Urban Lighting:
Planning for Public Spaces in Vancouver’s Southeast False Creek

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M.Pl Candidate 2012

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EXECUTIVE SUMMARY

Artificial light impacts orientation, use, safety and the visual quality of public spaces after dark. While fulfilling technical and security requirements – facilitating user movement along pathways and illuminating dark spaces in the public realm – artificial light also serves social and aesthetic functions by influencing how lit spaces are used and perceived. Urban Planners work to create safe and engaging public spaces, and lighting design is of critical importance to the vitality of these spaces. Yet there is little academic research, government support or best practice case studies on lighting design in North America from a planning perspective.

In the City of Vancouver urban planners are beginning to play an increased role in coordinating the illumination of public spaces for the purpose of reinforcing comprehensive and cohesive urban design. Combining lessons learnt from a review of international best practices and systematic self-observation of Vancouver’s Southeast False Creek, this report assesses the physical and perceptual qualities of urban lighting in Vancouver. Study analysis identifies key components of a successfully lighting plan and explores how plan elements translate to real use in the public realm. Recommendations are offered for the purpose of advancing strategies, concepts and coordination of lighting in municipal plans.

Research Methodology

Research methods for this report include a review of international lighting master plans, municipal document analysis and systematic self-observation of a study area supported by photographs, field notes, narratives, imagery and application of evaluation criteria.

Eight common themes, listed right, emerged from the three reviewed lighting master plans. These themes were compared with City of Vancouver planning documents to systematically analyse plan principals and concepts.

To assess how lighting strategies are perceived and interpreted by users of public spaces, an evaluative criteria was used to analyse observation of the case study area in Southeast False Creek.

COMMON THEMES
1. Identity and Heritage
2. Image and Elements
3. Environmental Considerations
4. Shadow, Darkness and Mystery
5. Illumination Levels, Skyglow, Over Lighting and Glare
6. Colour, Sound, Motion and Art
7. Safety and Connectivity
8. Collaboration, Innovation, Research and Monitoring
Context

Vancouver is compactly built upon 129 km² of hilly topography, and set on a peninsula nestled between mountains, ocean and rivers. The City’s natural setting is complemented by densely packed towers and a continuous public waterfront.

The study area in Southeast False Creek is a waterfront, remediated brownfield site centrally-located southeast of downtown Vancouver. The area was slated for residential development in the early 1990s, and the central Village neighbourhood, including the observation site was largely completed by 2010.

Observations were conducted in the Village’s Shipyards plaza and promenade. The study area was selected due to the variety of luminaires, ground surfaces, routes and access points within the field of observable area.

Lessons Learnt

Creating maximum value from urban lighting begins early in the development review process. Instituting detailed design objectives for urban lighting at the planning stage coupled with monitoring existing installations to better understand where improvements can be made, increases the likelihood of successfully meeting plan objectives as well as patron needs.

The common plan components identified from lighting master plan analysis influence the type, technologies and placement of luminaires in order to direct the movement and shape the perception of local residents and plaza users. In application, however, plan components are not equally evident. Aesthetic innovations were the most recognizable, such as the coloured luminance from the steel rib luminaires in Shipyards plaza. The functionality of lighting was more
difficult to observe, and therefore was determined by a measured of repeated, fluid use of lit spaces. For example, the bull rail luminaires create appropriate and well-directed light for the deck surfaces and as a result maintained the most frequent use.

Analysis of a case study site provides insight into the strengths and weaknesses of public lighting policy in Vancouver. Learning from Southeast False Creek, recommendations address urban lighting at a municipal level.

Recommendations

- Monitor and evaluate existing lighting strategies.
- Seek opportunities for additional illumination.
- Explore innovative luminaire technologies from best practice case studies.
- Investigate performance-based standards for streetlights.
- Develop a lighting master plan.

Unlit Stanley Park seawall 2012 (Vancouver, BC)  Glare from Lost Lagoon plaza 2012 (Vancouver, BC)

Concept: Lake-front walk (Jyväskylä, FI)  
Source: Jyväskylä, 2009

Concept: Above lit cycle path (Funen, DK)  
Source: lighting.philips.com
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All images created by author unless otherwise indicated

ACRONYMS

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<th>Description</th>
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<tbody>
<tr>
<td>CBD</td>
<td>Central Business District</td>
</tr>
<tr>
<td>CPTED</td>
<td>Crime Prevention through Environmental Design</td>
</tr>
<tr>
<td>HID</td>
<td>High-intensity discharge lamp</td>
</tr>
<tr>
<td>IDA</td>
<td>International Dark-Sky Association</td>
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<td>IES</td>
<td>Illuminating Engineering Society (of North America)</td>
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<tr>
<td>LED</td>
<td>Light-emitting diode</td>
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<td>LPD</td>
<td>Low-pressure discharge lamp</td>
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<td>LUCI</td>
<td>Lighting International Community Association</td>
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<tr>
<td>MOVE</td>
<td>Mesopic Optimisation of Visual Efficiency</td>
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<tr>
<td>SEFC</td>
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1 INTRODUCTION

Artificial light impacts orientation, use, safety and the visual quality of public spaces after dark. While fulfilling technical and security requirements – facilitating the movement of users along roads and pathways, and removing dark spaces in the public realm – artificial light also serves social and aesthetic functions by influencing how lit spaces are used and perceived. Urban Planners work to create safe and engaging public spaces, and lighting design is of critical importance to the vitality of these spaces. A large portion of everyday is spend in darkness, and it is only with the benefit of light, after all, that public spaces can safely and effectively be used at night.

