Pipe Dreams and Dirty Streams:

The politics of legitimising centralised urban water infrastructure

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Abstract

The objective of this research was to understand how and why centralised urban water infrastructure is legitimised, despite acknowledgement of its flaws and established alternatives. This research was motivated by criticism of traditional, centralised forms of urban water management on the basis of their negative social and environmental impacts, and the resulting emergence of sustainable management alternatives. The investigation was carried out using a qualitative case study of Auckland's proposed Central Interceptor. A dataset was formed using publicly available documents from the stakeholders involved in the city's urban water management. The dataset was analysed using inductive and deductive thematic analysis. Drawing on the case study and academic literature, several possible explanations for the legitimation of centralised infrastructure were found. Firstly, in some cases, the convenience of centralised networks and the public's lack of exposure to their negative impacts means they are not perceived to be illegitimate, and they do not need to be justified. Secondly, arguments for their legitimacy are based in technocratic decision making and proposed by supposedly a-political experts. These arguments are presented with objective, quantifiable proof that is difficult to dispute and assumed to be unbiased. Thirdly, infrastructure can be legitimised through discourse that presents the threat of emergency or promise of sustainability. The negative impacts of traditional management are used to justify its continued implementation. According to the literature, the incentives to legitimise centralised infrastructure appear to lie in the political and economic advantages they confer. The findings of this case study align with this to some degree. The importance of nuanced local political dynamics was highlighted for their role in perpetuating problematic environmental management practices. Further insight could be gained by investigating the impact of power dynamics within urban water management and their influence on the continued legitimacy of centralised water infrastructure.

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And

Thank you to Time, for passing and allowing this experience to be over. I'm sure I will miss it in a year when I am working for The Man.

Contents

Chapter 1: Introduction

This research seeks to understand why centralised water infrastructure continues be a legitimate approach for managing urban water, despite acknowledgement of its social and ecological flaws. This chapter introduces the reader to the background and reason for this research, outlines the methods and methodology used and summarises the main findings of this work.

Background

Chapter 2 provides an overview of the literature that informed this work. The purpose of this chapter is to give the reader insight into why centralised infrastructure would need to be legitimised and explore the ways in which this may be done. To understand why this may of interest, several questions are explored in this chapter. The first is what is centralised urban water management is and why is it problematic? In the case of wastewater, centralised infrastructure can generally be described as water supply that comes from a single or few sources, is transported to urban homes and businesses through reticulated pipe networks, then transported to wastewater treatment plants once it has been used and discharged at a single point into receiving waterways (Bell, 2015). One of the most widely discussed problems with this mode of management is the environmental degradation at the sites of extraction and discharge of water (Obertreis et al., 2016). However, there are more reasons these systems cause concern. For example, they enable consumptive behaviour in cities, unsustainable depletion of water resources and often reflects and perpetuates social inequalities (Tiwale, Rusca and Zwarteveen, 2018; Karvonen, 2011; Obertreis et al., 2016). Many of these systems are not fit to withstand emerging pressures such as climate change and population growth. They fail to account for the socio-ecological complexities that environment managers are expected consider today (Karvonen, 2011).

This leads into the second question explored in this literature review: what is the alternative? In response to the problems associated with centralised water management, the past three decades have seen the

emergence of 'sustainable urban water management' (SUWM) (White, 2017; Sharp, 2017). The major difference between SUWM and traditional, centralised approaches is a greater weight given to social and ecological values. This is implemented using diversified, decentralised and fit-for purpose infrastructures, as well as soft-path approaches such as demand management (Pahl-Wostl et al., 2008; Andersson, Otoo and Nalosco, 2018; Marlow et al., 2013; Bell, 2015; Cousins, 2017; Werbeloff and Brown, 2011). Transitioning towards more sustainable water management is expected to require institutional change. This is evident in the inconsistent uptake of SUWM and continued implementation of traditional, centralised approaches. Given the acknowledgement of the negative implications of centralised water infrastructures and the presence of an alternative solution it is curious that traditional, centralised approaches continued to be implemented and seen as legitimate. This is what this research seeks to understand how this is the case.

In preparation for this investigation academic literature was reviewed to gain an understanding of how centralised infrastructure is legitimised. Three broad explanations were identified. The first was that technocratic decision making can be used to legitimise particular types of infrastructure. The emergence of modern water management with the period of rapid industrialisation and the success of these engineering feats has meant there is a strong belief in the capacity of technical, engineering solutions to improve urban problems and quality of life (Kaika, 2005). As a result, the technical experts in urban water management hold a position of authority and continue to set the terms of how decisions are made. This not only helps to legitimate decisions to implement centralised infrastructure, it undermines the likelihood of sustainable alternatives being taken up. This is because the social and ecological values prioritised in SUWM are incompatible with the measurable, quantitative certainty valued in traditional water management (White, 2017; Pahl-Wostl et al., 2008. Therefore, the process of technocratic decision making used in traditional urban water management helps to facilitate the continued implementation of centralised infrastructure.

The other two possible explanations for the continued legitimacy of centralised water infrastructure relate to the relationship between urban society and water and the discourse used to 'sell' big infrastructure projects. In cities with centralised water systems, residents have deeply embedding everyday practices around water and rely on it for a multitude of uses including personal hygiene, food preparation, cleaning

and recreation, not to mention the importance of water in industry (Bell, 2015). Shifts away from centralised systems would require significant behavioural and social change and the acceptance of more personal responsibility for water management. On top of this, as the invisible medium that facilitates the movement of water through cities, centralised infrastructure acts as a cognitive barrier that prevents people from connecting negative social and environmental impacts with their own water use (Kaika, 2005). Therefore, the second explanation for the continued legitimation of centralised water systems in cities is simply that there is not enough drive from the public for these systems to change.

However, when this normalised relationship with water has been disrupted and there is public demand for action, how do managers continue to convince people centralised infrastructure is a good idea? The third explanation is demonstrated in a number of examples were found in overseas case studies, discursive tools are used to legitimise or 'sell' certain projects. For example, infrastructure has been established as a necessity on the basis that it is an emergency, crisis or that there is no alternative (D'Souza, 2012; Becket, 2013; Crow-Miller, Webber and Molle, 2017). Water security and environmental or sustainability discourses have also been used to present projects in a progressive light (Mills-Novoa and Hermoza, 2017; Warner et al., 2017). It is interesting to note that in each of these examples the negative outcomes of traditional water infrastructure are being used to justify the continued implementation of more centralised devices. From this, one may ask what the incentive is to legitimise this problematic form of water management.

The final part of the literature review seeks to explore the incentives for legitimising centralised water infrastructure. This appears to stem from the political and economic advantages of traditional, centralised networks. These include the improved quality of life, stimulation of industry and the symbolic representation of modernity that large-scale water projects can promote. However, these infrastructures can also be an opportunity for financial gains. This is both in terms of profiting from the sale of water and through the financialisation of infrastructure (Swyngedouw, 2004; Loftus and March, 2016). Whilst these incentives were identified in the literature, it was suspected that when observing the legitimisation and implementation of centralised infrastructure in a context specific setting, there would be local politics and individuals that would influence decisions in urban water management.

Research

Objective 1: *To explore the ways in which centralised infrastructure continues to be legitimised, despite its acknowledged flaws and existence of alternatives*

Objective 2: *Investigate the local incentives to implementing centralised urban water infrastructure*

Chapter 3 explains the methods, methodology and context for this investigation. The continued legitimation of centralised infrastructure was investigated using a qualitative case study. Qualitative research is a useful way to build a complex and holistic understanding of context specific social issues (Jencik, 2011). Case studies are well suited to investigations, such as this, where variables cannot be separated from their context, the investigator has little control over the events and the focus is on a contemporary phenomenon (Merriam and Tisdell, 2015; Yin, 1989). Qualitative case study research is often used to build on theories, rather than to prove generalisable cause and effect relationships (Breuning, 2011; Jencik, 2011). This style of research is often context bound and more focused on building on theories, rather than proving generalisable cause and effect relationships (Breuning, 2011; Jencik, 2011). This sets the tone for this investigation; the objective is to build or detract from the theories described above to understand how centralised infrastructure continues to be presented as a legitimate solution for urban water management.

The object of this case study is Auckland's proposed Central Interceptor project. The Central Interceptor is a large scale, centralised pipe that has been proposed as the solution to address the inadequacies of Auckland's storm and wastewater networks. Auckland has many problems with water quality due to an aging infrastructure system. Water managers have simultaneously expressed a desire to act and adopt water sensitive design, and a continued commitment to traditional water management. The case study is therefore appropriately positioned at the interface between a desire for more sustainable water management and continued commitment to traditional objectives such as growth. The close proximity of this case and timely nature were also incentives to use the Central Interceptor as a case study. This research is intended to represent a microcosm of urban water management, to offer insight into the larger phenomena of continued use of traditional management approaches, despite widespread acknowledgement of their problems.

The dataset for this research consisted of documents that represent the major stakeholders in Auckland's water management: central government, local government, the local Council-controlled water supplier and the public. Reports, plans, publications and articles produced by these stakeholders made up the raw data for this investigation. Due to the varying nature of these stakeholders, different selection criteria were used to obtain data for each stakeholder. Assessment of the dataset to investigate the research objective was carried out using a method of Thematic Analysis adapted from Braun and Clarke (2006). The processes used for data collection and analysis are described in more detail in chapter 3.

Findings

Chapters 4, 5 and 6 discuss the empirical findings of the investigation. In line with what was found in the literature review, chapter 4 discusses the findings around the use of technocratic decision making to both legitimise the Central Interceptor and delegitimise the proposed alternatives. Water managers were found to use quantitative proof of technical as well as social and environmental benefits of the projects to not only present it as the 'best practicable option' but as also as a step towards sustainable water management. This gives weight to concerns in academia that the steps towards sustainability are perceived to be unproblematic and self-evident, given the incompatibility between relational social and environmental values and numeric measurement (Wesselink et al., 2017; Cousins, 2017; Sofoulis, 2015). Interestingly, work was also done to undermine the alternatives and there appeared to be little industry speculation that decentralised alternatives be seriously considered. This indicates that a major reason for the continued legitimation of centralised urban water infrastructure is the continued institutional preference for such styles of management.

Chapter 5 explores the ways the social context and public discussions surrounding the Central Interceptor helped it to become a legitimate solution to addressing the city's wastewater needs. This was observed to happen in three main ways. Firstly, the Central Interceptor was publicly proposed when there was a high local and national awareness New Zealand's water quality issues and an eagerness to address them. This does not appear to be coincidental as local government in Auckland were actively working to present wastewater overflows as an urgent and disruptive problem requiring urgent intervention. Secondly, the Central Interceptor was presented as a solution to these water quality problems. And thirdly, analysis of the dataset found multiple instances where Auckland's public display implicit preferences for centralised solutions. However, the public discourse around the Central Interceptor also provides insight into why

work needed to be done to convince the public that it was the best solution. The project's uneven social benefits and its potential environmental impacts, commonly stated flaws of traditional, centralised infrastructure, were major concerns for the pubic. Again, this chapter confirmed the findings in the literature review, showing that discursive tools are used to 'sell' centralised infrastructure and in many cases, these use the failings of traditional management, such as declining water quality, to legitimate its continued use.

Chapter 6, the final empirical chapter of this thesis, seeks to understand why work was done to legitimise the Central Interceptor in Auckland. This part of the research was prompted no only by the evidence that a significant amount of work had gone into legitimising the Central Interceptor and evidence showing the capacity of water managers in Auckland to fluctuate their support of management approaches. Several possible explanations were found including potential financial gains, potential for the water corporation to gain more autonomy or the alignment of the Central Interceptor with the dominant political discourses of the city. Each aligns with expectations formed in the literature review. Unfortunately, there is a limitation to this line of investigation within the scope of this research. It is suspected there are further incentives are stakeholder dynamics that have driven the legitimation of the Central Interceptor that were not able to be identified within this research.

Finally, chapter 7 is summary and conclusion of the findings of this investigation. It draws on the discussions in each chapter to present this thesis; the continued legitimacy of centralised urban water infrastructure is due to its capacity to incite political or financial gains and provide urban residents with responsibility free use of water. Technocratic decision making and presentation of centralised projects as solutions to the negative effects of traditional water management are the tools used to achieve this perceived legitimacy.

Chapter 2: Literature Review

The purpose of this literature review is to provide the reader with an overview of the relevant academic literature and establish a basis for the research question: How is centralised infrastructure legitimised, despite its acknowledged flaws and the existence of alternatives, and why does central infrastructure continue to be implemented? There are several questions this chapter will address to clarify the reasons for this investigation. The first question is: what is centralised urban water management and why is it a problem? Or in other words: why would centralised infrastructure need to be legitimised? In reviewing the literature, several reasons were found. Centralised water infrastructure is most prominently criticised for its environmentally harmful impacts (Obertries et al., 2016). Although, degradation at the sites of water sources and sinks are more immediately evident, centralised systems enable consumptive lifestyles that cause cities to have ecological footprints hundreds of times the area of the city (Grimm et al., 2008). Together, these are the first incentives to transition away from a centralised mode of management, to prevent more environmental degradation and ensure water security for generations to come. Many of the concerns raised about centralised water are said to come down to the fact that engineers of the 19th century (when these systems were first implemented) did not understand the socio-ecological complexities required for water management (Bell, 2015; Karvonen, 2011). As a result, the networks that were built are inadequate to address emerging pressures such as climate change and population growth. To continue to implement the same infrastructures would be foolish as they have already proven to lack resilience. On top of these concerns, traditional, centralised infrastructure tends to reflect and perpetuate social inequalities and power asymmetries (Tiwale, Rusca and Zwarteveen, 2018; Karvonen, 2011). Therefore, it is expected that centralised infrastructure would need to be legitimised, as its continued implementation would perpetuate inadequacies in water management, environmental degradation, unsustainable resource depletion and social inequalities.

This leads into the second question: what is the alternative? This section explores the rise and implementation of sustainable urban water management (SUWM). Over the past three decades, multiple concepts have emerged from the water management and academic communities to address the concerns

described above (White, 2017; Sharp, 2017). One of the major changes in these more sustainable modes of urban water management is greater consideration of social and ecological values (White, 2017; Marlow et al., 2013). To implement these changes, four main differences in infrastructure were identified in the literature as a departure from traditional, centralised water management. These included decentralisation, diversification, fit-for-purpose water sources and use of soft path approaches (Marlow et al., 2013; Fletcher et al., 2015; Bell, 2015). However, as many academics have noted, this transition towards more sustainable management will not be seamless and significant institutional changes are required. This is evident in the uptake of SUWM in some regions, but its failure to make an impact in others. This establishes two co-existing pathways in urban water: sustainable and centralised, traditional management. This research seeks to understand what is required to legitimise the decision to pursue the traditional approach.

The next part of this chapter explores ways in which decisions in water management are legitimised. Three possibilities were identified. The first was through technocratic decision making. Due to the emergence of modern water management during the period of rapid industrialisation and the success of these engineering feats, there is a strong belief in the capacity of technical, engineering solutions to improve urban problems and quality of life (Kaika, 2005; Karvonen, 2011). As a result, the technical experts in urban water management hold a position of authority and continue to set the terms of how decisions are made. This helps to legitimise centralised infrastructure. At the same time, this undermines the likelihood that sustainable alternatives will be implemented because of the incompatibility of social and ecological values prioritised in SUWM and the quantitative, objective pursuit of certainty in traditional water management (White, 2017; Pahl-Wostl et al., 2008). Therefore, the forms of decision making expected in traditional urban water management facilitate the continued implementation of centralised infrastructure.

The other two possible explanations for the continued implementation of centralised water infrastructure relate to the relationship between urban society and water and the discourse used to 'sell' big infrastructure projects. Urban residents have deeply embedded practices around urban water. These would be difficult to change not only because the infrastructure that facilitates these practices is physically built into cites, they have also been normalised and further engrained due to their co-evolution with other infrastructure networks such as telecommunications and electricity (Kaika, 2005). Water networks have

been hugely transformative for the everyday lives of urban residents and the everyday uses of water. Transitioning away from centralised infrastructure would require a significant amount of behavioural change including the acceptance of more personal responsibility for water management (Sofoulis, 2005; 2015b). On top of this, because centralised water networks are buried underground, they act as a cognitive barrier that prevents people from connecting the negative social and environmental effects of urban water (Kaika, 2005). This effectively reduces the drive to transition away from it. This suggests that in some cases, centralised infrastructure does not have to be legitimised. However, when this normalised relationship with water has been disrupted, how do managers continue to convince people it is a good idea? The literature suggests there are a number of discursive tools that can be used to legitimise certain projects. Examples of these include the justification of infrastructure on the basis of emergency or that there is no alternative, using the threat of water security and by adopting environmental or sustainability discourses to present projects in a progressive light (D'Souza, 2012; Becket, 2013; Crow-Miller, Webber and Molle, 2017). These discursive tools are the third possible explanation for the continued legitimisation of centralised infrastructure. Interestingly, each of these examples use the negative outcomes of traditional water management to direct public focus towards the legitimation of more centralised devices, rather than reflect on the root of these issues.

The final question this chapter seeks to address is why work would be done to legitimise centralised infrastructure. It is suspected that the incentives for its continued implementation are rooted in the possible political or financial gains from centralised water management. In terms of politics, the improvements in quality of life, facilitation of industry and entry to the club of modernity triggered by the control of water through centralised water networks continue to be motivating factors for their implementation (Bell, 2015; Kaika, 2005). In terms of financial incentives, money can be made both from the sale of water via centralised networks and through the financialisation of infrastructure (Swyngedouw, 2004; Loftus and March, 2016). However, whilst these explanations are established in the literature, it is suspected there are more specific explanations to be found.

What is centralised urban water management and how is it problematic?

Modern urban water systems are understood through three purposes: to provide potable-water, dispose of wastewater and protection from stormwater (Rogers et al., 2015). Water management is firmly predicated on the explosion of urban living that came about with the industrial revolution and so is underpinned by a strong engineering discipline. This led to the proliferation of large-scale, centralised infrastructure, typically characterised by dams, large-scale pipes, sewage treatment plants and drainage networks (Bell, 2015; Ferguson et al., 2013). In contrast to natural systems where rainwater percolates into the ground to slowly and diffusely enter waterways, centralised stormwater management sees the collection of stormwater from impervious surfaces of cities using drains and culverts that discharge into waterways at higher volumes and irregular intervals. In regard to centralised water supply, water tends to come from one or several water sources near a city and is transported to individual households via reticulated networks of pipes. Once this water is consumed or metabolised, it is discharged into the sewage network and transported to a wastewater treatment facility and discharged at a single site. This system allows for predictable services with cheap and widespread distribution for domestic and industrial consumption (Werbeloff and Brown, 2011).

There have been undeniable benefits to residents in cities with this form of water management. For example, large scale infrastructure can protect urban residents from natural disasters such as flooding or drought and buffer their effects (Grimm et al., 2008; Ferguson et al., 2013). People no longer face the laborious task of finding and purifying water (Bell, 2015). The availability of clean water increases the ease with which household tasks such as cooking, cleaning, hygiene and laundry can be carried out. Improved hygiene practices and separation of waste from urban streets and waterways has meant that water related public health problems have mostly been eliminated where centralised water infrastructure exists (Bell, 2015). As a result of centralised water management in cities water security and control over water are now considered essential for quality of life, public health and safety (Ferguson et al., 2013; Bell, 2015).

However, the second half of the 20th century saw disillusionment of the heroic engineering feats that characterise centralised urban water (Kaika, 2005). Infrastructure built into the urban landscape at the start of the modern era of water management is proving to have negative implications for cities and their surrounding environments (Kaika, 2005). Centralised systems are now criticised for a number of reasons including their links with environmental degradation, resource depletion, lack of resilience and

susceptibility to abuses of power. The following paragraphs will expand on each of these points. The discussion centres on the problematisation of centralised water management and the reasons that alternative modes of managing water are increasingly sought.

Links to environmental degradation are the most prominent critique of centralised water networks (Obertreis et al., 2016). There is a plethora of ecological impacts associated with this kind of urban drainage and water supply. For example, stormwater runoff can lead to eutrophication, deoxygenation, fish kills, and accumulation and bioaccumulation of pollutants (Bell, 2015; Bakker, 2010). This is because urban runoff enters waterways in greater volumes than it would in a natural system and contains urban contaminants or even wastewater overflows, which affect water quality and stream geomorphology (Grimm et al., 2008; Strang, 2016). Another example is the alteration of waterways to secure water supply for cities. Dams are a commonly used mechanism for doing this. According to Bakker (2010), around 60% of the world's rivers are affected by dams in some capacity and they are acknowledged to have negative impacts on river, estuary and coastal environments, habitats, ecological processes and human lives (Bakker, 2010; Sofoulis, 2005). Lobbying from environmental groups has increased public awareness of the effects of centralised and hard infrastructure systems (Bakker, 2003). Large-scale projects, such as hydro-electric dams, are often contested based on their excessive social and environmental costs (Aledo Tur et al., 2018). These negative effects are the first indication that a different method of managing water in cities may be required. However, in many cases, the appearance of this damage has been incremental and overshadowed by the improvements to quality of life described above (Pentland, 2015). This undermines the urgency and necessity to act.

The ecological impact of centralised urban water does not stop at the immediate sites of water extraction and discharge. The environmental effects extend beyond urban boundaries because water networks create an illusion of limitless supply and demand (Bell, 2015). This enables highly consumptive behaviour and increases water demand and resource depletion (Bell, 2015). Traditionally, water suppliers have responded by maximising supply and minimising efforts at demand management (Bakker, 2010; Werbeloff and Brown, 2011). The outcome is modern cities with ecological footprints hundreds of times the area of city, due to the scale of flows of water, resources and services (including sinks for waste) required to sustain urban lifestyles (Grimm et al., 2008). This is intensifying in response to growth in urban

populations, consumerist lifestyles and globalisation (Bichai and Flamini, 2018; Sharp, 2017). This has significant implications for water security, one of the greatest modern global challenges (Tockner et al., 2016). As it stands, a 40% shortage of water globally is predicted by 2030 and traditional urban water management has had a significant role to play in creating this future (2030 Water Resources Group, 2009). Bakker (2003) suggests these threats are socially produced, which could be interpreted in two ways. Either, that the way in which water is used has led to these shortages. Or, that whether or not water is scarce depends on factors such as population density, sanitary habits and amenity uses and what are defined to be necessities (Bakker, 2003). In both cases, this indicates that movement away from centralised management could be instrumental in creating behavioural change to protect water security for future generations.

Many problems with centralised water management are rooted in the preference for technical decision making and technical solutions. It is increasingly apparent that the social and environmental complexities of urban landscapes were not understood or considered during the initial construction of centralised water networks (Karvonen, 2011). The rational decision making of economists and engineers involved in urban planning first came under question in the 1960s and 1970s (Obertreis et al., 2016). It is commonly argued that the rational, engineering solutions to 19th century problems are no longer adequate given the breadth of knowledge and ethics expected of water managers today (Bell, 2015). Several academics weigh in on this discussion. Ward and Winter (2016) argue that in traditional stormwater management, objectives of health and safety and flood protection overshadow considerations of the complexity of socio-ecological systems. Karvonen (2011) suggests there is an incompatibility between the 'command and control' approach used in centralised management and the ability to address decentralised problems such as nonpoint source pollution. Bell (2015) has been critical of the failure of water managers to acknowledge alternative understandings of problems (water shortages, rapid urban growth, climate change) and potential solutions. It is now widely accepted that water management is not solely a matter of hydrology, engineering and cost-benefits, although these perspectives still dominate the professional sphere (Obertreis et al., 2016). Urban systems are recognised to be complex socio-ecological systems with dynamics of change and limited ability to control variables (Ferguson et al., 2013). It therefore follows that emerging problems in urban water cannot be adequate addressed within the traditional management regime (Pahl-Wostl et al., 2008).

