The governance of local climate commons

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Suzanne Dunford, declare that this thesis, is submitted in fulfilment of the requirements for the award of Masters in Sustainable Futures, in the Faculty of Transdisciplinary Innovation at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Self-interest is for the past. Common interests are for the future
David Attenborough 2020

Abstract

As climate change impacts accelerate, there is an urgent need to understand and enhance the governance of climate change adaptation, or existing vulnerabilities will be exacerbated, and opportunities to accrue benefits from adaptive responses may be lost.

While a global phenomenon, climate change is experienced locally, varying significantly from place to place, and requiring local and context-specific adaptations. Using lenses of social ecological systems, common pool resources and subsidiarity, this thesis identifies attributes of governance that can support local and sub-local capacity to anticipate, adapt and address local climate change impacts on ecological and social systems.

Set in the Waverley Local Government Area, I examine how urban trees and vegetation, accessible to both public and private interests, represent a local climate commons that providing climate adaptation benefits such as heat regulation, to residents, visitors and ecological communities.

This mixed methods study draws on empirical evidence of community attitudes, document analysis and an extensive review of adaptation literature. It finds that by deepening the application of subsidiarity to existing institutional and governance arrangements, shared management of local climate commons can be achieved. Furthermore, it will promote and foster the diversity in approaches necessary to provide the best chance for successful transferability of inclusive, accountable and effective climate change adaptation.

Chapter 1 Introduction

Due to human-caused planetary warming, the past seven years have been the seven warmest on record, and climate change impacts and weather-related hazards are having life-changing and devastating impacts on communities around the world (WMO 2022).

Accelerating global heating brings many uncertainties, but one thing is clear. It is now impossible to separate nature from society and society from nature (Beck 1992). Adapting to climate change requires human societies to anticipate and organise informed, collaborative, and flexible responses, that manage the transitional pressures on communities.

Recent policy, political and scientific discourses (UN 2021, DAWE 2021c, IPCC 2021) confirm that adapting to the impacts of climate change requires immediate attention and action, and yet there is little consensus on how, and importantly who, can lead implementation of effective and agreed measures to reduce vulnerabilities and capture opportunities in a dynamic climate.

Although climate change is a global phenomenon, its impacts are experienced locally. In diverse contexts across the world, local responses to climate change already are occurring (Ostrom 2010), sometimes autonomously, regardless of international deliberations, declarations and negotiations.

Having worked in climate change adaptation in state and local government contexts for over a decade, I have observed that climatic changes in local systems are necessitating changes in the processes of governing. In my observation this is because, though presenting as a multitude of impacts, climate change represents a collective problem that affects and involves

actors in processes of interaction and decision-making, and coordination of cooperation, to improve the collective wellbeing of a group (Bosselmann 2008).

I have previously explored these coordinating processes and models of governance in the state of NSW within monocentric, multilevel and adaptive governance types. I concluded that while structurally inclined towards multilevel governance, climate change adaptation approaches in NSW remain generally monocentric, i.e., the state is the centre of political power and authority, with top-down implementation of its policies. (Termeer et al 2010).

I also found that forward-looking, adaptive governance approaches are emerging, including cross scale and cross level action to amalgamate and reorganise local governments, but that their attribution to climate change was tenuous, as the impacts climate change were manifesting multiple differentiated vulnerabilities at local scale (Dunford 2018[1]). Hence, emerging adaptation governance responses were place-based, largely autonomous, and not deliberate efforts to seek systemic transformation (Olsson et al 2006).

This has led me to investigate the emerging notion of climate commons, which explores the need for communities to have greater agency over assets and benefits of addressing climate change. (Webb, Stone , and Hunter 2021).

[1] See Appendix 1

As the objectives of adaptation programs are either generic (for instance, “to increase resilience”) or place-based (for instance, “to protect a specific asset”) some authors have noted that the governance of climate change adaptation often encompasses the protection of many existing and diverse social goals; that it is essentially about “everything,” (e.g. Huitema et al 2016 paraphrasing Wildavsky 1973) which risks confusion and cynicism among communities already subjected to divisive political commentary on climate change (Future Earth 2020). Confusion and cynicism about adaptation contrasts with action on climate change mitigation through greenhouse gas emissions abatement, which has increasingly well-defined actions and support linked to specific emission reduction targets (e.g. Net Zero Plan Stage 1 NSW Government 2020).

Ostrom (2009) proposed a polycentric governance approach to coping with climate change, which would encourage experimental efforts at multiple levels, develop methods for assessing the benefits and costs of particular strategies, and compare across regions and ecosystems. She also devised an Institutional Analysis and Development framework (IAD) to explain and predict outcomes by formally exploring and documenting the governance structures, the actors' positions, and the informal and formal rules devised for individuals to extract from common pool resources (Ostrom 1994).

This thesis examines the actors, enablers and constraints influencing the governance of place-based adaptation to local climate change impacts. Focused on the small metropolitan Local Government Area of Waverley, NSW, it scrutinises the coordination of the protection and management of urban trees and vegetation, which can moderate urban temperature increases.

Exposure to high and increasing temperature is an impact of climate change that varies spatially at local government scale (Jacobs and Delaney 2015, Lapola et al 2019) and enhancement of urban green spaces, one of the accepted strategies to mitigate urban heat (e.g., Taher et al 2019), should encompass both public and private users (Biernacka et al 2019). Similar to soils, urban vegetation provides ecosystem services across public and private tenures, because these attributes are bundled together in bulk property rights (Bartkowski, and Bartke, 2018)

These issues allow urban vegetation and green space to be defined here as a "climate commons" that is:

> *local, open-access public goods which contribute to and enhance the capacity of systems to prepare for and mitigate impacts of climate change* (Carattini et al 2019, Mackenzie et al b, 2019).

In this case study, urban vegetation and green space is not formally managed or protected for the climate adaptation benefits it provides, and remains vulnerable to biophysical changes, development pressures and socio-cultural preferences. While an extensive regulatory framework exists for management of local vegetation, including significant, heritage-listed and public trees, it is complex and currently unable to effectively prevent degradation and loss. Despite noted community support for greenery and amenity, this decline is most notably occurring of trees on private property.

Recent studies have concluded that 'cooling' represents a complex socio-cultural as well as biophysical issue and support the need for further qualitative research to contribute to the knowledge base about social resilience in the broader context of a climate-changed future (WSU 2016). Therefore, improving governance of the climate commons and services may

be less about specific approaches and more about building long term processes for cooperation and trust (social capital) (Carattini 2019) (Fraser, A and Kirbyshire, A 2017).

Ostrom (2009) demonstrated that commons can be governed successfully when actors trust one another, supported by monitoring and sanctioning of free riders, and studied how institutions (defined as structures and mechanisms of social order and cooperation governing the behavior of two or more individuals) behave and function according to both formal and informal rules. There are examples of applications of the IAD approach to aspects of green infrastructure (e.g. Mekala and MacDonald 2018), environment and inter-municipal relations (e.g. Lintz 2016), mature trees (e.g. Mackenzie and Gibbons 2019) and ownership of public land (e.g. Pethe et al 2012). However, the approach has not been applied to analysis of governance of the climate commons (in this case, the management of urban vegetation for heat mitigation) at a local scale in NSW.

Through a mixed methods study, I will draw on empirical evidence of community attitudes to urban greening, local government policy documents and novel findings from Europe on enablers of local-scale urban greening in the context of the 'progressive commons' (Gmeiner et al. 2020). I explore the governance of climate change adaptation, address identified gaps in the literature and identify constraints and enablers to enhance recognition of climate commons in the NSW local government context.

By further examining structural subsidiarity in Australia, I show why local government is best placed spatially, legislatively, and operationally to lead adaptation governance. However, I propose that subsidiarity must be extended further in practice, to encompass the neighbourhood (i.e. sub local)

-scale. This will enable appropriate resourcing and recognition for governance of infrastructure and services related to urban green spaces (Spiller and Murrian 2018), which is the scale at which a local climate commons can be realised.

The unique contribution that sub local governance can play must be recognised and supported without delay, or adaptation goals of enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change, will not be achieved at any scale.

Thesis Structure

In the context of global changes and localised impacts, this first chapter establishes the urgency and necessity for investigating and rapidly improving the governance of climate change adaptation and introduces urban vegetation as an example of a localised climate commons, to enable examination of climate change adaptation governance.

Reviewing relevant literature, Chapter 2 defines governance, and the roles of government in relation to climate change. It identifies five inherent climate adaptation governance challenges and summarises recommended approaches and attributes for arranging cooperation and coordination, finding success in governance systems that include bottom up, networked, decentralised, multi sector, multi-level, participatory and dispersed qualities. By comparing the approaches of different levels of Australian governments to achieve climate adaptation goals, it finds that local government is well placed to tackle the contextual governance challenges of climate change adaptation.

Chapter 3 presents the methodology for examining subsidiarity in relation to the governance of local climate services, which I have termed climate commons. By examining the management of urban vegetation in a densely populated metropolitan Sydney Council, I detail mixed methods approaches to understand the complex institutional and socio-cultural issues at play.

Chapter 4 presents the findings from the analysis of four sources of information described in Chapter 3: a brief community survey, a participatory workshop with members of the Waverley community, extraction of relevant information from Waverley Council's Community Satisfaction Survey, and analysis of place-based policy documents.

Chapter 5 shows that operational drivers and delivery capabilities limit local government's ability to protect and manage the climate commons of local urban vegetation, and that support from other levels of government, and community participation are required. And while the community's ideas for transforming urban vegetation management and protection demonstrates conformity with the Ostrom's IAD Design Principles, the emergence of a functioning commons, where accountability and responsibilities for decisions are shared among public and private actors, remains limited. It identifies a fundamental flaw in the application of subsidiarity in the Australian context, which limits the depth of subsidiarity required to recognise and manage climate commons at a neighbourhood scale and engenders regulatory and financial constraints to action.

Although this case study is highly contextual, Chapter 6 concludes that, governance that deepens subsidiarity in practice will foster and promote the diversity in approaches necessary to provide the best chance for success and transferability of climate change adaptation. Alternative institutional

arrangements which assign sufficient resources and institutional license to operationalise adaptation responses at the sub-local scale, are discussed. Unless communities close to the impacts of climate change are supported to protect their local climate services, and deliver diversity through local governance processes inclusive, accountable and effective adaptation will remain elusive, and the capability for multi-scale learning and collaboration, needed to swiftly adapt to local and global climate change, will remain constrained.

Chapter 2 Literature Review

Introduction

This chapter will review academic literature relating to governance, the roles of government in relation to climate change, and identify five inherent climate adaptation governance challenges. It explores the ability of different levels of government in Australia to realise adaptive governance and introduces the concept subsidiarity as a mechanism to negotiate effective adaptation because it acknowledges the need for multi-scale coordination but recognises that solutions that reflect the local context will be most socially and ethically valid.

In today's globalised world, environmental, social, economic, and technological factors impact communities in complex and unpredictable ways, placing pressure on traditional social and economic structures (Young et al 2006), and challenging sustainable development aspirations (UN 2017).

The changing global economy; tensions between development and natural resource management; rapidly evolving technology; and demographic and social change have been identified as influences that interact to directly impact Australian communities. This confluence of multiscale factors is diminishing traditional governance structures' ability to shape or control regions, requiring the development of new government processes that empower regions to make decisions and respond to change (RAI 2015). Even short-term transitional pressures highlight the need for government to build the capacity of communities to adapt to ever changing circumstances, and the importance of involving them in identifying and planning their own development needs. (Productivity Commission 2017)

Under current projections, climate change presents unprecedented but regionally differentiated threats to livelihoods, property, and business. It is recognised as a multiplier of existing threats and pressures including peak resources, rising population and consumerism, and over exploitation of the environment and the ecosystem services it provides (Ison 2010). Responding to and managing these threats requires urgent and decisive action, which will be constantly subject to political and scientific debate across regions, scales, and sectors (UN 2017).

Therefore, adapting to climate change presents a multi-level governance challenge for regions, where expected impacts and respective measures cut across government scales, sectors, and societal domains (Bauer & Steurrer 2014). Ensuring responses to climate change pressures are informed, collaborative and successful requires novel and expedient decision-making and implementation processes.

Governance and the role of government

The actions of interdependent individuals can affect others' wellbeing. This can lead to conflict or alternatively, if it is acknowledged that conflict may cause collective losses, cooperation. Governance is the coordination of this cooperation, and associated behaviours, to improve the collective wellbeing of a group (Bosselmann 2008).

Although it can be understood as the role or design of an overseeing, decision-making structure, more broadly governance encompasses a range of processes that enable decisions to be made, implemented, and assessed for efficacy, in a given context.

Governance is not a synonym for government, which is understood as the centralised institutional arrangement that structures authority and order (Bosselmann 2008). The growing interdependence of society and complexity of issues has resulted in a growing understanding that governance covers the wide-ranging interaction of government, other bodies, the private sector, and civil society, aiming to solve conflicts or problems and create social opportunity.

The different roles governments play in responding to the threat posed by climate change include the need to adapt its own programs and activities, to regulate to reduce community vulnerability and to build the adaptive capacity of the community to facilitate adaptive responses (Brooks et al., 2009). Because of the long-time horizon and prevailing uncertainties about climate change, the main role for government is to provide the correct legal, regulatory, and socio-economic environment to support autonomous adaptation (Fankhauser 1999). Such action would require the flexibility to change behaviour, policy, law, politics, and customs which may constrain adaptive responses (Jacobs et al 2014).

Inherent challenges of climate adaptation governance

Recent assessment has concluded that climate change governance is in a state of enormous flux (e.g. Ireland and Clausen 2019; Patterson and Huitema 2019). New and more dynamic forms of governance appear to be emerging spontaneously from the bottom up, producing a more dispersed and multilevel pattern of governing. However, the governance of climate change adaptation receives much less attention, research, and discourse than that of emissions mitigation (Jordan et al 2018).

Urgency

The United Nations Framework Convention on Climate Change (UNFCCC 1992) outlines the requirement to reduce the emission rates to prevent dangerous anthropogenic interference with the climate system. The goal is to achieve this within a timeframe that allows for the protection and preservation of key social- ecological systems, specifically:

- to allow ecosystems to adapt naturally to climate change;
- to ensure that food production is not threatened and;
- to enable economic development to proceed in a sustainable manner (UNFCCC 1992 page 5)."

The most recent assessment of climate change by the Intergovernmental Panel on Climate Change (IPCC 2021), states unequivocally that humans are responsible for warming of the atmosphere, land, and oceans, with catastrophic impacts becoming closer, due to the "unprecedented" pace at which the environment is being altered. Global surface temperatures are now warming faster than during the previous 2000 years and greenhouse gas concentrations are higher and rising faster than during the past two million years.

Acknowledging the increasing urgency at the most recent global negotiations, signatory nations to the convention were urged to further integrate adaptation into local, national, and regional planning, because climate and weather extremes and their adverse impacts on people and nature will continue to increase with every additional increment of rising temperatures. Emphasizing this urgency, signatories were urged to scale-up action and support to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change (UN 2021).

However, despite ongoing global negotiations, greenhouse gases have continued to increase with each year and each decade setting new temperature records (IPCC 2021). At the local and regional scales, we are now facing the thresholds we sought to avoid, and questions of responses, risk reduction and adaptation become alarmingly and increasingly urgent, but not uncomplicated.

Uncertainty

Despite unprecedented scientific information and data on climate crises, the exact operation, timing, nature, and severity of impacts is not able to be predicted. Therefore, the study of climate change falls into a category referred to as post-normal science (Funtowicz and Ravetz 1993) comprising deep unresolved uncertainties in both probabilities and consequences, which are unlikely to be resolved before society must make decisions regarding how to deal with their implications. (Ribot 2011) advises that climate adaptation is "noble, necessary and long overdue...", but notes that questions remain unanswered on how best to effectively use public expenditure through adaptation policies, measures, and investments to optimise human well-being. Governments, in attempting to act on the issues of vulnerability and adaptation to climate change, must cope with the interactions of chaos, complexity and contradiction that increasingly make the management of complex social systems intractable (Sardar 2010).

Multiscale and context specific

To "minimise risks and capture opportunities associated" (UNFCCC 1992 pg5) of a warming globe, a system of governance that can involve multiple actors in the decision-making process at multiple scales of social organisation (Boyd and Juhola 2014) is needed.

Climate change adaptation is context specific. Although climate change is a global phenomenon, climate impacts occur regionally and are increasingly emerging as systemic failures at local scale, varying significantly from place to place, and reflecting local cultural practices as well as (or in spite of) current national or regional governance structures (Julhola and Westerhoff 2011). Solutions are beyond the scope of science alone because they must be grounded in an understanding of unique historical trends (long term weather forecasting), rather than traditional reductionist approaches, and the input variables to decision making include the outcomes of political and ethical debates in the community (Collins and Evans 2002).

Attribution and Measurement

As adaptation spans multiple scales and sectors, this confounds the assessment of the results and contributions of different adaptive responses (Dinshaw et al 2014; Preston et al 2015). Moreover, adaptation defies simple cause and effect analyses because its complexity makes it impossible to untangle the range of interconnected factors that shape a long-term impact or outcome (for example, Rindfuss et al., 2008). As noted, these factors include drivers of social and political change that affect social vulnerability and may be unrelated to (but amplified by) changes in climate.

When adaptation succeeds it can be as a result of autonomous (often hyper-local scale) innovations and anticipatory planning (Dunford 2018). This requires a governance framework that can consider temporal dimensions of climate change impacts, requiring that uncertainty be explored as a time frame, and a point in which a critical threshold is likely to be exceeded (Werners et al. 2013). Problematically, autonomous community adaptation is frequently invisible to the institutions governing adaptation, becoming

recognisable as successful adoption rather than failure or early innovation, which confounds governance processes that need to encourage experimentation (Sabel & Zeitlin, 2012).

Because adaptation is a process of continual adjustment, a pathway between alternate system states, rather than an end point, it can contradict aims of governance that require the demonstration of outcomes in the short term (particularly to satisfy public funding objectives). Werners et al. (2013) suggested that it was important to encourage short-term actions to sustain current systems, whilst keeping longer-term activities open.