1.1 Defining the Problem

Urban lighting has traditionally been coordinated by architects, landscape architects, engineers or lighting designers who largely design luminaires to serve a particular purpose. Much of the literature informing industry practice in North America, such as that of the Illuminating
The Engineering Society (IES), addresses the technical requirements of luminaires (Jakle, 2001). When lighting is designed in isolation, luminaires can compete and conflict with one another. The human eye can only adapt to one level of illumination, therefore the anticipated effects of a luminaire is diminished when light sources compete (Figure 1-1). Critics of the outdoor lighting codes produced by the IES highlight the absence of research on social and aesthetic lighting design processes, specifically the ability of light to unify urban environments and reinforce neighbourhood character (Brandston, 1994).

Luminaires implemented by a variety of industry players to serve different purposes can produce excess light in public spaces, commonly referred to as light pollution. Poorly designed lighting strategies can negatively impact natural habitats and be viewed as a nuisance by neighbouring residents and patrons of lit public spaces.

According to Derek Phillips (2002, p.4), an International Association of Lighting Designers Lifetime Achievement Award recipient, there are five primary objectives of an exterior lighting strategy:

1. To provide a safe and secure environment for people;
2. To create safe routes for traffic, cyclists and pedestrians;
3. To facilitate the extended use of parks, open areas and sports facilities;
4. To enhance significant elements and key points... to create lighting opportunities; and
5. Finally, by means of a 'Visual Master Plan' to ensure the coordination of all the elements in unity.
Professional players prioritizing one objective over another can create large-scale inconsistencies in the illumination of public spaces that detracts from the function, aesthetic and unified sense of place (Brandi & Geissmar-Brandi, 2009). Urban planners possess the professional skills necessary to ensure the coordination and execution of all five objectives. Yet there is little academic research, government support or best practice case studies on lighting design in North America from a planning perspective.

1.2 Defining a Solution

Urban lighting satisfies multiple purposes in the public realm: functionally allowing public spaces to be safely used at night, and visually creating tone or atmosphere by highlighting physical qualities. The type of lamp dictates the colour (yellow, blue and white) and ambience (soft, bright, warm and cold) of illumination. Assisted by the shape and style of luminaire fixtures, different lamps also shape the direction and spread of light upon a surface (Brandi & Geissmar-Brandi, 2009). In the City of Vancouver urban planners are beginning to play an increased role in coordinating the illumination of public spaces for the purpose of reinforcing comprehensive and cohesive urban design. Lighting design is discussed by planners and city staff early in the development review process for neighbourhood community plans, public realm plans and urban design initiatives.

Combining lessons learnt from a review of international best practices and systematic self-observation of Vancouver’s Southeast False Creek (SEFC), this report will assess the physical and perceptual qualities of urban lighting in Vancouver. Recommendations will be offered for the purpose of advancing strategies, concepts and coordination of urban lighting in future municipal plans.

1.3 Research Questions

This report explores urban lighting through a review of best practices and systematic self-observation of an applied lighting strategy in SEFC for the purpose of identifying key components of a successful lighting plan. This report seeks to determine:

- What qualities of urban lighting are critical to establish an inviting public realm at all hours of the day?
- How are lit elements perceived and interpreted by the users of public space?
• What recommendations can be offered to the City of Vancouver for the development and coordination of future lighting strategies?

Three lighting master plans recognized for plan quality and exemplary implementation have been selected for study from a range of international best practices. Observation of the case study site is conducted to analyse how plan elements translate to real use in the public realm.

Report Structure

The remaining report will be organized into 5 chapters. Chapter 2 outlines the qualitative research methods used in this study, provides a theoretical background for the evaluation criteria and highlights study parameters and limitations. Chapter 3 introduces the local planning context and study area in SEFC. Chapter 4 and 5 outline the research analysis. Chapter 4 compares municipal policy for the study area with selected best practices, and Chapter 5 analyses observation findings. The final chapter presents conclusions and recommendations to the City of Vancouver based on study findings combined with additional research on urban lighting in public spaces.
2 RESEARCH METHODOLOGY

Research methods for this report include a review of international lighting master plans, municipal document analysis, and systematic self-observation of a study area supported by photographs, field notes and application of evaluation criteria.

2.1 Policy Analysis

To respond to the first research question – determining qualities of urban lighting that are critical to establish an inviting public realm – research must primarily address perceptual qualities of light. Academic research and literature from the lighting design industry has recognized a number of cities for exemplary lighting design. A lighting master plan illustrates and summarizes a city or region’s total lighting concept, and therefore to facilitate comparison between plans, only cities with lighting master plans were considered for analysis.* International best practices are concentrated in Europe due to broad acceptance of the illumination of space as an urban design tool (Gehl, 2010; Petty, 2007). These case studies serve as valuable benchmarks to investigate artificial light as a planning tool in Canada. Three international exemplars of urban lighting have been selected for review based on the following criteria:

* Only plans available in English or plans that could be accurately translated were reviewed.
Three lighting master plans were selected for further investigation: City of Lyon *Le nouveau Plan Lumière (New Lighting Plan [Trans.])* (2009), City of Jyväskylä *Valaistuksen Yleissuunnitelma (Lighting Master Plan [Trans.])* (2000) and City of Melbourne *Lighting Strategy* (2002). Eight themes, listed in Figure 2-1, were identified as common to all three lighting master plans.

The eight themes were systematically analysed and compared with the City of Vancouver *Southeast False Creek Public Realm Plan* (2006) with consideration for a number of primary and supplementary documents that complement this plan.

### 2.2 Systematic Self-Observation

Systematic self-observation is a flexible and adaptable research strategy used to understand ordinary life as it is experienced. This tool accounts for the complexity, the partial visibility and the dynamic pace of human action by identifying the researcher as both an observer and a social player (Rodriquez & Rave, 2002; Yin, 2009). Due to the subjectivity of self-observation, using multiple techniques for visual analysis help to validate findings and reduce researcher bias (Berg, 2009). A predetermined set of evaluation criteria, field notes, narratives and imagery systematize the researcher’s personal account of site observations.

