

2021

URBAN HEAT READY: SURREY CITY CENTRE

PROJECT PRIMER AND CURRENT REALITY ASSESSMENT

IN PARTNERSHIP WITH



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Introduction

City of Surrey is one of the fastest growing and culturally diverse cities in Canada working towards a long-term vision of a thriving, green, and inclusive city. Led by an award-winning Sustainability Charter 2.0, Surrey is actively pursuing ways to address the impacts of climate change.

Surrey's Climate Adaptation Strategy (2013) identifies minimizing the urban heat island (UHI) effect as a priority action under the Health and Safety sector of the plan. With climate projections suggesting hotter and drier summers in the years to come and the rapid urbanization and densification anticipated for Surrey, it is critical to address both the short-term cooling needs of the Surrey community and explore long-term solutions to urban heat impacts through land-use guidelines and innovative green design methods.

In February 2020, City of Surrey launched Urban Heat Ready, a two-year project that will focus on the rapidly densifying and urbanizing Surrey City Centre and bring together residents, frontline community organizations, building development professionals (e.g., developers, landscape architects, building operators), City staff and subject matter experts to collaborate and co-create lasting solutions to urban heat in our community. Project goals for Urban Heat Ready are to:

- **Understand** community cooling needs and existing cooling solutions, assets and best practices;
- **Generate** ideas on how to develop and urbanize with heat in mind; and
- **Collaborate** with community members to co-create lasting community-supported solutions to urban heat.

Co-created and community-supported solutions may include:

- Neighbourhood level interventions such as establishing an informal "heat network" and ambassador program, seasonal cooling centres, and community greening initiatives;
- City planning and policy interventions such as implementing a green roof or green wall policy for Surrey City Centre; and
- Updating Surrey City Centre design guidelines to integrate occupant thermal comfort (aligned with the BC Energy Step Code), applying best practices in urban heat mitigation opportunities and design to Surrey's Official Community Plan.

Lessons from this project will be shared with colleagues across City of Surrey's regional, national, and international partners through Metro Vancouver, Fraser Health Authority, Canadian Urban Sustainability Practitioners (CUSP) Network and the Urban Sustainability Directors Network (USDN).

Document Purpose

This document provides a general context for the Urban Heat Ready project and a 'Current Reality' snapshot of Surrey City Centre which will be the focus neighbourhood throughout this project. This document builds on Surrey's existing studies and research on urban heat impacts and can be used in tandem with *The Urban Heat Island Effect in the City of Surrey: Managing Urban Temperatures in the Context of Climate Change* report from 2017 (available upon request).

Surrey City Centre residents, frontline community organization representatives, City staff, building development professionals and other stakeholders can use this document to build a shared understand of the project background, purpose, goals and anticipated approaches to building an urban heat ready Surrey City Centre.

COVID-19

Soon after the launch of Urban Heat Ready in February 2020, the world was confronted with the COVID-19 crisis, shifting the focus of City of Surrey and its staff to providing essential services that ensure the safety and well-being of those impacted by the crisis.

The City temporarily put a stop to all community engagement initiatives. As Surrey recovers from this pandemic, the Urban Heat Ready Project Team will revisit community engagement approaches, and explore virtual engagement opportunities while looking to re-incorporate in-person engagement if and when health and safety protocols allow.

The Project Team also recognizes that the impacts of COVID-19 are not uniform across Surrey. Some community members are harder hit by the crisis including low-income households, families with children, and seniors in long-term care facilities, among others. With support and guidance from the project's Steering Committee, Advisory Committee, Technical Advisors and other community members, the Project Team will strive to create a transparent and inclusive engagement process that is in line with the current capacity of the community.

Statement of Recognition and Respect

The Urban Heat Ready Project Team recognizes that our work in City of Surrey takes place on the traditional territories of the Semiahmoo, Katzie, Kwikwetlem, Kwantlen, Qayqayt, and Tsawwassen First Nations.

About the Funder

The Urban Heat Ready project is made possible with funding from the Real Estate Foundation of British Columbia.

The Real Estate Foundation of British Columbia is a philanthropic organization working to advance sustainable land use and real estate practices in British Columbia, Canada.

Project Partners

This project is supported by partners from various sectors including Fraser Health Authority, BC Housing, Metro Vancouver, Lower Mainland Facilities Management, Vancouver Foundation, Canadian Urban Sustainability Practitioners (CUSP) Network, Bullitt Foundation, University of British Columbia (UBC)'s Collaborative for Advanced Landscape Planning (CALP) and Portland State University's Sustaining Urban Places Research (SUPR) Lab.

Project Context and Background

Climate change projections for Metro Vancouver suggest that Surrey will experience hotter and drier summers in the years to come¹ (see Table 1). By the 2050s Surrey is projected to experience 55 days where temperatures will be above 25°C, more than doubling the historic average of 22 days per year. The number of heat days, or days where temperatures are above 30°C, is also projected to increase from 2 heat days per year to 29 heat days per year by the 2080s.

Table 1: Hot Summer Indicators

	Past	2050s	2080s
Summer days (Number of days above 25°C)	22	55	79
Heat days (Number of days above 30 °C)	2	14	29

Source: Metro Vancouver, 2016

Due to the historically temperate climate of our region, the risk posed by heat has generally been overlooked by both policy makers and residents². For example, there is a lower prevalence of air conditioning units across residential buildings in Surrey when compared to other regions that experience hotter summers in Canada. Furthermore, Surrey residents are less likely to have acclimatized (adjusted to hotter temperatures) due to the historically temperate climate of our region. Those who have acclimatized through repeated exposure to high summer temperatures can be more tolerant to hot weather and experience less heat illnesses³.

Residents' perception of heat as a serious risk factor can also influence whether they experience the adverse impacts of heat.⁴ In other words, residents who perceive heat to be a risk are more likely to modify their behaviour after a heat warning is issued, better protecting themselves in the event of a heat wave. However, given the historically temperate climate of our region, heat is seldom considered as a risk factor, further increasing residents' vulnerability to heat.

Health impacts from high temperatures can be deadly. An eight-day extreme heat event (commonly known as a heat wave) in 2009 led to an estimated 156 deaths in British Columbia⁵.

