How are local governments planning for heat mitigation? A study of Metro Vancouver and Fraser Valley jurisdictions

by

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Abstract

Heat is a growing concern for Canada's increasingly urbanized populations, particularly for local governments, whose regulation and control of land and development impact the magnitude of the Urban Heat Island effect. This study is a document review of plans and policies from municipalities and regional districts in the south coast of mainland British Columbia, a region historically unfamiliar with extreme heat. The analysis explores heat mitigation actions: how they can be categorized, where they can be found, and what policy approaches are used by local governments. Our overall results showed a focus on specific heat mitigation interventions: urban greening, along with others at site-scales. Heat-mitigating interventions were not uniformly and explicitly signalled within and across governments. Effective heat governance at the local level requires regional coordination and alignment with higher levels of government, and opening policy windows reinforce the opportunity to create equitable heat outcomes for the entire region.

Keywords: Urban Governance; Heat Mitigation; Climate Action; Municipal and Regional Planning; British Columbia

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Table of Contents

List of Tables

List of Figures

Chapter 1.

Introduction

Heat is a present and growing danger for cities around the world. This is based on two trends: 1) the growing and increasingly urbanized global population (UN DESA, 2018), and 2) the effects of climate change, which spur increased temperatures, frequencies, length, and intensity of extreme heat events (IPCC, 2021). Definitions of extreme heat vary and its effect relative, but relevant jurisdictions have defined it as elevated daytime temperatures of over 31-33°C for two to three days (City of Vancouver, 2023; Gouvernement du Québec, 2023). The impacts of elevated temperatures are compounded in cities (McCarthy et al., 2010; Wouters et al., 2017) because of the urban heat island (UHI) effect (Oke, 1973; Stone & Rodgers, 2001). The UHI effect is the absorption and re-emission of heat within a built environment, disproportionally increasing temperatures compared to surrounding rural areas (Health Canada, 2009; US EPA, 2008). Average urban temperatures are approximately 3°C warmer than non-urban areas; within an urban environment, the UHI effect differs because of built form, climate, and other local characteristics (Hibbard et al., 2017).

The combination of climate change impacts and an increasing urban population means that more and more people are subject to potential extreme heat exposure every year. Thus, heat in cities is recognized as a threat to public health globally (Iungman et al., 2023; Tong et al., 2021; Tuholske et al., 2021). In response, formal municipal offices and efforts by governmental bodies and non-governmental organizations have been initiated to address the impacts of heat (Keith et al., 2021; Turner et al., 2022). The multifaceted nature of this threat requires coordination between governments, community and regional partners, and academics. The often localized aspects of the UHI effect and its influence on extreme heat mean that mitigating the effects of heat within cities is a challenge suited for municipal and regional governments. Municipal and regional planning offices, through their impacts on land use and design, urban greening, and overall development and built form, are well situated to take action on heat mitigation.

Future heat events in British Columbia (BC) prompt the need to not only respond to extreme heat, but also prepare for and mitigate its effects (Metro Vancouver, 2016). We

ask the question: How are Metro Vancouver and Fraser Valley jurisdictions preparing for extreme heat? In June 2021, BC, Washington, and Oregon experienced a heat dome event (White et al., 2023). BC faced temperatures at least 10°C above seasonal norms, causing over 600 excess deaths related to heat from June 27 to July 2, 2021 – the deadliest weather related event in Canadian history (Henderson et al., 2022). BC experienced a higher mortality than Washington and Oregon, two jurisdictions with comparable or higher populations (St. Denis, 2022). Preliminary public health analysis suggests that mortality outcome differences are linked to the UHI effect, population vulnerabilities, and urban greening (Henderson et al., 2022). Although analyses called the heat dome a 1 in 1000 year event (Philip et al., 2022; White et al., 2023), the increasing frequency, intensity, and seasonality of extreme heat events due to climate change (IPCC, 2021) means this region needs to prepare for extreme heat.

To answer the question of how Metro Vancouver and Fraser Valley jurisdictions are preparing for extreme heat, plans and policies were collected based on a heat planning analysis framework supported by the American Planning Association (Keith & Meerow, 2022). This framework, which is adapted for the BC context, helps answer two secondary questions: 1) How is heat mitigation categorized within jurisdictions?, and 2) what are jurisdictions doing to plan for heat mitigation? The initial plans and policies were supplemented by additional documents referencing the terms “heat” or “cool”. All collected documents were screened manually based on additional keyword text searches to determine if they are explicitly planning for heat. Documents with no search results were removed, but each search result was subject to three rounds of coding: categories, themes, and sub-themes. The analysis and discussion relied on BC’s planning context, urban governance, and plan analysis literature. The paper ends with summary and future directions for research.

While extreme heat is increasingly recognized as a climate threat to be managed locally (Nordgren et al., 2016; Turner et al., 2022), research focusing specifically on municipal heat mitigation is an emerging field (Elgendawy et al., 2020; Keith et al., 2019; Turner et al., 2022). As North American research has historically focused on regions with higher frequencies of heat events (Meerow & Keith, 2022 - see for example Gabbe et al., 2021; Turner et al., 2022), this research may be able to provide a useful study of heat planning for historically temperate climates.

Chapter 2.

Literature Review

This paper draws from literature at the intersection of climate hazard planning and urban heat mitigation, focusing on heat governance within cities. Recent trends in the literature are summarized and the role of local governments in heat mitigation strategies highlighted, with an eye towards the gaps and opportunities in the field. This review ends by making a case for why this type of research is needed within BC.

2.1. The Role of Local Government

Local governments are vital in addressing climate hazards in cities, within which urban planners play a critical role (Bush & Doyon, 2019). Planners must address the challenges posed by climate change in order to fulfill what planning associations state as their goals of bettering and securing the well-being of communities (American Planning Association, n.d.; Canadian Institute of Planners, n.d.; Nordgren et al., 2016). Unfortunately, municipal climate action often lacks coherence and consistent support from local governments, which speaks to the fragmentation of these plans and strategies (Grafakos et al., 2019), as well as the needs and resources that these types of initiatives require (Nordgren et al., 2016). A holistic understanding of how jurisdictions are preparing for climate hazards requires an understanding of how individual plans and policies express different strategies that integrate to form what literature calls “network of plans” (Berke et al., 2015; Malecha et al., 2019). Networks of plans are the collection of plans that have additive and interconnecting goals and mechanisms to guide urban development, ranging in scale from the comprehensive level to smaller, more discipline specific plans (Woodruff et al., 2022).

The concept of mainstreaming: centralizing climate action across departments, sectors, and regular budgeting processes/operations (Environment and Climate Change Canada, 2023) has arisen within urban climate governance (Uittenbroek et al., 2013; Wamsler, 2015). Mainstreaming can achieve efficient and holistic responses to growing climate crises (Birchall et al., 2021; Uittenbroek et al., 2013) and can further help multiple levels of governance achieve climate goals (Dale et al., 2020; Runhaar et al., 2018; Wamsler

et al., 2020). In dealing with extreme heat, cities worldwide have appointed heat management executives and offices (Adrienne Arsht-Rockefeller Foundation Resilience Center, 2023; Keith et al., 2021). However, for most local governments, broad climate hazards such as heat often do not have a specific “owner” or office, which creates a large barrier to action (Keith et al., 2019). Instead, actions towards heat are isolated into individual offices, separated from potentially beneficial coordinated actions and unified strategies (Keith et al., 2023; Meerow & Keith, 2022). Research addressing heat within cities has also focused on mechanisms and solutions for heat, with only a small proportion addressing policy solutions, particularly in the planning sphere (Degirmenci et al., 2021; Keith et al., 2019).

2.2. Responding to Heat

Responding to extreme heat is historically outside the scope of municipal planning, due to a primary association with public health responses and lack of specific resourcing (Gabbe et al., 2021; Keith et al., 2019). The lack of signals highlighting the importance of heat has reduced municipal support as well as legal and regulatory backing for more comprehensive strategies (Keith et al., 2019). Heat response strategies can be divided into two approaches: heat mitigation, and heat management/heatwave response (Gabbe et al., 2021; Meerow & Keith, 2022). Heat mitigation aims to reduce the UHI effect, and can be classified as longer-term passive strategies that modify urban form and landscapes to decrease heat within cities (Gabbe et al., 2021; Meerow & Keith, 2022). Heat management is active short-term actions initiated during heat events, including public health measures such as cooling centres and community outreach, emergency responses, and energy grid management (Gabbe et al., 2021; Meerow & Keith, 2022). While we acknowledge that a full response to heatwaves involves multiple levels of governance (Keith & Meerow, 2022), we choose to focus our research on heat mitigation policies exhibited through municipal and regional planning.

Heat mitigation in urban areas primarily aims to address the UHI effect by reducing solar radiation absorption, increasing airflow, and promoting cooling of the built environment (Karimi et al., 2022). The bulk of UHI studies historically focused on urban greening’s potential to mitigate heat, because of relative ease of implementation and awareness (Karimi et al., 2022; Keith et al., 2019), although urban greening strategies can take many years to fully realize benefits (Beugin et al., 2023). Complementary strategies

based on built form and how land is used can also alleviate UHI (Lai et al., 2019), but may require complex design and greater public support (Karimi et al., 2022). Urban planners are well positioned to facilitate heat mitigation given the profession's role in coordinating and regulating urban design, built form, and land use, which can improve thermal comfort for urban populations (Lai et al., 2019). Keith and Meerow (2022) have categorized these mitigation strategies into four main categories: urban greening, urban design, land use, and waste heat. We focus on the first three categories of urban greening, urban design, and land use, as these relate to long term development pathways (Keith & Meerow, 2022) that fall more strictly within the realm of planning departments in BC.

Urban greening is the implementation of increased vegetation such as parks, urban forestry and trees, green (stormwater) infrastructure, green roofs, and more (Meerow & Keith, 2022). Urban greening reduces air and surface temperatures, but specific effects depend on the ecological and physical traits of vegetation (Wong et al., 2021). These strategies are also linked to co-benefits from other ecosystem services (Cuthbert et al., 2022; Elmqvist et al., 2016). Urban design is built-form features that interact with the UHI effect, such as building technology, geometry and orientation, other shade structures, and "cool" surfaces that reduce absorption of solar radiation (Jamei et al., 2020; Middel et al., 2021; Rempel et al., 2022). Lastly, land use is the allocation of specific activities and uses such as industrial, commercial, greenspaces, and residential areas. Zoning and separation of different land uses can create drastically different outcomes across neighbourhoods (Gabbe et al., 2022; Ibsen et al., 2022).

Despite the increase in technical literature on the UHI, this knowledge does not appear to have been translated into actionable policy and the physical realm as compared with other climate hazards. One study of planning programs and policies across eighteen cities from the 100 Resilient Cities initiative, a selection of cities oriented towards innovation in resilience, found gaps within most metropolitan-scale plans for addressing heat (Elgendawy et al., 2020). Equity considerations are also missing from heat mitigation policy design (Grabowski et al., 2023), despite growing recognition of the impacts from recognitional, distributional, and procedural inequities (Keith et al., 2023; Meerow et al., 2019). Equity in hazard planning relates to intersecting identities and population vulnerabilities (recognitional), spatial and resource access vulnerabilities (distribution), as well as representation in participation and planning interests

(procedural) (Meerow et al., 2019). The missing pieces reflect a lack of knowledge mobilization, and call for literature that combines empirical technical analyses of UHI with policy oriented planning research (Degirmenci et al., 2021).

Lastly, the American Planning Association has noted the importance in preparing cities for heat, supporting a broad-scope evaluation framework for networks of plans spanning different categories of heat mitigation (Keith et al., 2022; Keith & Meerow, 2022). A recent comparative study of municipal climate adaptation planning within the fifty largest American cities revealed an increased recognition of heat as a local hazard, although overall level of preparation appears to be lacking (Turner et al., 2022). A more focused evaluation within California found uneven treatment across its biggest cities, and a greater disparity in heat acknowledgements and policies across the entire state's jurisdiction (Gabbe et al., 2021). Gaps between technical research and practice, as well as gaps between jurisdictions, show the need for studies that can provide snapshots of how local jurisdictions are preparing for heat. Analysing the range of mitigation and planning mechanisms within a broad planning framework (category) analysis and a finer-grained (thematic) analysis can provide both an impetus for heat mitigation planning improvements and an argument for better coordinated action within and across jurisdictions.

2.3. Why British Columbia

Public health officials have called for stronger policies to address the UHI within Canadian cities, in part because of the projected disproportionate effects of climate change on the Canadian population (Health Canada, 2020). This is an additional problem for BC, as its historically milder temperatures compared to the rest of Canada, may have lowered public perception of extreme heat risk (Lubik et al., 2017). Nonetheless, the Metro Vancouver Regional District has published projections suggesting that by 2050, Vancouver's climate will experience increased temperatures similar to current day San Diego, California (Metro Vancouver, 2016). An analysis of select municipal policies by the BC Centre for Disease Control (a public health agency) found a lack of long-term heat mitigation strategies targeting the built environment (Lubik et al., 2017). Unfortunately, the effects of the 2021 Western North America Heat Dome revealed these planning and policy gaps, which became apparent in the range of

inequitable spatial and demographic outcomes across jurisdictions (Henderson et al., 2022).