Finally, the dynamic nature of socio-ecological systems means that it is difficult to establish a fixed baseline from which to measure achievements (Kerner and Thomas 2014). With overall conditions deteriorating or in flux under a changing climate, the baseline itself may shift over time, which does not negate the need to commence adaptation interventions, especially those involving living infrastructure.

Collective perception

The capacity to adapt, latent in many communities, often remains unfocused on climate change through local knowledge deficits, market failure, media scepticism and conflicting political priorities (Jacobs et al 2016). This is related to the specific sociocultural factors that determine how a community will understand and experience climate change – most probably through direct experience of weather. Pluralism in experiences, knowledge and practices creates constructions of risk and enabling responses across multiple stakeholders at the community level and localised encounters may contrast with the techno-scientific accounts of climate change (Granderson 2014). It has been argued that analysing the social dimensions of climate change

matters as much as the scientific analysis (Geoghegan and Leyson (2012 pg 57), which recognises that as climate impacts are locally experienced, implementation must be tailored to context and top down approaches are unlikely to succeed (Ayers and Forsyth, 2009, Dodman and Mitlin, 2013).

For these reasons, some argue that adaptation is not a linear response to a biophysical change, but a contested social-political process that mediates how individuals and collectives deal with multiple types of simultaneously occurring environmental and social changes (Erikson 2015).

Governance attributes that support climate adaptation

Several authors have suggested a range of essential attributes of governance that could support climate adaptation. For example, Gupta et al. (2010) identified six characteristics of institutions that promote adaptive capacity for responding to continuous and unpredictable climate changes as those that: (1) encourage the involvement of a variety of perspectives, actors and solutions; (2) enable social actors to learn continuously and improve their institutions; (3) allow and motivate social actors to adjust their behaviour; (4) can mobilise leadership qualities; (5) can mobilise resources for implementing adaptation measures; and (6) support principles of fair governance.

Other key elements of effective governance that merit investigation include a need for profound cultural change, the facilitation of knowledge co-production, the creation of pluralist alliances, and the building of a new democratic capacity-democratic experimentalism (Sabel & Zeitlin, 2012; Cash, et al 2006; Monkelbaan, 2015; Young 2002). In NSW, Pugalis (2017) suggested the establishment of a 'Regional Deal' to strengthen intergovernmental relations and accords, agree roles and responsibilities for

contextual conditions and systemic adaptation outcomes, and provide a self-organizing structure to experiment on adaptation governance.

With growing needs for governance capacity that can respond flexibly and adapt to new circumstances 'Adaptive governance' has been identified as a mode of governance and a continuous problem-solving process that might best accommodate the challenges of climate change adaptation (Eshuis & Gerrits 2021). It refers to flexible and learning-based collaborations and decision-making processes involving both state and nonstate actors, often at multiple levels, with the aim to adaptively monitor, negotiate and coordinate management of social–ecological systems and ecosystem services (Folke et al 2005, Pahl-Wostl et al 2007, Chaffin et al 2014).

Adaptive governance is characterised by experimentation, learning and participatory processes. While it may not be well suited for large scale problems (Evans 2012) or rapidly emerging climate shifts (Hess and Ostrom 2007) it is well suited to addressing uncertainty and change, as is required with climate change adaptation (Munaretto et al 2014).

Other governance modes that are acknowledged to support and foster adaptation include multilevel governance, which advocates for decision-making among local governments, while ascribing responsibility for oversight and knowledge diffusion to higher levels (Becker et al. 2015) and network governance, which emphasises the relationship between public and private actors and the important role that governments play can play in creating and maintaining networks to connect these relationships. (Mees 2017)

Subsidiarity: the missing ingredient?

One element of governance that is seldom fully realised in formal centralised systems and which is consistent with the need for local forms of governance for adaptation is the principle of subsidiarity. Subsidiarity was first developed as a philosophical precept through the Catholic Social Tradition, and in all formulations of the principle there is a clear ethical content including "addressing injustice" or "respecting diversity" or minimising actions "contrary to the common good" (Mele 2005).

The Australia Federation is underpinned by the principle of subsidiarity, a principle of social organisation, which holds that social and political issues should be dealt with at the most immediate level that is consistent with their resolution (Brown 2002). This means, that a central authority should have a subsidiary function; performing only those tasks which cannot be performed effectively at a more immediate or local level.

In reference to climate change, this principle provides a useful foundation to underpin a system of governance, as those now experiencing localised climate impacts will usually be best placed to identify practicable responses for managing them effectively and efficiently, even though they may lack the technical or financial capacity to do so (e.g. Gurran et al 2005; McColl and Young, 2005; Ensor et al 2015, Melo Zurita, et al 2015).

Social-ecological systems have always adapted to climate and its natural variation, and so adaptation to human-induced climate changes has been understood as incremental responses, intended to avoid major disruption at a given location (Pelling 2011). However, as atmospheric concentrations of greenhouse gases rise, the rate of climate change increases dynamically, and demand for adaptation increases.

Reactive adaptation is likely to lag emerging risks. To be effective, adaptation must anticipate risks associated with climate hazards to social and technological development, maximizing co-benefits and minimizing adverse impacts. However, where vulnerabilities and risks can be reduced only by novel or dramatically enlarged adaptations, this is known as transformative adaptation (Fazey et al 2018). Transformations may be technological or behavioural or they may include fundamental changes in institutional arrangements, priorities, and norms (Kates et al 2012).

Recently, system transformation has received increased attention as a necessary response to climate change to overcome 'lock in traps' inherent in the promotion of resilience (Handmer and Dovers 1996; Pelling 2011). However, there are ethical and political issues for centralised governments in promoting deliberate transformation because such fundamental changes in local systems will alter the structure of community vulnerability and cause local power shifts and imbalances (Schulz and Siriwardane 2015).

Embedding the principle of subsidiarity in climate change governance may provide a mechanism to negotiate effective and successful transformational adaptation because it prevents a 'one size fits all' approach, requiring instead strategies that allow for bespoke solutions that reflect the local context in which they operate but remain constitutionally valid. Subsidiarity may also mitigate overlapping desires and outcomes, and thereby neutralise political influence (Blank 2010), again engendering greater cooperation in the protection of commons.

Current climate governance in Australia

Federal and State Government

As reflected in the National Communication on Adaptation (Australian Government 2021), presently there are no direct legislative or regulatory responsibilities that relate to climate change adaptation in NSW. However, in 2013 the Council of Australian Governments Select Committee on Climate Change has endorsed roles and responsibilities for adaptation which outline that:

- private parties should be responsible for managing risks to private assets and incomes,
- governments – on behalf of the community – should primarily be responsible for managing risks to public goods and assets (including the natural environment) and government service delivery and for creating a regulatory environment that supports private action. (DAWE 2021 pg 2)

At the Federal level, articulated roles include the provision of national science and information, managing Commonwealth assets and programs, leading national adaptation reform, and maintaining a strong economy.

At the State level, the NSW Minister for the Environment oversees the development of policy in relation to climate change and has carriage of expenditure of the New South Wales Climate Change Fund. This Fund supports climate change activities through a levy on electricity distribution businesses. However, climate change is a cross-sectoral issue, and to ensure an effective climate response requires prioritisation of expenditure to future climate risks and opportunities across government service planning and delivery in all portfolios.

In an attempt to embed climate change considerations across the Government, the adaptation program of work is dispersed across an agency comprising planning, infrastructure, and environment portfolios. This includes separately managed funding and programs for delivery of climate projections, assessing and supporting regional and sectoral vulnerability and capacities, coastal management, flood management, strategic and land use planning, infrastructure delivery, reserve management and primary industries. The current administration has set an aspirational target to make the state more resilient to a changing climate, through a policy framework (NSW 2016). While an annual report outlines expenditure and programs, it does not provide a framework for monitoring and evaluation of the target. Details and funding of the complete programs and mechanisms that deliver on this target are focused, developed, and considered internally, within the State government only.

The State's environment portfolio has set corporate objectives and dedicated resources to progress climate adaptation activities through the delivery of fine scale climate projections and impact information, regional and sectoral vulnerability assessments, and supporting and funding small-scale project implementation to build capacity.

This framework has been informed by identified components of requisite adaptation architecture to support effective implementation (Stirling 2010) including political leadership and institutional organisation, extensive stakeholder engagement, climate information and use of decision analysis techniques, consideration of barriers, funding, technology development and diffusion, and adaptation research (Jacobs et al 2016). However, strong policy options may be unworkable in practice and potentially be counterproductive (Measham et al. 2014).

A recent audit of one aspect of the program (risk assessment management and capacity in State government agencies) found the commitment for a state-wide climate change action plan had not been delivered, and that many agencies that own or manage assets do not have climate risk management in place. (Audit Office of NSW 2021). So, while cross agency engagement had been active, especially in regional contexts, a prevailing monocentric approach to administrative and executive responsibilities, has resulted in sectoral divisions of state portfolios and the absence of a targeted plan has hampered coordinated governance of climate change adaptation in NSW; failures not unique to NSW (Unwin and Jordan 2008).

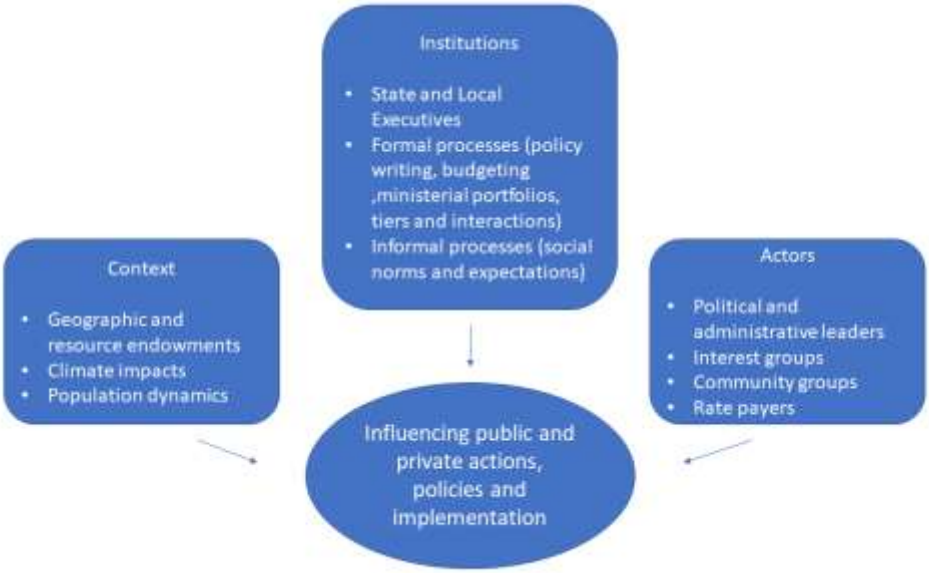


Figure 1 Climate change adaptation governance in NSW, adapted from Fritz et al (2009). Problem-driven Governance and Political Economy Analysis: Good Practice Framework

Termeer et al (2010) note that a monocentric government approach to scale or capacity challenges can abolish existing layers or create new ones. While

not directly climate related, both approaches have been instigated in NSW. The creation of the Greater Sydney Commission, a new level of governance, with a semi-independent agency was created in 2015 to address strategic land use planning in the rapidly urbanizing metropolitan region. While established to coordinate across portfolios, concerns have been raised that this disconnects planning power from the community, and that government appointed commissioners and a board structure lack accountability.

In 2016, as part of a local government reform process, a new approach to governance in the most western and least populated planning region of NSW was put forward (NSW OLG 2016). The Far West Initiative proposed establishing a new regional authority, in the process amalgamating eight local councils with state and federal agencies to fill gaps in the delivery of services. This proposal was not progressed.

While their efforts are absent from the recent audit on managing climate risks to government assets and services, local government has been a key participant in State sponsored climate change adaptation activities, and working collaboratively at the regional scale to co-create transition pathways, identify and build learning networks, and tackle vulnerabilities in each the 12 state planning regions, through a managed process based on the Integrated Regional Vulnerability Assessment method (Jacobs et al 2015). In this process, local and state government decision makers interpret climate and socio-economic data, through staged participatory learning, engaging as office bearers, professional experts, and members of regional communities. The approach displays some elements of localised multilevel governance, as a process of continuous interactions among governments and private entities, operating at, and between, several administrative levels and ultimately aiming at the realisation of collective goals (Termeer 2010).

Although some Commonwealth representatives participate in the NSW vulnerability assessment process and development of climate projections, integration with Federal adaptation initiatives is limited to research support and ad hoc discussions, and any international or supranational aspect to this work is not obvious. Failing to adapt domestic governance approaches to align with international developments is not only a challenge to adaptation policy. The Australian government has instigated minimal change to the federation since its establishment and a willingness to ignore criticism in relation to climate policies has been noted (SGI Network 2017).

So, while some of the structure and plans for adaptive governance are in place, the scale of operation is not yet appropriately matched to the varying needs of regional service delivery, local communities or the ecosystems that support them (Jacobs et al 2016). In addition, a lack of central authority ensures a general lack of strong policy instruments to 'enforce' climate adaptation responses through planning and implementation.

In current appraisal, NSW State level governance of climate change has not realised adaptive governance. This is because it has not recognised continuous and abrupt challenges, with unpredictable consequences (Termeer 2011). Furthermore it has not been able to mobilise and connect the necessary actors and knowledge quickly and effectively across different levels to respond, through bridging organisations, network leadership (Olsson et al. 2006) and by enabling legislation and policies. However, it has been noted that strong policy options may be unworkable in practice and potentially be counterproductive, suggesting instead that 'soft policy' may be a more appropriate reaction, by presenting adaptation as a non-political issue (Remling 2018 and Den Uyl & Russel 2018). Soft policy options could include positive path dependencies; through an adaptation pathways

approach, benchmarking; which involves linking goals to learning by comparing progress across regions, and Functional Regulatory Spaces; where novel regulation emerges across policy sectors in different institutional territories and at different levels of government. It has been trialled in European Union trans-boundary river catchments. (Measham et al. 2014).

Local Government

Local government in Australia operates at the scale at which climate change is most acutely experienced and which is most readily accessible by civil society (Measham et al 2011). Its' authority is delegated from State government statutes and States also set political agendas, direct operational responsibilities, and regulate revenue raising for local services.

Local government has a duty of care to protect its communities from exposure to hazards, which are increasing due to climate change, though local scale information on spatial and temporal exposure to hazards may not be available. Information, institutional settings, and resourcing deficits in this cross-scale context are noted barriers that constrain the capacity of local government to implement climate change adaptation (Measham et al 2011, Mukheibir et al 2014).

However, there are several objects of the *NSW Local Government Act (1993)* that directly support capacity to consider and address climate change impacts, and also achieve adaptive governance, specifically including in relation to:

Decision making (Section 8A)

- *(c) Councils should consider the long term and cumulative effects of actions on future generations.*
- *(d) Councils should consider the principles of ecologically sustainable development.*

Integrated planning and reporting (Section 8B):

- *(h) Councils should manage risks to the local community or area or to the council effectively and proactively.*
- *Councils should make appropriate evidence-based adaptations to meet changing needs and circumstance*

And financial management (Section 8C):

- *(d) Councils should have regard to achieving intergenerational equity, including ensuring the following:*
    - *policy decisions are made after considering their financial effects on future generations,*
    - *the current generation funds the cost of its services.*

Recent surveys tend to suggest that climate adaptation action by local government is outpacing State government responses. In 2015, over 82% of NSW local council had assessed their climate change risks (LGNSW 2015). Three years later the use of climate information to guide planning and operation had increased by 22%, and a 27% increase of climate adaptation activities in annual delivery plans and budgets (LGNSW 2018).

To understand the capacity for local government to support a climate commons, existing institutional arrangements for governing green spaces in the context of community sentiment and preferences will be explored. As

this involves the governance of climate change adaptation, it can be considered a “wicked problem”, in search of a positive, normative outcome.

Wicked problems are defined as urgent, requiring contributors to participate in the rectification of the problem, but lacking in, or featuring a weak, centralised point of management. Mertens (2015) noted that in such instances traditional analytical techniques are poorly equipped to identify solutions, but that mixed methods research can help find solutions to wicked problems because it stimulates new kinds of questions and involves the use of innovations needed to address complexity and can support the need for science designed to change society for the better (Mertens et al., 2016).

Furthermore, the recognition of urban vegetation as a climate commons, aligns with two specific United Nations Sustainable Development Goals, which are normative goals with global applicability and emphasise the imperative for improved governance of adaptation:

> SDG 11. Sustainable cities and communities - Make cities and human settlements inclusive, safe, resilient, and sustainable.
>
> SDG 13. Climate action Take urgent action to combat climate change and its impacts.

In summary, there are inherent challenges in attempting climate change adaptation governance, but there are established characteristics and modes of governance that can meet these challenges. In examining the current roles and efforts of Australian governments, it would appear that local government is best placed structurally, legislatively and operationally to lead adaptation governance, although resources for financial and technical

capability are not assured by legislation and are unevenly distributed across the sector.

The next chapter explains why adapting to localised climate change, in this case managing the urban trees and vegetation in Waverley, presents a governance challenge, and describes the methodology for examining subsidiarity in relation to the governance of local ecosystem services for cooling, which I define here as climate commons.

Chapter 3 Methodology

Background

Climatic changes in local systems necessitate changes in the processes of governing because, though presenting as a multitude of impacts, climate change represents a collective problem that affects decision-making, and coordination of cooperative stakeholder actions, to improve the collective wellbeing of a group (Bosselmann 2008).

Although climate change is a global phenomenon, climate impacts occur regionally and are increasingly emerging as systemic failures at local scale, varying significantly from place to place, and reflecting local cultural practices as well as (or in spite of) national or regional governance structures (Julhola and Westerhoff 2011).

As the evidence of alarming climate disruption mounts (IPCC 2021), society struggles to respond and as a result climate change governance is in a state of enormous flux (e.g. Ireland and Clausen 2019; Patterson and Huitema 2019). New and more dynamic forms of governance are emerging spontaneously from the bottom up, particularly in relation to action on carbon emissions (e.g. Azevedo et al 2017), producing a more dispersed and multilevel pattern of governing (e.g. Lutsey and Sperling 2008; Palermo et al 2020). However, when examining the literature it is evident that the governance of climate change adaptation receives much less attention, research and discourse than emissions mitigation (Biesbroek & Lesnikowski 2018).

