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The Impact of Extreme Heat Conditions on Montréal's Urban Development

Formal Report

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ABSTRACT

Background: One of the most imminent consequences of climate change is the increased frequency and intensity of heat waves leading to negative health repercussions. In Québec, July 2018 was marked by another unprecedented heat wave. The purpose of this study is to examine the impacts of heat waves occurring within the region and investigate how the City of Montréal should intervene more rapidly during these increasingly recurrent extreme heat events. Further investigation of intervention methods is needed to prevent further casualties throughout the region during increased climate abnormalities.

Methods: Based on a review of key research as well as interviews with local authorities and experts, this report assesses whether there is widespread action that can be taken within the development sector to reduce potential health risks from extreme heat temperatures. This report covers five major topics: what we know about urban heat islands, what research indicates about urban heat islands and health effects, what segments of society are at the greatest risk of heat fatalities, what local government authorities and the public have to say, and what actions are being taken locally and federally to avoid future risk.

Results: To combat the heat disparities from previous years and to prevent further casualties, the City should focus on ways for further increasing the ownership of household air conditioning systems and other forms of urban cooling to mitigate the urban heat island effect, especially in residential areas.

Conclusions: This report concludes by acknowledging the ongoing crisis faced by the City of Montréal and by recommending immediate and relatively inexpensive precautionary steps for the community to reduce heat-related fatalities.

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INTRODUCTION

Overview

One of the most critical issues facing our world today is climate change, which the United Nations has described as one of the greatest challenges facing humanity (UN-HABITAT, 2011). Simply put, climate change is a byproduct of human-related driving forces such as the combustion of fossil fuels and land-use changes, with wide-ranging consequences for the planet and human settlements in all corners of the world. One of the most imminent consequences of climate change is the increased frequency and intensity of heat waves (Bustinza, Lebel, Gosselin, Bélanger, & Chebana, 2013). According to Bustinza et al. (2013), heat waves can have considerable health impacts, even in the context of developed countries. Since 1880, the global average surface temperature has increased by 0.85°C (Maslin, 2014), and as more and more CO₂ emissions are released into the atmosphere, the effects of climate change will gravely threaten and challenge human society.

Environment and Climate Change Canada (ECCC) (2010) has shown that in Canada, all four seasons have seen a warming trend since 1948. According to ECCC's study, the hottest year on record was surpassed in 2010 making it the warmest year for Canada in 63 years. The study showed that the temperatures for the 12-month period from December 2009 to November 2010 averaged 2.9°C warmer than normal and almost a half degree higher than the previous warmest years in 2006 and 1998. For Montréal Québec, July 2018 was marked by another oppressive heat wave during the period July 1st to 8th. Recent climate abnormalities in Montréal have led to unforeseen casualties amongst the local population, evidently becoming a very contentious issue in Canada. During the week of July 1 to July 8, 2018, heat indexes soared over 37°C, resulting in over 90 deaths throughout the province (Woods, 2018), leading many to speculate what the direct cause is behind these heat-related fatalities, and it has also prompted an investigation on how the region

should intervene more rapidly during these increasingly recurrent extreme weather events. Conclusive research may take years, meanwhile, concerned citizens worry about avoiding potential risks. Thus, further investigation on intervention methods is needed to prevent further casualties throughout the region during increased climate abnormalities.

Scope of Report

In order to develop cogent, balanced, and well-supported recommendations, the following report unpacks the following areas of inquiry:

1. What are the major problems associated with urban heat islands in Montréal?
2. How would implementing mitigation strategies in the development sector help improve the overall welfare of the City?
3. What have other cities done to mitigate this issue?

Methods

Based on a review of key research as well as interviews with local authorities and experts, this report assesses whether there is widespread action that can be taken within the development sector to reduce potential health risks from extreme heat temperatures. The primary data has been collected from two key individuals: Ms. Jackie Coffey, Acting Assistant to Councillor Tom Jackson for the City of Hamilton, Ontario; and Mr. Tyler Hermanson, a Senior Designer, Consultant, and Certified Energy Advisor in Calgary, Alberta. Secondary data includes a review of government reports available from the City of Montréal, media reports on heat waves in Montréal, and statistical data taken from Statistics Canada.