The 2021 Heat Dome resulted in widespread human and non-human impacts (White et al., 2023). Urgent calls for improved governance regarding heat management and heat mitigation strategies have been made for this geographic region (Henderson et al., 2022; Kearl & Vogel, 2023). However, for one prong of heat mitigation, urban greenery, basic metrics have plateaued or decreased in Canadian cities, including most Metro Vancouver municipalities (Griffiths, 2022; Lantz et al., 2021). Its equitable distribution is another key concern (Labbe, 2021; Whittingham et al., 2022). In line with many jurisdictions around North America (Turner et al., 2022), annual climate surveys (Local Government Climate Action Program surveys) from municipalities within the Metro Vancouver and Fraser Valley regional districts cited extreme heat and heat stress as a significant climate hazard, a sign of awareness and prioritization of local government action. An analysis of regional and municipal plans and policies across each jurisdiction's network of plans can provide foundations for improved heat governance now and into the future.

Chapter 3.

Methods

To answer the question of how municipal and regional governments are planning for extreme heat, this research evaluates how jurisdictions' network of plans (Berke et al., 2015; Malecha et al., 2019) address this hazard. This is done by adopting the broad-scope plan evaluation framework supported by the American Planning Association's guidebook for urban heat planning (Keith et al., 2022; Keith & Meerow, 2022) as a foundation for document collection (see Table 1 below). This research differs from the approach found in Keith and Meerow's (2022) work in two ways, the use of the collected documents, and the focus on mitigation categories of urban greening, urban design, and land use, with the addition of strategic jurisdiction-wide plans such as comprehensive plans (in BC, Official Community Plans) (see Table 1). In addition to categorizing individual policies for each jurisdiction, a thematic analysis was performed to allow for analysis of the subjects, targets, and actions of each strategy. These themes were further subdivided into sub-themes, some derived from planning literature (Hodge et al., 2021; Keith & Meerow, 2022) and others derived from inductive analysis grounded by the local context of BC.

Table 1. Heat Mitigation Planning Matrix (adopted from Keith & Meerow, 2022)

Heat Mitigation Categories				
	Urban Greening	Urban Design	Land Use	Strategic Plans
Definitions	The network of planned and unplanned green spaces in an urban area across both the public and private realms	Development scale influences on microclimates and the UHI effect. Includes building efficiency through weatherization and building materials	The mix of urban development patterns and natural areas across a jurisdiction	Jurisdiction-level plans targeting a specific issue, or calls for future planning centred around particular issues
Document Collection				
Plans and Policies	Description			

Official Community Plans	Jurisdiction-wide comprehensive plans required by legislation in BC (except for the municipality of Vancouver)
Regional Growth Strategies	Comprehensive plans for regional districts, approved by jurisdictions within each regional district
Area Plans	Specific named areas within a jurisdiction selected for specialized planning processes and approved plans
Climate Plans	Plans to address climate change, which can include heat mitigation strategies/policies, or include policies with heat mitigation co-benefits
Parks, Greenspace, and Recreation Plans	Plans managing networks of planned and unplanned vegetated, natural, open spaces, managed as an integrated systems across public and private property
Urban Forest, Tree Management Strategies	Plans managing the tree population in urban settings (encompassing public and private realms)
Green Infrastructure	Plans addressing stormwater management using greenery, with explicit mention of co-benefits including heat mitigation
Zoning and Land Use	Plans, policies, and bylaws addressing the allocating of specific uses to different areas of land within a jurisdiction
Building Bylaw	Bylaws and policies adding to or adopting provincial bylaws for building standards and codes
Green Building Strategies	Policies and plans addressing improvements in building technology, efficiency
Housing Strategies	Policies addressing building standards/codes/technology/efficiency/comfort as it relates to housing and dwellings
Urban Design Guidelines	Related to site level orientation/layout/massing, and other design variables
Annual Reports and Surveys	A jurisdiction's annual reporting or publicly available summary of actions and plans

3.1. Document Collection

In researching how local governments explicitly plan for heat, the regional districts of Metro Vancouver and Fraser Valley were selected due to their geographic and climatic contiguity, as well as a mix of urban, suburban, and rural contexts (see Figure 1). Within these two regional districts, there are twenty-seven municipalities; other jurisdictions

such as electoral areas and treaty first nations were excluded for ease of comparison. In BC, municipalities derive powers from provincial legislation[1] with the exception of Vancouver, which has special, charter legislative status[2] (Hodge et al., 2021). Municipalities are responsible for providing local services and governance, and control land use and development (Union of BC Municipalities, 2022). Regional districts are also enabled by the province, but their powers are reliant on their constituent municipalities and unincorporated areas (Union of BC Municipalities, 2022). Regional districts can plan for and provide infrastructure, coordination, and municipal-like services (Bonnett & Birchall, 2023; Wolman, 2019). Plans and policies were collected from 27 municipalities plus the 2 regional districts, for a total of 29 jurisdictions (see Table 2).

Table 2. Subject Jurisdictions

Jurisdiction	**Regional District**	**Population (Canadian Census, 2021 (Statistics Canada, 2022))**	**Area (km^2)**
Fraser Valley Regional District		339,701 (2021 estimate (Ministry of Citizens' Services, 2023))	
Abbotsford	Fraser Valley	153,524	375.33
Chilliwack	Fraser Valley	93,203	261.34
Harrison Hot Springs	Fraser Valley	1,905	5.49
Hope	Fraser Valley	6,686	40.87
Kent	Fraser Valley	6,300	168.59
Mission	Fraser Valley	41,519	226.98
Metro Vancouver Regional District		2,764,939 (2021 estimate (Ministry of Citizens' Services, 2023))	
Anmore	Metro Vancouver	2,356	27.53

[1] Primary legislation includes the *Local Government Act*, RSBC 2015, c 1 and the *Community Charter*, SBC 2003, c 26

[2] *Vancouver Charter*, SBC 1953, c 55

Jurisdiction	Regional District	Population (Canadian Census, 2021 (Statistics Canada, 2022))	Area (km^2)
Belcarra	Metro Vancouver	687	5.5
Bowen Island	Metro Vancouver	4,256	50.12
Burnaby	Metro Vancouver	249,125	90.57
Coquitlam	Metro Vancouver	148,625	122.15
City of North Vancouver	Metro Vancouver	58,120	11.83
Delta	Metro Vancouver	108,455	179.66
District of North Vancouver	Metro Vancouver	88,168	160.66
Langley City	Metro Vancouver	28,963	10.18
Township of Langley	Metro Vancouver	132,603	307.22
Lions Bay	Metro Vancouver	1,390	2.53
Maple Ridge	Metro Vancouver	90,990	267.82
New Westminster	Metro Vancouver	78,916	15.62
Pitt Meadows	Metro Vancouver	19,146	86.34
Port Coquitlam	Metro Vancouver	61,498	29.16
Port Moody	Metro Vancouver	33,535	25.85
Richmond	Metro Vancouver	209,937	128.87
Surrey	Metro Vancouver	568,322	316.11
Vancouver	Metro Vancouver	662,248	115.18
West Vancouver	Metro Vancouver	44,122	87.18
White Rock	Metro Vancouver	21,939	5.17

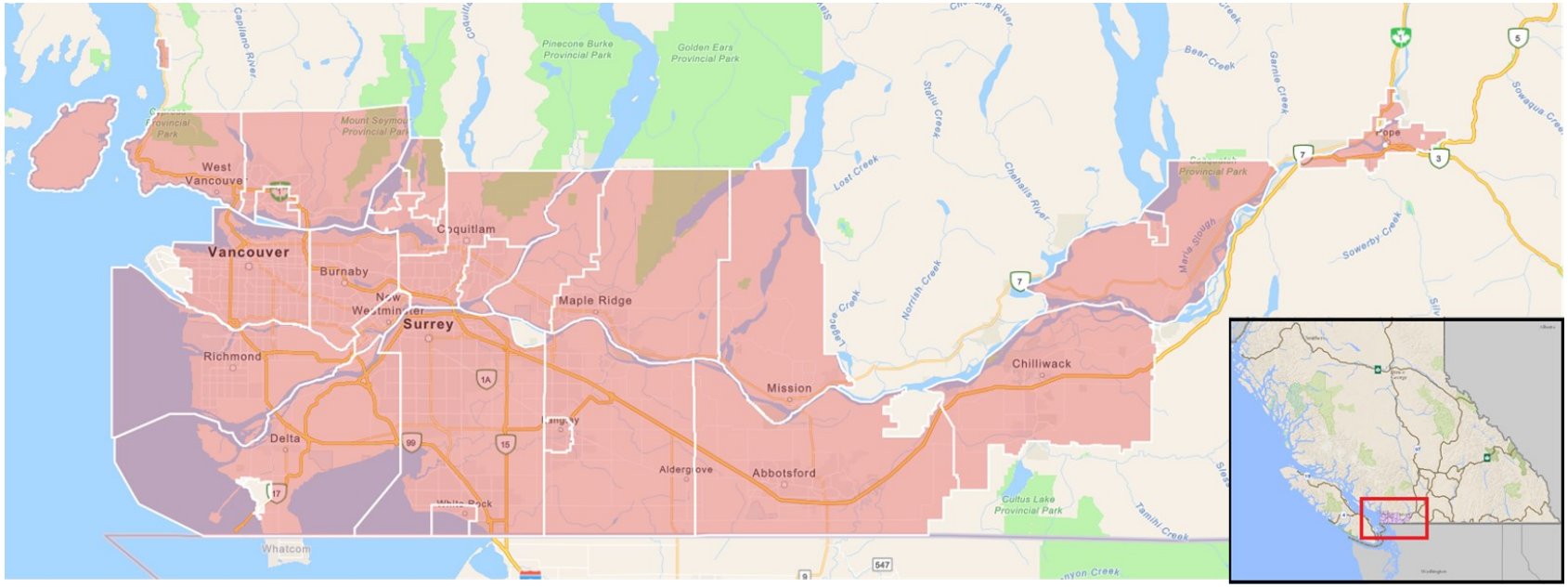

Figure 1. Subject Jurisdictions of the Metro Vancouver and Fraser Valley Regional Districts (Government of British Columbia, 2023a)

Plans and policies were collected for the 29 jurisdictions based on the categories of heat mitigation: urban greening, urban design, land use, and strategic plans. Further plans were included within the document review using a keyword search on each jurisdiction's website for plans and policies incorporating the terms "heat" and/or "cool". To maintain project scope, only completed or approved publicly available documents were collected (see Table 1; note that council minutes are not included). The collection time period was May 1, 2023 to June 5, 2023, providing a snapshot in time of local government planning. Plans needed to be considered current at time of collection; in other words, plans and policies that were determined to be explicitly superseded or not in effect due to newer plans were not collected. This screening process also selected the most updated or recent version of documents as a reflection of active status within the jurisdiction. A total of 650 documents were collected for review. These documents range in publication dates from the early 2000s to 2023, although a few comprehensive plans (Official Community Plans and Area Plans) are updates of documents from the 1970s/80s/90s (e.g., the City of Burnaby's Official Community Plan was adopted in 1998, and most recently updated in 2014).

3.2. Document Screening and Analysis

Further text searches were conducted within each document for any of the following terms: heat, urban heat island, UHI, temperature, weather, season, cool, shade, hot, air, solar, thermal, passive. Each search result was reviewed to determine if it was specifically signalling or responding to the dangers of extreme heat. Out of the 650 collected, documents with no signals of extreme heat as a danger or explicit current or future responses to heat were removed from the scope, leaving a remainder of 243 documents to be analyzed (see Appendix A).

Next, the 243 documents were uploaded into NVIVO, a qualitative analysis software for review and coding. The search terms above were repeated for each file, and each of the research results were coded at two levels: First, whether or not the dangers of heat were merely signalled/mentioned, or if actions/responses were described. Second, these results were coded into the four categories– urban greening, urban design, land use, and strategic plans. A second round of coding followed for thematic analysis into five broad themes to characterize the subjects, targets, and actions of each strategy. These larger themes – Buildings, Environmental, Planning Tools, Scale & Jurisdiction, and

Equity – were selected based on literature and knowledge of the BC planning context (Hodge et al., 2021; Keith et al., 2022; Keith & Meerow, 2022).

A third round of coding followed for sub-themes, which distinguished individual mechanisms and nuances within each of these themes. Sub-themes were derived both deductively (from planning literature and planning context), as well as inductively, across the range of strategies found. Regardless of their deductive or inductive origins, these sub-themes align with organizational branches of local government departments and North American development practices (Davidson & Dolnick, 2004; Hodge et al., 2021; Keith & Meerow, 2022; Moore & Doyon, 2023; Union of BC Municipalities, 2022). See Table 3 for the five themes and nested sub-themes, as well as Appendix B for the full coding key used. Because of the multi-faceted nature of these codes, it is possible for each search result/strategy to be coded across multiple themes and sub-themes.

