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Space for Adapting: Reconciling Adaptation and Mitigation in Local Climate Change Plans

Elisabeth M. Hamin, *University of Massachusetts - Amherst*

Nicole Gurran, *University of Sydney*

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Space for Adapting: Reconciling Adaptation and Mitigation in Local Climate Change Plans 1 2

Elisabeth M. Hamin and Nicole Gurran 3

Abstract Amid the complexity of actually planning for adaptation and mitigation 4
in cities, spatial form matters. Denser urban environments generally have lower per 5
capita emissions because they enable transit and more efficient heating. At the same 6
time, a larger green infrastructure can be beneficial to adaptation, as it provides 7
room for urban greening, storm and flood water management, and treatment of other 8
ill-effects of climate change. City plans need to reconcile both goals to be fully 9
climate resilient, but to date, there has not been an empirical evaluation on whether 10
the adaptation policies cities are choosing create conflict with mitigative goals. To 11
address this, we undertake a content analysis of policies in 11 major adaptation 12
plans and explore the implications of these for mitigative potential in the urban 13
form. Overall, we found that many of these policies do not require dedication of new 14
space and likely have little effect on mitigation. For those that require more space, 15
we suggest ways this can be managed to still facilitate mitigation. Examples include 16
repurposing automobile roads into green infrastructure and using coastal retreat and 17
habitat corridors to transfer development to more transit-friendly urban areas. We 18
see a virtuous circle emerging where mitigation and adaptation work together at the 19
city scale to create more desirable cities. 20

Keywords Land use • Spatial form • Green infrastructure • Municipal policy 21
• Municipal planning 22

E.M. Hamin (✉)

Department of Landscape Architecture and Regional Planning, University of Massachusetts
Amherst, 109 Hills North, Amherst, MA 01003, USA
e-mail: emhamin@larp.umass.edu

N. Gurran

Urban and Regional Planning Program, University of Sydney, Wilkinson Building (G04),
148 City Road, Sydney, Australia
e-mail: ngurran@arch.usyd.edu.au

1 Introduction

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Urban areas have essential roles to play in both mitigating climate change and in preparing for expected changes. Regarding mitigation, cities are the primary source of greenhouse gas (GHG) emissions, but they also have enormous potential to provide GHG reductions (United Nations Human Settlements Programme, UN-Habitat 2011). In developed countries, part of this potential comes from the greater efficiency of public transit, biking, or walking as compared to auto travel. Hence, situations that encourage effective alternative transportation tend to reduce per capita GHG emissions (Ewing et al. 2008). Denser environments also provide heating efficiency through shared walls and more efficient delivery (Ewing and Rong 2008). The result is that in developed countries city residents tend to have smaller ecological footprints than their suburban counterparts, so cities are both the problem and solution to at least part of the global mitigation challenge (Rees and Wackernagel 2008). Given the pressing need to reduce emissions in all feasible domains (Pacala and Socolow 2004), urban spatial forms that are denser and more transit friendly are important policy goals.

In terms of adaptation, by 2050, it is expected that over 70% of the world's population will be urban (UNFPA 2007). Many of the world's largest cities are located at environmentally sensitive locations—sea coasts, riverbeds, tidal flats—and are likely to experience significant climate impacts (IPCC 2007). Designing and planning the urban form to reduce the harm caused by those climate impacts—in other words, climate adaptation—is essential to protect human populations. But in the built form, effective adaptation often comes from policies that keep more open space in the urban fabric—space to allow storm water to infiltrate, trees to cool the air, species to migrate, and breezes to flow (Pizzaro 2009; Roaf et al. 2005). Adaptation may be easier in less-dense settings.

Following this logic, in previous work, we have argued that in urban areas the challenge is space—how to make cities dense enough for bus/biking/walking, without reducing adaptive capacity (Hamin and Gurran 2008). At that time, few municipalities had completed adaptation plans, so our argument was largely prospective and theoretical. Four years later, there are enough municipal adaptation plans that we can empirically test whether the adaptation policies cities are choosing create conflict with mitigative goals. In this research, we review the policies prescribed in leading adaptation plans, primarily in USA and Australia but also in Europe and South Africa. We selected either complete adaptation plans or substantive chapters in the combined adaptation and mitigations plans. We selected only plans that provided concrete recommendations with some spatial repercussions. Using these criteria, we found 11 plans that could be included in the analysis—see the Appendix for a full list.

2 Adaptation Policies Selected by Cities in the Sample

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Table 1 depicts the various adaptation policies that cities are choosing.¹ Water management is the item receiving the most attention. Given that climate change will lead to an intensification of the hydrological cycle in most parts of the world, it is appropriate that water is the top policy concern when it comes to the physical design of our cities. Attention to water can particularly benefit the poor, as low-income households tend to be located in or near the flood zones and the poor tend to have less access to drinking water (Rosenzweig et al. 2011).