Climate change adaptation is context specific (Moloney et al 2017). As adaptation spans multiple scales and sectors, attribution versus contribution

of adaptive responses is difficult to define, because its complexity makes it impossible to untangle the range of interconnected factors that shape a long-term impact or outcome of adaptation actions (for example, Rindfuss et al., 2008). These factors include the drivers of social and political change that affect social vulnerability and may be unrelated to (but amplified by) changes in climate.

When adaptation succeeds it can be as a result of hyper-local scale innovations, which require a governance framework that can consider temporal dimensions of climate change impacts, requiring that uncertainty be explored as a time frame and a point in which a critical threshold is likely to be exceeded (Werners et al. 2013).

Exposure to high and increasing temperature is an impact of climate change that varies spatially at local government scale (Jacobs and Delaney 2015, Lapola et al 2019). Enhancement of urban green spaces, one of the accepted strategies to mitigate urban heat (e.g. Taher et al 2019), should encompass both public and private users (Biernacka et al 2019). These issues allow urban green space to be defined as a "climate commons" that is: local, open-access public goods which contribute to and enhance the capacity of systems to prepare for and mitigate impacts of climate change (Carattini et al 2019, Mackenzie et al, 2019).

Ostrom (2009) demonstrated that commons can be governed successfully and developed a framework (IAD) to assist in the analysis of commons, and which have been applied to urban commons (Cole et al 2019). However, most urban ecological structures globally are situated within various forms of privately or collectively-owned land (Ossola et al 2018). At local scale, conflict

among private and common property regimes ensures that governance of urban greening remains a highly contentious issue in communities.

This conflict has led to calls for new approaches that move beyond property rights to incorporate ethical principles in commons governance. (Gmeiner et al 2020) have encapsulated these principles in the concept of the 'progressive commons' to promote deeper consideration of values associated with sovereignty, re-democratisation, and social-ecological sustainability, which provides a useful framework to examine local climate commons issues. In this thesis, I examine the potential role for local governments to facilitate the management of common pool climate services, by examining existing institutional arrangements for governance of green spaces to mitigate the effects of urban heat, currently the most pressing climate impact affecting Sydney (GSC 2019).

Using the Waverley Local Government Area as a case study, I will explore the following research questions (RQ):

RQ1: What are the major barriers and enablers to effective governance of climate services in a metropolitan, Sydney-based Local Government Area?

RQ2: What alternative institutional arrangements might enhance cooperation and management of localised climate commons?

RQ3: What institutional changes could enhance governance of climate adaptation in Waverley, and how do they operate to support subsidiarity?

The Study Area

Waverley Local Government Area (LGA) is the one of the smallest in Australia at only 9.2 km^2. It is densely populated (by Australian standards) with over

74,000 residents, resulting in over 654 residents per hectare of open space (NSW OLG 2018), and the population is estimated to grow to 80,000 in the next 10 years. Consequently over 80% of residential dwellings are classified medium or high density and mean average house price is one of the highest in Australia (EconomyID 2020).

Figure 2 - Map of Waverley Municipal Council, NSW

Waverley is home to iconic beaches and coastline, with over 17 state heritage listings and 1 national listing, Bondi Beach.

Given its close proximity to the Sydney CBD, Waverley LGA is one of the most visited in the country, welcoming and servicing over 2.3 million tourists and visitors each year.

The area is largely sandy soil overlying sandstone and retains some remaining pockets of rare biodiversity and remnant bushland (NSW Government 2019).

The current climate provides a pleasant and almost year-round access to its famous beaches and open spaces, for a wide range of recreational activities. NSW Government climate projections (NSW Government AdaptNSW 2014) indicate that average temperatures are increasing, with the greatest

warming in winter and spring. Average rainfall is projected to decrease in winter but increase between 20-50% in spring and summer (with summer runoff projected to increase by 26%). There is the increased likelihood of extreme rainfall events and storms in the summer months, with intense rain periods (1 in 40-year rainfall events) projected to increase by 12% by 2050. In addition, the number of hot days is likely to double by 2030.

As a noted threat multiplier, increasing average and maximum temperatures are likely to exacerbate existing localised heat islands. These interacting impacts may result in disruptive climate shocks and stressors that present operational and maintenance challenges to council managed vegetation, assets and facilities that service year-round tourism, as well as health and safety risks, not only to vulnerable residents but to visitors, unaware of local conditions and appropriate responses.

The study area includes suburbs of Bondi, Bronte, Dover Heights, Queens Park, Rose Bay, Tamarama, Vaucluse and Waverley. The community is diverse, 38% having been born overseas, with large populations of Spanish, Russian, Portuguese, Italian and French speakers. They are highly educated, with nearly 50% having a bachelors or higher degrees, and they enjoy relatively high levels of employment (68%) and high medium weekly income (Waverley Community Strategic Plan 2018).

The community is also environmentally motivated; 95% of respondents to a community survey agreed that the environment is important to them and that they are partly responsible for protecting it, 92% aspiring to live a more sustainable life where they can personally make a difference, and that climate change is a key motivator for environmental behaviours and values (Waverley Council 2021)

Not surprisingly, the Community of Waverley value the amenity of their green open spaces (Waverley Community Strategic Plan 2018). In response, the Waverley Council Local Strategic Planning Statement commits to grow the urban canopy in both public and private properties to a level of 29%, to provide shade for open spaces and walking, and to minimise water, energy and resource use. This is a challenging target because in 2014 levels of urban green cover were assessed (Jacobs et al. 2014) that indicated a low level of canopy at 17% tree cover (11th lowest in the Sydney Metropolitan area), and 59% of hard (non-permeable) surfaces (4th highest in Sydney Metropolitan area).

Healthy tree canopy is increasingly recognised as an effective and acceptable tool for increasing climate resilience in urban neighbourhoods (e.g. Lee et al 2015). Trees provide shade and evapotranspiration, which reduces ambient temperatures and mitigates urban heat islands (urban hot spots where concentrated amounts of non-permeable and dark-coloured surfaces cause localised warming, Mills 2004). It has been calculated that every 10 percent increase in tree canopy cover can reduce land surface temperatures by 1.13 degrees Celsius (Adams and Smith, 2014).

Healthy urban vegetation also provides a range of co-benefits in addition to urban heat mitigation including, habitat for urban biodiversity, protection for the health of soil and waterways, improved air quality, and promoting social cohesion and wellbeing (see Threlfall C et al 2016, Chen W 2017, Ossola A et al 2015 and Rugel et al 2019) It can also boost economic value; a 10 percent increase in street tree canopy can increase the value of properties by an average of $50,000 (Swinbourne and Rosenwax, 2017).

Finding sustainable ways to increase shade and greenspace in Waverley is extremely challenging, given the acquisition of land for additional open space is prohibitive, due to land prices and existing residential densities. There is limited vegetation in the commercial centres, where urban heat islands are already emerging (see Figure 2). Council's ability to protect and enhance greening on both public and private land is therefore critical to effective responses the climate change.

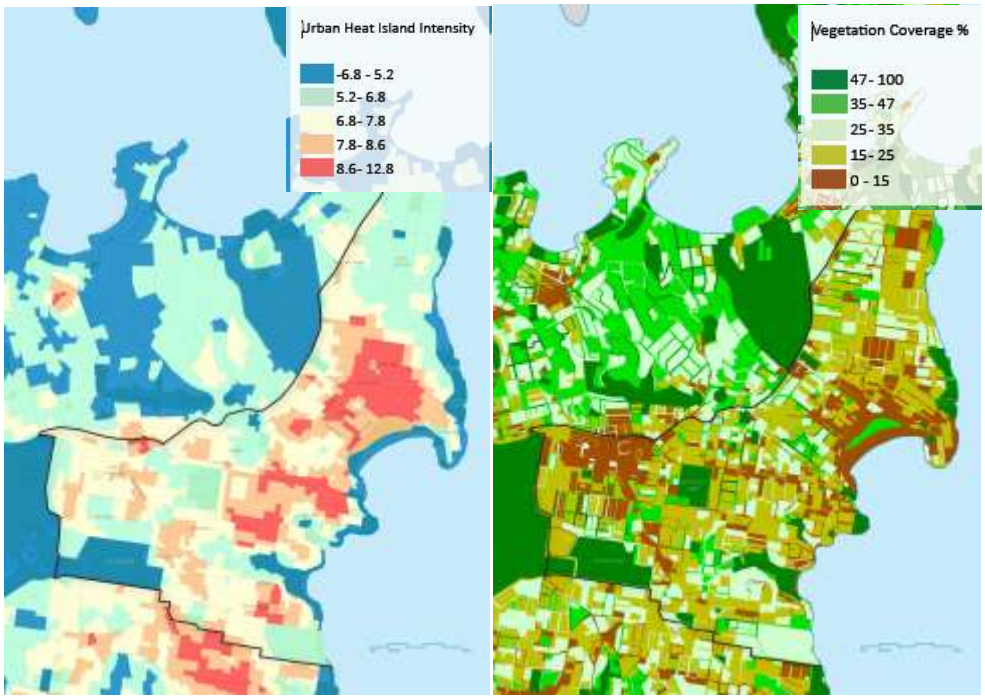


Figure 3 - Waverley Urban Vegetation cover (left) compared to Urban Heat Islands (right) in 2016 (DPIE 2019)

Data collection

Empirical data collection for this study followed a mixed methods approach using a brief community survey, a participatory workshop, extraction of relevant information from an existing broad-based survey of LGA residents (Micromex 2021) and analysis of Waverley Council policy documents on

urban greening (e.g. Environmental Planning Policy). Mixed methods is broadly defined as “research in which the investigator collects and analyses the data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods in a single study or a program of inquiry” (Tashakkori & Creswell 2007 p.4). The approach allows the use of quantitative and qualitative research methods to seek answers to research questions within a social science context (Cresswell et al., 2003; Doyle et al., 2009).

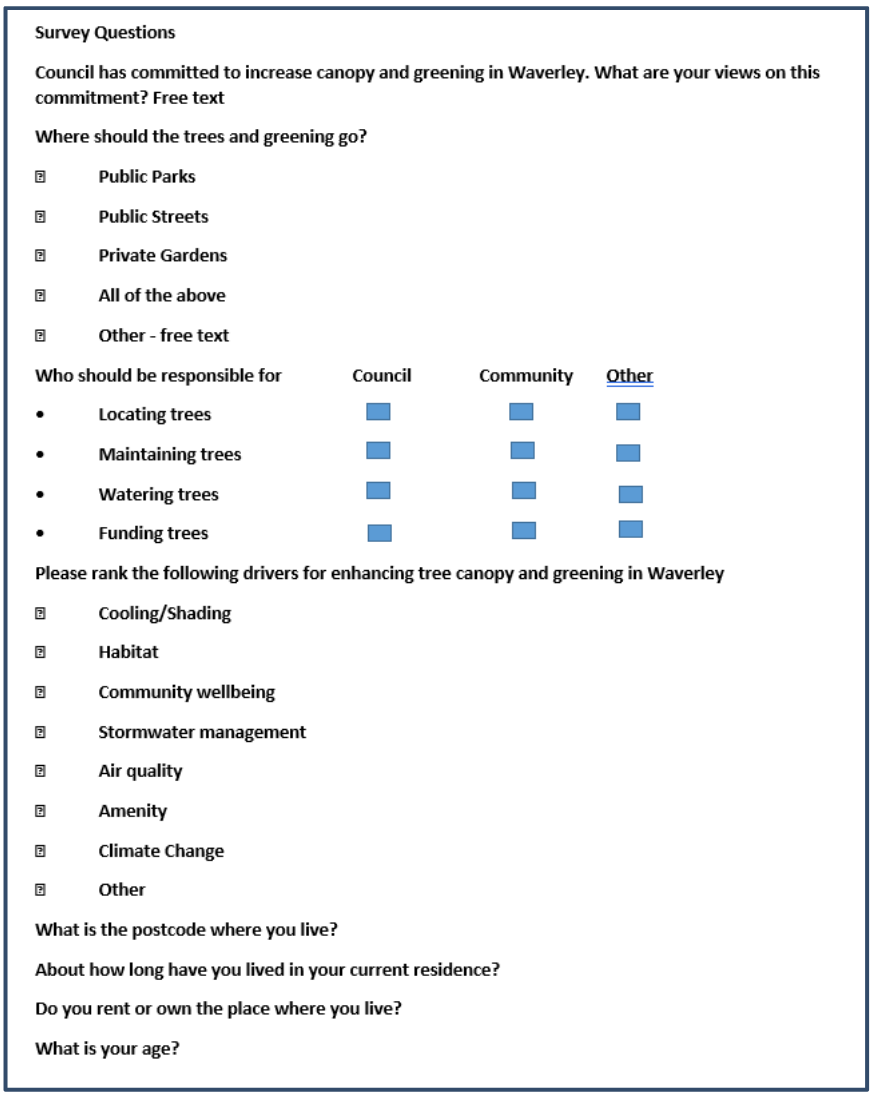
Data collection methods and sources were selected to allow triangulation from multiple lines of evidence, which has been suggested as an approach that can contribute to responsible research, identify further research questions, facilitate application of the necessary methods, and ‘create the intricate and elaborate findings needed to inform strategies for social change’ (Molina-Azorin and Fetters 2019 p280). Mixed-methods approaches have been critiqued on the basis that qualitative and quantitative techniques belong to separate paradigms, and that integration is often superficial within a single paradigm leading to difficulties in interpretation of findings (Bryman, 2007; Cresswell et al., 2003; Creswell et al., 2007).

Despite these criticisms, the theoretical development of mixed methods approaches has continued research and they have become established as a methodological approach alongside qualitative and quantitative research (Johnson et al., 2007). The approach appears well suited to exploring complex issues associated with urban greening at local government scale and is commonly used to enable the capture of social-ecological system diversity and to seek comprehensive answers to complex research questions in urban environments (e.g. Juntti and Lundy, 2017; Rout and Galpern, 2021; Talal and Santelmann, 2020;).

Community survey

An on-line survey (Figure 4) consisting of 10 questions was issued via a URL in Waverley Council's *Second Nature Environmental Newsletter* and posted on the Facebook page of the *Bondi Community Noticeboard*. Subscribers to these outlets were encouraged to share the survey link among their local networks within the Waverley LGA to achieve snowball sampling.

Twenty completed surveys were returned over a two-month period. Data were analysed using descriptive statistics (mean and percentage responses by categories) and presented as a series of charts and word clouds. It was anticipated that due to the survey dissemination method that the sampling frame would show confirmation bias (Hunt et al 2017), that is, be biased towards residents with positive sentiment to urban greening. It appeared unlikely that residents with negative feelings towards tree preservation would voluntarily undertake a survey seeking their opinion or would be engaged through these distribution methods. Accordingly, the results were used judiciously as one line of evidence to inform potential change in governance. The survey was used also to elicit contacts from potential participants in a subsequent 'change modelling' workshop.



Survey Questions

Council has committed to increase canopy and greening in Waverley. What are your views on this commitment? Free text

Where should the trees and greening go?

- ☐ Public Parks
- ☐ Public Streets
- ☐ Private Gardens
- ☐ All of the above
- ☐ Other - free text

Who should be responsible for	Council	Community	Other
• Locating trees	☐	☐	☐
• Maintaining trees	☐	☐	☐
• Watering trees	☐	☐	☐
• Funding trees	☐	☐	☐

Please rank the following drivers for enhancing tree canopy and greening in Waverley

- ☐ Cooling/Shading
- ☐ Habitat
- ☐ Community wellbeing
- ☐ Stormwater management
- ☐ Air quality
- ☐ Amenity
- ☐ Climate Change
- ☐ Other

What is the postcode where you live?

About how long have you lived in your current residence?

Do you rent or own the place where you live?

What is your age?

Figure 4 – Community Survey Sentiment Questions

Participatory workshop

A three-hour community workshop was held with 10 community survey respondents to further explore community attitudes to greening, to understand the current state of urban greening and identify attributes of a desirable 'greener' future for Waverley LGA from a community perspective. The participants were also asked to consider the actions required to bridge

the gap between the current situation and the 'transformed' future as a series of 'pathways'.

A transformation model template (Figure 3) was used to guide workshop discussions. The template is based on a modified 'three-horizons' approach used in futures work that connects the present (horizon 1) with emerging innovations (horizon 2) and visioning divergent futures based on a set of values (horizon 3) (Curry and Hodgson 2008). Information gathered from the stakeholders was used to populate the four components of the transformation model (i.e. drivers of change, business-as-usual, transition pathways and the transformed system) (Jacobs et al. 2016).

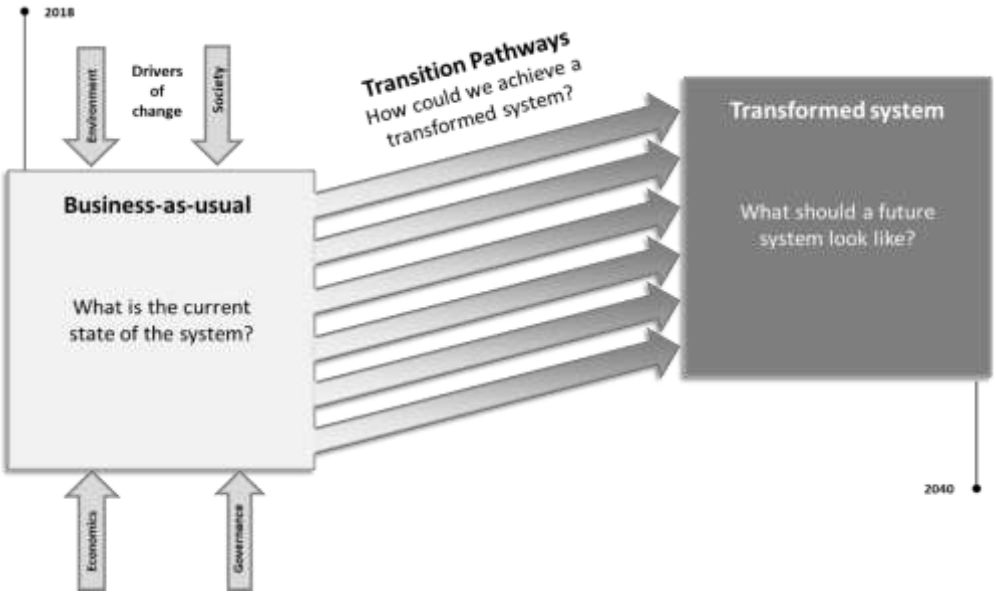


Figure 5: Template used as a workshop boundary object in the development of an urban greening transformation model for Waverley LGA (Adapted from Jacobs et al. 2016)

The workshop participants comprised long-term residents from seven suburbs within the LGA. All participants indicated a strong commitment to

‘trees’ based on their personal environmental values, including the roles of trees in habitat, carbon sequestration and climate change, and also the aesthetics of nature, citing beauty and attractiveness of vegetation and nature as characteristics they particularly valued.