This scope of this report covers five major topics: what we know about urban heat islands, what research indicates about urban heat islands and health effects, what segments of society are at the

greatest risk of heat fatalities, what local government authorities and the public have to say, and what actions are being taken locally and federally to avoid future risk. This data and feedback from experts in the field concludes that in order to combat the heat disparities from previous years and to prevent further casualties, the City should focus on ways for further increasing the ownership of household air conditioning systems and other forms of urban cooling to mitigate the urban heat island effect, especially in residential areas. It will be up to the Montréal City Staff to decide if these recommendations fall within their budget and resources.

DATA SECTION

Context and Vulnerability to Heat Waves

The issue of rapidly changing climatic conditions is becoming increasingly more prevalent in Canada as well as around the world. In Montréal, there has been an upward trend of heat waves, with a 58% increase in high-humidex nights, between 1953 to 2012 (City of Montréal, 2017). On the territory of the Montréal agglomeration, there have been over 400 deaths attributed to heat waves in the last 30 years (City of Montréal, 2017). Montréal is particularly susceptible to heat waves because approximately 28% of the surface of Montréal is covered by urban heat islands (City of Montréal, 2017). Urban heat islands are the areas within a metropolitan region that are significantly warmer than the surrounding rural regions due to the concentration of asphalt and concrete which traps in heat. There are several contributing factors that cause urban heat islands such as the type of materials (i.e. bricks, stone, asphalt, tar, etc.), lack of vegetation, soil sealing, human activities (i.e. air conditioning, vehicle engines, and some industrial activities), and urban morphologies (i.e. narrow streets and tall buildings) (City of Montréal, 2017). Figure 1 shows a temperature map of the areas on the Island of Montréal that are hotter relative to the surrounding areas.

