1868:22), but in the 1874 Health Care Charter, which primarily applied in towns, health, water, and sanitation was firmly connected. Municipal authorities, trough the mandatory Health Board, were obligated to arrange for the disposal of wastewater and a responsibility to supervise the quality of drinking water (also in the countryside). These regulations were transferred to the 1999 Environmental Code.

The new Sanitary Charter of 1919 was also based on health and sanitary motives. It confirmed the articulation of publicness, by stating that modern sanitary measures included public water and sewage systems. The 1919 health care charter was replaced by the 1958 health care charter, which was in effect until 1983 when the Health Protection Act (SFS 1982:1080) came into force, which was in turn replaced by the Environmental Code of 1999.

From the 1955 Public Water and Sewage Works Act, it was clear that piped water and sewerage in urban areas was a central part of municipal obligations due to health and sanitary reasons. The law clarified the municipality's obligations to provide piped WS. The law of 1955 was revised in 1970 (1970:244) and replaced by the Public Water Services Act (2006:412) and again in 2023 (with the same number).

Simultaneously, as the health aspects of water and sanitation legislation were developing, the pollution of the environment because of untreated wastewater became evident. The emissions from individual drains as well as from industries, such as leather processing industries and the cellulose industry, clogged up water courses, killed fish and led to eutrophication due to an oversupply of nutrients, mainly nitrogen and phosphorus.

Environmental concerns were in fact present already in the so-called 1915 Ditching Committee preparing the 1879 Ditching Act, but it was until 1942 that environmental issues were included in water legislation, in an amendment in the 1918 Water Act. As discussed, legislators had so far focused on sanitary aspects, but the new rules aimed at protecting the environment. This change in attitude came quite late concerning that political debates and scientists had since long called for measures on environmental protection due to water pollution from sewage. In 1956, requirement

[287] Christensen, J. (2015). *Juridiken kring vatten och avlopp. En översiktlig genomgång av juridiken kring dricksvattenförsörjning samt avledning och rening av spillvatten och dagvatten*. Havs- och vattenmyndighetens rapport 2015:15, chapter: 1.3

for further purification than only sludge separation was introduced and 1964 the rules were further tightened by introducing special protection for drinking water sources.

In 1969, the new Environmental Protection Act was introduced. This legislation was the first in water and sanitation that dealt with both health and environment issues in combination. However, there was still some regulation left in the 1958 health care charter, and later in the 1982 health protection act, but through the 1999 Environmental Code all regulations have been brought together.

The requirements in Environmental Protection Act of 1969, together with the introduction of state subsidies, led to the initiative to build large treatment plants all over Sweden dealing with primarily with purification of phosphorus. These initiatives meant that large-scale sewage related problems basically disappeared in Sweden, even though eutrophication is still a problem. The largest contributor concerning eutrophication is probably agriculture although individual, private sewage solutions also contribute with quite large discharges.

The second contextual factor affecting (late) twentieth century articulation of publicness in water and sanitation (which would be Christensen's third "generation") was of course *sustainability*. From the beginning of the 1980s, and especially after the publication of the so called Brundtland report in 1987, the belief in infinite availability of natural resources was torpedoed and the need of recycling and reuse was emphasized. In WSS, the rise of sustainability, and "circular economy", as driving forces for public engagement, has led to a focus on housekeeping off resources in sewage as well as in a focus on water conservation. It is perfectly clear that our present-day concerns for global warming effects and an upcoming climate crisis, has strengthened the sustainability arguments and made it even more urgent to reuse and circulate resources as well as to reduce emissions and energy use.

In WS legislation sustainability became the fundament for the Environmental Code of 1999: "The Environmental Code requires that consideration must also be given to the management of natural resources as well as the reuse and recycling of e.g. energy and nutrients. The intention is to create cycles of natural resources, with the aim of both reducing emissions and reducing the need to extract natural resources.[288] The importance of these issues was strengthened with the Swedish adoption of EU directives. For example, the EU has through the seventh environmental action program, committed all its members to resource management and a circular economy.

Thus: in the post-war period and onwards, the public commitment was articulated through the environmental issue, it simply become too dirty, which led to the massive expansion of large treatment plants. Then, in the late 90s, publicness was articulated through resource cycles and sustainability. This discussion did not give so many concrete results but gained momentum during the first part of the 21st century with global warming.

WSS on a national scale

When public water mains in were built in Stockholm 1861 the town and got continuous access to water as a means of transport with meant the possibility for modern sewage systems, i.e. underground pipes in a sufficient slope to be self-purifying (which since the 1840s had been built in Europe's largest cities).[289] The reason to put sewerage in pipes was that the old gutters were not sufficient to drain the cities anymore, waterlogging and clogged ditches causing stench and

[288] Christensen, J. (2003) *Enskilda avlopp – miljöbalken har ändrat de rättsliga förutsättningarna* in Michanek, G. & Björkman, U. (red.) (2003). *Miljörätten i förändring: en antologi*. Uppsala: Iustus, pp. 5-7
[289] Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 94-120

inconvenience became common problems. Based on simple hydrological principles, what came into the system must get out. Now, when even more wastewaters had to be disposed, the old sewers were inadequate.

As Hallström (2203) notes: "The sewers would transport dirt, "matter out of place," to its rightful place, the river, which, in its turn, would clean or dilute the dirt, or finally send it to the immense sea, where it would disappear. The rationale of the sewer system was thus perfectly logical to the actors, both in its theory and practice: it freed the city of harmful substances, and the running water of the river purified them, thus restoring the categories and the social order."[290]

As mentioned, in Stockholm WC-connection was allowed to the piped sewage system in 1909 and the revised and national health care act of 1919 confirmed the development and stated that modern sanitary measures included public water and sewer systems. From this year it is evident that piped WS in urban areas was indeed a central part of municipal obligations (SFS 1919:566) "The pipe-bound system can thus be considered to have consolidated its leading position and thereby Sweden also had its first clearly stated water and sewage strategy." [291]

During the interwar years more and more towns built piped water systems and after WW2 this development also reached the countryside.[292] The motive was to include rural areas into the Swedish welfare society and an important feature was a widespread expansion of WSS starting in the early 1930s, with the help of national funding in the form of relief work was issued by the National Unemployment Commission: "Water and sewage works constituted a central part of the national relief works and could represent as much as 90–100% of the total construction costs."[293]

However, this expansion happened under the general water law from 1918, which did not really include water and sewage systems. These areas were covered in the first national comprehensive legislation specifically addressing public water and sewage: The 1955 Act on public water and sewage facilities (SFS 1955:314). [294]

In the state investigation preparing the act of 1955 the investigators confirm my thesis that water and sewage has primarily been a private and not a public matter in a historical perspective:

"The water and sewage issues have only become the subject of more detailed regulation from the public's side only relatively recently. No uniform regulation at all has been achieved, but the regulations have been announced in various contexts in health care, planning and water legislation as well as certain other statutes… In the countryside, the WS conditions are different than in the

[290] Hallström, J. (2003). Constructing a Pipe-Bound City: A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910 (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 93
[291] Drangert, J.-O., Löwgren, M., (2005). *Förändring eller kontinuitet?: faktorer som påverkat va-systemens utveckling i Linköping och Norrköping under perioden 1960–1990*. Chalmers tekniska högskola, Göteborg, p. 13; Avlopp | Helsingborgs stadslexikon
[292] Söderholm, K.,(2012). *When Infrastructure-related Risk-taking Moves from the Local to the National Level: The Planning and Construction of Centralized Water and Sewer Systems in Two Municipalities in Northern Sweden 1900–1950*. Research report. Luleå University of Technology; Söderholm, K. (2013). Governing socio-technical transitions: Historical lessons from the implementation of centralized water and sewer systems in Northern Sweden, 1900–1950, *Environmental Innovation and Societal Transitions*, **7**, 37-52.
[293] Söderholm, K. (2013) Governing socio-technical transitions: Historical lessons from the implementation of centralized water and sewer systems in Northern Sweden,1900–1950, *Environmental Innovation and Societal Transitions,* **7**, *37– 52.*
[294] 1955:314, Lag om allmänna vatten- och avloppsanläggningar; given Stockholms slott den 3 juni 1955; SOU 1951: 26, 1946 års vatten- och avloppssakkunniga (1951). *Vatten- och avloppsfrågan: utredning och förslag*. Stockholm: Nordiska bokhandeln; Prop. 1955_121 med förslag till lag om allmänna vatten- och avloppsanläggningar, mm.

cities. It was not long ago that the WS question in rural areas was invariably considered the sole concern of the individual property owner."[295]

The investigation strengthens the impression of scattered regulations from many fields of law and a patchwork of many stakeholders in WS. The act on public water and sewage facilities sets out to remedy this and to create a sound juridical base for WSS.

They conclude that older regulations such as the act of order from 1868 and the 1874 health act has failed to put WS in its right place: Not even the revised act of 1919 gets free from criticism because it lacks regulations where a municipality can be forced to "…carry out WC facilities. The lack of regulations to this effect may lead to doubt as to whether such an obligation exists. …Nowadays, however, it is generally considered that municipalities can, with the support of the reproduced provisions in the health care charter, be ordered to carry out water and sewage facilities, if so called for by sanitary conditions. "[296]

The new law clearly stated that it was a municipal obligation to provide for water and sanitation and the state investigation argues that there is "…no reason to differentiate between sewage and water supply facilities with respect to the municipality's obligations. Within a city-planned area, the sanitary interests in general cannot be satisfied satisfactorily without common water facilities." [297] This was the first time in the history of water and sanitation that publicness was clearly articulated in legislation together with a municipal responsibility provide.

The general principles laid down in the law on public water and sewage facilities from 1955 is still valid today although the law has been revised in 1970 (1970:244) and replaced first in 2006 with the new law on public water services and later in 2022 with a revised law on public water services.

Water and sewage systems grew fast in Sweden during the first half of the twentieth century; the total pipe-length increased from about 3 500 km to 10 000 km, and even more up until the 1980.s. This physical growth was of course coupled with increased numbers of users, but also because of increased public investments and the forming of institutions and organizations supportive of the system, all contributing to system inertia. [298]

The movement towards centralized municipal WSS had its ideological roots in the growing conservation and environmental movement that viewed safe water as a human right and WSS as the solution. Söderholm (2013) finds the connection between environmentalists and WSS "…a bit paradoxical given that a key explanation behind this movement was the increasing wastewater pollution of Swedish watercourses from the increased use of WCs in urban areas in the early 1900s; as late as the mid-1930s, only 11 out of 111 Swedish cities treated its wastewater. In addition, industrial emissions also increased. Hence, water pollution became increasingly troublesome over the first half of the 20th century, especially in nearby towns, with dying fish and generally

[295] SOU 1951: 26, 1946 års vatten- och avloppssakkunniga (1951). *Vatten- och avloppsfrågan: utredning och förslag*. Stockholm: Nordiska bokhandeln, pp. 83 and 106
[296] SOU 1951: 26, 1946 års vatten- och avloppssakkunniga (1951). *Vatten- och avloppsfrågan: utredning och förslag*. Stockholm: Nordiska bokhandeln, pp. 83
[297] SOU 1951: 26, 1946 års vatten- och avloppssakkunniga (1951). *Vatten- och avloppsfrågan: utredning och förslag*. Stockholm: Nordiska bokhandeln, pp. 88.
[298] Cettner, A., Söderholm, K., & Viklander, M. (2012). An adaptive stormwater culture? Historical perspectives on the status of stormwater within the Swedish urban water system. *Journal of urban technology*, **19**(3), 25-40. p. 30 (1944 års Kungörelse angående statsbidrag till anläggningar för vattenförsörjning och avlopp)

contaminated water supplies and public beaches."[299] Nevertheless, environmental concerns became very important in the Swedish society and in relation to WSS.

The expansion of WSS in Sweden was also influenced by a municipal reform in 1952 that merged and reduced the number of municipalities from around 2 500 to about 1 000. This move gave the now larger municipalities increased planning capacity for undertakings such as centralized and big WSS. An important tool for the state were grants and subsidies for the improvement of infrastructure. After the Second World War, state grants were introduced on a larger scale for the expansion of the water and sewage pipes of cities and larger communities (SFS 1946:287 and 1948:441). The maximum contribution was 75% of the construction cost. The state, via the Swedish Environmental Protection Agency, started a program for water provision in the countryside in the late 1960s. aiming at environmental improvements. By now, the urban WS networks were largely completed. The state subsidy during 1970s primarily concerned improvements to protect surface and groundwater and the expansion of wastewater treatment plants targeted at phosphorus reduction. Economies of scale lead many municipalities to connect sewage from areas in the city's surroundings to a central purification plant and since transmission lines would still be buried, it was advantageous to lay down water pipes at the same time, thus centralizing both water and sewage. The state subsidies ended in 1980, when the expansion was completed.[300]

According to Cronström the general Swedish history of sewerage in can be divided in these periods:[301]

- 1910: no purification necessary
- 1930: Mechanical but not biological purification
- 1953: Mechanical and biological purification, but not nutrition salt separation
- 1970: Mechanical and biological purification as well as phosphorus separation

To sum up, there were ideological, environmentalist and economic motives for municipalities to push for centralized solutions. With the help of government subsidies and optimistic assessments of population growth, large, expensive sewage treatment plants had been built which meant that cost comparisons between a new, possible smaller, local plant and subsidized transmission lines to a central plant came out even. The investment made in a central solution had a decisive influence, a so-called lock-in effect, on the choice of subsequent investments. Also, in the 1960s and 1970s, actors shared mental images and visions of large scale, "big is beautiful" WSS that had a very strong influence in the sector. Large scale WSS was a new and exciting a field for planners at ministries, the Swedish Environmental Protection Agency, county boards and municipal politicians, and engineering consultants designing the large-scale solutions. The technical and the political elite had a common project.[302]

Before moving on to the next section highlighting that even though large scale WSS and "big is beautiful" certainly had an almost total impact, it did not reach all parts of the country. Sweden still

[299] Söderholm, K. (2013). Governing socio-technical transitions: Historical lessons from the implementation of centralized water and sewer systems in Northern Sweden, 1900–1950, *Environmental Innovation and Societal Transitions*, **7**, 37-52, pp. 44

[300] Drangert, J.-O., Löwgren, M., (2005). *Förändring eller kontinuitet?: faktorer som påverkat va-systemens utveckling i Linköping och Norrköping under perioden 1960–1990*. Chalmers tekniska högskola, Göteborg, pp. 16-18; Mårald, E. (2002). Vårt bästa guld: Agrara perspektiv på urban teknik från 1800-talets mitt till dagens kretsloppssamhälle. *Bebyggelsehistorisk tidskrift*. **44**, 25-38.

[301] Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 94-120

[302] Drangert, J.-O., Löwgren, M., (2005). *Förändring eller kontinuitet?: faktorer som påverkat va-systemens utveckling i Linköping och Norrköping under perioden 1960–1990*. Chalmers tekniska högskola, Göteborg, pp. 72-74

has many off-grid and "pre-modern" WS arrangements. Furthermore, the centralized system was also criticized. During the 1980s and 90s there was a heated debate on reuse of resources in wastewater, such as urine diversion and sludge as fertilizers in agriculture. It is wort noting that Sweden was a pioneer in the field of resource-oriented solutions in sanitation. But these pioneering attempts failed, and the reasons were mainly connected to the inertia of the existing system. It was very hard to change the direction of a large infrastructural system to optimize the recovery of resources when it was originally designed to improve urban hygiene and to control water pollution.[303] The history of reuse and resource in sanitation is described like this by Vidal (2022): "Sweden is an interesting case in the context of resource-oriented sanitation because the country was an early pioneer of urine diversion and there has been relatively strong political awareness of alternative sanitation solutions…However, the implementation rates have been slow. The centralization of the Swedish sanitation system (based on sewers for mixed wastewater connected to a main WWTP) is continuously expanding…(and)…that the centralization of areas with local or no municipal sanitation was generally the preferred option. A large-scale technological system, such as the centralized sanitation system, is the overall result of many, long-standing incremental changes, decisions, and efforts…the extensive "lock-in" of the centralized sanitation solution was due to strong national policy intervention for a major, long-term upgrading and development of the sanitation system. A major overall motivation for expansion of the centralized sanitation system in the 1970s was to relieve small local receiving waters of inputs from inadequate and malfunctioning private on-site sanitation systems, and to adapt to increasing treatment requirements."[304]

Pre-modern and off-grid never disappeared.