When it comes to the spatial character of the implementation choices, a majority of the policies cities are choosing utilize no new space at all, demonstrating that there is quite a bit a city can do to encourage adaptation without requiring dedication of scarce urban space. Actions such as encouraging light-coloured roofs, recommending plant species that will be hardy in emerging climate conditions, and revising engineering and building standards do not directly impact people's property and development rights. Further, it appears that none of these require significant energy to operate and tend to actually encourage more energy-efficient buildings (e.g. green roofs, LEEDs certification). These adaptive actions are either neutral or pro-mitigation.

The approximately 40% of policies that will require the dedication of urban land are more complicated to evaluate for pro- or anti-mitigation effects. With the exception of urban greening, each of these could be used to create or enlarge

Table 1 Policies selected by cities by frequency and spatial implication

Revised engineering standards (e.g., larger storm pipes)	10	t1.1
Revised design guidelines (LEEDs, building code, etc.)	9	t1.2
Green roofs and walls	7	t1.3
Permeable/porous pavement	6	t1.4
Revised planting lists	4	t1.5
Public space design for cooling	4	t1.6
Design for flooding or seawall improvements	4	t1.7
Albedo lightening	4	t1.8
<i>Space neutral actions</i>	48	t1.9
On-site stormwater treatment	8	t1.10
Zoning changes to limit development in vulnerable areas	7	t1.11
Expansion of coastal setbacks, natural floodplains and waterways	6	t1.12
Significant new urban greening/forests	6	t1.13
Habitat corridors to preserve migration routes	3	t1.14
Increased urban agriculture and food security	3	t1.15
<i>Space-absorbing actions</i>	33	t1.16

n = 11 plans, 81 policies, see [Appendix](#) for a list of plans and cities

¹More detail on some of these plans and our analysis is available in Hamin and Gurrán (2008) and Hamin (2011).

growth boundaries, encouraging development to occur in existing urban areas or in new but moderately dense nodes that are easy to serve with public transit. Coastal retreat, for instance, can be used to preserve public access to beaches and to preserve habitat, while moving development to denser inland neighbourhoods. In Australia, the quarantining of development rights in low-lying coastal foreshores has become a major concern for homeowners and local authorities, operating within an uncertain regulatory framework (House of Representatives 2009).

The policies could also just push development further out into previously undeveloped areas, encouraging sprawl in the name of adaptation. Urban greening in particular is one of the most challenging policies. Trees are perhaps the single best way to provide air cleansing, urban cooling, and storm water management and may be placed into already-paved areas, creating a huge adaptive win while also sequestering carbon (Currie and Bass 2008). Trees also improve the liveability and desirability of urban areas, and therefore make dense neighbourhoods more popular. But aggressive, large-scale urban greening and urban agriculture initiatives may instead reduce overall densities and create sprawl. The adaptation plans are not specific enough to be able to judge which way these will go.

Despite the challenges mentioned above, there is one particular urban retrofit policy that holds promise in reconciling the need for urban greening with the need to maintain urban densities. In urban retrofit areas, land can be transitioned from automobile-related uses to adaptive uses (Felsen and Dunn 2008). This is already underway in some cities. New York City, which exemplifies competition over urban space, has moved land use from roadway to ecoway. Broadway, one of Manhattan's main roads, has become narrower and greener as two entire lanes have become bicycle lanes and protective seating/infiltration land (Neuman 2008). Chicago, in another example, is renovating its system of urban alleys to become green alleys (City of Chicago n.d.). The plan for North Vancouver calls for every third street to be a green street, supporting on-site storm water management and pedestrian and bike mobility instead of automobile travel (Condon 2010). Less roadway for cars and more for the alternatives—buses, bikes, pedestrians—makes alternative travel more likely (Newman and Kenworthy 1989) and thereby should reduce per capita greenhouse gas emissions. If the 'green streets' are designed with minimal impermeable pavement, more trees, more on-site storm water management potential, we may get cooler, safer, better adapted cities, without making them more spatially dispersed. We gain the benefits of urban greening and create more adapted cities, without sacrificing reductions in greenhouse gas emissions.

These actions seem likely to be more effective when done as part of a systemic, regional approach. An emerging way to frame and characterize this is as green infrastructure (GI)—multipurpose, regionally connected open space that provides some of the same services as traditional 'grey' urban infrastructure, but in a way that is more similar to natural hydrological processes (Gill et al. 2007). Examples of GI include substituting on-site storm water treatments for piped systems, using trees for cooling and air purification rather than air conditioners, etc. This research finds that indeed, cities are choosing green infrastructure for climate adaptation (see Table 2).