### COMMON THEMES

1. **Identity and Heritage**: establishing an urban identity by emphasizing perceptible or latent heritage components or characteristics
2. **Image and Elements**: identify urban elements to emphasize, maintain or protect
3. **Environmental Considerations**: explore and implement sustainable luminaire technologies
4. **Shadow, Darkness and Mystery**: recognize the benefits and opportunities of contrasting dark and lit spaces
5. **Illumination Levels, Skyglow, Over Lighting and Glare**: recognize and reduce the negative impacts of illumination
6. **Colour, Sound, Motion and Art**: explore multi-media tools to enhance short and long term lighting installations
7. **Safety and Connectivity**: increase the perceived safety and ease of travel through public spaces
8. **Collaboration, Innovation, Research and Monitoring**: further the field by engaging with stakeholders, monitoring existing projects and exploring future possibilities

- Recently developed or updated lighting master plan coordinated by a municipal urban planning or urban design department;
- Recognized by international lighting design communities or urban theorists as having implemented outstanding examples of urban lighting; and
- Plan components demonstrate a balance between aesthetics, functionality and sustainability.
2.2.1 Environment

Systematic self-observation was conducted at Shipyard plaza, inlet and promenade in Vancouver’s Southeast False Creek (SEFC) over a two week period from December 2011 to January 2012 for the purpose of documenting the movement and activities of plaza users. A total of eight, one hour observations sessions were conducted at various times throughout the day, concentrated after 4:30 pm when luminaires are lit. An effort was made to conduct observations during dry weather, however there was a persistent potential for rain during the majority of site observation sessions. The time of year and associated weather may impact the use of the plaza; especially during evening observation times when few patrons are expected to spend extended periods of time in the plaza.

2.2.2 Evaluation Criteria

A number of tools have been created to evaluate public spaces. Pedestrian audit tools evaluate how different environments influence user travel behaviour (Active Living Research, 2004). Design tools identify elements within the public realm necessary to create functional, pedestrian-oriented environments (Gehl, 2010; Jacobs, 1993). Visual analysis tools analyze how humans experience and relate to their environments to decode urban landscapes (Moutin, 2003; Whyte, 1980; Lynch 1960). However, all these tools holistically analyse public space, evaluating how all design features contribute to a site’s overall function. As a result, it would be unwise to apply these tools to analyse a
single feature.

To determine the contribution of a single component to an urban environment, it must be assessed for the unique qualities it imparts on an environment and a user. In *The Image of the City* Kevin Lynch identifies qualities that urban forms can impart on an observer (1960). According to Lynch (1960, p.6),

"[t]he environment suggests distinctions and relations, and the observer – with great adaptability and in the light of his own purposes – selects, organizes and endows with meaning what he sees".

Lynch defines form qualities as patterns and relationships created by built form that help to decode how design elements contribute to the atmosphere of a place. These qualities can help to categorically explore the purpose of a lighting component, and reveal how this urban feature is perceived and interpreted by users of a space. Lynch’s form qualities are used to guide self-observation analysis.

2.2.3 Field Notes and Mapping

Field observation methods are modeled after techniques used by William H. Whyte in *The Social Life of Small Urban Spaces* (1980). Field notes provide an account of nuanced activities and reactions within the study site. Since observation occurs for only an hour a day, it is important to strategize observation methods in advance. The researcher, acting as a participant-observer, can observe plaza activities from a distance and also engage with patrons to clarify observations to gain further insight. Casual conversations do not qualify as interviews, but they do support data collection for field observations (Andranovich & Riposa, 1993).

Field observations begin with a windshield survey of the study area. An initial site visit is used to determine appropriate maps boundaries and to create a checklist of users and activities to orient future observations. See Appendix A for the field observation template.

2.2.4 Photography

Photos and visual aids provide site context, support observations and supplement analysis and report recommendations. Photographs provide a catalogue of luminaires, as well as provide a visual representation of how plaza patrons can utilize and traverse design elements within the space. Photography is highly reflexive as a picture provides a single perspective with little contextual background and thus can influence audience perception (Rose 2007). It is important that all images support, and are supported by report text. This allows the imagery to function as
a visual representation of the site as well as a generalizable concept that can be applied to other locations.

2.3 Data Analysis and Synthesis

The information gathered through plan and policy review coupled with systematic self-observation are used to analyze the critical components and perceived effects of urban lighting. Data collected from systematic self-observations is synthesized in the form of abridged field notes, synthesized maps and categorized images, and analyzed with evaluation criteria. Together these methods provide the foundation for discussion and recommendations.

2.4 Study Limitations

Systematic self-observations and analysis focuses on observed behaviour, but does not address socio-economic or macro-level variables. Plaza users are observed within the case study environment with no knowledge of user motivation to enter the observed space. Site observations are primarily collected by a single observer. To increase the reliability of the observational evidence as well as to fulfil the requirements of Queen’s University safety requirements multiple, casual observers assisted in conducting numerical observations and site mapping. To reduce bias, systematic observations are assessed using multiple assessment tools, therefore addressing issues of construct validity and subjectivity of the research (Yin, 2009).

Given the constraint of time upon this research, observations have not been conducted in warmer weather. Expanding on this research and comparing the effects of seasonal changes on plaza use would produce more robust findings and serve to confirm or counter the results and recommendations of this report.

An overview of relevant lighting technologies is provided in Appendix B to allow for a deeper understanding of lighting design. However, as this report focuses on public lighting for the planning of public spaces, engineering parameters, safety and crime prevention tools, cost, installation and lumen measures are considered outside the parameters of this study.

Conclusions and recommendations derived from this study are geared towards application within the City of Vancouver. Research universality, or applicability to other municipalities, is an empirical question that only further research in the topic area will begin to resolve (Rodriquez & Ryave, 2002).
3 CONTEXT

3.1 City of Vancouver Profile

Vancouver is the largest city in British Columbia, situated on the Pacific Ocean in south-western Canada, compactly built upon 129 km² of hilly topography, and set on a peninsula nestled between mountains, ocean and rivers (Berelowitz, 2005). Vancouver is recognized for maintaining a high quality of urban life. The City’s picturesque natural setting is complemented by densely packed towers and a continuous public waterfront (Punter, 2003).