¹ Metro Vancouver (2016). Climate Projections for Metro Vancouver

² BC Centre for Disease Control (2017). Developing a Municipal Heat Response Plan: A Guide for Medium-sized Municipalities

³ Health Canada (2011). Communicating the Health Risks of Extreme Heat Events: Toolkit for Public Health and Emergency Management Officials

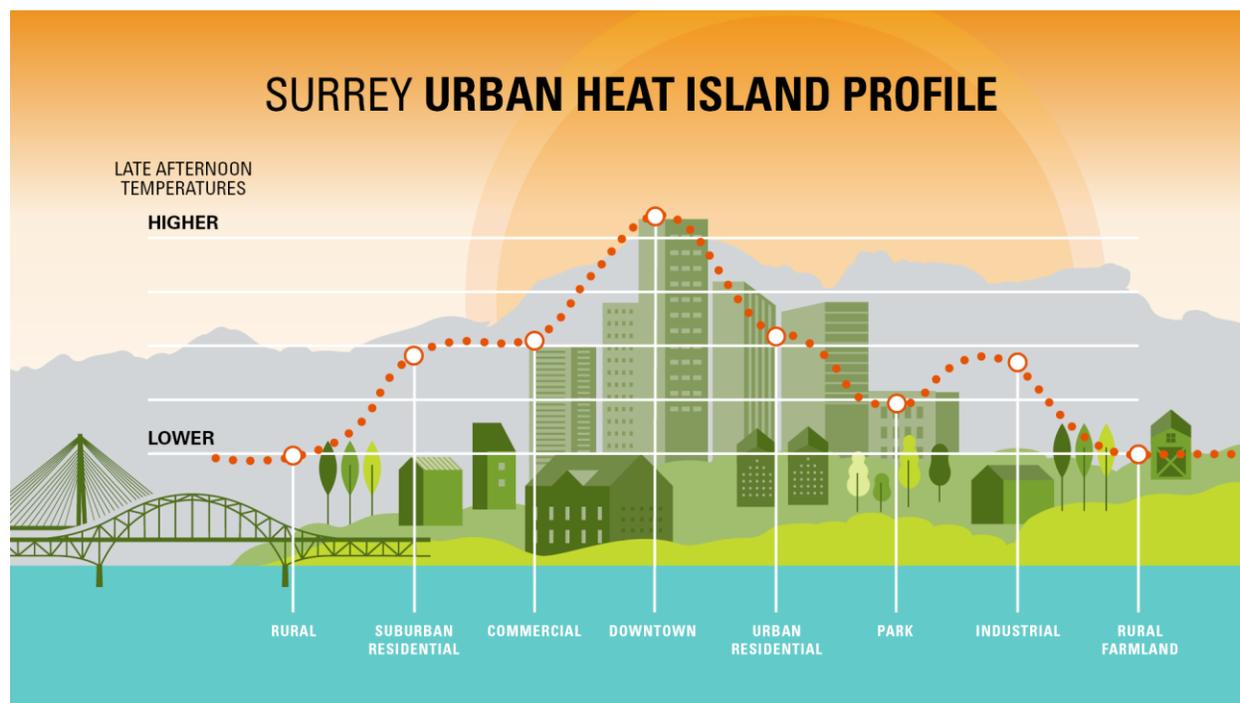
⁴ Stewart, R.E., Betancourt, D., Davies, J.B. *et al.*, (2017) A multi-perspective examination of heat waves affecting Metro Vancouver: now into the future

⁵ Kosatsky, T. (2010). Hot Day Deaths, Summer 2009: What Happened and How to Prevent a Recurrence

Many victims were either in the 65–74 age group, low-income, or people experiencing mental health illnesses⁶.

Physical and environmental factors can also influence the severity of heat impacts⁷. Some parts of Surrey are already hotter than others due in part to their built environment (e.g., more concrete buildings, roads and sidewalks, and less green spaces and trees). Dense urban areas like Surrey City Centre tend to be hotter than surrounding areas (see Figure 1) as explained by the urban heat island (UHI) effect⁸ (see Appendix A for more information on the UHI effect). These warmer temperatures in urban centres can magnify health risks during heat waves and impact the quality of life and livelihoods of residents in urban areas.

Figure 1: Urban Heat Island Profile



Source: City of Surrey, 2021

Urban Heat Ready is an opportunity to invite and listen to the community’s lived experience with urban heat, employ the expertise of staff and building development professionals to explore opportunities to address cooling needs, and work collaboratively to co-create lasting solutions, interventions and build resilience to shape an urban heat ready City for the future.

⁶ Stewart, R.E., Betancourt, D., Davies, J.B. *et al.*, (2017)

⁷ Stewart, R.E., Betancourt, D., Davies, J.B. *et al.*, (2017)

⁸ Health Canada (2015). Adaptation Bulletin: Reducing the Urban Heat Island Effect in Canadian Communities

Project Roots

In 2017, a graduate student research project was conducted to provide in-depth and localized context on the UHI effects, its drivers, impacts, mitigation, and policy intervention opportunities for Surrey. The report, *The Urban Heat Island Effect in the City of Surrey: Managing Urban Temperatures in the Context of Climate Change*, recommends that Surrey:

- Identify neighbourhoods that are already experiencing heat impacts due to the UHI effect and assess opportunities for cooling interventions such as planting more trees, de-paving unused asphalt spaces, and establishing cooling centres;
- Explore ways to integrate urban design solutions to future planning and development in the City to minimize the UHI effect; and
- Collaborate with staff from various City departments to maximize co-benefits of urban heat mitigation tactics e.g., green roofs help keep urban areas cool and improve storm water runoff, protecting the City's local streams and wildlife habitats.