The information collected from workshop participants was synthesised into a ‘change model’, which will be described in the Chapter 4.

Broad-based attitudes survey

As the sample sizes and sampling frames of the community survey and workshop described above were small and potentially biased, use was made of an existing broad-based survey, conducted independently of this study by Waverley Council. It was used to provide additional evidence of community values and triangulate findings regarding the primary drivers of community views and issues identified by community with the vegetation system in Waverley.

Questions within Waverley Council's Community Satisfaction Survey (Micromex April 2021) contained open-ended comments from respondents related to urban greening and trees. The Community Satisfaction Survey is undertaken by a commercial service provider every three years to determine the community’s levels of satisfaction with Council’s service levels and is subjected to comprehensive statistical analysis. The data used in this study were drawn from 183 qualitative responses to the final survey question (Section 4 of the survey report): ‘Thinking about Sustainable Environment, what could be done to improve your Local Area?’ Here ‘Sustainable Environment’ refers to Council’s administration of environmental services and protections but spans multiple departmental responsibilities. Although trees and vegetation are not under the remit of the Council’s Environment

Department, the overwhelming majority of responses (65%) to this question pertained to trees, making this a useful source of independent empirical data for the current study.

The free text comments were extracted from the survey results and a manual deductive coding approach was used to thematically analyse for community attitudes and concerns about urban greening. These responses were then used to cross-reference and corroborate results from the initial survey and community modelling workshop.

Analysis of policy documents

A document analysis was undertaken to investigate how Council support for protection and enhancement of urban vegetation is reflected in existing Council documents, and how the rules in use set the context in which the system of collective vegetation management is situated.

However, the documentation related to management of the urban vegetation system in NSW is extensive. A recent review of statutory planning policy in NSW relating only to trees on private urban land, identified significant repetition across 12 separate State Environmental Planning Policies, comprising 129 different statutory elements, including 56 that were indirect, such as determining setbacks and 73 that were direct, such as landscaping, deep soil, bushfire, heritage or amenity provisions (Hurley et al 2021).

Since 2009, local government, strategic and operational planning in NSW is directed and driven by the Community Strategic Plan and the resourcing strategies that sit behind it, which are required under the Integrated Planning and Reporting Framework. This structure is nested in the NSW land

use planning and regulatory system, which provides objectives for land use and development from the Regional Plan, District Plan, Local Strategic Planning Statement, Local Environment Plan and local Development Control Plans (NSW Office of Local Government 2021).

Avoiding the complexity of State level documents that relate to urban vegetation protection and enhancement, the focus here was on Local Government plans, policy and operational documents. Documents that related to the management of trees on public and private land, and that could influence the removal or enhancement of tree canopy on both public and private land were examined to understand their interrelationship and interpretation by a non-technical reader or community member. The documents examined included Waverley Council's:

- Local Strategic Planning Statement 2020
- Community Strategic Plan 2018
- Local Environmental Plan 2012
- Development Control Plan Part 4 Tree Preservation (2020) which guides changes on private property
- Tree Management Policy (2019) - tree planting and removal
- Street Tree Master Plan (2008)
- Public Doman Technical Manual –standards for tree planting in different areas.

Compliance with ethics approval

This study was approved by the University of Technology Sydney (UTS) Human Research Ethics Committee (HREC) Approval Number 20-4753. All procedures followed were in accordance with the National Statement on Ethical Conduct in Human Research (2007) (National Statement).

Informed consent was obtained from all participants in the Community workshop included in the study. See Appendix 2. Partial access to the Micromex Community Satisfaction survey was approved through an informal application to the Waverley Governance team under the *Government Information (Public Access) Act 2009* (GIPA Act), because the access and use of the requested information could reasonably be expected to contribute to positive and informed debate on issues of public importance such as Environmental Sustainability. See Appendix 4

Chapter 4 Results

Triangulating community sentiment, policy frameworks and progressive governance capability

This chapter presents the findings from the analysis of four sources of information described in Chapter 3, comprising a brief community survey, a participatory workshop with members of the Waverley community, extraction of relevant information from Waverley Council's Community Satisfaction Survey, and analysis of policy documents pertaining to urban greening in Waverley LGA.

Community Sentiment Survey

The majority of respondents in the community sentiment survey were over 40 years of age, were homeowners and had a long connection to the suburb, suggesting an invested opinion of the management of their local area and its public assets.

Nonetheless, concerns about 'messy' trees and problem trees were raised (by 10% of respondents), as were questions on the policy coherence of council, specifically its commitment to environmental policies and targets while approving large residential and mixed-use developments.

Figure 6: Word cloud of key terms related to urban greening extracted from Community Sentiment Survey of Waverley residents.

When asked "Where should greening go?" There was a strong preference (by 80% of respondents) for planting on public spaces, but general support for inclusion of private land. Other suggested locations for greening included rooftops, alley ways, schools, aged care facilities, and specifically in the commercial business district of Bondi Junction.

When asked who should take responsibility for the trees, there was unanimous support for Council to oversee situating and funding trees, and strong preference (95% of respondents) for Council to maintain, and to a lesser degree, irrigate trees. The 'community' was the next most popular response to the question of responsibility for trees, but some saw roles for businesses, NSW and federal tiers of government.

While cooling of the local environment was seen as the primary service provided by trees, followed closely by provision of habitat, all co-benefits of trees ranked highly as reasons for enhancing the area and number of trees and shrubs in the LGA.

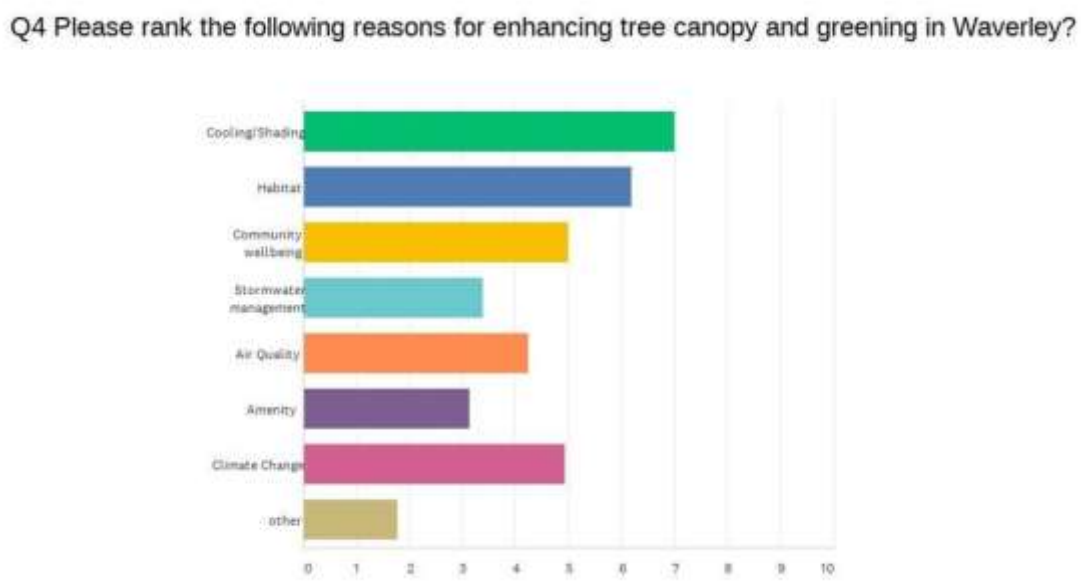


Figure 7: Bar chart ranking benefits of enhancing urban greening and canopy drawn from a Community Sentiment Survey of Waverley residents.

The diversity of views regarding responsibility may indicate the governing context of the service the trees themselves are providing – for example, if the tree is providing a climate change service it may be appropriate for federal government to be involved, but if the tree is providing localised amenity, it may be seen primarily as the role of the local government authority or relevant community members.

Community Participatory workshop

The diverse socio-cultural values of the community and the bureaucratic and non-transparent management of trees were raised as predominant concerns by survey respondents. Council's intention to grow the urban tree canopy on both private and public property was applauded by workshop participants, but dissatisfaction with current tree management practices was a focus of discussions.

A series of workshop exercises contributed information for the synthesis of an urban greening change model for Waverley to describe Urban Greening and Canopy in Waverley (Figure 8).

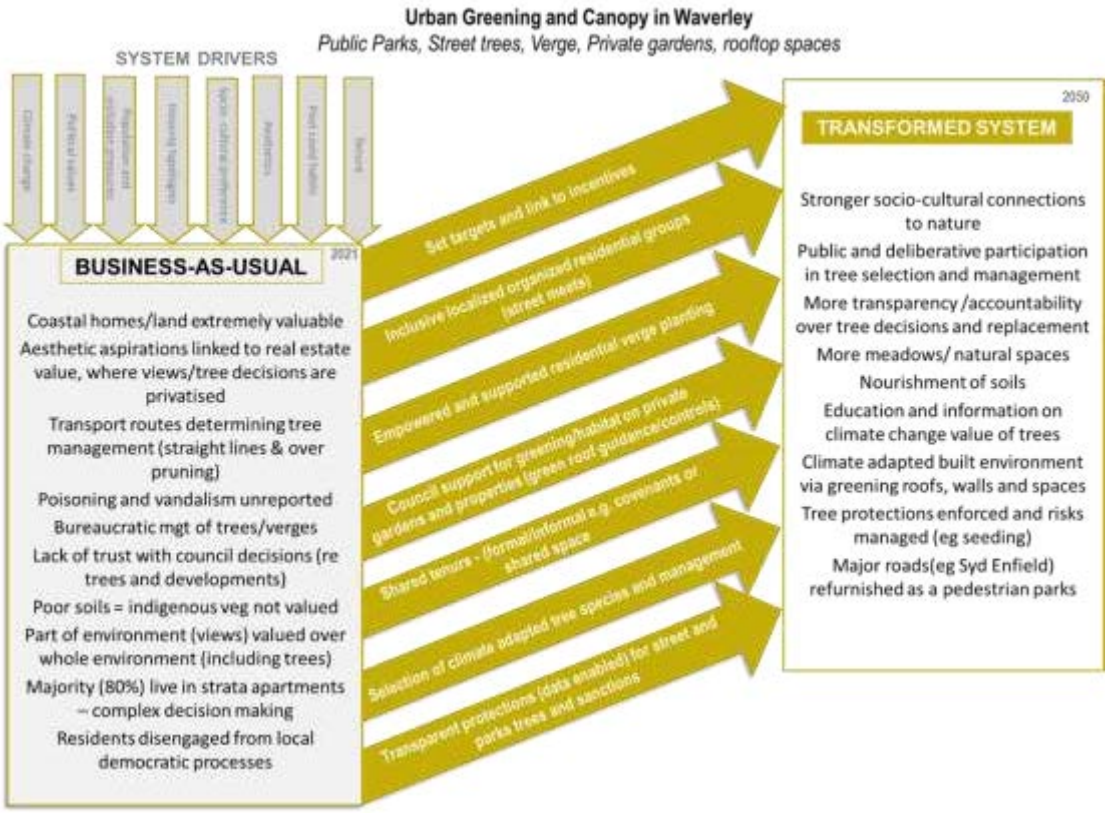


Figure 8: Transformation model developed through participatory engagement with selected members of the Waverley community.

The Current System

While a changing climate was acknowledged as having a broad influence on the current urban vegetation in the LGA, political and aesthetic influences were discussed as more significant drivers of the current system, with structural drivers, such as tenure, housing types and population demographics of less importance. These issues are reflected among the drivers of change of the state of existing greening in Waverley (Figure 7).

As homeowners, most participants were aware of the extremely high land values of the LGA (median house price: $2,821,429) and the additional value that ocean views provide. Consequently, the participants spoke about aesthetic aspirations linked to and reflected in Sydney's real estate market and value. The removal of trees and greening to increase property values was agreed as a common and accepted norm; effectively privatizing decisions of the commons. A lack of accountability and enforcement of tree replacements or provision of deep soil zones on development sites was seen as a failure of Council, as was the unreported scale of tree vandalism.

A general lack of trust was expressed with Council's decision-making processes, regarding private trees and property development, which was described as rigid, bureaucratic, and lacking transparency. This was echoed in concerns over excessive pruning, and the requirement for uniformity of vegetation in the public areas ('straight lines'), which is an historical legacy of past planning decisions, and facilitates service provision by State Government transport and utility (water, electricity etc.) agencies.

The biophysical challenges of maintaining vegetation on poor coastal soils and in a dense neighbourhood were acknowledged by some participants, but the primary challenge was ascribed to a lack of consensus about the environmental and co-benefits of vegetation. Some aspects of the environment were viewed as being effectively privatised through incorporation in property values. This appeared to skew community preferences towards maintenance of views and beach access over the broad public benefits delivered by trees and other forms of environmental restoration. It was also acknowledged that for the majority of residents (~80%) living in strata apartments, complex decision-making and lack of opportunity was a barrier to increasing vegetation, as was a general

disengagement from local democratic processes (i.e., participation in council decision making). However, it was noted that there was growing appreciation of public parks and green spaces following the COVID lockdowns of 2020.

The Transformed System

In the transformed system there is collective, and stronger, socio-cultural connection to nature, where vegetation is appreciated for its own sake, and rigid, vegetation management gives way to the restoration of more natural spaces, such as meadows, and major roads are refurbished as pedestrian routes and parks. The built environment is adapted to the changing climate with the incorporation of vegetation on roofs and walls and novel spaces. Importantly there is more transparency and accountability over tree decisions and replacement, tree protections are enforced, and the community is involved in tree management and selection.

Suggested Transition Pathways

Pathways that could transition Waverley towards the transformed preferred system include the setting of targets and provision of incentives to encourage residential and development support for enhanced greening. Supported community stewardship of neighbourhood vegetation, especially of the verge, is achieved through inclusive community groups and street meets. Specific roles for Council were envisioned to include the provision of guidance on selection of climate-adapted species for local planting, development controls to enable more integration of vegetation in the built environment, and dedicated support (advice and plants) for residents to develop habitat on their property. There was an appetite to pursue innovative agreements or covenants on private land to expand tree protections and shared responsibilities or tenures (e.g. easements). All

pathways were underpinned by an expectation of greater accountability (potentially data enabled transparency) for public trees and the reporting of non-compliance with these new social norms with appropriate sanctions to be enforced.

Themes extracted from broad-based community survey

Given the small sample size of the community sentiment survey and community workshop, a broad-based survey of LGA residents (MicroMex 2021) was also analysed to test the findings from the initial data collection. It reflected the transactional expectations of the community in relation to council's responsibility for tree management, and the diverse socio-cultural attitudes of the community (Figure 6).

Of primary concern, at 30% of responses, was the need to improve public tree management or maintenance by Council, including changes to species selection, maintenance regimes and compliance. The next most highly nominated issue, at 26% of responses, indicated a desire for changes to Council's policies to improve, or in some cases relax, control of local vegetation, citing development applications, tree removals and replacements, and prioritisation of areas for tree planting over other competing land uses. Comments relating to the need for more or better quality green open space and public interests represented 22% of responses, including better protections for trees and citing urban heat islands as the cost of over development in the LGA.

In common with the initial survey and workshop, 12% of responses related the influence on urban greening in Waverley of private interests and preferences, such as view-obstructing trees on neighbouring properties (arguably associated with 'free riders'), and 10% of comments comprising

complaints or suggestions on conflicts between infrastructure (such as powerlines and street curbs) and trees or vegetation.

It is worth noting that while the survey question was open ended and related to the improvement of the environment as a whole, the benefits, concerns and management of trees were the overwhelming topic of response, indicating the potency of trees as a symbol of the overarching environmental context, in a dense urbanised location. The responses also illuminate the scale at which this community perceive their urban vegetation, with experiences at street, lot and neighbourhood level informing observations, attitudes and concerns regarding Council services.

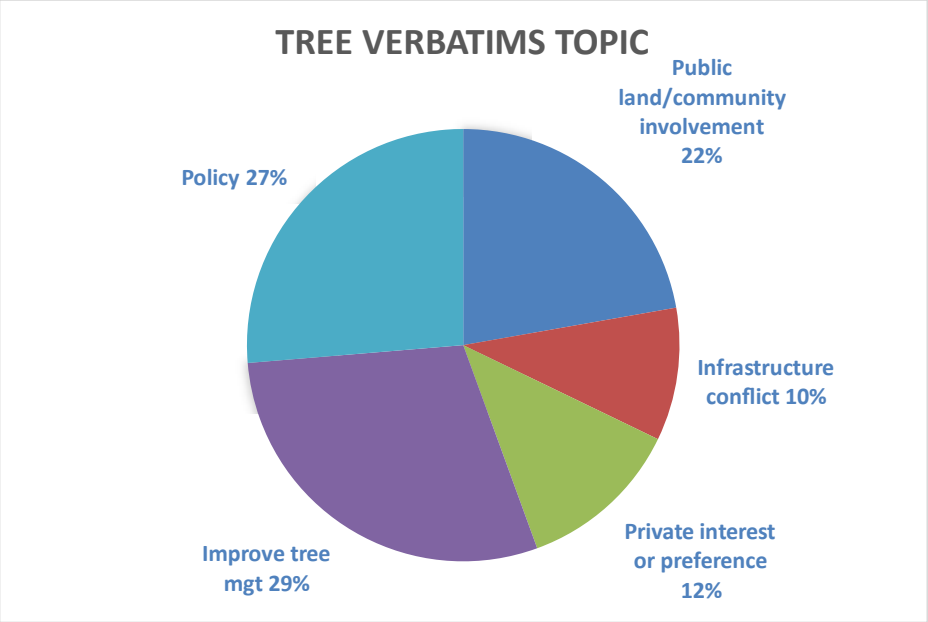


Figure 9: Themes identified from free text responses on environmental service delivery by Council extracted from an independent broad based Community Satisfaction Survey.