One major outcome of this failure of water managers to account for complexities is the lack of resilience of hard, large-scale infrastructure. Much of the current centralised infrastructure in cities was installed in the 19th and early 20th century. These systems now face pressures and uncertainty due to population growth, climate change, over consumption of resources and social and economic constraints (Marlow et al., 2013; Burn, Maheepala and Sharma, 2012; Bell, 2015). For example, climate change is expected to bring more erratic rainfall, more intense flooding or drought and altered hydrological systems, but the centralised systems already built into urban landscapes were not designed to deal with this (Keath and Brown, 2008; Bichai and Flamini, 2018). The risks associated with these pressures are exacerbated by unwillingness and inability to maintain or repair networks (Bakker, 2003; 2010). Not only are system repairs and upgrades expensive and disruptive, service providers often operate on constrained budgets (Sharp, 2017; Marlow et al., 2013; Karvonen, 2011). As a result, networks have little resilience to existing conditions, let alone additional pressures from climate change and population growth. This shows that it would be foolish to replace these systems with more centralised infrastructure. Not only would more centralised infrastructure continue to deliver the environmental harm described above, it would inevitably need expensive and inconvenient repairs or replacing (which is observed to be difficult on a constrained budget) and be susceptible to increasingly intense and uncertain risks such as climate change. As it stands, the centralised infrastructure built into cities has already proven itself to lack resilience or flexibility to cope with future changes.

It is important to note that the benefits gained from centralised water management and exposure to its detrimental effects are not evenly distributed throughout the population. The development and maintenance of centralised infrastructure is susceptible to influence by political forces and power asymmetries that can develop, perpetuate and reflect socio-economic inequalities (Tiwale, Rusca and Zwarteveen, 2018). There are many easily found examples of this. In the 1960's when water quality in Seattle's Lake Washington was found to be declining rapidly due to urban sewage flows, work was done to divert the sewage to the Duwamish River (Karvonen, 2011). The river, already significantly altered by industrial activity, was a critical source of food and recreation for Native Americans and low-income fishermen in the area (Karvonen, 2011). Both lacked the political power to resist (Karvonen, 2011). This aligns with claims by Obertreis et al. (2016), that infrastructure provision accentuates uneven development and indigenous groups often suffered the most. In the Malawian city of Lilongwe, work was

undertaken to construct a dam that considered the water demands of all the city's residents (Tiwale, Rusca and Zwarteveen, 2018). However, following its construction only the wealthier neighbourhoods could afford to be connected to the supply, as no funding was put aside for unplanned neighbourhoods despite their needs being the initial rationale for the dam (Tiwale, Rusca and Zwarteveen, 2018). This is evidence to show that socio-economic differentiation of costs and benefits is heightened when access to services is dependent on profitability (Swyngedouw, 2004; Moore, 2011; Bell, 2015). The poorest residents of a city may pay the most for water services due the costs of extending networks to poor areas or unplanned, illegal slums that no one is willing or able to pay for (Bell, 2015). Tiwale, Rusca and Zwarteveen (2018) refer to this as the 'dehydration' of slum dwellers, minorities and low-income communities. It reflects and reinforces inequalities. This tells us that if cities continue to use these modes of centralised water management, we will continue to perpetuate inequalities in society by degrading resources used by disenfranchised populations to provide for wealthy urban centres consuming more than their share of resources. Centralised water infrastructure is not a sustainable way to manage water in cities. Its continued use is a promise that there will be more environmental degradation, resource depletion, fragile infrastructure and increasing hardship for the underprivileged populations that experience the majority of these negative effects. It is for these reason that its continued implementation should require some form of legitimation.

The rise in sustainable urban water management

In recognition of the shortcomings of traditional, centralised approaches, the past three decades has seen movement toward more sustainable urban water management (White, 2017; Sharp, 2017). It is increasingly understood that preservation of natural resources is central to the continuation of urban life and water shortages require significant shifts in resource management (Bichai and Flamini, 2018; White, 2017). Developed nations in particular present a growing awareness of the need for more integrated and inclusive approaches (Pahl-Wostl et al., 2008). Aspirations for change in urban water management fall under a number of labels (Marlow et al., 2013). The following concepts all fall under the overarching call for more sustainable urban water (Marlow et al., 2013):

- Integrated Urban Water Management (IUWM) (Fletcher et al., 2015)
- Total Water Cycle Management (Fletcher et al., 2015)
- Water Sensitive Urban Design (Fletcher et al., 2015)

- Sustainable Urban Drainage Systems (SUDS) (Bell, 2015)
- Integrated Water Resource Management (IWRM) (Sharp, 2017; Bichai and Flamini, 2018)
- Adaptive Water Management (Sharp, 2017)
- Sustainable Urban Water Management (Bichai and Flamini, 2018)

Although these alternatives are not identical, they predominantly share objectives of broader professional and stakeholder engagement, institutional change, more thoughtful engagement with the urban water cycle, greater citizen involvement in management and production of a positive ecological legacy (White, 2017; Marlow et al., 2013). They seek to counteract the escalating water stress experienced in cities and exacerbation of existing challenges by climate change and population growth (Pentland, 2015).

Arguably the most significant difference between sustainable urban water management and more traditional approaches is the acknowledgement that social, ecological and economic impacts of urban water challenges are intertwined (Hodson and Marvin, 2009). Managers aim to incorporate environmental considerations such as ecosystem protection, the value of ecosystem services and the potential to provide habitats for aquatic biota (Vorosmarty et al., 2010; Sharp, 2017; Grimm et al., 2008). This is observed in a number of ways. For example, in many places environmental issues have been formally integrated into water resource planning through the requirement of environmental impact assessments and mediation efforts (Bakker, 2010; D'Souza, 2012). Movements including WSUD are attempting to change behaviours (White, 2017). SUWM broadens its focus from public health to include community well-being (Marlow et al., 2013). This also means new metrics should be used to judge success. For example, rather than just the numeric value of water usage or savings, rainwater harvesting can have benefits such as habitat value for urban bird and insect life, amenity value through gardening or behavioural changes though consumer behaviour (Sofoulis, 2015b). In addition to this broader recognition of values, the practical application of sustainable management calls for the implementation of alternative technologies and soft path approaches. These alternatives, discussed in more detail below, are argued to reduce environmental impact and reliance on capital intensive centralised infrastructure (Aledo Tur et al., 2018; Marlow et al., 2013).

From the literature, four key differences were found of the types of infrastructure used in sustainable urban water management and the traditional, centralised management discussed above. The first is decentralisation. Decentralised infrastructure is purported to be a more flexible and accessible way of treating water problems at their source (Pahl-Wostl et al., 2008; Andersson, Otoo and Nalosco, 2018). It can be used to mimic a more natural water cycle by disconnecting waterways from impervious surfaces to make flow regimes more natural and allow diffusion and filtering of nutrients and pollutants that would otherwise enter waterways (Marlow et al., 2013; Sofoulis, 2015b). According to Hodson and Marvin (2009), decentralisation in some cities manifests in the withdrawal from reliance on international and national networks and infrastructures in attempt to re-internalise cities and make them more resilient. This involves re-localising resources and resource sinks, rather than relying on ever distant environments to sustain the city (Hodson and Marvin, 2009). There are downsides and uncertainties associated with decentralised or localised approaches, such as unknown risks or lost advantages afforded by wider networks. One example is the user health risk associated with poorly managed rainwater tanks (Sofoulis, 2015b). However, in the case of rainwater tanks, their environmental risks are minimised by their small scale and decentralised solutions can have broader social repercussions (Sofoulis, 2015b). Decentralised infrastructure can promote innovation, improve landscape amenity, contribute to community wellbeing and prompt social learning and behavioural change (Marlow et al., 2013; Sofoulis, 2015b). Globally, uptake of decentralised systems is increasingly common. For example, household rainwater tanks and greywater systems are used in parts of Australia (Tapsuwan et al., 2014), household level water purification systems along the Texas-Mexico border (Vandewalle and Jepson, 2015), and installation decentralised stormwater devices in various towns and cities of the United Kingdom (Ossa-Moreno, Smith and Mijic, 2017; Henry, 2012).

The second key difference in the two modes of water management is the call for diversification of infrastructure in sustainable water management (Marlow et al., 2013, Bell, 2015). Diversification is a direct response to concerns about the resilience of aging, centralised infrastructure. It aims to increase urban resilience and adaptability to water shocks, such as extreme rain events and droughts, and form a more holistic strategy for managing water (Cousins, 2017; Werbeloff and Brown, 2011). A diverse range of water infrastructure may include multiple water sources, a range of demand management initiatives and use of both centralised and decentralised technologies at multiple scales (Werbeloff and Brown, 2011).

An example of this approach is in the Ethiopian city of Addis Ababa's use of a range of supply and demand management approaches as part of their Integrated urban water management (Worku, 2018). The city aims to use a range of water sources, including surface water supplies, groundwater development and stormwater harvesting, promote cleaner production through pollution prevention, water recycling, reuse and conservation and inclusion of demand management techniques (Worku, 2018). This is a direct contrast to the hard-path approaches of traditional water infrastructure. Flexible infrastructure allows managers to adapt to impending challenges such as climate change and urban population growth with greater ease. However, although this appears to be a pragmatic response to concerns about infrastructure resilience, it may only be in regions where there is sufficient threat of water shortage that managers take steps to implement it. In Ethiopia and Australia, countries that have attempted to diversify the water infrastructure, have both faced serious threats of water shortage. Addis Ababa faces pressures of water scarcity due to the regional weather patterns and conditions are already strained due to climate change, population growth and water demand (Worku, 2018). Therefore, while this seems like a sensible response, the drive to implement it may only exist in regions already experiencing problems with water security. This limits its use because, as described above, often it is not the regions experiencing problems that are responsible for causing them.

The third main difference in the infrastructure of traditional, centralised water management and more sustainable approaches is the uptake of 'fit-for-purpose' water systems. 'Fit-for-purpose' water systems attempt to use water from multiple sources and treat it based on the quality required for the end use (Bichai and Flamini, 2018). This was prompted by the re-evaluation of water as a valuable and increasingly scarce resource (White, 2017; Sharp, 2017). Instead of solely coming from sources such as dams, reservoirs or rivers, water could also come from non-traditional sources such as wastewater reuse, rainwater, stormwater harvesting and desalination (Bichai and Flamini, 2018). The SUWM literature proposes that through more integrated approaches water throughout the water cycle could be used for its most appropriate uses (Marlow et al., 2013). This could be used to address many of the environmental problems discussed above. For example, stormwater harvesting via decentralised devices can supply water for non-potable uses and protect downstream ecosystems from urban runoff (Rogers et al., 2015). Wastewater recycling networks can also return sewage to non-drinking water standards for non-potable

uses (Rogers et al., 2015). Non-potable water can be used to meet multiple demands such as landscape irrigation, industrial applications, groundwater recharge and recreational uses (Marlow et al., 2013). This can reduce demand on potable water sources and reduce to the discharge of polluted water into rivers and creeks (Marlow et al., 2013; Rogers et al., 2015).

The fourth and final key difference that was identified in the literature was the promotion of soft-path approaches in sustainable urban water management. This includes mechanisms such a pricing, user participation, awareness raising, retrofitted approaches, information accessibility and empowering of water users (Crow-Miller, Webber and Molle, 2017; D'Souza, 2012; Swyngedouw, 2004). It is a significantly different approach to traditional urban water management, which privileges the use of technical solutions and technocratic decision making. A major soft-path mechanism is demand management. This shifts the focus away from finding new water sources to reducing demand through conservation, new water saving techniques and technology, water reuse and education (Bakker, 2010). It is important to note that implementation of these alternative approaches is not without challenge. Sofoulis (2015a; Fam and Sofoulis, 2015) argues for inclusion of social science and humanities experts to facilitate better industry understanding of how localised water cultures, behaviours, geographies and histories may be instrumental in shifting behavioural patterns. As it stands, the traditional scientific, rational approach to water management lacks the expertise to understand and influence the complexity and sociology of water behaviour (Sofoulis, 2013). It has not escaped the notice of those pushing for more sustainable urban water, that the existing institutional systems that manage water in cities will be a significant barrier to achieving change.

To successfully transition to more sustainable urban water management, a more inclusive and transdisciplinary approach to urban water is needed (White, 2017). Successful integration of broader values and different, diverse infrastructure is predicated on institutional changes within water management. To make this a reality the academic literature calls for integration across sectors, more sharing of information (Pahl-Wostl et al., 2008), continuous collaboration between science, policy and urban planning, (Ferguson et al., 2013; Bell, 2015) greater openness to experimentation (Karvonen, 2011), more transparency and accountability for managers (Pentland, 2015) and finally, more public participation and engagement (Bell, 2015). Evidently, this is no small or simple task. On top of this, the role of the public

would need to change. Rather than acting solely as the receivers of water services, as they currently do, under sustainable urban water management the public would become active stakeholders in its management (Sharp, 2017; Ward and Winter, 2016). This means community acceptance and buy-in is critical (Andersson, Otoo and Nalosco, 2018). However, Bakker (2010) warned that although water can be effectively managed by communities in some circumstances, such when communities are small and have a high degree of social capital, success is not guaranteed. She suggested that transitions towards more inclusive management requires critical reflection on what is meant by community (2010). This hints to another barrier in the transition towards sustainable water management; in order to be successful, the public have to want it. Otherwise, there is no drive to make it happen.

Two established pathways

What emerges from the last three decades of push for sustainability is a fork in the road, with two established pathways: sustainable urban water management and traditional, centralised control of urban water. As demonstrated in the discussion above, the attitudes and infrastructures proposed in the SUWM literature have been adopted and implemented in many regions. However, promotion of sustainable approaches has not gone unchallenged and the transition has not been seamless. Many ideas behind SUWM are considered 'nirvana concepts' in that they paint the future in very broad terms which are difficult to disagree with but are open to very different interpretations (Molle, 2008). Many calls for sustainable water management have been criticised for their unclear definitions and lack of evidence to support their purported benefits (Sharp, 2017; Marlow et al., 2013). Another issue is that the transition is expected simply to be the next evolutionary step for urban water management, despite warnings from academics that sustainability will not simply be a matter of progression of political values and technological efficiency (Marlow et al., 2013). There are complicated issues around governance and the distributions of knowledge and responsibility that must be attended to (Sofoulis, 2015b). It is also important to note that in many cases, the immediate challenges in urban water continue to be lack of access to safe water, sanitation and adequate drainage and while there has been some evolution, the dominant model of service provision remains unchanged (Gandy, 2004; Marlow et al., 2013).

It is perhaps for these reasons the push for decentralised and soft path approaches has failed to make an impact in many regions. In many countries, particularly in Southeast Asia, Africa and South America, there never was a turn away from centralised management and the dominant regimes have been resolutely

resistant to change (Crow-Miller, Webber and Molle, 2017; White, 2017). This is observed in India's minimal acknowledgement of demand management solutions or the lack of movement away from fiscally cheap but ecologically expensive end of pipe solutions in multiple European nations, despite conflicting directives from the European Union (Crow-Miller, Webber and Molle, 2017; Strang, 2016). Examples of large scale projects underway include China's South-North Water Transfer Project, South Korea's 33 km seawall construction and Jakarta's (recently foiled) Great Garuda Sea Wall project (Colven, 2017). Officials and scholars in China have criticised water managers for their failure to reflect upon the dangers of failed large-scale projects throughout the 20th century (McCormack, 2001). These projects may be indicative of a trend towards centralised approaches that reinforce the dominance of the engineering management of urban water (Crow-Miller, Webber and Molle, 2017). Interestingly, this trend is also observed in nations that have expressed objectives of sustainable water management. For example, in 2011 London completed construction of a £270 million desalination plant and are in the process of constructing the £4.2 billion Thames Tideway Tunnel (Loftus and March, 2016). The World Bank has returned to investing in large dams and nations including Australia, South Africa and Mexico have large-scale projects underway, despite a rhetoric of demand management and integrated water resource management (Crow-Miller, Webber and Molle, 2017; McCulligh and Tetrault, 2017; Strang, 2016).

It is this fork in the road of urban water management that prompts the overarching question for this research: how is centralised water infrastructure legitimised, despite acknowledgement of its flaws and presentation of alternative pathways? In order to approach this investigation from an informed decision, academic literature was reviewed to find reasons for the continued implementation of centralised infrastructure. The possible explanations found, and discussed in more detail below are organised into three main categories. The first explanation is that technocratic decision is used to legitimise centralised infrastructure. The second, is that due to the embedding of centralised water infrastructure in cities and the resulting behavioural changes, the public do not expect to see a shift away from traditional water management unless the negative repercussions are significant enough to trigger action. The third category applies when this is the case and involves the use of discursive arguments to legitimise centralised infrastructure.

Using technocratic decision making to legitimise centralised water infrastructure

This section explores how the technocratic management found in traditional urban water works to legitimise the continued implementation of centralised water infrastructure in cities. A major part of the perceived legitimacy of certain infrastructures is the authoritative position of the water managers and experts who propose them. This authority has its roots in the 'heroic saviour narrative'. This stems from the period of rapid industrialisation from the mid-19th century that Kaika (2005) terms humanity's 'Promethean project'. The Promethean project is named after the Greek god Prometheus, whose gift of fire enabled humanity to harness and control nature for society's betterment (Kaika, 2005). Scientists and engineers are credited as the Prometheans of the modern era. They are the 'heroic saviours' of humanity, in its quest to control nature in the name of progress (Kaika, 2005). It is easy to understand why the projects suggested by these managers and experts would be accepted. The implementation of modern water networks under the direction of their predecessors lead to the virtual elimination of water based public health problems and urban residents were emancipated from concerns about water quality and quantity (Bell, 2015). This initiated a leap in progress and prompted a new ideology that with technology, nature could be harnessed to improve quality of life (Kaika, 2005). To this day, there is an unwavering belief in 'technological salvation' and the ability of engineering and engineers to overcome emerging problems, including environmental challenges (Karvonen, 2011; Colven, 2017). It is partly due to this highly regarded position in water management that the technocratic solutions of water managers and experts, including centralised infrastructure, continue to be privileged, revered and accepted.

Is accepting the suggestions of water managers on this argument alone too simplistic? Water managers can set the terms in which decisions are made. Water management has long been considered a technical process, backed by the scientific ideal of objectivity, quantitative knowledge, population statistics, measurable hydrology and emphasis on problem solving through better linkages between science, technology and the market (Sharp, 2017; Sofoulis, 2015a; Fam and Sofoulis, 2015; D'Souza, 2012; Cousins, 2017). Decisions based in these technical and rational considerations are expected to be neutral and a-political (Karvonen, 2011). This rationalist approach enables the complex social, political and environmental implications of water management to be redefined as technical problems (Wesselink et al., 2017; Sofoulis, 2015a; Karvonen, 2011). Therefore, any attempt to pursue sustainable water management, which seeks to incorporate potentially unquantifiable social and ecological values, is fundamentally at odds with traditional modes of management. A good example of this is found in Sofoulis'

(2015b) discussion on the reasons for the mixed attitudes towards rainwater tanks within urban water management. Tanks are judged by the same criteria as centralised water supply systems and are therefore considered economically inefficient and inadequate for supply augmentation (Sofoulis, 2015b). However, this criterion does not account for their potential environmental or social benefits or frequency of people installing tanks for reasons other than to save money (Sofoulis, 2015b). Innovation is also frequently resisted by policy makers due to barriers such as uncertainty around costs and performance, lack of perceived legitimacy and institutional inertia (White, 2017). This resistance to alternatives indicates that anywhere traditional management regimes remain, centralised infrastructure has a greater chance of being perceived as legitimate because its benefits can be proven using the metrics described above.

Preference for technical engineering solutions in water management has been observed and discussed by multiple academics. In discussion with water managers, Cousins (2017) found that better management was perceived to be best achieved by improved science, stricter regulation, expert problem solving through science and technology. There tends to be a culture where engineers only see and value engineering solutions (Cousins, 2017). This is reinforced by the inability or unwillingness of managers to engage with diverse actors (Rogers et al., 2015). According to Kingdon (1984), policy alternatives are often generated by a narrow field of specialists. The exclusion of non-scientific, non-rational and non-engineering experts reduces the pool of alternative ideas to be taken up. The high value placed on scientific knowledge also acts as a barrier. Science is one of the most authoritative forms of knowledge and is the dominant language of persuasion in modern societies (Knaggard, 2015; Goodwin et al., 2001). Local knowledge has a comparatively low status and holds less weight in decision making (Knaggard, 2015). On top of this, Karvonen (2011) claims that to further cement their role, the techno-managerial elite have managed to solidify their role by extending their role into environmental management. Alternative approaches that prioritise environmental values are considered romantic, idealistic and unrealistic (Strang, 2016). This paints a picture of an urban water management trajectory that is characterised by a reinforcing and expert led technological momentum (De Souza, 2012; Cousins, 2017). Once again this indicates under traditional management regimes, centralised solutions are likely to be considered legitimate by decision makers.

So far, this review has acknowledged the authoritative position of water managers, but not the political implications of this. Centralised infrastructure is more likely to be considered legitimate because it is proposed by these 'heroic' water managers and the water management community prefer technical solutions that can be backed with objectivity and certainty. It is this objectivity that suggests technical management is a-political. This is a problematic and flawed assumption. The weight given to scientific knowledge and technical decision making can obscure power dynamics and political objectives. People making decisions could be biased by a plethora of factors including professional networks, organisational monopolies, incentives for career advancement and the prevailing ideology that centralised planning and organisation is required for infrastructure management (Colven, 2017; Crow-Miller, Webber and Molle, 2017; Scott, 1998). In their case study of Lilongwe, Malawi, Tiwale, Rusca and Zwarteveen (2018) observed multiple ways engineers perpetuate inequalities due to political or financial pressures. They found that found that field level engineers regularly divert water away from poorer regions to better serve areas under the orders of their superiors. This demonstrates that it is important to consider the ways in which science may be unbiased, but scientists and engineers may not be; rational assessments may be swayed by political agenda (Knaggard, 2015; Zwarteveen et al., 2017). This is indicative of the power given to a-political experts and the capacity of water management regimes, under the guise of administrative rationalism, to pursue political objectives. Therefore, while managers have the authority to judge what is considered to be legitimate in urban water management, there may be larger power or incentives for them to privilege traditional solutions.