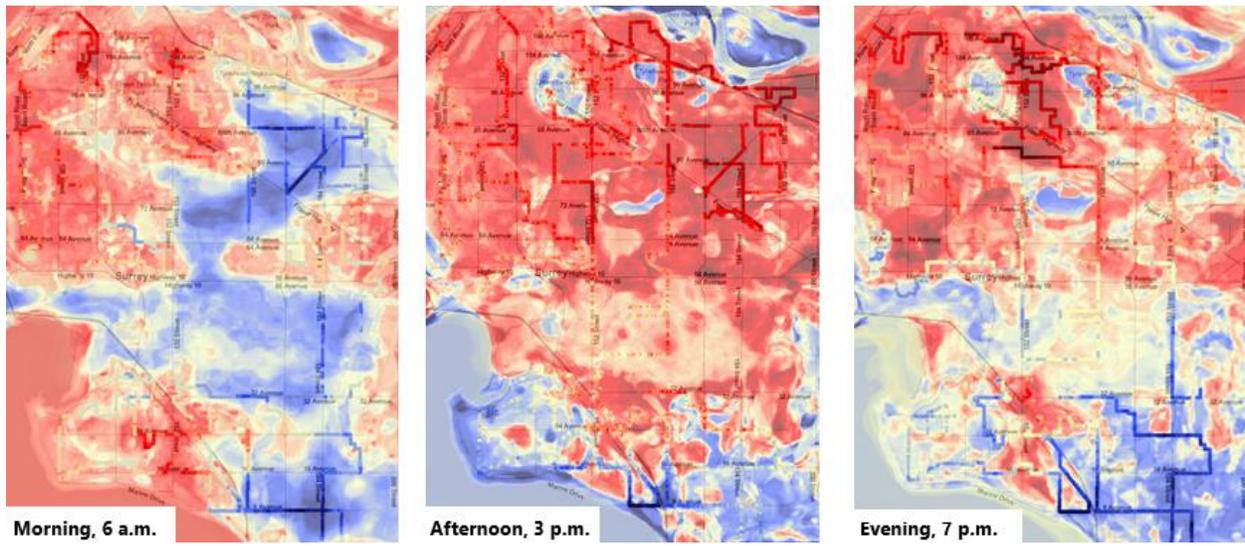
Urban Heat Ready builds on this report by bringing together residents, City staff and stakeholders across the community to better understand community cooling needs and existing cooling solutions, assets, and best practices, and to generate ideas on how to develop and urbanize with heat mind by identifying community-supported short-term and long-term solutions to urban heat.

Heat Mapping Campaign

In 2017, City of Surrey also partnered with Portland State University's (PSU) Sustaining Urban Places Research (SUPR) Lab to conduct a field mapping campaign to better understand the distribution of the City's urban heat.

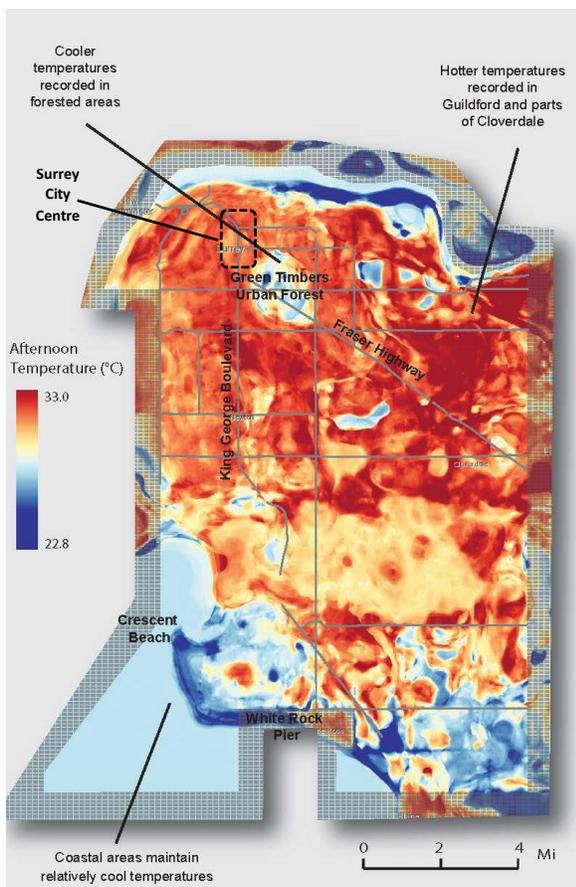
With support from SUPR Lab researchers, nine City staff volunteers took to the streets during a heat wave on August 28th and 29th with highly sensitive thermometers and with location detector GPS units mounted to their cars to collect real time information about the hottest places in Surrey. Each volunteer drove across one of the eight pre-determined routes at a pace between 20 and 50km per hour at three periods throughout the day (6 a.m., 3 p.m. and 7 p.m.). Along each route, the thermometers recorded the outdoor air temperature (ambient temperature) at one-second intervals across the City. The collected data was combined with satellite-derived land cover information (e.g., forests, buildings, roads) and analyzed using a machine learning algorithm that resulted in three distinct heat maps (see Figure 2). The satellite and ambient temperature data are critical to understanding how landscape factors (both built and green) can impact spatial and temporal variation in urban heat across Surrey.

Figure 2: Surrey Heat Campaign Maps



Source: SUPR Lab, PSU, 2017

Figure 3: 2017 Surrey Heat Map – Afternoon Temperature



Source: SUPR Lab, PSU, 2017

This project observed a 10°C temperature difference between the coolest and hottest areas in the City. The largest differences in temperature were observed in the evening. Urban areas like Surrey City Centre, and neighbourhoods within town centres of Guildford and Fleetwood as well as industrial lands such as Campbell Heights and Port Kells recorded some of the highest temperatures. Cooler temperatures were recorded in South Surrey, agricultural areas and near Green Timbers Urban Forest (see Figure 3).

Additionally, data from this campaign was integrated with the City's demographic data from the 2016 census as well as other spatial data, including the City's vegetation cover data, to create a Heat and Vulnerability Map of Surrey. This comprehensive tool can be used to help City staff pinpoint the most vulnerable areas of the City to urban heat.

Regional Initiatives

City of Surrey staff have been actively engaged in regional initiatives on climate adaptation, health and vulnerability, and green infrastructure. City of Surrey was an engaged partner for the REFBC-funded project *Community Resilience and Well-being Through Neighbourhood-scale Green Design* led by UBC CALP launched in 2018. Findings from this project will directly support Urban Heat Ready by informing design guidelines, shaping building development professional resources, and considering opportunities to pilot the green design interventions in Surrey.