Policy analysis

From the data collection, limited consensus on the purpose, amount, benefits or disbenefits of trees was evident. However, support within the community for enhancement of vegetation to capture environmental and amenity co-benefits, including cooling was noted.

Within Waverley Council at a strategic level, policy support for enhancing vegetation to capture benefits is comprehensively and contextually articulated. Waverley Council has set targets and has committed to enhance greening and canopy in its Community Strategic Plan (2018) and the Environment Action Plan (2015, 2018). Specifically, from a 2016 baseline of 15.9% tree canopy cover and 19% shrub cover, Council has committed to deliver an increase in the tree canopy to 29% by 2029, and will investigate mechanisms to minimise existing canopy loss, and increase new canopy.

These initiatives are also detailed in the Waverley Local Strategic Planning Statement 2020, across many contexts and benefits including to:

- Increase amenity and cooling along pedestrian routes:

Improve walkability throughout Waverley with a 'walking strategy' that identifies key walking routes with greater amenity, and prioritise public domain upgrades and canopy tree planting to these routes (page 27).

- As a key element of local character:

Local character includes the built form, vegetation, streetscapes, activity types, and emotional and cultural experience of a place. Waverley's defining characteristics include the mature tree canopy, views to the stunning coastline and a large stock of InterWar buildings (page 44).

- To reduce the impact of urban development in the context of a changing climate:

Council's strategy is to continue to grow the urban tree canopy on public and private land, as well as requiring deep soil areas and a range of climate hardy plants on private property to both reduce the urban heat island effect, and improve conditions for wildlife. A changing climate is likely to increase pressures on our local plants due to potential changes in rainfall and temperature (page 62).

To reduce the urban heat island effect in our area, Council intends to grow the urban tree canopy which includes canopy on both private and public property. This is a key priority for our area to continue to provide shade in open spaces and along key walking and cycling routes to encourage active transport and outdoor activity (page 74).

To protect and increase the quantity and diversity of trees and plants in the public and private domain, to ensure that the tree canopy continues to be a dominant feature of the area and that species are resilient to projected changes in climate (page 75).

In summary, perception of issues relating to trees in the study area is highly localised and personalised. Although trees can be divisive, due to biophysical realities and socio-cultural preferences, prioritising the management and protection of climate adaptation services provided by vegetation is strongly supported by both the community and the Council.

The next chapter will discuss these findings with a focus on extenuating operational drivers and delivery capabilities of local government in the

current system. I find conformity between the community's proposed urban greening arrangements and Ostrom's Institutional Analysis and Development (IAD) Framework Design principles, and further examine where institutional barriers exist to realising practical subsidiarity in the local governance of climate change adaptation.

Chapter 5 Discussion

Operational Drivers

As stated in the Waverley Local Strategic Planning statement the intention to grow canopy cover on public and private land to 29% by 2029 is strongly aligned with an increasing occurrence and intensity of hot days, and the desire to reduce the urban heat island effect in the area. However, when discussed with the community, urban heat was not a primary concern, perhaps reflecting the coastal environment of the area that benefits from cooling sea breezes (Adams and Smith, 2014) or a lack of awareness of the risk.

Recent research (Croeser et al 2021a) has identified that while strategic support for green infrastructure in cities is strong, delivery and implementation is poor, as organisations responsible for greening, such as local councils, are hamstrung by significant path dependencies through existing frameworks, which are self-enforcing, making change difficult.

Waverley's Vegetation Management Framework is composed of policy, technical and general information documents, and statutory and legislative requirements (Figure 10).

Figure 10: Depiction of the vegetation management framework, following document analysis – dashed boxes indicate elements in development.

Operational vegetation management and protocols at Waverley are complex and siloed across several different teams. The Tree Management Policy sits with Asset Management, who take responsibility for technical aspects of street tree management. The Compliance Team manages vandalism policy and incidences, and requests relating to Tree Protection Orders (TPOs).

The Strategic Planning team oversees vegetation controls pertaining to development and planning. The Heritage Team deals with Significant Tree and Heritage Trees, and the Open Space and Parks Team are responsible for trees and vegetation in parks including maintenance, species selection landscaping plans and implementation. The Community Programs Team supports and administers public gardening, including community and verge gardening, and the Sustainability Department administers volunteer bush-

care and urban ecology outcomes through remnant and restored vegetation management and support for biodiversity corridors.

The complexity of the framework contributes to a lack of transparency (Figure 8). Reasons for tree removal, and maintenance and management decisions, are undertaken by Council according to set standards and regulations, generally to ensure public safety and satisfaction. However, the channels through which community interacts with Council regarding trees, such as Tree Protection Orders, Development Applications, Significant Tree Register requests and general complaints are administrative, and operational management decisions are reactive. This may re-enforce a transactional relationship regarding trees with rate payers/customers rather than engendering relational responsibility among community members for tree governance (e.g. Sebastian and Jacobs 2020).

The extensive and complicated regulatory system also leads to communication challenges with multiple information sources. For example, there are over 30 pages of information relating to tree and vegetation management on the Council website (Waverley Council 2021). Information is updated incrementally in accordance with minor and major regulatory or organisational reforms. In addition, State Government control of the land use planning system may create disillusionment with Council decisions because residents confuse the level of authority for some development decisions, which can override Council's expression of community concerns.

While physical (existing residential densities) and economic (land prices) barriers exist to acquiring land for additional vegetated open space, there is also a disconnection between community sentiment, strategic intent, and Council administration, which prevents effective governance of climate

commons in Waverley via collective and enhanced vegetation management. There is also an untested apprehension within Council to the inclusion of community involvement in decision-making or delivery of urban greening.

Assessing delivery capabilities

Building on the community sourced data and the document review and analysis in this study, the ability of Waverley Council to achieve its urban canopy targets was examined. The capability of Council was evaluated against the specific "success factor" traits identified in a comprehensive review of the academic literature (Croeser, et al 2021b), namely:

- Stable executive and political support
- Internal processes, standards, regulations and policy
- A well-resourced team
- Advanced community engagement skills
- Supportive internal departments
- Culture of innovation and risk tolerance
- Supportive departments in other level of government
- Access to suitable technical skills

There is currently insufficient evidence available to assess Council against this entire set of criteria. Here, I assess Council against two criteria, supportive internal departments and a well-resourced team, based on publicly available evidence in published policy documents and website information. Firstly, supportive departments at other levels of government are present, with the State government delivering the Greening our City program, which aims to plant 5 million trees in metropolitan Sydney (NSW 2021). Termed a Premier's Priority, the program seeks to support and empower local councils to develop strategic urban greening policy and programs for their LGAs,

promoting protection and expansion of canopy cover, through data, guidance and grant programs.

While these NSW Government initiatives appear to support urban greening at LGA scale, State policy and regulations are duplicative and may appear contradictory where tree protections are perceived as weak, particularly on private land (Hurley et al 2020), and regulatory reform to support this program is yet to occur. It remains to be seen how effective this program will be in enabling delivery of more canopy in Waverley, as site-specific approvals may encounter regulatory barriers from specific agencies (e.g. energy or transport infrastructure) where they are seen to interfere with operational priorities.

Secondly, comprehensive resources and staff are available to undertake meaningful and inclusive community engagement. This is a legislative requirement under Division 2.6 and Schedule 1 of the *Environmental Protection & Assessment Act 2001* NSW, to ensure Council inform, seek input from and involve the community in Council planning and decision making. Under this requirement removal of and works to vegetation and trees are considered a relevant planning matter for consultation, and Waverley Council has dedicated officers and requirements for consulting and exhibiting relevant proposals. While this level of capacity in community engagement is positive, operational, and technical teams are not trained in engagement, and this may limit deeper engagement beyond the legislated requirements.

So, while two success factors are present, evidence of the capacity to deliver urban greening under the remaining elements of the assessment framework is limited because they take place in an operational and internal context. This situation suggests that Council could benefit from a capability self-

assessment against the best practice criteria to determine where constraints could be addressed through capacity building. Nonetheless, Council appears to have a robust, albeit complex, framework in place for managing existing vegetation under current policy and regulatory controls.

Despite the small sample size there was considerable consistency across the multiple lines of evidence from the range of data gathering methods employed in this study, indicating that significant challenges exist in Waverley to the protection and enhancement of local vegetation. Given density and development pressures, achieving urban greening goals in Waverley requires significant public support and the participation of private property owners to be successful, potentially providing passive opportunities for urban climate change adaptation. (See Egerer et al 2021)

Design principles for sustainable management of common-pool resources, developed by Ostrom (1990) provide another set of best practice characteristics that have been observed to be regularly associated with the long-term sustainability of a system. While not all principles need to be realised in all circumstances, the prospects for sustainable governance tend to increase when more of these principles are in place (See McGinnis 2020).

Using the community-developed change model (Figure 5), the transition pathways were examined against IAD design principles to determine if conformity with the principles would be increased through the pursuit of the model pathways envisioned to lead to alternative arrangements for vegetation management, where accountability and responsibilities for decisions are shared among public and private actors.

Table 1: Comparison of community envisioned change in urban greening arrangements with Ostrom's IAD Design principles.

IAD Design Principles	Business as Usual	Transition Pathway and Transformed System
Boundaries (biophysical and social) are clearly defined	Clear delineation between council responsibility of public trees and operational control of public spaces. Boundaries of private residential spaces only triggered through development applications or tree removal processes	Devolution of responsibility to shared boundaries – blurring of the social and biophysical boundaries between responsibility and preferences regarding trees on private spaces and public spaces.
Congruence between appropriation and provision rules (for fairness considerations) and fitness to local conditions (for practicality).	Currently common pool resource (cooling) is diminishing with each tree removal. Tree replacement is managed by council. Residents can request planting nearby, but may not receive it	Improved tree and vegetation protections in the transformed model would enhance appropriation and provision rules. Local community participation could enhance contextual appropriateness or species selection and deployment.
Collective choice processes enable most affected individuals to participate in making rules.	Regular consultation – but largely on existing regulatory requirements	Empowered through involvement of community in decision-making and recognition of vegetation management and maintenance.
Monitors are accountable to appropriators (or are the appropriators themselves).	Currently no measurement of cooling properties or vegetation provision	Data enabled transparency could enable greater accountability to appropriators
Graduated sanctions are applied to rule violators (in increasing levels of intensity).	Information is obfuscated (and subsequently concerns vandalism is protected)	Accountability improved through data enabled transparency and education, though authority for sanctions is not established.

Participants have easy access to low-cost local arenas to resolve conflicts.	Council stays out of residential/civic disputes	Street meets and council educational resources improves cultural tolerance. Data enabled transparency may assist conflict resolution.
Minimal recognition by "higher" authorities that appropriators have rights to self-organise and devise their own institutions	No explicit support or recognition for independent groups in relation to vegetation management	Benefits of localised cooling may enable recognition of new beneficiaries/ appropriators – eg advantages to local business from use and visitation, potential wellbeing benefits (but hard to measure)
Nested enterprises for appropriation, provision, monitoring, enforcement, conflict resolution, and governance	Currently limited nested management (public gardens and verge gardening)	Greater opportunity for nested participation in roles, including monitoring and governance. Costs of provision are unclear.

From the comparison in Table 1, the validity of the system appears strong, accounting for multiple actors across multiple tenures, although not comprehensively. For all attributes of the redesigned system, there is enhanced conformity to the design principles, through a community-supported vegetation management approach (the transition model), which includes private land, and private management of public land (i.e. verge gardens). This indicates a better or more feasible approach to implementing and maintaining local greening and could support the recognition of the climate commons. While incentives are proposed in the model, the capacity to implement sanctions remains unavailable, and therefore authority to protect the commons appears unclear. The revised arrangements note but do not fully resolve the socio-cultural differences, including diverse ethnic, property ownership and socio-economic factors, that exist in the community, which remains a critical gap.

So, while the alternative arrangements depicted in the model demonstrate community concerns and ideas, they do not fully reflect the limited opportunities for expanding greening in Waverley, which result from a lack of space, technical and resourcing capabilities to deliver, and regulatory complexities of enhanced urban greening. Also, they fail to resolve the financial implications of shared responsibility for trees as public assets, where monetary value and liability risks are not articulated (e.g. Lyytimaki 2017; Rotherham 2021).

While incomplete, this analysis has revealed the essentially universal difficulties and barriers to enhancing greening in urban settings that exist today. However, the impacts of a rapidly changing climate, including extreme weather events and changing seasonality, will magnify challenges to water security, ecosystem stability and subsequently vegetation success and survivability, which will undoubtedly occupy community concerns in the future.

Institutional barriers to enabling localised climate adaptation

Ostrom (1990) first recognised the commons, not only as a resource, but as the social institution necessary for governing shared resources. This requires a rethink of existing institutional arrangements when considering the local climate commons provided by urban vegetation management and protection.

Local Government currently manages vegetation as a common pool resource on public land, though its effectiveness is subject to enabling factors, including resourcing, support from other levels of government and attitudes to risk (Croeser et al 2021a). Influencing the amount of vegetation on private land is challenging (Hurley et al 2020), and due to the amount and value of

private property in the dense coastal location of Waverley, this resource is vulnerable to development pressures and socio-cultural preferences and is being degraded by individuals at the cost of collective well-being.

The complexity and urgency for involving community in the management and protection of vegetation in Waverley is daunting. New approaches to governance that recognise the deeper consideration of ethical and moral values, such as progressive commons (Gmeiner et al 2020) may help to address conflict between private and common property regimes, relax the contention of trees and vegetation in local communities, and enable a process for expeditious and local adaptation governance to succeed.

Progressive Commons describes how commons thinking can respond to the key socio-ecological challenges of resource privatisation and commodification and global environmental damage, by re interpreting the values underlying traditional property regimes as sovereignty, re-democratisation, and sustainability in the global context. As management of a climate commons transcends clear lines of property rights and ownership, it recognises that modern upheavals in economic, social and environmental states are resulting in changes to traditional property regimes (Lazoroska and Palm, 2019; Sorrensen, 2018), but that our relationship to property, whether private or common, has developed based on an ethical or moral underpinning (Porter 2013), including individual security and freedom, societal welfare and recently ecological economic sustainability (Gmeiner 2020).

This thinking can be applied when examining local community values, captured through the community workshop and transition modelling exercise in Waverley, presented in chapter 4. The participatory workshop

and ensuing discussion identified the presence of privatisation and environmental degradation challenges in the current system:

- removal of trees and greening to increase property values as a common and accepted norm; effectively privatising decisions of the commons.
- changing climate acknowledged as having a broad influence on the current urban vegetation in the LGA, and political and aesthetic aspirations linked to and reflected in Sydney's real estate market and value.
- Noted preferences towards maintenance of views and beach access over the broad public benefits delivered by trees and other forms of environmental restoration.
- A lack of accountability and enforcement of tree replacements or provision of deep soil zones on development sites and the unreported scale of tree vandalism.

Furthermore, the transition pathways and resulting transformed system reveal strong alignment with the Progressive Commons framework values of sovereignty, democratisation and sustainability (Table 2).

Table 2 Comparing progressive commons values with community sentiment

Emergent Progressive Commons Values	Community sentiment in the Transition Model
Sovereignty – individual and communal access thereby reflecting a successful life and agency (Sen 1985)	Preference for the establishment of shared tenures and negotiation of formal or informal covenants for shared space
Democratisation – actors getting involved in designing the rules in the spaces they live - experimenting, enlarging their scope of action and	A desire for public and deliberative participation in selection and management of trees.

empowering over subjugating (von Borries 2016)	The development of incentives for enhanced greening, more accountability and data-enabled institutional transparency over tree decisions. The reporting of non-compliance with these new social norms with appropriate sanctions to be enforced.
Social ecological sustainability - beyond economic independence of a resource and towards concern for anonymous others (including futures generations) (Ostrom 1999, Stern 2011) -	All workshop participants indicated a strong commitment to 'trees' based on their personal environmental values, including the roles of trees in habitat, carbon sequestration and climate change. An aspiration to collective, and stronger, socio-cultural connection to nature, where vegetation is locally appreciated for its own sake.

The Waverley transition model, created by 'likeminded' individuals, identified the need for community-led, social groupings ('street meets') and educational campaigns supporting movements to self-organise management responses to realise elements of their desired "greener" state. This potentially indicates the genesis of an emergent progressive climate commons, in that groups of resources users are conceptualising their own institutions to overcome the social dilemma of overuse or resource degradation.

Linnenluecke et al (2017) identified a number of transformational changes in planning needed to address sustainability challenges, that appear to be present in the minds of the community participants in Waverley, including the connection of planning to ecological limits and the development of guidance to private sector organisations about how to engage in broader planning debates on societal levels. They suggested that a research agenda to achieve a sustainable future needed to establish a fit between planning approaches, tools and sustainability challenges, to adapt governance and

organisational structures for transformative change, and to design for and facilitate future change.

While willing, albeit conceptually, to enhance sharing of spaces to promote urban greening in Waverley, it remains untested whether the individuals involved in the workshop process described here would in reality contribute their own private space or resources to realise a commons, or whether they were simply volunteering the private resources of other community members. The costs involved in sharing of spaces and tenures is not addressed. Furthermore, organising *community led management responses* as identified in the transformed system, would incur costs, including significant time, resources and coordination. Merely suggesting examples and options for building community led measures, incentives and activities, such as coordinated guerrilla gardening, verge planting and maintenance or mulch sharing networks does not make them a reality. Existing tensions in the Waverley community towards backpacker tourism (Wilson et al 2007) and local opposition to the extension of the rail transport to Bondi Beach (Avila 2017) suggest underlying dimensions of social capital may need deeper investigation before attempting to implement a progressive commons in practice.