In conjunction with possible incentives to continue to use traditional approaches, centralised infrastructure may be easier to legitimise because of the limited adoption of SUWM ideology with the water sector. Despite industry assumption that the steps towards sustainable management are self-evident and unproblematic, scholars maintain the change will not occur through progress in technical efficiency and political values alone (Wesselink et al., 2017; Bell, 2015). Sofoulis (2012) suggests that stronger assimilation of social sciences will help managers create better tools to combat the issues with current water management practices. Management of urban water continues to be dominated by engineers who lack value and respect for social science, remain ambivalent towards community driven interventions and indifferent towards directing outreach and education towards the community and household levels (Wesselink et al., 2017; Sofoulis, 2015a; Cousins, 2017). Attempts to introduce decentralised infrastructure have been impaired by these attitudes. For example, Australia's demand

management strategies failed to achieve their intended impact (Werbeloff and Brown, 2011). Werbeloff and Brown (2011) propose demand management may have been more successful had it not been developed in isolation without considering how different experts could have made it more successful. Sofoulis (2012) suggests that strengthening linkages to social science could increase understanding of human impacts on the environment and create better tools to combat this. Another issue is that policy makers continue to address issues and formulate policies in silos (Werbeloff and Brown, 2011). For example, there is a disconnect between Australia's 'Security through Diversity' policy and how it has been interpreted by those who implement it (Werbeloff and Brown, 2011). The implication of this is that centralised infrastructure continues to be considered legitimate because there is not enough pressure within water management for it to be considered otherwise.

This discussion suggests that traditional urban water management, in its current form has the authority and tools to continue to legitimate its preferred centralised solutions. It also appears that scientific, objective forms of knowledge are considered in technocratic decision making to the exclusion of alternative ways of knowing, social and ecological values and the experts that would improve the integration of these elements into urban water management. Going back to the very start of this chapter, the centralised infrastructure pursued by technocratic experts is known to have a myriad of negative social and environmental effects. Even if centralised infrastructures can be legitimised within the urban water management community, how can they be presented as legitimate to the public?

The mutual transformation of water and society

This next section seeks to understand how the public are convinced of the legitimacy of centralised infrastructures. In conjunction with the prevailing trust in engineers and technocrats, their hard path, centralised approaches remain prevalent in cities due to their physical permanence. As a result, they have been normalised and this increases the likelihood of their continued implementation. The legacy of past water management regimes is literally built into cities (Bell, 2015). The longevity of these early engineered

systems, such as the Victorian sewers, was ensured through major initial investments of funding, labour and materials (Strang, 2016; Swyngedouw, 2004). On top of this, water management and broader urban planning have co-evolved with the existing networks and this is reflected in the normal practice of city planning and urban metabolism (Karvonen, 2011). These centralised systems are further normalised because they have similar structure and modes of governance to other large technical systems, such as telecommunications and electricity (Karvonen, 2011). But these infrastructures have had far more than simply a physical impact on modern cities. The control of water in cities using centralised infrastructure has fundamentally changed the day to day lives of urban dwellers. The following section explores the ways in which the transformative impact of embedded centralised infrastructure in cities undermines the desire to transition to more sustainable ways of managing water. In effect, without the demand to eliminate centralised systems, there may not be a need to publicly legitimise them.

The permanence of traditional modes of water management is in part due the undeniable benefits of modern water systems for health, sanitation and quality of life. Prior to what Solomon (2010) refers to as the industrialised world's 'sanitary awakening', urban water networks had significant impacts on public health. Illegal dumping of waste into surface water networks led to public health crises, including epidemics of cholera and typhus (Karvonen, 2011). Urban dwellers faced the laborious task of finding, transporting and purifying water (Bell, 2015). However, through the installation of large-scale, centralised water infrastructure, water became disciplined and controlled according to the will of society (Ferguson et al., 2013; Bell, 2015). These networks made water available for domestic and industrial use and safeguarded cities from certain natural disasters, such as flooding or drought (Grimm et al., 2008; Ferguson et al., 2013). The taming and control of water is now a prerequisite for urban development, deemed essential to good public health and understood as an entitlement of citizens of industrialised cities (Kaika, 2005; Bell, 2015; Bakker, 2010). Expectations of a sanitised city extend to expectations of free flowing water within individual household. The private bathroom is only made possible by a whole culture of engineering and infrastructure (Sofoulis, 2005). Non-existent prior to the sanitary awakening, private bathrooms are now necessities for households in modern cities. The unlimited flow of water into houses is now deemed normal and essential for everyday activities including showering, flushing toilets, kitchen uses and laundry. The embedding of these norms in society mean that urban residents now expect these services and do not foresee a future where their behaviour around the use of water will have to change.

The way in which urban residents receive water has transformed the ways in which it is consumed. Conventional water infrastructure systems are central to allowing consumptive practices (Bell, 2015). According to Illich (1985) the volume of water used by the average U.S family increased from one to three gallons per day to 30-100 once they gained access to water through domestic taps. Bell (2015) claims that modern levels of water consumption cannot be explained by hedonistic social values, they are a product of urban infrastructure and domestic technologies. According to sociologist Elizabeth Shove (2003), environmentally significant consumption is directly related to norms and expectations of convenience. Domestication of water has emancipated people from regimes of diurnal and seasonal change (Shove, 2003). Tasks such as laundering that, in the past, would take all day, now only require a few moments of attention (Shove, 2003). The extent of these consumptive behaviours is exacerbated by a positive feedback loop: tasks are now expected to take less time to complete, therefore more tasks are expected to be carried out and this necessitate more (consumptive) technology to enable fulfil these expectations (Shove, 2003). Household water consumption is determined by cultural, generation and workplace values around cleanliness (Sofoulis, 2005). However, people have developed uses of water that go beyond basic health and sanitation (Bell, 2015). The private, domestic use of water means it is a "socially anonymous resource" (Shove, 2003: 5) and its consumption through infrastructure largely goes unnoticed (Bell, 2015; Shove, 2003). People are only challenged on their water use when something goes wrong with the network (Bell, 2015; Shove, 2003). Centralised water networks have directly transformed the way water is used in society and the anonymity and normality of the ways in which residents consume water reinforces its continued management in this way. A significant amount of behavioural change would be required to transition aware from a reliance on centralised infrastructure.

Evidently, centralised networks in cities have conveyed significant improvements to urban life. On top of this, the hydro-social contract used in traditional water management delegates responsibility for water to local government and 'big water', permitting the users minimal accountability. The hydro-social contract is an implicit agreement between communities, businesses and governments on how water should be managed and valued (Wong and Brown, 2009). Residents consider stormwater management to be primarily the responsibility of local municipalities and the responsibilities of the recipients of wastewater services "flush away users' responsibilities for water's post-supply fate" (Ward and Winter, 2016; Sofoulis,

2005). Sofoulis (2005) described the responsibility for water concerns as delegated to 'Big Water' and 'Big Shit' organisations and a hydro-social contract where individuals' autonomy over water is surrendered in return for water, convenience and security (Sofoulis, 2015b). In contrast to this, proponents of more decentralised systems imagine that individuals will have a much more active role and have ingrained values of protecting intergenerational equity, natural resources and ecological integrity (Wong and Brown, 2009; Brown, Keath and Wong, 2009). With these considerations in mind it is easy to understand the appeal of centralised water infrastructure. The need to legitimise traditional forms of water management because its negative social and environmental impacts, is arguably less urgent or essential from the perspective of someone in a developed city experiencing all of these benefits, minimal responsibility and not exposed to the social inequalities that are the by-product of this system. This suggests that perhaps in some cases, centralised infrastructure does not have to be legitimised.

Kaika (2005) suggests that urban water networks are a cognitive barrier between water users and their negative impacts. The supports the idea that centralised infrastructure does not need legitimising. Kaika (2005) refers to these networks as 'material mediators'. They transform nature into resources, utilities and services such as water supply, gas and electricity (Kaika, 2005). Water supply networks transform water from a natural element into a socially produced commodity that is potable and safe to drink (Kaika, 2005). However, the infrastructure also acts as a structural and cognitive barrier between people and receiving waterways (Ward and Winter, 2016). A 2016 study by Ward and Winter found that although urban residents were generally concerned about the health of urban water waterways, they did not understand the link between their behaviour and changes in ecological conditions. Due to the buried and invisible nature of these networks, it is not apparent where water has come from and urban residents are not regularly forced to reflect on its source or the ecological impacts of its use (Kaika, 2005; Ward and Winter, 2016). Sofoulis (2005) also described the user-friendly water devices in homes reinforce the existing hydro-social contract and restrict change. For example, unobtrusive taps and unpluggable drains are designed for using and wasting water quickly, deferring responsibility to 'big water' (Sofoulis, 2005). This inhibits transitions to alternative modes of water management. During times of crisis or attempts to address consumption of water and energy it is the two ends of the pipe, rather than the pipe itself (and its associated practices and expectations) that comes under scrutiny (Bell, 2015; Shove, 2003). Effectively, the compelling reasons for transitioning away from centralised water infrastructure are hidden from urban residents by the very infrastructure that causes them. This decreases the perceived urgency to change and the need to legitimise the choices of water managers.

Using discourse to legitimise centralised water infrastructure

As it stands, residents of wealthy, industrialised cities may have little motivation to alter their conventional water networks. Wealthier nations tend to tolerate higher levels of stress on their waterways because they can reduce negative impacts with infrastructure and technology (Vorosmarty et al., 2010). In these cases, the negative impacts of centralised systems could be considered conditions rather than problems because they can be ignored or endured (Kingdon, 1984). However, disruptive events, such as a natural disaster or crisis, may draw attention to negative conditions or reveal threat of devastation (Kingdon, 1984; Michaels, Goucher and McCarthy, 2006). According to Shove (2003), redefinition of habits will not occur until environmental considerations are weighty enough to displace current understandings of how everyday life should be and moments of de-routinisation are critical enough to make people reflect on their habits. These moments of critical reflection have been observed to take place during disruptive events such as droughts. Drought can make people consider the connection between their homes and water supply from dams and has triggered people to take water supply into their own hands out of skepticism of the reliability of utility services (Kaika, 2005; Sofoulis, 2015b). An event, such as this, could be disruptive enough to make urban residents question their embedded water systems. When citizens have started to demand answers, how do water managers continue to legitimise their centralised solutions?

In reviewing the academic literature, it was found there are several ways that the discourse used to sell infrastructure projects has shifted. The first of these was the argument that large-scale water projects are a necessary response to crisis. The politics of emergency is a discursive tool used to convince people of the need for infrastructure (D'Souza, 2012). An emergency situation is a state of exception that incites the understanding that emergencies are moments of great danger and necessitate an urgent response (D'Souza, 2012; Becket, 2013). In such a state response, such as the implementation of centralised infrastructure, that could be objected to under ordinary circumstances, are legitimised as the appropriate response by powers of authority. 'There is no alternative' is another rhetorical device often associated with implementing infrastructure (Crow-Miller, Webber and Molle, 2017). This goes with the idea that infrastructure building is a no regrets process; Everyone can agree that something needs to be done and

so there are only two options; advance or retreat (Crow-Miller, Webber and Molle, 2017). In both cases, infrastructure can be legitimated on the implicit suggestion that refusal to allow it would be disastrous.

Another discursive tool used to legitimise large-scale, centralised water infrastructure is the threat of water security. Security against climate change threats such as flooding, sea-level rise and water shortage is provided as the rationale for projects that increase storage capacity (Crow-Miller, Webber and Molle, 2017). For example, uncertainty around climate change and water supply in Nevada, USA, has been used to justify additional water supply infrastructure because demand management was judged incapable of combating continual shortage in the Colorado River (Welsh and Endter-Wada, 2017). Public anxiety about drought in California has also been used as major political tool to gain public consent for large scale projects (Kaika, 2005). Another example is the 2007 announcement by the Victorian government in Australia for plans to construct a desalination plant that could supply one third of Melbourne's annual water supply (Rogers et al., 2013). Prior to this, desalination had not been seriously considered due to the assumed high level of security in the city's existing reservoirs (Rogers et al., 2015). However, as the Millennial drought became more acute in 2006, desalination began to be considered more seriously by the government (Rogers et al., 2015). Interestingly, what is observed in these examples is the use of public discourse to direct public focus towards the legitimation of more centralised devices, rather than reflect on the traditional water management systems at the root of these issues.

Lastly, large centralised projects are adopting environmental and sustainability discourses to convince the public of their need. For example, in Peru discursive and legislative soft path and participatory processes have been useful in attracting financial investments and justifying mega projects (Mills-Novoa and Hermoza, 2017). The nation's water resource management policies emphasise an integrated approach but have mechanisms that allow for the approval of large scale-process when it is considered an exceptional measure for public interest (Mills-Novoa and Hermoza, 2017). In Ecuador, a discourse of respect for Mother Earth is used to promote dams as clean energy projects and champion irrigations schemes and flood control structures as part of a greening the economy (Warner et al., 2017). Environmental impacts can also be assimilated into consumer culture as a marketing method (Shove, 2003). Policy makers can encourage citizens and consumers to make the environment their preferred brand by imbuing ordinary products and activities with environmental significance (Shove, 2003). What is

observed in all three of these discursive tools is the use of problems that are intrinsically related to centralised water management, to convince the public or legitimate the need for more centralised infrastructure.

Why is work being done to legitimise centralised infrastructure?

This prompts the next major question of this investigation: why is work done to legitimise centralised infrastructure? Analysis of the academic literature on urban water management suggests this is because water is a resource that can be exploited for political and economic gain. Circulation of water is a fundamental part of modern society. It is a critical part of industry, agriculture, energy production and urban utility provision, not to mention: a basic necessity for life. Centralised water infrastructure, facilitates centralised control of this resource (Strang, 2016; Sharp, 2017). It is therefore widely held that the control of water is an inherently political issue (Aledo Tur et al., 2018; Bell, 2015; Swaarteveen et al., 2017). Drawing on the literature and examples from overseas, this final section of the literature review explores some of the political and financial incentives for implementing centralised infrastructure and therefore, for working to legitimise it.

Since their boom in the industrial revolution, large scale water projects have been attractive as symbols of modernity and tools for nation building. In the 19th and early 20th century, centralised projects, particularly dams, symbolised a nation's entry to the 'club of modernity', technical prowess, industrialisation and progress in regional and global power (Bakker, 2010; Tockner et al., 2016; Colven, 2017). This period of hydraulic progress was symbolic of a nation's ability to dominate nature for its own gain (Colven, 2017; Bakker, 2010). Although dam production slowed towards the end of the 20th century, they are beginning to re-emerge as a show of modernity (Bakker, 2010; Crow-Miller, Webber and Molle, 2017). For example, as China becomes more open to the world it is showcasing its ability to rely on its own technical capacity through large scale projects, such as the Three Gorges dam or The South-to-North Water Diversion Project (Crow-Miller, Webber and Molle, 2017). Symbolism of modernity and progress continue to be strong incentives for infrastructure construction in the 21st century. The 'world class city' is powerful imagery and attempts to achieve a 'world class aesthetic' tend to justify and prompt investment into large, visible, modern projects (Ghertner, 2015; Colven 2017). Indonesia's Great Garuda Seawall is an example of this. The project was pursued by political elites to be a visual representation of

capital accumulation and Jakarta's desire to be world class (Colven, 2017). Although the popularity of large-scale water projects may have dropped for a time in the 20th century, that the vision of modernity and becoming 'world class' seemingly continues to be a powerful incentive to invest in centralised infrastructure.

Another development from the industrial revolution was the narrative that urban growth is necessary in order to produce wealth, employment and housing for society's betterment (Dryzek, 1997). This narrative continues to fuel the implementation of centralised systems. Growth was, and continues to be, closely associated humanity's promethean project and the quest to control and tame nature through technology, human labour and investment (Kaika, 2005; Swyngedouw, 2004). For urban water, this was manifested through command and control management approaches (Karvonen, 2011). The prevalence of these concepts in the past has implications for the future of urban water. Based on the (widely held) assumptions that future development will take place within the requirements of capitalist economies, there are expectations that lifestyles should improve over time, abundance and demand for natural resources will expand and one of the basic requirements of governments is to ensure continued economic growth (Shove, 2003; Sharp, 2017; Dryzek, 1997). The prevalence of growth narratives even extends to the pursuit of sustainability. There is a view that achieving sustainability in cities and attention to environmental and social concerns are predicated on economic growth (Hodson and Marvin, 2014; Strang, 2016). The continued presence of these discourses in the 21st century indicates that urban water will continue to be subject to political expectations that privilege management solutions that facilitate growth.

Infrastructure itself is regularly touted as an appropriate investment to stimulate gains in prosperity (Flyvbjerg, 2009; Aledo Tur et al., 2018). It is understood to be essential to society's betterment and instrumental in harnessing nature for urbanisation, industrialisation, improving productivity and competitivity and supporting capital accumulation (Helm, 2008; Bell, 2015; Bakker, 2003). Water infrastructure is considered to be particularly important for social and economic growth for several reasons. First, it forms the basis of other sectors including power, communications, irrigation for agriculture and reclamation for land development (Bakker, 2010). For example, a key part of Brazil's Growth Acceleration Programme was investment into hydropower (Aledo Tur et al., 2018). This was intended to stimulate growth in the nation's GDP and improve access to basic utilities and service

provision (Aledo Tur et al., 2018). This follows the prevailing assumption that sustained growth in water use is necessary for economic growth and provision of services for population growth (Bakker, 2003). Secondly, water infrastructure is useful because it facilitates the socio-environmental transformation of water into a commodified good, initiating a chain of monetary exchange (Kaika, 2005). Residents pay for water, being connected to the water network and the processes involved in maintaining these services (Kaika, 2005). Third, large-scale infrastructure acts as a visual symbol of industrial expansion and economic growth (Sharp, 2017). "In short, technology networks are the carriers of goods and services that promise to deliver the modernist dream for a happier, better society, with supply of water, electricity, health, food for all (Kaika, 2005: 33)." Therefore, there is a political incentive for investment into water infrastructure for the betterment of the nation's collective well-being.

Large-scale water infrastructure projects can also be attractive for their potential to facilitate financial gains (Loftus and March, 2016). Mega-projects, such as the Thames Water Desalination Plant and the Great Garuda Seawall Project, are attractive to developers because they hold potential for speculative gains, financialisation or present opportunities for future investment (Loftus and March, 2016; Colven, 2016; Loftus, March and Nash, 2016). For example, the Great Garuda Seawall was intended to stimulate property investment on reclaimed land, construction of a toll road and to produce profits to cross subsidise flood mitigation infrastructure (Colven, 2017). London's desalination plant relied on a broader prioritisation of large infrastructure at the expense of strategies of demand management (Loftus and March, 2016). At the same time, despite wide availability of decentralised and water savings technologies, uptake is limited because private companies are reluctant to invest (Swyngedouw, 2004; Cousins, 2017). The more water people save, the less money can be made corporatising and commodifying it (Sofoulis, 2005). This risk shifting power away from big water organisations (Sofoulis, 2005). Devices such as household rainwater tanks are sites where water organisations are not in control and this reduces the likelihood they will receive the necessary political and institutional backing required for their implementation (Sofoulis, 2015b; Bell, 2015).

In the latter part of the 20th century many nations including the United Kingdom, Australia and New Zealand, experienced shifts in water governance in line with wider neoliberal reforms (Castree 2003, 2005). These changes have implications for the continued implementation of centralised infrastructure.

Generally, these reforms involved deregulation of state control over industry, opening of trade in natural resources, exposure to market mechanisms and corporatisation or privatisation of state service providers (Castree, 2003; 2005). Environmental management, including of water, was influenced by these changes because it was the state's responsibility (Castree, 2003). In water management, privatisation usually refers to the sale of the state's infrastructure assets (rather than water itself) to an organisation or institute (Castree 2003; 2005). Proponents of privatisation suggest private companies perform more efficiently than the state, mobilise better experts, have the capacity to deliver profits to the state and its citizens and produce more environmentally friendly outcomes (Bakker, 2010; Castree, 2003). In addition, making utilities independent is said to de-politicise them in favour of business-like management (Furlong et al., 2018). Publicly owned corporations are also common; purported to achieve the business benefits of private companies, with retention of state ownership (Furlong et al., 2018). Like private companies, water corporations make use of neoliberal methods such as full cost recovery, volumetric metering, market-based performance measuring more applicable to utility management (Furlong et al., 2018). The level of autonomy corporations hold is contextual, it is negotiated and reflective of the relative power of the region's public and private sectors (Furlong et al., 2018). As it stands, the centralised networks managed by these organisations facilitate monopolistic control and profitability (Swyngedouw, 2004). According to Sofoulis (2005), it is through these infrastructures that they reinforce this monopoly and resist emergence of decentralised alternatives that are a risk of lost revenue. It therefore appears likely that under neoliberal management of urban water, centralised infrastructure will be pursued for their measurable efficiency and profitability.

The increasingly global scale at which water is managed has also been observed to influence the type of management that takes place. This manifests in three major ways. The first is international competition for water resources. The physical transnational nature of water and the escalating threat of water scarcity has raised concerns about future conflicts over access to clean, freshwater resources (D'Souza, 2012; Solomon, 2010). Although there have been attempts to establish global rules and regulatory mechanisms for water use and management, many national internal policies are trending towards water securitisation through large infrastructure (Obertreis et al., 2016; D'Souza, 2012). The second is the movement of water management upwards and away from national control. In alignment with global market forces, water management in some cases is becoming part of multi-location and transnational companies (Swyngedouw, 2004; Crow-Miller, Webber and Molle, 2017). If control of freshwater is placed in the hands

of companies geographically outside of national and societal boundaries, nations lose their capacity for control and this creates the image of power moving beyond society's control (Strang, 2016). In addition, international organisations that benefit from freshwater resources are often geographically distant from the environment that resources are taken from (Strang, 2016). They are sheltered from the negative environmental and social repercussions of their actions and can avoid standard expectations, such as tax (Strang, 2016). Although, as Strang (2016) stresses, these organisations are very diverse in their intentions, the emergent trend of transnational ownership and management presents the risk of unrestrained power. The third is the increasing scale of water infrastructure. Examples of this include the growing size of water diversion channels in China (Yu et al., 2018) and the boom in mega-projects in South East Asia (Douglass, 2010). This expands the number of people influenced by these projects and the scale of potential ecological degradation. The increased scale at which infrastructure is managed and constructed may be indicative of the future trajectory of urban water.

Conclusion and further questions

At the end of this literature review two questions emerge: how does centralised water infrastructure continue to be legitimised and why is work done to ensure it continues to be implemented? These questions are grounded in the problematisation of traditional, centralised urban water management and the establishment of more sustainable alternatives. The widespread criticism of centralised infrastructure indicates that some form of work would be required to prove that it is indeed a legitimate way to manage water in cities. In reviewing the academic literature and overseas examples, explanations for how this may be emerged. The first is that technocratic decision making is used to privilege traditional, centralised infrastructure. It appears there is often very little pressure from within water management regimes to transition to more sustainable management and the quantitative, measurable forms of decision making used undermine the inclusion of relational social and environmental values. The second explanation for the continued legitimacy of centralised infrastructure is simply the lack of public drive to see it change. This is due to the physical and social embedding of centralised water networks in modern cities and the cognitive barrier they form that prevents urban residents from critically reflecting on their social and

environmental implications. However, in some cases a disruptive event, such as drought or flood, can change these attitudes and trigger the public calls for change. This leads to the third way centralised water is legitimised: through discourse. Discursive tools such as the threat of emergency or presentation of projects as sustainable have been observed in overseas examples of the work done to legitimise large-scale water infrastructure. Interestingly, these discursive tools tend to use the negative outcomes of traditional, centralised infrastructure to justify its continued implementation. Drawing on these findings from the literature and examples from overseas, the first objective of this investigation is to expand on and identify news in which technocratic decision making, social context and discourse can be used to legitimise the continued implementation of centralised infrastructure.