The Urban Heat Ready Project Team is also closely engaged with the Climate Change and Health Adaptation Capacity Building Program’s (HealthADAPT) Community Health and Climate Change project that will support Lower Mainland health authorities (including Fraser Health Authority) prepare and adapt to climate change impacts by increasing climate resiliency of the health system. Aligning approaches between the City and Fraser Health Authority strengthens the critical systemic approach to addressing climate adaptation hazards and impacts in Surrey.

Heat Risk and Inequity

Not everyone experiences the impacts of heat in the same way. Some community members are more likely to bear the brunt of the urban heat burden (see Appendix B). Furthermore, as outlined in Table 2, both individual and community factors can increase the likelihood of a person’s heat exposure and vulnerability⁹.

Table 2: Individual and Community Factors Impacting Heat Vulnerability

Community Factors	Individual Factors
Local climate – Higher frequency length and severity of extreme heat events, humidity levels, night-time temperatures, seasonal weather variability.	Health status – Chronic illness, pre-existing mental health needs, need for medications that increase heat-health risks, dependence on caregiver.
Community design – Cities are often warmer than their non-urban surroundings (phenomenon referred to as the urban heat island effect) which is increased by black roofs or concrete surfaces that hold heat and release it at night, and limited tree-shaded areas that have a cooling effect and could be as much as 5°C cooler than the surrounding area.	Air conditioner – Availability of an air conditioner and its use during extreme heat events.
	Social isolation – Limited access to heat-health information and services.
	Income level – Utility bill arrears, concerns with costs associated with running an air conditioner and accessing other cooling options.
Availability and accessibility of services to cope with extreme heat – Public transportation, health services, community outreach services, easy-to-access cooling options with air-conditioning.	Behaviours during extreme heat events – Strenuous physical activity, inadequate hydration, type of clothing.
	Type and location of place of work/residence – Individuals in occupations with high temperature exposure or those living on higher residential floors without an air conditioner, those precariously housed and homeless.

Source: Health Canada, 2011

Urban Heat Ready centres equity as a project value with the goal of reducing the disproportionate heat impacts on certain communities. Centering equity in this project means:

- Acknowledging that environmental inequalities, like exposure to heat, often exist in majority low-income neighbourhoods and in marginalized communities;

⁹ Health Canada, (2011)

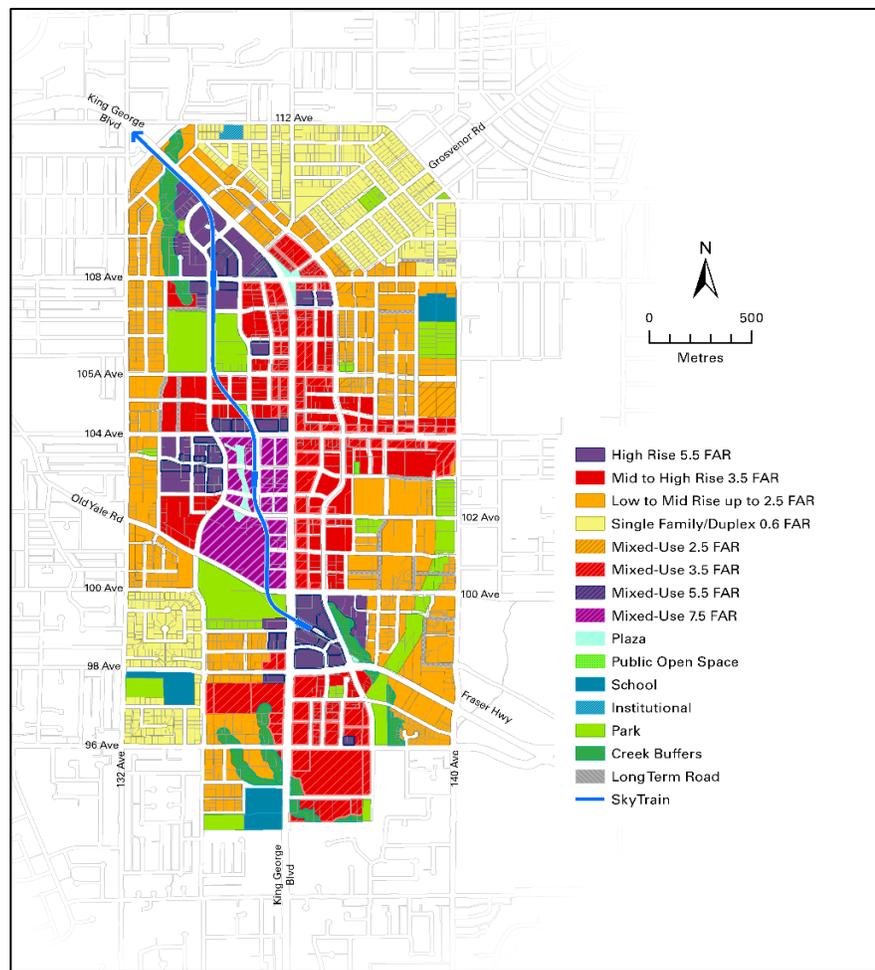
- Pursuing inclusive practices that value, uplift and amplify the voices and experiences of marginalized communities;
- Understanding how City of Surrey’s systems, policies and procedures might create barriers that maintain these inequities; and
- Prioritizing and redirecting resources towards dismantling these barriers where possible.

By actively engaging community members with lived experience and frontline community organizations that support those at risk of heat impacts, the City can identify solutions and opportunities that are most effective in addressing urban heat in the local context.

About Surrey City Centre

Geographically located in the northwest area of the City, Surrey City Centre is undergoing a significant transformation. What was once a suburban town centre is rapidly developing into a walkable, transit-oriented downtown serving the vast area south of the Fraser River, attracting significant investments in high density residential, commercial, mixed-use, and institutional development (see Figure 4).

Figure 4: Surrey City Centre Plan Area



Source: City of Surrey, 2017

In October 2019, Surrey Council approved staff to undertake a review of the City Centre Plan. This review provides an opportunity for recommendations from Urban Heat Ready to be considered in the new Surrey City Centre Plan by actively integrating community-supported urban heat mitigation solutions, minimizing the UHI effect over the long term, and increasing resilience of the Surrey City Centre community to urban heat.