In the evolution of an infrastructural system for water and sanitation in Sweden there is one untold story. The account given so far might give the impression that the WS infrasystem is totally dominant, comprehensive, and covering all parts of the country. And it is certainly true that we can see a development from privately managed WS arrangements to public municipal infrastructure, the articulation of publicness is loud and clear. Nevertheless it is very important to note that large parts of the countryside did not get access to piped water until way up into the 1970.s. As the investigation on the first national water service law in 1955 stated: "The water and sewage issues have only become the subject of more detailed regulation from the public's side only relatively recently. No uniform regulation at all has been achieved, but the regulations have been announced in various contexts in health care, planning and water legislation as well as certain other statutes… In the countryside, the WS conditions are different than in the cities. It was not long ago that the WS question in rural areas was invariably considered the sole concern of the individual property owner."[305]

As discussed in the chapter on roads and street history, there is a big portion of the Swedish road network, civic roads, that are managed by private property owners living close to the road according to the old mode of road keeping based the pre-modern "interest and utility" principle. But still, civic roads are quite well aligned with the public infrasystem and to some extent controlled by the state road administration. This is not entirely the case in water and sanitation, where local level and off-

[303] Söderholm, K., Vidal, B., Hedström, A., & Herrmann, I. (2022). Flexible and Resource-Recovery Sanitation Solutions: What Hindered Their Implementation? A 40-Year Swedish Perspective. *Journal of Urban Technology*.
[304] Vidal, B. (2022). *Small Sanitation Systems – Treatment Efficiency, Sustainability and Implementation* (PhD dissertation, Luleå University of Technology), pp. 54-56; Söderholm, K., Vidal, B., Hedström, A., & Herrmann, I. (2022). Flexible and Resource-Recovery Sanitation Solutions: What Hindered Their Implementation? A 40-Year Swedish Perspective. *Journal of Urban Technology*.
[305] SOU 1951: 26, 1946 års vatten- och avloppssakkunniga (1951). *Vatten- och avloppsfrågan: utredning och förslag*. Stockholm: Nordiska bokhandeln, p. 83 and 106

grid service arrangements are less aligned to the public WS system. However, even if they are off-grid and not technically connected to the infrasystem, there are public rules and regulations mainly concerning environmental issues that must be considered.

Before going further on small-scale WS in Sweden it can be noted that in Finland cooperatives seems to be the preferred form of organizing decentralized water and sanitation. In an interesting article on alternative "paradigms" in WS governance Hukka and Katko (2009) points to Finnish experiences with its long tradition of cooperatives operating in rural and smaller urban settings for decades. There are approximately 1500 water and wastewater cooperatives in Finland. Denmark has some 2500 water cooperatives. Cooperatives can be found also in the US and since a long time in Latin America. [306] The actual number of cooperatives in Sweden is probably small. The preferred organisation seems to be a joint property unit/community association (Samfällighet) just like in civic road keeping. A study focusing on the archipelago in Norrtälje, north of Stockholm (Roseen, 2020) claims that there are approximately 9 000 of these community organizations in Sweden.[307] Water communities, once formed, have the same powers as civic road communities. But the most important difference is that an individual property owner cannot force other residents to join the formation of a community organization for water or sanitation. Everyone is free to cater for themselves if they can show that the individual arrangement for WS provision can be managed safely regarding health and environment.[308] This legal disparity strengthen the thesis that water and sanitation has a weaker articulation of publicness than roads/streets. WS is still largely a private matter.

Returning to the question of pre-modern and off-grid, Sweden still has a large part of its population still depending on private arrangements for water and sanitation. These, what might be called *pre-modern* WS arrangements, are still to a high degree still present and consists of private property owners arranging for their own off-grid WS solutions. In Sweden´s well-developed WS-system with around 1,5 million properties connected to the municipal water and sewerage grid, almost 1 million properties, of which around 450-500,000 leisure properties are not connected. [309]

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[306] Hukka J. & Katko T. (2009). Complementary paradigms of water and sanitation services: lessons from the Finnish experience. In Castro E. & Heller L. (eds). *Water and Sanitation Services: Public Policy and Management,* (pp. 153-172). Eartscan, pp. 164; Seppälä O. & Katko T. (2009). Management and organization of water and sanitation services: European experiences. In Castro E. & Heller L. (eds). *Water and Sanitation Services: Public Policy and Management,* (pp. 86-103). Eartscan.

[307] Roseen, P. (2020) Rapport: Erfarenheter och analys från förvaltning av VA-samfälligheter. Vatteninfo Sverige AB, Rapport: GEMVA 1, Norrtälje 2020.

[308] Personal communication with Uno Jakobsson, REV (210629)

[309] This section builds on Nygren, J., & Hjort, P. (2020). Master thesis, supervisor Pär Blomkvist, *Systemuppbyggnad och entreprenörskap från grunden: "off- grid" vatten- och avloppslösning på Värmdö* ("*System development and entrepreneurship from below*: "off- grid" water and sewage solution at Värmdö"). See also: Avlopp (naturvardsverket.se); Avloppshantering och miljömålsarbetet (naturvardsverket.se); HAV: Havs- och vattenmyndigheten. (2013). *Styrmedel för en hållbar åtgärdstakt av små avloppsanläggningar*: https://www.havochvatten.se/hav/uppdrag--kontakt/publikationer/publikationer/2013-09-13-styrmedel-for-en-hallbar-atgardstaktav-sma-avloppsanlaggningar.html ; Grönvall, A. (2018). *Vägar till hållbara vattentjänster* [SOU 2018:34]. Stockholm: Elanders Sverige AB; Olshammar, M., Ek, M., Rosenquist, L., Ejhed, H., Sidvall, A., & Svanström, S. (2015). *Uppdatering av kunskapsläget och statistik för små avloppsanläggningar* (Rapport Nr 166 2015). SMED, Sveriges Meteorologiska och Hydrologiska Institut; Söderholm, K., Vidal, B., Hedström, A., & Herrmann, I. (2022). Flexible and Resource-Recovery Sanitation Solutions: What Hindered Their Implementation? A 40-Year Swedish Perspective. *Journal of Urban Technology*; Schulte-Herbrüggen, H. M. A., Christensen,

The private character of drinking water and sanitation/sewage is still a reality and public authorities accept their existence, especially concerning drinking water from private wells where regulations on water quality certainly exists but they are not as forceful as rules for private sanitation/sewage arrangements. In fact the public control of private wells is almost non-existent according to informants. [310] The reason for the difference in attention and the view that drinking water quality is up to the individual – still not articulated as a fully public responsibility – is because private sanitation arrangements can possibly contaminate ground water sources, i.e. the well of your neighbor, and at the same time pollute nearby water courses and recipients. According to the environmental law (SFS 1998: 808), the owner of a sewage facility has an obligation for proper maintenance to protect the environment.

Although hard to estimate, around 25% of Sweden's one million small-scale private sewage facilities lack adequate treatment processes. This means that approximately 250 000 small scale and private sewage arrangements do not meet the requirements placed by legislation.[311] Other estimations paint an even bleaker picture. An inventory (in 2008) in the municipality of Värmdö, close to Stockholm, of 10% of the approximately 20 000 off-grid sewage arrangements, showed that 30% of the property owners failed in their management their installations. [312]

The Ordinance on environmentally hazardous activities (FMH 1998:899), § 12 states: "It is prohibited to discharge wastewater from a water toilet or densely populated areas, into a water area, if the wastewater has not undergone further purification than sludge separation. However, what is said in the first paragraph does not apply if it is obvious that such a release can be made without risk of inconvenience to human health or the environment."

Discharging WC sewage without more extensive treatment than only sludge separation is illegal only if the discharge takes place into a water area. Discharge of only sludge-separated WC sewage is therefore legal if it is done to the ground, provided that no risk of nuisance arises.

The crux, then, is how to define the concept of *water area.* I have no opportunity or sufficient expertise to determine what is right or wrong in this debate. But it can be stated that opinions differ among experts in small drains. According to authorities, 25% of the small sewers lack more advanced treatment, which everyone agrees upon, but there is not the same agreement on the question of whether this would mean that they also are illegal. [313]

Instructions on how to build small drains were available from the 60s onwards.[314] They dealt exclusively with land-based facilities, i.e. purification using the soil. The focus of instructions from

J., Olofsson, B., Morey Strömberg, A. (2022). *Dricksvatten från små dricksvattenanläggningar för privat bruk*. Livsmedelsverkets externa rapportserie. Livsmedelsverket, Uppsala, 2022.

[310] Based on personal an email conversations 23-04-12 and 13 with Björn Eriksson, editor on small scale sewage at the journal *The water and sanitation guide* (VA-guiden), bjorn.eriksson@vaguiden.se www.vaguiden.se

[311] Nygren, J., & Hjort, P. (2020). Master thesis, supervisor Pär Blomkvist, *Systemuppbyggnad och entreprenörskap från grunden: "off- grid" vatten- och avloppslösning på Värmdö* ("*System development and entrepreneurship from below*: "off-grid" water and sewage solution at Värmdö; Söderholm, K., Vidal, B., Hedström, A., & Herrmann, I. (2022). Flexible and Resource-Recovery Sanitation Solutions: What Hindered Their Implementation? A 40-Year Swedish Perspective. *Journal of Urban Technology.*

[312] Söderholm, K., Vidal, B., Hedström, A., & Herrmann, I. (2022). Flexible and Resource-Recovery Sanitation Solutions: What Hindered Their Implementation? A 40-Year Swedish Perspective*. Journal of Urban Technology,* 15.

[313] Personal email conversation with Peter Ridderstolpe, 2023-05-28; Corroborated by Jonas Christensen

[314] The following is based on personal an email conversations 23-04-12 and 13 with Björn Eriksson, editor on small scale sewage at the journal *The water and sanitation guide* (VA-guiden), bjorn.eriksson@vaguiden.se www.vaguiden.se

the 1960s-1980s is on construction and construction and the chronology of public involvement looks like this:

- "Sewage investigation 1950s: Investigations concerning small sewage plants. The state's public investigations 1955:18
- "Royal Road and Water Works Board - Small Sewage Works: Royal Road and Water Works Board 1962, No. 8, Small Sewage Works.
- "Small Sewer Facilities 1974 Guidance and description of technology for small sewers (SA, infiltration and soil bed) from 1974.
- Special print from the National Environmental Protection Agency's (SNV) publication 1974:15, 3rd edition. Small sewage plants – Treatment of wastewater from individual properties
- Nordic Council of Ministers and SNV 1985 Infiltration of wastewater. Infiltration of wastewater - Conditions, function, environmental consequences. Nordic joint report The Environmental Protection Agency informs. Nordic co-production - Environmental Protection Agency Nordic Council of Ministers, 1985
- The Swedish Environmental Protection Agency's general advice (1987) 87:6: Small sewage plants - Domestic wastewater from no more than 5 households (AR 87:6), Often called "the blue book", apply to the design of conventional infiltration facilities and soil beds (has been replaced by Factsheet 8147, with the same content).

The requirements for the off-grid sewage were rooted in health protection and the starting point was that sewage treatment was to be solved with the help of soil retention. A protective distance was specified, especially to wells. When the soil was unsuitable (too permeable or too dense), it could be a question of mini sewage treatment plants and sometimes a closed tank for WC (however, most commonly for holiday homes). During the 1980s state authorities put the purification processes in the small-scale sewage under scrutiny and especially with the environmental law from 1999, the eutrophication problem was addressed in relation to off-grid sewage. This turn towards environmental issues was due to The Baltic Marine Environment Protection Commission, also known as the Helsinki Commission (HELCOM) and its Baltic Sea Action Plan from 1974 where Sweden agreed to map and remedy nutrient leakage into the Baltic Sea to protect the marine environment from all sources of pollution. It was signed in 1974 by all Baltic Sea coastal countries, seeking to address the increasing environmental challenges from industrialization and other human activities and that were having a severe impact on the marine environment.[315] The mapping at a national level resulted in a new attitude towards small scale sewage. The emissions from these installations were compared to emissions from municipal treatment plants and off-grid sewage was pointed out as an important source of eutrophication of the Baltic sea. The debate focused on the fact that nobody really knew how many small sewage facilities existed and that their technical status was unclear. The industrial organization, Swedish water stated that the Swedish works had a high degree of purification of phosphorus and that it would result in unreasonable marginal cost of purifying more. The farmers organization (LRF) claimed that agriculture basically had done everything reasonable. Thus, in many cases off-grid arrangements were at the center of attention when it came to combating eutrophication. The Swedish Environmental Protection Agency initiated large projects to draw attention to small sewage and overfertilization and launched an inspection campaign called “Small scale sewage – no nonsense” (Små avlopp – ingen skitsak).

[315] https://helcom.fi/

The Agency also published new general advice on small drains in 2006. It specified basic requirements and introduced the concepts of normal and high protection levels, for either environmental protection or health protection. For health protection, the previous attitude was maintained (the advice from 1987) that the sewage release must not mean an increased risk of the spread of infection and the protective distances were maintained. For environmental protection, recommended reduction rates were formulated, like the requirements for the large sewage treatment plants. The advice from 2006 recommended that a facility in the so-called normal level of protection should be able to remove 70% of total phosphorus during its lifetime. For small scale and off-grid arrangements, this level is considered quite high. Furthermore, as mentioned, it was in also 2006, when the new national water law was accepted, replacing the law of 1977, that environmental protection was firmly established as a criterion alongside individual health as a foundation for public engagement in water and sanitation.[316] In fact, environmentally motivated regulations continued to put higher demands on both on and off-grid sanitation. Requirements for the treatment of wastewater have increased from the mid-1970s following the heavy expansion of sewage plants between 1965–1975 and government subsidies for high-grade biological and chemical treatment.[317] In an interesting article Söderberg et.al. (2022) investigates the history of alternative sewage solutions in Sweden since the 1980.s. Resource recovery such as urine separation and usage of fertilizers from sewage sludge has been in focus. The authors conclude that, although many promising attempts, alternative sanitation solutions have met lots of resistance, mainly due to the inertia of the existing system: "The inherent inflexibility of the centralized sanitation system is further explained by the difficulties to optimize the recovery of resources from a system originally designed with a different purpose, i.e., to improve urban hygiene and to control water pollution." [318]

To conclude, the articulation of publicness in off-grid water and sanitation was quite weak until environmental concerns and especially eutrophication of the Baltic sea was put high on the agenda in the end of the 1990s. Since then the local arrangements, especially in sewage, has been a topic for much debate in municipalities around Sweden, especially concerning environmental demands put on off-grid sewage. This is not the place for, and I do not have the expertise to, determine who is right and wrong, but there are actors claiming that municipalities place excessive demands on treatment in individual sewers and that the fear for are eutrophication exaggerated. The argument is that soil retention in most cases takes care of the phosphorus content. [319]

The water and sanitation system today

Water provision and sewerage (WSS) is presently regulated by the Public Water Act (until recently SFS 2006:412 and in a revised version from 1st January 2023. It states that the municipalities have the responsibility for the whole "water cycle": from the water source via purification, distribution, use, wastewater treatment and return to recipients.[320] However, it is important to point out that it is not a responsibility throughout the country, but only in those areas where "for environmental or

[316] Söderholm, K., Vidal, B., Hedström, A., & Herrmann, I. (2022). Flexible and Resource-Recovery Sanitation Solutions: What Hindered Their Implementation? A 40-Year Swedish Perspective. *Journal of Urban Technology*, 8.
[317] Söderholm, K., Vidal, B., Hedström, A., & Herrmann, I. (2022). Flexible and Resource-Recovery Sanitation Solutions: What Hindered Their Implementation? A 40-Year Swedish Perspective. *Journal of Urban Technology,* 8.
[318] Söderholm, K., Vidal, B., Hedström, A., & Herrmann, I. (2022). Flexible and Resource-Recovery Sanitation Solutions: What Hindered Their Implementation? A 40-Year Swedish Perspective. *Journal of Urban Technology*, 1.
[319] Personal mail conversation with Peter Ridderstolpe, Tekn. Lic. Applied Ecology, Senior consultant at Water Revival Systems (WRS), Uppsala, Sweden: https://www.lansstyrelsen.se/vastra-gotaland/om-oss/vara-tjanster/publikationer/2009/markbaserad-rening.-en-forstudie-for-bedomning-av-kunskapslage-och-utvecklingsbehov..html; https://wrs.se/projekt/markretention-rapport/
[320] Svenskt Vatten (2017), *Lagen om allmänna vattentjänster 10 år – Svenskt Vattens förslag på vidareutveckling och förbättring;* Svenskt Vatten (2019) *Vattnets kretslopp*.

health reasons it needs to be arranged in a larger context" according to § 6. In the 290 Swedish municipalities there are around 1 750 waterworks and just over 2 000 municipal sewage treatment plants.[321] In many cases municipalities cooperate over borders in municipal and even regional organization managing water and sewerage.[322] A majority of the 290 Swedish municipalities manage water and sanitation in a separate municipal administrative unit (61%). A minority 3% has a municipal WS company, 14% run multi-utility organizations where WS and other services such as electricity are managed jointly. About a quarter of the municipalities (22%) manage their water and sanitation systems in cooperation with other municipalities.[323]

Below is a list of the most important legal acts concerning water and sanitation (Christensen, 2015):[324]

Swedish legal acts:

• **Environmental Code, 1998:808.**

o Ordinance (1989:899) on environmentally hazardous activities and health protection.

o The Environmental Assessment Ordinance (2017:966).

o The Water Management Ordinance (2004:660).

o Ordinance (1998:944) on prohibitions etc. in certain cases in connection with the handling, importation, and exportation of chemical products (section 20).

o Waste Ordinance (2020:614).

o The Environmental Supervision Ordinance (MTF 2011:13).

o Ordinance on self-control (1998:901). o Announcement with regulations on the control of discharges to water and land recipients from facilities for the treatment of wastewater from urban areas, Swedish Environmental Protection Agency SNFS 1990:14.

o Proclamation with regulations on protection of the environment, especially the soil, when sewage sludge is used in agriculture, the Swedish Environmental Protection Agency SNFS 1994:2.

o Announcement with regulations on the treatment of waste water from urban areas. Swedish Environmental Protection Agency SNFS 1994:7.

o The Environmental Protection Agency's regulations on environmental report NFS 2006:9.

o Ordinance (2001:554) on environmental quality standards for fish and mussel water. o Bathing water regulation (2008:218)

• **Act (1998:812) with special provisions on water activities. o Ordinance (1998:1388) on water operations.**

[321] Avloppssystemet - Tekniska museet
[322] Samarbeten i kommunförbund (Erik Winnfors) + Maria Hubinette /RISE – ta kontakt)
[323] Svenskt Vatten, *VA-organisationen*, https://www.svensktvatten.se/vattentjanster/organisation-och-juridik/vaorganisationen/ ; VA-organisationen - Svenskt Vatten
[324] Christensen, J. (2015). *Juridiken kring vatten och avlopp. En översiktlig genomgång av juridiken kring dricksvattenförsörjning samt avledning och rening av spillvatten och dagvatten*. Havs- och vattenmyndighetens rapport 2015:15, chapter: 1.3

• Planning and Building Act (2010:900). o Planning and building ordinance (2011:338).