The literature review also explores possible incentives for centralised infrastructure. It is more attractive than decentralised alternatives because it has more tangible financial and political gains. Dating back to its successful implementation during the industrial revolution, centralised water networks have been associated with improved quality of life, growth of industry and entry to the club of modernity. Due to the continued importance of growth in modern society and the capacity of centralised infrastructure to facilitate this, it remains an attractive option for urban water management. The neoliberalisation and globalisation of water management also indicates that the future will see water managed more for efficiency, profitability and the implementation of increasingly large infrastructure. However, this focus on the economic benefits of centralised infrastructure seem s too simplistic and narrow. Therefore, the second objective of this investigation is to explore the incentives for legitimising centralised infrastructure in a localised, context specific setting.

Chapter 3: Methods, methodology and context for research

Objective 1: *To explore the ways in which centralised infrastructure continues to be legitimised, despite its acknowledged flaws and existence of alternatives*

Objective 2: *Investigate the local incentives to implementing centralised urban water infrastructure*

This chapter provides an overview of the methods and methodology used in this thesis. The research was a qualitative case study looking at the implementation of Auckland's Central Interceptor, a new sewer proposed to address inadequacies of the existing network. A case study approach was adopted as it allowed the researcher to explore the reasons for the continued use of centralised infrastructure in a specific, real world context and gain insight into how broader trends in water management may or may not manifest and why. Qualitative analysis was used because it enables the researcher to build a complex and holistic understanding of context specific issues and expand established theories. The dataset for this research was composed of documents including annual reports and budgets, plans, newsletters and articles from the major stakeholders in Auckland's water management. These stakeholders were central and local government, Watercare (Auckland's water and wastewater service provider) and the public. To investigate the legitimisation of the Central Interceptor, these documents were assessed using Thematic Analysis. This thesis and the argument for why a centralised approach was adopted in Auckland was developed by taking an iterative approach; informed by the dataset and relevant academic literature, the dataset was coded and eventually arranged into themes following the method described by Braun and Clarke (2006). The final themes and reasons for the legitimisation of the Central Interceptor were dominance of technocratic water management, the deep embedding of centralised water management in society and the political incentives to maintain centralised control of water. The following chapter expands on the way in which this research was undertaken and is organised into three main sections: research design, data collection and data analysis.

Research design: A qualitative case study approach

The purpose of this research was to understand the continued legitimisation of centralised water infrastructure. As shown in the literature review, there are a multitude of social, technical, institutional and political reasons for the continued presence of traditional water management, despite concerns about its negative impacts. To understand how these elements are influential in a real-world setting, a qualitative case study approach was adopted for this investigation. Qualitative research is a useful way to build a complex and holistic understanding of context specific social issues (Jencik, 2011). Researchers tend to focus on people, social interactions, events and intangible aspects of social life, such as discourses, from multiple perspectives (Jencik, 2011; Winchester and Rofe, 2016). This was appropriate for this study because of the significant role of power dynamics, social relations and discourses in shaping water management decisions. Qualitative research is advantageous because it gives the investigator greater capacity to ground their research in reality and adopt inductive forms of logic as the study progresses (Breuning, 2011; Jencik, 2011). Qualitative research is often context bound and more focused on building on theories than proving generalisable cause and effect relationships (Breuning, 2011; Jencik, 2011). This sets the tone for the investigation; the objective is to build on theories from the academic literature rather than conclusively show why centralised water infrastructure is still put in place.

A case study was used for its capacity to give the researcher insight into the ways trends or phenomena manifest in specific contexts (Gerring, 2004). Case studies are well suited to situations where it is impossible to separate variables from their context, the investigator has little control over the events and the focus is on a contemporary phenomenon (Merriam and Tisdell, 2015; Yin, 1989). These conditions are true in all cases of urban water management. This research was designed to be a critical case study; useful for gaining an understanding of when and how theory-based hypotheses or predictions come to fruition (Bryman, 2012, Yin, 1989). It can extend, challenge or confirm theories (Yin, 1989; Flyvbjerg, 2006). The theories to be explored in this study were developed and explained in the literature review. The first theory was the continued presence of technocratic experts and rational decision-making in water management being instrumental in the continued implementation of centralised infrastructure. The second was that transformation of society by embedding water networks in cities and the resulting relationship between water and society enables the continued legitimation of centralised infrastructure.

The final theory established in the literature review was that the political and economic benefits of centralised infrastructure are a powerful incentive for its continued implementation and this is the overarching reason it continues to be legitimised as an option for water management. The objective of this study is to extend, challenge or confirm these theories and explore the ways they manifest.

This investigation will focus on water management in Auckland, New Zealand as a case study. The most common critique of traditional urban water, and its influence on environmental degradation, is readily observed in Auckland. Wastewater and stormwater management in the city has contributed to the physical modification of streams, estuaries and harbours, and pollution of these waterways with nutrients, pathogens, toxic chemicals, micro-plastics and rubbish (Hauraki Gulf Forum, 2017). Like many other regions, sustainable management of water resources in New Zealand is considered to be increasingly important (Lennox, Proctor and Russell, 2011). Auckland appeals as the focus of a case study because these issues are recognised and there is apparent readiness to act. Local government explicitly state the environment and commitment to water sensitive design (a more sustainable approach to water management) are priorities. However, according to Ferguson, Brown and Werbeloff (2014) the greatest priority of Auckland's water practitioners is to increase capacity, to the detriment of social and ecological focus. The case study is appropriately positioned at the interface between a desire for more sustainable water management and continued commitment to traditional objectives such as growth.

One of the most significant problems with Auckland's water management is the lack of resilience and frequent failures of the sewage network. Large parts of Auckland's drainage systems are old, undersized and create risk of flooding in the central city (Miselis, Sharman and Davis, 2012). Older parts of the city continue to use a combined sewage network (Miselis, Sharman and Davis, 2012). This means stormwater in this region enters the wastewater network to be transported to treatment facilities. The network was designed to overflow into the environment to alleviate pressures caused by pipe breaks, blockages and heavy rain (Hauraki Gulf Forum, 2017). This mechanism is commonly used in sewer networks; it reduces the potential of wastewater becoming a public health hazard (Hauraki Gulf Forum, 2017). Due to development and population growth in Auckland the system regularly overflows to discharge into the Waitemata and Manukau harbours. An average of 4.5 million cubic metres of diluted wastewater overflows into the Whau, Oakley, Motions and Meola creeks annually (Miselis, Sharman and Davis, 2012).

As a result, a number of Auckland's beaches and lagoons are regularly contaminated with faecal matter, putting residents at risk and leading to regular or permanent beach closures (Hauraki Gulf Forum, 2017). This research focused specifically on the proposed solution to this public and ecological health crisis as an example of the continued adoption of centralised approaches to water management, despite increasing awareness and calls for sustainability.

The Central Interceptor is the proposed solution to wastewater overflows from Auckland's combined sewer network. This is a 13km tunnel extending from Western Springs, a central Auckland suburb, to the Mangere wastewater treatment plant in South Auckland. The pipe will divert overflows from the old sewer to the treatment plant and prevent overflows into the Waitemata and Manukau harbours. In addition, the pipe is purported to provide additional network capacity for growth and development in the city and duplicate aging infrastructure at risk of failure. It is part of a series of network upgrades and interceptor installations planned across the city over the next 15 years. A project of this scale is not out of the ordinary in contemporary urban water. Large scale, centralised projects are underway or recently completed in nations including China, Korea and the United Kingdom (Colven, 2017; Loftus and March, 2016). The close proximity of this case and timely nature were incentives to use the Central Interceptor as a case study to investigate the continued implementation of centralised infrastructure to manage urban water. This case study research is intended to represent a microcosm of urban water management, to offer insight into the larger phenomena of continued use of traditional management approaches, despite their widespread discreditation.

Although case studies have been argued to be a relatively unbiased method of testing hypotheses (Flyvbjerg, 2006), the internal and external validity is still of concern (Yin, 1989; Bryman, 2012). Internal validity is the truth in claims of causal relationships within the data (Yin, 1989). It was important to be mindful throughout the investigation that regardless of the size of the dataset it would be impossible to gain a complete understanding of how or why the Central Interceptor was legitimised, particularly as there are multiple perspectives to be considered. Although the report draws attention to a number of correlating phenomena, care was taken not to assert any definitive causal relationships as this would undermine the legitimacy of the results. External validity relates to whether or not the results are generalisable (Yin, 1989). While this is of concern, any claims made in the reporting of this research are

careful not to assume they would be observed outside of this context. Although this restricts the usefulness of this study, the main intention of this investigation was to extend the understanding of how the legitimation of centralised infrastructure can manifest, rather than to produce a prediction of how this will manifest generally. This also serves to maintain the validity and integrity of the research.

Data Collection

The intention for the raw data collected in this investigation was to capture the perspectives of the major stakeholders in Auckland's water management. Representation of multiple perspectives surrounding the case should produce a more holistic view of the phenomenon and better capture the complexity of the subject matter (Noor, 2008; Stake, 1995). It also works to reduce bias and improve the accuracy of results (Yin, 1989). The major stakeholders in Auckland's water management are central government, local government (Auckland Council), the Council controlled organisation for water supply and wastewater (Watercare) and the public. Reports, plans, publications and articles produced by these stakeholders made up the raw data for this investigation. Due to the varying nature of these stakeholders, different selection criteria were used to obtain data for each stakeholder. The role of each stakeholder and the methods of data collection for each are detailed below.

Central Government:

Water governance in New Zealand takes place at multiple levels. The primary responsibility for the nation's freshwater management lies with regional councils and unitary authorities. Central government is responsible for setting policy frameworks within which freshwater governance takes place (Eppel, 2014). This is undertaken by the New Zealand Parliament and several government agencies such as the Ministry for the Environment, Department of Conservation and Ministry of Primary Industries (Eppel, 2014). There are several key pieces of legislation that guide water management. The first is the Resource Management Act (1991). This regulates activities based on their environmental effects (Lennox, Proctor and Russell, 2011). Under the Resource Management Act (1991), central government can produce National Policy Statements, such as that for Freshwater Management (2014/2017) which steer the overall direction of water management (Lennox, Proctor and Russell, 2011). To gain insight into central government perspectives of urban water management, the National Policy Statement for Freshwater Management (2014/2017) was included in the dataset. The New Zealand Coastal Policy Statement was

initially included, but discarded once analysis began, as it contained no directly relevant insights to urban water. Although not entirely focused on water management the National Infrastructure Plan (2015) was included. This was used to gain an understanding of the central government's attitude towards infrastructure development across industries, including freshwater management. No explicit time parameters were used in the selection of central government sources, as there was only a small number of relevant documents. Parliamentary Acts and policies such as the Resource Management Act (1991) were not used as they were outside the scope of this investigation and it was assumed any proposed infrastructure would conform to these laws.

Auckland Council, Local Government:

Under the Resource Management Act (1991), regional councils are responsible for natural resource management, including storm and wastewater (Lennox, Russell and Proctor, 2011). In Auckland, the Auckland Council is responsible for stormwater management and Watercare, a Council controlled organisation, is responsible for water supply and wastewater management. The Council's roles regarding stormwater management include technical design of networks, asset management, planning, operation and maintenance and protection of receiving waterways (Ferguson, Brown and Werbeloff, 2014; Auckland Council, 2015a). The Council is explicitly moving away from reliance on 'hard engineering solutions (e.g. Pipes and culverts)' and shifting towards the use of 'greener infrastructure, utilising innovative water sensitive design' in stormwater management (Auckland Council, 2015b: 5). The Council's objectives reflect Hodson and Marvin's (2009) claims that sustainable urban water systems aim to give more weight to ecological and social values. This case study was appealing as Auckland has advocates for both traditional, centralised water management and movement towards more sustainable approaches. It was therefore important to capture the perspective of Auckland Council on the Central Interceptor and general water management in the city, not only because of their key role in the city's water governance, but also to capture the strength and content of arguments for sustainable water management in Auckland city.

To represent this perspective in the dataset all Auckland Council annual reports since its amalgamation were used in addition to several budgets, the Auckland Plan and other relevant plans such as the Stormwater Asset Management Plan (2015-2045) and the Auckland Council Regional Plan: Air, Land and Water (2013). As many of these documents had much broader subject matter than water management, only directly relevant sections were analysed. The Auckland Council document analysed in this investigation are provided in the appendix.

Watercare, the water corporation:

Watercare, a Council controlled organisation, is Auckland's main provider of water and wastewater services. The corporation's key tasks are water provision, wastewater disposal and continual investment in infrastructure to provide these services. This is carried out using traditional, centralised water management techniques. Drawing on over 20 sources including dams in the Hunua and Waitakere ranges and the Waikato river, Watercare supplies Auckland's homes and businesses with roughly 360 million litres of water everyday via an extensive pipe network (Watercare, 2018; Auckland Council, 2018). Around 458 million litres of wastewater is collected every day, most of which is sent to Watercare's Mangere and Rosedale wastewater treatment plants. Treated effluent from these sites is discharged to the Manukau Harbour and Hauraki Gulf and dewatered biosolids are disposed of in landfill (Watercare, 2015).

Watercare's mode of management operates differently to stormwater management at Auckland Council. According to the Three Waters Review (Auckland Council, 2017) the two organisations lack shared objectives and hold different views on what long-term sustainability for the city's stormwater and wastewater systems will look like. This manifests in the pursuit of decentralised approaches by the Council and a continued implementation of large-scale pipe networks by Watercare. The corporation owns over $1.3 billion worth of assets including 8000km of wastewater pipes, storage facilities, dams and 18 wastewater treatment plants (Hauraki Gulf Forum, 2017). The ownership structure of the organisation and natural monopoly on Auckland's water means that Watercare is less susceptible to the growth pressures or competition a regular business would face (Tregidga and Milne, 2006). However, despite being Council-owned, the corporation is entirely self-funded and receives no financial support from local or central government (Watercare, 2017). According to Watercare, continuous investment in new infrastructure, including the Central Interceptor, is essential to the maintenance of levels of service and capacity in the city (Watercare, 2017).

As the responsible party for implementing the Central Interceptor, it was critical to investigate the project from Watercare's perspective. All publicly available Watercare reports and publications were analysed. This included annual reports, community newsletters and asset and demand management plans in

addition to documents directly related to the development of the Central Interceptor such as the Resource Consent Application and Hearing and the Three Waters Strategic Plan (2008). The documents included in the dataset is provided in the appendix.

Public:

Auckland's residents are a significant party of the city's water management for a number of reasons. Firstly, it is for these residents that water services exist. Expectations of water supply and removal are deeply engrained in everyday activities of these residents. Should more sustainable approaches be adopted, a significant amount of behavioural change would be required as the public would take a more active role in water management (Sharp, 2017). Secondly, it is Auckland's residents who fund these systems. Stormwater operations are funded through rates and wastewater infrastructure is paid for through service charges paid directly to Watercare. Thirdly, the city's streams and beaches are highly valued by the community and their health is considered to be a vital part of Auckland's vision to be the 'world's most livable city' (Ferguson, Brown and Werbeloff, 2014). In a 2018 study by Allpress et al. it was found 94% of Auckland beach users felt water quality at beaches and lagoons was important and 84% were concerned about pollution. The study also found that almost two-thirds of respondents were learning more about their own impacts on water quality (Allpress et al., 2018). Public discussion of these issues is becoming more prominent, with water quality being of critical public concern during the 2017 national election and increasing media coverage of poor water quality in Auckland's beaches and waterways (Hauraki Gulf Forum, 2017; Allpress et al., 2018). For these reasons, it was considered important to capture how public perspectives on water quality and water management influenced or were influenced by the legitimation of the Central Interceptor project.

Newspaper articles were used to capture public discourse around water quality in Auckland and the implementation of the Central Interceptor. According to Tucker (1998), media is useful to analyse because it both reflects and influences how policy issues are defined or promoted publicly. Commentary that exists outside of publicly acceptable discourse is unlikely to influence policy (Entman, 1993). Articles dating back to 2000 were found using search engines from the NZ Herald and Stuff.co.nz websites. The majority of Auckland's local newspapers were represented in this search. The following keywords were used in the search: central interceptor, sewage overflows, wastewater overflows, Waitemata harbour pollution,

Waitemata harbour water quality, Manukau harbour pollution, Manukau harbour water quality, Auckland beach pollution, Auckland beach water quality and Safeswim. A complete list of the newspaper articles analysed can be found in the appendix.

Data Analysis

Thematic analysis was used as a method for identifying and analysing patterns within the dataset. Thematic analysis is one of the most commonly used approaches in qualitative research (Bryman, 2012). The process of building themes is central to qualitative, interpretive studies to organise data (Cope, 2003). Often this involves a process of coding the dataset in order to understand the meanings of the text and identify categories, patterns and eventually themes (Cope, 2003). Coding is also a way of ensuring a more systematic methodology, the absence of which is a common critique of qualitative research (Cope, 2003). To ensure reliability of the result it can be useful to use multiple coders in the investigation (Cope, 2003). Unfortunately, this was outside of the scope of the research.

The dataset was coded and assessed following the approach to thematic analysis presented by Braun and Clarke (2006). This method of interpretative analysis aims to identify and examine underlying ideas and assumptions within the dataset that are shaping the content of the data through the development of themes (Braun and Clarke, 2006). The following six steps (adapted from Braun and Clarke, 2006) were followed to assess the dataset:

1. A portion of the dataset from each of the stakeholders discussed above was read and key words and reoccurring themes were recorded. The recognition of these themes was informed by expectations formed by the literature review. For example, some of the initial themes and ideas generated in this way included: 'physical path dependencies' and 'economic considerations'. Other initial codes such as 'visions of the future' and 'immediate (context specific) threats to water quality' were solely informed by the dataset. Although Braun and Clarke (2006) recommend using the entire dataset for this initial theme generation, only around a quarter was used due to time pressures and the repetitive nature of many documents, particularly the annual reports.

2. Initial codes were generated by grouping and comparing the keywords and themes generated in step 1. This was done by producing physical cards, each with a key word or theme, and arranging (and re-arranging) them into categories or groups. From this the initial codes were produced. In addition to those mentioned above, examples of these early codes include 'stakeholder conflict/criticism', 'stakeholder actions/objectives', 'discussed/proposed solutions' and 'additional pressures/alternative priorities (i.e. population growth, limited budget etc.)'. Almost all of these early codes were adapted as the investigation progressed.

3. The dataset, including the documents used to create codes in step 1, was then read and coded using NVivo software. NVivo is a software package commonly used in qualitative analysis to assist in the management of datasets (Bazeley, 2008). It allows researchers to work with a wide variety of data types and methodologies (Wiltshier, 2011). The software does not influence the analysis or result found (Wiltshier, 2011). At several stages throughout this process, the appropriateness of individual codes was reflected upon and changed. Changes were most often made when a code was found to be too narrow or too broad. For example, the code 'public discussions of overflows' was found to be too broad and was separated into more specific categories including:

    - Criticism of action/inaction
    - Effects of overflows
    - Monitoring/Safeswim
    - Reasons for overflows
    - Signage and public warnings
    - Sites of overflows
    - Timespan of overflows

    At the end of the coding process (which followed step 4 and 5 due to the iterative nature of Thematic Analysis) twenty major codes were used, many with sub-codes within them. The information in some of these codes proved to be more useful or insightful than others. Examples of the more useful codes include:

    - Alternative solutions suggested
    - Development and growth in Auckland

- Public discussions of overflows
- Global comparison
- Harbour equity
- Public response

4. Each code was assessed individually to draw out information that answered or provided insight into the research objectives. For example, for data coded under 'alternative solutions suggested' and 'alternatives already used in Auckland' the information was further organised into more specific sub-categories such as 'who the alternative was suggested by', 'where the alternative was used or could be used', and where applicable, the arguments used to de-legitimise them. By going through a similar process for each category, preliminary arguments for the continued implementation of centralised infrastructure in Auckland were formed.

5. Following the establishment of several arguments and insights to explain the permanence of centralised water infrastructure, it was found these could be categorised by three over-arching themes: technocratic water management, the relationship between water, society and discourse and the political incentives to maintain centralised control of water. At this stage literature relating to each of these themes was revisited to ground the case study investigation in broader academic understandings of the permanence of traditional water infrastructure and understand how the Auckland case study was different.

6. The final step was production of the report. This formed the three empirical chapters following this one. Each chapter draws upon evidence found in the dataset. This evidence was compared and contrasted with academic literature to give insight into the reasons for the continued legitimation of centralised urban water management.

Throughout this process, analysis was iterative, with frequent shifts between a holistic view of the dataset, coded extracts and the research findings. The investigation used a combination of inductive (derived from theoretical framework) and deductive (emergent from the dataset) coding to produce themes, as demonstrated by Fereday and Muir-Cochrane (2014). Thematic analysis is intended to be fluid, dynamic and ongoing through the research project (Cope, 2003). Braun and Clarke (2006) also stress that datasets

are not without contradiction and the final themes do not have to be smoothed out or have inconsistencies ignored.

Limitations

There were two major limitations of this work. The first was the lack of repeatability. Thematic analysis is an iterative process that uses both inductive and deductive reasoning. Due to the scope of this research, all the thematic analysis was performed by one person. Unfortunately, this meant that the resulting codes could not be tested by a secondary coder. The second major limitation was the absence of primary evidence that gave insight into internal decision-making processes or private opinions of stakeholders. The resources used were sufficient to represent multiple perspectives on the implementation of the Central Interceptor; however, it cannot be guaranteed that the stakeholder's positions were captured completely. Although this would be true regardless of the depth of the dataset, more insight could have been gained through contact with the stakeholders using tools such as interviews or surveys. Once again, this was outside of the scope of this investigation; however, the findings from this research could be used as the basis for questioning in future research.

Chapter 4: Exploring the use of technocratic decision making to legitimise the Central Interceptor

The first major finding in this investigation was that experts and technocratic decision making were critical in the legitimation of the Central Interceptor. This chapter will explore the ways in which the pursuit of a centralised approach was justified on the basis of reductive and quantifiable arguments and supported by active de-legitimation of alternatives approaches. This is done in three main sections. The first explores the ways in which prioritisation of technical, financial and administrative concerns, and reduction of considerations to numerical values was used to objectively present the Central Interceptor as the 'best practicable solution'. The objective and quantitative presentation of this evidence made claims of legitimacy difficult to dispute and even worked to present the Interceptor as a step towards sustainable water management. The second section explores the delegitimisation of decentralised alternatives in planning documents and media articles. Interestingly, many of the arguments used against alternatives in this case study were also levelled at the Central Interceptor or other centralised projects. This observation leads to the third main section of this chapter. This seeks to understand why, given the arguments both for and against the Central Interceptor, it became the legitimised solution to addressing wastewater problems in Auckland? One possible explanation is that there was no expectation of the technical decision-making community to seriously consider decentralised options and their final decision has a weight of authority, due to their status as a-political experts. The following chapter expands on each of these points.