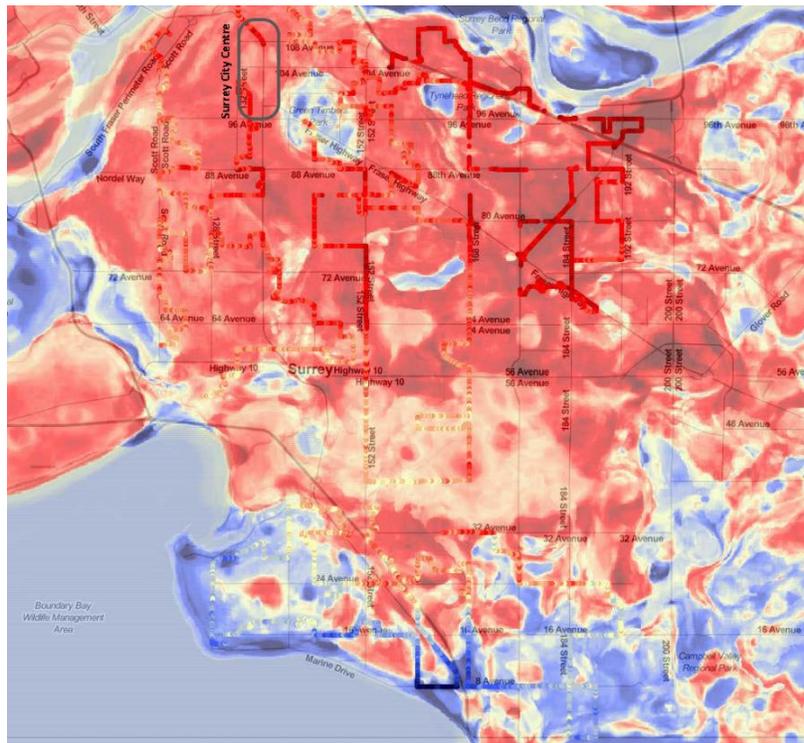
Why Focus on Surrey City Centre?

The Metro Vancouver Regional Growth Strategy designates Surrey City Centre as the region's second metropolitan centre and the centre of activity south of the Fraser River¹⁰. Surrey City Centre is also:

One of the hottest neighbourhoods in Surrey

- Surrey's 2017 heat mapping campaign identified a dozen neighbourhoods that were at times, 10°C hotter than other areas in the City. Surrey City Centre was one of these identified neighbourhoods (Figure 5).

Figure 5: Surrey City Centre Outline in Surrey Heatmap (Afternoon)



Source: SUPR Lab, PSU, 2017

Rapidly growing and densifying

- Though Surrey City Centre encompasses only 548 hectares, about 1.7% of Surrey's total land area, it is estimated that by 2046, close to 10% of Surrey's population will be living in Surrey City Centre¹¹.
- Between 2011 and 2016 Surrey City Centre's population grew by 18% compared to Surrey's overall population growth rate of 11%¹².

¹⁰ Metro Vancouver (2010). Metro Vancouver 2040 Shaping Our Future

¹¹ City of Surrey. Population Projections 2020 – 2046

¹² City of Surrey (2016). City Centre Community Profile

A regional hub of activity

Transit Hub

- 36% of Surrey City Centre residents commute to work using public transit¹³, significantly higher than the Surrey average of 15%¹⁴.
- An important and growing rapid transit hub for the region with three Expo Line SkyTrain stations (Gateway, Surrey Central, and King George).
- Plans are underway to extend the Expo Line SkyTrain by 16 kilometers to Langley City Centre along Fraser Highway, expanding connectivity within the region.

Post Secondary Education Hub

- Simon Fraser University (SFU) established its Surrey Campus in 2005 and recently unveiled its Sustainable Energy & Environmental Engineering Building where its School of Sustainable Energy and Engineering (SEE) welcomed its first cohort in Fall 2019. The institution plans to continue to expand its Surrey presence in Surrey City Centre in the decades to come.
- Kwantlen Polytechnic University's (KPU) newest campus is situated in the heart of Surrey City Centre offering post-baccalaureate and graduate diplomas and programs in continuing and professional studies.
- Douglas College, Sprott Shaw College, and Stenberg College also have satellite campuses in Surrey City Centre.

Healthcare Hub

- Surrey Memorial Hospital is the largest of three regional hospitals in Fraser Health's integrated network of care and the second largest hospital in the province with the busiest Emergency Department¹⁵.
- The Health and Technology District is BC's rapidly growing and dynamic new health-tech sector emerging around Surrey Memorial Hospital in Surrey City Centre. This district will include eight high-tech buildings encompassing over one million square feet and is expected to attract 500 companies and created estimated 15,000 direct and indirect jobs¹⁶.

Home to many of Surrey's most at-risk population

- Average household income is \$53,761, about 43% lower than Surrey's average household income of \$93,586¹⁷.
- 1 in 4 residents, or 25% of the population, are considered to be low income in this neighbourhood¹⁸.

¹³ City of Surrey (2016). City Centre Community Profile

¹⁴ City of Surrey (2016). City of Surrey City Profiles

¹⁵ Fraser Health Authority (2020). Surrey Memorial Hospital

¹⁶ The Real Estate Institute of BC (Spring 2020). INPUT: Health Care Facilities

¹⁷ City of Surrey (2016). City Centre Community Profile

¹⁸ City of Surrey (2016). City Centre Community Profile

- 39% of seniors are considered to be low income¹⁹.
- 5% of Surrey's urban Indigenous population live in this neighbourhood²⁰.
- 57% of households are renter households²¹, significantly higher than the Surrey average of 29%²².
- 43% of renter households spend more than 30% of their household income on rent²³. In Canada, housing is considered unaffordable if rent costs more than 30% of a household before tax-income²⁴.
- Many residents are experiencing energy poverty and struggle to cool and heat their homes and power their lights and appliances²⁵. A household is considered to be in energy poverty if they are spending over 6% of their total after-tax household income to meet their home energy needs.
- Residents report a low sense of community belonging²⁶. In fact, Surrey City Centre residents reported the lowest sense of belonging when compared to all other Metro Vancouver neighbourhoods in the My Health My Community survey from 2014.
- 644 residents are experiencing homelessness in Surrey²⁷, many of whom access services and programs offer in and around Surrey City Centre.