Table 3. Themes and nested Sub-themes

Buildings	**Environmental**	**Planning Tools**	**Scale & Jurisdiction**	**Equity**
Active Cooling	Ecosystem Services	Objectives	City	Recognitional
Passive Cooling	Land Conservation	Goals	Area	Distributional
Efficiency	Parks & Greenspace	Guidelines	Subdivision	Procedural
Retrofit	Water Bodies	Development Permit Area (DPA)	Site	
Ventilation	Green Infrastructure	Zoning	Private	
Building Materials	Greening Buildings	Bylaws	Public	
Landscape Materials	Trees	Research & Engagement		
Shade Additions				
Shade Structure				
Massing				

Site Orientation				
Housing				

Chapter 4.

Results: Actions and Responses to Heat

4.1. Category Analysis

From 243 documents analyzed (Appendix A), 784 search results were coded. The first round of coding separated these into Mentions (17% of all results): extreme heat signalled as a danger without specific strategies, actions, or responses to be taken, or Action/Response (83%): current or future long-term actions, responses, strategies, and policies. Action/Response codes were further coded into four categories of local government action. This allows us to respond to the secondary research question, “How is heat mitigation categorized within jurisdictions?” From highest to lowest, the category codes were: Urban Greening (n=401), Urban Design (n=258), Strategic Plan (n=92), Land Use (n=81).

Tables 4 and 5 provide an overview of codes per jurisdiction. Cells are coloured to indicate if a specific jurisdiction is above average[3] for the particular code (green), below average (yellow), or did not have a code (red). While all jurisdictions had at least one coded category, the distribution of codes was uneven and often sparse. The municipalities with the smallest populations: Anmore, Belcarra, Bowen Island, Harrison, Hope, Kent, and Lions Bay, along with the Fraser Valley Regional District, had large gaps, lacking codes across three out of four categories. Conversely, jurisdictions with medium populations varied: for instance, New Westminster and Port Moody had high numbers of codes for all categories, compared to contemporaries such as Chilliwack, Delta, Port Coquitlam, and West Vancouver. The two most populous municipalities, Vancouver and Surrey, along with Metro Vancouver Regional District, have the largest number of Action/Response codes. Figure 2 presents the distribution of codes across the four categories of local government action from the top ten jurisdictions.

[3] Averages were calculated across each category/theme based on the number of codes per jurisdiction

Table 4. Summary of coded documents for each jurisdiction

	Abbotsford	Anmore	Belcarra	Bowen Island	Burnaby	Chilliwack	City of North Vancouver	Coquitlam	Delta	District of North Vancouver	Fraser Valley Regional District	Harrison	Hope	Kent	Langley (City)	Langley (Township)	Lions Bay	Maple Ridge	Metro Vancouver Regional District	Mission	New Westminster	Pitt Meadows	Port Coquitlam	Port Moody	Richmond	Surrey	Vancouver	West Vancouver	White Rock	**Total**
Number of Docs	10	2	2	4	11	7	6	10	6	8	4	2	1	1	7	12	2	7	21	5	16	3	4	10	8	20	43	6	5	**243**
Mentions	1	0	1	4	10	4	5	7	1	8	5	1	0	1	1	8	1	1	13	1	6	3	1	7	4	11	26	2	1	**134**
Action/ Response	19	2	1	1	23	6	21	22	6	29	4	1	1	1	13	42	1	20	63	12	59	5	4	32	23	61	161	10	7	**650**

Table 5. Summary of coded categories for each jurisdiction

	Abbotsford	Anmore	Belcarra	Bowen Island	Burnaby	Chilliwack	City of North Vancouver	Coquitlam	Delta	District of North Vancouver	Fraser Valley Regional District	Harrison	Hope	Kent	Langley (City)	Langley (Township)	Lions Bay	Maple Ridge	Metro Vancouver Regional District	Mission	New Westminster	Pitt Meadows	Port Coquitlam	Port Moody	Richmond	Surrey	Vancouver	West Vancouver	White Rock	**Total**
Urban Greening	17	0	0	1	11	3	16	18	4	17	0	0	1	0	9	29	0	14	32	8	39	4	3	15	14	37	98	7	4	**401**
Urban Design	6	2	1	1	9	1	9	8	1	10	0	1	0	1	7	14	0	4	35	4	24	1	1	14	9	27	63	2	3	**258**
Land Use	1	0	0	0	2	1	5	3	0	1	0	1	0	0	1	6	1	3	10	1	11	0	1	6	3	5	17	1	1	**81**
Strategic Plan	3	0	0	0	9	3	4	3	1	6	2	0	0	0	1	2	0	0	5	1	5	2	0	11	2	8	23	1	0	**92**
Totals	**27**	**2**	**1**	**2**	**31**	**8**	**34**	**32**	**6**	**34**	**2**	**2**	**1**	**1**	**18**	**51**	**1**	**21**	**82**	**14**	**79**	**7**	**5**	**46**	**28**	**77**	**201**	**11**	**8**	

Legend (colours)	Zero value for code	Below average values for code	Above average values for code

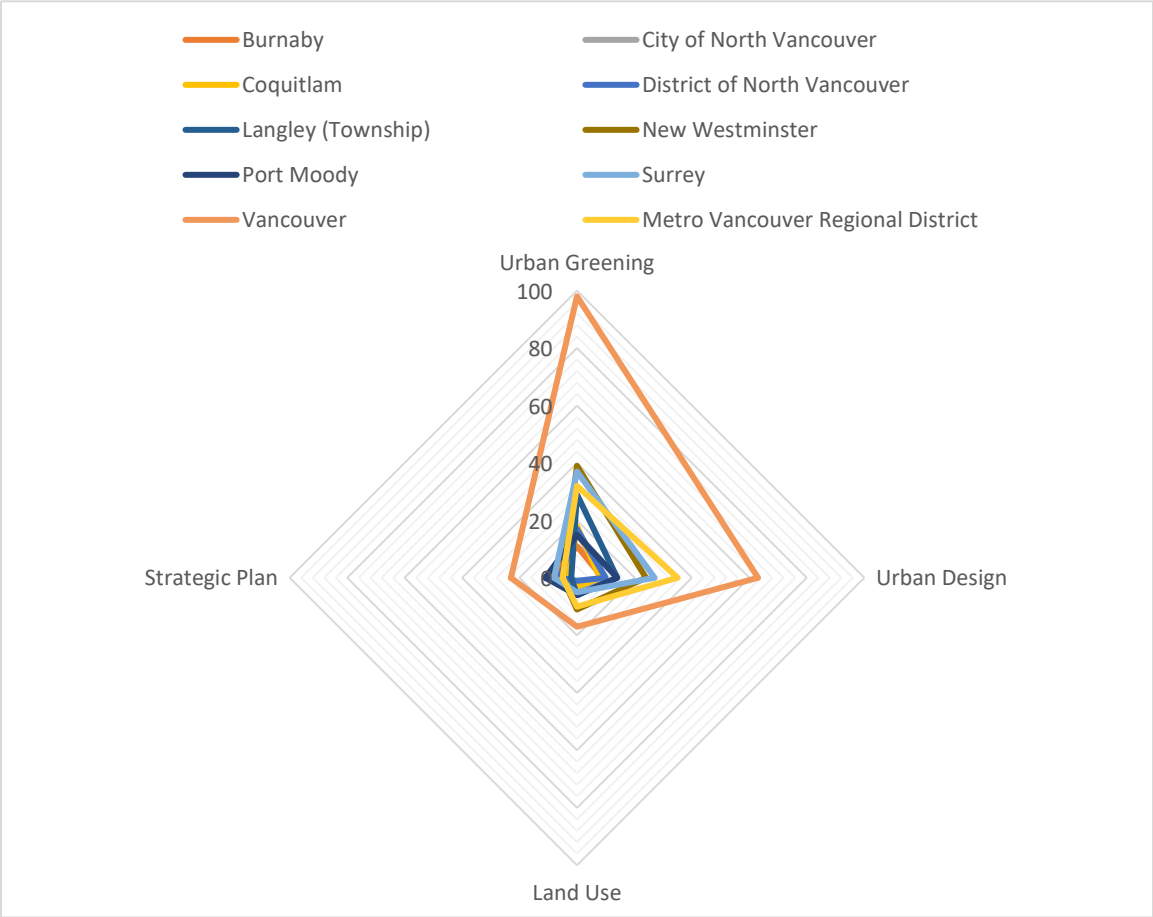

Figure 2. Counts of each Category code for the top 10 coded jurisdictions

Urban Greening was found across 23 jurisdictions in comprehensive plans - Official Community Plans (OCPs) and Regional Growth Strategies (RGS), area plans (e.g. Vancouver's Broadway Plan), and climate action/adaptation plans (see in particular Port Moody, Surrey, Vancouver). Some jurisdictions have more specific Urban Greening-oriented policies; these include urban forestry plans (e.g. Vancouver, Township of Langley), street tree policies (City of North Vancouver), and design guidelines for biodiversity areas (Surrey). Vancouver's Rain City Strategy was the top coded document; it focused on potential co-benefits of stormwater and rain infrastructure on heat mitigation. It states: "GRI [Green Rainwater Infrastructure] implementation has a role to play in helping Vancouver address the climate emergency and sequester carbon, cool our urban environment, help mitigate flooding…through distributed and resilient water management infrastructure, among other benefits" (2019: Page 8).

Urban Design category codes can be found across 26 jurisdictions. These include documents such as comprehensive plans (OCPs), area plans, climate plans (particularly in Port Moody), and extreme heat-focused plans (Burnaby, Port Moody, Surrey, Vancouver). A key subset of policies focused on building performance (Metro Vancouver) and specific building types, such as housing (Metro Vancouver), municipal facilities (Vancouver), and childcare facilities (Richmond). Metro Vancouver's Climate 2050 Roadmap: Buildings is the top coded document, with a prototypical strategy reading: "Overheating in buildings…poses particular risk to vulnerable populations and those without the means to cope. Reducing this risk requires a thoughtful combination of passive and mechanical cooling measures" (2021: Page 17). Increased consideration of heat has been codified in Vancouver's Building By-law[4], calling for buildings to be "designed, maintained and operated to adequately withstand ever changing climatic loads" (2019: Book I, Division B, Appendix C).

Land Use and Strategic Plan codes were found in more populous, Metro Vancouver jurisdictions. For Land Use codes, these were found in area plans, climate plans (City of North Vancouver, Metro Vancouver, Port Moody), and urban forestry strategies (Township of Langley and Vancouver). These strategies range from land conservation for urban greening, to development permit area regulations and guidelines. Metro Vancouver's Tree Regulation Toolkit calls for use of zoning bylaws to establish "rules for lot sizes, setbacks, building coverage, and how land can be used, which can in turn affect land cover and where tree canopy (and associated environmental benefits such as urban heat mitigation and stormwater interception) is distributed" (2021: Page 15). Port Moody's Climate Action Implementation Strategy states: "development permit areas are an effective tool to set guidelines and rules for new structures in certain areas of risk that ensure they can adapt to and recover from climate change impacts" (2022: Page 84).

Strategic Plan codes were primarily found within high-level environmental policies, climate action/adaptation plans (Vancouver, Burnaby, District of North Vancouver, Port Moody), and extreme weather specific plans (Surrey, Port Moody, Vancouver). A typical example is from Burnaby's Climate Action Framework, which "commits the City to develop, adopt and begin implementation of a comprehensive Urban Forest Strategy to

[4] Vancouver's Building By-law (2019, By-law No. 12511) occupies a unique role among BC municipalities, as the city is not subject to the province's building code.

increase and enhance the existing urban forest on public land for urban cooling…equity considerations to ensure that all neighbourhoods have cooling urban forests/parks" (2020: Page 18). Surrey's Urban Heat Ready Project Primer shows a second route for Strategic Plans with calls for further study and learning "to identify short-term and programmatic opportunities that meet the needs of those most vulnerable while also identifying practical long-term infrastructure and built environment solutions…following various urban heat projects across the region [and North America]" (2021: Page 13).

4.2. Thematic Analysis

A second round of coding was conducted to characterize subjects, targets, and actions (themes) linked to each Action/Response. This thematic coding allows for overlapping codes and hierarchical analysis through a third round of coding for sub-themes to explore specific focus areas, nuances, and mechanisms (Nowell et al., 2017). This allows us to tackle the secondary research question, "What are jurisdictions doing to plan for heat mitigation?" As with category codes, the least populous jurisdictions had the lowest theme codes. There were some jurisdictions that contained an above average amount of codes for all themes: Township of Langley, Metro Vancouver, New Westminster, Port Moody, Surrey, and Vancouver. Conversely, there were medium-population jurisdictions (Chilliwack, Delta, Port Coquitlam, West Vancouver) with limited theme codes. Planning Tools and Buildings themes were found in the most jurisdictions (27 each); Equity was the least coded theme, only substantively found in larger jurisdictions (Burnaby, Township of Langley, Metro Vancouver, New Westminster, Port Moody, Surrey, Vancouver) but missing for the least coded, lowest populated jurisdictions. Tables 6 and 7 include themes and sub-themes for all jurisdictions, with the same colours above (green, yellow, and red) also representing above average, below, and no codes respectively. Figure 3 presents the distribution of codes across the five themes from the top ten jurisdictions.