Legitimising the Central Interceptor using objective and quantitative methods of decision making

Justification for early decision making around the Central Interceptor project was documented in the Three Waters Strategic Plan [2008].[1] This plan was produced by a working group composed of water managers from district Councils and regional water suppliers in Auckland. They were brought together to address Auckland's water infrastructure issues and determined that greater trunk sewer and wastewater treatment capacity was one of the city's greatest needs. A centralised approach was deemed necessary. From the early design phase of the Central Interceptor, decisions were made based on measurable evidence, such as the financial and technical costs and benefits of the project. This is not surprising. There is an expectation in the professional water management community that decisions should be based on objective knowledge and technical solutions (Sofoulis, 2015a). This is observed in the selection criteria used to choose a site for the new infrastructure. Preference was given to sites and designs that met the following technical and financial requirements:

- maximising gravity flow of wastewater to reduce energy use
- maximising investment in existing plants to deter the need for further expenditure
- maximise future flexibility
- minimising risks of delay associated with land acquisition and resource consent requirements
- minimise risks associated with inaccessibility to existing sewers
- technical feasibility and an appropriate balance of social, cultural, environmental and economic well-beings.

  - The Three Water Strategic Plan [2008]

In the end, four sites were considered for the new pipe and wastewater treatment plant. Most of the justifications for this were technical or administrative. Technical reasons included ease of tunnel construction, peak flow restrictions or ability to maximise gravity flows. Administrative considerations included preferred time frame, ease of consenting processes, financial considerations and potential issues due to land ownership. There was only one argument with environmental reasoning and no mention of social or cultural implications of each site at this stage.

The final design and site selection for the Central Interceptor project was decided based on reductive and quantifiable analysis of 14 short-listed options. Each option was a variant on a new large-scale pipe system

[1] Square brackets indicate this is a reference from the dataset. These references can be found in the 'Dataset Reference' list found at the back.

with a new or upgraded wastewater treatment plant at one of four locations. An example of two of the considered options is provided in figure 4.1. The Three Waters Strategic Plan [2008: 38] called for a 'pragmatic assessment of all key factors' and the use of multi-criteria assessment techniques. The methodology used to compare the options is summarised as follows: Four specialist groups analysed 14 short-listed options on the basis of social, cultural and environmental well-being and legal, technical, risk and timing issues. The specialist groups scored the extent to which each option contributed to each goal on a numerical scale of 'very good' (+4) to 'very poor' (-4). A separate, peer reviewed process was used to score the projects against economic goals. Following this, each option was graded for each quality and ranked. Through this process the final Central Interceptor design was established as the 'best practicable option', a claim founded upon fulfilment of traditional engineering requirements and standards of a big infrastructure project.

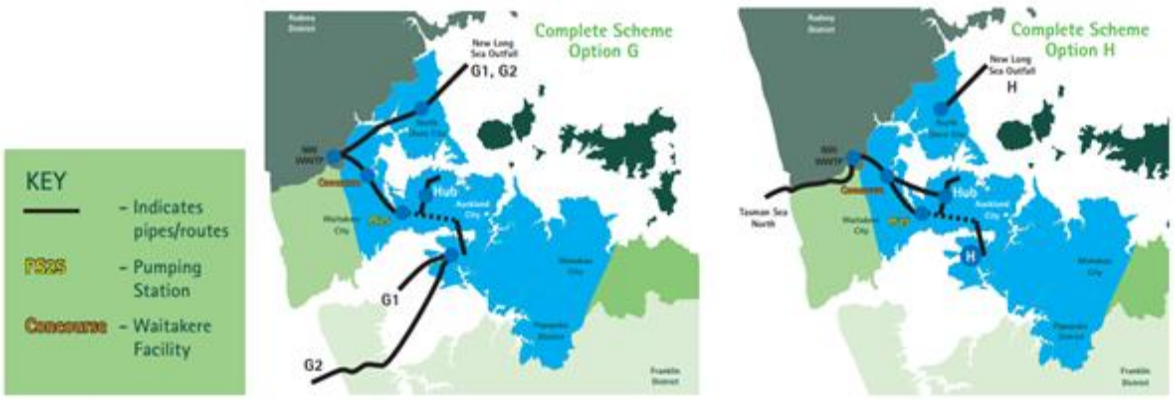

Figure 4.1 - Example of two options considered using multi criteria analysis in the Three Waters Strategic Plan [2008:40]

The preferential emphasis on technical considerations and reduction of social, cultural and environmental effects into numeric values is characteristic of technocratic decision making. It is used to simplify complex realities and make them more legible and susceptible to control (Scott, 1998). Quantitative project analysis, such as that described above, is common practice in decision-making and documentation for major projects (Flyvbjerg, 2009). Comparison of alternatives using numerical or set values gives planners precise proof of the legitimacy of their final proposals. In this case, it provides seemingly objective evidence that the Central Interceptor is the best option. By establishing these practical terms of decision making it becomes difficult to challenge the final design on its inadequacies such as flawed cultural or social outcomes of the project, due to the subjective nature of these arguments. In addition, this mode of decision making meets the expectations of the water management community. Sofoulis (2015a) critically

refers to it as an epistemological monoculture that only allows for quantitative and objective knowledge. Therefore, the Central Interceptor was legitimated in part by its conformity with the expectations of traditional water management and its base in objective, technical decision making.

Interestingly, this use of technocratic decision making is also used to present the project as a legitimate step towards sustainable water management. It is important to note that the Strategic Plan [2008] did access options for the Central Interceptor by considering the potential social, cultural and environmental impacts and express a desire to implement sustainable water management. In New Zealand, consideration of these elements is a legal requirement under the Resource Management Act (1991). From the results of the multi-criteria analysis used in the report it could be assumed that the Central Interceptor, one of the top three scoring options in terms of potential social, cultural and environmental impacts, is indeed a sustainable solution. However, the mode of analysis gives weight to Wesselink et al.'s (2017) claim that the steps towards sustainable management are assumed to self-evident and unproblematic. The academic literature suggests there is a cultural problem within water management where engineers only see and value engineering solutions without respect for social science (Cousins, 2017; Wesselink et al., 2017; Sofoulis, 2015). Despite calls from social researchers for better engagement with local knowledge and more inclusion of social science and humanities in water management, this does not appear to be seriously considered when centralised plans are made (Tadaki, Allen and Sinner, 2015; Sofoulis, 2015a). The reduction of social and cultural considerations to quantitative values in the Three Waters Plan [2008] is a perfect example of this. The effect is the legitimation of the Central Interceptor in terms of its quantitatively proven social, cultural and environmental credentials, despite the inherent incompatibility between these relational values and numeric measurement.

As a testament to the Central Interceptor's objectively proven social, cultural and environmental credentials, the legitimacy of the project and authority of the water managers was seemingly validated in the resource consenting process. At the resource consent hearing, a major public concern was the interceptor's Emergency Pressure Relief (EPR) system which will discharge large quantities of untreated storm and wastewater into the Manukau Harbour in the event of an emergency. There were expressed concerns about the effect of a large overflow on public health and safety as well as potential environmental effects such as impaired water quality or habitat destruction. The public were also

suspicious of Watercare's lack of scientific data to support their claim the effects of an overflow would be negligible. In response to this controversy, Watercare's Belinda Peterson said the hearing commissioners had agreed the Central Interceptor was the "best practicable option". Accepting the proposed Central Interceptor as the "best practicable option" relies on the assumption that the engineers and water managers designing this solution are the most equipped to make this decision. The argument of the Interceptor being the best option is flawed because it was designed only from the perspective of administrative rationalists that required simplification of reality to make their decision. Regardless, the public are forced to accept it as the solution because it is presented as the only one, despite its documented flaws. According to Aledo Tur et al. (2018), reduction of complexity of this kind is a common way to convince the public that large-scale projects are necessary. Proponents of these projects may use the argument that there is no alternative (Crow-Miller, Webber and Molle, 2017). This is observed in Brazil, where investment in hydro-power is presented as a choice between immediate poverty or the possibility of an unsustainable future (Aledo Tur et al., 2018). The legal acceptance of the Central Interceptor as the 'best practicable option' shows that the word of water managers holds enough authority for the project to be considered legitimate under the Resource Management Act (1991), despite public concerns about the impacts of this centralised design.

Delegitimisation of the alternatives

In conjunction with the work done to legitimise the Central Interceptor as the only solution to Auckland's wastewater problems, investigation of the broader dataset found that work was also done to delegitimise alternative, decentralised options. The information provided in the Three Waters Strategic Plan [2008] only seriously considers the option of a centralised solution to Auckland's wastewater issues. However, in relation to the problems the Central Interceptor claims to address, five decentralised management options were discussed publicly. Broadly speaking, these options included:

- Demand management
- Water sensitive design
- Local storage and detention tanks
- On-site treatment
- Education and non-structural solutions

Of these alternatives, only on-site treatment and local storage/detention tanks were explicitly presented as alternatives to the Central Interceptor project. These were presented in the resource consent hearing by representatives for community groups and a policy analyst. Other options were discussed by the public as solutions to the problems the Central Interceptor is claimed to address. For example, demand management is presented as a way of delaying the need for new infrastructure and education is carried out to raise awareness of behaviour that can be detrimental to existing waste and stormwater systems. In contrast to the objective decision making displayed in the selection of sites for new infrastructure, the above alternatives require a mode of water management that is more inclusive of types of knowledges and knowers beyond those involved in the decision making of traditional urban water.

As discussed in the literature review, the technocratic management strategies of urban water management are increasingly criticised, both socially and academically, for their adverse social and ecological effects. There are a growing number of calls for managers to consider alternatives to the traditional 'command and control' approach to urban water and a greater attention to cultural values and environmental impacts. But urban water systems have proven to be deeply institutionalised as is observed in the decision-making strategies used to continue the pursuit of centralised infrastructure (Rogers et al., 2015). The regimes of control have not developed the required capacity to enable different ways of doing things due to the prevalent strategies and technocratic culture which has long been established in the system (Van de Meene et al., 2010). Investigation of this case study found several ways in which corporate water managers delegitimise alternative policy approaches and 'sell' their preferred option. Alternatives in this case were opposed on the basis that they:

1. Will not work or will have detrimental impacts
2. May work but not in this context
3. Are not financially viable

These three reasons are each discussed in detail below. In many cases, the rationale behind discrediting these options can be delegitimised in return. The variety in the arguments used to defend the water corporation's (Watercare) preferred option showcases the work being done to promote it.

The first of these reasons was observed in cases where alternatives were undermined by claims from water management that either they would not work or would exasperate environmental problems**.** For example, the Three Waters Strategic Plan states that on-site solutions would have little effect on network requirements, were not appropriate for Auckland's high-density population and would be a threat to public health, safety and the environment. According to the plan, demand management would not affect wastewater in the foreseeable future and the Watercare's Assessment of Environmental Effects (AEE) [2012] claimed wastewater minimisation would not be effective in reducing overflows from the combined system because the main cause of overflows was inflow from stormwater. According to the Council, decentralised options can lead to problems, including adverse environmental impacts, which are exasperated by inappropriate design, maintenance systems, increased occupancy and changing lifestyle expectations. New Zealand Scientists have commented on the inhibitory factors of transitioning to the Water Sensitive City (a sustainable urban water management regime) including implementing changes in built up areas, the structures and norms of decision-making and the difficulties associated with long-term decision making (White et al., 2017). These views, many dating over ten years may have prevented any serious consideration of decentralised management options as legitimate solutions to the problems the Central Interceptor is claimed to address.

The same arguments have been used against the Central Interceptor. Whilst experts dismissed on site solutions as creating a risk of environmental harm, potential harm to the Manukau harbour was one of the major concerns with the Central Interceptor. Documents including the AEE [2012] show that there was concern that the project would lead to degradation of water quality, increased volume of discharges into the harbour, growth in red algae and altered shellfish life due to a combination of the increased load into the harbour and its shallow conditions that prevent it from flushing each day. These complaints were raised by residents with support from scientists. The notion, pushed by the water corporation, that on-site solutions would not work has been criticised in academia. For example, according to Sofoulis (2015b), these expressions of concern about residents' control over devices such as rainwater tanks work to confirm the experts as superior and serve as reminders of the risks of giving non-experts control over systems. She suggests that some so-called 'dumb user' stories are more likely a result of 'dumb designs', created without cultural intelligence and with the assumption that users will not know how to operate decentralised systems with the technical rationality of water managers.

The second basis for the delegitimisation of alternatives was the claim that alternative approaches lacked the capacity to work, despite their promotion by experts in other contexts. Managers refuted several alternatives with the claim that they could be only part of the solution, but not the solution itself. For example:

None of the [urgent issues of wastewater management] *issues can be addressed by water demand management, low impact design, on-site wastewater treatment or local treatment plants. These options may all have a role to play, but in association with the continued use of existing infrastructure and upgrading works.* – Excerpt from the Three Waters Strategic Plan [2008: 10].

In other contexts, local government and water suppliers promoted and use management options such as demand management, education programs and decentralised and green infrastructure. Watercare regularly promotes water savings in their community newsletter and have ongoing education programs to combat misuse of pipes. The Council fund door-to-door education and septic tank assessments as well as waiving consent fees to improve the conditions of septic tanks used in Piha and Karekare. But, both organisations are reluctant to accept these alternative solutions to problems necessitating the Central Interceptor.

"The unitary plan provides and encourages green solutions. However, they are only one tool used to mitigate the effects of urbanisation," Craig McIlroy, Healthy Waters General Manager – [A60][2]

While wastewater minimisation should form part of the planning for any modern wastewater system, it was not considered to be an effective solution alone for addressing the network capacity issues facing a growing Auckland. – Excerpt from AEE [2012: 66-67]

These dismissive attitudes work to undermine the capacity of alternatives and are an exercise in asserting the authority of water managers. The acceptance of some alternatives in certain contexts but not in relation to the problems being addressed by the Central Interceptor suggest there could be an underlying

[2] [A60] refers to article 60 used in this dataset. This system is used in Chapters 4, 5 and 6 to reference quotations coming newspaper articles. A reference for these article can be found in the 'Dataset References' found in the back pages.

incentive for pursuing the central interceptor project. Work on Jakarta's large-scale Great Garuda Sea Wall, a project intended to mitigate the area's problems with land subsidence was criticised for similar reasons used by the experts in Auckland: it did not address the problem (land subsidence), it was not a solution in its own right and its success was dependent upon other measures such as improving sanitary conditions in the city (Colven, 2017). Despite its shortcomings, the project was pursued due to its ability to serve other functions, including to act as catalyst for the city's development and economic revitalisation (Colven, 2017). This is an example of how experts can suppress alternatives in favour of projects that may hold economic or political favour.

The third way experts were observed to delegitimise alternatives was using financial arguments. Alternatives were dismissed on the basis they would lead to too much community disruption or financial cost**.** The water corporation claimed the centralised project was preferred over decentralised storage tanks because it could be done with the least adverse effects on the community and a lower financial cost. According to the planners, storage tanks would still require significant upgrades to network requirements and additional infrastructure would be required. In regard to decentralised devices such as rain tanks and septic tanks, Watercare claim they are too expensive for Auckland residents:

"We're not a monopoly. There's no law in New Zealand that prevents anyone else from supplying water and waste water services. The reason they don't is because costs are too high. So, they want us to do it."

– Raveen Jaduram, Watercare Chief Executive – A23 [2016]

This argument has been refuted in the media. For example, policy analyst and planner Joel Cayford argued that it is centralised systems that are expensive to build and - as expectation for environmental consideration increase - alarmingly expensive to maintain. It is also worth mentioning that in the case of decentralised devices, it is inevitable the experts would not recognise the economic benefits because they do not benefit from the economies of scale that centralised systems have (Sofoulis, 2015b).

At the same time as undermining decentralised options based on cost, Watercare's argument for the legitimacy of the Central Interceptor based on its low cost is disputable. Figure 4.2 (below) from Watercare's Assessment of Environmental Effects [2012] showcases the cost comparison of the Central

Interceptor with other alternatives considered by water managers. The Central Interceptor is shown to be the lowest cost option. However, the reliability of this argument is debatable. Figure 4.3 shows the reported cost of the Interceptor in the dataset according to publication date. It shows that the projected cost of the project has increased by $410 million (55%) since the Three Waters Strategic plan in 2008. This does not disprove that this option was the most financially preferable at the time. However, it does show that the estimated prices used to compare options in 2008 were unreliable because the actual increase in price (55%) is far greater than it would have been solely due to inflation (19.2%) (Reserve Bank of New Zealand, 2018). According to Flyvbjerg (2009), misinformation about costs, benefits and risks is the norm in project development and decision making. Analysis of transport infrastructure costs found that in the US and the UK, in most cases the most unfit proposals went ahead (Flyvbjerg, 2009). This was because the forecasted estimates of the costs and benefits were regularly very different from the actual costs and benefits, due to encouragement of project promoters to present the projects in the best light (Flyvbjerg, 2009). The construction of these arguments that support the water corporation's centralised project and seek to discredit decentralised alternatives are further proof that work is being done by water managers to legitimise their preferred option.

Option	Critical needs of Auckland Isthmus wastewater network			
	Network capacity	Duplication of lower Western Interceptor	Overflow mitigation	Option Cost
Do nothing	×	×	×	NA
Wastewater minimisation	×	×	×	NA
Network duplication	✓	✓	✓	$1.35 billion*
Combined Sewer Separation	✓	✓	✓	$1.42 billion #
Local storage	✓	✓	✓	$1.1 billion #
Local treatment and disposal	✓	✓	✓	$1.05 billion #
Central Interceptor scheme	✓	✓	✓	$800 million

*Made up of $870M for duplication works and $480M for local storage for overflow mitigation
includes $620M required for Central Interceptor main project works
All costs are in 2011 New Zealand dollars

Figure 4.2 – Comparison of potential solutions to Auckland's wastewater network needs in Watercare's Assessment of Environmental Effects [2012: 68]

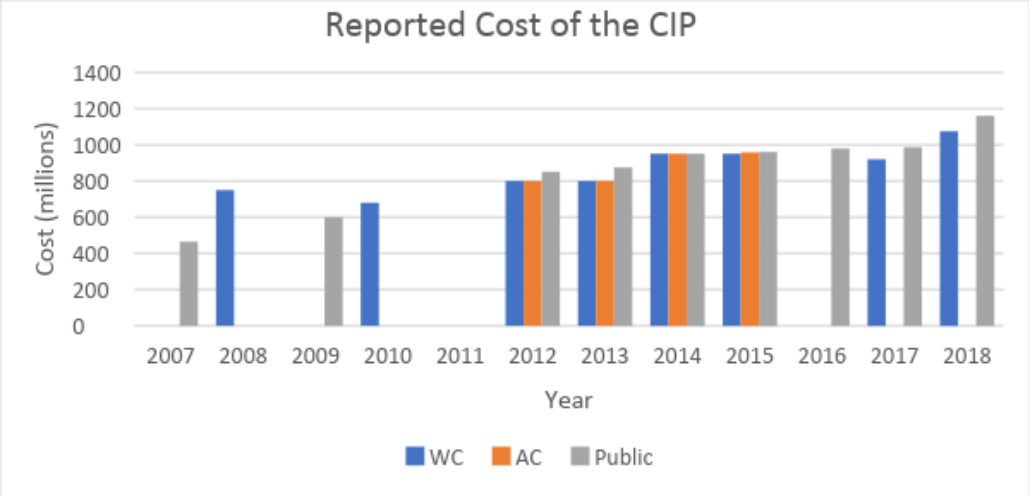

Figure 4.3 – Reported cost of the Central Interceptor in the dataset according to document publication date

Using the authority of the a-political expert to legitimise the Central Interceptor

It is clear discourse around the Central Interceptor contains arguments both for and against the project and its centralised approach. It is unclear, in this context, why it was preference of the technical decision-making community that was accepted as the legitimate solution to the city's wastewater issues, despite the projects documented flaws. One explanation could be that there was no expectation within the technical decision-making community that decentralised options be seriously considered, despite public awareness and discussion of those options. Decentralised alternatives were suggested by local community groups, members of the private sector and academia and in some cases local government. At the project's resource consent hearing, several members of the public, including members of the Mangere Bridge Residents and Ratepayers Association, were critical of the adequacy of water corporation's consideration of alternatives. In response the following definition of adequate was provided at the consent hearing:

At the outset we note that it is reasonably settled law that "adequate" does not import the meaning of "complete" or "comprehensive" but, rather, sufficient to demonstrate that a requiring authority has turned its mind in a genuine manner to the alternatives. Furthermore, it is not a requirement to adopt any particular alternative, or even necessarily the "best" alternative. - Excerpt from Resource Concept Hearing [2013:18]

This suggests that while alternative modes of water management are discussed and understood in Auckland, expectations of their uptake have not penetrated the decision-making community. The

continued adoption of this centralised approach is seen as legitimate by the Auckland's water management because the industry does not expect to have to consider alternatives as legitimate options.

Following the selection of the Central Interceptor approach, the public and interested stakeholders had little influence on the design or outcome of the project. For projects of this kind to go ahead under the Resource Management Act (1991), consultation must take place with relevant stakeholders. For the Central Interceptor, this was done with the intention of improving concept design and to assist with preparation of resource consenting documents. Watercare, the water corporation, consulted with various Council and government-controlled entities, council units and relevant agencies such as the New Zealand Historic Places Trust and the Department of Conservation were consulted. The water corporation also communicated with affected landowners and communities, both directly through mechanisms such as telephone calls, emails, open days and distribution of information sheets and through advisory, liaison and Residents and Ratepayers groups. It is unclear how much influence these consultations had on the final project. The community was consulted after the main project works had been decided on. This is problematic because the experts had already defined the problems and although consultation is required, often planners are not obliged to accept advice and critique or involve the community in further decision making (Sofoulis, 2015a). Tadaki, Allen and Sinner (2015) suggest that in order to embrace the heterogeneous nature of socio-ecological and biophysical considerations, local perspectives should be involved in decision-making. This arguably superficial mode of consultation simultaneously worked to legitimise the Central interceptor by going through the tick box exercise of consultation and preclude the uptake of alternatives because the water corporation were able to set the terms of the discussion.

How did the water managers designing this project come to hold the authority to push their project through in such as way? From the early planning stages of the Central Interceptor, it was presented as an objective and technocratic project. This fits the commonly held assumption infrastructure is not political (Hodson and Marvin, 2009). The project was proposed by the Three Waters Policy Working Group, a program established in 2004 to assess Auckland's future provision of wastewater, water supply and stormwater infrastructure. The Group claimed to be a-political; their decisions held no official status and were intended to reflect the views of relevant experts without considering local government politics. By conforming with the prevailing expectation that infrastructure be managed by technical experts, they

gave weight to the necessity and legitimacy of the Central Interceptor. However, the group's claim of being a-political are questionable because it was made up of experts from the region's bulk water supplier, local network operators and members of local council. Their involvement with local government and financial interests could have been a source of prejudice. In addition, the program formed at the request of the Watercare Shareholders Representative group. Watercare, as the regions bulk water provider at the time stood to benefit from the increased business the Central Interceptor will facilitate. These potential sources of bias are indicative of Swaarteveen et al. (2017) and Colven's (2017) suggestions that decisions around who is considered an expert and the management solutions they pursue are subject to economic and political considerations. In effect, the group's claims of being a-political legitimised the project and masked any interests it may serve.