Urban Heat Ready will help facilitate discussions with community stakeholders on ways to future-proof Surrey City Centre from the impacts of urban heat. In doing so, Surrey can better protect the livelihoods, assets and investments made by its growing community of residents, community organizations, businesses, and in Surrey City Centre.

¹⁹ City of Surrey (2014). Age Friendly Strategy for Seniors

²⁰ City of Surrey (2016). City Centre Community Profile

²¹ City of Surrey (2016). City Centre Community Profile

²² City of Surrey (2016). City of Surrey City Profile

²³ City of Surrey (2016). City Centre Community Profile

²⁴ Canada Mortgage and Housing Corporation (2018). About Housing Affordability in Canada

²⁵ CUSP (2019). The Many Faces of Energy Poverty in Canada

²⁶ My Health My Community (2014). Neighbourhood Health Indicators – Surrey Central

²⁷ BC Non-Profit Housing Association (2020). 2020 Homeless Count in Metro Vancouver

Project Overview

How Our Approach Advances Existing Body of Work on UHI Mitigation

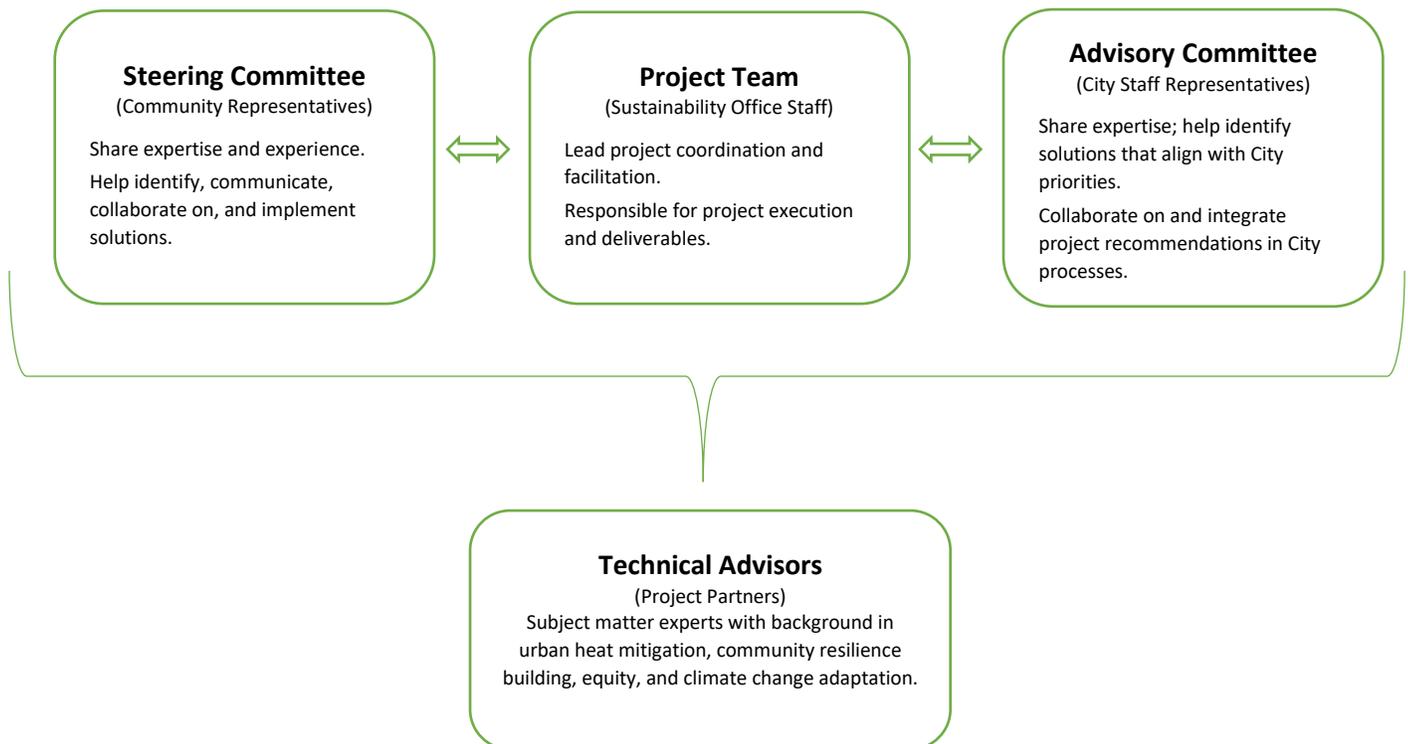
While there are many proposed infrastructure solutions to urban heat and opportunities to build community resilience to the impacts of climate change, there are few examples of municipal approaches that focus on the needs of the communities most impacted by urban heat. Urban Heat Ready seeks to identify short-term and programmatic opportunities that meet the needs of those most vulnerable while also identifying practical long-term infrastructure and built environment solutions that can yield the greatest benefit for all.

The Project Team have connected with peers in the City of Philadelphia, Pennsylvania and the City of Portland, Oregon to learn about their experiences, successes, and challenges in working on similar community engaged urban heat projects and documenting best practices along the way. Staff are also following various urban heat projects across the region and are open to learning from and sharing project findings with others.

Project Governance

Urban Heat Ready is supported by a project Steering Committee, Advisory Committee and Technical Advisors (see Figure 6).

Figure 6: Urban Heat Ready Governance Structure



Source: City of Surrey, 2020

Project Phases and Timeline

Urban Heat Ready includes five project phases as outlined in Figure 7 below:

Figure 7: Project Phases



Source: City of Surrey, 2020

Phase 1: Foundation Building (February – July 2020) COMPLETED

During this phase, the Project Team focused on building foundational relationships with potential partners and stakeholders and developing project resources and engagement materials including the project website. The Project Team established the Advisory and Steering Committees by presenting at community tables and engaging in 1-1 conversations with potential committee members. Additionally, the Project Team reviewed existing City policies, guidelines, and other relevant documents to build a strong foundational understand of existing best practices and opportunities across the City and beyond to be considered throughout the project.