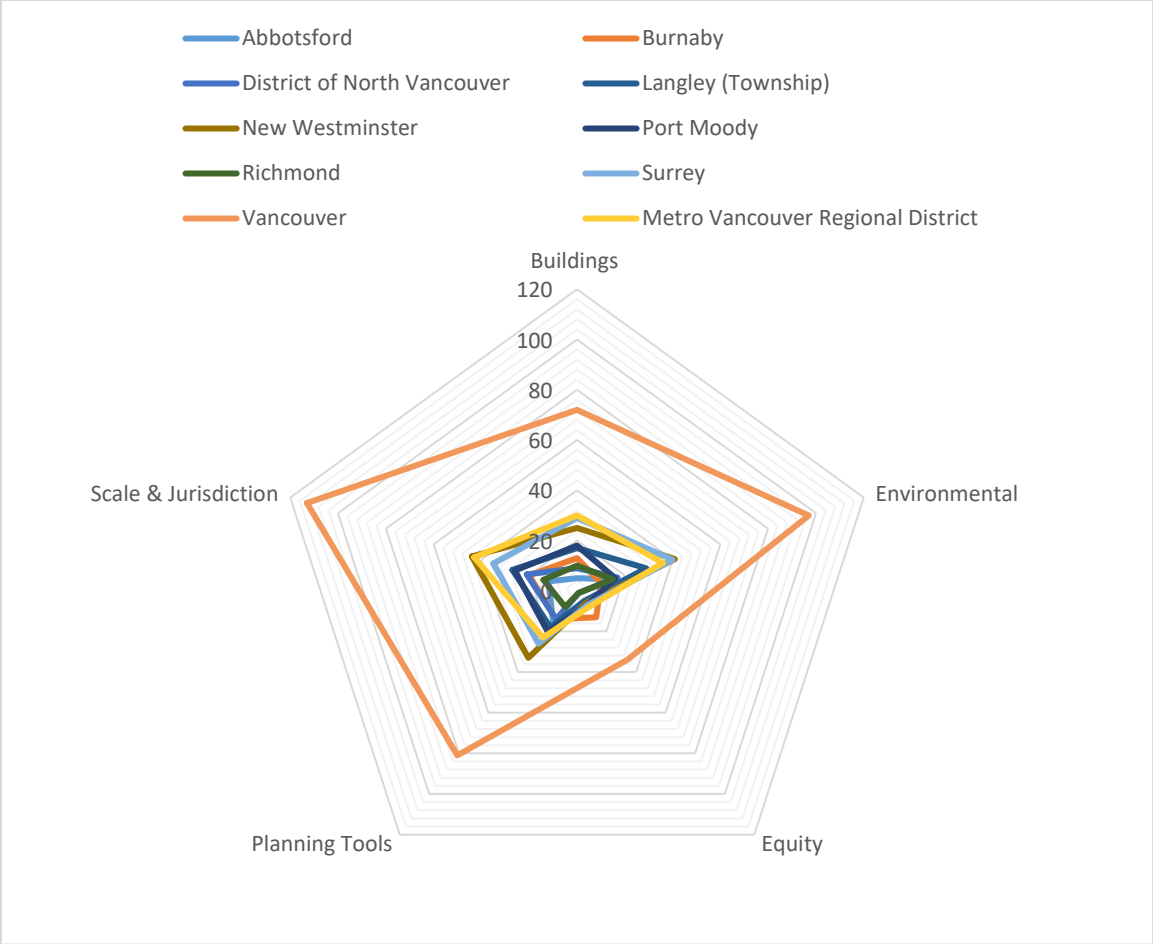

Figure 3. Counts of each Theme code for the top 10 coded jurisdictions

Table 6. Summary of coded themes for each jurisdiction

	Abbotsford	Anmore	Belcarra	Bowen Island	Burnaby	Chilliwack	City of North Vancouver	Coquitlam	Delta	District of North Vancouver	Fraser Valley Regional District	Harrison	Hope	Kent	Langley (City)	Langley (Township)	Lions Bay	Maple Ridge	Metro Vancouver Regional District	Mission	New Westminster	Pitt Meadows	Port Coquitlam	Port Moody	Richmond	Surrey	Vancouver	West Vancouver	White Rock	**Total**
Buildings	5	2	1	1	13	1	7	7	1	9	3	1	0	1	6	17	0	5	30	5	25	1	1	18	10	29	72	2	3	**276**
Environmental	15	0	0	1	10	4	16	17	5	17	0	1	1	0	9	29	1	14	36	7	41	4	3	16	15	40	97	7	4	**410**
Equity	0	0	0	0	13	0	1	2	0	1	0	0	0	0	0	5	0	2	8	0	6	0	0	7	1	7	34	2	0	**89**
Planning Tools	16	1	1	1	14	3	8	6	4	14	3	1	0	1	9	18	0	10	23	5	33	3	3	20	8	26	81	3	4	**319**
Scale & Jurisdiction	12	0	0	1	20	5	10	12	2	21	0	1	1	1	8	27	0	11	43	11	44	3	4	26	14	35	113	7	4	**436**
Totals	**48**	**3**	**2**	**4**	**70**	**13**	**42**	**44**	**12**	**62**	**6**	**4**	**2**	**3**	**32**	**96**	**1**	**42**	**140**	**28**	**149**	**11**	**11**	**87**	**48**	**137**	**397**	**21**	**15**	

Table 7. Summary of coded sub-themes for each jurisdiction

	Abbotsford	Anmore	Belcarra	Bowen Island	Burnaby	Chilliwack	City of North Vancouver	Coquitlam	Delta	District of North Vancouver	Fraser Valley Regional District	Harrison	Hope	Kent	Langley (City)	Langley (Township)	Lions Bay	Maple Ridge	Metro Vancouver Regional District	Mission	New Westminster	Pitt Meadows	Port Coquitlam	Port Moody	Richmond	Surrey	Vancouver	West Vancouver	White Rock	**Total**
Buildings																													
Active Cooling	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	7	0	2	10	0	0	**39**
Passive Cooling	2	1	0	0	1	0	3	0	0	2	0	0	0	0	1	2	0	0	8	1	7	1	0	1	0	5	10	0	2	**47**
Efficiency	0	2	1	0	1	1	2	1	1	4	0	0	0	0	0	4	0	1	15	1	5	0	0	6	3	5	22	1	0	**76**
Retrofit	0	0	0	0	7	1	2	0	0	1	0	0	0	0	0	0	0	0	7	0	1	0	0	9	0	2	4	0	0	**34**
Ventilation	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	3	0	5	1	0	1	0	0	6	1	1	**21**
Shade Structure	2	0	0	1	0	0	2	0	0	1	0	0	0	0	2	1	0	0	0	1	2	0	0	1	2	0	6	0	0	**21**
Shade Additions	1	0	0	0	0	0	1	1	0	1	0	0	0	1	0	4	0	1	2	1	7	0	0	3	1	4	13	0	1	**42**
Building Materials	0	0	0	0	0	0	1	2	0	1	0	0	0	0	2	3	0	0	1	0	5	1	1	0	2	8	4	0	1	**32**
Landscape Materials	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	2	0	3	2	1	5	0	0	0	1	8	12	0	2	**39**
Massing	0	0	0	0	0	0	2	1	0	0	0	1	0	0	0	5	0	0	1	0	3	0	0	0	1	5	2	0	0	**21**
Site Orientation	2	1	0	0	0	0	0	2	0	2	0	0	0	1	1	3	0	0	2	1	4	0	0	0	1	1	4	0	1	**26**
Housing	0	0	0	0	3	0	1	0	0	0	0	0	0	0	1	0	0	0	6	0	0	0	0	2	1	0	10	0	0	**24**
Environmental																													
Ecosystem Services	4	0	0	0	3	1	1	6	0	2	0	0	1	0	0	2	1	1	6	0	4	3	0	3	2	11	11	5	0	**67**
Green Infrastructure	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	4	0	4	4	1	3	0	0	2	3	6	34	0	0	**64**
Greening Buildings	0	0	0	0	0	0	0	1	0	2	0	0	0	0	2	9	0	1	1		4	0	0	2	3	8	13	0	1	**47**
Trees	14	0	0	1	4	3	12	10	4	14	0	1	0	0	6	19	0	10	23	4	25	3	2	3	11	15	40	4	2	**230**

	Abbotsford	Anmore	Belcarra	Bowen Island	Burnaby	Chilliwack	City of North Vancouver	Coquitlam	Delta	District of North Vancouver	Fraser Valley Regional District	Harrison	Hope	Kent	Langley (City)	Langley (Township)	Lions Bay	Maple Ridge	Metro Vancouver Regional District	Mission	New Westminster	Pitt Meadows	Port Coquitlam	Port Moody	Richmond	Surrey	Vancouver	West Vancouver	White Rock	**Total**
Parks & Greenspace	1	0	0	0	5	3	3	5	1	2	0	0	0	0	2	0	1	0	6	2	8	1	1	7	1	7	11	0	1	**68**
Water Bodies	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	2	4	0	0	**12**
Land Conservation	0	0	0	0	1	0	1	1	0	1	0	0	1	0	0	0	1	0	5	2	2	1	0	2	0	2	7	1	0	**28**
Scale & Jurisdiction																														
City	3	0	0	0	5	1	3	2	0	3	0	0	1	0	2	2	0	1	9	0	6	2	1	12	5	9	25	4	1	**97**
Area	2	0	0	0	2	3	0	2	0	1	0	0	0	0	0	1	0	3	1	1	13	0	0	4	1	20	27	0	1	**81**
Subdivision	1	0	0	0	2	0	1	0	0	1	0	1	0	0	1	3	0	2	5	2	4	0	2	4	3	5	15	0	0	**52**
Site	6	0	0	1	8	1	6	4	1	14	0	0	0	1	5	20	0	4	23	6	27	2	1	7	5	13	54	2	2	**213**
Private	6	0	0	0	1	1	0	0	0	1	0	1	0	0	2	4	0	2	2	2	2	0	2	2	1	2	8	1	1	**41**
Public	2	0	0	0	5	0	3	4	1	3	0	0	0	0	1	1	0	2	5	1	7	0	0	6	2	2	17	1	0	**63**
Planning Tools																														
Bylaws	0	1	1	0	0	0	2	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	4	0	0	10	1	1	**24**
Development Permit Area	10	0	0	0	0	0	0	0	0	6	0	0	0	0	2	12	0	5	1	3	22	0	1	5	4	5	0	0	3	**79**
Zoning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	0	16	1	0	**21**
Research & Engagement	0	0	0	0	4	1	1	0	0	0	3	0	0	0	0	0	0	0	3	0	0	1	0	4	0	2	11	1	0	**31**
Objectives	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	6	0	0	**13**
Goals	1	0	0	0	2	2	4	1	0	4	0	0	0	0	0	5	0	2	11	1	5	0	0	6	1	7	10	1	0	**63**

	Abbotsford	Anmore	Belcarra	Bowen Island	Burnaby	Chilliwack	City of North Vancouver	Coquitlam	Delta	District of North Vancouver	Fraser Valley Regional District	Harrison	Hope	Kent	Langley (City)	Langley (Township)	Lions Bay	Maple Ridge	Metro Vancouver Regional District	Mission	New Westminster	Pitt Meadows	Port Coquitlam	Port Moody	Richmond	Surrey	Vancouver	West Vancouver	White Rock	**Total**
Guidelines	4	0	0	1	7	0	1	5	2	5	0	1	0	1	6	2	0	1	7	1	4	1	0	0	3	12	30	0	0	**94**
Equity																														
Recognitional	0	0	0	0	7	0	1	1	0	1	0	0	0	0	0	4	0	0	7	0	4	0	0	4	1	4	18	1	0	**53**
Distributional	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	1	0	2	2	0	2	0	0	3	0	4	21	1	0	**41**
Procedural	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	2	2	0	0	**9**

4.2.1. Buildings

The Buildings theme was coded in 27 jurisdictions. With twelve different Building sub-themes, jurisdictions varied in their choice of actions/responses. Alternatively, building sub-themes can also be grouped into clusters (Figure 4) that can tie into how we think about policy development and climate action. Clusters represent different pathways for building-related interactions with local government departments (from siting to completion): **Envelope** relates to building and code reviews (Government of British Columbia, 2015; Moore & Doyon, 2023); **Shade** relates to planning reviews of public space (Punter, 2003); **Materials** relates to planning and building reviews of architecture and design (Carmona et al., 2010; Punter, 2003); **Site Design** relates to land use planning and building footprint reviews (Union of BC Municipalities, 2022); and **Housing** relates to building and planning reviews of housing (Hodge et al., 2021).