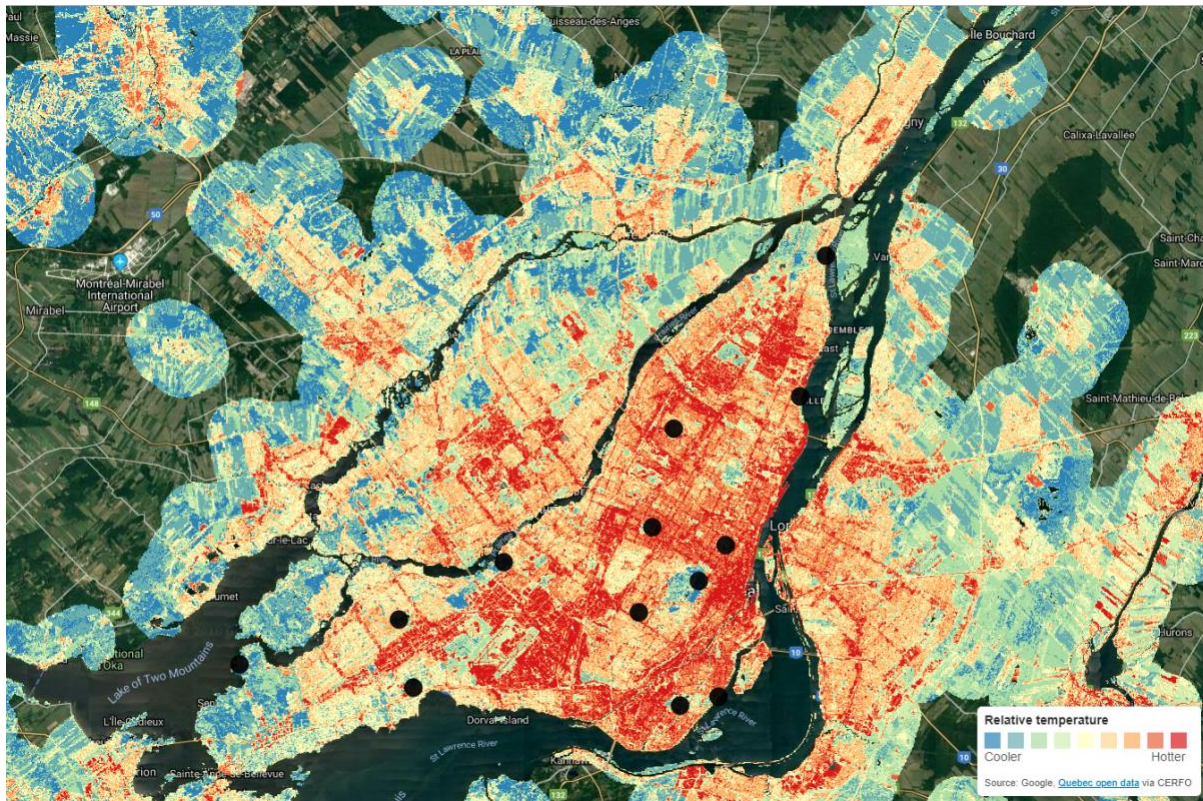


Figure 1. Temperature map of relative temperature differences on the Island of Montréal. Parks with tree cover are shown to be the coolest places on this map. The black circles represent the 13 sectors across Montreal that are both cool and contain a high percentage of tree coverage. Reproduced from *CBC News*, by R. Rocha, 2018, Retrieved from <https://www.cbc.ca/news/canada/montreal/montreal-warm-cool-places-interactive-1.3669639>

As the issue of climate change and its related effects continues to worsen, it has become overwhelmingly clear that heat-related issues are substantially affecting the development of cities. Montréal, and cities worldwide, have shown that heat waves can be fatal weather events. Incidentally, the Montréal agglomeration has experienced many extreme heat waves in the last 70 years (City of Montréal, 2017). Two particularly noteworthy heat episodes occurred in this region in 1987 and 1994 which resulted in 169 and 103 deaths respectively (City of Montréal, 2017).

Bustinza et al. (2013) notes that heat-related deaths are largely preventable through appropriate communication and prevention measures. Bustinza et al. further indicated that since 2006, a formal Heat Action Plan has been implemented at the provincial level for all relevant health regions in Québec to promote a more proactive approach. Moreover, Bustinza et al. also found that there have been

gradual changes in the population's behaviour during heat waves, particularly the increased use of air conditioning systems since 1987. For all households in Québec, the ownership of air conditioning systems increased from 15% to 42% in 2010 (Bustinza et al., 2013). Though despite the measures taken since the violent heat episode in 2010, further precautions are still needed in the development sector to prevent more people from falling victim to future deadly heat events.

Actors Involved and Views Expressed About the Issue

The majority of those who died in Montréal this summer from heat-related complications were living in private dwellings; however, four of the victims were living in rooming houses (i.e. private houses in which rooms are rented for temporary living), and eight were living in private seniors' residences (Laframboise, 2018; Woods, 2018). Canadian health authorities have also indicated that most of the victims were living in urban heat islands (Laframboise, 2018). The presence of populations that are vulnerable to this hazard are young children and seniors, especially those who live alone or suffer from chronic illnesses. This reality poses a particularly serious threat to residents in Montréal as Canadian cities, in general, are expected to undergo an ageing of the overall population (Bustinza et al., 2013). Furthermore, socioeconomic factors influence the vulnerability of citizens facing higher risks from oppressive heat conditions. Specifically, air conditioning is often not accessible to those in lower socioeconomic conditions (City of Montréal, 2017), reflecting severe social inequalities within the City.

Based on recent media reports, it appears that the City of Montréal is eagerly working to remediate this issue. The City indicated in its Climate Change Adaptation Plan 2015-2020 (City of Montréal, 2017) that heat waves are affecting municipal operations and services which often lead to an increased demand for facilities, such as pools, wading pools and splash pads, and for extended hours of operation at air-conditioned public spaces such as libraries and community centres. The

City's Adaptation Plan also indicated that due to this increased demand for services, Montréal is seeing an increased number of interventions and a higher demand for staff to provide services, maintain infrastructure and, enact emergency measures. Thus, it is in the City's best interest to mitigate this issue.

Furthermore, Québec's public health institute indicated that the province needs to invest one percent of its budget into creating green spaces in the city, which translates to approximately \$170 million per year (CBC News, 2018). Dr. Pierre Gosselin, head of the institute's climate and health program, has called the issue of urban heat islands "a major public health problem" (CBC News, 2018, para. 8). According to Gosselin, there can be a difference of 10 degrees under the shade of a tree compared to an open sidewalk. Additionally, Montréal Public Health released a recommendation report (Santé Montréal, 2018) to help prevent vulnerable residents from suffering in the event of future heat episodes. It reported that there needs to be a greater collaboration with the City and community organizations involved with rooming houses to monitor the residents when temperatures begin to increase (Laframboise, 2018).