This points to the conclusion that one of the main reasons for the legitimisation of the Central Interceptor was the authority of the water managers who designed the project. Water managers hold this authority because technocratic decision making is often assumed to be the most appropriate method of water governance. The underlying strategy of technocratic and administrative governance is to reduce political problems to technical ones (Aledo Tur et al., 2018; Caramani, 2017). This is achieved by prioritising expertise, rationality and empirical evidence to identify and implement objective solutions (Caramani, 2017). Therefore, Urban water is traditionally managed by scientists, engineers and administrative mechanisms (Karvonen, 2011; Hodson and Marvin, 2009). However, water management fails to be a-political for two reasons. The first is the exclusionary systems that privilege the views of the 'expert'. There is a mutually constitutive relationship between knowledge and power (Swaarteveen et al., 2017). The norms and rules that dictate who is considered an expert in water management determine who has access to this power (Swaarteveen et al., 2017). The second reason is that water is a resource subject to exploitation for economic and political power (Sharp, 2017). Not only are the norms and rules about who is considered an expert subject to deeply political choices, the motivation behind implementation of management strategies can be heavily influenced by provision of capital, economic activity and political ambitions (Swaarteveen et al., 2017; Colvin, 2017). Swaarteveen et al. (2017) conclude their study with the statement that water governance, at its core, is about politics. It is reasonable to expect then that those with power would actively seek to maintain this control and privileging of technocratic decision making is a mechanism to achieve this. What this chapter shows is that water managers are instrumental in the continued legitimation of centralised water infrastructure. What emerges from this conclusion is

the question of why these managers should choose to pursue traditional, centralised approaches over more sustainable, decentralised alternatives?

Conclusion

To summarise this chapter, a major reason for the legitimisation of the Central Interceptor was the grounding of the project in technocratic decision making and work done by water managers to delegitimise alternative modes of water management. There were several ways that technocratic decision making was used to establish the Central Interceptor as the 'best practicable option'. This claim was founded in the prioritisation of technical, financial and administrative concerns and proven quantitatively. Even relational values, such as cultural and environmental considerations were reduced to numeric values. Firstly, this effectively served as objective evidence of the Central Interceptor's legitimacy and made it difficult to dispute on subjective or qualitative terms. Secondly, it worked to present the project as a step towards sustainable water management and legitimate it in those terms. Interestingly, this also gives weight to the concerns of academics that the steps towards sustainability are often perceived to self-evident and unproblematic due to continued use of this type of decision making despite the inherent incompatibility between these relational values and numeric measurement. And lastly, this mode of decision making helped to legitimise the Central Interceptor as 'the best practicable option' because it conforms with the expected style of planning in traditional urban water management.

Work was also done to delegitimise alternative ways of addressing water quality problems in Auckland. The dataset revealed water managers argued that decentralised alternatives would not work or would exacerbate environmental problems, could only be part of the solution, not the solution itself and were not financially viable. For each of these claims there were counter-arguments levelled against the Central Interceptor. For example, the project is a potential risk to the health of the Manukau harbour, should the Emergency Pressure Relief system trigger a discharge of untreated wastewater into the harbour. The case study shows there were arguments both for and against the Central Interceptor, so why was it the traditional option that came to be selected? One explanation is that despite public awareness and discussion of alternatives, there was no expectation within the technical decision-making community that decentralised options be seriously considered or feedback from community consultation be acted on. Regardless, the water managers and planners for the Central Interceptor could

defend their project and its necessity because they presented themselves as a-political experts which masked bias they may have. This speaks to the power of technocratic and administrative governance to reduce social and political problems to technical ones. Water management is inevitably political; it is based in exclusionary systems that privilege the views of the expert – these rules dictate who has access to power because water is a resource subject to exploitation for economic and political power. This chapter shows how the Central Interceptor was legitimised by experts but still leads to the question: why would the water managers in Auckland continue to pursue traditional, centralised options for water management over alternative, decentralised infrastructures?

Chapter 5: The role of social context and discourse in the legitimation of the Central Interceptor

The second major finding in this investigation was that the Central Interceptor was legitimised through discourse in the media around water quality problems in Auckland and presentation of the project as a solution to these issues. This chapter discusses this claim in four sections. The first section explores public discussions around water quality in Auckland. It was found that in conjunction with a growing national concern for declining water quality, work was done to heighten awareness of wastewater overflows in Auckland, in order to increase public willingness to address this problem. The second section looks at the public's implicit preference for a centralised solution to their wastewater woes. This is observed in the level of disruption caused by polluted waterways being insufficient to drive behavioural change and therefore the responsibility to act was delegated to local government. The third section describes the way that Central Interceptor was represented in the media as the solution to the public's growing concerns about water quality. In the media, the project's environmental benefits were overemphasised and the spatial benefits and capacity of the infrastructure were sometimes vague and misleading. The effect of this was the public impression that investment in the project would improve water quality across the city, despite only affecting a specific region for one type of pollutant. The final section looks at why this work needed to be done to convince the public that the Central Interceptor is a legitimate option for urban water management. The public do not explicitly have issues with the project for being centralised infrastructure. Many of the objections to the Interceptor are concerns commonly associated with traditional water infrastructure such as environmental harm and uneven distribution of the promised costs and benefits. This implicit dissatisfaction with centralised infrastructure was insufficient to delegitimise the project.

Raising awareness of poor water quality

The public's willingness to address water quality issues in Auckland helped legitimise the need for projects like the Central Interceptor. Over the past several years, water quality has become a national election

issue in New Zealand; transitioning from a condition to be endured to a problem that must be fixed (Hauraki Gulf Forum, 2017). According to Michaels, Goucher and McCarthy (2006), transformations of this kind are often triggered by focusing events that create public awareness and appetite for change. In New Zealand, possible triggers for this raised awareness include the highly publicised impact of intensive agriculture on rural waterways and high-profile urban water supply crises, such as a contamination of Havelock North's drinking water supply. According to freshwater ecologist Russell Death, "publicity over the poor state of our waterways, including as one of the major issues in the current election, has made large numbers of people aware of the issue [A58]."

A problem, such as declining water quality, is more likely to reach and remain on the government agenda if it is highlighted repeatedly with public feedback or in connection to other problems (Kingdon, 1984). This was observed in this case study. Multiple newspaper articles showcase public concerns about the capacity of wastewater infrastructure in Auckland and concern about the effects of uncontrolled growth on the environment. An example of this is the dissatisfaction, particularly from urban residents, in central government's proposed plan to improve water quality nationwide, the Clean Water Package (2017). A spokesperson for a community lobby group responded to the Package by saying:

"*We fear there is a danger of government organisations cherry-picking streams suitable for being designated as clean, which ignores the fact you only need one unhealthy and rubbish-laden stream flowing into the harbour to get a whole lot of filthy 'third world' style beaches covered in plastic, toilet paper and pathogens,*" - Liz Walker (STEPS* spokesperson) – [A126]

Backlash of this kind reinforces the probability that water quality problems will be addressed. It sets the precedent that this is a problem New Zealand's public will support action against.

Water quality in Auckland, particularly in relation to wastewater overflows, has been discussed more frequently in Auckland newspapers in recent years. Analysis of the dataset found the number of articles that report water quality issues in Auckland increased over the period from 2000-2018. Figure 5.1, below, displays the number of newspaper articles each year that report water quality problems at a specific site. Figure 5.2 displays the number of beaches reported to have water quality problems each year. In both

cases, the number of reports is comparable between 2000 and 2011, although it was reported more consistently after 2007. Both figures show an increase in discussions of water quality issues over time.

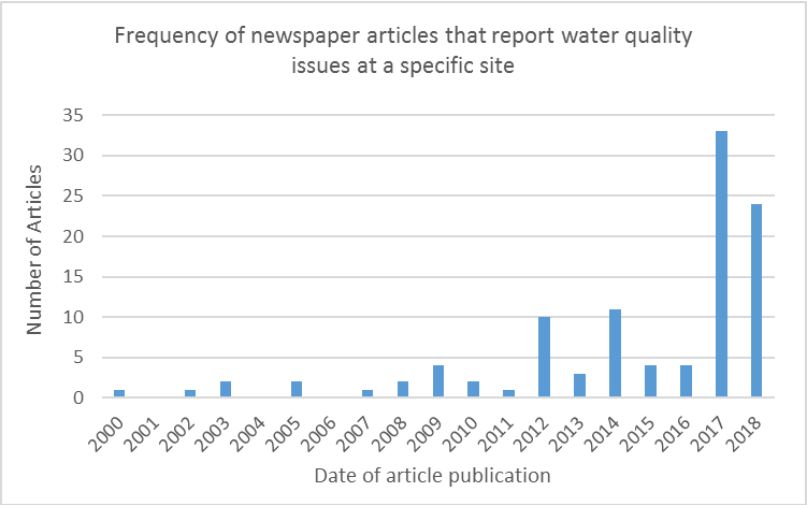

Figure 5.1 – The number of articles in the dataset each year that report water quality issues at a specific site in Auckland.

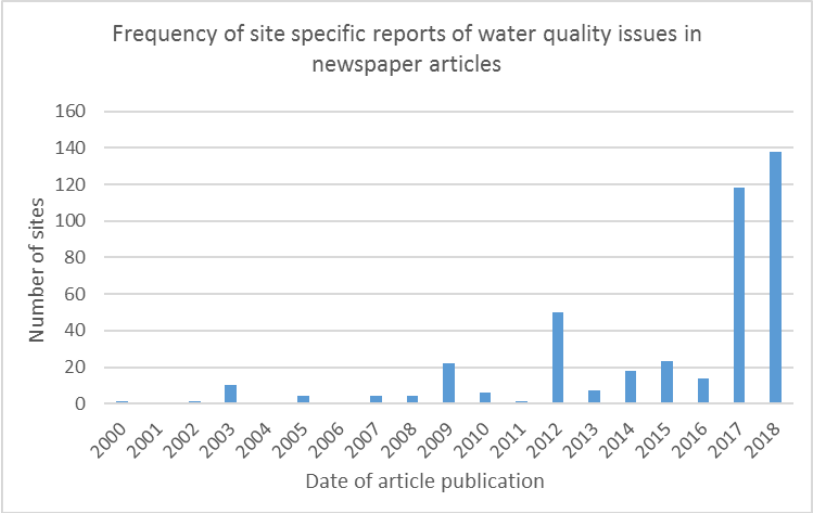

Figure 5.2 – The number of sites in the dataset each year that are reported to have water quality issues

However, this problem is not new – residents in affected areas have been aware of these overflows for decades. Seventeen newspaper articles within the dataset refer to poor water quality in the region as 'not a new problem' or discuss it as a historical issue. For example, a resident quoted in a 2018 New Zealand Herald article [A168] said:

> *"Auckland has known for at least 40 years its sewage and stormwater systems on older parts of the isthmus were prone to overload in heavy rain and pollute outflows to the sea."* – Anon [A168]

Several articles express the annoyance of affected locals over the years. For example, residents claim to know "which beaches it's dangerous to swim at, and where and when it's best not to breathe in too deeply" [A180]. Another homeowner has reportedly grown "sick and tired of finding poo on his Auckland property for the last 20 years" and the pollution is referred to as a "normality locals had learnt to put up with" [A67]. Outrage at the lack of action is not new either. In 2005, a Meola Creek resident was reported expressing frustration at having to call the Council about overflows into the creek every time it rained. Mr McCaffery, president of the Manukau Harbour Protection Society from 1975 until the mid-1990s claims he spent years trying to get sewage out of the Manukau Harbour. In 2017, journalist Simon Smith asked why this has been allowed to go on for so long and why are we acting now [A219]?

Increases in public discussion, despite the apparent longevity of the problem, correlate with actions by local government and the water corporation. For example, both figure 5.1 and 5.2 show water quality being discussed more frequently in 2012. This was the year Watercare lodged their resource consent application for the Central Interceptor project. Another major example is the upgrade of the Safeswim website in 2016. The Safeswim website was set up to provide real-time information on water quality risks around Auckland. It is a combined project of Auckland Council, Watercare, the Auckland Regional Public Health Service and Surf Lifesaving Northern Region. The 2016 upgrade sought to improve the website's public profile, which was previously low due to its unidirectional, crisis-oriented communication methods and aimed to present water quality more accurately (Neale et al., 2018). The upgrade appears to have worked. Comparison of figure 5.3 with figures 5.1 and 5.2 indicates there is a correlation between the number of articles that mention Safeswim and the increase in discussions on water quality in local newspapers.

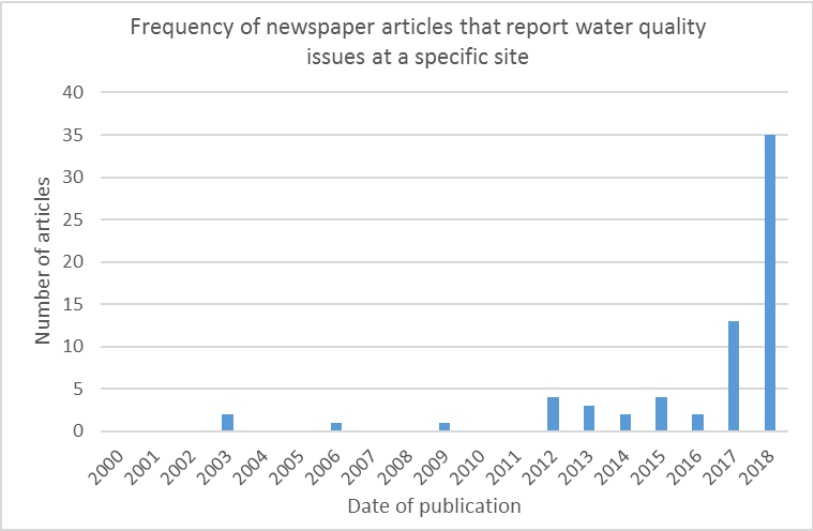

Figure 5.3 – The number of articles in the dataset each year that mention Safeswim.

Multiple Auckland Councillors have confirmed that Safeswim is being used to increase awareness and disruption due to water quality and promote an appetite for change. For example, the following quotes were found in newspaper analysed articles:

The council's Healthy Waters Strategy and Resilience Manager, Andrew Chin, says it will be interesting to see if there's an upswing in public complaints about water quality once the Safeswim programme goes live. – [A310]

"…if you're seeing a freshwater environment that repeatedly scores low it gives an imperative for council working with communities to identify means of improving fresh water environments, so it provides impetus for change." – Grant Barnes, manager of the Council's Research, investigations and monitoring unit – [A117]

Environment and Community committee Chair Penny Hulse claimed the public knowing what is happening in the harbour will enable the Council to "engage Aucklanders and do something about it [A310]." Public media have also commented on the resulting increase of awareness. According to one Auckland Now article, Auckland beach-goers are more aware that some beaches are unsafe for swimming and people are people are checking the water quality website before swimming. Reporter Alexia Russell warns that the new system would make the situation look a lot worse, due to more accurate and up to date figures. However, Hulse supported this claim:

"It's not like anything has really changed - we are being more transparent," - Auckland Councillor Penny Hulse – [A310]

The Safeswim upgrade does two important things for the legitimation of the Central Interceptor project. The longevity of the problem of wastewater overflows at Auckland beaches has proven to insufficient to provoke action. Whilst the status of water quality as an election issue and growing public awareness goes some of the way to putting the problem on the political agenda, some kind of agency is required to couple these problems with a long-term indicator (Saint-Germain and Calamia, 1996; Kingdon, 1984). Safeswim serves as this indicator and majorly contributes to the disruption caused by overflows as the real time

sensors ensure more beach closures. Therefore, when a solution such as the Central Interceptor is proposed, the public are much more likely to accept that the project is necessary. The second thing Safeswim does is initiate the 'politics of emergency', which substantiates the necessity to act. According to Jones and Baumgartner (2005), problems are given attention according to their urgency rather than importance. Governments can only address a certain number of issues at a time (Jones and Baumgartner, 2005). The politics of emergency operates on the tacit understanding that emergencies are moments of great danger that necessitate an urgent response, which allows certain responses to be carried out (Becket, 2013). Safeswim does this by increasing the frequency with which water quality problems disrupt activities creating the illusion that water quality is getting worse because it is being discussed more frequently. This is good for the Interceptor: not only are the public more likely to accept that it is necessary, the implied emergency decreases the likelihood that the public will question the approach or seek an alternative solution.

Public receptivity to a centralised approach

The public discourse around water quality and infrastructure is important because it reflects the hydro-social contract and what the public expects from water managers. The hydro-social contract is an implicit agreement between the public and government around how water should be managed and valued (Wong and Brown, 2009). Throughout the 20th century, the standard contract has seen people exchange autonomy over water supply and disposal for convenience and security (Sofoulis, 2015b). Sharp (2017) describes the public in this contract as infantilised and dependent. This hydrosocial contract can be validated and reinforced through public discourse, which means the way the public understands the problem of poor urban water quality and the proposed solution sets the tone for how water is managed. Once a discourse becomes widely accepted, anything outside its bounds is unlikely to influence public policy (Entman, 1993). The way a problem is defined affects the types of policies that are pushed and who should be involved in its management (Knaggard, 2015). The following three paragraphs explore the ways the public in Auckland were found to relate to and understand the problems associated with the Central Interceptor. This is important to understand because the way the problems are understood influences the types of solutions that are accepted.

Analysis of newspaper articles in the dataset indicated the Auckland public believe that water quality is the responsibility of local government or 'big water'. 'Big water' is a term used by Sofoulis (2005) to describe water management through large-scale, centralised engineering projects. This facilitates minimal user responsibility and fosters a continued expectation of the traditional hydrosocial contract (Sofoulis, 2005). A continued expectation of this contract is apparent in Auckland. This is observed in concerns that local government are not adequately addressing stormwater and wastewater problems in the inner city, where intensified development is set to take place. Civic groups, such as the Stop Auckland Sewage Overflows Coalition, are calling for better planning of the city's water infrastructure to meet environmental protection and pollution management standards. For example:

"We should not have to live like this...I want Watercare to fix the problem. Not only is all that wastewater going into the creek, but it's also flooding my place. It's pretty frustrating mate." - John Seward, Auckland resident [A222]

These civic calls for local government to act have been met with acknowledgement and agreement from officials:

"Water quality is one of Auckland's long-standing issues and the public are telling us loud and clear that we must raise the bar. It seems that people are starting to value water much, much more. For the first time in my career we've seen people march for water." – Andrew Chin, Auckland's Waters Programme Manager, Healthy Waters - [A11]

"Poor water quality is no longer acceptable to me, and it's no longer acceptable to the majority of Aucklanders who love our beaches" – Auckland Mayor Phil Goff – [A109]

These calls for action show that the solution the public seek is one in which local government or 'big water', rather than individuals, take action. Therefore, a centralised, 'big water' approach, such as the Central Interceptor, is likely to be considered legitimate because it fulfils the expectation of minimal disruption and responsibility for the public.

There are two main reasons Auckland's public appear to be more receptive to a traditional, centralised solution to their water woes, over a decentralised alternative. The first is that water quality problems in Auckland have minimal impact on everyday water practices. Beach closures due to wastewater overflows are an annoyance, but do not significantly impact everyday habits. A study of Aucklander's perceptions of water quality found that less than half of respondents understood the main causes of beach pollution (Allpress et al., 2018). Much of the alarm in water quality expressed in the media came from growing media attention and accusations, rather than first-hand experiences. For example, opinion pieces accuse city dwellers of using its "waterways as a giant long drop" [A249] and "being guilty of what we denounce dairy farmers around the world of doing [A24]." Despite sufficient public dissatisfaction with water quality to warrant action, the disruption is unlikely to be enough for the public to reflect on the ways personal behaviour contributes to these problems. Current habits are unlikely to be redefined until their environmental repercussions become imposing enough to warrant it (Shove, 2003). Therefore, a decentralised approach that requires de-routinisation of habits and adoption of new ones is unlikely to be accepted as a solution to Auckland's water quality problems. Instead, the Central Interceptor is the perfect example of a comfortable solution that continues to facilitate current water habits.

The second reason Auckland's public appear to more receptive to a centralised approach is the embeddedness of traditional understandings of water management. This is observed in the media's problematisation of water quality. One outcome of centralised water infrastructure is the production of 'good' and 'bad' water. Good water (cleaned, purified, controlled) is invited into the domestic space via pipes and taps and bad water (grey water, metabolised water) is expelled and excluded from the familiar domestic environment (Kaika, 2005). These hybridised understandings of water are perpetuated in Auckland's media. For example, there are claims that the "beaches, harbours and islands are the jewel in the crown of Auckland" and that heading to the beach during summer is part of the birth-right of Aucklanders [A301]. Meanwhile, the public also display disgust at 'bad water'. Articles quote mothers who are disappointed their children are unable to swim at local beaches and there is irritation about having to wonder when it last rained before swimming. Residents have complained of issues on their own properties such as tampons, toilet paper and faeces appearing as well as flooding [A222]. The networks that mediate this transformation of clean, purified water into pollution and waste are hidden underground. It is understandable that the public would be upset about the effects of declining infrastructure that cause these problems, but not criticise the type of infrastructure itself as the problem.

This is why, despite similarities with the centralised infrastructure currently causing pollution in Auckland's beaches and waterways, the Central Interceptor is still capable of being viewed as an acceptable solution. The legitimacy of the proposed project is supported by the fact that it reinforces the production of these norms of good and bad water, rather than challenging residents to interact with untamed, uncontrolled water.

The Central Interceptor is packaged as a solution to Auckland's water quality issues

An important contribution to the legitimation of the Central Interceptor is the way it was been presented in the media as the solution to Auckland's water quality issues. Media discussion around the project disproportionately represents its environmental benefits, catering to the public appetite for improved environmental quality. Table 5.1 summarises the services and benefits that the Central Interceptor will contribute to, according to official plans/reports and media discussion. Official documents report provision for population growth, additional capacity and improved asset conditions at similar frequencies. However, reduction in wet weather overflows is the most frequently stated purpose of the Central Interceptor. In comparison, almost 70% of the beneficial claims in the media were in relation to wet weather overflows. Official documents and news articles both present other purposes or services, but to a much lesser degree. This implies that public discussion is more focused on improving overflows, which is what ties the project to the problem of declining water quality in Auckland. This reflects an emerging trend in the justification of large-scale infrastructure using language of environmentalism. Projects are presented as solutions to environment-related problems, such as food or water scarcity and climate change using discourses such as 'greening the economy', resilience and mother earth ideologies (Warner et al., 2017). The mother earth discourse in particular has been used to promote investment into hydro-power projects in Ecuador (Warner et al., 2017). Presentation of soft-path and participatory processes in Peru have been instrumental in securing funding for 'mega projects' (Mills-Novoa and Hermoza, 2017). Shove (2003) also discussed the ways in which environmental significance can be assigned to products and used as a marketing method. It appears that these tactics have been used to promote the environmental benefits of the central interceptor and reinforce its linkages to the heightened awareness of the city's water quality problems.

Table 5.1 – The number of times services or benefits provided by the Central Interceptor were reported in official plans/reports and media.

