BNQ 3019-190/2013

Reducing the Urban Heat Island Effect — Parking Lot Development — Design Guide

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BUREAU DE NORMALISATION DU QUÉBEC

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Reducing the Urban Heat Island Effect — Parking Lot Development — Design Guide

Lutte aux ilots de chaleur urbains — Aménagement des aires de stationnement — Guide à l'intention des concepteurs

ICS: 13.020.40; 13.040.01; 91.120.99; 93.080.99

BUREAU DE NORMALISATION DU QUÉBEC

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FIRST EDITION — 2013-02-14

This document is published in both French and English. In case of incompatibility, the French version prevails.

The date of publication of this version corresponds to the date of publication of the French version, even though it was translated at a later date.

ISBN 978-2-551-25955-7 (printed version)
ISBN 978-2-551-25956-4 (PDF)

Legal deposit — Bibliothèque et Archives nationales du Québec, 2016

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Annexes are also informative and provide additional information intended to assist in the understanding or use of elements of this document or to clarify its implementation.

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FOREWORD

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The development of this document was made possible thanks to the financial support of the following organizations and funding sources: the Ministère des Affaires municipales, des Régions et de l'Occupation du territoire, Ouranos and the Québec government's Green Fund for Measure 21 of the 2006-2012 Climate Change Action Plan (CCAP). This project was also carried out in cooperation with Natural Resources Canada.

This document is offered free-of-charge through the financial support of the Ville de Montréal and the Québec government's Green Fund for Measure 21 of the 2006-2012 Climate Change Action Plan (CCAP).

The translation of this document was made possible thanks to the financial support of Health Canada.

The Bureau de normalisation du Québec (BNQ) is also grateful to the following people for their help reviewing the English terminology: Sheila Boudreau (Urban Designer, City Planning, City of Toronto) and Patrick Cheung (Senior Engineer, Toronto Water, City of Toronto).

This translation has been published under the responsibility of:

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REDUCING THE URBAN HEAT ISLAND EFFECT — PARKING LOT DEVELOPMENT — DESIGN GUIDE

INTRODUCTION

Eleven of the last twelve years rank among the warmest years recorded since 1995 and can be attributed to rising levels of greenhouse gases (GHGs) in the atmosphere [61]. North American cities, "that currently experience heat waves, are expected to be further challenged by an increased number, intensity and duration of heat waves during the course of the century" [61]. In Québec, the warmest ten years of the 20th century were recorded starting in the 1980s [66]. Projections indicate that average temperatures will continue to rise in the coming decades [61], [14].

This constant rise in temperature, which has been observed and is still projected, will accentuate an issue that has now become familiar: the urban heat island effect. Urban heat islands occur in urban areas where the surface temperature or ambient air temperature is significantly higher than the average temperature of the overall city. In addition to the local climate - influenced by various meteorological parameters like temperature, relative humidity and wind - several anthropogenic causes promote the emergence and intensification of urban heat islands. These causes are the progressive loss of forests and vegetation cover, the impervious nature and low albedo of materials, the thermal properties of materials, the urban morphology, the size of cities and the heat production associated with human activity (air conditioning, vehicles, commercial and industrial activity and so forth). Moreover, intensified urbanization exacerbates this phenomenon in Québec's southern regions.

Urban heat islands present a risk to public health, particularly to certain vulnerable populations, including socially isolated people and the elderly. Summer heat waves, accentuated by urban heat islands, can cause discomfort, weakness, loss of consciousness, cramps, fainting, heat stroke and can further exacerbate existing chronic illnesses like diabetes, respiratory failure and cardiovascular, cerebrovascular, neurological and kidney diseases to the point of causing death [13], [52]. On the recommendation of the World Health Organization, health agencies from around the world, including those in Québec, have instituted various programs to mitigate the effects of intense heat and to reduce urban heat islands. The Institut national de santé publique du Québec, in conjunction with the Direction de santé publique de Montréal, produced a mapping tool to detect urban heat islands and locate certain vulnerable populations in Québec.

Large urban areas that have been paved, including road infrastructure, school yards, streets and parking lots, are covered in bitumen and other low albedo materials that absorb most of the solar radiation. During hot sunny days, these surfaces can reach temperatures as high as 50°C, creating urban heat islands [63]. However, an integrated development approach can counter the formation of

urban heat islands and also help better manage stormwater runoff, two issues that could worsen in a context of climate change.

With public health protection in mind, this guide aims to counter the formation of urban heat islands in parking lots by proposing courses of action for more tailored and strategic development.

If the design objective is to limit the increase of a city's overall area covered by parking lots, there are several measures that can be implemented to this effect, including urban development methods that foster sustainable mobility, the use of public transit and car pooling or tightening urban perimeters.

However, these topics are not addressed here since they require other kinds of intervention, while this guide focuses on parking lot development techniques with the aim of reducing the urban heat island effect.

It should be noted that the organisation Vivre en ville proposes a broader approach that looks at those concepts.

1 PURPOSE AND SCOPE

The purpose of this guide is to provide information, guidelines and recommendations to improve the thermal performance of parking lots in order to reduce the urban heat island effect.

The guide presents the properties of urban heat islands, urban heat island mitigation measures and reference documents on this topic.

This guide focuses on certain development practices like the use of natural green spaces, landscape techniques, road surfaces and infrastructure relating to stormwater runoff and other land uses. It provides examples and recommendations for developing parking lots.

This guide applies to the development and redevelopment of off-street parking lots, whether small or large. It applies to existing parking lots, projected parking lots or parking lots due to be renovated.

This guide is intended for designers, landscape architects, municipalities, agencies, government departments and parking lot owners.

2 REFERENCE DOCUMENTS

The reference numbers in square brackets indicate documents whose full reference is given in Annex H. The references to other documents that address the topic of this guide are given in the bibliography of Annex I.

3 DEFINITIONS

For the purpose of this document, the following definitions shall apply:

albedo, n. The ratio between the solar radiation reflected by a surface and the overall incident solar radiation upon it. French: ***albédo***.

> NOTE — Albedo values vary between 0 and 1. The higher the albedo of a surface, the more the surface reflects light and the less it heats the ground and, consequently, the atmosphere.

emissivity, n. The property of a body's surface to emit heat by radiation, expressed as the ratio between the radiation emitted by this surface and that emitted by a body that absorbs and transmits all the radiation reaching it (called a black body), when both bodies are at the same temperature. French: ***émissivité***.

> NOTE — The emissivity of an aluminium sheet is 0.09 and that of a brick 0.90. A material reflecting all the radiation reaching it will have no emissivity at all.

impervious surface, n. A parking lot surface that allows water to run off and reach an evacuation outlet without allowing the water to infiltrate into the ground. French: ***surface imperméable***.