Table 2 Green infrastructure

	On-site storm water	Permeable/porous pavement	Significant new urban greening/forests	Restoration/expansion of natural floodplains and other waterways	Habitat corridors to preserve migration routes	Increase urban agriculture and food security	Green roofs and walls
t2.1							
t2.3							
t2.2							
	Non-GI responses						
Less clearly, but maybe GI							
t3.1	Zoning changes to limit building in vulnerable area	Revised engineering standards (e.g. onsite storm water)	Revised design guidelines (require green roofs etc.)	Design for flooding or seawall improvements	Revised engineering standards (e.g. larger storm pipes)	Revised design guidelines (building code, etc.)	Albedo lightening
t3.2							
t3.3							

3 Summary and Conclusions

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This is exploratory research and comes with a number of limitations. Our study 129
 focused on plans that are web-available in English; it would be helpful to include 130
 a more global sample in the next phase of our research. This research reports what 131
 policies cities propose, but not what they are actually implementing or how effective 132
 those steps are—this is also essential knowledge to improve adaptation practice as 133
 it develops. Finally, there is a great need for research to help cities determine how 134
 to optimize the adaptive capacity of green infrastructure and other policies listed 135
 here for achieving adaptive capacity without interfering with mitigation. Clearly 136
 this work is only the beginning. 137

As we noted at the start, theorists have worried that given a need to prioritize, 138
 cities may choose adaptation actions even if they conflict with mitigation. Our 139
 research suggests that at least in our sample, this is not occurring, and in fact, 140
 cities are prioritizing adaptive actions that are unlikely to interfere with mitigation 141
 or may even support it. As the analysis points out, there is a range of options from 142
 which cities can choose, and many of the preferred policies do not require new 143
 urban space for implementation. We also found that many city policies fit into 144
 the general framework of green infrastructure, suggesting that developing more 145
 regional, systematic approaches to adaptation will be possible. 146

When cities need to adopt policies that require dedication of urban space, the 147
 analysis suggests that there are four approaches to finding space for adaptation, 148
 arranged from likely easier to implement to the more difficult actions: 149

1. Upgrade existing frontages, sidewalk areas, and parks and backyards that have 150
 little tree canopy or storm water infiltration with better planting. 151
2. Insert larger areas of urban green with care, to encourage nodal and corridor 152
 development between dense and transport-efficient neighbourhoods. 153
3. Repurpose selected roadways to ecolanes designed to make bicycle and pedes- 154
 trian movement easy, treat storm water, and cool the urban environment through 155
 plantings. 156
4. Extend coastal foreshores or existing floodways to accommodate settlement 157
 retreat or relocation and more nuanced approaches to designing for water, 158
 transferring development to more appropriate locations. 159

Each of these shows ways to increase an urban area's adaptive capacity without 160
 interfering with mitigation. Taking this one step further, it is apparent that the 161
 list of actions that cities propose for adaptation—urban greening, better storm 162
 water management, cooling stations, and coastal open space—are actions that make 163
 the cities themselves more attractive, more desirable, more liveable. Better cities 164
 mean fewer residents opting for the suburbs. More urban residents mean lower per 165
 capita GHGs. Adaptation brings liveability, brings urban growth, and brings GHG 166
 reductions per capita. Adaptation can not only be reconciled with mitigation, but if 167
 done well, it is mitigation. 168

Appendix: Plans Reviewed

City/region	Year of plan	Pop. density per km	Plan name	Author
t4.1 Byron and Tweed Shire Councils	2009	64	Climate Change Adaptation Action Plan: Assessing Climate Change Risk and Adaptation Strategy Development in the NSW Northern Rivers Region	GHD Consultants
t4.2 Cairns Regional Council	2010	251	Positive Change—Climate Change Risks and Opportunities for the Cairns Region; Climate Change Adaptation Action Plan	AECOM Consultants
t4.3 Chicago	2008	4447	Chicago Climate Action Plan (esp. Chapter 6)	Chicago Climate Task Force
t4.4 Ethekwini/Durban	2009	3,919	Climate Change Municipal Adaptation Plan: Health and Water	ERM Consultants
t4.5 Halifax, NS ^a	2007	68	Climatesmart: Climate Change Risk Management Strategy for Halifax Regional Municipality	Halifax Regional Municipality
t4.6 Keene, NH	2007	240	Adapting to Climate Change: Planning a Resilient Community	City of Keene and ICLEI
t4.7 King County, WA	2007	315	King County Climate Plan (esp. Chapter 6B)	City Hall, King County, Washington
t4.8 London	2010	4,807	The Draft Climate Change Adaptation Strategy for London, Public Consultation Draft	Mayor of London
t4.9 Melbourne	2009	1,566	City of Melbourne Climate Change Adaptation Strategy	City of Melbourne
t4.10 Rotterdam	2008–2010	2,850	Rotterdam Climate Proof: The Rotterdam Challenge on Water and Climate Adaptation and the follow up 2010 Programme	Rotterdam
t4.11 Toronto	2008	3,972	Ahead of the Storm ... Preparing Toronto for Climate Change	Toronto Environment Office

^aThe Halifax plan is a set of options for treating particular hazards, but these options have been run through a fairly rigorous multistage screening process already and so are similar in specificity and likelihood of implementation to policies listed in other plans

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