Figure 3-1: City of Vancouver context map
Source: bcwireless.net/moin.cgi/VancouverMaps
A mix of warm temperatures, ocean winds and mountain barriers has produced a temperate rainforest climate resulting in moderate summers and mild winters. Exceptionally high precipitation levels from November to March justify the moniker grey city for Vancouver, but also contribute to the rich soils, high quality air and water, and vibrant colours of the landscape. Overcast weather also presents opportunities for illumination, for example by reflecting urban lighting in the ocean surrounding the Vancouver peninsula and on sidewalks and other urban features, thereby adding to the city’s character and aesthetic (Figure 3-2).

3.1.1 Urban Lighting and City Policy

The City of Vancouver implemented the living first strategy in the 1980s prioritizing residential development in the downtown core, particularly through megaprojects (Punter, 2003). This strategy called for investment in the public realm, citing the importance of public space to express civic identity and support community life. The living first strategy suggested urban design interventions such as sidewalk beautification and street art, including unique styles of lighting and signage (Beasley, 2000).

The City’s Urban Design Department incorporates guidelines for urban lighting early in the review process for public realm plans. The City does not have an urban lighting master plan, but local area plans address site specific characteristics whilst following universal design principles.
Lighting design components in City plans are growing continuously more comprehensive. The 2002 *Gastown Heritage Management Plan* specifies height requirements for luminaires on private building and along public sidewalks (Figure 3-3). Design specifications outlined in the 2007 *Under the Granville Bridge Neighbourhood Commercial Centre Policies and Guidelines* are more robust (Figure 3-4). This plan outlines the colour, type and location of lighting along the exterior (with recommendations for the interior) of building, streets, pedestrian areas and the underside of the bridge (Vancouver, 2007a).

Urban design concepts submitted to the City are reviewed by the Urban Design Panel (UDP) prior to development approval (Punter, 2003). The UDP is an advisory body made up of educated, accredited, multi-disciplinary professionals that provide professional advice to the Director of Planning, Development Permit Board or City Council on proposals or policy affecting the community’s physical environment. Applicable projects include civic works, such as parks and public spaces, civic buildings and design competitions. Panel comments are typically prescriptive, assessing physical qualities (amount and location of luminaires) rather than offering specific design guidance (Vancouver, 2011).

3.2 Study Area: Southeast False Creek

The most comprehensive lighting strategy implemented at this time of writing this report is the 2006 *Southeast False Creek Public Realm Plan*, according to staff Senior Urban Designer Scot Hein (personal communication, 19 October 2011). The plan presents a framework for the conceptual design for public spaces within Southeast False Creek (SEFC).

3.2.1 Historical Land Use and Development

SEFC comprises 32 hectares of centrally-located, remediated brownfield land southeast of downtown Vancouver. Industry, including sawmills, foundries, shipbuilding, metalworking, salt distribution warehousing and the City’s public works has flanked the shoreline of SEFC since the late 1800s. Significant shoreline adjustments during the industrial period created much of the land mass on which SEFC sits (Vancouver, 2006 &1999).

SEFC was rezoned for residential development with the goal of “creating coherent, identifiable, and supportive neighborhoods; and fostering liveable urban design and architecture” (Beasley, 2000). The 1999 *Southeast False Creek Policy Statement* sets targets for sustainability, ecosystem health, economic vitality and community health, targeting waterfront access, parks, and public plazas. Subsequent plans and development in SEFC have upheld these targets.
The majority of developable land (north of 1\textsuperscript{st} Avenue) is City owned, including the recently occupied Village neighbourhood, the first stage of residential development in SEFC. The remaining development surrounding the Village is under construction, however public spaces, including the central plaza and waterfront seawall, designed by consultants Phillips Farevaag Smallenberg and Dialog | Vancouver (formally Hotson Bakker Boniface Haden), are already in regular use. At full build-out the neighbourhood will house 6,600 units with an estimated total population of 11,000 – 13,000 people (Vancouver, 2010).

3.3 Observation Site: Shipyard Plaza and Promenade

Observations were conducted in Shipyard plaza and promenade. The study area is bound by Shipyard inlet to the west, Athletes Way to the south, Creekside Community Centre to the east and False Creek to the north. These study limits were selected because of the variety of luminaires, ground surfaces, routes and access points within the field of observable area.

The waterfront decks have been named according to their location within the study area to help orient the reader. All observations within this report will correspond to the luminaire and location labels specified in this chapter section.
Figure 3-6: Observation site luminaire map
4 POLICY REVIEW AND ANALYSIS

Eight common components emerged through analysis of the City of Lyon’s *Le nouveau Plan Lumière (New Lighting Plan [Trans.])* (2009), City of Jyväskylä *Valaistuksen Yleissuunnitelma (Lighting Master Plan [Trans.])* (2000) and the City of Melbourne’s *Lighting Strategy* (2002). These components address plan themes (identity and heritage; image and elements), technical considerations (environmental considerations; illumination levels, skyglow, over lighting and glare; shadow, darkness and mystery), aesthetic innovations (colour, sounds, motion and art), functionality (safety and connectivity) and advancement of the field of urban lighting (collaboration, innovation, research and monitoring). See Appendix C for a detailed overview of the lighting master plan best practices.

The eight components were used to analyze planning documents for Southeast False Creek (SEFC). Although the documents produced for SEFC do not qualify as a lighting master plan, the SEFC *Public Realm Plan* (2006) together with supplementary plans and documents produce sufficient detail to allow for in-depth analysis.
4.1 Southeast False Creek Public Realm Policies

The *Southeast False Creek Public Realm Plan* (2006) provides an outline for the design of open spaces, plazas, street, lanes and pathways within SEFC. The plan divides the land area into three distinct neighbourhoods and outlines design strategies that highlight existing and latent heritage components for each.