• Act on public water services (2006:412; revised from January 1st 2023).

o Ordinance (2007:701) on public water services.

• Construction Act (1973:1149).

• Act (2003:778) on protection against accidents.

o Ordinance (2009:956) on flood risks.

• Food Act (2006:804).

o Food Ordinance (2006:813).

o The Swedish Food Agency's regulation (LIVSFS 2022:12) on drinking water.

Legal acts from the EU:

• The sewage directive. Implemented primarily through the MB (ch. 9) and the environmental review ordinance (MPF 2013:251).

• The Drinking Water Directive (EU) 2020/2184/ LIVSFS 2022:12)

• The framework directive for water. Implemented mainly through MB (ch. 2 and 5) and regulation (2004:660) on management of the water environment.

• The priority substances directive. Implemented through the regulations of the National Maritime and Water Authority.

• Groundwater Directive.

• The Flood Directive. Implemented by regulation (2009:956) on flood risks and the Swedish Agency for Public Safety and Emergency Preparedness regulations (MSBFS 2013:1) on risk management plans.

• Bathing water directive Implemented through the National Maritime and Water Authority's regulations and general advice (HVMFS 2012:14) on bathing water.

• "To live well within the limits of the planet". The EU's seventh environmental action program.

The WS system is not as well aligned and cohesive as the road system. There is no central system builder at the state level and vertical integration is quite low. The WS system is not as well aligned and cohesive as the road system. There is no central system builder at the state level and vertical integration is quite low. Again WSS does not exhibit a strong *vertical integration*. (Blomkvist and Larsson, 2013; Blomkvist and Nilsson, 2017) Instead we see a development towards *horizontal integration* where municipalities has created horizontal linkages and formed inter-municipal bodies. (Alm, et.al, 2021; Alm and Paulsson, 2023)

The list below is not complete but gives a picture on the many stakeholders in WSS: [325]

[325] Christensen, J. (2015). *Juridiken kring vatten och avlopp. En översiktlig genomgång av juridiken kring dricksvattenförsörjning samt avledning och rening av spillvatten och dagvatten*. Havs- och vattenmyndighetens rapport

- The municipal water and sewage department/company
- The municipal environmental division (overseer)
- The municipal planning and housing development division
- The municipal roads and streets division
- The County (Länsstyrelsen)
- The national environmental agency (Naturvårdsverket)
- The ocean and water authority (Havs- och vattenmyndigheten)
- The Swedish Food Agency (Livsmedelsverket)
- The Public Health Agency (Folkhälsomyndigheten)
- The land surveyor (Lantmäteriet)
- Sweden's Geological Survey (SGU)
- Sweden's Municipalities and Counties (SKL)
- The Swedish Meteorological and Hydrological Institute (SMHI)
- Swedish water (Svenskt vatten)

The many stakeholders in water and sewage are also reflected in laws and regulations. As mentioned, we have the general Public Water Act (SFS 2006:412) as the juridical foundation which regulates larger sewage systems and their areas of operation, individual sewers can be found in the Environmental Code (MB), SFS 1998:808 and in the regulation on environmentally hazardous activities and health protection (FMH), SFS 1998:899. Other areas are covered by the Planning and Building Act (PBL), SFS 1987:10 and the Construction Act, SFS 1973: 1149, the Environmental Protection Act, the Health Protection Act, The EU Wastewater Directive (1991), the Environmental Code (1999) and the EU Drinking Water Directive (2020).[326]

Concerning sewage the organizational responsibilities look like this (text from Avlopp (naturvardsverket.se):

The Swedish Environmental Protection Agency is responsible for guidance on sewage plants that are sized from 200 pe and up, sewage plants that are sized for up to 200 pe but which are burdened by wastewater from operations where the wastewater is neither domestic waste water nor waste water whose content is comparable to domestic waste water and storm water. In addition, the Swedish Environmental Protection Agency is the responsible authority for guidance regarding dry toilet solutions regulated by § 40 FMH as well as waste and cycle issues linked to waste related to "small" sewage plants. The Swedish Environmental Protection Agency is also an expert in sewage issues in EU work and decides on grants for stormwater efforts and efforts for advanced purification.

The Swedish Sea and Water Authority provides guidance on "small" sewage plants for domestic wastewater and are designed for up to and including 200 pe as well as "small" sewage plants that are designed for up to 200 pe and which are not burdened by waste water from homes or service facilities, but where the content of the waste water is still comparable to domestic waste water.

2015:15; Christensen, J; Palmér Rivera, M; Johansson M, (2008) *Planera VA! Rättsregler för kommunal VA-planering.* Länsstyrelserna i Skåne, Stockholm och Västra Götaland

[326] Interview Jonas Christensen and Christensen, J. (2015). *Juridiken kring vatten och avlopp. En översiktlig genomgång av juridiken kring dricksvattenförsörjning samt avledning och rening av spillvatten och dagvatten*. Havs- och vattenmyndighetens rapport 2015:15; Christensen, J; Palmér Rivera, M; Johansson M, (2008) *Planera VA! Rättsregler för kommunal VA-planering.* Länsstyrelserna i Skåne, Stockholm och Västra Götaland

County Administrative Board

The County Administrative Board is the supervisory authority for the large sewage treatment plants, i.e. treatment plants subject to a permit according to the environmental assessment regulation (2,000 PE or more).

In cases where the county administrative board has delegated supervisory responsibility for sewage facilities in the county to the municipalities, the county administrative board has a responsibility to provide the municipalities with supervisory guidance regarding sewage treatment plants. Five county administrative boards are appointed by the government to be the water authority in each of their water districts. The water authorities are responsible authorities for management plans and action programs and for deciding on environmental quality standards.

The municipality

The municipalities are the supervisory authority for sewage plants designed for less than 2,000 pe. The municipalities can also be the supervisory authority for sewage treatment plants for 2,000 pe or more if the county administrative board has delegated the supervisory responsibility.

It is easy to see that the regulations on water and sanitation, in the words of researcher and environmental lawyer Jonas Christensen (2003), is a "patchwork". There is no clear logic governing legislation and some rules from the middle of the twentieth century and earlier still are overlaid by recent EU regulations and directives.[327]

It is obvious that the multifaced and non-coherent appearance of WSS is because water and sewage touch upon so many sectors in society. What is lacking is a state level system builder responsible for the "local water and sewage cycle". The *local* cycle in WSS cannot be left to the municipalities, especially not the small ones.

Chapter 10: Thematic discussions on water and sanitation

The system builders and technical development in WS and WSS

In water and sanitation we do not see a clear central system builder role compared to roads and streets. As been shown the state and municipal authorities had the ambition and they surely tried to manage sanitation, but most often their efforts were fruitless. In water provision public involvement has been less apparent and came later. We still do not see a state level system builder in WS.

This historical heritage, I would argue, influenced the way modern water and sewage was introduced in the second half of the nineteenth century and onwards. Lacking a clear public agenda and a recognized state system builder or system operator, the field was open for commercial municipal engineers and consultants interested in infrastructure to act in a field of unclear public positions.

Furthermore, Sweden did not have any real knowledge on WS-construction within its borders and technical know-how was, as been indicated, imported from Great Britain. In the second half of the nineteenth century though, "in-house" expertise was built up and it was done mainly three persons: Wilhelm Leijonancker, of course (1819–1883), Josef Gabriel Richert (1828–1895) and his son Johan Gustaf Richert (1857–1934). They were all involved in a majority of Swedish WS projects in the late

[327] Christensen, J. (2003) *Enskilda avlopp – miljöbalken har ändrat de rättsliga förutsättningarna* in Michanek, G. & Björkman, U. (red.) (2003). *Miljörätten i förändring: en antologi*. Uppsala: Iustus, p. 5.

1800.s, establishing domestic water and sewage system expertise. This led to a teaching position in water conduit, sewage, and waterpower at the Royal Institute of Technology in Stockholm from 1898, held by Johan G. Richert, who in 1903 was appointed the first professor in water construction in 1903.[328]

In fact, Sweden had no higher education for engineers until the mid-19th century: "For instance, the engineers who participated in the construction and building of canals such as the famous Göta Canal, completed in 1832, were often, in a sense, self-taught. 1846 these conditions changed, when the Technological Institute of Stockholm (Teknologiska institutet) was reorganized and given resources for scientific higher education. It was renamed the Royal Institute of Technology (KTH, Kungliga tekniska högskolan) in 1877. The Royal Corps of Civil Engineers (Kungliga Väg- och vattenbyggnadskåren), had been founded some years earlier, in 1851, and it consisted of the first Swedish engineers with higher technical education, either from the military academy at Marieberg or the Technological Institute. Their task was to assist in large public works such as canals and railroads, as well as to supervise the military engineering in times of war. As Sweden did not take part in any wars, the Corps was almost entirely dedicated to *civil* engineering in the true sense." [329]

Johan G. Richert was influential also in the technical consulting business. In 1902 he started the Water works agency (Vattenbyggnadsbyrån/VVB) which was to become Sweden's largest consultancy firm in municipal engineering and waterpower. Engineers as the three mentioned above, VBB and other technical consultant had an enormous influence in establishing large scale WSS in Sweden already from the start but even more so in the big boom of WSS after World War two (later in the report).[330] In a recent dissertation historian Karolina Wiell (2018) also underscores the importance of the municipal engineers and their successful strategy to transform sanitary issues from the medical to the technical domain.[331]

The organization that became most influential, and in fact can be seen as the system builder of sorts in WSS, was the Swedish Association of Municipal Engineers. As mentioned, it was founded in 1902 by high-ranking engineers in municipal administrations in Stockholm, Gothenburg and Gävle and very soon other municipal engineers from Sweden's larger towns joined the ranks. Membership grew from 97 members in 1902, to 330 in 1925, and to 675 in 1950. [332]

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[328] Tjulin, R. (2002). *I kommunalteknikens intresse: svenska kommunal-tekniska föreningens verksamhet under 100 år.* Master thesis, KTH, Stockholm, supervisor Pär Blomkvist; Tullgren, E. (red.) (2002). *Svenska kommunal-tekniska föreningen 100 år: [1902-2002]*. Stockholm (the master thesis by Tjulin is printed in this book); Söderholm, K. (2013). Governing socio-technical transitions: Historical lessons from the implementation of centralized water and sewer systems in Northern Sweden, 1900–1950. *Environmental Innovation and Societal Transitions*, **7**, 37-52, p. 42; Bjur, H. & Malbert, B. (1988). *Under staden: perspektiv på kommunal infrastruktur*. Stockholm: Statens råd för byggnadsforskning, pp. 30 ff

[329] Hallström, J. (2003) *Constructing a Pipe-Bound City: A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, p. 59

[330] Söderholm, K. (2013). Governing socio-technical transitions: Historical lessons from the implementation of centralized water and sewer systems in Northern Sweden, 1900–1950. *Environmental Innovation and Societal Transitions*, **7**, pp. 37-52; Drangert, J.-O., Löwgren, M., (2005). *Förändring eller kontinuitet?: faktorer som påverkat va-systemens utveckling i Linköping och Norrköping under perioden 1960–1990*. Chalmers tekniska högskola, Göteborg.

[331] Wiell, K. (2018*). Bad mot lort och sjukdom: den privathygieniska utvecklingen i Sverige 1880–1949*. Diss. Uppsala: Uppsala universitet, 2018, pp. 50; See also Cettner, A., Söderholm, K., & Viklander, M. (2012). An adaptive stormwater culture? Historical perspectives on the status of stormwater within the Swedish urban water system. *Journal of urban technology*, **19**(3), 25-40.

[332] Cettner, A., Söderholm, K., & Viklander, M. (2012). An adaptive stormwater culture? Historical perspectives on the status of stormwater within the Swedish urban water system. *Journal of urban technology*, **19**(3), 25-40, pp. 31; Tjulin, R. (2002). *I kommunalteknikens intresse: svenska kommunal-tekniska föreningens verksamhet under 100 år*. Master thesis, KTH, Stockholm, supervisor Pär Blomkvist Stockholm, 2002; Tullgren, E. (red.) (2002). *Svenska kommunal-tekniska föreningen 100 år: [1902-2002]*. Stockholm

The association of municipal engineers worked in many areas to disseminate knowledge on WSS construction and management. Perhaps their most important contribution has been their successful testing and standardization of pipes, construction methods, tariffs, etcetera and, not the least their efforts to provide statistics on all sorts of issues related to WSS. In 1962 water and sanitation related areas were transferred in the newly founded Swedish Water and Wastewater Works Association which today is called Svenskt vatten (Swedish Water), an industry organization which represents most of Sweden's municipal water and sewage departments and water service companies.[333]

Swedish Water is still the most important provider of knowledge in technology, jurisprudence, and management of WSS. Their influence relies on the fact that many municipalities are small and not able to build up their own expertise in the area. They simply must trust Swedish Water.

On their web page Swedish water introduce themselves like this:

"Svenskt Vatten is the industry organization for Sweden's most important food producers and environmental companies - the water and wastewater providers. Svenskt Vatten's vision is that Sweden has clean drinking water and healthy lakes and seas. We represent the interests of our members in national and international contexts. The water and wastewater industry are under strong pressure to change and is facing the biggest structural transformation since the '70s. Climate change, urbanization and developed regulations pose new demands. The role of water and wastewater operators in municipality planning is developing at the same time as our facilities need to be upgraded. We have a long history in acting at both national and at EU levels."[334]

I conclude by pointing out that WSS is very different from other infrastructures in Sweden with its lack of a state level system builder. The special dynamics of interest groups, technical expertise, commercial interest and state and municipal strategies in WSS deserves its own doctoral thesis.