Phase 2: Community Engagement (August– October 2020) COMPLETED

During this phase, a Communication and Engagement Strategy was drafted, and community engagement opportunities identified to better understand how residents experience heat in the summer and to generate community supported interventions to minimize urban heat in Surrey City Centre.

Engagement activities included a social media campaign, mail drops delivered to over 16,000 residential units in Surrey City Centre as well as a resident survey that received close to 1,000 responses. This survey helped map out existing community cooling practices, needs and barriers, preferred land-use interventions, as well as data on the prevalence of air conditioning units within the community. Engagement results were compiled in an engagement summery report and shared with the Advisory and Steering Committees for discussion and made available to the community on the project website.

All in-person engagement activities were cancelled during this phase due to the COVID-19 pandemic.

Phase 3: Reflection and Action (November 2020 – May 2021) UNDERWAY

During this phase, the Project Team is working with subject matter experts and consultants to lead hands-on workshops, focus groups and scenario modeling exercises to test out and evaluate potential solutions to urban heat in Surrey that reflects community feedback from the previous

phases. This phase focuses on engaging City staff, building development professionals and representatives from frontline community organizations.

Phase 4: Community Engagement (June – September 2021) PLANNED

The second round of summer community engagement will invite residents to participate in follow-up project surveys, focus groups and community walking tours (dependant on COVID-19 restrictions), implement existing community engagement best practices such as CALP's Citizen's Toolkit activities, and help generate support for heat-relieving interventions. Facilitated virtual community mapping and a modified version of USDN's "Game of Heat" can be a fun and engaging opportunity to receive community feedback on the proposed heat-relieving interventions and strategies. Engagement activities planned for Phase 2 that were postponed due to the COVID-19 pandemic will also be implemented in this phase.

Phase 5: Project Wrap up and Legacy Building (October – February 2022) PLANNED

For the final phase, the Project Team will work closely with the Steering Committee and Advisory Committee to finalize project recommendations and strategies as informed by engagement input. During this final phase, the Project Team will pursue knowledge-sharing opportunities to broadly communicate the project approach, process and outcomes with other municipalities interested in this issue by actively sharing resources through Metro Vancouver, Fraser Health Authority, CUSP and USDN.

Upon project completion, legacy documents from will remain available to be leveraged in the creation of interventions, strategies, and roadmaps in the future to help transform Surrey's heat landscapes in the short- and long-term. For example, items could include land-use policies, green (e.g., tree) and built environment (e.g., building material, rooftop standards), and neighbourhood cooling and heat response plans.

Closing Notes

This collaborative Urban Heat Ready project seeks to build a better understanding of the UHI effect's impacts in Surrey City Centre and support ongoing discussions to Surrey's heat response efforts and community cooling resources. The outcomes of this project aims to have lasting impacts on Surrey's urban heat landscape starting with its Surrey City Centre and implemented in different contexts throughout the City and the region. The project seeks to support the City to strengthen relationships and foster trust with residents, frontline community organizations, and the building development professionals. Lessons from this project can have multiplying effects within Surrey and beyond and prepare the City for the impacts of urban heat.

Appendix A: What is the Urban Heat Island Effect?

Dense urban areas tend to experience hotter temperatures due to the pattern of urban development and this is magnified by the urban heat island (UHI) effect²⁸.

Table 3: Factors that contribute to urban heat

Loss of vegetation	Urban development, including the removal of trees, shrubs and green spaces and the increase in impermeable surfaces reduces the natural cooling capacity of an area.
Materials used	Heat absorbing materials used in buildings, pavements and roads such as asphalt, tar, and concrete can intensify both surface and air temperatures.
Building typology and urban geometry	Building size, height, form and arrangement can alter air flows and trap heat in urban areas.
Heat release	Heat release into the air from human activities such as building heating and cooling systems, electronic equipment, and vehicles can exasperate UHIs.

Source: Health Canada, 2020

Appendix B: Heat Impacts and Risks

Heat impacts everyone, but some people are at a greater risk. According to Health Canada, populations most susceptible to heat related illness and death include²⁹:

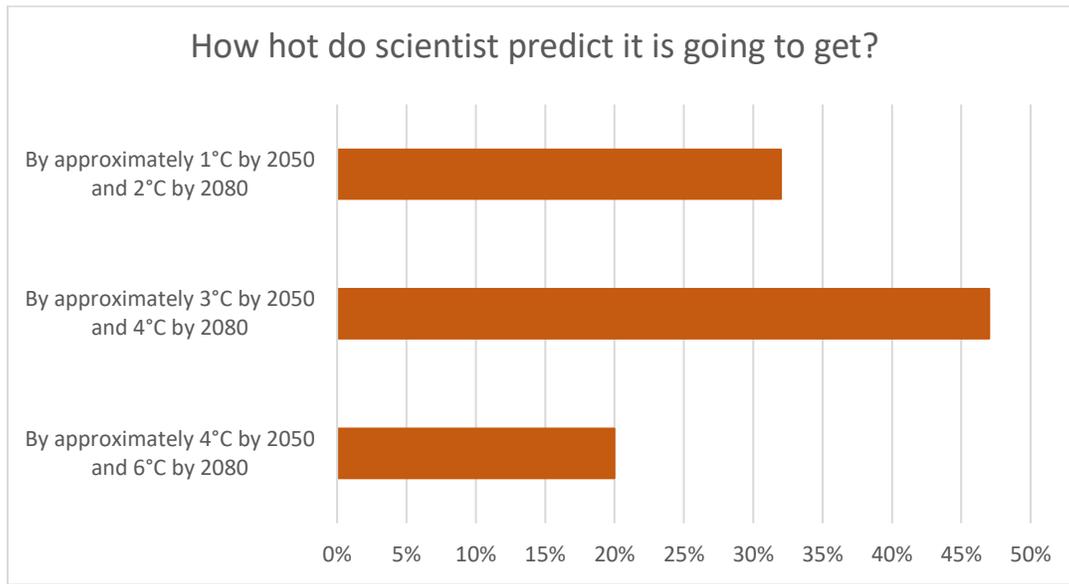
- Older adults
- Infant and young children
- People with chronic illness or who are physically impaired
- Individuals and communities who are socially disadvantaged
 - People (or households) with low income
 - People who are precariously housed or homeless
 - People living alone/ socially isolated
- Refugees and newcomers to Canada
- Other

Due to the historically temperate climate of the Metro Vancouver region, residents are largely unaware of the impacts of extreme heat on their health and wellbeing. A HealthChat survey on Extreme Heat conducted by Fraser Health in 2019 found that most people underestimated the amount of temperature rise in Metro Vancouver due to climate change.