Specific objectives for urban lighting in the *Public Realm Plan* include reducing light pollution by preventing excess ground lighting, using efficient fixtures to reduce glare and limiting obtrusive illumination along the water to protect city and water views. The plan defines view ports as ‘moments’ or places to pause, reflecting the importance of city skyline, mountain and water views for the sense of place in Vancouver (Vancouver, 2006). No written links are made between light design and urban features; however the Lighting Strategy Map demonstrates that luminaires are to mirror the location of many key urban elements such as public plazas and along the waterfront (Figure 4-1).

![Lighting Strategy Map](image)

**Figure 4-1: Lighting strategy**  
*Source: Public Realm Plan (2006)*)
Few specific lighting concepts are proposed in the *Southeast False Creek Public Realm Plan*. Vertical light columns, also referred to as steel rib luminaires due to their shape resembling the ribs of a ship, are suggested for the Shipyard plaza (Dialog | Vancouver, 2010; Vancouver 2006). Bollards are suggested to define corners and separate pedestrian and vehicle spaces. The plan also calls for high colour rendition luminaires for pedestrian areas.

Details of lamp types are disclosed in the supplementary *Southeast False Creek Private Lands Public Realm Enrichment Guide* (2009) (Figure 4-2). In this guide the City elaborates on the proposed design for luminaires along roadways and pedestrian routes. This guide also illustrates a variety of luminaire types, including multi-purpose poles for streetlights that incorporate high-pressure sodium lamps that produce an amber light common on Vancouver streets. White-light producing metal halide lamps are suggested for pedestrian routes and sidewalks to fulfill Crime Prevention through Environmental Design (CPTED) requirements (Hein, personal communication, 19 October 2011).

Figure 4-2: Landscape lighting plan
*Source: Private Lands Public Realm Enrichment Guide (2009)*
Details of the urban lighting themes and objectives are outlined in the *Southeast False Creek Art Master Plan* (2007). In the section entitled *Illuminative Arts*, concepts of legibility, security and drama are explored. The plan addresses consistent illumination levels to avoid confusion and competition caused by over lighting and light clutter. The plan calls for mixing light, shadow and colour to create intrigue, enhance textures and attract plaza users during the long periods of high precipitation and darkness in the winter months.

The three plans, in combination with conceptual strategies set in the SEFC *Official Development Plan* (2007c) and *Policy Statement* (1999) contain all municipal information on urban lighting for SEFC produced by and for the City of Vancouver.

### 4.2 Policy Analysis

#### 4.2.1 Identity and Heritage

<table>
<thead>
<tr>
<th><strong>IDENTITY AND HERITAGE:</strong> establish an urban identity by emphasizing perceptible or latent heritage components or characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference in Plans</strong></td>
</tr>
<tr>
<td><strong>Vancouver</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Lyon</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Jyväskylä</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Melbourne</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The City of Vancouver’s plans emphasize the importance of creating a strong identity for SEFC through urban design. Existing heritage components from the area’s former industrial uses are referenced directly through interpretive plaques and markers and indirectly through the design of urban features. Where the reviewed master plans highlight luminaire consistency as a means of reinforcing a unified neighbourhoods image, Vancouver’s *Public Realm Plan* for SEFC calls for *differentiation* in the treatment of lighting design to denote individual land uses, neighbourhoods and public spaces. Luminaires are primarily purposed to add visual interest and encourage increased use of the area, while other urban design features such as paving patterns and landscape materials reinforce the identity of each neighbourhood in SEFC.
4.2.2 Image and Elements

| IMAGE AND ELEMENTS: identify urban elements to emphasize, maintain or protect |
|-----------------------------------|---------------------------------------------------------------------|
| **Vancouver**                     | Gateways, nodes, paths, landmarks, linkages, views                 |
|                                  | Waterfront, seawall, plazas, parks                                 |
| Lyon                             | Views, gateways, landmarks, paths                                  |
|                                  | Topography, rivers, hills, silhouettes, campuses                    |
| Jyväskylä                        | Views, landmarks, destinations, gateways, paths                    |
|                                  | Waterfront, port, stations, facades, parks, water tower, campuses  |
| Melbourne                        | Paths, nodes, markers, landmarks, edges                           |
|                                  | Waterfront, cemetery, parks, gardens                              |

SEFC’s *Public Realm Plan* begins with discussion of key urban elements (nodes, paths, landmarks, and gateways) and the location and priorities for these elements are mapped in detail (Vancouver, 2006). A conceptual lighting strategy is also introduced later in the *Public Realm Plan*, and luminaire locations correspond to the locations of the identified urban elements. Expectantly, street and sidewalk luminaires follow road, cycle, and pedestrian routes and linkages facilitating safe passage at night. The plan calls for the protection of city views, noting where and where not to place luminaires in order to preserve these views.