Service provided by CENTRAL INTERCEPTOR	**Official Plans and Reports**	**Public Media**	**Total**
Provide for population growth	10	6	16
Provide additional capacity	10	0	10
Improve Asset Conditions	14	6	20
Reduce wet weather overflows	22	31	53
Sustainability	2	0	2
Resilience	1	0	1
Minimise construction nuisance	0	1	1
Politics	0	1	1
Health and Safety	2	0	2
Meet customer needs	1	0	1
Reduced costs	1	0	1
Cultural values	1	0	1

Media discussion around the Central Interceptor has also misrepresented the spatial benefits of the project. In official reports produced by Auckland Council and Watercare, specific regions of the city were named as the areas that would benefit from the project from the reduction of wastewater overflows. However, in newspaper descriptions of the project, the distinction of which areas will benefit is vague. This includes articles where an explanation is given by a spokesperson from Watercare or Auckland Council, creating opportunity for the public to overestimate the projects beneficial outcomes. One example of this is a New Zealand Herald piece that interviewed Auckland Mayor Phil Goff about the project. In the article [A12] Goff claimed that with the right level of investment, the council could clean up beaches and harbours within a decade, reducing wastewater overflows by as much as 80-90%. He does not specify where these reductions will occur. Figure 5.4 (below) shows the regional distribution of waterways reported to have water quality issues in newspaper articles used in this investigation.[3] For any non-specific claim, such as Goff's, about the spatial distribution of the Central Interceptor's benefits, it could be assumed to be about any of the city's waterways represented in figure 5.4. However, the reports

[3] *Not all of these reports were specifically due to wastewater overflows.

of water quality problems inside the catchment affected by the Central Interceptor make up only 18% of the total reported sites with poor water quality in Auckland. Some articles also contained false information about the project. For example, one New Zealand Herald article incorrectly states that the Central Interceptor was specifically intended to reduce overflows in the Manukau Harbour. Although the project promises to reduce the risk of overflows into the Manukau Harbour, the vast majority of overflow points that will be altered discharge into the Waitemata Harbour (>100:14). The misinformed public perception of the spatial benefits of the Central Interceptor may be working to convince the public of its legitimacy.

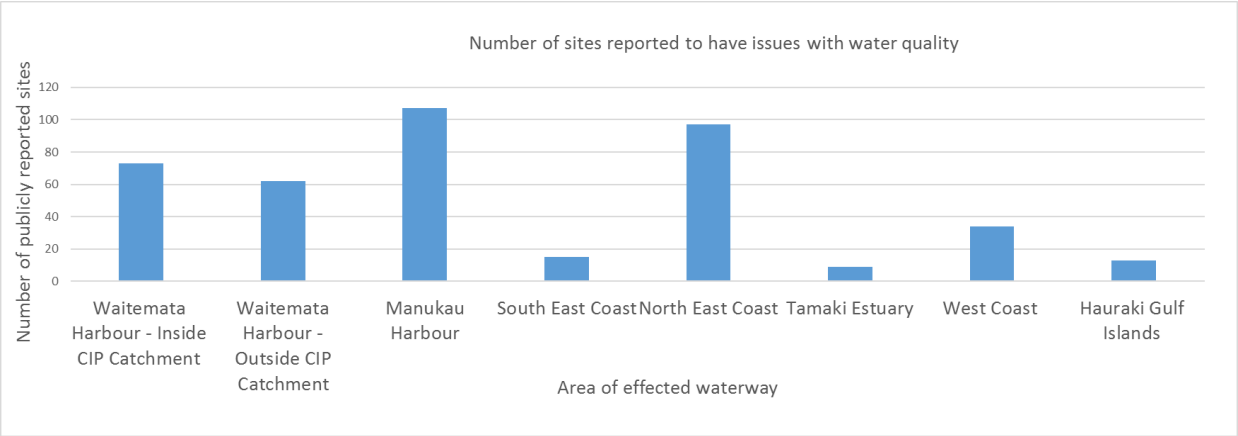

Figure 5.4 – Number of sites (by region) in newspapers articles in the dataset reported to have water quality issues.

In conjunction with the vague presentation of the project's spatial benefits, early plans for the Central Interceptor appear to have oversold the project's capacity to reduce wastewater overflows. Early in the water corporation's resource consenting process, they claimed the project will "dramatically reduce overflows and associated pollution loads from a network that currently discharges wastewater to the environment" [AEE, 2012:28]. According to the corporation's hydraulic modelling, the project would reduce annual wastewater overflows by 90%. The corporation also presented the project as the best practicable option and denied the need for sewer separation on the basis that "international practice is that most wastewater utilities with combined sewer systems have determined that separation is not feasible" and has not been successful when implemented in Auckland [AEE, 2012:27]. However, from 2016 onwards it was increasingly clear that the Central Interceptor was not the complete solution. Watercare's 2016 Asset Management Plan refers to the project as "an interim solution for stormwater issues" and anticipates that by the time the project is complete the catchments that it services will be fully separated [p4]. In addition to sewer separation, hundreds of millions of dollars will be required to extend the pipe

to Grey Lynn and Waterfront suburbs. None of these solutions address the environmental impact of stormwater runoff into urban streams. This is an example of how large-scale projects overestimate their benefits. According to Flyvbjerg (2009), the promoters of projects tend to over-represent the benefits and present them in their best light in order to gain approval or funding. The Central Interceptor project has been misrepresented, publicly and by local government and its water supply arm as addressing a problem it does not have the long-term capacity to address. This is problematic, particularly because, as described above, reduction of overflows is what the project is primarily understood to do and demonstrates how the project has oversold its benefits.

Why does the public need to be convinced?

Looking at the ways the project has been packaged and sold to the public prompts an important question: why does the public need to be convinced that the Central Interceptor is a good idea? The answer may lie in underlying problems with the project that have been met with contentious public response. A major example of this is the concern the Interceptor will disproportionately benefit residents in Auckland's central suburbs to the detriment of residents in the lower income suburb of Mangere adjacent to the city's biggest wastewater treatment plant. The residents of Mangere and other South Auckland suburbs bordering the Manukau Harbour had many concerns. Examples include:

- Foul odours from an associated air vent
- Imposition of new infrastructure
- Compromising the archaeologically significant landscape
- Water quality in the Manukau harbour
- Greater volumes of waste being treated in South Auckland

A significant theme was opposition to the project on the principle that it was "just another move in a long tradition of 'dumping' on their community" [A215]. For example:

"We want Mangere Bridge to be known for its beautiful landscape, its pahoehoe lava, its rich birdlife, its rugged harbour, its bustling village, its community spirit and its Maori history...We don't want a symbol of sewage prominently placed on our esplanade." – Frances Hancock, Mangere Resident [A215]

"It's not okay to take wastewater and stormwater from the Waitemata and just shove it into the Manukau. Let's not treat it as the backdoor and rubbish dump of Auckland," – Bronwen Turner[4] –[A17]

Residents surrounding the southern harbour claim that it has long been considered a dirty inlet with a history of neglect including from surrounding freezing works, rubbish tips and sewage plants. This is frequently commented on in newspaper articles, including one titled 'Manukau Harbour Protection Society incensed at having to take Waitemata wastewater' [A181]. The Mangere Bridge Residents and Ratepayers association took it to the extent of seeking legal advice on further action to halt the Central Interceptor project. The group were disappointed the project would be going ahead, despite the number of submissions against it. The Mangere Bridge Residents and Ratepayers Association, Onehunga Enhancement Society and Manukau Harbour Protection Society had all lodged appeals with the Environment Court regarding the project. This dissatisfaction is evidence of the undesirability of the Central Interceptor because of the inequalities it perpetuates in the city. It is also indicative of why the public needs to be convinced of its merits.

Another reason the public need to be convinced the project is legitimate is because the proposed method of payment for the project, by all the city's residents, is not reflective of who will receive the benefits. Prior to the Council's amalgamation in 2010, investment in water infrastructure in different regions was uneven. For example, treatment plants in the Franklin District did not comply with health standards, Manukau City and Auckland City required $400 million and $1.4 billion, respectively, worth of system upgrades. Meanwhile, North Shore City spent millions in the early 2000s to upgrade its sewer system to increase its capacity. The different levels of historic investment was warned to be a point of contention following the Council amalgamation and equity issues were predicted when Auckland moved to a single integrated entity for water and wastewater services. This prediction came to fruition in discussions following announcement of the Council's proposed targeted rate for water quality. This rate would

[4] Turner's family has lived on the harbour since the 1880s [A17]

average at $1.28 per household per week and is reported to raise $400 million towards the $1 billion Central Interceptor, in conjunction with other projects. Members of the public claimed to support the targeted rate but wanted to see evidence and transparency around the projects to ensure the money didn't "dissipate into the network" [A109]. The targeted rate has not been unanimously accepted. Auckland Councillor Chris Darby has publicly questioned the equity of the targeted rate. According to Darby, much of the targeted rate would go towards the "$1 billion plus' giant pipeline" to reduce overflows from the central suburbs into the harbour [A112]. He claims the North Shore and other areas such as Pukekohe, Rodney and Papakura will not get much benefit from the rate. Devenport-Takapuna Local Board member, Jan O'Connor, also questioned the targeted rate saying it would mostly benefit Auckland City. A spokesperson for the Mangere Bridge Residents and Ratepayers Association had expressed concern that the cost of the Central Interceptor would pass to areas that had already paid to have their sewage and stormwater pipes separated through their rates. Others were against the proposed rate because they expected funding to keep beaches clean should come out existing rates charges. This is further indication as to why discussion around the Interceptor project has been vague about which areas will receive the benefits of the project.

The reasons that the public need to be convinced of the legitimacy of the Central Interceptor are not explicit because it is a centralised solution. However, the major objections to the project, on the basis of unfairly distributed costs and benefits, are well documented problems associated with centralised infrastructure. These problems are associated with the pipe in a number of ways. Firstly, there is danger of environmental impact and detrimental effects to the Manukau Harbour. Eutrophication, deoxygenation, fish kills, accumulation and bioaccumulation of pollutants commonly result from urban water infrastructure (Bell, 2015). Secondly, the inadequate investment and declining condition of wastewater systems in various Council's prior to the amalgamation are reflective of the global trend of aging water infrastructure and reluctance to invest in repairs or maintenance because it is expensive and disruptive (Bichai and Flamini, 2018; Sharp, 2017; Marlow et al., 2013). Third, the benefits and impacts of the infrastructure is differentiated according to socio-economic standing. Infrastructures may develop and perpetuate inequalities. A similar outcome was observed to result from the interceptor pipeline constructed to protect Lake Washington in Seattle. While the lake was protected, the Duwamish River received the polluted effluent to the detriment of low-income fishermen and Native Americans who relied

on the river for food and recreation (Karvonen, 2011). Finally, the disgruntled residents of Mangere failed to have their concerns about the project heard adequately.

Mobilisation of large-scale infrastructures is assisted by members of society that have the resources to swing political and social tides towards their own objectives (Kingdon, 1984; Crow-Miller, Webber and Molle, 2017; Colven, 2017). The negative impacts fall disproportionately on the poor, who do not have the resources to resist them (Blomkvist and Nilsson, 2017). Dam, pipeline and canal construction in the Gujarat region of India undermines the independence of the minority groups of the region and makes them dependent on the state's willingness to give them water (Crow-Miller, Webber and Molle, 2017).

To summarise, the public needs to be convinced that the Central Interceptor project is a worthwhile investment due to its negative repercussions, commonly observed in relation to centralised water projects. Although the project is not opposed explicitly on the basis of it being a centralised, large-scale engineering solution, it is objected to for the very reasons that have seen academics and water managers shift towards more sustainable alternatives to urban water. As with the conclusions drawn in chapter 4, the findings in this chapter prompt the question: Why, despite its negative repercussions of centralised infrastructure, does it continue to be implemented?

Conclusion

- There were three main ways in which public discourse influenced the legitimation of the central interceptor. The first was the social context of public receptivity to addressing water quality problems. To some degree nationwide there was an existing and growing concern for declining water quality which was reinforced by public backlash to inadequate government responses. In Auckland, although pollution of inner-city beaches was not a new problem, public discussions around this issue have increased in recent years. This increase correlated with the renovation of the Safeswim website. A major purpose of this revamp had been to increase public willingness to address poor water quality in Auckland. Therefore, the city's residents were more receptive to a new water quality project not only due to a nationwide awareness, but also because of the

work by local government to present beach pollution as an urgent and disruptive problem requiring urgent intervention. The second was the public's implicit preferences for a centralised response. This was observed in the delegation of responsibility to local government and big water, the perpetuation of dual notions of water embedded by traditional modes of management and the lack of significant disruption to everyday life caused by pollution of local waterways. These all suggest that Auckland's public would be more receptive to a comfortable solution that does not disrupt the status quo. The third way public discourse legitimated the central interceptor was the project being packaged as a solution to the public's concerns about water quality. Media discussion of the project was found to over-emphasise the project's environmental benefits and blur the spatial benefits and capacity of the infrastructure. The effect of this was the public impression that investment in the project would improve water quality across the city, despite only affecting a specific region for one type of pollutant. Similar approaches have been observed overseas to sell large scale infrastructure projects, including use of environmental discourses and overselling the promised benefits. It is also interesting to note that public discourse indicates why the public need to be convinced the Central Interceptor is a good idea. The inequity of the project and its potential for environmental degradation are major concerns of the public. In this case although concerns are not explicitly expressed as issues with centralised infrastructure, they are commonly stated flaws of traditional water infrastructure. In conclusion, public discourse was an important factor in the legitimation of the Central Interceptor. Although receptivity to the project was certainly eased by a pre-existing concern for waterway health, work was done not only to increase awareness of beach pollution but also to sell the Central Interceptor as the appropriate solution. Public discourse also revealed that there is implicit dissatisfaction with centralised water infrastructure in the city, but this proved insufficient to derail the mobilisation of the project.

Chapter 6: Understanding the appeal of legitimising the Central Interceptor

This chapter seeks to explain why work was done to legitimise the Central Interceptor as the 'best practicable option' to combat Auckland's water quality and wastewater needs. The desire to understand the motivation for supporting the Central Interceptor stems from the previous two chapters. Each explores the ways in which work has been done by in the process of technical decision making and in public discussions of Auckland's water quality to legitimate the project. However, each chapter falls short of capturing the incentive is to do this. Three explanations are proposed here. The first is that the Central Interceptor is an attractive opportunity to generate profit or financialisation. This is supported by findings in the literature review. The second is that the project is attractive to the water corporation as a tool to gain more power or autonomy from their sole stakeholder, the local government. These claims are related. In its own right the Central Interceptor cannot be used to generate profit. However, due to its high cost, it could prompt legislative change or alternative funding options for the project that could move the water provider closer to a position where it could generate a profit from projects of this kind. Interestingly, despite this potential shift in power, the Central Interceptor is also an attractive option for Auckland Council as a way of meeting the growing public expectation that they address water quality issues in the city. The Council's support of the Central Interceptor could be due to a shift in power, driven by Watercare's desire for autonomy and profit, or it could be the Council eschewing responsibility for wastewater overflows because it cannot or will not fund the decentralised alternatives it claims to promote. There is a third, somewhat separate explanation also proposed in this chapter as an incentive to the legitimation of the Central Interceptor. This is simply that it fits with or facilitates the dominant narratives of urban and economic growth, and the desire to be a world class city, that are present in Auckland's political discourse. When combined, these explanations indicate that the reason for the legitimation of the Central Interceptor was that it was attractive to the two major organisations involved in urban water management and it seemingly fits the city's visions of the future.

Fluctuating support of centralised solutions

The need for a large-scale pipe to fix Auckland's water quality problems has not been a permanent narrative in the city's water management. Investigation of the dataset revealed that for many years sewer separation was the preferred solution to the city's wastewater overflows. Prior to 2012, multiple separations were carried out, including millions spent on the CBD in the lead up to the 2000 America's Cup and several projects conducted by Metrowater[5] in central suburbs such as Kingsland and the Motion's Creek catchment. However, in 2007, plans for more separations were halted and eventually dismissed. The public speculated this was due to the Council's desire to receive more money from Metrowater's charitable payments, rather have the money spent on capital works. This coincided with the Auckland City Council announcement of an $86 million cut to its funding of sewer separation over the following 10 years. In 2012 the Central Interceptor emerged in the media as the new favoured option. Between 2012-2016 the Central Interceptor was claimed to double as a storage tank to collect diluted sewage from the combined sewer system and act as a long-term solution. In conjunction with this new response, local government and water managers publicly presented several arguments that de-validated sewer separation. For example, it was argued not to work because old combined pipes (which would become the stormwater pipes following separation) did not have sufficient capacity to hold the regions stormwater. They also claimed areas that had been separated continued to have issues with overflows and international practice has shown separation to be infeasible. As late as 2017, Council officials were opposed to separation on the grounds that it was expensive and disruptive. Instead, the Central Interceptor was presented as meeting the requirements of sewer separation, with additional benefits.

In 2016 the narrative began to change once again. In contrast to earlier documents, Watercare's 2016 Asset Management Plan claimed the Central Interceptor would act as an 'interim' solution to give the Council time to separate the sewer. The report states that network separation is necessary because reliance on the wastewater network (and Central Interceptor) for stormwater collection is not sustainable. From 2018, this view was also expressed by Council representatives and civic groups, including Auckland Mayor Phil Goff and community group SASOC[6]. The latter argued that separation would never be easier than now, before building in the central suburbs is further intensified. This is an example of how the proposed benefits of the Central Interceptor were manipulated to gain approval for their project. It

[5] A former water supplier in Auckland.

[6] Stop Auckland Sewage Overflows Coalition (Community group)

demonstrates that water managers are capable of legitimising one form of infrastructure one day and finding arguments to dismiss it the next. It prompts the questions: why would managers choose to exercise this power and why would they choose to support one mode of management over another?

Legitimising the Central Interceptor for profit and financialisation

The first possible explanation is that large-scale and centralised infrastructure can be an opportunity to create profit or support financialisation and this is an incentive for its implementation. In the literature review, it was found that these can be motivational factors for implementing centralised infrastructure. In capitalist societies, the commodification of water has affected the way it is managed (Swyngedouw, 2004; Bakker, 2010). In nations that have experienced neoliberal reforms in water management, there can be a weakening of the view that water is a public right (Furlong et al., 2018). Instead, with profitability in mind, residents are treated more like customers and water companies have incentive to support projects that can generate a profit (Furlong et al., 2018; Bakker, 2010). If not a direct profit, large-scale projects can also be attractive for their potential to generate investment opportunities or support the growth of wealthy organisations (Colven, 2016; Loftus, March and Nash, 2016; Crow, Webber and Molle, 2017). An example of this was the pursuit of Jakarta's Great Garuda Seawall, which was intended to stimulate property investment on reclaimed land, construction of a toll road and to produce profits to cross subsidise flood mitigation infrastructure (Colven, 2017). At the same time, the absence of these opportunities deters the uptake of decentralised infrastructure and demand management strategies. The more water people save, the less money can be made corporatising it which would shift the balance away from the water organisations (Sofoulis, 2005). This suggests profit and financialisation could be a motivating factor for the legitimation of the Central Interceptor in Auckland.

There is some evidence to suggest this is the case. Despite being wholly owned by the local government, Watercare funds all its activities through customer service charges (including for water supply and wastewater removal) (47%), infrastructure growth charges (21%) and borrowing (32%) [Tapped In, Autumn 2017]. Borrowing is justified on the assumption that population growth in Auckland will bring more customers and therefore more income from service charges to repay debt. This is demonstrated in this quote in a New Zealand Herald article:

"We do not have a problem to fund the infrastructure that's required for growth. So growth funds us. If there's growth, there's more charges and therefore there's more money," Raveen Jaduram, Watercare Chief Executive [A23, 2016]

According to Swyngedouw (2004), when profit becomes the motive for water management, water organisations are continuously required to extend, replace and update water networks to generate income. This is observed in Auckland. Watercare invest millions of dollars every year on growth related projects to expand the city's network capacity. The Central Interceptor is one of these projects. More growth means more customers and therefore more income for the water corporation. On top of this, the Interceptor is attractive because it facilitates intensification of inner city development, where land prices are high and development had formerly been restricted by the limited sewage capacity and risk of wastewater overflows. The opportunities for profit from a centralised project also explain the why water managers in Auckland would want to delegitimise decentralised technologies or demand management techniques. Less water supply or wastewater would reduce income from service charges, as these are calculated volumetrically. This would move profit out of the hands of the water corporation.

There are two significant flaws in the argument that the actions of the water corporation are motivated by profit. The first is that Watercare are not allowed to make a profit and their shareholders, Auckland Council, are prohibited from receiving a dividend. Any monetary excess gained by the water corporation must be used to reduce their debt. This makes it difficult to claim that profit was the motivation behind the legitimation of the Central Interceptor when the stakeholders are legally prevented from making one. The second is that, with a cost of over $1 billion NZD, a significant amount of investment is needed before any financial benefits would be gained. Historically, lack of public funds has been used as a justification for underinvestment in the water sector (Bakker, 2003). Reluctance to invest is also observed in Auckland, where rates that fund stormwater management must be shared with many other local government services, and there is little appetite to see these rates increase. What this says, is that financial incentives cannot be the sole driver of the work done to legitimise the Central Interceptor. In general terms, this suggests that other motivating factors on top of profit would be required to drive the implementation of centralised infrastructure.

Legitimising the Central Interceptor to be used as a tool for power or autonomy

The second explanation for why the Central Interceptor was backed could be its potential value as a tool to gain more autonomy or power for the water corporation, Watercare. Although they are both owned by Auckland Council, Watercare and the Council's Healthy Waters[7] department do not have cohesive management styles or approaches. According to the Three Waters Merger [2017]:

> *"Watercare and Healthy Waters operate very differently with distinct and different cultures and operating styles. The beliefs and values that lead to each organisation's operating norms have created tensions between them and represent a risk, particularly when they are using softer collaborative governance methods."*

The document goes on to state that the organisations lack shared objectives and incentives to address joined opportunities such as the reuse of storm and wastewater. This lack of unity has led to a focus on individual benefits of each of the three waters rather than the potential shared outcomes of working collaboratively on all three. This sets up divergent (yet coexisting) trajectories for the city's water management: the corporation's centralised command and control approach to supply and wastewater and local governments movement towards a decentralised style of stormwater management.

There are also indications of an imbalance of financial capacities between the organisations. As the owner of Watercare, Auckland Council should presumably hold more power and financial stability. Watercare is a Council controlled organisation and their debt is managed on the Council's balance. The increased debt Watercare must take on to fund the Central Interceptor is problematic for the Council's budget, who are already close to their specified debt limit. There is public and industry speculation that the council will struggle to secure the "billions of dollars" required to keep pace with the city's unprecedented growth [A211]. A New Zealand Herald article reporting on a financial firm's investigation in the Council's budget raised several questions, including whether it was appropriate to use rates for large project investments and if the council could afford to rely primarily on debt funding. In contrast to this, Watercare claim to have a more secure financial standing and willingness to invest in infrastructure. According to their 2017

[7] Healthy Waters is the Council unit responsible for stormwater management.

Statement of Intent, Watercare intend to invest $4.9 billion on infrastructure before 2027. The same year, the Council's investment in stormwater was equivalent to less than 30% of Watercare's spending. The water corporation also pride themselves on their debt to asset ratio, in comparison to other utility companies worldwide. This suggests the local government is struggling to keep up with the high spending and debt accumulation of their water corporation.