As been touched upon above pre-modern WS technology for a long time had a distinct local character using manual labor to fetch water from wells, rivers or lakes and disposing of waste and excrement in cesspools, privy vaults or into street gutters. In larger towns so-called proto systems were tried but never really became a reality in the long run. Apart from institutional factors such as lack of organizational and financial capacity the piped proto systems had a crucial technical drawback: the main pipes were made of wood (a log with a drilled longitudinal hole) and smaller service pipes were often made of lead. According to Rosen (2015) discussing the situation in England, in the beginning of the industrial revolution sometimes steam pumps and iron pipes were applied "…but, up to the first decade of the nineteenth century the mains continued to be made chiefly of wood. It was the burgeoning iron industry that made possible a more extensive use of iron pipes." Gradually wooden pipes were replaced with cast iron pipes with socket joints were sealed with cast lead and in 1827 the use of iron was made compulsory in England. Despite these advances, inadequacies remained. Inefficient methods of jointing resulted in leakage and intermittent supply was common until well into the nineteenth century especially in poorer dwellings where a standpipe often was the source of supply for several houses. [335]

[333] Tjulin, R. (2002). I kommunalteknikens intresse: svenska kommunal-tekniska föreningens verksamhet under 100 år. Master thesis, KTH, Stockholm, supervisor Pär Blomkvist; Bäckman, H. (1984). *Avloppsledningar i svenska tätorter i ett historiskt perspektiv.* Göteborg: Chalmers tekniska högskola. Meddelande nr 74; https://www.svensktvatten.se/

[334] https://www.svensktvatten.se/globalassets/om-oss/in-english/svenskt-vatten-sustainable-water-services-2050.pdf

[335] Rosen, G. (2015). *A history of public health*. Rev., expanded ed. Baltimore, Md.: Johns Hopkins University Press, pp. 82; See also Isgård, E. (1998). *I Vattumannens tecken: svensk VA-teknik från trärör till kväverening*. Örebro: Ohlson and Winnfors; Hallström, J. (2003). Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal

Water quality improvements took a long time to develop. In many cases water came from polluted rivers and lakes. Purification technologies such as new methods to filter water with slow sand filters, originating in England around 1830, were gradually introduced. As already mentioned, the situation was similar in Swedish towns and when the piped water, and later, sewage systems were being introduced, most of the technical inspiration and know-how came from Great Britain. [336]

The expansion of the Swedish sewage systems took place until about the 1950s with a mixture of combined systems (wastewater and storm water in one pipe), separated systems (wastewater in pipes and storm water in ditches) or duplicate systems (wastewater and storm water in two pipes). According to statistics in 1942, 74% of 132 communities applied only the combined system. The combined system was preferred up until the 1950s, and in the 1960s became the norm, However, the rearrangement of combined systems was questioned in the 1970s and the Swedish Environmental Protection Agency wrote that the clean-up of sewage network does not necessarily mean that all combined lines must be separated. Today, the general sewage network consists of approx. 13% of combined pipes. But an extensive private service pipeline network is also connected to the public sewer network. The private drinking water network and wastewater system make up just over 20% and the private storm water network a full 78% calculated as km of pipeline.

Approaches to stormwater management gradually changed from the 1970s with the introduction of ideas of "Long-term sustainable stormwater management":

- Until 1975, the focus was only quantity problems and diversion to the nearest recipient.
- Between 1975 - 1995 attention was drawn to the fact that stormwater contained pollutants that needed to be taken care of.
- From 1995, the term "Gestaltning" was added with storm water as part of general urban planning.

Thus, in the Climate and Vulnerability Investigation (SOU 2007:60), the perspective for stormwater management was lifted from a "simple pipe issue" to an issue for "community planning". The realization was that pipe systems cannot fully handle extreme torrential events, so the diversion must take place in so-called downpour roads. Today, this is a generally accepted insight and there are many examples both in Sweden and abroad. Superficial downpour management is a prerequisite for being able to handle extreme weather. But there are many problems, for example that "no actor has full control over stormwater management" (more on this later).[337]

In the report I have not included the question of pipe material and the details in the work headed by the Swedish Association of Municipal engineers to standardize dimensions and construction techniques in the sewage systems. Likewise, I have not included the development of the so-called *Shaft-free* technology to renew the pipeline network starting in the 1970s and is now an extensive business for both water and sewage renewal. [338]

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in Norrköping and Linköping, Sweden, 1860-1910 (PhD dissertation). Linköping University Electronic Press, Linköping. (p. 16-17)

[336] Anderberg, S. (1986). *Stockholms vattenförsörjning genom tiderna*. Stockholm; Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg: Göteborgs VA-verk.

[337] Bäckman, H. (1984). *Avloppsledningar i svenska tätorter i ett historiskt perspektiv. Göteborg: Chalmers tekniska högskola. Meddelande nr 74,* pp. 27-32

[338] Personal communication with Hans Bäckman February 2023; For details: *Bäckman, H. (1984). Avloppsledningar i svenska tätorter i ett historiskt perspektiv. Göteborg: Chalmers tekniska högskola. Meddelande nr 74*, (chapter 3: ”Rör och fogmaterial 1900- ca. 1960”); Swedish Water: SVU 2011-14 Rörmaterial i Svensk VA-ledningar; On Shaft-free technology see: www.sstt.se; Bjur, H. (1988) *Vattenbyggnadskonst i Göteborg under 200 år*, Göteborg, Göteborgs VA-verk.

Technological path dependence in WSS

This section is a thematic deepening (with some repetitions) of the discussion above on technology in WSS, focusing on *technological* path dependence related to the building of combined sewer systems.

As been discussed earlier in this report: "Filth and stench were normal nuisances to be tolerated. But there was also concern, because medical opinion saw bad smells, in particular *miasmas* emerging from decaying organic matter, as causes of diseases. But no action was taken because health was seen as an individual responsibility. The shared conviction was that people had to take care of themselves." [339]

But all of this changed with the sanitary movement and industrialization. The rationale and general motivation for modern WS technology is characterized like this by Hallström (2003): "Faith in progress through science and modernization was great in the Western world in the late 19th century, and the cities in particular embodied this idea. Urban social, sanitary, and environmental problems, themselves to a great extent products of modern industrial society, were to be solved through health and building legislation, different preventive health measures, as well as "city improvement," that is, the application of modern technologies. Decreasing mortality rates seemed to confirm that this was the right path to tread." [340]

According to Tarr (1996): "The movement in nineteenth-century cities away from a localized and labor-intensive water-supply system to a more capital-intensive system that utilized distant sources took place primarily for four reasons in addition to population increase: [341]

- water from local sources used for household purposes was often contaminated, tasted and smelled bad, and was suspected as a cause of disease.
- more copious water supplies were required for firefighting,

[339] Geels, F. W., (2006): The hygienic transition from cesspools to sewer systems (1840–1930): The dynamics of regime transformation, *Research Policy*, **35**(7), 1069-1082, pp. 1073

[340] Hallström, J. (2003). *Constructing a Pipe-Bound City: A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 16-17; More on technology, combined sewers, and path dependence in WS: Halliday S. "Death and miasma in Victorian London: an obstinate belief", *British Medical Journal*, 2001 Dec 22-29;323(7327):1469-71; Halliday, S. (2001[1999]). *The great stink of London: Sir Joseph Bazalgette and the cleansing of the Victorian metropolis*. Stroud: Sutton; Halliday S. (2001), "Death and miasma in Victorian London: an obstinate belief", *British Medical Journal*, 2001 Dec 22-29;323(7327):1469-71; Halliday, S. (2001[1999]). *The great stink of London: Sir Joseph Bazalgette and the cleansing of the Victorian metropolis*. Stroud: Sutton; Hallström, J. & Melosi, M. V. (2022). *History of technological change in urban wastewater management, 1830–2010*. Routledge handbook of urban water governance, pp. 163-172; Hamlin, C (1992) Edwin Chadwick and the engineers, 1842–1854: systems and anti-systems in the pipe-and-brick sewers war. *Technology and Culture 33/1992 (4),* pp. 680–709; Jakobsson, E. (1999). Introduktion av WC i Stockholm: ett vattensystemperspektiv på staden. *Polhem*. **1999**(17), 2-4, pp. 118-139; Melosi, M.V., (2000). *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present.* Johns Hopkins University Press, Baltimore; Nilsson, D. 2011. *Pipes, progress, and poverty: Social and technological change in urban water provision in Kenya and Uganda 1895-2010*. PhD thesis. KTH, Royal Institute of Technology, Stockholm, Sweden; Porter, D. H. (1998). *The Thames embankment: environment, technology, and society in Victorian London*. Akron, Ohio: Univ. of Akron Press; Rosen, G. (2015). *A history of public health*. Rev., expanded ed. Baltimore, Md.: Johns Hopkins University Press, pp. 82; Söderholm, K, (2013) Governing socio-technical transitions: Historical lessons from the implementation of centralized water and sewer systems in Northern Sweden,1900–1950. *Environmental Innovation and Societal Transitions,* **7***, 37– 52*; Tarr, J. (1999). The separate vs. Combined sewer problem: a case study in urban technology and design choice. In Smith, D. (ed.), *Water-Supply and Public Health Engineering*. Ashgate Variorum, cop. Aldershot, United Kingdom.; Tarr, J. et al. (1984). Water and Wastes: A Retrospective Assessment of Wastewater Technology in the United States 1800-1932, *Technology and Culture*, **25**, 226-263; Tarr, J. A. (1996). *The search for the ultimate sink: urban pollution in historical perspective*. 1. ed. Akron, Ohio: Univ. of Akron press

[341] Tarr, J. A. (1996). *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective* (Technology and the Environment) [Elektronisk resurs]. University of Akron, pp. 182

- water was needed for street flushing at times of concern over epidemics; and developing industries required a relatively pure and constant water supply.
- In addition, rising affluence in the nineteenth century undoubtedly increased household demands for water.

When the piped water systems led more water into the cities the problem of getting rid of the wastewater got more acute, especially after the introduction of the flush toilet (WC). In general most cities, in Europe, the US and in Sweden piped sewage was introduced after the modern water provision: "The idea of using running water to carry off excreta had appeared at an early period…In the eighteenth century, water closets while no longer a novelty were still a rarity… However, the introduction of this amenity soon created more problems than it solved, since the cesspits were cleaned out very infrequently and the contents seeped out into the soil saturating the ground over large areas and polluting springs and wells used for water supply. Furthermore, it was deceptively easy to dispose of sewage by allowing it to discharge into the sewers that existed under many cities by this time. The only thing the matter with this solution was that the sewers were designed to carry off rainwater; in consequence, as the practice became more general, rivers and lakes in or near all the larger towns were turned into nothing less than open sewers. [342]

This process was common all over Europe and in Northern America. As in Stockholm urban sewers were for stormwater only and they became *combined* sewers when households continued to use them after the installation of running water and especially when water closets were used. The problems with installing WC were indeed discussed but the problems with its discharges still surprised most proponents of piped water works.[343] Thus, due to the historical legacy of already existing technology i.e. stormwater drainage, combined sewers for stormwater and wastewater/excrements became the norm.[344]

Seen as an infrasystem, modern sewage, in contrast to earlier privy vault–cesspool arrangements, were capital rather than labor intensive: "They operated in automatic fashion, almost eliminating the need for human decisions and actions to remove the wastes and offered greatly improved conditions of convenience, cleanliness, and the elimination of nuisance. And sewerage systems solved both the collection and transportation problems, moving the wastes in a wastewater stream from the immediate to a distant locality. Proponents of the system maintained that municipalities should adopt them primarily for three reasons: the capital and maintenance costs of sewerage systems would represent a saving over the annual cost of collection and cleaning with the privy vault–cesspool system; sewerage systems would create greatly improved sanitary conditions and result in lowered morbidity and mortality from infectious disease; and because of improved sanitary

[342] Rosen, G. (2015). A history of public health. Rev., expanded ed. Baltimore, Md.: Johns Hopkins University Press, pp. 83-84; One of few exceptions was Luleå, a town in the northern part of Sweden (and my home town) that built its sewage system before piped water: Söderholm, K., (2012). *When Infrastructure-related Risk-taking Moves from the Local to the National Level: The Planning and Construction of Centralized Water and Sewer Systems in Two Municipalities in Northern Sweden 1900–1950*. Research report. Luleå University of Technology.

[343] Tarr, J. A. (1996). *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*, *Technology and the Environment*, University of Akron, pp. 118-121; Jakobsson, E. (1999). Introduktion av WC i Stockholm: ett vattensystemperspektiv på staden, *Polhem*. Tidskrift för teknikhistoria, **17**(2-4), pp.118-139.

[344] From a technical perspective the wastewater pipes were "…mainly characterized by circular or egg-shaped sewers for *self-cleaning* sewerage, either with small, glazed earthenware pipes (circular) or larger brick sewers (egg-shaped)." Hallström, J. (2003). *Constructing a Pipe-Bound City: A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping. (pp. 16-17)

conditions, cities that constructed sewerage systems would attract population and industry and grow at a faster rate than those that did not." [345]

Also in London when the city constructed a sewerage system in 1858, based on the plan of Joseph Bazalgette, a combined sewage system was chosen. A separate system was rejected with the argument that storm water because of animal excrement was as much polluted as sewage and ought to be treated as such.[346] Bazalgette, Chief Engineer of the Metropolitan Board of Works designed a series of interconnecting sewers which carried the sewage eastwards away from the main centers of population to be dispatched on the outgoing tide. The Bazalgette plan also included the construction of embankments along large sections of the River Thames in central London. The embankments concealed the new sewers and acted as flood defenses.[347]

The combined sewers operated on the rationale of the theory of the self-purification of streams, that running water purified itself within a given distance..." and potential hazards resulting from the disposal of sewage in streams or lakes were often dismissed with the argument that "running water purifies itself." Up until the 1890 s, this hypothesis seemed confirmed by existing methods of chemical analysis of water quality. Except for specific localities with severe nuisance problems from sewage disposal, municipalities resisted installing sewage treatment facilities that promised to provide direct benefits only to downstream cities and instead relied on dilution to dispel the worst concentrations of pollutants. [348]

Tarr (1996) claims that the most common choice to process drinking water was to purify it when taken from the polluted recipient (sand filter, chlorine, etc.), rather than cleaning the wastewater before it ended up in the recipient: "Americans believed not only that technology was beneficial but also that nature and its resources were meant to be exploited for material benefit. This value originally derived from the frontier experience and was tied to the concept of progress, playing a central role in its formulation. As a value, it was associated with sewerage technology by the assumption that waterways could be utilized almost without restriction for waste disposal. The so-called scientific justification was that running water purified itself. As it turned out, this hypothesis was true only in a limited sense and under special conditions."[349] However the prefeed method was to discharge untreated wastewater and then purify drinking water intake. Tarr (1996) quotes American sanitary engineer Allen Hazen, who claimed that "a dollar spent in water purification goes much farther toward protecting a community from the dangers of sewage pollution in its potable water supply than a dollar laid out in sewage-treatment works.'' From 1900 into the 1920 s, the adoption of filtered water supplies proceeded at a much faster rate than the selection of technology for sewage treatment.[350]

The belief in self-purification of running water was dominant also in Sweden. The influential physician Klas Sondén investigated the water pollution in Stockholm in 1889 and concluded that that sewage would not contaminate the recipients to any greater degree. He was more concerned that

[345] Tarr, J. A. (1996). *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*, *Technology and the Environment*, University of Akron, pp.134
[346] Tarr, J. A. (1996). *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*, *Technology and the Environment*, University of Akron, pp. 136
[347] Halliday, S. (2001[1999]). *The great stink of London: Sir Joseph Bazalgette and the cleansing of the Victorian metropolis*. Stroud: Sutton; https://historicengland.org.uk/images-books/archive/collections/photographs/the-great-stink/
[348] Tarr, J. A. (1996). *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*, *Technology and the Environment*, University of Akron, pp. 118-121
[349] Tarr, J. A. (1996). *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*, *Technology and the Environment*, University of Akron, pp. 203
[350] Tarr, J. A. (1996). *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*, *Technology and the Environment*, University of Akron, pp. 126

high tides in the Baltic Sea would lead to saltwater penetration into Lake Mälaren and thereby contaminating the freshwater reservoir. Others as for example J G Richert argued in the 1909 Sewer plan that it would be desirable if all sewers were built so that they could be equipped with sewage treatment devices in the future. Sondén in 1910, turned against this view. He believed that it would be a long time before the sewage would cause any significant problems. Later, Sondén changed his opinion though and in 1930 advocated mechanical purification as it was "…inevitable to purify the sewage from floating impurities and sludge." [351]

The choice of combined sewars created a systemic lock-in and created a strong path dependence in water supply and sewerage. In the words of Hallström (2003): "A commitment to permanence . . . often locked in specific technologies and thus limited choices for future generations. Problems could arise if systems were either too well built or too poorly constructed. In the case of the former, an existing system could prove resistant to change; in the latter case, it might be in desperate need of replacement. Consequently, decisions made about sanitary systems in the nineteenth century had a profound impact on cities more than 100 years later."[352]

Systems culture in water and sanitation: a pipe bound mentality.

Building on the above-described movement towards large and centralized piped water and sewage facilities Cettner et.al. (2012) claims that problems in WSS today and especially concerning combined sewers for both excrement and latrine can be explained by institutional and technical path dependence (sunk costs) and by a "pipe-bound mentality" of actors within WSS: "…a "mental map" of the centralized water and sewer system as a piped, technological, underground, and obvious system." [353]

As mentioned, from the 1870s towns applied the logic of the old gutter-based sewers when building new underground pipes, because sewerage had always been meant to drain stormwater and to get rid of excess wastewater. Thus *combined* pipes (in contrast to separate pipes) became the most common design choice.[354] Furthermore WSS grew fast in the first half of the twentieth century and large-scale facilities became firmly established as the best solution in professional and political circles as well as in the environmental movement.