4.2.3 Environmental Considerations

| ENVIRONMENTAL CONSIDERATIONS: explore and implement sustainable luminaire technologies |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Vancouver**                      | Install energy-efficient lamps for new projects                                                                                                                        |
| Lyon                               | Investigate the ecology of light                                                                                                                                         |
|                                    | Use green sources of energy and reduce electricity waste                                                                                                                  |
|                                    | Be mindful of the effects of light on man and nature                                                                                                                      |
|                                    | Use lead- and mercury-free lamps, recycle inefficient lamps                                                                                                                 |
| Jyväskylä                          | Update luminaires to more energy-efficient fixtures                                                                                                                        |
|                                    | Investigate reducing illumination levels by combining light sources                                                                                                      |
| Melbourne                          | Investigate timers to increase energy efficiency                                                                                                                          |
|                                    | Investigate green power from renewable sources                                                                                                                           |
|                                    | Conduct an Environmental Assessments for new projects                                                                                                                        |

The detail in which green technology is addressed reflects cultural and local perceptions of environmental stewardship. The Melbourne plan applies the greatest detail in describing ways to sustainably implement, maintain and dispose of inefficient lamps. In both the Lyon and Jyväskylä plans many of these environmental considerations were only briefly mentioned because policies for environmental sustainability are already in place. Jyväskylä, for example, utilizes biofuel to power public works, and therefore little reference is made to energy conservation (FINBIO, 2012).
Considering the breadth of environmental services in place in SEFC, the Public Realm Plan makes only brief reference to sustainable lamp technology. However, as this plan outlines lighting as a conceptual component, it may be out of place to go into depth on maintenance or disposal of inefficient technology. None the less, it is interesting to note that the City’s position on sustainable lamps is not present in any of the plans or supplementary documents for SEFC.

4.2.4 Illumination Levels, Skyglow, Over Lighting and Glare

<table>
<thead>
<tr>
<th>Reference in Plans</th>
<th>ILLUMINATION LEVELS, SKYGLOW, OVER LIGHTING AND GLARE: recognize and reduce the potential negative impacts of illumination</th>
</tr>
</thead>
</table>
| Vancouver          | • Reduce light pollution both on the ground and leaking upwards  
                      • Encourage white light in pedestrian areas for improved colour rendition  
                      • Incorporate bollards and bull rail luminaires along the water’s edge  
                      • Use multi-purpose utility poles to accommodate street and pedestrian-level luminaires |
| Lyon               | • Accommodate for additional light from retail windows  
                      • Upgrade lamps to reduce energy consumption while emitting the same levels of illumination |
| Jyväskylä          | • Avoid skyglow and over lighting by upgrading luminaires  
                      • Reduce glare on streets, especially focusing on pedestrian and cycle routes  
                      • Reduce illumination levels in parks and along the water  
                      • Move away from warm light with low colour rendition |
| Melbourne          | • Do not dilute the impact of luminaires by over lighting  
                      • Consider a spectrum of illumination across different land uses  
                      • Upgrade high-pressure sodium to metal halide to increase colour rendition  
                      • Upgrade all lamp casings to full cut-off fixtures |

Along with the benefits of urban light in the public realm, the analysed plans also discuss the unanticipated consequences of improperly directed or distributed illumination. The SEFC Public Realm Plan comments on the need to restrict excess luminance on the ground (over lighting) as well as light radiating into the sky (glare and skyglow). By conceptualizing lighting design at the planning stage, the City of Vancouver is taking an active step in ensuring that luminaires are compatible and luminance levels are balanced. Downward facing lights and full cut-off fixtures – where the cut-off angle is less than 90° (Figure 4-3) – are also introduced in the plan as methods of counteracting glare and skyglow. Over lighting is not thoroughly addressed in the SEFC Public Realm Plan. Luminance from ground floor retail establishments surrounding Shipyard plaza receives separate treatment in City plans. Competing internal and external lighting can result in the over illumination of public spaces.
4.2.5 Shadows, Darkness and Mystery

**SHADOW, DARKNESS AND MYSTERY:** recognize the benefits and opportunities of contrasting dark and lit spaces

<table>
<thead>
<tr>
<th>Reference in Plans</th>
<th>Vancouver</th>
<th>Lyon</th>
<th>Jyväskylä</th>
<th>Melbourne</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preserve view corridors of the city</td>
<td>Leave parks and rivers in darkness or shadows</td>
<td>Utilize shadows created by the illumination of trees</td>
<td>Identify areas for darkness to protect biodiversity</td>
</tr>
<tr>
<td></td>
<td>Use light and shadow to enhance textures and colours</td>
<td>Create areas for <em>nocturnal contemplation</em></td>
<td>Reduce horizontal lighting to protect views of the city</td>
<td>Use darkness to create provocative spaces</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Punctuate dark places</td>
</tr>
</tbody>
</table>

Shadows and darkness serve important functional and aesthetic purposes. Shadows protect habitats that thrive in darkness or require natural solar patterns to survive. Shadow and darkness also create a sense of mystery or drama in open spaces by contrasting and, consequently, amplifying lit landscapes. The City of Vancouver’s *Art Master Plan* asserts that contrast between light and dark can be used to enhance textures, shapes and colours. Artificial light can, therefore, enhance and modify our perception of urban features at different times of the day.

The *Public Realm Plan* references the importance of darkness to preserve and enhance viewports from SEFC. Along the water’s edge, bull rails with luminaires low to the ground are suggested to ensure that illumination on SEFC’s elevated decks is contained to its intended surface. The bull rails guard against light trespass that would diminish views over the water and of the city and mountains.

4.2.6 Colour, Sound, Motion and Art

**COLOUR, SOUND, MOTION AND ART:** explore multi-media tools to enhance short and long term lighting installations

<table>
<thead>
<tr>
<th>Reference in Plans</th>
<th>Vancouver</th>
<th>Lyon</th>
<th>Jyväskylä</th>
<th>Melbourne</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use changing colours of illumination to draw interest</td>
<td>Use lamp colour to identify neighbourhoods</td>
<td>Consider colour, neon and laser technology to combat unattractive environments and to off-set overcast conditions</td>
<td>Develop purpose-built fixtures to accommodate temporary light installations</td>
</tr>
<tr>
<td></td>
<td>Work with theatrical lighting designers and artists to encourage lit art installations</td>
<td>Encourage lit art installations</td>
<td>Explore luminaire poles as an art tool, the tallest piece of street furniture</td>
<td>Support event lighting and short-lived displays by implementing permanent utility services</td>
</tr>
</tbody>
</table>
Urban lighting is an urban design tool capable of infusing colour, sound, motion and art into the public realm. The reviewed lighting master plans suggest methods of using light to create nighttime landscapes that appear as abstractions of their daytime image. In other words, these plans seek not only to illuminate environments but to transform the way they are used and perceived by patrons at night. The City of Vancouver calls for the transformation of nocturnal landscapes in the SEFC Art Master Plan, for what it terms as the ‘illuminative arts’ (Vancouver, 2007b). This plan encourages the use of colour to draw interest, especially important on overcast days. The plan explores the idea of transforming urban elements, such as a bench, from serving a utilitarian purpose during the day to functioning as a canvas for light and colour at night.