Despite qualifying as social innovations, community-led environmental action has been characterised by uncertainty and unpredictability (Scott-Cato & Hillier, 2010), and their impact described as ephemeral and difficult to trace (Rey, Tremblay, & Brousselle, 2013). While community-led responses are an essential manifestation of social capital, they risk being unable to meet Ostrom's definition of robustness (e.g., Ostrom 1990 pg 58) which is the ability to withstand challenges such as environmental shocks or social economic upheavals.

What, then, is the most appropriate institution to manage a local climate commons? Given its proximity to the community, can local government lend "robustness" to community led institutions for addressing the social dilemma of degradation of urban trees, or adaptation more broadly, and enable collective place-based adaptation responses? And how could it support and negotiate the establishment of formal and informal social structures with norms, duties and rules, to allocate forms of access and use rights?

Local authority and capacity to govern adaptation.

The transformed system of the community model suggests that if, in response to climate change, trees and urban vegetation were managed for collective benefit, they could be protected from private interests. As a hyper-local socio-ecological system, a climate commons in Waverley would have well defined boundaries, and should be easily monitorable.

In essence what is needed is place-based cooperation that addresses the collective action problem of degradation of local trees and vegetation. Ostrom proved that cooperation was more likely when individuals can monitor the situation and sanction detractors, can communicate and share information, know each other and have conflict resolution mechanisms available. But an action situation must be legitimised by an external political structure to cooperate, and self-organise. (Ostrom 1990).

It is worth noting that the pathways for transforming vegetation management in Waverley, including setting of targets, provision of incentives supported community stewardship and greater accountability and sanctions for vandalism, all require an organising authority for coordination and negotiation; a role the community members seemed happy for Council to play.

As previously noted, the literature on adaptation is clear that the local scale is where adaptation is centred (Lambert and Beilin 2021), and in many instances, adaptation that is local, self-organising and increasingly connected, is emerging around the world, showing governance characteristics that are adaptive, multilevel, and networked, which are recognised as key to Ostrom's framework for governing the commons.

Based on the community's understanding, and noting identified deficits in operational capabilities, Council as an institution would need to co-evolve (Lewin et al 1999) with new forms of self-organisation to establish a climate commons. Participatory mechanisms and engagement to enhance public understanding and involvement will be required (Flinders and Domment 2013), as will resources, organisational capacity and cohesions associated with social capital (Rolfs 2016).

But is the authority and capacity for local government to lead climate change adaptation governance available, or recognised, by other levels of government?

Can subsidiarity help?

In theory, subsidiarity requires that *powers and responsibilities are managed by the lowest level of government practicable, enabling greater local input into decision-making and policies, and services customised to suit local preferences and contexts* (Council of Australian Federation 2021).

In practical terms, subsidiarity allocates risk in a federal system, and guarantees a degree of independence for lower authorities in relation to higher or central governments. This approach forms the institutional basis for federated Nations such as the United States and Australia. It has also been

applied as a legal and policy tenet at a supra-national level, in the formation of the European Union, where it has been described as a scaling device in environmental governance. (Benson and Jordan 2014).

Originating in Catholic Social tradition, subsidiarity also has an ethical underpinning of the protecting the common good, and as a capacity building mechanism in relation to environmental stewardship.

Let us keep in mind the principle of subsidiarity, which grants freedom to develop the capabilities present at every level of society, while also demanding a greater sense of responsibility for the common good from those who wield greater power. (Laudato Si' Pope Francis 2015 Chapter 5, pg 196.)

Some scholars have noted that subsidiarity is nicely applicable to environmental problems, which tend to be experienced in local or regional contexts (Longo 1999) and that subsidiarity also mandates the localisation of problem solving and includes an obligation to ensure that individuals are equipped to participate fully in collective decision-making, regarding issues that affect them and their communities (Vischer 2001). It is also emphasised in the Agenda 21 Action Plan devised at the 1992 Earth Summit, which highlights that environmental issues are best handled at the relevant level and stresses the crucial role of local authorities, in particular because of their functions and ability to mobilise people's support (UN 1992). This has strengthened the case for local government authorities to play a key role in environmental policy making, and be granted financial resources commensurate with expanding responsibilities, in order to adequately respond to the needs of the communities they service (Longo 1999 pg 14).

Moral and environmental authority awarded by the subsidiarity principle is likely to strengthen as climate change risks to communities' increase. Climate

change will not only amplify the threats to local greening (Lohr et al, 2014), but also the need for sub local climate adaptation benefits and services that the urban vegetation provides, including cooling, biodiversity habitat and community health and well-being (Andersson-Skold et al, 2015; Choi et al 2021; Raymond et al, 2017).

Therefore, one might expect the principle of subsidiarity in the Australian constitution to support placed-based responses and implementation of management actions for addressing local socio-ecological issues. Yet there are limited examples of where the constitutional principle of subsidiarity has been exercised to improve outcomes in the management of Common Pool resources. One example is where regional community- based Landcare groups (Marshall 2008) were resourced directly by the Commonwealth to manage a socio-ecological system. But by skipping over state and local government, this example confounds the structure of formal subsidiarity conveyed by the Australian federation.

Applying subsidiarity to Climate Change Adaptation

At first glance, it might appear that subsidiarity has been applied to the governance of climate change adaptation in Australia. In 2012, the Council of Australian Governments agreed on the roles and responsibilities for climate change adaptation at each level of government, and this structure is reflected in Australia's National Climate change and Adaptation Strategy 2021-25 (Dept Agriculture, Water and Energy 2021c).

Recognising its constitutionally stipulated legislative, fiscal and policy functions, the Commonwealth Government is to:

- Provide leadership on national adaptation reform.

- Manage national assets and programs.
- Provide national science and information.
- Maintain a strong, flexible economy and a well-targeted social safety net.

Notably no implementation of adaptation, or collaborative action is specifically assigned to the highest tier of government.

The State and Territory governments, who exercise regionally relevant legislative and policy functions, such as regulatory frameworks relating to land-use planning and property rights, are responsible for

- delivering adaptation responses in their areas of policy and regulation. This includes service delivery and infrastructure in areas of emergency services, health system, the natural environment, planning and transport, and
- providing regionally appropriate information.

Local government in Australia is the lowest tier and has no constitutional basis. Its limited regulatory power is framed by state legislation and it is dependent on higher tiers of government for resources to enact policy or implement programs (Aulich 2009). Yet from this weak position of influence, responsibilities in relation to climate change adaptation are to:

- Ensure local circumstances are considered in the overall adaptation response.
- Ensure local communities are directly involved in efforts to facilitate effective change.
- Play a central role in land-use planning and managing local roads.
- Inform other levels of government about the on-the-ground needs of local and regional communities.

It has been noted internationally that, by default, climate adaptation issues are most often placed in the laps of local and regional authorities despite capabilities at this level typically limited (Huitema et al 2016), and this risks the likelihood of small initiatives to have broader impacts or reach others who could benefit from these novel approaches.

In the Australian context, adaptation responsibilities are devolved to Councils, but they have no ability to determine their own contextual responses, as they are relegated to being only an implementer of national and state/territory policies and programs (Dept Agriculture, Water and Energy 2011). With private parties only tasked with managing private risks, localised commons are exposed.

Even more problematically, the current definition does not extend sufficiently to recognise or respect the role of the community, or groups, to drive adaptation governance processes that can contribute to the common good.

Deepening and enhancing subsidiarity

By limiting the subsidiarity principle to arrangements between levels of government, Australian subsidiarity is fundamentally flawed, as it has effectively locked councils into a formal operational context that makes it difficult to allow for governance arrangements that encourage the deeper subsidiarity required to manage climate commons. The application of subsidiarity to climate adaptation in Australia fails to recognise the plurality of our society and necessity for a broad, informal and sub local scale approaches.

This is due to a narrow application of subsidiarity theory, which emphasises formal government, instead of social ontology. Cahill (2017) challenges the use of the term “levels” when discussing subsidiarity. She argues from a social ontological approach that the decision priority of lower levels is in fact greater than that of higher levels, as lower levels are the primary position of action. Reframing lower levels as primary “units” recognises the role of naturally occurring (non-government) groups with primary and presumptive responsibility for making decisions for the good of any group; or the Common good. This lens also notes the requirement for secondary units (i.e. higher levels) to use their superior capacity to help the primary units persist and achieve their goals.

Subsidiarity fails in the context of Australian local action, because it stops at local government, whereas it should allow for sub-local decision making at neighbourhood scale and ensure that governance at this scale is appropriately resourced to achieve goals and deliver and protect the needs of communities; communities that will increasingly live in densely populated and developed urban suburbs, such as Waverley.

Sub local decision making is especially needed for infrastructure and services related to urban green spaces, which can encompass localised climate commons. Recent analysis (Spiller and Murrian 2018) has identified and categorised the infrastructure and urban services that are best governed at each scale, from the neighbourhood to the national, based on the capacity of each scale to resolve service levels to meet community needs (table 3). Conspicuously local streets and parks, where a significant proportion of Waverley’s climate commons resource is located, is ideally allocated to the neighbourhood/suburb scale.

Table 3 Infrastructure services form local to national scales, from Spiller and Murrian 2018 Table 6.1

Table 6.1. Tabulation of infrastructure – local descending to national

Item	Infrastructure/service	Item	Infrastructure/service
1	Local streets, sewers and drains	33	Hospitals – subregional
2	Local parks	34	Regional stadia
3	Local community facilities (libraries, childcare, neighbourhood multi-purpose facilities)	35	Universities
4	Heritage protection – local	36	Technical and trade training
5	Collector and subarterial roads	37	Police – local
6	District main sewers and drains	38	Police – regional/metropolitan
7	Local spatial planning	39	Inter-urban bus services
8	Development assessment – local	40	Development assessment – state/ national significance
9	Local arts programs, facilities and events	41	Electricity generation
10	Preschools	42	Airports – regional
11	Primary schools	43	Prisons
12	Secondary schools	44	Courts, judicial review and administrative review
13	Collector bus services	45	Heritage protection – regional/state
14	Intra-regional arterials	46	Social housing provision
15	Dams and other high-level water-harvesting infrastructure	47	Food standards
16	Wastewater treatment plants – regional	48	Public health standards and enforcement
17	Wastewater treatment plants – local and subregional	49	Aged care – hostels
18	Inter-regional and inter-urban highways and freeways	50	Aged care – nursing homes
19	Line haul (commuter) bus services	51	Airports – international
20	Tramways	52	Transfer payments – health insurance
21	Metro rail systems	53	Transfer payments – unemployment
22	Line haul (commuter) rail services	54	Transfer payments – disability
23	Regional economic development	55	Transfer payments – age pension
24	Metropolitan-level spatial planning	56	Transfer payments – housing assistance
25	Regional spatial planning (non-metro)	57	Defence
26	Development assessment – regional and metropolitan	58	Aviation regulation
27	Flagship arts and cultural institutions, programs and events	59	Broadcasting regulation
28	Household waste recycling	60	Heritage protection – national
29	Industrial waste processing	61	Indigenous affairs
30	Electricity transmission	62	Immigration and border protection
31	Electricity distribution	63	Police – federal
32	Hospitals – regional and metropolitan		

By applying a subsidiarity framework for analysis, based on funding and delivery responsibilities, it can be seen that many functions and services in the US are administered at a neighbourhood scale, yet this level of governance does not exist in the Australian context.

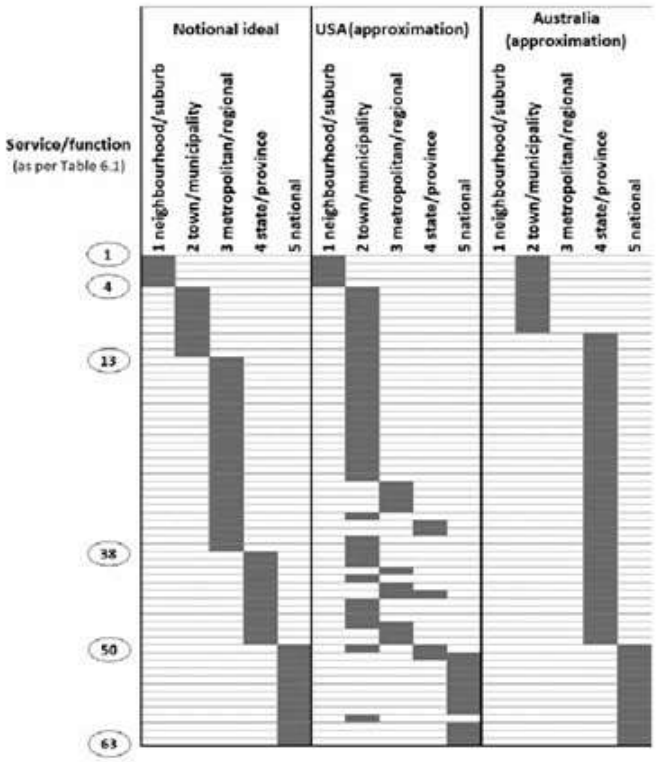


Fig. 6.1. Subsidiarity-based allocation of infrastructure and service functions

Figure 11 from Spiller and Murrian 2018 - Figure 6.2

In a comparison with a notional ideal situation, and unlike the United States, subsidiarity in Australia does not operate to support governance at neighbourhood/suburb scales. (Figure 10 from Spiller and Murrian 2018 Figure 6.2)

With almost 80% of taxation revenue collected centrally in Australia, devolution of responsibility is not being matched by devolution of resources or authority for urban governance, or decision making that necessitates the inclusion of Councils and non-government neighbourhood-based groups.

Without recognition or representation, this scale of governance cannot inform other multi-level units to adjust the overall response with local circumstances, or on-ground needs, and becomes easily isolated to performative tasks rather than connected processes (Lambert and Beilin 2021). Currently only one Adaptation Working Group (DAWE 2021) includes local government views, provided by the Australian Local Government Association, in senior official discussions on adaptation and resilience. It has no decision-making power or resourcing capabilities.

Recent assessment of climate action at the local government level confirms Australian councils are well placed to drive and influence action on climate change through the services they deliver, their strategic functions, and roles as community leaders, employers, large-scale procurers and landlords. Importantly, Councils are directly accountable to their constituents for their decisions and delivery of services, and can be better placed to take immediate action than national officials (Ironbark Sustainability and ICLEI 2021), provided they have the necessary elements of capacity in place (Croeser et al 2021b).

Top down approaches to adaptation have been criticised (Bulkeley and Betsill 2013; Naess 2013) for imposing government policy or engineering solutions on local communities because they may ignore the specificities of place, use impractical technologies, involve little to no consultation, and create resistance in local communities. It has also been noted that

adaptation to climate change has tended to prioritise hard engineering solutions and more linear policy approaches, such as increasing protection via sea walls and large flood control schemes. These adaptations may give communities a 'false sense of security', reducing flexibility, while actually exposing communities to greater risk (Lawrence et al. 2015; Simon et al 2017).

A more realistic approach, that recognises the role of plural participation in building resilience has been proposed by the Planning institute of Australia which calls for *local governments to be empowered as place managers to design governance arrangements and implement adaptive management… so that mutual obligations to manage risks are maintained among community, landowners, and agencies* (Planning Institute of Australia 2021 page 6). This discussion paper outlines the four characteristics of resilient systems, which include adaptability, redundancy, modularity and subsidiarity.

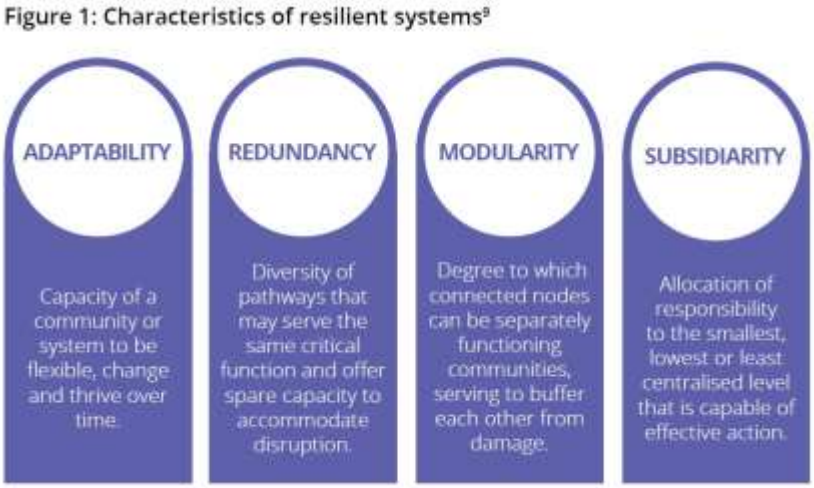


Figure 12: Characteristics of Resilient Planning Systems, from PIA 2021 Role of Planning in adapting to a changing climate.

Based on the noted regulatory complexity and barriers in the Waverley Case study, the absence of these characteristics makes the NSW Planning System "anti-resilient". Instead of adaptability, planning regulation in NSW backs consistency and uniformity. Instead of redundancy, planning regulation prioritises efficiency of operations. While operationally multilevel, it does not support modularity, but promotes centralised, 'low cost' government. And as already demonstrated, responsibility for local action is only devolved as far as local government, missing opportunities for novel participation in inclusive governance involving community and other groups, and subsequently risks may not be allocated or managed at the most appropriate scale.

In summary, despite Australia's Roles and Responsibilities for Climate Change Adaptation in Australia providing a coherent subsidiarity structure, by overloading local government without resources or decision-making authority for implementation, and by precluding governance from non-government actors or groups, it is obstructing adaptation, especially at the critical suburban scale.

Chapter 6 - Conclusion

This thesis investigates barriers, enablers and institutional arrangements to realise cooperation and management of localised climate commons through a case study of the governance of urban greening in Waverley LGA, one of Sydney, Australia's most densely populated urban regions. In particular it examines the role and operation of subsidiarity, a central tenet of Australia's formal system of governance, in the governance of the climate commons. Supported by literature on climate change impacts on social-ecological systems, supportive governance attributes, theories surrounding the use of common pool resources and the research findings of the case study, this thesis makes several conclusions on how governance of the climate commons could be improved to better enable community scale adaptation to climate change.