Recommendations

Governments around the world are grappling with the effects of climate change in various ways. Craggs (2016) reported that, in Canada, city councillors in cities such as Hamilton, Ontario have recently ratified new climate-related city bylaws such as the "adequate heat bylaw" which reduced the length of time heat is required for rental properties from nine to eight months. As springs have begun to usher in warmer temperatures earlier than previous years, and summers are becoming prolonged, Craggs further reported that "adequate heat bylaw" idea came from Tom Jackson, Ward 6 councillor, who expressed that he had been getting complaints from people in seniors' buildings. Jackson stated in the media that, "instead of three months of having air conditioning, four will be

available” (Craggs, 2016, para. 7) however, when I reached out to Mr. Jackson via email correspondence to learn more about this heat initiative, I discovered that this is in fact false. In an emailed response sent by Jackie Coffey, Acting Assistant to Councillor Tom Jackson, she indicated that, “while the bylaw does speak to the timeframe in which heat must be provided, it does not mandate the provision of air conditioning. Some of our Hamilton Housing buildings do have central air for example, but due to the age of many of our buildings, it is not standard. So for those in rental units, the landlord must provide heating during the appropriate dates, but air conditioning is not required.” Though it is unfortunate the the City of Hamilton has not implemented any kind of cooling initiative, a similar initiative to this would be a useful first step for mitigation in the City of Montréal.

Wright (2016) reported that many city bylaws in Canada require that buildings remain heated during the winter months, with many utility companies not having the authority to turn off a home’s heat in winter, even if a bill goes unpaid. However, as Wright points out, there are no such bylaws in place to protect people when the temperature gets extremely hot. Wright further reported, in an interview with Alan Hedge, professor in the department of design and environmental analysis at Cornell University, heat can be more challenging to deal with than the cold. Hedge stated that Canadians are typically more accustomed to dealing with cold days than hot and the buildings in Canada are therefore ill-equipped to withstand extreme heat. Moreover, Hedge stated that Canadian cities also have a lot of concrete, which exacerbate the urban heat island effect making cities hotter than rural regions. With Health Canada expecting the number of extremely hot days to double in many parts of the country in the coming years, Hedge posits that Canadians begin thinking differently by designing environments that can keep people cooler when temperatures are extraordinarily hot (Wright, 2016).

The rising death toll prompted Montréal Public Health to suggest fighting the heat island effect by planting more trees and vegetation (Laframboise, 2018). However, since the majority of those who died in Montréal from heat-related complications were living in private dwellings, Montréal city staff should therefore focus their attention on residential dwellings. Tyler Hermanson, a Leadership in Energy and Environmental Design designated home designer in Calgary, indicated that if a house is well-built, then there should be no need for air conditioning (Wright, 2016). According to Hermanson via our discussion on LinkedIn, the same mechanisms that keep a house warm in the winter will likewise keep it cool in the summer. Hermanson specified by making smart choices regarding a home's structural soundness such as wall insulation, air-tightness, and window selections then one can lower the usage of air conditioning needed, at which point operation of air conditioning would lead to compromised energy efficiency.

Once the coroner's reports and all other records concerning the 2018 heat wave become available, a report will be done comparing this heat episode with the episode that occurred in 2010. Once completed, it will become apparent as to what measures Québec should take in order to reduce the death toll in future scenarios. What is discernible, is that many residents lack access to air conditioning, thus implementing household air conditioning systems in residential dwellings as well as other forms of urban cooling would be an adequate initial precaution in the prevention of heat-related deaths in Montréal.

CONCLUSION

In summary, the City of Montréal is contended with a heat crisis that is undoubtedly having negative impacts on certain segments of society, particularly young children and seniors who suffer from chronic illnesses, leading to higher mortality rates which can be only remediated through public mitigation. To combat the heat disparities from previous years and to prevent

further casualties, the City should focus on ways for further increasing the ownership of household air conditioning systems and other forms of urban cooling to mitigate the urban heat island effect, especially in residential areas. Heat-related mitigation and adaptation measures will also need to be more vigorously addressed by the Montréal city staff in order to make its citizens more resilient to climate change. The greatest challenge Montréal faces is dealing with these climate-related issues without deterring economic growth and prosperity. However, through the collaboration of Montréal city developers and policy-makers along with those engaged in research and development, the City can successfully implement innovative and effective solutions that will combat future heat extremities.

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