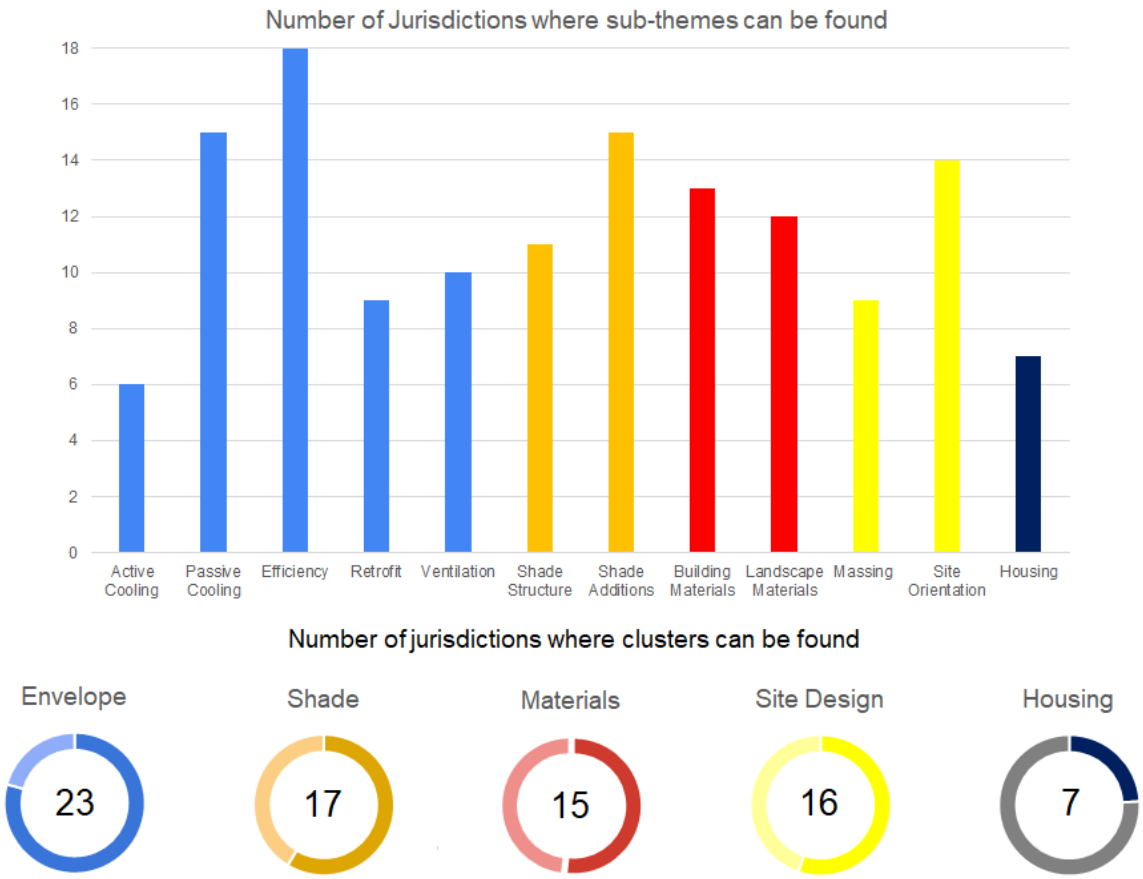

Figure 4. **Number of jurisdictions for Building sub-themes and Building clusters**

Active Cooling, Passive Cooling, Efficiency, Retrofits, and Ventilation all relate to a building **Envelope**, with Vancouver, Metro Vancouver, Port Moody, and New Westminster as leaders. A prototypical strategy from Metro Vancouver's Climate 2050 Roadmap: Buildings for both new projects and retrofits states: "passive design is key to simultaneously reducing cooling demand and energy costs… After maximizing passive measures, mechanical systems such as heat pumps can help to meet additional cooling needs" (2021: Page 42). Another associated cluster is **Shade** Structures and Additions, where New Westminster and Vancouver are leaders. An example from Vancouver's Northeast False Creek Plan states: "ensure exceptional sustainable building design, with a focus on envelope efficiency, including air-tightness, improved insulation, minimizing thermal bridges, appropriate glazing ratios to avoid excessive heat gain/loss, and shading" (2018: Page 90). Building and surrounding Landscape Materials form a cluster (**Materials**), with another being Massing and Site Orientation (**Site Design**). Surrey and Vancouver are leaders for both clusters, with Township of Langley and New Westminster also leading in the latter. Finally, Metro Vancouver and Vancouver are key policy leaders for the **Housing** cluster. A strategy that cuts across sub-themes (Housing, Efficiency, Retrofits, Ventilation) is from Metro Vancouver Housing - Extreme Heat Protocols:

> "When it comes to addressing extreme heat in new housing developments and retrofit projects, balance is key….This is especially true for the new forms of housing Metro Vancouver Housing is building – high-energy performance wood frame apartment buildings up to 6 stories [which] tend to get hotter than townhouses because they include internal corridor spaces, upper stories tend to be taller than trees or landscaping that might offer natural shading, and it's more challenging to provide windows on multiple sides of a unit that could provide cross-breezes to support natural cooling. [A] layered approach is needed, to apply both passive and active strategies" (2022: Page 55).

4.2.2. Environmental

The Environmental theme was coded in 25 jurisdictions. New Westminster had a high number of codes proportional to its size and population. This was buoyed by the second highest (n=25) Trees sub-theme codes, found not only in urban forestry and tree plans, but also in area plans and its OCP. Trees were the highest coded sub-theme for all jurisdictions except Burnaby and Port Moody (both of which had Parks and Greenspace as their highest). Conversely, the sub-theme with the lowest number of jurisdictions

(n=6) was Water Bodies, which represents a lack of recognition for this heat-mitigating mechanism. Distributions of sub-themes for the top 10 coded jurisdictions can be found in Figure 5.

The dominance of Trees in heat mitigation was especially prevalent in jurisdictions such as Abbotsford, City of North Vancouver, District of North Vancouver, Langley Township, Maple Ridge, and Richmond. Some significant documents include the City of North Vancouver's Street Tree Master Plan (2004; also noteworthy for early attention to heat mitigation), the District of North Vancouver's 2050 Community Energy & Emissions Plan (2019), the Township of Langley's Community Forest Management Strategy (2022), Metro Vancouver's Climate 2050 Strategic Framework (2019), New Westminster's Urban Forest Management Strategy (2016), and Vancouver's Urban Forest Strategy (2018). As seen in the Township of Langley's Community Forest Management Strategy, "trees act as nature's air conditioners by offsetting the urban heat island effect - deciduous trees planted on the south and west sides of buildings provide shade" (2022: Page 14). This example also points to the importance of site placement for Trees, which is further explored in the Scale & Jurisdiction sub-theme, Site (to be discussed further below).

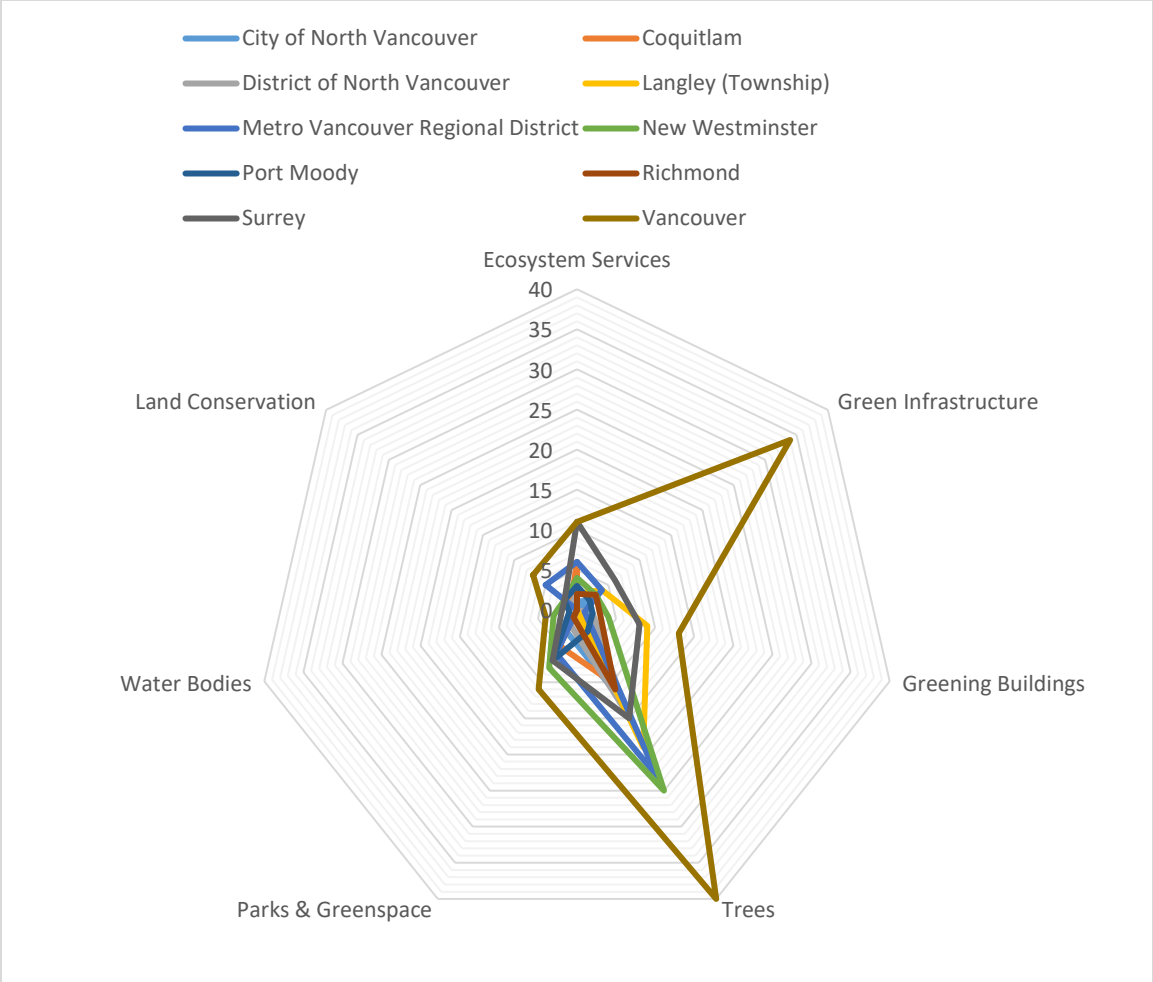

Figure 5. Counts of each Environmental sub-theme code for the top 10 coded jurisdictions

Another common sub-theme was Ecosystem Services, or the co-benefits of greenery, which shows growing recognition of benefits provided by environmental features. More explicit strategies tied to this sub-theme were Green Infrastructure: use of greenery for storm/rainwater management, and Greening Buildings: use of green technologies associated with buildings. Green Infrastructure was prominent in Vancouver, such as in the city's Rain City Strategy: "[add] blue-green roofs, rain gardens or harvest and reuse systems to new and existing buildings and sites. The targeted redesign of streets, public spaces and parks will help meet rainwater management needs related to water quality, greening, urban heat" (2019: Page 83). The choice to highlight benefits from the environment also provides impetus for Land Conservation as well as Parks and Greenspace, as seen in Surrey's Parks, Recreation and Culture Strategic Plan: "Parks will play an increasing role in the mitigation of the impacts of climate

change…Recognizing and incorporating the green infrastructure provided by parkland into policy and practice is a key issue for Parks to lead (2018: Page 39).

4.2.3. Scale & Jurisdiction

The Scale and Jurisdiction theme was coded in 25 jurisdictions. The Scale and Jurisdiction codes describe where Action/Responses occur (City, Area, Subdivision, Site, Public, and Private); note that codes may overlap (e.g. Site interventions noted within an Area plan). The City sub-theme was prominent in Metro Vancouver through the Climate 2050 Strategic framework and linked plans for Housing, Buildings, Energy, and Trees, and in Port Moody through climate action plans and implementation strategies. For the Area sub-theme, New Westminster's Downtown Community Plan and Surrey's City Centre Plan were leading documents. Vancouver was highly coded for all, most notably within climate and environmental plans (Climate Change Adaptation Strategy, Rain City Strategy, Climate Emergency Action Plan, and Planning for Extreme Heat Memo), area policies (Broadway Plan, Northeast False Creek Plan), and guidelines (Facilities and specific Zoning Districts).