1. Deepening the application of subsidiarity

This thesis has revealed that the current application of subsidiarity in the Australian formal governance context is flawed, because it rigidly devolves adaptation responsibilities to the lowest level of *government* practicable (See CAF 2021) but does not allocate requisite powers to respond to these responsibilities. Not only is decision making skewed towards the higher tiers of government, control of financial resources is also centralised. This situation limits opportunities for identifying and informing the appropriate allocation of financial resources to meet adaptation needs at a local community level. In addition, it does not recognise forms of governance at scales finer that local government and fails to recognise or support sub-local

or neighbourhood interventions that could enable the 'deeper' subsidiarity required to manage localised climate commons.

Because of this flawed application of subsidiarity, barriers to governance of climate services in Waverley Local Government Area persist; including limited local operational and delivery capabilities, unresolved conflict between public and private property regimes, lack of consensus on the collective value of urban vegetation, unfolding uncertainty surrounding climate change impacts and costs and the complexity of urban tree management and regulation, which all impede adaptation at the local scale (see Croeser 2021a, Gmeiner et al 2021, Hurley et al 2020 and Hughes et al 2021).

However, the engagement activities described in this study, albeit limited, and published research (e.g. Shandas and Messer 2008, Bush 2020) indicate community and strategic support for greenery and amenity, progressive commons thinking, and an articulated willingness for novel processes to allocate accountability and responsibilities between Council and community roles. Specific enablers identified at the local and sub-local scale, such as incentives, targets, supported community stewardship, education and guidance and improved accountability and sanctions, represent tangible governance processes, which if resourced and led by the Council could lend robustness to a transformed system of urban greening management.

2. Recognising the opportunity for local governance of climate adaptation

Governance can improve the collective wellbeing of a group (Bosselmann 2008) only when it embraces the wide-ranging interaction of government, other bodies, the private sector and civil society, at multiple scales. Understanding and improving governance is more important than ever given the growing interdependence of society and complexity of issues, not least

the acceleration of climate change impacts, which are most acutely experienced at the local scale.

While the problems and challenges revealed in the Waverley Council case study are context-dependent, there are broad lessons emerging from this study that may be transferable to adaptive responses for local communities in general. For example, the Urban Greening and Canopy transformation model (Fig.7), developed through a community engagement process, suggests that urban density and neighbourhood scale relationships could be better harnessed by local government to deliver genuinely inclusive community involvement in decision-making and implementation approaches. Therefore, supporting communities to recognise climate commons and protect local climate services is a feasible pathway for implementing effective adaptation governance.

There is sound logic for local government, in Waverley and elsewhere, to lead adaptation governance, as it is well positioned to address identified adaptation governance challenges (as summarised in Figure 13).

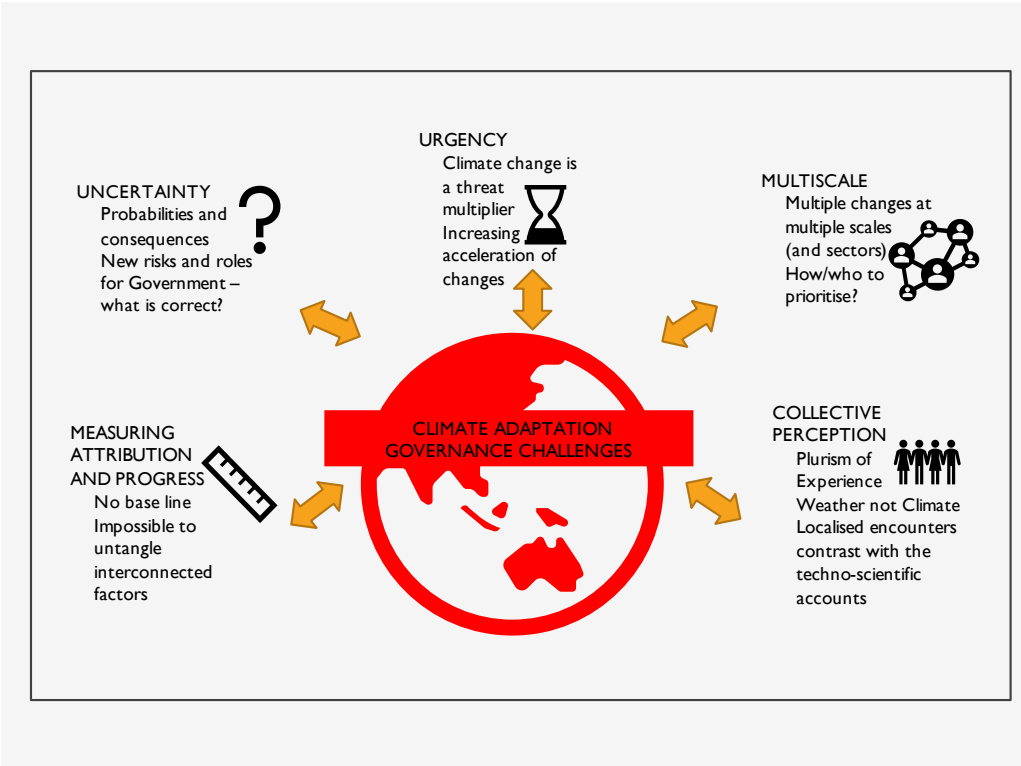


Figure 13: Conceptual Model of noted climate adaptation governance challenges, which can be addressed at a local scale

Local government's proximity to the community's vulnerabilities to climate change impacts place it in a unique position in Australia's formal governance systems to recognise continuous and abrupt challenges, often with largely unpredictable consequences (Termer 2011). Its positioning facilitates the creation of the right links, at the right time, around the right issues (Olsson et al. 2007), and the ability to mobilise and link the necessary actors and knowledge quickly and effectively across governance levels, through boundary spanning activities, as a bridging organisation, and through network leadership (Olsson et al. 2006). These activities increase the knowledge of adaptation needs and the visibility of informal, community adaptation responses that are often autonomous and invisible to higher levels of government (e.g. Sabel and Zeitlin, 2012, Jacobs et al 2021) because:

- Uncertainty is reduced when the location, timing, and consequences of climate change are immediately evident. Experiences can be empirically shared, and climate change impacts are understood as more than probabilities.
- Urgency can be personalised and realised, linked to immediate, local (not global) events and impacts, as localised encounters are more easily understood and trusted than techno-scientific accounts.
- Collective perception is concentrated where the plurism of experience is underpinned by social networks and physical proximity, supporting the emergence of localised climate commons, and
- though impossible to untangle interconnected factors at a federal scale, acknowledging and understanding socio-cultural and biophysical factors at local and sub-local scales can simplify challenges of prioritisation, and indicators could be developed that reflect community values and norms for measuring attribution and progress of adaptation.

Ultimately, these activities should improve the flow of information between levels of government and communities, thereby ensuring that climate change policies align with community needs. However, achieving this requires that the principle of subsidiarity be practically applied to mandate local government's primary role in guiding climate change adaptation.

Local governments already exist to operationalise state policies and legislation, and so they are already playing a fundamental role in multiscale systems, therefore at the level where impacts are felt most acutely, roles and mechanisms for prioritisation are currently available.

3. Adapting institutional arrangements to foster sub local participation and implementation

Climate change is a continuous and intensifying driver of change in social-ecological and sociotechnical systems that require flexible, diverse, adaptive responses by communities and institutions, despite efforts to reduce greenhouse gas emissions (IPCC 2021). In this context, a co-evolution of community and council roles is required to address the collective action problem of urban vegetation degradation.

Already the traditional responsibilities of local government for 'roads, rates and rubbish' have been superseded with more nuanced community development and environmental protection roles for Councils, through enhanced citizen participation (Aulich 2009). For example, the consultation requirements by the State government for the production of 10-year Community Strategic Plans demonstrates the more active and direct function of Councils to collaboratively set and achieve goals with their community, which strengthens accountability to the community and to the State. Targets to enhance Waverley's vegetation, to capture climate adaptation, wellbeing and cooling benefits are already acknowledged and documented in the Council's strategic plans, which are in line with noted international growth in urban climate responses and interest, where aspirations for climate resilience include rethinking the governance of development, travel, household consumption and urban nature (Bulkeley 2021).

For adaptation governance to succeed, place managers, including community members, need to be empowered to ensure local responses are not only enabled, but that they can influence and inform the cross scale regulatory and financial frameworks in which they operate, as outlined in the social-ecological transitions framework developed by Sievers-Glotzbach and

Tschersich (2019). Recognition of the role of the sub-local scale in managing and providing services, such as climate services through stewardship of urban vegetation, could be pursued through alternative institutional arrangements, which would enhance cooperation and management of local climate commons.

Outdated information regarding climate change risk in regulatory frameworks, which reinforce the lack of explicit or implicit recognition of the need to adapt to climate change, could be addressed by injecting future climate projections into planning instruments to anticipate exposures, and trigger reviews of regulations and standards with sufficient frequency to reflect rapidly changing climate (Dunford and O'Leary 2021).

Financially, the costs of adaptation are already likely to be beyond local government revenue raising capabilities, and as climate change impacts accelerate, adaptation costs will grow. However, it has been estimated that Council finances in Australia, as a share of tax revenue, are the fourth lowest among the 30 industrialised nations in the Organisation for Economic Co-operation and Development (Hughes et al, 2021). A new application of subsidiarity, that empowers local and sub local action, both spatially and socially, would more readily inform understanding at national scale of the cost implications of adaptation, and the capacity needed at local scale. This could inform new long-term funding mechanisms to enable subsidiary management of climate risks, so that informal functions and adaptations can occur, including at the sub-local sphere.

Further investigation of how to transform the Australia's regulatory and resourcing structure to realise a deeper application of subsidiary, which supports a role for neighbourhood scale interactions is recommended.

4. Delivering diversity through localised governance processes

Given the nature of climate change impacts, fostering diverse community responses offers the greatest potential for success; many adaptation 'experiments' will likely fail (Preston et al 2013). A multitude of actions and experiments must be encouraged to meet the urgent needs of a rapidly heating world, which aligns with the concept of adaptation as a process rather than an outcome. Responses that are local and self-organised can foster active adaptation especially in crisis situations, like extreme climate events (Huitema et al 2013).

Creating conditions to support local governance of adaptation through enabling legislation and policies could support and apply a deeper level of subsidiarity in practice, and would foster a broader array of experiments and measures in adaptation governance, which can share knowledge (e.g. Ross et al 2015).

As climate change impacts intensify, the more diverse the range of community responses the more likely it is that some will lead to successful adaptations. The knowledge gained through sharing information on successful adaptation offers the chance of transferability, scalability and learning.

Often the concept of 'mainstreaming' is promoted in relation to adaptation and has been leading with the pursuit of voluntary climate strategies that are not directly linked to the developments at other scales of governance (e.g. Juhola 2010). Diagnostic rather than prescriptive approaches have been promoted to assess adaptation risk as allowing improved understanding of community vulnerability/resilience, sustainable development needs and disaster risk, by incorporating existing agendas, knowledge, risks, and issues

(Jones and Preston 2011). Likewise, prescriptive approaches to adaptation governance are unlikely to enable the flexibility required in local government to respond to evolving community risks. Governance that is adaptive, networked, and involves plural alliances that reflect local social contexts are likely to be most effective in fostering experimentation and promoting diversity, and hopefully success.

In summary, unless communities closest to the impacts of climate change are supported to recognise climate commons, and empowered to protect localised climate services, inclusive, accountable and effective adaptation governance will be limited. Consequently, the opportunity for multi-scale collaboration across institutions and society, needed to swiftly adapt to global climate change, will be lost.

Local government is best placed to deliver the collaborative long-term processes, characterised by partnering and shared design, stewardship and accountability for outcomes and impacts, to commence a process to acknowledge and establish a climate commons.

However, under the current roles and responsibilities for adaptation in Australia, a mismatch between localised knowledge and implementation and the decision-making and resourcing scales persists. These need to be rearranged to better meet and empower adaptation governance needs at the local level.

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Appendix 1 Previously published paper by Dunford 2018

Attributes of good governance for effective adaptation action, and regional transitions (5470)

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Economic, social and technological drivers are changing regional communities. Climate change presents a disruptive, threat multiplier to known transitional pressures which will require robust and flexible decision making processes to ensure regional responses are informed, collaborative and successful. There is an urgent need to understand Governance of adaptation or existing vulnerabilities will be exacerbated, and opportunities will be wasted.

Using lenses of social ecological systems, transformation and subsidiarity, this paper will explore attributes of governance that may support communities to adapt, anticipate and manage transitions at a regional scale.

1. INTRODUCTION

In today's globalised world, environmental, social, economic, and technological factors impact communities in complex and unpredictable ways, placing pressure on traditional social and economic structures, and challenging sustainable development aspirations.

The changing global economy; tensions between development and natural resources; rapidly evolving technology; demographic and social change have been identified as influences that directly impact and interact on regional Australia. This confluence of multiscale factors is diminishing traditional governance structures' ability to shape or control regions, requiring the development of new government processes that empower regions to make decisions and respond to change. (RAI 2015). Even short term transitional pressures highlight the need for government to build the capacity of communities to adapt to ever changing circumstances, and the importance of involving them in identifying and planning their own development needs. (Productivity Commission 2017)

Under current projections, climate change presents unprecedented and but regionally differentiated threats to livelihoods, property and business. It is recognized as a multiplier of existing threats and pressures including peak resources, rising population and consumerism, and over exploitation of the environment and the ecosystem services it provides (Ison 2010). Responding and managing these threats requires urgent and decisive action, which will be constantly subject to political and scientific debate across regions, scales and sectors (UN 2017).

Therefore, adapting to climate change presents a multi-level governance challenge for regions, where expected impacts and respective measures cut across government scales, sectors and societal domains (Bauer & Steurrer 2012). Ensuring regional responses to climate change pressures are informed, collaborative and successful requires novel and expedient decision-making and implementation processes.

Governance and the role of government

The actions of interdependent individuals can affect others wellbeing. This can lead to conflict or alternatively, if it is acknowledged that conflict may cause collective losses, cooperation. Governance

is the coordination of this cooperation, and associated behaviours, to improve the collective wellbeing of a group (Bosselmann 2008).

Although it can be understood as the role or design of an overseeing, decision-making structure, more broadly governance encompasses a range of processes that enable decisions to be made, implemented and assessed for efficacy, in a given context.

Governance is not a synonym for government, which is understood as the centralized institutional arrangement that structures authority and order (Bosselmann 2008). The growing interdependence of society and complexity of issues has resulted in a growing understanding that governance covers the wide-ranging interaction of government, other bodies, the private sector and civil society, aiming to solve conflicts or problems and create social opportunity.

The different roles governments play in responding to the threat posed by climate change include the need to adapt its own programs and activities, to regulate to reduce community vulnerability and to build the adaptive capacity of the community to facilitate adaptive responses (Brooks et al., 2009). Because of the long-time horizon and prevailing uncertainties about climate change, the main role for government is to provide the correct legal, regulatory and socio-economic environment to support autonomous adaptation (Fankhauser 1999). Such action would require the flexibility to change behaviour, policy, law, politics and customs, which may constrain adaptive responses (Jacobs et al 2014).

Inherent challenges of climate adaptation governance

In the 1992 United Nations Framework Convention on Climate Change (UNFCCC), sought to “prevent dangerous anthropogenic interference with the climate system”, within a time frame

- 〈 to allow ecosystems to adapt naturally to climate change;
- 〈 to ensure that food production is not threatened and;
- 〈 to enable economic development to proceed in a sustainable manner.”

Despite ongoing global negotiations, greenhouse gases have continued to increase and last decade and last year, yet again, set a global heat records. At the local and regional scale we are now facing the thresholds we sought to avoid, and questions of responses, risk reduction and adaptation become alarmingly urgent, but not uncomplicated.

The study of climate change falls into a category referred to as post-normal science (Funtowicz and Ravetz 1993) comprising deep unresolved uncertainties in both probabilities and consequences, which are unlikely to be resolved before society must make decisions regarding how to deal with their implications.

Ribot (2011) advises that climate adaptation is “noble, necessary and long overdue…”, but notes that questions remain unanswered on how best to effectively use public expenditure through adaptation policies, measures and investments to optimize human well-being. To “minimize risks and capture opportunities associated” (UNFCCC) with a warming globe, a system of governance that can involve multiple actors in the decision-making process at multiple scales of social organisation (Boyd and Junola 2015) is needed.

Governments, in attempting to act on the issues of vulnerability and adaptation to climate change, must cope with the interactions of chaos, complexity and contradiction that increasingly make the management of complex social systems intractable (Sardar, 2011). Solutions are beyond the scope of science alone because they must be grounded in an understanding of unique historical trends (long term weather forecasting), rather than traditional reductionist approaches, and the input variables to decision making include the outcomes of political and ethical debates in the community (Collins and Evans 2002).

Therefore, in summary, governance of societal action to adapt to climate change is inherently difficult for several reasons. Climate change adaptation is context specific. Although climate change is a global phenomenon, climate impacts occur regionally and are increasingly emerging as systemic failures at local scale, varying significantly from place to place, and reflecting local cultural practices as

well as (or in spite of) current national or regional governance structures (Julhola and Westerhoff 2011).

As, adaptation spans multiple scales and sectors, this confounds attribution versus contribution of adaptive responses. Moreover, adaptation defies simple cause and effect analyses because its complexity makes it impossible to untangle the range of interconnected factors that shape a long-term impact or outcome (for example, Rindfuss et al., 2008). A noted, these factors include drivers of social and political change that affect social vulnerability and may be unrelated to (but amplified by) changes in climate.

When adaptation succeeds it can be as a result of autonomous (often hyper-local scale) innovations and anticipatory planning. This requires a governance framework that can consider temporal dimensions of climate change impacts, requiring that uncertainty be explored as a time frame, and a point in which a critical threshold is likely to be exceeded (Werners et al. 2013).