²⁸ Health Canada (2020). Reducing Urban Heat Island To Project Health in Canada: An Introduction for Public Health Professionals

²⁹ Health Canada, (2011)

Figure 8: HealthChat Extreme Heat Survey Result



Source: Fraser Health, 2019

Data graphed by City of Surrey staff using HealthChat Extreme Heat Survey Results by Amy Lubik and Sergio Pastrana

The survey also found that while most respondents were aware of age and pre-existing medical conditions as risk factors for extreme heat related illness, not many were aware of mental illness, behavioural disorders due to drug or alcohol use and living circumstances (e.g., social isolation, reduced income, reduced access to cooling options, confinement to bed) as risk factors.

Table 4: Heat-vulnerable groups and examples of challenges they may face in adapting to extreme heat events

Heat-Vulnerable Groups	Examples of Challenges
Older adults	<ul style="list-style-type: none"> • Physiological characteristics that may contribute to increased vulnerability to heat: <ul style="list-style-type: none"> ○ reduced thirst sensation ○ reduced fitness level ○ reduced sweating ability ○ increased susceptibility to chronic dehydration • Visual, cognitive and hearing impairments • Agility and mobility challenges • Differing perceptions of risks and vulnerabilities based on life experiences • Reduced literacy • Social isolation
Infants and young children	<ul style="list-style-type: none"> • Physiological and behavioural characteristics that may contribute to increased vulnerability to heat: <ul style="list-style-type: none"> ○ increased body heat production during physical activity

	<ul style="list-style-type: none"> ○ faster heat gain from the environment if air temperature is greater than skin temperature, due to greater surface-area-to-body weight ratio ○ inability to increase cardiac output ○ reduced sweating ● Dependence on caregiver to recognize heat impacts and take recommended actions
People with chronic illness or who are physically impaired	<ul style="list-style-type: none"> ● Physiological characteristics that may amplify health risks, such as failing cardiovascular or respiratory system, psychiatric illnesses, renal illnesses ● Taking certain medications that affect heat sensitivity by interfering with the body’s cooling functions or water/salt retention (e.g., antihypertensives, antidepressants, antipsychotics, anti-Parkinsonian) ● Confined to bed or dependence on caregiver, family or friends for assistance with daily living (e.g., water access) ● Communication, sensory, cognitive impairment ● Characteristics related to health status or behaviour (e.g., chronic dehydration, does not leave home) ● Social isolation
Socially disadvantaged individuals and communities: <ul style="list-style-type: none"> ● Low income ● Homeless ● Living alone 	<ul style="list-style-type: none"> ● Limited financial resources to adequately take protective actions ● Reduced access to clean water and cool places ● Limited access to health care and social services ● More environmental exposures (e.g., homeless, living on higher floors with no air conditioning) ● Higher rates of alcohol and drug dependency ● Social isolation
Newcomers to Canada and transient populations such as tourists	<ul style="list-style-type: none"> ● Language and literacy barriers for non-English or -French speakers ● Cultural differences, such as food consumption habits, clothing choices, pre-existing social or cultural beliefs ● Unique media use patterns ● Limited knowledge of local alert systems, health and social service programs
Occupational groups	<ul style="list-style-type: none"> ● Environmental and workplace exposures (e.g., farmers, construction workers, miners, tree planters) ● Increased physical strain ● Variation in health and safety regulations, codes and standards ● Irregular exposure to heat (i.e. lack of acclimatization) for new workers with job-related heat exposures and those faced with early season extreme heat events
The physically active	<ul style="list-style-type: none"> ● Greater environmental exposures (e.g., marathon runners, recreational athletes, people who walk or bike) ● Increased physical strain ● Reduced perception of risks and heat vulnerabilities ● Expectation of usual performance in the heat

Source: Health Canada, 2011

Glossary

Acclimatization

Acclimatization refers to the physiological adaptations in response to repeated exposure to a hot / dry or a hot / humid environment and can have a dramatic effect on a person's ability to tolerate these types of conditions. People who have adjusted to heat (acclimatized) through improved thermoregulation and repeated exposure to high summer temperatures can be more tolerant of hot weather and experience less heat illnesses.

Ambient Temperature

Ambient temperature refers to the common measurement of how hot or cold it is outdoors, usually measured in degrees Celsius or degrees Fahrenheit. Studies have shown a clear relationship between increases in morbidity, mortality and increasing ambient temperature, above a "threshold" value, which varies from place to place.

Building Development Professionals

An umbrella term used throughout the Urban Heat Ready project to describe professionals in building design, development and operations including developers, landscape architects, urban planners, and others.

Extreme Heat Event

There is no standard definition of an extreme heat event, commonly known as a "heat wave". Most jurisdictions define extreme heat events based on the potential for prolonged hot weather conditions resulting in significant levels of health effects, including increased mortality.

Heat Days

Heat days refers to the number of days where the daytime temperature exceeds 30°C.

Heat Wave

A commonly used term for extreme heat event.

Urban Heat Island Effect

The urban heat island (UHI) effect is a phenomenon where the ambient temperature in an urban area is hotter than that of surrounding rural areas. UHIs occur where there is minimal vegetation cover and a high percentage of dark surfaces such as roofs, asphalt roads or parking lots. The dark surfaces absorb the sun's rays and radiate it out slowly, thereby increasing the ambient temperature. UHIs can exacerbate the impact of an existing extreme heat event, putting additional stress on the health of vulnerable people.

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