Site codes were the highest sub-theme for most jurisdictions; this was especially true for the District of North Vancouver and the Township of Langley. For the District of North Vancouver, these were in comprehensive and strategic plans, such as the OCP and Community Energy Emissions Plan; for the Township of Langley, these were in neighbourhood plans nested within area plans, such as the Willoughby and Brookswood-Fernridge plans. These site-level interventions connect to both Building and Environmental sub-themes. They can be specific, as in Langley's Willoughby Community Plan which notes: "[to] minimize high-angle heat gain in summer months, design for flexible sunscreens, louvres or overhangs for windows on south and west facing elevations.…Deciduous trees placed on the south and west sides of a structure will offer shade in summer" (2022: Page 82) or provide general guidance, as in the District of North Vancouver's OCP which states: "site planning should strive to minimize building coverage, preserve natural features and minimize rainwater run-off. Mature trees shade and cool homes in the summer" (2021: Page 245). For the Public or Private sub-themes, more strategies are explicitly assigned to the public sector (n=63) compared to the private sector (n=41).

4.2.4. Planning Tools

The Planning Tools theme was coded in 27 jurisdictions. Planning Tools sub-themes are different relevant planning department actions. Sub-themes can overlap; for instance, Development Permit Areas (DPAs) contain guidelines, while Goals may call for further research and engagement. Distribution of sub-themes per jurisdiction is quite diverse (Figure 6). Vancouver was the leading jurisdiction, although it lacked codes utilizing DPAs. The leading jurisdiction in DPAs was New Westminster, which had DPA guidelines for the city at large and within specific Area Plans. Honourable mentions go to Abbotsford and the Township of Langley, both of which also had high numbers of DPA codes. A noteworthy example from New Westminster's Official Community Plan: Development Permit Areas (for Multiple Unit Residential) states: "new developments should integrate trees into their landscape plan. Distribute trees and landscaping throughout the site to soften and screen public/ private boundaries, reinforce circulation routes, create pleasant pedestrian conditions and/or maximize shade" (2023: Page 54).

Vancouver was the leading jurisdiction across all Planning Tools sub-themes. For the two least common sub-themes, Zoning and Objectives, the city's policies are key sources. A representative Objective is from Vancouver's Climate Emergency Action Plan, which re-iterates the city's goal for "planting 150,000 trees between 2010 and 2020" (2020: Page 55). Most Objectives were related to Environmental actions, such as Trees for canopy cover improvements. In contrast, Goals (generally longer-term and less specific than Objectives) were more widely used. Most Goals were found in strategic and climate-oriented plans, such as Metro Vancouver's Housing 10-Year Plan, which calls for resiliency as an "approach [for] the design of new housing, and explore required upgrades in existing housing, to ensure tenant safety and well-being (*e.g.*, effective cooling and air filtration, spaces of refuge, backup power in the event of emergencies)" (2022: Page 23). Bylaw codes were found in only 11 jurisdictions, most commonly in Building Bylaws (or documents that reference Building Bylaws), explicitly representing desired design temperatures for new buildings.

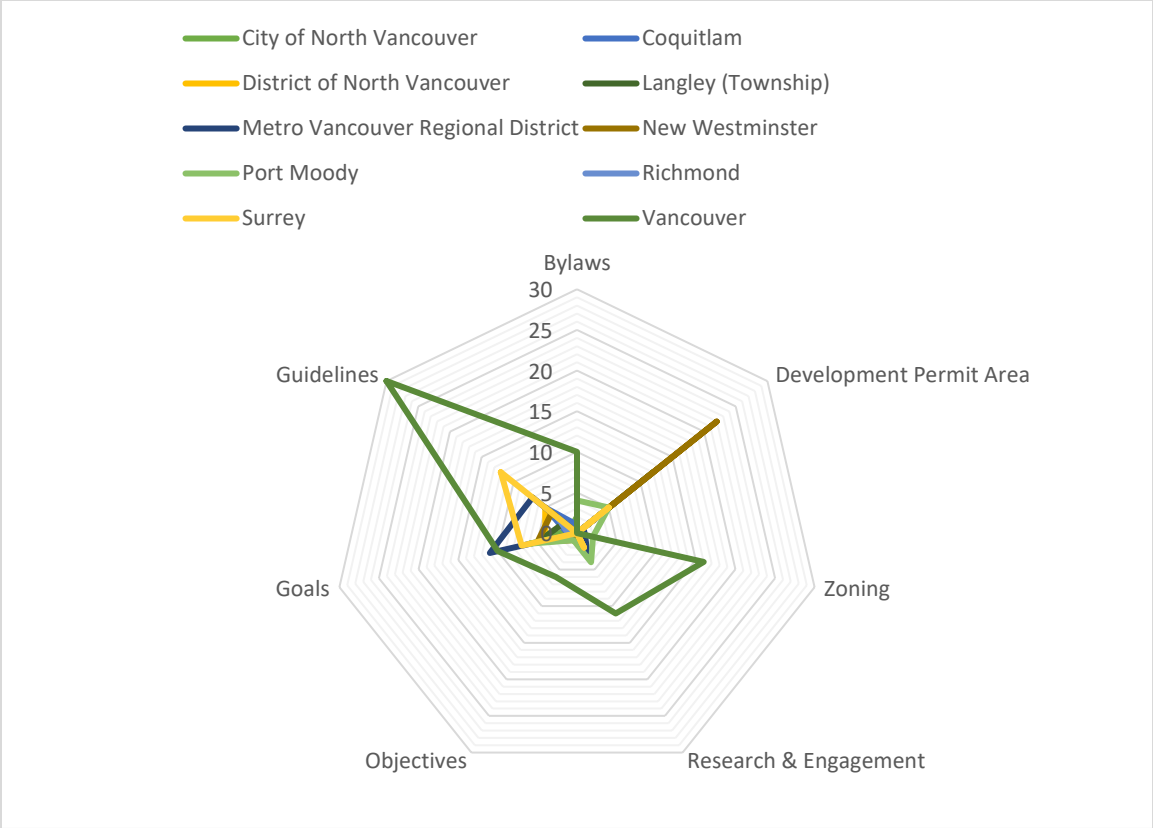

Figure 6. Counts of each Planning Tools sub-theme code for the top 10 coded jurisdictions

4.2.5. Equity

Equity was the least coded theme, only found in 13 jurisdictions. There were some larger jurisdictions (City of North Vancouver, Coquitlam, Delta, District of North Vancouver, Port Coquitlam, and Richmond) with minimal to zero Equity codes. This theme was most commonly coded within climate action/adaptation plans, environmental strategies, urban forestry plans, extreme weather policies, and most notably, in two comprehensive plans (New Westminster's OCP and the Vancouver Plan). An example of how Vancouver's Climate Change Adaptation Strategy connects Recognitional and Distributional Equity: "[identify] where high population vulnerability to heat intersects with areas of high surface and air temperatures" (2018: Page 30). While found in area plans for certain neighbourhoods noted by the city (Marpole, Downtown Eastside), Distributional Equity has also been mentioned for other neighbourhood plans (West End, Grandview Woodland, Cambie Corridor, Broadway Plan). Procedural Equity is rare, being found in only six jurisdictions. One key example is from Burnaby's Zero-Emission Retrofit Task

Force Report, which calls for “centring reconciliation with Indigenous [P]eoples…advancing equity for those most vulnerable to climate impacts…lower-income residents and supporting co-benefits for the community” (2022: Page 6). Operationally, this includes Vancouver’s Planning for Extreme Heat Memo, which calls for implementation of measures of equity in “land use planning and heat preparedness” (2022: Page 12) and Surrey’s Urban Heat Ready Project Assessment which calls for integration of its data with spatial and demographic data to create a “comprehensive tool [that] can be used to help City staff pinpoint the most vulnerable areas of the City” (2021: Page 7).

Chapter 5.

Discussion

How are jurisdictions preparing for extreme heat? The popularity of Urban Greening and the sub-themes of Trees, Greenspace, and Ecosystem Services is in line with surveyed United States planners (Meerow & Keith, 2022), as well as document analyses in California (Gabbe et al., 2021) and other populous US cities (Turner et al., 2022). Urban Greening creates a strong public narrative of co-benefits, increasing its popularity (Keith et al., 2023), political acceptability, and introduction into policy (Lesnikowski et al., 2021). Co-benefits of Urban Greening can also help justify implementation and integration, especially for smaller jurisdictions (Bonnett & Birchall, 2023). However, less common sub-themes such as Land Conservation and Water Bodies face challenges in up-take due to topographical and land-use concerns (Hutton, 2011). Cross-jurisdictional ecological corridors and services, which benefit from network and connectivity effects, may be best planned for regionally (Hodge et al., 2021). Holistic land-use strategies developed with a regional consensus may receive more traction and influence within municipal policies (Bonnett & Birchall, 2023), particularly if benefits are more publicized (Baynham & Stevens, 2014). Metro Vancouver and the Fraser Valley's interconnected infrastructure and development patterns means that their regional policies are suitable for these issues (Gifford et al., 2022; Hodge et al., 2021).

The Envelope cluster was most prominent in the Buildings theme analysis. This may be linked to increases in performance certification standards for new buildings (Adekanye et al., 2020), and thus, greater adoption by local governments (Moore & Doyon, 2023). Nonetheless, improving the built environment for extreme heat requires improving building and housing stock (Beugin et al., 2023), with certain sub-themes (Retrofit, Active Cooling, and Housing) being clear areas for improvement. In addition, policy interventions like active cooling are a growing area of focus nationally (Environment and Climate Change Canada, 2023), provincially (Beugin et al., 2023), and in the popular media (Canadian Press, 2023; Griffin, 2023), providing further impetus for local government policies that target this mechanism. Improvements in older buildings and housing also speak to equity, an area of concern for both provincial and national

adaptation planning (Beugin et al., 2023; Environment and Climate Change Canada, 2023).

Site is by far the most common Scale for Environmental and Building responses to heat. The overlap with sub-themes like Trees, Green Infrastructure, Efficiency, Site Orientation, and Passive Cooling represent a recognition of the UHI effect for development projects. Development projects also rely on Planning Tools such as Guidelines and Development Permit Areas, which typically set standards for *future* projects and buildings, rather than retroactively to existing stock (Hodge et al., 2021; Union of BC Municipalities, 2022). However, a lack of Subdivision-level interventions suggests a gap in heat mitigation planning. As suburban growth often relies on subdivision-level greenfield development (Hodge et al., 2021), it is important for these growth policies to consider heat mitigation, given the impact of land use and land cover on the UHI effect (Ibsen et al., 2022; Welegedara et al., 2023). Metro Vancouver has lost hundreds of square kilometres of ecological spaces in the last 15 years, arising from developments planned in the long-term at the subdivision scale and above (Griffiths, 2022). Reinforcing heat mitigation considerations for subdivisions can bridge site-level interventions to area, city-wide, and regional strategies and goals.

Comprehensive plans, the highest-order of local plans, are underused vehicles for heat mitigation. Instead, current prominent vehicles are climate adaptation or action plans, urban greening plans, and some area plans. Comprehensive plans are suitable for heat planning as they set overarching priorities for the community, which translates into actions and resources across local government (Keith et al., 2023), and are particularly important for development and land use planning as a nexus for a jurisdiction's network of plans (Hodge et al., 2021; Woodruff et al., 2022). Comprehensive planning also requires direct community engagement (Hodge et al., 2021) which may spread awareness of heat mitigation interventions (Keith et al., 2023). When planned appropriately and in conjunction with local lived experience, civic participation and engagement can build knowledge and acceptance of climate action (Dale et al., 2020; Khatibi et al., 2021), particularly when issues are mainstreamed and supported across government sectors (Wamsler et al., 2020). Mainstreaming an issue in high-order (comprehensive) planning also creates larger and more receptive audiences when used to coordinate measures across different scales, planning tools, and policies (Birchall & Bonnett, 2021; Seasons, 2021).

To understand how heat mitigation is centralized and its importance signalled, this research focused its analysis on strategies and interventions that *explicitly* seek to mitigate heat. Signals reflect the danger of a threat and represent the mainstreaming of a hazard, which can help break through the silos that often permeate large local bureaucracies. Silo-ed approaches to climate governance can present large barriers to collective action (Keith et al., 2023), both within and across levels of government (Dale et al., 2020). Planning agencies play a role in mainstreaming by integrating strategies, improving implementation, and increasing the range of (planning) tools used to achieve these outcomes (Lyles et al., 2018). Comprehensive planning processes that implement targeted goals and objectives (Birchall & Bonnett, 2021) may help associated bodies such as non-governmental organizations and the development industry better understand strategic priorities and participate in heat mitigation governance. Particularly, in light of inequitable heat outcomes (Henderson et al., 2022) and the gaps in recognitional, distributional, and procedural mechanisms, comprehensive plans may also be a strong platform for mainstreaming heat mitigation equity (Keith et al., 2023)

On the whole, smaller and many medium sized jurisdictions had less explicit heat interventions and many significant thematic gaps (i.e. within Buildings, Environmental, and Equity) compared to their larger counterparts. Small local governments face capacity, information, and financial challenges (Gifford et al., 2022), worsened by increasing delegation of responsibilities to the local level (Momani & Khirfan, 2013). With limited staff time, smaller jurisdictions may be less able to assess challenges, apply for funding, and implement interventions, leading to a more conservative, *status quo* policy regime (Gifford et al., 2022; Meerow & Keith, 2022). To meet growing challenges, many municipalities rely on the expertise and experience of planning consultants to help create plans and policies (Momani & Khirfan, 2013). Use of consultants may provide informal coordination on strategies and even nudge policy and planning processes in specific directions (Linovski, 2019; Loh & Norton, 2015). Thus, their role in climate adaptation governance should not be understated, particularly towards the highest-order local plans.