Thus, Sweden's environmental protection initiatives in the 1960s, contributed to system inertia because public funding was mainly directed towards sewerage. These funds for "…high-grade purification works in the 1960s and the 1970s implied far-reaching, lock-in effects in the sense that the funds (in combination with over optimistic population growth projections) implied the construction of large and expensive purification works, generally resulting in extensive excess capacity." The public funding created an expansion and an increased centralization of the piped

[351] Sondén, K. (1889), *Stockholms afloppsvatten och dess inflytande på vattendragen kring staden.* Bihang till Stockholms stads helsovårdsnämnds årsberättelse 1888; Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag, pp. 133-135; Jakobsson, E. (1999). Introduktion av WC i Stockholm: ett vattensystemperspektiv på staden, *Polhem*. Tidskrift för teknikhistoria, **17**(2-4), pp.118-139.
[352] Hallström refers to Matin Melosi: Hallström, J. (2003). *Constructing a Pipe-Bound City: A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping*, Sweden, 1860-1910 (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 45-46.
[353] Cettner, A., Söderholm, K., & Viklander, M. (2012). An adaptive stormwater culture? Historical perspectives on the status of stormwater within the Swedish urban water system. *Journal of urban technology*, **19**(3), 25-40, pp. 27
[354] Cettner, A., Söderholm, K., & Viklander, M. (2012). An adaptive stormwater culture? Historical perspectives on the status of stormwater within the Swedish urban water system. *Journal of urban technology*, **19**(3), 25-40, pp. 28; Söderholm, K. (2013). Governing socio-technical transitions: Historical lessons from the implementation of centralized water and sewer systems in Northern Sweden, 1900–1950. *Environmental Innovation and Societal Transitions*, **7**, 37-52, pp. 44

networks. Moreover, new legislations made centralized water and sewer system a central municipal responsibility and this became the accepted "Swedish water and sewage strategy." [355]

Cettener et.al. argue, building on Drangert and Löwgren (2005), that the extensive public funding and the many institutions, and organizations dependent on the existing system crated a strong inertia and a "self-sustaining systems culture" among the actors "...i.e., an agreed idea of proper design, operation, expansion, and management of the system. The system culture could be formed through the interaction and many times common educational institutions of the actors [356]

WS systems were quite open and flexible concerning design choices in the initial stages of construction at the end of the nineteenth century up to around the 1950.s. Thereafter centralized, and large scale WSS became increasingly more rigid and difficult to change, partly due to the large investments (sunk costs), the durability of the technical components in the system and, as mentioned because of the establishment of a system supporting social and political environment. All of this consolidated the centralized WSS as the Swedish water and sewage strategy and contributed to system inertia and lock-in. An inertia that was strengthened by the system culture of WSS, the pipe-bound mentality:

"The culture of the system became clear when the ideas of local disposal of stormwater began to emerge in Swedish government investigations in the 1970s, and even more so in connection with subsequent local initiatives to implement such ideas. Stahre (2008), as well as the international scholars Brown and Farrelly (2009), identify socio-institutional barriers among different stakeholders involved in the planning and implementation of the new ideas as the greatest challenges when it comes to tackling the slow pace at which these ideas are being implemented."[357] It seems as if Cettner et.al. has a strong point:

"As we have seen, a young, industrialized society tied stormwater management to a pipe-bound centralized water and sewer system. To achieve a more sustainable stormwater management program, municipalities must break away, both physically and mentally, from the traditional system and its culture. This process should recognize the two approaches to stormwater management—the nature-oriented and local solution (the sustainable approach) and the technically oriented and centralized solution (the traditional approach)." [358]

Furthermore, the storm water issue got looked-in by another institutional factor because roads/streets and WSS was managed by different organizations. In the 1940-50s municipalities tried to move away from the combined sewage system to some extent financed by the state and the Royal Roads and Waterworks Agency. However, the state subsidy was targeted at the drainage of municipal streets by using separate storm water pipes, but the grants did not include the associated service lines from municipal or private housing. This resulted in the hardened surfaces, such as rooftops, remained on the old sewer line. It is an interesting question if the design of the state subsidies can explain the fact that this so called "additional water" still burden the municipal

[355] Cettner, A., Söderholm, K., & Viklander, M. (2012). An adaptive stormwater culture? Historical perspectives on the status of stormwater within the Swedish urban water system. *Journal of urban technology*, **19**(3), 25-40, pp. 31-32
[356] Cettner, A., Söderholm, K., & Viklander, M. (2012). An adaptive stormwater culture? Historical perspectives on the status of stormwater within the Swedish urban water system. *Journal of urban technology*, **19**(3), 25-40, pp. 31-32; Drangert, J.-O., Löwgren, M., (2005). *Förändring eller kontinuitet?: faktorer som påverkat va-systemens utveckling i Linköping och Norrköping under perioden 1960–1990*. Chalmers tekniska högskola, Göteborg.
[357] Cettner, A., Söderholm, K., & Viklander, M. (2012). An adaptive stormwater culture? Historical perspectives on the status of stormwater within the Swedish urban water system. *Journal of urban technology*, **19**(3), 25-40, pp. 36
[358] Cettner, A., Söderholm, K., & Viklander, M. (2012). An adaptive stormwater culture? Historical perspectives on the status of stormwater within the Swedish urban water system. *Journal of urban technology*, **19**(3), 25-40, pp. 36-37

treatment plants. Water engineer Hans Bäckman at Swedish water claim that it was unfortunate that the drainage of the street and the installation of stormwater wells ended up on the "street side", while the stormwater was diverted to the "WSS side" and its combined stormwater pipes. This divide between street drainage and storm water still exists today.[359]

As will be elaborated in the section on future municipal infrastructure, right now many municipalities make efforts to remedy the problems created by combined sewers. To meet challenges from global warming and more rainfall it is not considered possible to rebuild or re-size the sewage pipes which of course would be very expensive. Instead, the whole municipal planning process must be revised towards a more holistic and preventive approach (what Cettner et.al call "a nature-oriented and local solution"). For example one must consider how hard surfaces such as roof tops and roads affect storm water management so that effects are reduced. To deal with these issues departments dealing with building permits, environment, etc. must be included and the water utility or the road department will not any longer be the only municipal department responsible for storm water. In a new addition to the national water law from 2023, this ambition is strengthened in §6b which stipulates that every municipality must have a "Water Service Plan" addressing these issues. This means that the new §6b tries to fix what Cettner et.al. (2012) argue is the main problem by encouraging local disposal of stormwater. The law tries to change the dominant systems culture based on a pipe-bound mentality.[360]

Chapter 11: Summary and analysis of WS and WSS

This is a list of the most important events and laws in Swedish modern WS and WSS history. It is evident that the articulation of publicness has changed over time influenced by a changing society and its new contextual factors:

- 1853: Proposal for municipal water supply in Stockholm (Leijonancker)
- 1861: Stockholm's waterworks is inaugurated (Sweden's first)
- 1862: The Municipal Act: The cities were allowed to collect taxes
- 1909: Water closets are allowed which spurs piped underground sewers
- 1930: The new plan for Stockholm's sewerage (the "Sewage bible")
- 1960s-70s: Municipal water in the countryside and a massive expansion of treatment plants

WS Legislation

• 1868 Ordinance Statute (1868:22)

Certain regulations for the protection of surface water and gutter management

• 1874 Health Care Charter (primarily applies in cities)

It was the responsibility of the Health Board to ensure that wastewater could flow freely from streets and other public places and to direct it from farms and plots out to the street gutter.

• 1918 Water Act, 1918:523 (replaces the 1880 Water Rights Ordinance): Lucrative water companies

Water pollution regulations was introduced in 1942. In 1956, the requirement for further purification than sludge separation was introduced and 1964 the rules were further tightened by introducing special protection for drinking water sources.

[359] Hans Bäckman, personal communication by email 23-01-05.
[360] Gilbert Nordenswan, seminar Värmdö municipality, 22-11-29

• 1919 Health Care Charter (SFS 1919:566).

The Revised and charter of 1919 confirmed the development that modern sanitary measures included public water and sewage systems. But the law could not force a municipality to build VA. The 1919 health care charter was replaced by the 1958 health care charter, which came into effect until 1983 when the Health Protection Act (SFS 1982:1080) came into force. The Health Protection Act was repealed when the Environmental Code entered into force on 1 January 1999.

• 1955:314: VAL (Public Water and Sewage Works Act)

From the water and sewage act in 1955, it was established that piped water and sewerage in urban areas were a municipal obligation. It clarified the municipality's obligations to provide VA, not just supervisory obligations.

1967: The Swedish Environmental Protection Agency is formed

• The 1969 Environmental Protection Act

In 1969, the new Environmental Protection Act was introduced. This legislation was the first in water and sanitation that dealt with both health and environment issues in combination.

• 1970:244: VAL (Public Water and Sewage Works Act): Revision of the act of 1955

• Health Protection Act 1983

• EU Wastewater Directive 1991

• EU's Drinking Water Directive 1998

• 1999 Environmental Code (replaces the Environmental Protection Act from 1969)

Through the code, for the first time, resource management is singled out for its own sake as an interest that has been given the protection of the legal system. What is extracted from nature must sustainably be used, reused, recycled, and disposed of with the least possible consumption of resources without damaging nature. The Environmental Code is based on the concept of Sustainable Development launched by the Brundtland Report and developed in Agenda 21.

• 2006:412: LAV (Public Water Services Act; replaces VAL 1955)

• EU Framework Directorate for water 2000

The Sea and Water Authority was established in 2011.

The Public Health Authority is established in 2014.

• EU new Drinking Water Directive 2020

• 2006:412: LAV (Public Water Services Act)

• 2020:900: Plan and Building Act PBL (replaced 1987:10)

Planning must take place with consideration of nature and cultural values, as well as promote long-term good management of land and water and of energy and raw materials…the impact on the groundwater that may be harmful to the environment must be limited. Every municipality must have an overview plan, which must provide guidance for decisions on the use of land and water areas.

Articulating publicness in pre-modern and modern water and sanitation

As been mentioned many times, Roman law had many regulations on water issues, including drinking water, and Rome also had a quite impressive administrative apparatus managing water provision, but despite all this and although Rome had left us with an impressive heritage of water and sewage systems, it is not correct to talk about an institutional or technical trajectory stretching from Roman times to the early nineteenth century, the arc was broken for 500 hundred years or so.

In the first Swedish national legislations on water the private, non-public, character of drinking water is visible. Publicness in water was not articulated as drinking water provision in the pre-modern era. Instead the national laws on water focused on *defensive* projects such as drainage and *lucrative* project such as waterpower. Nothing was mentioned about drinking water provision, groundwater extraction or domestic water from watercourses. Thus, contrary to the situation in ancient Rome, in Swedish legislation drinking water was generally treated as a private good and a productive resource rather than a common good.

Furthermore, there is no sign in the older history of rural areas, such as village ordinances or by-laws, legislation, or court proceedings, that treats drinking water as a public concern. Drinking water provision in the countryside of Sweden was simply not regarded as a Common Pool Resource in the meaning of Elinor Ostrom, at least not in any formal sense in written laws and regulations.

In towns however, due to higher population density, the situation was different. Trough the 17th and 18th centuries in Europe, water provision in towns in many cases partly relied on *proto systems*. In the larger Swedish towns like Stockholm, Göteborg and Malmö attempts were made using various types of proto systems for piped water during the Middle Ages and the following centuries.

Hallström (2003) summarizes the history of drinking water like this: "Before the 1860s, the primary ways of obtaining fresh water in urban areas was from wells, springs, and waterways. There were a few smaller water pipes in certain cities, the most famous one being *Kallebäcksledningen* in Göteborg, but modern piped systems were wholly missing, and urban residents had mainly to resort to manual, decentralized water supply." [361]

Common wells for water supply certainly existed but drinking water was not the only, or even the main, reason for building and maintaining them. Rather, public drinking water could be seen as a welcome side effect of the basic motives for the common wells: fire protection and street cleaning. Thus, in the articulation of publicness concerning water, fire security and tidiness were articulated more strongly than provisioning of drinking water for the people. It is my belief that the overly optimistic view of public engagement in drinking water in historic times is due to an interpretation of history from a present-day standpoint. Today it is almost impossible to think of a situation where water provision is not a central public concern in Sweden, which makes it easy to believe that this has always been the case.

In conclusion, it is difficult to find evidence for a strong public articulation on behalf of city authorities, to provide arrangements for drinking water before the beginning of the nineteenth century. There were attempts made but compared to street cleaning and fire protection, water provision was not seen as a priority. Furthermore, the articulation of publicness in drinking water was much weaker than in other sectors such as roads and streets and even compared to sanitation. I

[361] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping, pp. 61-61

have found no evidence for the existence of a serious obligation from state or city authorities to provide for drinking water and there was not really an expressed public desire to provide.

To sum up: in towns, the early and scattered attempts on proto systems were rarely successful in the longer run and common wells were not only for drinking water provision. It is hard to interpret their existence as signs of high public engagement in drinking water and they certainly did not transcend into the modern piped system of the late nineteenth century.

Concerning pre-modern sanitation the situation was somewhat different. Before the beginning of the nineteenth century, sanitary measures were associated with "Politi", i.e. good order, cleanliness, and tidiness, and was directed towards outer sanitation. In this earlier period public sanitation relied on open diches and gutters to deal with street cleaning and storm water.

From around 1800 sanitation was gradually associated with human health and wellbeing, a matter that increasingly became a public concern. This movement changed the motives in outer sanitation, away from Politi, and towards individual health. It also gradually transformed inner sanitation into a public concern and responsibility in the first half of the nineteenth century. Public interest now focused on earlier private practices such as house cleaning and personal hygiene and Swedish towns tock a firmer grip on excrement handling by a gradual takeover of latrine barrel collection by publicly employed personnel. However, modern underground sewers were not introduced for excrements until the end of the nineteenth and the beginning of the twentieth century and this process was directly linked to the establishment of modern piped water systems.

In conclusion, it is important to note that many ancient civilizations and towns had water and sewage arrangements that were much more advanced than in Europe before the eighteenth century.[362] In fact, one of the most surprising traits in European WS history is the weak public involvement from the fall of Rome and up to the modern era. Even more surprising is perhaps, at least in Sweden, the non-existence of CPR management of drinking water and sanitation in the premodern period. In Sweden with its well established and century old local self-government with the villages by-laws regulating common tasks such as grazing and drainage, I have not been able to find any evidence of similar CPR-management of WS arrangements.

Water and sanitation became gradually more public from the first half of the nineteenth century. This process impelled authorities to take on a more active role and off-grid service *arrangements* for WS were slowly transformed into on-grid *infrastructural systems* at a time when the municipalities were able to shoulder the system builder role. Outer and inner sanitation were firmly made into a public concern and undertaking when municipal authorities took the responsibility for both in the end of the nineteenth century.

The first suggestions for a municipal system for piped water in Sweden was put forward in 1851 in Stockholm and motivated by hygienic, social, medical, and economic advantages of piped water, not to mention its importance for firefighting. Wilhelm Leijonancker were commissioned to design the water supply system. I believe that if one wants to find a "Swedish model" of sorts for WS infrastructure Leijonancker's design plan is a good starting point. It certainly influenced many of the following towns building water, and later sewage systems in the decades after Stockholm.

[362] See also: Boccaletti, G. (2021). *Water: a biography*. First edition New York: Pantheon Books, pp. 67ff: "At the time of Augustus, Rome already had far better infrastructure than most European cities would have until the nineteenth century." (p. 74, Augustus was the Roman emperor from 27 BC to 14 AD)

Leijonancker's suggestion was motivated by these main points, covering all aspects that earlier research has listed as important components in water provision history:

- Concern about the poor who lived far from water sources and on upper stories in the houses.
- More convenience for the better off citizens.
- Alleviate sanitary conditions in the whole town including street cleaning.
- Increasing the health standard of the population.
- A resource for water consuming industries.
- Firefighting gets more effective-
- Creates opportunities for public baths and washing facilities-

I also want to stress the profound influence of Chadwick's *Health of Towns Enquiry*. Leijonancker openly referred to the sanitary movement and it reports on the health situation in England, comparing and adjusting the results to Swedish a context. Most of his general motivations for the piped water systems are blueprinted on Chadwick and the sanitary movement.

It must be noted that the initiative to build a piped water network in Stockholm was launched ten years before the acceptance of the Municipal act of 1862 and that the system was ready for operation ten years before the Public Health Act of 1874. As mentioned, many other towns followed suit and Sweden already had functioning water works in approximately ten towns by 1874.

This development strongly indicates that the contextual factors discussed in this report had a profound influence on the articulation of publicness and the development of WS and that the formal legislations were codifications of a more positive attitude in society towards publicness and interventions from the state and from municipalities in domains previously seen as private.