Problematically, autonomous community adaptation is frequently invisible to the institutions governing adaptation, becoming recognisable as successful adoption rather than failure or early innovation, which confounds governance processes that need to encourage experimentation (Sabel & Zeitlin, 2012).

Because adaptation is a process of continual adjustment, a pathway between alternate system states, rather than an end point, it can contradict aims of governance that require the demonstration of outcomes in the short term (particularly to satisfy public funding objectives). Werners et al. (2013) suggested that it was important to encourage short-term actions to sustain current systems, whilst keep longer-term activities open.

The capacity to adapt, latent in many communities, often remains unfocused on climate change through local knowledge deficits, market failure, media skepticism and conflicting political priorities (Jacobs et al 2016).

Finally, the dynamic nature of socio-ecological systems means that it is difficult to establish a fixed baseline from which to measure achievements. With overall conditions deteriorating or in flux under a changing climate, the baseline itself may shift over time.

For these reasons, some argue that adaptation is not linear response to a biophysical change, but a contested social-political process that mediates how individuals and collectives deal with multiple types of simultaneously occurring environmental and social changes (Erikson 2015).

Current climate change adaptation governance in NSW

Presently there are no direct legislative or regulatory responsibilities that stipulate climate change adaptation in NSW. However, the Council of Australian Governments Select Committee on Climate Change endorsed roles and responsibilities for adaptation in July 2013, which outline that while private parties should be responsible for managing risks to private assets and incomes, governments – on behalf of the community – should primarily be responsible for managing risks to public goods and assets (including the natural environment) and government service delivery, and for creating a regulatory environment that supports private action.

The NSW Minister for the Environment oversees expenditure of the New South Climate Change Fund, which supports climate change related activities through a levy on electricity distribution business (NSW OEH 2017). To ensure an effective climate response across sectors and scales requires prioritization of expenditure to future climate risks and opportunities across government service planning and delivery in all portfolios. The current administration has recently set an aspirational target to make the state more resilient to a changing climate, through a policy framework (NSW 2016) but details of the complete programs and mechanisms that will deliver on this target are still being considered. (NSW OEH 2016)

For the last eight years, the State's Office of Environment and Heritage has set corporate objectives and dedicated resources to progress climate adaptation activities through the delivery of fine scale climate projections and impact information, regional and sectoral vulnerability assessments and

supporting funding and small-scale project implementation to build capacity. This work has been informed by identified components of requisite adaptation architecture to support effective implementation (Stirling 2009) including political leadership and institutional organisation, extensive stakeholder engagement, climate information and use of decision analysis techniques, consideration of barriers, funding, technology development and diffusion and adaptation research (Jacobs et al 2016).

Cross agency engagement has been active, especially in regional contexts, but with a prevailing monocentric approach to administrative and executive responsibilities, coordinated governance of climate change adaptation in NSW is hampered by the sectoral divisions of state portfolios, which is not unique to NSW (Unwin and Jordan, 2008).

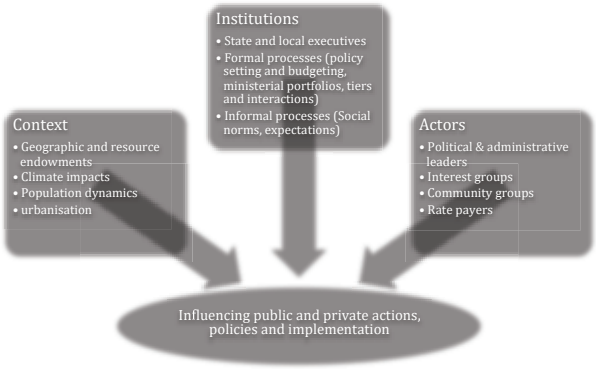

Figure 1 Climate change adaptation governance in NSW, adapted from Fritz, V, Kaiser, K and Levy, B 2009. Problem driven governance and political economy analysis: good practice framework

Termeer (2011) notes that a monocentric government approach to scale or capacity challenges can abolish existing layers or create new ones. While not directly climate related, both approaches have been instigated in NSW is the past two years. The creation of the Greater Sydney Commission, a new level of governance, with a semi-independent agency was created in 2015 to address strategic land use planning in the rapidly urbanizing metropolitan region. While established to coordinate across portfolios, concerns have been raised that this disconnects planning power from the community, and that government appointed commissioners and a board structure lack accountability.

In 2016, a part of a local government reform process, a new approach to governance in the most western and least populated planning region was put forward. The Far West Initiative proposed establishing a new regional authority, amalgamating eight local councils with state and federal agencies to fill gaps in the delivery of services. Current progress of this proposal is unclear.

Moving toward adaptive governance

Local government has been a key participant in the OEH led climate change adaptation activities, delivering 21 collaborative adaptation projects (LGNSW 2017), and co-creating transition pathways, identifying networks, vulnerabilities and adaptive responses in 10 of the 12 state planning regions, through a managed process based on the Integrated Regional Vulnerability Assessment method (Jacobs et al 2015). In this process, local and state government decision makers interpret climate and socio-economic data, through staged participatory learning, engaging as office bearers, professional experts and members of regional communities. This displays some elements of localised multilevel governance, as a process of continuous interactions among governments and private entities, operating at, and between, several administrative levels and ultimately aiming at the realization of collective goals (Termeer 2011).

Although some Commonwealth representatives participate in the NSW process, integration with Federal adaptation initiatives has been limited to research support and ad hoc discussions, and any international or supranational aspect to this work is not visible. Failing to adapt domestic governance approaches to align with international developments is not only a challenge to adaptation policy. The Australian government has instigated minimal change to the federation since its establishment and a willingness to ignore criticism in relation to climate policies has been noted (SGI Network 2017).

So, while some of the structure for adaptive governance is in place, the scale of operation is not yet appropriately matched to the varying needs of regional service delivery, local communities or the ecosystems that support them (Jacobs et al 2016). In addition, a lack of central authority ensures a general lack of strong policy instruments to 'enforce' climate adaptation responses through planning and implementation.

In contrast to monocentric and multilevel governance approaches, the concept of scales is not limited to spatial and jurisdictional. Temporal, institutional, management, network, and knowledge scales are also (Cash et al. 2006, Gupta 2008) important to understanding and implementing appropriate governance for climate change adaptation.

In current appraisal, NSW governance of climate change has not realised adaptive governance, that is the ability to recognise continuous and abrupt challenges, often with largely unpredictable consequences (Termer 2011), because it requires the ability to create the right links, at the right time, around the right issues (Olsson et al. 2007), by mobilizing and linking the necessary actors and knowledge quickly and effectively across different levels, through bridging organizations, network leadership (Olsson et al. 2006), and enabling legislation and policies. However, some have noted that strong policy options may be unworkable in practice and potentially be counterproductive (Measham et al. 2014).

A number of authors have suggested a range of essential attributes of governance that could support climate adaptation. For example, Gupta et al. (2010) identified six characteristics of institutions that promote adaptive capacity for responding to continuous and unpredictable climate changes as those that: (1) encourage the involvement of a variety of perspectives, actors and solutions; (2) enable social actors to learn continuously and improve their institutions; (3) allow and motivate social actors to adjust their behaviour; (4) can mobilise leadership qualities; (5) can mobilise resources for implementing adaptation measures; and (6) support principles of fair governance.

Ostrom (2009) proposed a polycentric approach to coping with climate change, which would encourage experimental efforts at multiple levels, develop of methods for assessing the benefits and costs of particular strategies, compared across regions and ecosystems. Other key elements of effective governance that merit investigation include a need for profound cultural change, the facilitation of knowledge co-production, the creation of pluralist alliances, and the building of a new democratic capacity-democratic experimentalism (Sabel & Zeitlin, 2012; Cash, et al 2006; Monkelbaan, 2015; Young 2002). An option could be establishing a Regional Deal (Pugalis 2017), to strengthen intergovernmental relations and accords, agree roles and responsibilities for contextual conditions and systemic adaptation outcomes, and providing a self-organizing structure to experiment on adaptation governance.

Subsidiarity: the missing ingredient?

One element of governance that has not yet been fully explored to support climate change adaptation is the principle of subsidiarity. Subsidiarity was first developed as a philosophical precept through the Catholic Social Tradition, and in all formulations of the principle there is a clear ethical content including "addressing injustice" or "respecting diversity" or minimising actions "contrary to the common good" (Mele 2005).

The Australia Federation is underpinned by the principle of subsidiarity, which holds that social and political issues should be dealt with at the most immediate level that is consistent with their resolution. This means, that a central authority should have a subsidiary function, performing only those tasks, which cannot be performed effectively at a more immediate or local level. Though often conflated, Blank (2009) notes that that federalism and subsidiarity are distinct, and subsidiarity is a better fit for the task of articulating multi-level governance, with potential to minimise decentralization and overlapping desires and outcomes.

In reference to climate change, subsidiarity provides a useful foundation to underpin a system of governance, as those experiencing localised climate impacts will usually be best placed to identify practicable responses for managing them effectively and efficiently, even though they may lack the technical or financial capacity to do so (e.g. Gurren et al., 2005; McColl and Young, 2005; Ensor et al 2015).

Recently system transformation has received increased attention a necessary response to climate change to overcome 'lock in traps' inherent in the promotion of resilience (Handmer and Dovers 1996; Pelling 2010). However, there are ethical and political implications for centralised governments in promoting deliberate transformation because such fundamental changes in local systems will alter the structure of community vulnerability and cause local power shifts and imbalances (Schulz and Siriwardana 2015). Blank has proposed that subsidiarity should also be differentiated from federalism, through its ability to neutralize political influences and potentially political cycles.

Embedding the principle of subsidiarity in climate change governance experiments may provide a mechanism to negotiate effective and successful transformational adaptation because it prevents a one size fits all approach, requiring instead strategies that allow for bespoke solutions that reflect the local context in which they operate, diffusing political cycles but remaining constitutionally valid.

ACKNOWLEDGMENTS

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Appendix 2 Previously published article Dunford and O'Leary 2021

Future Proofing Residential Development to Climate Change

Rachel O'Leary, Coordinator Sustainability and Resilience, Waverley Council
Suzanne Dunford, Manager Sustainability and Resilience, Waverley Council

Are we locking in climate vulnerabilities for occupants of residential buildings with building controls based on historical climate records? If so, what adaptations are available to improve the resilience of residential development and protect the safety of our communities in a warming world?

Background

Nationally, it is estimated that 500,000 dwellings will be built over the next three years.[1] At the same time, Australia's climate is changing with average and extreme temperatures increasing and rainfall in the southeast declining; most notably in winter.[2] These climate changes impact our health and wellbeing, our energy and water infrastructure and supply, and should impact how we manage our built environment.

In 2014, it was observed that planning for demographic and population changes had failed to account for climate change related risks and hazards in Metropolitan Sydney.[3] Despite numerous heat events and resulting research, building controls still do not account for projected warming caused by climate change or the affect this will have on residential communities.[4] As a consent authority for residential development in Sydney's Eastern Beaches, Waverley Council designed a project to see if the residential buildings we approve today, will be safe in the hotter, dryer climate of the future. And if not — how can they be adapted to be more resilient to climate change.

Aim

The aim of the *Future Proofing Residential Development to Climate Change* research project was to model the performance of residential dwellings in Randwick, Woollahra and Waverley council areas against future climate projections to determine the effects of climate change on building performance and identify appropriate responses.

Method

Council officers selected five recently approved residential buildings (detached, attached, low-rise, mid-rise and high-rise) common to the Eastern Beaches (217 dwellings in total) that met NSW Building Sustainability Index (BASIX) requirements, and sought to review the performance of each building type against:

- Thermal comfort i.e. estimated heating and cooling loads (MJ per m^2 per year);
- Energy consumption and greenhouse emissions (kg CO_2 per person per year); and
- Water consumption (litres of water per person per year).

Each building type was then assessed for these criteria under three different climate scenarios:

- Present day 2020 (to serve as a Baseline Year)
- Near future change 2030 (average 2020—2039)
- Far future change 2070 (average 2060—2079)

It is worth noting that though the baseline year was 2020, the climate data in the current NatHERS software used to model the heating and cooling loads and energy consumption of dwellings is from predominantly last century (1970—2004). Similarly, BASIX uses climate data from pre-2004 to model estimated outdoor water consumption and the productivity of rainwater tanks.

Therefore, to undertake this research the historical data files were replaced with projected climate data for Eastern Suburbs Climate Zone 56, using high emissions scenarios. For NatHERS we used RCP8.5[5] data for 2030 and 2070 provided by CSIRO's Energy Division. For the BASIX tool we used NSW and ACT Regional Climate Model (NARCLIM) A2 data for 2030 and 2070, provided by NSW Department of Planning, Infrastructure and Environment.

Through the modelling conducted by WSP, it was identified that although average temperature is projected to rise by only 1-2°C, the cumulative impact of hot/warm hours will drive significantly increased cooling loads. For Eastern Sydney Climate Zone by 2030, there will be almost an extra month of warm days per year over 25°C and by 2070, there will be an extra 2.5 months per year of warm weather compared to the Baseline year.[5]

Results

Under the future climate scenarios, there will be less energy required for heating and substantially more energy required to cool our homes. Despite a relatively mild coastal climate, all compliant dwellings in the Eastern Beaches failed regulated thermal comfort requirements for cooling by 2030, because cooling loads increased by 70% on average above the Baseline Year for all dwelling types. By 2070, cooling loads increased by 308% on average above the Baseline Year . Essentially, this project shows that dwellings approved today under existing NSW regulatory controls will be unsuitable for occupation by 2070, without extremely high levels of mechanical cooling. This raises important questions about affordability and equitable access to cooling for Sydney's vulnerable communities, not to mention looming peak electricity demand challenges as the climate warms and the frequency of extreme heat events increase. It also calls into question the feasibility of governments' net zero and resilience aspirations.

We next asked our building modellers to identify what treatments would enable the five BASIX buildings to reach thermal comfort compliance under 2030 and 2070 climate scenarios. Compliance Design Treatments included building fabric improvements (e.g. glazing performance, insulation, cross ventilation), shading improvements (e.g. eaves, awnings, venetian blinds, lighter coloured walls and roofs, reducing, removing or shading skylights), glazing area reductions, modelling of ceiling fans, and combined treatments (i.e. two or more treatments listed below).

	Baseline Year		2030		2070	
	Warm	Hot	Warm	Hot	Warm	Hot
Hours/year	1110	26	1323	28	2162	52
Days/year	125	5	150	6	200	9

Figure 1: Number of warm and hot days per year, Eastern Suburbs Baseline Year 2020, 2030 and 2070 (WSP, 2020)

Pleasingly, a range of existing design solutions enable the modelled buildings to meet the current thermal comfort compliance requirements in both 2030 and 2070.[4] To reach compliance in 2030, the modelled detached house required high performance single glazing, an increase in wall and roof insulation and the installation of a high-performance ventilated skylight. By 2070, the house also required high performance double glazing, a reduction in skylight area, light-coloured walls and roofs, openable windows in all rooms and ceiling fans in bedrooms and living areas to stay cool. These design modifications would deliver a dwelling that was thermally comfortable and safe to live in over its design life.

Discussion

With global temperatures projected to rise by 2.5°C in the next century, residential buildings and homes will need to withstand hotter temperatures, drier climates and more extreme weather events. Our project demonstrates that if projected climate data is incorporated into building controls, then designs will incorporate requisite building fabric improvements and increased ventilation, delivering homes that are built to stay cool over the lifetime of the dwelling.

As local government professionals, we want to ensure our communities are not forced to live in dwellings that are maladapted for the near future. Therefore, we are advocating for the use of future climate data to inform current planning tools. This will ensure that the houses built today are thermally comfortable and safe for occupants to live in well into the future. The BASIX tool is a State-wide policy while the NatHERS software is used nationally in the National Construction Code, and both are currently undergoing updates. As demonstrated by this project, adopting future climate data in both tools is a simple and available measure that can be implemented today, benefiting homes built across NSW and ultimately across the whole country. ■

Figure 2: The project team (left to right: Rachel O'Leary, Katie Fallowfield, Nick Asha and Suzanne Dunford) receive the Greater Sydney Planning 'Disruptor' Award for 2021 from Geoff Roberts AM.

Acknowledgement — This project was assisted by the New South Wales Government and supported by Local Government NSW, and our council partners.

***Suzanne Dunford** has worked in climate change at both State and local government levels, and is passionate about harnessing social, regulatory and environmental systems to ensure a just transition to a climate adapted world.*

***Rachel O'Leary** is an environmental scientist who is passionate about providing safe, comfortable, and affordable housing for all people.*

Endnotes

1. https://hia.com.au/-/media/HIA-Website/Files/IndustryBusiness/Economic/fact-sheet/window-into-housing.ashx?la=en&hash=984BFC13938B3F2F997E099A71545B151044C2B50 Housing Institute of Australia (HIA), 2020, Window into Housing.
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Appendix 3 – GIPA Approval to use internal survey data

Sent: Wednesday, 17 November 2021 6:25 PM
To: [redacted] <[redacted]>
Subject: HPE Trim file D21/100684 Verbatims - Sustainable Enviro

Hi Suzanne

I refer to your request to access and use the data contained within HPE Trim file XXXXXX Verbatims, Sustainable Enviro (tab 4) for your own research, which I have processed informally under the *Government Information (Public Access) Act 2009* (GIPA Act).

Under the GIPA Act, there is a presumption in favour of the disclosure of government information unless there is an overriding public interest against disclosure. I am required under the GIPA Act to consider reasons for disclosure and reasons against disclosure. I have found no reasons against disclosure.

I am granting you access under the GIPA Act because the access and use of the requested information could reasonably be expected to contribute to positive and informed debate on issues of public importance such as Environmental Sustainability.

I have no objection to you accessing and using the requested data for your Masters 'Governance of the Climate Commons', Chapter 4 'Triangulating Community Sentiment, Policy Frameworks and Progressive Governance Capability. '

Regards

Governance Officer
Cnr Paul St and Bondi Rd, Bondi Junction NSW 2022
W: waverley.nsw.gov.au

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Waverley Council acknowledges the Bidjigal and Gadigal people, who traditionally occupied the Sydney Coast and we pay respect to all Aboriginal and Torres Strait Islander Elders both past and present.