4.2.7 Safety and Connectivity

<table>
<thead>
<tr>
<th>Reference in Plans</th>
<th>Safety and Connectivity: increase the perceived safety and ease of travel through public spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vancouver</strong></td>
<td>• Use white-light for CPTED purposes</td>
</tr>
<tr>
<td></td>
<td>• Use pedestrian-scale lighting along the seawall</td>
</tr>
<tr>
<td><strong>Lyon</strong></td>
<td>• Create safe and comfortable pedestrian areas</td>
</tr>
<tr>
<td></td>
<td>• Create well-lit pedestrian networks</td>
</tr>
<tr>
<td><strong>Jyväskylä</strong></td>
<td>• Use pedestrian-scale luminaires along pedestrian and cycle routes</td>
</tr>
<tr>
<td></td>
<td>• Identify unsafe areas and use luminance to increase safety and create atmosphere</td>
</tr>
<tr>
<td><strong>Melbourne</strong></td>
<td>• Work with the private sector to prevent shadows cast into the public realm</td>
</tr>
<tr>
<td></td>
<td>• Promote way-finding and visual comfort through luminance</td>
</tr>
<tr>
<td></td>
<td>• Implement luminaires along ‘soft’ transportation routes such as tram routes</td>
</tr>
</tbody>
</table>

Safety is a key concern when designing and implementing lighting strategies. Historically, the illumination of public space has been directed by engineering standard focused on improving safety and circulation along roadways (Brandston, 1994). Best practice case studies, however primarily emphasize pedestrian safety. The illumination of pedestrian and cycle routes are also a primary component of the lighting strategy within the SEFC Public Realm Plan, as represented in Figure 4-1. This lighting strategy suggests custom fixtures producing white light for pedestrian and cycle routes.
4.2.8 Collaboration, Innovation, Research and Monitoring

**COLLABORATION, INNOVATION, RESEARCH AND MONITORING:** further the field by engaging with stakeholders, monitoring existing projects and exploring future possibilities

<table>
<thead>
<tr>
<th>Reference in Plans</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vancouver</strong></td>
<td>• Utilize computer-controlled LED lights</td>
</tr>
<tr>
<td>• Consult local social and economic players to define area specific features</td>
<td></td>
</tr>
<tr>
<td>• Collaborate and provide training for city technicians, manufacturers, academics and regional partners</td>
<td></td>
</tr>
<tr>
<td>• Continue to research electronic management tools</td>
<td></td>
</tr>
<tr>
<td>• Monitor existing installations</td>
<td></td>
</tr>
<tr>
<td><strong>Lyon</strong></td>
<td>• Work with local businesses and private building owners to promote a unified image for luminaires</td>
</tr>
<tr>
<td>• Explore the possibility of combining tree and street lighting to reduce streetlight illumination levels</td>
<td></td>
</tr>
<tr>
<td>• Explore DMX technology to control ‘intelligent’ lighting fixtures and dimmers</td>
<td></td>
</tr>
<tr>
<td><strong>Jyväskylä</strong></td>
<td>• Work with local businesses and private building owners to promote a unified image for luminaires</td>
</tr>
<tr>
<td>• Explore the possibility of combining tree and street lighting to reduce streetlight illumination levels</td>
<td></td>
</tr>
<tr>
<td>• Explore DMX technology to control ‘intelligent’ lighting fixtures and dimmers</td>
<td></td>
</tr>
<tr>
<td><strong>Melbourne</strong></td>
<td>• Work with private sector to create a unified image for urban light</td>
</tr>
<tr>
<td>• Encourage innovative luminaires for new development projects</td>
<td></td>
</tr>
<tr>
<td>• Continue to monitor the performance of installations, conduct a before and after analysis</td>
<td></td>
</tr>
</tbody>
</table>

The studied lighting master plans offer a variety of techniques for gaining public support, building interest and increasing civic value placed on lighting installations by involving private business owners, residents and other important players. Although, little mention of public involvement in regards to urban lighting is made in the studies plans, the development of SEFC did involved extensive public consultation as noted in the SEFC Policy Statement (1999). The City successfully incorporated community feedback in plan design.

To ensure the intentions of the plan are materializing and meeting the needs of the users of the space, it is also important to monitor existing installations to better understand where improvements can be made and innovation applied. Ongoing monitoring is not included as a component of Vancouver’s *Public Realm Plan*. The lack of monitoring in SEFC has been recognized by City staff, but to date the City has not conducted a post-implementation assessment of lighting within the public realm (Hein, personal communication, 19 October 2011).

### 4.3 Policy Analysis Summary

Analysis of the City of Vancouver’s SEFC *Public Realm Plan* and supplementary documents indicates that the City’s principals and techniques for urban lighting are consistent with international best practices. All eight key plan themes were evident in the City’s plans for SEFC in varying levels of detail. The key theme of ‘identity and heritage’ received the strongest treatment in plans for SEFC. Land-use heritage was represented in plan objectives and development strategies as well as in the final design of individual lit components. The lighting
design of Shipyard plaza and promenade demonstrates thoughtful attention to the themes of ‘environmental considerations’ and ‘colour, sounds, motion and art’; however these themes received minor attention in the written plans for SEFC. The key theme of ‘collaboration, innovation, research and monitoring’ received the weakest treatment in plans for SEFC. The plans provide little information of the extensive public consultation processes undertaken during the planning process, and no guidelines for future monitoring.