In hindsight it seems a bit strange the water and sewer pipes were not built at the same time. Presumably the towns did not dare to venture into another large-scale undertaking. The prevailing view was that not before the moment the water main had reached its full extent, and only then, the surplus funds could be used for the construction of sewage pipes. It would take until the middle of the 1870s, before the sewer network got any significant expansion and this expansion continued until the 1970s.

During the interwar years more and more towns built piped water systems and after WW2 this development also reached the countryside. The motive was to include rural areas in the Swedish welfare society and an important feature was a widespread expansion of WSS starting in the early 1930s, with the help of national funding in the form of relief work was issued by the National Unemployment Commission.

Water and sewage systems grew fast in Sweden during the first half of the twentieth century; the total pipe-length increased from about 3 500 km to 10 000 km, and even more up until the 1980.s. This physical growth was of course coupled with increased numbers of users, but also because of increased public investments and the forming of institutions and organizations supportive of the system, all contributing to system inertia.

The movement towards centralized municipal WSS had its ideological roots in the growing conservation and environmental movement that viewed safe water as a human right and WSS as the solution. The expansion of WSS in Sweden was also influenced by a municipal reform in 1952 that merged and reduced the number of municipalities from around 2 500 to about 1 000. This move

gave the now larger municipalities increased planning capacity for undertakings such as centralized and big WSS. An important tool for the state were grants and subsidies for the improvement of infrastructure. After the Second World War, state grants were introduced on a larger scale for the expansion of the water and sewage pipes of cities and larger communities. The state, via the Swedish Environmental Protection Agency, started a program for water provision in the countryside in the late 1960s. aiming at environmental improvements. By now, the urban WS networks were largely completed. The state subsidy during 1970s primarily concerned improvements to protect surface and groundwater and the expansion of wastewater treatment plants targeted at phosphorus reduction. Economies of scale lead many municipalities to connect sewage from areas in the city's surroundings to a central purification plant and since transmission lines would still be buried, it was advantageous to lay down water lines at the same time, thus centralizing both water and sewage. The state subsidies ended in 1980, when the expansion was completed.

To sum up, there were ideological, environmentalist and economic motives for municipalities to push for centralized solutions. With the help of government subsidies and optimistic assessments of population growth, large, expensive sewage treatment plants had been built which meant that cost comparisons between a new, possible smaller, local plant and subsidized transmission lines to a central plant came out even. The investment made in a central solution had a decisive influence, a so-called lock-in effect, on the choice of subsequent investments.

Having said that, in the evolution of an infrastructural system for water and sanitation in Sweden there is one untold story. The account given so far might give the impression that the WS infrasystem is totally dominant, comprehensive, and covering all parts of the country. And it is certainly true that we can see a development from privately managed WS arrangements to public municipal infrastructure, the articulation of publicness is loud and clear. Nevertheless it is very important to note that large parts of the countryside did not get access to piped water until way up into the 1970.s and that Sweden still has a large part of its population still depending on private arrangements for water and sanitation. These, what might be called *pre-modern* WS arrangements, are still to a high degree still present and consists of private property owners arranging for their own off-grid WS solutions. In Sweden´s well-developed WS-system with around 1,5 million properties connected to the municipal water and sewerage grid, almost 1 million properties, of which around 450-500,000 leisure properties are not connected.

As discussed in the chapter on roads and street history, there is a big portion of the Swedish road network, civic roads, that are managed by private property owners living close to the road according to the old mode of road keeping based the pre-modern “interest and utility” principle. But still, civic roads are quite well aligned with the public infrasystem and to some extent controlled by the state road administration. This is not entirely true in water and sanitation, where local level and off-grid service arrangements are less aligned to the public WS system. However, even if they are off-grid and not technically connected to the infrasystem, there are public rules and regulations that must be considered.

The private character of drinking water and sanitation/sewage is still a reality and public authorities accept their existence, especially concerning drinking water from private wells where regulations on water quality certainly exists but they are not as forceful as rules for private sanitation/sewage arrangements. In fact the public control of private wells is almost non-existent according to

informants. [363] The reason for the difference in attention and the view that drinking water quality is up to the individual – still not articulated as a fully public responsibility – is because private sanitation arrangements can possibly contaminate ground water sources, i.e. the well of your neighbor, and at the same time pollute nearby water courses and recipients. According to the environmental law (SFS 1998: 808), the owner of a sewage facility has an obligation for proper maintenance to protect the environment.

Today, urbanization, peri-urbanization, and global warming push the WS system develop decentralized and hybrid solutions. But changing a piped WSS is difficult. Most often WS-systems, as most infrastructural systems, develop gradually through incremental innovations.

The historical legacy in water and sanitation: resource and systemic characteristics

Water provision was of course in a sense a public matter and by its nature a common good, but there were no strong initiatives to put drinking water on top of the political agenda. The authorities did not really see this resource as a public concern, if compared to roads and outer sanitation. But this changed dramatically when water provision was connected to the value of "sanitary economy/ hygieneism" based on a new perception of "preventive/prophylactic health". Furthermore the new industrialists also realized that factory workers were a valuable production factor that needed to be kept in good health to be able to create surplus value. The story ends and water and sewage are joined together in a modern infrastructural system starting in the first half of the twentieth century.

Modern drinking water provision is a *distributive* arrangement/system with a strong *local* character, due to the locality of water resources and thus exhibiting weak positive network externalities. Historically, drinking water was for a long time regarded as an exclusively private and local matter. In the countryside and in sparsely populated areas, this did not really change until the first half of the twentieth century. In towns, population density spurred more cooperation in water management such as common wells and water selling, thus increasing network externalities. However, the local character of the resource prevailed. This locality was not changed even when Sweden, around 1850-70´s, started to plan and build water works and their associated piped networks. In the present, water provision, and to some extent sewage, has lost some of its local qualities as both water and sewage are transported quite long distances between cooperating municipal WSS organizations.

Provision of drinking water has historically and for a long period mostly been defined as a *private* good concerning the possibility to exclude other users. It is quite easy to put up a fence around your private well. Rivalry over drinking water has not been an important issue in Sweden. If there is no apparent shortage, water is not a rivalrous good. Perhaps the relative abundance of water in Sweden is a reason why drinking water has not really been articulated as a public domain.

Inner and outer sanitation are *accumulative* arrangements/systems with less visible positive network externalities, at least in sparsely populated areas. It is not obvious for the individual that cooperation with others is beneficial. Waste and excrement can be managed *locally* withing your own property, and this is exactly what has been the historical norm. This was true also for Swedish towns when they were relatively small. Inner and outer sanitation, storm water management, street cleaning, and excrement handling was a private matter for property owners and the Burghers. However, with growing population density and higher public involvement, the need for cooperation, first in outer and later for inner sanitation, became pressing and positive network externalities became more

[363] Based on personal an email conversations 23-04-12 and 13 with Björn Eriksson, editor on small scale sewage at the journal *The water and sanitation guide* (VA-guiden), bjorn.eriksson@vaguiden.se www.vaguiden.se

apparent. Nevertheless, as mentioned, modern pipe bound sewerage did not become a reality until the end of the nineteenth century, after the introduction of piped drinking water.

Piped sewage and water systems are tightly coupled in a technical sense, the pipes can only be used for their intended purpose but exhibit loose coupling and a low level of vertical integration, from an institutional perspective.

As a concluding remark it must be noted that even if water and sewage gradually turned into a unified system in the Swedish towns and eventually all over Sweden, some institutional differences persisted. The historical legacy of arrangements for water provision and sewage removal is evident in which municipal organizations that were put in charge of the systems. In Stockholm, for example, drinking water was managed by specialized municipal bodies, i.e. the board of the water works in cooperation with the financial board (Drätselnämnden) up until the 1920s when water management was merged with another infrastructure, the gas works. Sewage, on the other hand was first managed by the financial board and its divisions dealing with buildings and street management. The connection between sewerage and street management had its origin in the heritage from street cleaning and stormwater management, which belonged to municipal bodies dealing with street keeping and waste removal. This legacy survived until 1974 when water and sewage was joined in a common organization, the Water and sewage works (today the municipal company Stockholm water and waste).[364] The same organizational division seems to have been the norm all over Sweden, and even today some of this legacy is still alive. Piped sewage is normally managed by the municipal water works while the emptying of latrine from three-chamber wells outside the grid is handled by the street/roads divisions. Thus, the same human refuse is managed as sewage by one municipal body and as solid waste by another.

Chapter 12: Comparing the historical evolution of municipal infrastructure.

In this last section I compare the development in streets/roads, water, and sanitation. First by discussing similarities and differences concerning ownership and financing. Second, and lastly, I summarize my findings in a table focusing on the most important factors affecting publicness and the historical legacy in the three areas.

Articulating publicness, ownership and financing of the services delivered.

A central component in the articulation of publicness in streets, water, and sanitation has of course been the ownership of the service arrangements/infrasystems and how the building and operations has been financed.

In public roads on the countryside the state has had a strong interest in articulating publicness since at least the Middle Ages, but it is not correct to talk about ownership in any real sense until the first half of the twentieth century. For many hundred years the state had to rely on cooperation and goodwill of the farmers and the county authorities to manage the road sector based on the principle of “utility and interest” of the property owners living nearby. It must be noted that in civic roads the involvement of property owners and the principle of utility and interest is still a living fundament.

Real state ownership of public roads came gradually, accelerating in the 1920s when the principle of interest and utility and road keeping in kind by farmers and property owners became obsolete, in

[364] Cronström, A. (1986). *Stockholms tekniska historia 3 Vattenförsörjning och avlopp*. Stockholm: Liber Förlag.

the 1930s when the principle of "right of way" was legally established and finally, in 1944 when public roads were nationalized.

In municipal streets, an area for a long time only concerning larger towns, the city ownership was articulated a bit stronger. Street keeping in towns was based on the same principles of "interest and utility" that governed public roads with the Burghers and the property owners as designated road keepers. Nevertheless, city authorities had a stronger grip on street keeping compared to the state in public roads. Streets were clearly, and since a very long time, articulated as a public, municipal undertaking and city authorities had the responsibility for public places and squares as well as public roads passing through the town. Furthermore, many of the larger towns also transferred street management under municipal/city authority already in the first half of the nineteenth century, long before public roads came under state ownership.

From an infrastructural systems perspective it is quite clear that state and municipal public interests and ownership evolved gradually as other contextual factors in society changed the playing field of the sector. Nevertheless, I would argue that state and municipal involvement was very strong a long time before roads and streets were turned into infrasystems. Publicness came ahead of systemization.

Setting these differences in ownership aside, roads and streets have always been financed through taxation. Early in history the tax was paid in kind for maintenance and as a general tax for road and street building. There are very few examples of road/street pricing using fees or tolls in Sweden. The financing by taxation is a clear sign of a strong articulation of publicness in roads and streets that makes this sector differ from water and sanitation which was more often financed by individual fees as will be discussed below.

Drinking water provision had a weak articulation of publicness for a very long time. Water provision was seen as a private domain where the individual was expected to take care of business. This was especially true on the countryside. Although the village bylaws had many regulations concerning the management of common pool resources such as roads, pasture etcetera, drinking water was not articulated as a public concern needing cooperation. Instead it seems that informal rules and customs on water sharing as a moral obligation governed provisioning of drinking water.

In towns drinking water had a somewhat stronger articulation of publicness. The city authorities made some efforts, in some towns, to build proto systems for piped distribution and common wells were certainly quite common. However, drinking water distribution was not the prime motive for these service arrangements. Instead firefighting and street cleaning were the areas where publicness was most strongly articulated. Drinking water was a welcome side effect.

The same argument goes for national legislation all the way back from Medieval and pre-modern landscape, city, and national laws (12th-18th centuries), where drinking water was left outside the realm of public obligations. This is also the case in modern, nineteenth century general water legislations which articulated public concerns with water projects such as land drainage in agriculture and waterpower for industry (defensive and lucrative projects). In contrast to drinking water provision, the Ditching Act of 1879 encouraged CPR management of land drainage projects, which is a clear indication of differences in the articulation of publicness.

Thus, public ownership of early service arrangements for drinking water was not really an issue. State and especially municipal ownership became a reality from the beginning of the nineteenth century when many contextual factors in society reinforced the growing public interest in drinking

water. These contextual factors became apparent in the sanitary movement and in the national health act of 1874. But already in the middle of the century Stockholm and other large towns stared to discuss and plan for municipal water works and a piped distribution network. Following Wilhelm Leijonanker´s suggestions the norm (the "Swedish model") of municipal ownership was firmly established in most towns and later in almost every municipality. It is fair to say that in drinking water publicness came, not before as in roads/streets but in conjunction with systematization.

The articulation of publicness has always been stronger in sanitation compared to drinking water but weaker than in roads and streets. Outer sanitation, street cleaning, storm water disposal in gutters and waste removal, were closely linked to street keeping in Swedish towns and therefore a more obvious public domain. In pre-modern times the motives were grounded in the ideology of "Politi", i.e. good order, cleanliness, and tidiness. From around 1800 sanitation was gradually associated with human health and wellbeing, a matter that increasingly became a public concern. This movement changed the motives in outer sanitation, away from Politi, and towards individual health. It also transformed inner sanitation into a public concern and responsibility in the first half of the nineteenth century. Public interest now focused on earlier private practices such as house cleaning and personal hygiene and Swedish towns tock a firmer grip on excrement handling by a gradual takeover of latrine barrel collection by publicly employed personnel. However, sanitation as an infrasystems, with modern underground sewers were not introduced for excrements until the end of the nineteenth and the beginning of the twentieth century and this process was directly linked to the establishment of modern piped water systems. Piped sewerage, just like piped water distribution also came under municipal ownership in most towns and municipalities. In fact sewerage was considered a clear natural monopoly, more so than piped drinking water, which made municipal ownership the obvious choice.

Regarding the financing of water and sanitation the most common choice has been different forms of user fees. It is true that some towns distributed piped water "for free", i.e. paid over the municipal budget based on taxation, but this model for financing did not last for long. Sanitation, both inner and outer, was mostly financed by individual fees and in some periods as work in kind by the property owners. As mentioned the differences in financing between these areas of service arrangements gives a clear indication that roads and streets had a stronger articulation of publicness compared to water and sanitation. It is interesting to note that the reliance on individual fees prevailed when the older service arrangements for WS turned into infrastructural systems and that fees for every connected user to the municipal WS-grid still is the chosen business model all over Sweden.

To conclude: ownership and financing of infrastructural systems truly show the dependance of historical choices made and the importance of understanding the historical context that shaped the transformation of off-grid service arrangements into gridded infrasystems. The institutional path dependence and the historical heritage is apparent in the evolution of municipal streets, water, and sanitation.

Following from the above I want to stress a fundamental difference between the road and street sector compared to water and sanitation from an historical perspective. In roads and streets there has been little or no debate whether they ought to be a public responsibility or not. Publicness, in this general sense, has been clearly articulated for a very long time. Instead the debate has centered on the question on who, which groups in society, that ought to be responsible to carry out the tasks in road keeping. Who must carry the road burden? Thus, roads and street management were not so much affected by the changed attitudes discussed above related to the possibilities for the

municipalities (and the state) to intervene in earlier private matters. The road and street sector had "always" been articulated as a public domain and it was not until the end of the 1920s. that public bodies took over the practical tasks in road and street keeping.

In water and sanitation however, for a long time, the debate was much more heated on whether these areas should even be seen as public in the first place. The articulation of publicness in WS was related to the specific contextual factors discussed above (the social issue/ high mortality, cholera epidemics and new perceptions of health and sickness/ the Sanitary movement and the Health act of 1874). These factors started to influence water and sanitation in the beginning of the nineteenth century and was of course a part of the changed relationship between public and individual spheres of society, which gave a mandate for the municipalities, to intervene in various areas. (Kilander, 1991). The articulation of publicness in water and sanitation was much more closely linked to the question on which groups that were supposed to perform the tasks at hand and public responsibility and ownership were closely related to this articulation process.

To sum up: in roads and streets, publicness was articulated long before actual public responsibility became a reality. In WS the articulation of publicness was simultaneous to the public taking over the tasks. In other words, in roads and streets the articulation of publicness predated the creation of an infrastructural system. In WS, on the other hand, the articulation of publicness went hand in hand with systematization.

Comparing resource and systemic characteristics

The systematization of streets, water, and sanitation took place at the same time as new infrasystems such as gasworks, railroads and trams developed as public undertakings. These were driven by technological innovations and the municipalities had not dealt with them before. The newness and the fact that these infrastructures were built as proper infrasystems from the start provided scope for new ways of organizing how the infrastructural service was managed. Roads, sewers, and water were ancient, semi-public, or private service arrangements. They were stuck in an established tradition. When technical and institutional innovations came in these areas, when they were exposed to transformative pressures, it was difficult to start with a blank slate. The logic of older times, premodern legislation, and connections with other areas of society remained to a much greater extent than for the new technical systems. The technical and institutional legacy in streets, water, and sanitation deeply affected the transformation of these earlier service arrangements into modern infrasystems. I claim the history still affects modern day management of municipal infrastructure.