This potential power imbalance could weaponise the Central Interceptor, making it a tool to further remove Watercare from the Council's control. According to Aledo Tur et al. (2018), the way corporations work in relation to local government is a product of time and place and depends on the relative power of the public and private sectors. Whilst the New Zealand public strongly believe that public ownership of water is important, private sector involvement is expected to increase in the financing of large-scale projects. The debt Watercare intends to take on to fund its large-scale projects is expected to increase significantly over the next ten years. With the intention of relieving the stress on the Council's budget, the water corporation investigated alternative modes of financing the project, detailed in publicly letter available published in Stuff. The alternatives proposed by the water corporation include:

- Continue with current financial plans, although Watercare does not necessarily need to borrow through the Council.
- Implement a public-private partnership (PPP) or special purpose vehicle (SPV) to assist with project delivery or financing
- Auckland Council could sell >50% of their Watercare shares to remove Watercare's debt from their balances.
- Watercare could reduce forecasted capital investments
- Watercare could increase its service charge.

A number of these options, including an SPV and the sale of Watercare would require legislative changes. It is worth noting that one of the discrediting arguments for financial benefits being an incentive for the Central Interceptor is that Watercare is legally prevented from making a profit. Should legislative changes take place to allow private involvement in the funding of the project, including if the Council sold its majority shares, this would allow the water corporation to indeed make a profit. The Central Interceptor

could be a weapon to achieve more autonomy (and profit) because its high cost could force the Council to release some of its financial stake in the water corporation.

Surprisingly, there are ways in which the shift in power would also be beneficial for the local government. The poor water quality in Auckland's waterways is a testament to the Council's reluctance or inability to fund the maintenance of stormwater infrastructure. Generally, underinvestment in water is a politically convenient strategy, because the impact of underinvestment can take a long time to become apparent to the public, in comparison to other sectors (Bakker, 2003). As the discussion in the previous chapter shows, public discontent with the state of water infrastructure and poor water quality is growing and local government can no longer avoid the issue. It is beneficial for the Council to address their stormwater issues with a large-scale wastewater project that is not solely funded by already restricted rates. The Central Interceptor is appealing to local politicians because it fits with the local government agenda of improving water quality without increasing debt or general rates. This may explain why the local government's Long-Term Plan [2015] simultaneously presents its aims of becoming a 'Water Sensitive City', whilst supporting Watercare to invest billions of dollars over the next 30 years in a series of centralised trunk sewers around the city and increased supply capacity. The Council's support of the Central Interceptor could be due to a shift in power, driven by Watercare's desire for autonomy and profit, or it could be the Council eschewing responsibility for wastewater overflows because it cannot or will not fund the decentralised alternatives it claims to promote. Therefore, another incentive to legitimise the Central Interceptor could be for the Council to alleviate some of its responsibilities.

Either way, the local government has demonstrated its support of the water corporation. This was observed in several claims in the media and the Central Interceptor consent hearing that the water corporation is granted and held to resource consents more leniently than other organisations. A significant point of contention in the resource consent hearing was the corporation's absence of management plans around the project. According to one submitter, almost all the mitigation measures for the project were to be addressed through management plans which had not been drafted at the time of submission. Although these plans would still need approval from the Council, decisions that would directly and profoundly affect submitters and neighbours would be removed from public scrutiny. This concern was reiterated by other submitters who added that consent application in its original state did not set out how

adverse effects were to be avoided, mitigated or remedied. The submitters doubted the Council would appeal or object to the management plans, due to their stake holding role in the water provider. While the hearing panel accepted these objections in principle, they were not found to be sufficient ground for declining approval or recommending the withdrawal of the application. The relationship between the organisations has also been criticised by New Zealand Herald journalist Brian Rudman. Rudman claims local government deliberately turns 'a blind eye' to uncontrolled overflows during heavy rain, allow roughly 110 engineered overflows per year to take place per site, despite the consented limit of only two per year at each site. What this arguably preferential treatment demonstrates that both organisations have an interest in legitimising the Central Interceptor and played a significant part it its acceptance as the preferred solution to Auckland's wastewater overflows. This indicates that localised political interest have a role to play in the continued implementation of centralised water infrastructure.

Legitimising the Central Interceptor to meet public and political expectations

In addition to the possible financial and political incentives to legitimising the Central Interceptor, there is a third possible explanation. This is that the large-scale, centralised approach fits with the political narrative of urban planning and growth in Auckland. There are three major ways this was observed. Firstly, the Central Interceptor aligns with the dominant theme in planning documents for Auckland: facilitating urban growth. Every Auckland Council and most Watercare documents analysed mentioned population growth as a critical challenge in the city's future. The expectation that Auckland will absorb 60% of the nation's growth over the next 30 years drives the formation of infrastructure plans to meet demand. Watercare's planning documents reflect the sentiment that control of water is necessary for economic growth and urbanisation. The prioritisation of growth is symptomatic of the promethean discourse Dryzek refers to as 'growth forever'. Within this discourse growth is assumed to be good as it generates more income, housing, employment and wealth (Dryzek, 1997). This is facilitated by institutions that work within capitalist economies and political systems that are set up to maintain and enable growth (Dryzek, 1997). Within this 'growth forever' narrative found in Auckland, the Central Interceptor is an attractive piece of infrastructure because it facilitates this positive growth by increasing sewer capacity. This is an incentive to legitimise it.

Secondly, in New Zealand infrastructure is considered to be a fundamental part of having a strong economy and acceptable standard of living. According to the 2015 National Infrastructure Plan, quality infrastructure enables New Zealanders to reach their full potential, play a meaningful role in the economy and society and economic performance is strong when infrastructure supports international connectedness, increased productivity, exports and growth. These ideas and the notion that quality of life and economic well-being in Auckland depend on investment in infrastructure are also expressed by the local government. These sentiments show that the Central Interceptor is being implemented in a context where a high value is placed on infrastructure projects. This value for infrastructure is observed overseas. For example, investment in infrastructure to stimulate the economy is used in many countries, including the United States, China and Brazil (Flyvbjerg, 2009; Aledo Tur et al., 2018). The idea that modernisation through technological change and capital expansion is fundamental to the improvement of living conditions remains a prevalent ideology in the 21st century (Kaika, 2005; Bakker, 2010). The effect is that in nations such as New Zealand, large infrastructure projects such as the Central Interceptor, continue to be attractive as they contribute to the narrative that investment in infrastructure will improve quality of life.

The third way that narrative around urban planning in Auckland promoted the legitimation of the Central Interceptor was through the vision of making Auckland the 'world's most liveable city'. This vision is frequently used to justify or necessitate investment in infrastructure. All of Auckland Council's planning documents and annual reports and many of Watercare's start with a declaration of this objective. For example, the 10 Year Budget [2015] lists multiple infrastructure items, including water and sewerage networks as 'essential ingredients of a great city'. Nation building visions, such as this, were common in the early 20th century. They frequently provided the impetus for large-scale projects such as dams and reticulated water supply systems. These projects were symbolic of dominance over nature, progress, power and had economic and political implications (Bakker, 2010; White, 2017). Auckland Mayor Phil Goff is quoted multiple times in the media dataset using vision of a world-class city to promote action for water quality, wastewater overflows in particular. For example:

"Auckland is a global city and we shouldn't have wastewater overflows polluting our harbour," – Mayor Phil Goff [A37]

He has also suggested the 'clean, green, 100% pure' image New Zealand uses to promote itself to the world is not the current reality [A9] and that the "current situation is not acceptable for a world class city [A57]". Critiques of Auckland in terms of its 'world-class' status are also presented in several newspaper articles reflecting on problems with wastewater overflows. For example:

"I'd say we are heading down to Second World Status. I don't think you can claim First World Status when you're discharging untreated sewage into your coastal environment." – Gemma Tolich Allen (Biologist) – [A22]

Articles suggested that whoever had ranked Auckland as the third best city in the world had not come after a downpour and were critical of Auckland failing to meet basic requirements for hygiene and sanitation. However, this nation building discourse does not neatly explain the appeal of the Central Interceptor. According to Ghertner (2015), contemporary attempts to achieve 'world-class' aesthetic commonly motivates investment in visible, modern infrastructure projects. The Central Interceptor is neither visible nor a modern concept. The vision of 'the world's most liveable city' promotes the need for the project, by insinuating that without this infrastructure to circulate water throughout the city, Auckland could lose its international competitiveness, preventing financial flows that would facilitate achievement of this vision. This discourse in the city's urban planning is another strong motivating factor in the legitimation of the Central Interceptor.

The above explanations are the speculative reasons for why work was done to legitimise the Central Interceptor in Auckland, that emerged through thematic analysis in this investigation. The findings provide insight into the broader contexts of the continued implementation of centralised water infrastructure. As discussed in the literature review, the financial opportunities afforded by centralised infrastructure are a common incentive for their implementation. Although this was found to be a contributing factor in the Auckland case study, the high cost of the project was more important for its implications for altering the power dynamics in local politics than for its economic potential. The fit of the Central Interceptor with narratives of growth and world class cities in local political discourse was also a driving factor for its implementation. This suggests that while money and political power are important factors in the continued implementation of centralised infrastructure, the ways in which these factors drive it are highly context specific and dependent on political dynamics and discourses. It is also important to note that due

to the scope of this research, these explanations may only scratch the surface of why the Central Interceptor was pursued. Closer communication with the stakeholders could expand these theories, disprove them or find altogether new incentives or explanations for the legitimation of the Central Interceptor. Regardless, attempts to shift towards more sustainable urban water management should be informed by the politics around local government and water management to best understand why its uptake continues to be undermined by the permanence of traditional urban water management.

Conclusion

This chapter sought to explain why work was done to legitimise the Central Interceptor, a proposed piece of centralised water infrastructure, in Auckland. The previous two chapters work to show that a significant amount of work has been done in Auckland to legitimise Watercare's Central Interceptor as the 'best practicable option' for the city's water management needs. This chapter opened by demonstrating that water managers have the capacity to fluctuate in their support of management approaches. These findings prompted the question: what is the incentive to legitimate of one mode of management over another? In the case of the Central Interceptor, three possible explanations were determined.

The first, is that a large-scale, centralised project such as this, is attractive for its ability to create profit or support financialisation. There is some evidence to support this claim and it fits with examples of this being a strong motivating factor in the implementation of mega-projects overseas. However, there is a fundamental flaw in this argument: Auckland's water supply corporation are legally prevented from earning a profit and the high price of the project indicates it would be some time before financial benefits are realised.

The second explanation could be that the Central Interceptor was attractive for its potential to gain more autonomy or power for the water corporation. Again, there is some evidence to support this claim. Watercare and Auckland Council have stark contrasts in their preferred methods of water management and capacity to fund these. Due to the high price of the Central Interceptor, Watercare have investigated several options that would alleviate the stress of the project's debt the Council's financial balance. Should the financial imbalance between the organisations reach a point where legislative changes allow the private involvement in the project, the Interceptor would have acted as a tool to increase the autonomy of the water corporation and bring them closer to profiting off water supply. The Central Interceptor is

also an attractive response for the local government. The poor water quality in Auckland's waterways is testament to the Council's reluctance or inability to fund the maintenance of stormwater infrastructure. Their documented support of the Central Interceptor could be because it alleviates some of its responsibilities to the public.

The third explanation for the legitimation of the Central Interceptor is that it fits with the dominant political discourses in Auckland's urban planning. These include urban and economic growth; a high value being placed on infrastructure to improve quality of life and a vision to make Auckland the 'world's most liveable city'. Legitimation of the Central Interceptor is therefore incentivised because it fits with all the major objectives or values for Auckland's future. This research suggests work was done to legitimised Auckland's Central Interceptor because the project not only fits with the major objectives for the city, but also because it is attractive to the two major players in the city's water management, despite their opposing modes of management. Unfortunately, due to the scope of this research, this cannot be argued conclusively. However, it is a strong indicator that while financial and political incentives are important factors in the continued implementation of centralised infrastructure, the ways that these factors are important is an outcome of the local political context.

Chapter 7: Conclusion

The objective of this research was to understand how and why centralised urban water infrastructure is legitimised, despite acknowledgement of its flaws and established alternatives. It was found to be legitimised through technocratic decision making and discursive tools used to promote the need for infrastructure and the applicability of certain projects. In circumstances where the public is not exposed to the negative impacts of centralised networks they may not be perceived as illegitimate, and therefore do not need to be justified. The motivation to implement traditional, centralised forms of urban water management appears to be rooted in political and economic incentives. This research highlights the importance of nuanced local political dynamics in perpetuating problematic environmental management practices.

This research was inspired by divergence in urban water management practices. There are two established pathways. The first, traditional urban water management uses centralised infrastructure and centralised management to control water supply, wastewater removal and stormwater in cities. Critique of traditional management led to the emergence of more sustainable alternatives. Although there are variations in the application of sustainable urban water management, broadly speaking it calls for greater consideration of social, cultural and ecological values and the use of diversified, decentralised and fit-for-purpose infrastructures. The negative implications of traditional, centralised water infrastructures, and the presence of alternative approaches raises the question of why the former continues to be implemented and seen as legitimate. This study seeks to understand why.

A qualitative case study of Auckland's proposed Central Interceptor was used to explore two objectives:

Objective 1: *Explore the ways in which centralised infrastructure continues to be legitimised, despite its acknowledged flaws and existence of alternatives*

Objective 2: *Investigate the local incentives to implementing centralised urban water infrastructure*

This approach was adopted because modes of urban water management are highly context specific and the research required a holistic understanding of how stakeholders work to legitimise management choices. Qualitative case study research is often used to build on existing theories rather than prove generalisable cause and effect relationships (Breuning, 2011; Jencik, 2011). This aligned with the objectives for this investigation which sought to draw from both academic literature and this context specific example.

The object of the case study is Auckland's proposed Central Interceptor. The Central Interceptor is a large scale, centralised pipe that has been proposed as the solution to address the inadequacies of Auckland's storm and wastewater networks. Water management in Auckland has support for both traditional, centralised infrastructure and alternative, sustainable management. It was therefore considered an appropriate case to explore why this was the solution that was legitimated and accepted. The investigation was carried out using thematic analysis of a dataset that represented the view of the major stakeholders in Auckland's water management: central government, local government, the Council-controlled water corporation responsible for the city's water supply and wastewater, and finally, the public. The dataset consisted of publicly available documents from each of these stakeholders and provided a broad insight into the opinions and motivating factors behind water management in Auckland. Unfortunately, the findings of this study were limited to what was publicly available and therefore it cannot be assumed that these perspectives were captured completely. Direct contact with stakeholders was outside of the scope of this research due to time constraints, however these findings could form the basis for direct contact in future research.

The first major finding of this study was the use of technocratic decision making to legitimise centralised water infrastructure. The academic literature suggests that technical experts in urban water management hold authoritative positions and continue to set the terms of how decisions are made. This was true of the Auckland case study. It was observed in the establishment of the Central Interceptor as the best practicable option, through the prioritisation of technical, financial and administrative concerns, and the reduction of social and environmental considerations to numerical values. This made the project's legitimacy difficult to dispute. According to the literature, the dominance of technocratic decision making in water management undermines the uptake of sustainable alternatives. The quantitative basis for the Central Interceptor was also used to present it as a sustainable project, despite its misalignment with

sustainable water management practices. Public discussion around the Central Interceptor contained arguments both for and against its implementation and several alternative solutions were proposed. Not only was work done to publicly delegitimise these alternatives, there appeared to be no expectation within the technical decision-making community that alternatives or public feedback be seriously considered. Regardless, the water managers and planners for the Central Interceptor could defend their project and its necessity because they presented themselves as a-political experts. This masked potential bias. These findings conform with expectations informed by the academic literature. It leads to the conclusion that centralised water infrastructure continues to be considered an acceptable form of urban water management due to work done by a-political experts to legitimise it.

The second major finding of this investigation was the power of social context and discourse to legitimise centralised infrastructure. A major reason for the continued legitimacy of centralised water infrastructure is the transformative impact it has had on quality of life, and the lack of exposure of urban resident to its negative social and environmental impacts. There is little expectation for these systems to change, except when the normalised relationship with urban water is disrupted. When this occurs, new large-scale infrastructure projects can be promoted using the discursive threat of emergency or the promise of sustainability. Often it is the negative impacts of traditional water systems that are used to justify the legitimacy of new ones. The findings from the case study aligned with the academic literature. To create the necessity for the Central Interceptor, work was done to increase public awareness of declining water quality in the city's waterways. Public response held local government responsible for addressing these issues. This indicates the disruption caused by polluted urban beaches was not sufficient to trigger the behavioural change required for sustainable urban water management. The acceptance of the Central Interceptor was also helped by its public presentation as the solution to the city's wastewater overflows. This is an example of how negative impacts of centralised water infrastructure can be used to necessitate its continued implementation. However, the public were not unanimously accepting of the proposed Central Interceptor. Many of the concerns with the project were commonly stated flaws of traditional water infrastructure, such as uneven social costs and benefits, and possible environmental degradation. In effect, the legitimisation of centralised water infrastructure was due in part to the social context of its implementation, including the receptivity to improving the existing network and exposure to the negative impacts of centralised networks. However, work done to create the necessity for new infrastructure and presentation of the Central Interceptor as the solution to water quality issues was instrumental in the continued implementation and legitimacy of centralised infrastructure.

The third and final finding of this research was insight into the incentives for legitimising centralised infrastructure. According to academic literature, traditional, centralised infrastructure has political and economic advantages that are incentives for its legitimation. These include associations with improved quality of life, stimulation of industry, symbolism for modernity and progress, and opportunities for financial gains. This was observed to partially explain the appeal of the Central Interceptor in Auckland. However, from the outset of this investigation, it was suspected these incentives were too broad or did not adequately explain the continued use of centralised systems. Legislation around water supply in Auckland prevents the water corporation from earning a profit from water supply. The high price of this infrastructure suggests it would be years before financial benefits were realised. An alternative incentive could be the project's potential political benefits for both local government and the Council-controlled water corporation. The infrastructure could be used as a tool by the water corporation to leverage more autonomy and a way for local government to alleviate their responsibility for declining water quality. The case study indicates that local political dynamics within urban water management can have a significant influence on the decision to pursue centralised options. Although this research supports claims that political and economic advantages of centralised infrastructure incentivise its implementation, it highlights the role of nuanced local political dynamics in sustaining problematic environmental management. Further insight could be gained by investigating the impact of localised power dynamics within urban water management and their influence on the continued legitimacy of centralised water infrastructure.

To summarise and conclude this thesis, the objective was to understand how and why centralised urban water infrastructure is legitimised. This was investigated using a qualitative case study of Auckland's proposed Central Interceptor. It was found that the transformative role of centralised networks on quality of urban life and the lack of exposure to the negative impacts of these systems undermines the urgency to transition to more sustainable forms of management. Centralised infrastructure was found to be legitimised through technocratic decision making and discursive tools used to promote the need for infrastructure and the applicability of favoured projects. In Auckland, it appears to be a combination of traditional political objectives and nuanced dynamics in local politics that have incentivised the legitimation of centralised infrastructure.

Appendix: Overview of dataset

Central Government Documents:
The Thirty Year New Zealand Infrastructure Plan 2015
National Policy Statement for Freshwater Management 2014/2017
New Zealand Coastal Policy Statement 2010

Local Government Documents (Auckland Council):
The 10-Year Budget: The Long-term Plan 2015-2025 (Volume 1)
The 10-Year Budget: The Long-term Plan 2015-2025 (Volume 2)
2018 Unitary Plan: E1. Water quality and integrated management
2018 Unitary Plan: B11. Monitoring and environmental results
2018 Unitary Plan: B3. Ngā pūnaha hanganga, kawekawe me ngā pūngao - Infrastructure, transport and energy
2018 Unitary Plan: B7. Toitū te whenua, toitū te taiao – Natural resources
2018 Unitary Plan: D3. High-use Stream Management Areas Overlay
2018 Unitary Plan: D4. Natural Stream Management Areas Overlay
2018 Unitary Plan: D7. Water Supply Management Areas Overlay
The Auckland Plan: Chapter 12 - Auckland's Physical & Social Infrastructure
The Auckland Plan: Chapter 7 - Auckland's Environment
The Auckland Plan: Chapter 8 - Auckland's Response to Climate Change
The Annual Report 2010/2011
The Annual Report 2011/2012 (Volume 1)
The Annual Report 2012/2013 (Volume 1)
Annual Report Summary 2013/2014
Annual Report Summary 2014/2015
Annual Report 2015/2016
Auckland Council Regional Plan: Air, Land and Water
Auckland Growing Greener
Decision following the hearing of an application for resource consent and Notices of Requirement
Stormwater Asset Management Plan 2015-2045

Local water supply and wastewater corporation Documents (Watercare Services Limited):
Statement of Corporate Intent July 2011-June 2014
Statement of Intent July 2012-June 2015
Statement of Intent 2013-2016
Statement of Intent 2014-2017
Statement of Intent 2015-2018

Statement of Intent 2016-2019
Statement of Intent 2017-2020
2015 Supplementary Material: Biodiversity
2015 Supplementary Material: Wastewater treatment performance
Annual Report 2011
Central Interceptor Main Project Works Resource Consent Applications and Assessment of Effects on the Environment (Part 1 - AEE Report)
Asset Management Plan July 2012-June 2022
Annual Report 2010
Annual Report 2012
Annual Report 2013
Annual Report 2014
Annual Report 2015
Annual Report 2016
Annual Report 2017
Auckland Regional Water Demand Management Plan 2013-2016
Auckland Regional Water Demand Management Plan 2011
Tapped in Autumn 2017 (Community Newsletter)
Tapped in Autumn 2018 (Community Newsletter)
Tapped in Autumn 2017 (Community Newsletter)
Tapped in Spring 2015 (Community Newsletter)
Tapped in Spring 2016 (Community Newsletter)
Tapped in Spring 2017 (Community Newsletter)
Tapped in Summer 2016 (Community Newsletter)
Tapped in Summer 2017 (Community Newsletter)
Tapped in Winter 2015 (Community Newsletter)
Tapped in Winter 2017 (Community Newsletter)
Tapped in Summer 2015-2016 (Community Newsletter)
Tapped in Winter 2016 (Community Newsletter)
Wastewater Asset Strategy 2016
Water Asset Strategy 2016
Auckland Water Efficiency Strategy 2017-2020
Asset Management Plan July 2011-June 2012
Asset Management Plan 2016-2036

Public - Articles taken from the following newspapers:
Auckland City Harbour News (3 articles)
Auckland Now (29 articles)
Central Leader (7 articles)
East and Bays Courier (4 articles)
Eastern Courier (4 articles)

Manukau Courier (16 articles)
New Zealand Herald (197 articles)
Newsroom (1 article)
North Harbour News (2 articles)
North Shore Times (18 articles)
Papakura Courier (2 articles)
Rodney Times (4 articles)
Stuff (41 articles)
Sunday Star Times (4 articles)
The Press (1 article)
Western Leader (16 articles)

Other

National Science Challenges - The Deep South: Climate Change & Stormwater and Wastewater systems
Metrowater Annual Report 2011
Auckland City Council Annual Report (2009/2010) - *Prior to amalgamation*
Three Waters Review (2017)
Three Waters Final Strategic Plan (2008)
Minutes of meeting: Central Interceptor Community Liaison Meeting (10 May 2017)

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