Climate adaptation action in local governments has been described as an incremental approach (Environment and Climate Change Canada, 2023). This may be especially true for smaller and medium-sized jurisdictions that lack capacity compared to larger jurisdictions (Meerow & Keith, 2022). The reliance of local governments on provincial

direction (Hodge et al., 2021; Seasons, 2021) has exacerbated the lack of local focus on heat mitigation, as provincial-level policies have not emphasized this climate priority (Birchall & Bonnett, 2021; Dale et al., 2020). With recurring heat events and increasing public perception of extreme heat dangers, the policy window has opened for coordinated governance in this field. Provincial and national-level policies may expand policy options, considering that senior governments are important funding sources for municipalities (Gifford et al., 2022; Hodge et al., 2021). Robust policies can also be achieved when research outcomes are proactively integrated within multi-level governance (Dale et al., 2020).

Canada's 2023 National Climate Adaptation Plan outlines explicit infrastructure and adaptation planning for local governments, with a focus on equitable outcomes (Environment and Climate Change Canada, 2023). Provincial policies also have begun to emphasize select strategies, such as heat performance standards (Government of British Columbia, 2023b) and promotion of active cooling devices: e.g. heat pumps, air-conditioning (CBC News, 2023; Wyton, 2023). Nonetheless, critics argue that more should be done through BC's statutory powers and coordinating functions, particularly considering extreme heat's inequitable impacts (Beugin et al., 2023). This suggests that further senior government action is possible. Local governments should capitalize on this support through both rapidly deployed heat mitigation interventions as well as longer-term strategies involving larger scale (i.e. land-use) changes within municipal governance. Incremental actions can still achieve transformative outcomes over the long-term, if adaptation is mainstreamed across government policies to build climate resilience and capacity (Birchall et al., 2021).

How should we plan for extreme heat? A robust heat mitigation regime mainstreams the hazard and incorporates specific to broad measures that are addressed in site to comprehensive level plans, aligned across levels of governance (Dale et al., 2020; Lyles et al., 2018). By using the diversity of interventions, scales, and planning tools noted above, jurisdictions can expand their ability to mitigate extreme heat. In addition, combining local perspectives with strong governance structures can help jurisdictions implement successful interventions (Keith et al., 2023; Wamsler et al., 2020), including stronger coordination and integration of regional and municipal planning. Lastly, implementation of climate interventions can actually worsen spatial urban inequities if distribution is not considered (Meerow & Mitchell, 2017). Given growing emphasis in

senior governments for ensuring climate equity, local governments would be remiss if they did not incorporate measures of recognitional, distributional, and procedural equity, to build a region that addresses heat for all its residents.

5.1. Future Directions and Considerations

Because of BC's historically moderate climate, active (and passive) cooling have not been explicitly required in private sector, non-commercial/institutional buildings (Beugin et al., 2023). Provincial and national recommendations for maximum indoor temperatures have not been implemented, except for new Vancouver buildings starting in 2025 (City of Vancouver, 2022). This will change with the pending BC Building Code update (Government of British Columbia, 2023b), which also allows for setting of objectives and targets for indoor spaces. Performance standards and other planning tools can signal that local jurisdictions are concerned about heat performance, improving heat governance for all buildings (Moore & Doyon, 2023). Follow up studies can focus on building performance in several areas: 1) evolving policies in active cooling, 2) passive cooling measures, and 3) housing thermal comfort in new buildings and retrofits. In addition, equity has been described as a key prong of provincial and federal adaptation planning. Building on literature, the performance of specific pathways such as urban greening, urban design, or land use to provide equitable heat mitigation can be investigated. This can be done through analytical frameworks, developed from literature and tested with local case studies. Staff interviews and lived experiences could further inform how jurisdictions are incorporating equity (Fitzgerald, 2022; Jang & Doyon, 2023).

Chapter 6.

Conclusion

Plans and policies (n=243) from 27 municipalities and 2 regional districts in the south coast of mainland BC were coded for explicit mentions of heat mitigation. Category and thematic analysis of codes helped us answer our two sub-questions: 1) How is heat mitigation categorized within jurisdictions? and 2) What are jurisdictions doing to plan for heat mitigation? Strategies and interventions categorized around Urban Greening and Urban Design were the most prominent. Thematic analysis showed corresponding emphasis on Site-scale interventions, but also a dichotomous range of Planning Tools across jurisdictions. Trees were the most prominent Environmental strategy, with Building sub-themes being relatively more balanced. There were large variations in codes, especially between medium-sized jurisdictions, which reflects diverse planning range, capacity, and different foci for heat mitigation.

To meet the increasing dangers of heat, local governments should work intra-departmentally and reduce silos, to centralize heat mitigation as a priority internally and externally to the public, development industry, and other relevant groups. Local governments should also learn from each other and work together to achieve better performance at all scales and across jurisdictions. Finally, effective multi-level governance can be achieved through alignment with senior governments and other national bodies, seizing on policy windows and broadening the scope of heat mitigation in BC.

A note on limitations: This study was conducted using plans and policies collected between May 2023 and June 2023 and should be considered a snapshot in time within a rapidly evolving policy regime. For comparison purposes, this includes municipalities and regional districts, but not First Nations and other Indigenous groups. Successful heat governance must be inclusive in scope, in order to better ensure that this climate challenge can be met for everyone.

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Appendix A.

Documents Used

Table A.1. Analyzed Documents from Subject Jurisdictions

Jurisdiction	Document Name	Plan Type
Abbotsford	Official Community Plan (2016); UDistrict Neighbourhood Plan (2018); City Centre Neighbourhood Plan (2019); Historic Downtown Neighbourhood Plan (2019)	Comprehensive Plan
	2020 Sustainability Report (2021); Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Transportation and Transit Master Plan (2018)	Land Use Plan
	Green Community Plan (2013); Parks, Recreation, and Culture Master Plan (2018); Urban Forest Strategy: 2020-2045 (2022)	Urban Greening
Anmore	Official Community Plan (2014)	Comprehensive Plan
	Building Bylaw (2018)	Bylaw/Urban Design
Belcarra	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Building and Plumbing Code Regulation Bylaw (2003)	Bylaw/Urban Design
Bowen Island	Climate Action Strategy (2020)	Climate Plan
	Hazard, Risk and Vulnerability Assessment (2018); Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Active Design Guidelines (2019)	Urban Design
Burnaby	Community Energy and Emissions Plan (2016); Environmental Sustainability Strategy (2016); Climate Action Framework (2020); Extreme Heat Operational Response Plan (2022)	Climate Plan
	Climate Action Plan Progress Report 2020-2021 (2021); 2021 Heat Events Summary Report (2021)	Climate Report
	Official Community Plan (1998, updated and revised 2014); Community Safety Plan (2020)	Comprehensive Plan
	2022 Annual Municipal Report (2023); 2023-2027 Financial Plan (2023)	Annual Report
	Urban Village Design Guidelines; Zero-Emission Building Retrofit Task Force Final Report (2022)	Urban Design
Chilliwack	Sardis Neighbourhood Plan (2020); South Vedder Neighbourhood Plan (2022); Yarrow Neighbourhood Plan (2022)	Comprehensive/Area Plan
	Community Climate Action Plan (2022); Corporate Climate Action Plan (2022)	Climate Plan

Jurisdiction	Document Name	Plan Type
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Active Transportation Plan (2022)	Land Use Plan
	2021 Municipal Report (2022)	Annual Report
	Design Guidelines: Commercial, Intensive/Multi-Family Residential, and Mixed Commercial – Residential Development (2017)	Urban Design
	Greenspace Plan (2020)	Urban Greening
City of North Vancouver	Climate Change Adaptation Plan (2013)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan (2014); 100 Year Sustainability Vision (2009)	Comprehensive Plan
	Active Design Guidelines (2015)	Urban Design
	Street Tree Master Plan (2004)	Urban Greening
Coquitlam	Climate Adaptation Strategic Plan (2020); Environmental Sustainability Plan (2022)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan (2002); Urban Design + Development Permit Areas – OCP, Part 4 (2022)	Comprehensive Plan
	Building Bylaw (2003)	Urban Design/Bylaw
	Green Development Guide (2008)	Urban Design
	Mundy Park Forest Management Plan (2015); Parks, Recreation & Culture Master Plan (2017); Town Centre Park Master Plan (2018)	Urban Greening
Delta	Community Energy and Emissions Plan (2013)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan (1985, updated to 2022)	Comprehensive Plan
	Building/Plumbing Bylaw (2002)	Urban Design/Bylaw
	Green Growth Index (n.d.), Urban Forest Strategy (2020)	Urban Greening
District of North Vancouver	Climate Change Adaptation Strategy (2017); Climate Emergency White Paper (2020); Climate Ready Rezoning Policy for New Part 3 Buildings; 2050 Community Energy & Emissions Plan (2019)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan (2011, revised 2021); Target Official Community Plan Review Action Plan 2021-2030 (2021)	Comprehensive Plan
	Lions Gate Public Realm Strategy (2015)	Urban Design
Fraser Valley Regional District	Climate Change Adaptation Program – Regional Adaptation Strategies: Fraser Valley (2015); Fraser Valley Adaptation Strategies Update (2018)	Climate Plan

Jurisdiction	Document Name	Plan Type
	Climate Action Revenue Incentive Public Report (2019)	Climate Report
	Fraser Valley Regional Growth Strategy Monitoring Report (2023)	Report
Harrison Hot Springs	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Parking Master Plan (2022)	Urban Design
Hope	Official Community Plan (2016, updated to 2018)	Comprehensive Plan
Kent	Kent 2040 Official Community Plan (2014)	Comprehensive Plan
City of Langley	Community Energy and GHG Emissions Plan (2010)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan (2021)	Comprehensive Plan
	2023-2027 Financial Plan (2023)	Annual Report
	Master Transportation Plan (2014)	Urban Design
	Environmentally Sensitive Areas Mapping Study (2016)	Land Use
	Downtown Master Plan (2010)	Area Plan
Township of Langley	Willowbrook Community Plan (1991, consolidated to 2020); Willoughby Community Plan (1998, consolidated to 2022); Aldergrove Community Plan (1979, consolidated to 2017); Brookswood-Fernridge Community Plan (2017);	Area Plan
	Climate Action Strategy (2021); Climate Action Strategy Action Items (2021); Low Carbon Mobility Plan: Electric Vehicles (n.d.)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan (2013, amended to 2018)	Comprehensive Plan
	Annual Report 2021 (2022)	Annual Report
	Building Bylaw (2008, consolidated to 2022)	Urban Design/Bylaw
	Community Forest Assessment Report: 2021 Update (2021); Community Forest Management Strategy (2022)	Urban Greening
Lions Bay	2021 Annual Report (2022)	Annual Report
	Smart Growth – Principles of Development (n.d.)	Urban Design
Maple Ridge	Lougheed Transit Corridor Development Permit Area Guidelines (2021); Official Community Plan (2014)	Comprehensive Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Building Bylaw (2012, consolidated to 2021)	Urban Design/Bylaw
	Environmental Management Strategy (2014); Green Infrastructure Review (2020); Green Infrastructure Management Strategy (2021)	Urban Greening

Jurisdiction	Document Name	Plan Type
Metro Vancouver Regional District	Climate Adaptation Environmental Scan and Gap Analysis (2015); Climate 2050 Strategic Framework (2018, revised 2019); Climate 2050 Snapshot (2022); Clean Air Plan (2021); Climate 2050 Roadmap – Buildings (2021); Climate 2050 Roadmap – Transportation (2021); Climate 2050 Roadmap – Energy (2023); Climate 2050 Roadmap – Industry & Business (2023); Climate 2050 Roadmap – Nature and Ecosystems (2023)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Metro 2050 Regional Growth Strategy (2023)	Comprehensive Plan
	Metro Vancouver Housing 10-Year Plan 2022 Progress Update (2022); Metro Vancouver Housing – Extreme Heat Protocols (2022); Sustainable Infrastructure & Buildings Design Guide for Metro Vancouver (2021)	Urban Design
	Design Guidebook – Maximizing Climate Adaptation Benefits with Trees (2017); Urban Forest Climate Adaptation Framework for Metro Vancouver (2017); Metro Vancouver Tree Regulations Toolkit (2021); Ecological Health Framework (2018); Policy Backgrounder – Green Infrastructure in Metro Vancouver (n.d.); Connecting the Dots – Regional Green Infrastructure Network Resource Guide (n.d.); Regional Tree Canopy Cover and Impervious Surfaces (2019)	Urban Greening
Mission	Mission City Downtown Action Plan (2013); Waterfront Revitalization Master Plan (2022); Official Community Plan (2017, consolidated to 2022)	Comprehensive Plan
	Environmental Charter 2022-2027 (2022)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
New Westminster	Our City 2041: New West Minster Official Community Plan (2017); Official Community Plan – Schedule B: Development Permit Areas (consolidated to 2023); Downtown Community Plan (consolidated to 2023); Queensborough Community Plan (consolidated to 2023)	Comprehensive Plan
	Climate Action Revenue Incentive Public Report for 2018 (2019)	Climate Report
	Corporate Energy & Emissions Reductions Strategy (2020); Community Energy and Emissions Plan 2050 (2022); Environmental Strategy & Action Plan (2018); Envision 2032 – New Westminster's Sustainability Framework (2013)	Climate Plan
	Downtown Building and Public Realm Design Guidelines and Master Plan (2016)	Urban Design
	Zoning Bylaw (2001)	Land Use