Building an infrastructure system requires large initial investments that few, if any, individuals, or private companies can afford. The construction has a long lead time, and it is not an easy task to build a system gradually because it is hard to get return on investments until the whole system is completed and all users are connected.

Because of these reasons the state or the municipality has often stepped in as a guarantor of construction and maintenance, and most Swedish infrastructure systems have been nationalized, although many were originally built by users/appropriators in local cooperatives (electricity, telephone, etc.). Since the end of the 20th century, we have witnessed a re-regulation of the infrastructure systems which resulted in private companies taking over ownership, operation, and maintenance.

In the history of roads and streets the state and the cities have since medieval times shown a public engagement, but they cannot really be called system builders. In the beginning of the twentieth

century though, the state got enough power and resources to act as system builder and create a true infrasystem. In water and sanitation we do not see this clear central system builder role. As has been shown the state and municipal authorities had the ambition and they surely tried to manage sanitation, but most often their efforts were fruitless. In water provision public involvement has been less apparent and came later. We still do not see a state level system builder in WS.

Service arrangements such as road-keeping, sewerage, or water provision can well be a public concern (undertaking/ responsibility) and yet not a real infrastructural system. These three areas of public service grew slowly, and in various paces, into fully developed infrasystems. They were gradually *systemized,* and their systemic characteristic became more apparent over time. In some, like roads, and to some extent sanitation, publicness came before *systemization*. In others, like piped water and sewage, full publicness developed in conjunction with *systematization* and with the building of the first piped networks.

Historical legacy and municipal capabilities in infrastructure

The future challenges for municipal infrastructure are not only about dealing with catastrophic events such as flooding and heavy rain due to global warming. Just as important is to manage the maintenance deficit mentioned in the introduction of this report. For both areas the issue of municipal *capacity* is at the center. The capacity problems are related to size. For obvious reasons larger municipalities and towns has the resources to hire experts and develop critical capabilities in their infrastructure departments which seldom can be matched by smaller units. Nevertheless, the small municipalities still must deal with the same problems and follow the same regulations in for example environmental legislation.

The problems connected to long term management of infrastructure maintenance is described like this in a recent article by Alm et.al. (2021):

"Heavy public investments were made in large infrastructure networks for public roads as well as water and sewage during the period from 1950s to mid-1970s. Over the years, sections of these networks have become outdated, fallen into despair and are generally in extensive need for reinvestment. The Swedish Association of Local Authorities and Regions (SALAR, 2016) estimates that there is a neglected, and so urgent need for, maintenance for about 18% of the municipal road network, which corresponds to a cost of 12 billion SEK. A similar pattern could be found within water and sewage infrastructure. The Swedish Water and Wastewater Association (SWWA, 2017) states that the current estimated level of reinvestments on 12 billion SEK on water and sewage supply needs to increase to 35% to secure safe drinking water. To finance these investments, the tariffs need to be doubled over the coming 20 years. In short, the long period of underinvestment in maintenance and repair of critical infrastructure networks, often caused by short-term financial considerations and a run-to-failure mentality, has led to the growth of a so-called maintenance debt". Up to 10% off the public roads are reported to be in a very bad shape.[365]

Alm et.al. (2021) discuss different forms of municipal capacity that is needed to successfully manage streets (roads) and WSS and they investigate this local capacity in five interrelated aspects:

1. Technical capacity
2. Financial capacity

[365] Alm, J., Paulsson, A., & Jonsson, R. (2021). Capacity in municipalities: Infrastructures, maintenance debts and ways of overcoming a run-to-failure mentality, *Local Economy*, **36**(2), 81–97, pp. 2; SvD 230420: Tt. (2023). Var tionde väg i mycket dåligt skick. *SvD.se*. https://www.svd.se/a/Q73R1P/var-tionde-vag-i-mycket-daligt-skick, accessed 30/4 2023

3. Institutional capacity
4. Political capacity
5. Social capacity

While the importance of each of the aspects will vary from municipality to municipality, they are interrelated and influence each other and will all to some extent influence the overall capacity of an organization to achieve its objectives. They describe the difference between municipal street keeping and WSS like this in their analysis of how Swedish municipalities work with the routine maintenance of infrastructures, including municipal road networks as well as water and sewage systems: "For the road networks, maintenance is generally outsourced to contractors and there is also a large degree of tolerance for various standards on different road segments within and between the municipalities. Less used road segments are not as prioritized as those with heavy traffic. For the water and sewage systems, in-house technical capacity is needed as differences in water quality are not tolerated. Economies of scale mean that in-house capacity is translated into the creation of inter-municipal bodies."[366]

Leaving the differences between maintenance of streets and WSS aside, it is perfectly clear that population size, economies of scale and the ability to recruit capable personnel is crucial for the municipal capacity expressed in the five aspects above. To put it bluntly, it is often impossible for smaller municipalities to present the technical, financial, institutional, political, and social capacity needed to successfully manage infrastructure.

Thus, the historical legacy of a municipal organization of these infrasystems has a distinct influence even today. For street keeping, the state level is influential, but the heritage of municipal self-governance has kept much of the area under local authorities. Concerning WSS the problems for small municipalities are even worse. They are under an even stronger culture of local independence due to the historical development of the area. In both cases, the legacy of local management makes it difficult to deal with the present-day problems related above. Municipal self-governance of streets, water and sanitation seemed like a natural choice some hundred and fifty years ago. Today, local level management creates tensions and difficulties not foreseen by the historical actors back in the days. I argue that local management might well be a root cause to problems in WSS today. What is lacking is a state level system builder responsible for the "local water and sewage cycle". Although *local* in its character, WSS cannot be left to the municipalities, especially not the small ones.

Articulating publicness in future municipal infrastructure: large or small scale?

As mentioned, global warming will affect society and municipal infrastructure. We will see both drought and more rain. But climate models show that *flips* from severe drought to heavy downpours, so-called *compound extreme events* will become more frequent which will lead to increased risks in "health, ecosystems, infrastructure, supply and food", according to the IPCC's latest major report.[367] Consequently, climate change effects forces municipal utilities to implement change in many infrastructural systems that historically have been stable in the last fifty to a hundred years. According to the United Nations there is "…a need to increase the resilience in traditional large-scale infrastructural systems…" and the UN call for "bold and transformative steps

[366] Alm, J., Paulsson, A., & Jonsson, R. (2021). Capacity in municipalities: Infrastructures, maintenance debts and ways of overcoming a run-to-failure mentality, *Local Economy*, **36**(2), 81–97, pp. 1
[367] SYNTHESIS REPORT OF THE IPCC SIXTH ASSESSMENT REPORT (AR6) finalized in March 2023 https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_LongerReport.pdf, pp. 16; DN 230409: Alestig, P. (2023, April 9). Peter Alestig: Skyfall kan vara en katastrof efter en torka. *DN.SE*. https://www.dn.se/varlden/peter-alestig-ja-ett-skyfall-kan-vara-en-katastrof-efter-en-torka/, accessed 30/4 2023.

which are urgently needed to shift the world on to a sustainable and resilient path".[368] The Swedish Environmental Agency (Naturvårdsverket, 2026) warned that that both water shortages and flooding will impose challenges for conventional technologies for water distribution and treatment. The world economic forum also identifies water scarcity as serious risk. [369]

Thus, global warming challenges municipal infrastructure in both street and WSS. The common dominator and the most profiled risk area is storm water management. Furthermore, the biggest obstacles seem to be the many stakeholders in the infrastructural sector and that nobody really knows who is responsible for storm water issues (lack of rådighet). The responsibilities are often organized in silos where the actors deal with their own area with little or no coordination. Until recently, for example, the Traffic administration in Stockholm dealt with storm water but in 2021, Stockholm water were given the responsibility for storm water management. This situation also affects the ability for innovation and future foresights, which seems to be left to outside consultancy firms. Therefore, more cooperation between actors in municipal infrastructure is needed to deal with the strain on both municipal streets and on WSS. Earlier management practices where these two areas were kept separate is no longer working. In the two biggest towns in Sweden, Gothenburg and Stockholm, cooperation and cross sectoral work is emphasized and in Stockholm this need for action across professional and political borders is described like this:

"A denser city is a challenge when available areas for handling stormwater decreases. At the same time, the need to provide space for the stormwater because higher demands are placed on improved recipient quality. The buildings also need to be adapted to meet the effects of climate change as well as increased expectations to meet needs of urban greenery. A traditional urban environment largely consists of hard surfaces. Here has the natural drainage channels, which provide delay and infiltration, largely replaced by technical stormwater systems. These changes give stormwater a very rapid runoff. The rapid runoff results in a reduced fixation of pollution. This means that pollution is instead added and burdened receiving lakes and streams." [370]

A strong movement towards circular economy can be found in future oriented discussions on public infrastructure, especially in WSS. The articulation of publicness is framed in a movement from waste disposal to reuse of resources and the slogan is: "Today's treatment plant - tomorrow's resource plant." [371] In Helsingborg in the south of Sweden the municipality has started an acclaimed and often mentioned project called "RecoLab - Pilot Recovery Plant for Sustainable Management of Wastewater and Food Waste". From a historic perspective the circle is closed, and we are back in premodern sanitation practices where latrine was seen as valuable resource and fertilizer in agriculture.[372] As touched upon, this holistic view was also an early fundament for Edwin Chadwick and the Sanitary movement in the first half of the nineteenth century: "…public health should be preventive in character, and the appropriate solution to these sanitary problems was technological systems such as piped water supply and sewerage, to which water closets were connected in order to transport fecal matter and waste to farmlands outside the city. The residue would pay for the sanitary improvements in the cities but would also benefit agriculture. As Chadwick claimed, ´we

[368] UN, Agenda 2030
[369] Naturvårdsverket, 2016
[370] https://start.stockholm/globalassets/start/om-stockholms-stad/politik-och-demokrati/styrdokument/dagvattenstrategi--stockholms-vag-till-en-hallbar-dagvattenhantering.pdf, p. 6; https://vaxer.stockholm/sok/?query=skyfall ; Similar thoughts are expressed in Gothenburg; Stadsutveckling – Stadsutveckling Göteborg – Göteborgs Stad (goteborg.se); Rapport Göteborgs Stad (goteborg.se)
[371] Dokument Delegationen för cirkulär ekonomi (svensktvatten.se); svensktvatten_utblick2050.pdf
[372] Sjöstrand, Y. S. (2014). *Stadens sopor: Tillvaratagande, förbränning och tippning i Stockholm 1900-1975* (PhD dissertation). Lund

complete the circle, and realize the Egyptian type of eternity by bringing as it were the serpent's tail into the serpent's mouth´" [373] In Helsingborg they try to bring the serpent´s tail into its mouth once again and they have gone from reuse to "getting rid of" (kvittblivning) and back again to reuse. In popular terms the "three pipes out" project is presented like this on the web site:[374] "The new city district of Oceanhamnen in Helsingborg has created a solution for separating and recovering different kinds of wastewater and food waste at source. This leads to sustainable reuse of resources through Sweden's first recovery plant, Reco Lab." Gothenburg also had a black water test plant in 2007-2008 that was tested at full scale in an area with BDT water separation, black water with waste mills.[375]

However, and as mentioned earlier, to discover reuse and resource-oriented solutions in sanitation one does not have to go so far back in history to the era of Chadwick. Sweden was in fact an early forerunner in this field. The pioneering attempts failed though, and the reasons were mainly connected to the inertia of the existing system: "Sweden is an interesting case in this context because it was an early pioneer in UD (urine diversion), and the political awareness of alternative sanitation solutions have been significant Still the adoption rates have been slow, and the centralization of the Swedish sanitation system is continuously expanding." [376]

Nevertheless, technical, and organizational innovations in circular economy is not the only strategy. Currently the dominating trend to mitigate climate change effects and to meet expected population increase in Stockholm (and in London) is to build large scale sewage facilities.

London is constructing a "Super sewer" to extend the old Victorian sewage system designed by Bazalgette. Thames water, the public water and sanitation organization, has hired Tideway (Bazalgette Tunnel Limited) to finance, build, maintain and operate the Thames Tideway Tunnel under the HM Treasury's National Infrastructure Plan. Preparatory work began in 2015 and construction is now underway. The new tunnel system will be 25km long and 7.2 meters in diameter, will cost £4.3bn to complete and is anticipated to be completed in 2025.

This large-scale project is motivated by the prospect of increased rainfall due to climate change and an expected increase in population from 9 million to 16 million in 2160 (the Bazalgette system was designed for 4 million people). But the sewage produced by the increasing population does not seem to be the main problem, storm water overflowing into the river is the real challenge:

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[373] Hallström, J. (2003). *Constructing a Pipe-Bound City : A History of Water Supply, Sewerage, and Excreta Removal in Norrköping and Linköping, Sweden, 1860-1910* (PhD dissertation). Linköping University Electronic Press, Linköping. pp. 16-17; See Simmons, D. (2006) Waste Not, Want Not: Excrement and Economy in Nineteenth Century France. *Representations*, Vol. 96, No. 1 (Fall 2006), pp. 73-98, University of California Press for a fascinating story on *Circulus*, an ideological movement advocating "circularity" under the leadership of the French utopian socialist Pierre Leroux (1797–1871). The idea was that human excrement should be collected by the state in the form of a tax and used as fertilizer and thereby end world hunger.

[374] *News - Smart City Sweden*. (2020, April 17). Smart City Sweden. https://smartcitysweden.com/best-practice/333/reco-lab-sustainable-management-of-domestic-wastewater-and-food-waste/, accessed 30/4 2023, See also: Helsingborg: Tre rör ut - NSVA - Projektwebb; Miljöfördelar med Tre rör ut - NSVA - Projektwebb; RecoLab

[375] *Systemstudie Avlopp. En studie av framtida hållbara system för hantering av avlopp och bioavfall i Göteborgsregionen. Ale. Kungälv. - PDF Gratis nedladdning*. (2023). https://docplayer.se/2048819-Systemstudie-avlopp-en-studie-av-framtida-hallbara-system-for-hantering-av-avlopp-och-bioavfall-i-goteborgsregionen-ale-kungalv.html, accessed 30/4 2023; *Återvinning av näringsämnen ur svartvatten – utvärdering projekt Skogaberg | Vattenbokhandeln*. (n.d.). Vattenbokhandeln. https://vattenbokhandeln.svensktvatten.se/produkt/atervinning-av-naringsamnen-ur-svartvatten-utvardering-projekt-skogaberg/, accessed 30/4 2023

[376] Vidal, B. (2022). *Small Sanitation Systems – Treatment Efficiency, Sustainability and Implementation* (PhD dissertation, Luleå University of Technology), pp. 54-56

"Sewage is the last significant source of pollution in the river. The Super Sewer is the solution…The Thames Tideway Tunnel will protect the river for at least the next 100 years."[377]

Stockholm is also building a similar super-sewer, and even if that name is not used the utility claims they are building "One of the world's most modern treatment plants" An extensive modernization of the plant in Henriksdal, south of the city center, began in 2015. The project also includes a 14 km tunnel stretching under the town from an earlier treatment plant in the west suburbs which will be closed. Construction of the tunnel began in January 2020, and it will be operational in 2026. The tunnel will also alleviate problems due to the many combined sewers in Stockholm (most sewers built before the 1950.s in Sweden were combined).

Henriksdal's treatment plant is being upgraded and optimized with membrane technology and the expanded treatment plant will be well equipped for future requirements: "The treatment plant is equipped with new biological treatment and one of the world's largest facilities with membrane filtration. With membrane technology (Membrane bioreactor technology, MBR) we can purify larger amounts of wastewater, which at the same time is purified better than before. We are also improving pre-treatment and sludge treatment."[378]

Apart from the large-scale examples above, there is also a trend towards small scale and local alternatives in WSS that exists alongside the large-scale facilities. [379] As mentioned, even though Sweden has a well-developed WS-system with around 1,5 million properties connected to municipal water and sewerage facilities, in 2015 almost 1 million properties, of which 500,000 leisure properties were not connected.[380]

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[377] Tideway. (2023). *The Tunnel*. Tideway. https://www.tideway.london/the-tunnel/

[378] https://www.stockholmvattenochavfall.se/en/sfa-start/about-the-project/stockholms-future-wastewater-treatment/why-has-the-project-been-planned/#!/stockholm-is-growing (DEN HÄR LÄNKEN FINNS INTE LÄNGRE)

[379] 210629: Telefon med Uno Jakobsson, REV: Vattensamfälligheter har, när de väl blivit bildade, samma maktbefogenheter som vägsamfälligheter. Men det som skiljer är att en fastighetsägare inte kan tvinga igenom bildandet av en samfällighet för vatten; See also: Correljé, A. & Schuetze, T. (2012). Decentral water supply and sanitation. In Egyedi, T. M. & Mehos, D. C. (eds). *Inverse Infrastructures: Disrupting Networks from Below*, (pp. 161–186). Edward Elgar, Cheltenham.; Edwards, P. N. (2003). Infrastructure and modernity: force, time, and social organization in the history of sociotechnical systems. In Misa, T., Brey, P. & Freeberg, A. (eds). *Modernity and Technology,* (pp. 185–225). MIT Press, Cambridge, MA.; Takala, A. J., Arvonen, V., Katko, T. S., Pietilä, P. E., & Åkerman, M. W. (2011). The evolving role of water co-operatives in Finland. *International journal of co-operative management*, **5**(2), 11-19.; Egyedi, T. M. (2012). Disruptive inverse infrastructures: conclusions and policy recommendations. In. Egyedi, T. M. & Mehos, D. C. (eds). *Inverse Infrastructures: Disrupting Networks from Below,* (pp. 241–266). Edward Elgar, Cheltenham; Egyedi, T. M. & Mehos, D. C. (2012). *Inverse Infrastructures: Disrupting Networks from Below*. Edward Elgar, Cheltenham; Katko, T. (1992). Evolution of consumer-managed water cooperatives in Finland, with implications for developing countries. *Water International*, Official Journal of IWRA **17**(1), 12–20; Vinnari E. M. & Hukka J. J. (2010) An international comparison of the institutional governance of water utility asset management and its implications for Finland. *Water Policy,* **12**, 52–69; Heino, O. & Anttiroiko, A-V. (2014) *Enabling and Integrative Infrastructure Policy: The Role of Inverse Infrastructures in Local Infrastructure Provision with Special Reference to Finnish Water Cooperatives*, University of Tampere, 2014, *MPRA Paper No. 60276*; Forsberg, A. (2013). Local responses to structural changes: collective action for rural communities in Sweden In Westlund, H. & Kobayashi, K. (eds). *Social Capital and Rural Development in the Knowledge Society,* (pp. 247–272). Edward Elgar, Cheltenham.

[380] This section builds on Nygren, J., & Hjort, P. (2020). Master thesis, supervisor Pär Blomkvist, "Systemuppbyggnad och entreprenörskap från grunden: "off- grid" vatten- och avloppslösning på Värmdö" ("*System development and entrepreneurship from below*: "off- grid" water and sewage solution at Värmdö"). See also: HAV: Havs- och vattenmyndigheten. (2013). *Styrmedel för en hållbar åtgärdstakt av små avloppsanläggningar*; Grönvall, A. (2018). *Vägar till hållbara vattentjänster* [SOU 2018:34]. Stockholm: Elanders Sverige AB; Olshammar, M., Ek, M., Rosenquist, L., Ejhed, H., Sidvall, A., & Svanström, S. (2015). *Uppdatering av kunskapsläget och statistik för små avloppsanläggningar* (Rapport Nr 166 2015). SMED, Sveriges Meteorologiska och Hydrologiska Institut. See also: Trottier, J., & Slack, P. (2004). *Managing water resources past and present*. Oxford University Press, p. 6 (on communal water management: "Elinor Ostrom (1992,1993) and others responded to Hardin with the common properties' movement. Research on customary forms of

One example of the growing interest and actuality of small scale WS can be found in Värmdö, a municipality outside Stockholm with 45,000 permanent inhabitants, which grow to around 100,000 in the summer. It is a coastal region with more than 10,000 islands and about 15,000 holiday homes. Today Värmdö has between 15-20 000 individual water and sewerage facilities in holiday houses, which often lack capacity for permanent living. Urbanization makes people increasingly relocate to the cities, but due to an overheated housing market, many move outside the city center to find affordable dwellings. This means that areas earlier used for summerhouses and recreation are exploited, putting pressure on infrastructural systems not well adapted for permanent living. During the last decade, around 3 000 holiday-homes have been transformed into permanent dwellings. In total around 27 000 persons live in houses not connected to the municipal WS grid and the regime has no knowledge on what sort of technologies are used by these private property owners. There is an increasing number of technical solutions, from private mini treatment plants to septic tanks, and decisions on technology taken by individual property owners at a free market. For the utility in Värmdö the influx of people living permanently in refurbished summerhouses has changed the expectations on WS services and few, if any, accept dry solutions for latrine. Instead the there is a strong trend towards wet solutions/WC. As more areas are being transformed to permanent dwellings and Värmdö municipality foresees water shortages and serious sewerage problems in some areas. Furthermore, the regime actors predict that effects related to the Corona pandemic is pushing for a trend where even more people settle permanently in Värmdö and using digital communication technology to work from their homes. In 2020-2021 applications for building permits almost doubled.

The situation in Värmdö is not unusual in Sweden. Many municipalities close to larger cities experience simultaneous trends of urbanization and peri-urbanization that together with global warming push the WS system develop decentralized and hybrid solutions. And these trends also affect municipal street and road keeping. As discussed elsewhere, new inhabitants moving in from the city centers are used to a higher standard of street and road quality. They expect asphalt pavements, street lightning, not to speak of other facilities such as daycare and schools, and, perhaps most importantly, they demand that these services should be taken care of by the municipality. What we see is a clash of city dweller expectations and the reality in peri-urban

water management repeatedly dispelled the myth of the unilinear progression from less to more control or less to more technology. It demonstrated that open access cases were extremely rare in the case of water and that communal property regimes regulated most water sources involved in irrigation."; Takala, A. J., Arvonen, V., Katko, T. S., Pietilä, P. E., & Åkerman, M. W. (2011). The evolving role of water co-operatives in Finland. *International journal of co-operative management*, **5**(2), 11-19; Correljé, A. & Schuetze, T. (2012). Decentral water supply and sanitation. In Egyedi, T. M. & Mehos, D. C. (eds). *Inverse Infrastructures: Disrupting Networks from Below*, (pp. 161–186). Edward Elgar, Cheltenham; Edwards, P. N. (2003). Infrastructure and modernity: force, time, and social organization in the history of sociotechnical systems. In Misa, T., Brey, P. & Freeberg, A. (eds). *Modernity and Technology,* (pp. 185–225). MIT Press, Cambridge, MA; Egyedi, T. M. (2012). Disruptive inverse infrastructures: conclusions and policy recommendations. In. Egyedi, T. M. & Mehos, D. C. (eds). *Inverse Infrastructures: Disrupting Networks from Below,* (pp. 241–266). Edward Elgar, Cheltenham.; Egyedi, T. M. & Mehos, D. C. (2012). *Inverse Infrastructures: Disrupting Networks from Below*. Edward Elgar, Cheltenham; Katko, T. (1992). Evolution of consumer-managed water cooperatives in Finland, with implications for developing countries. *Water International*, Official Journal of IWRA, **17**(1), 12–20; Heino, O. & Anttiroiko, A-V. (2014) *Enabling and Integrative Infrastructure Policy: The Role of Inverse Infrastructures in Local Infrastructure Provision with Special Reference to Finnish Water Cooperatives*, University of Tampere, 2014, *MPRA Paper No. 60276*; Forsberg, A. (2013). Local responses to structural changes: collective action for rural communities in Sweden. In Westlund, H. & Kobayashi, K. (eds). *Social Capital and Rural Development in the Knowledge Society,* (pp. 247–272). Edward Elgar, Cheltenham.

municipalities. The articulation of publicness in municipal infrastructure has not stopped to evolve and it still cause controversy. [381]

A suggestion on further research on the influence domain of municipal WS utilities

Earlier (in the report/book) I have discussed the *systems culture* in WSS developing in connection to the massive expansion after WW2 of piped water and sanitation and the building of large treatments plants all over Sweden in the 1960-70s. This systems culture is often described as a "piped paradigm"[382] with its actors sharing a "piped mentality". The strong preference of expanding WS infrastructure by underground water and (gravity flow) sewage pipes has created a potent technical path dependence and inertia of the traditional system. The municipal utilities have a powerful position in the piped paradigm as they decide on where and when to expand and what type of technology is to be used in this expansion.

This description is quite accurate, but it needs to be nuanced. The "technological power" of the utilities is not the only explanation for the inertia in the existing system. It is not only the piped paradigm that makes WSS resisting change and it is not only the piped paradigm that makes it difficult to expand water and sanitation services by using small scale, decentralized or off-grid technologies.

Apart from the power to decide on technology the utilities have another type of power adding to the inertia of the traditional system. This power resides in the utilities obligation to oversee and control the abidance of health and environmental legislations imposed on both large and small service providers. These regulations put the same demands private or collective WS arrangements as it does on municipal WSS, and it is the municipality that checks if regulations are followed in decentralized and off-grid arrangements. The power to decide on rule abidance in health and environmental issues can be called "institutional power".

Thus, the municipality has two roles to play in the WS sector: both as system builder, with "technological power" and as overseer of legislation with "institutional power". Most often these two roles are managed by two separate municipal bodies which can create "silo" effects within the organization and confusion on the local level of users and costumers.

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[381] Blomkvist P. (2010). Om förvaltning av gemensamma resurser: Enskild väghållning och allmänningens dilemma i svensk historia 1200–2010 (Managing Common Pool Resources: Road Keeping and the Dilemma of the Commons in Swedish History 1200–2010), Division of Industrial Dynamics, KTH (Royal institute of Technology), Stockholm, Sverige; Blomkvist P. & Larsson J. (2013). An Analytical Framework for Common-Pool Resource–Large Technical System (CPR-LTS) Constellations. *International Journal of the Commons*, **7**(1), 113–139. One interesting aspect which is left out of this report is the possibility to learn small scale and decentralized solutions in WSS from the Global south, see for example: Heino, O. & Takala, A. (2019) Transformation of Urban Water Service Provision: Potential of Hybrid Systems in Public Works Management and Policy 1–16, 2019; Blomkvist P. & Nilsson D. (2017). On the need for system alignment in large water infrastructure: understanding infrastructure dynamics in Nairobi, Kenya. *Water Alternatives* 10(2); Blomkvist P., Nilsson D., Joma B. & Sitoki L. (2019). Bridging the critical interface: Ambidextrous innovation for water provision in Nairobi's informal settlements. *Technology in Society,* **60**.; Lawhon M., et.al (2017). Thinking through Heterogeneous Infrastructure Configurations, *Urban Studies*.; Nilsson D. (2011). *Pipes, progress, and poverty: Social and technological change in urban water provision in Kenya and Uganda 1895-2010. PhD thesis*. KTH (Royal Institute of Technology), Stockholm, Sweden.; Nilsson D. & Blomkvist P. (2020). Is the "self-read water meter" a pro-poor innovation? Evidence from a low-income settlement in Nairobi. *Utilities Policy*, **68**.

[382] Braadbaart, O. (2009) North–South Transfer of the Paradigm of Piped Water: The Role of the Public Sector in Water and Sanitation Services. In Castro. J.E. & Heller, L. (eds.) *Water and Sanitation Services Public Policy and Management.* 2009, Routledge, London.

The health dimension in water and sanitation was established from the very beginning. Already in the middle of the nineteenth century the municipalities got the institutional power to oversee public health and when water systems, and later sewage, was established, control of health issues became even more central. Many municipalities built piped water and sewage systems, but it was not until 1955, in the *Public Water and Sewage Works Act* (VAL; 1955:314) that it was established that piped water and sewerage in urban areas were a municipal obligation. It clarified the municipality's responsibility to provide WSS, not just supervising public health.

Environmental issues due to pollution of rivers, lakes, and the sea, were discussed early in the history of Swedish water and sanitation but not a lot of action was taken. However, the above-mentioned initiative to build sewage treatment plants in the 1960-70s was a direct result of severe environmental degradation due to raw sewage being disposed straight into recipients. Accordingly, the environment was included in WSS legislation at the end of the 1960s. In 1967 The Swedish Environmental Protection Agency was formed and in 1969 Sweden got its first national *Environmental Protection Act*. This law was the first in water and sanitation that dealt with both health and environment issues in combination. One year later, in 1970 this development was codified in the new *Public Water and Sewage Works Act* (VAL; 1970:244) in a revision of the act of 1955.

In earlier research me and colleagues have talked about the *critical interface* between the WS utility (the regime level) and unconnected user outside the grid (the local level) and that the regime tries to *bridge the interface* aiming to incorporate more and more of the unconnected users at the local level. [383]

This description is correct, but we have mainly focused on the pipes. We have been stuck in technology and (physical) system building aspects, concentrating on how the regime aims to connect the local level by traditional methods, i.e. expanding the well-tried piped network. The regime can use this expansion strategy because off its “technological power”.

But there is another method to *bridge the interface*, based on “institutional power”. By using its position as overseer and controller of legislation on health and environmental issues, the regime can expand its control over peripheral (private or collective) non-grid WS solutions. Although the law is stipulated by the state, the municipality has been given the “institutional power” and the task to enforce the environmental legislation concerning water and sanitation. Thus, an institutional expansion strategy, through environmental legislation, is the second option for the regime to bridge the critical interface and to exert control over areas outside the grid.

What we see, apart from technical expansion, is the regime taking an ever-stronger grip over the WSS sector by forcing non-grid property owners to abide to the letter of the law. The regime exerts technological and institutional power by acting in both its roles: As the technical system builder and the overseer of health and environmental legislation.

In parallel to technical expansion through building of the grid and institutional expansion by environmental legislation, the building department of the municipality (Byggnadskontoret) also exerts, at least indirect, control over the WS sector by its municipal monopoly on building rights by stipulating which areas that are going to be incorporated in the future “detailed building plan”.

[383] Blomkvist P. & Nilsson D. (2017). On the need for system alignment in large water infrastructure: understanding infrastructure dynamics in Nairobi, Kenya, in *Water Alternatives,* **10**(2): Blomkvist P., Nilsson D., Joma B. & Sitoki L. (2019). Bridging the critical interface: Ambidextrous innovation for water provision in Nairobi’s informal settlements, in *Technology in Society,* **60**.

These areas are labelled “areas of activity” (Verksamhetsområden). In “areas of activity”, the most common way to bridge the critical interface is by connecting the properties to the piped network.

Following from the above, I would argue for further research of the water and sanitation sector in Sweden fucusing on how the regime have pushed the critical interface outwards from the center and expanded, what I would like to call, its “influence domain”. The process started around 1850 with a clear focus on technical expansion of first water provision using pipes (copied from England) and somewhat later water-borne sewage. In 1920-30 pollution of the water recipients came up on the agenda and water purification was addressed and later cleaning of the sewage. This was part of the technical expansion and involved enrolling science like chemistry and biology to fix problems with the piped system. After WWII and accelerating from the 1960.s and onwards came the great expansion period, connecting the countryside to the piped WS system. This technical expansion was accompanied by an institutional expansion including the first water law in 1955 and the first serious attempts of environmental legislation in the WS sector.

The result is a piped WS system reaching about 80 % of the population and 95% in the city centers (that is today). However, as mentioned, Sweden still has about 700 000 properties not connected to the grid. In the best of worlds, these unconnected properties are supposed to be under the influence domain of the regime. However, the actual environmental status of many small scale (enskilda) WS arrangements is highly unclear.

Reference list

The reference list includes more items than is cited directly in the text. I have added lots of background material which I used in in my research when trying to get an understanding of the history of municipal infrastructure. The reason is that I want to give the reader an overview of the large number of prime sources and literature in the field.

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Mistra InframMaint är ett forskningsprogram som ska ge kommuner och VA-verksamheter bättre underlag för att bygga sina beslut om underhåll på. Vår vision är en hållbar infrastruktur som är tillgänglig och säker dygnet runt. För att nå visionen behöver vi bland annat ta till vara möjligheter med ny teknik. Vårt fokus är här underhållet av VA samt gator och vägar under kommunalt ansvar.

Effektivt och smart underhåll
Inriktningen på programmet är tillståndsbedömning, prognoser och beslutsstöd för investeringar, finansierings- och affärsmodeller samt hur kommunala processer och organisation kan utvecklas, för att på bästa sätt möta de stora investeringsbehov som samhället står inför.

Tillsammans för en infrastruktur för framtiden
Vi är ett starkt konsortium med forskare från institut och högskolor, men speciellt viktigt är delaktigheten från kommuner och andra behovsägare. Seniora forskare kompletteras med doktorander som till stor del arbetar i de kommunala organisationerna. Det innebär att forskningen utgår från behoven vilket ska ge goda förutsättningar för direkt tillämpning och nytta av resultaten. Kompetensspridning är också en viktig målsättning för programmet.

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