Jurisdiction	Document Name	Plan Type
	Parks and Recreation Comprehensive Plan (2008); Urban Forest Management Strategy (2016); Tree Planting Master Plan (2020-2030); Biodiversity and Natural Areas Strategy (2022); Integrated Stormwater Management Plan – Volume I (2017); Integrated Stormwater Management Plan – Volume II: Best Management Practice Toolkit (2017)	Urban Greening
Pitt Meadows	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan (2022)	Comprehensive Plan
	Environmental Inventory and Management Strategy (2022)	Urban Greening
Port Coquitlam	Enviroplan Port Coquitlam (2011)	Climate Plan
	Climate Action Revenue Incentive Public Report for 2018 (2019)	Climate Report
	Official Community Plan (2004, revised 2020)	Comprehensive Plan
	Proposed Policy for Trees and a new Tree Bylaw Report (2019)	Urban Greening
Port Moody	Climate Action Plan (2020); Climate Action Plan – Phase One Climate Action Implementation Strategy (2020); Phase Two Climate Action Implementation Strategy (2022); Climate Ready Homes and Buildings Plan (2022); Extreme Weather Resilience Plan (2022)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan (2014, consolidated to 2022)	Comprehensive Plan
	2021 Annual Report (2022)	Annual Report
	Building Bylaw (2019)	Urban Design/Bylaw
	Parks and Recreation Master Plan (2015)	Urban Greening
Richmond	2050 Community Energy and Emissions Plan (2022); City of Richmond Climate Action Programs (n.d.)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan 2041 (2012)	Comprehensive Plan
	Child Care Design Guidelines (2019)	Urban Design
	2022 Parks & Open Space Strategy (2013); Ecological Network Management Strategy (2015); Public Tree Management Strategy 2045 (2019)	Urban Greening
Surrey	Anniedale-Tynehead Neighbourhood Concept Plan (2012); City Centre Plan (2013); City Centre Plan Appendices (2013); East Clayton Neighbourhood Concept Plan (2003); East Newton South Neighbourhood Concept Plan (1997); Grandview Heights Area 1 (2005); Central Newton Cultural Commercial District (2013); Newton-King George Boulevard Plan (n.d.); Newton Town Centre Plan (2020); Semiahmoo Town Centre Plan (2022)	Area Plan

Jurisdiction	Document Name	Plan Type
	Climate Adaptation Strategy (2013); Community Climate Action Strategy (2013); Urban Heat Ready Report Summary (2021); Urban Heat Ready: Surrey City Centre – Project Primer and Current Reality Assessment (2021)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Plan Surrey 2013 – Official Community Plan (2014); Development Permit Guidelines (2014)	Comprehensive Plan
	Biodiversity Conservation Strategy (2014); Shade Tree Management Plan (2016); Parks, Recreation & Culture Strategic Plan 2018-2027 (2018); Biodiversity Design Guidelines (2021); Urban Forest Management Strategy (2023)	Urban Greening
Vancouver	Southeast False Creek Official Development Plan (2007)	Area Plan
	Still Creek Rehabilitation and Enhancement Study (2002); Arbutus Ridge/Kerrisdale/Shaughnessy Community Vision (2005); Riley Park/South Cambie Community Vision (2005); West End Community Plan (2013); Downtown Eastside Plan (2014); Marpole Community Plan (2014); Grandview-Woodland Community Plan (2016); Cambie Corridor Plan (2018); Northeast False Creek Plan (2018); Broadway Plan (2022);	Area Policy
	Green Buildings Policy for Rezoning – Process and Requirements (2010, amended 2022); Passive Design: Demountable Green Walls (2011); Passive Design: Natural Ventilation and light (2011); Shading Design and Yard Projections (2009; amended 2022); Sustainable Large Developments (2018, amended 2022); Zoning Districts Bulletins (consolidated; various dates)	Bulletins
	Climate Change Adaptation Strategy – Update and Action Plan (2018); Resilient Vancouver – Connect/Prepare/Thrive (2019); Climate Emergency Annual Report 2022 Indicator and Financial Dashboard (2022); Climate Emergency Action Plan (2020); Planning for Extreme Heat and Air Quality Mitigation – Memo to Mayor & Council (2022)	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Vancouver Plan (2022)	Comprehensive Plan
	Spaces to Thrive – Vancouver Social Infrastructure Strategy (2021)	Strategic Plan
	East Fraserlands – Section C: Character and Expression (2010); Civic Facilities Guidelines (consolidated, various dates); Zoning Districts Guidelines (consolidated, various dates)	Guidelines

Jurisdiction	Document Name	Plan Type
	Downtown Eastside Rezoning Policy (2014, amended 2022); Marine Landing Policy Updates (2021); Mount Pleasant Employment-Intensive Light Industrial Rezoning Policy and Guidelines (2021);	Land Use Policies
	Oakridge Centre Policy Statement (2007); Arbutus Centre Policy Statement (2008); New St. Paul's Hospital and Health Campus Policy Statement (2017); Heather Lands Policy Statement (2018); Downtown Public Space Strategy (2020); City of Vancouver Engineering Design Manual (2019);	Urban Design
	Vancouver Building By-law (2019)	Urban Design/Bylaw
	Urban Forest Strategy – 2018 Update (2018); VanPlay – Imagine Parks + Recreation – 10 Goals to Shape the Next 25 Years – Report 2 (2018); Rain City Strategy (2019); Vancouver Board of Parks and Recreation – Park Development Standards (2022); City of Vancouver Design Guidance Manual – Green Infrastructure Standards (n.d.)	Urban Greening
West Vancouver	Community Energy & Emissions Plan – Full Technical Report (2016);	Climate Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	2021 Annual Report (2022)	Annual Report
	Building Bylaw (2004, amended 2021)	Urban Design/Bylaw
	West Vancouver's Natural Assets (2019); State of the Urban Forest Report – Appendix A to Urban Forest Management Plan (2022)	Urban Greening
White Rock	Town Centre Design Guidelines (2011)	Area Plan
	Local Government Climate Action Program Survey Submission Report (2022)	Climate Report
	Official Community Plan (2017, consolidated to 2021)	Comprehensive Plan
	Parks & Recreation Master Plan (2017); Tree Protection Bylaw (2021)	Urban Greening

Appendix B.

Coding Key

Table B.1. Buildings: Related to buildings or their built surrounding landscape

Code	Definition	Reference
Active Cooling	Cooling of buildings through devices that require the use of electricity or other forms of energy (e.g. Heat pumps, air-conditioning)	(Ford et al., 2022)
Passive Cooling	Codes that target heat mitigation through general mentions of building design, without the use of active mechanical devices or energy usage	(Ford et al., 2022)
Efficiency	Improvements in building envelope technology and design that reduce heat infiltration (e.g. insulation, window glazing, etc) for *new* buildings	(Keith & Meerow, 2022)
Retrofit	Improvements in technology to reduce heat infiltration for *existing* buildings	(Keith & Meerow, 2022)
Ventilation	Measures that are concerned with air movement to provide thermal comfort	(Keith & Meerow, 2022)
Shade Additions	Additions to a building attached as architecture features (e.g. awnings, overhangs, sun shades) for the specific purposes of improving comfort from weather	(Keith & Meerow, 2022)
Shade Structures	External constructed structures that provide relief from heat (e.g. pergolas, canopies, etc)	(Keith & Meerow, 2022)
Building Materials	Mentions of buildings materials used to increase albedo, reduce effects of the Urban Heat Island effect	(Keith & Meerow, 2022)
Landscape Materials	Materials to increase albedo and reduce UHI of surfaces surrounding buildings (including evaporative pavements, lighter colour “cool” pavements)	(Keith & Meerow, 2022)
Massing	Size/shape of buildings within the site, which helps determine how much solar radiation the building is exposed to	(Keith & Meerow, 2022)
Site Orientation	Placement and directionality of buildings with relation to site and streetscape	(Keith & Meerow, 2022)
Housing	Codes related to living conditions and places of dwelling	

Table B.2. Environmental: Related to the natural environment or a replication of natural processes

Code	Definition	Reference
Ecosystem Services	Specific mentions of additional benefits of greenery, including heat mitigation	(Elmqvist et al., 2016)
Land Conservation	Mentions of preservation of specific areas of land with the intent of greenspace/natural area preservation	
Parks & Greenspace	Mentions of areas of land used as greenspace/park space	
Water Bodies	Natural or constructed bodies of water, including lakes, streams, rivers that create cooling effects on localized microclimates	(Bartesaghi Koc et al., 2017; Keith & Meerow, 2022)
Green Infrastructure	Engineered measures mentioned as also instituted for the purposes of managing rainwater/stormwater infiltration and flow	(Bartesaghi Koc et al., 2017; Keith & Meerow, 2022)
Greening Buildings	Additions of greenery, landscaping and trees on roofs or other portions of buildings; includes green roofs and green walls	(Keith & Meerow, 2022)
Trees	Includes street trees, tree canopy, urban forests as a whole	(Bartesaghi Koc et al., 2017; Keith & Meerow, 2022)

Table B.3. Scale & Jurisdiction: Related to the level or land size or the responsibility for implementation

Code	Definition	Reference
City	Covers the entirety of a jurisdiction's formal boundaries; applies when the whole city is called out	(Hodge et al., 2021)
Area	Specific areas outlined by the jurisdiction – applies when coded in an area plan, or when specific areas are called out in a code (e.g. Neighbourhood/Area plan)	(Davidson & Dolnick, 2004)
Subdivision	The unit of land that is divided into multiple lots when subject to development, either greenfield, brownfield, or greyfield. Includes streets and public infrastructure serving these lots that are developed at the same time	(Davidson & Dolnick, 2004; Hodge et al., 2021)
Site	Individual property located on an individual legally defined lot	(Davidson & Dolnick, 2004)
Private	Who is responsible for implementing this intervention? Non-governmental bodies: Includes developers, private owners, and individual landowners	
Public	Who is responsible for implementing this intervention? Governmental bodies: Primarily the local government, this can include other institutions such as hospitals, schools, and other public agencies	

Table B.4. Planning Tools: Related to the measures and interventions exercised by local planning departments

Code	Definition	Reference
Objectives	Specific, desired outcomes or targets by a jurisdiction	(Hodge et al., 2021)
Goals	Desired general outcomes by a jurisdiction	(Hodge et al., 2021)
Guidelines	Prescriptive and actionable recommendations, exclusive of Development Permit Areas	(Carmona et al., 2010)
Development Permit Area (DPA)	From a jurisdiction's comprehensive plan (i.e. OCP) requirements instituted for a defined area through required development permits	(Hodge et al., 2021; Union of BC Municipalities, 2022)
Zoning	Land-use regulatory bylaws regarding the assignment of different land use types, density, forms, and requirements for each type of zone	(Hodge et al., 2021; Union of BC Municipalities, 2022)
Bylaws	Prescriptive requirements found in bylaws: regulations codified by elected local government representatives (excluding bylaws that cover Zoning/OCP/Area Plans)	(Union of BC Municipalities, 2022)
Research & Engagement	Calls for public engagement towards particular measures, technologies, incentives, or for further research to take place	

Table B.5. Equity

Code	Definition	Reference
Recognitional	Where different characteristics of the population (e.g. age, socioeconomic status, ethnicity) are noted for linkages to vulnerabilities, shaped by history and different intersecting identities	(Meerow et al., 2019)
Distributional	Where there are differences in vulnerability due to physical geography and differences in terms of access to land use, infrastructure, amenities, goods, services, and opportunities	(Meerow et al., 2019)
Procedural	Where there is a recognition that *participation and planning for heat mitigation* should incorporate less-represented and more vulnerable groups	(Meerow et al., 2019)

References Specific to Coding Key:

Bartesaghi Koc, C., Osmond, P., & Peters, A. (2017). Towards a comprehensive green infrastructure typology: A systematic review of approaches, methods and typologies. *Urban Ecosystems*, *20*(1), 15–35. https://doi.org/10.1007/s11252-016-0578-5

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