The treatment of public spaces in the plans for SEFC mirror key planning principals and techniques found in academic literature and lighting master plan best practices. The vision and objectives for SEFC’s public realm are clearly description in the Provincial Policy Statement and have remained consistent in subsequent plans through to the development of the site (1999).

Urban design components, such as street trees, curb bulbs, paving patterns and lighting receive individual attention in the Public Realm Plan. However, compared to other design components, urban lighting receives limited attention. Key principals of urban lighting, such as energy efficiency, colour rendition and glare, are mentioned by name but are not expanded on or explored. The plan offers design and location options for components such as street and boulevard trees and pavers but none for luminaires. One luminaire option per main purpose (street, pedestrian, decorative) is suggested, and all options have since been implemented in Shipyard plaza. Established design rather than proposed design options may have limited flexibility or innovation at the time of implementation.

To assess how the implemented elements are perceived by users of public spaces, site observation is necessary. Systematic self-observation will provide insight into the qualities of urban lighting that are critical to establishing an inviting public realm.
SITE OBSERVATIONS

5.1 Setting the Scene

5.1.1 Observation Setting

Shipyard plaza and promenade contain design features that connect to, and interact with the natural environment. Cycle, pedestrian and vehicle routes weave through the observation site, with active transportation routes meandering along the water’s edge. The observation area contains a number of spaces to sit and stop, the most popular being the pedestrian bridge and waterfront decks.

The observation site contains spaces filled with light as well as areas left in shadow along the water. Overhead light services routes and paths while ground light accentuated design features and highlight places to pause. In wet weather, very few plaza users were observed pausing in the space responding to a lack of sheltered areas.

5.1.2 Observed Users

The majority of plaza patrons were younger adults (25-40 years old). Some patrons travelled with babies in strollers, but there were very few children observed in the area. The few small
children that were observed greatly impacted observations. Families spent extended periods of time in the plaza, and children tended to utilize more structures and surfaces for play. Children also had the greatest reaction to the changing patterns of illumination.

There were notably few seniors observed in the plaza. A small number of seniors were observed walking along the seawall, but none were observed stopping in the plaza or entering the plaza on route south to the residential area.

Observations that occurred after 5 pm tended to have a majority of cyclists or lone walkers who, judging by their attire, looked as if they were coming home from work. There were also a number of joggers during and after this time period. After 7 pm activity in the plaza tended to subside significantly, with only a few plaza users walking in couples or walking dogs. See Appendix D for an abbreviated transcript of field notes.

5.2 Form and Use Analysis

Vancouver’s continuous seawall, also termed seaside route, connects downtown and the west side of Vancouver through SEFC and through the study area. The seawall runs along the north edge of the study area, and contributed to the majority of observed plaza use. Roughly ¼ of all observed plaza users were joggers following the seawall (see Figure 5-1 and Appendix E for a detailed breakdown of plaza use). The greatest number of joggers were observed entered the plaza area at around 6 pm on weekdays, jogging with organized groups. The decision for these groups to traverse this section of the seawall in SEFC speaks to the legibility of the route at night. The decision of plaza users to further explore the plaza reflects the functionality and aesthetic appeal of SEFC.

<table>
<thead>
<tr>
<th>Uses</th>
<th>Single</th>
<th>Couple</th>
<th>Group 3</th>
<th>Group 4+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>398</td>
<td>264</td>
<td>42</td>
<td>54</td>
<td>758</td>
</tr>
<tr>
<td>Jog</td>
<td>184</td>
<td>54</td>
<td>9</td>
<td>80</td>
<td>327</td>
</tr>
<tr>
<td>Pause</td>
<td>10</td>
<td>14</td>
<td>9</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>Cycle</td>
<td>175</td>
<td>29</td>
<td>3</td>
<td>0</td>
<td>207</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skate/Roll</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Wheelchair</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>775</td>
<td>361</td>
<td>63</td>
<td>134</td>
<td>1333</td>
</tr>
</tbody>
</table>

Figure 5-1: Total observed users table
The pedestrian bridge immediately draws your attention due to its shape and colour of luminance. The bridge is brightly lit with white light below the bridge railing and on its supportive beams (Figure 5-2). The angular shape contrasts with the softer and naturalized illuminated environment that surrounds it, such as the blue-lit granite blocks, stepped shoreline and the low-lit wooden decks around Shipyard inlet (Figure 5-3). Light from the bridge reflects in the water directly beneath it, but does not project into False Creek to the north or Shipyard inlet to the south. The importance of the pedestrian bridge within Shipyard plaza was continuously reinforced during observations. The bridge was a common place to pause, likely owing to the preserved viewports from the bridge to the city and mountains.

![Figure 5-2: Pedestrian bridge looking north](Photo Credit: “D_Henney”, Flickr 2012)  
![Figure 5-3: Stepped shoreline looking south](Photo Credit: “D_Henney”, Flickr 2012)

Although there are a variety of routes for pedestrians around Shipyard inlet, almost all pedestrians choose to traverse the bridge. When there were no pedestrians in the area, cyclists would veer away from the cycle path and cross the bridge, requiring cyclists to reduce their speed. The decision for cyclists to cross the pedestrian bridge rather than continue around the cycle path did not appear to be due to a confusion of the appropriate routes but rather a deliberate decision by a curious traveller. In fact, the cycle route was easily navigated by cyclists at night. When approaching Shipyard plaza from the east, the cycle path takes a sharp left-hand turn before the pedestrian bridge following the natural curve of the shoreline around Shipyard inlet (Figure 5-4). Yet cyclist were able to easily follow the route at night without reducing speed owing to the constant and continuous pattern of illumination.
There are very few cycle/pedestrian route signs in the observation area. Path illumination was observed as the primary guide for cyclists at night. Paving patterns helped to identify the cycle route during the day, but at dusk pavers are not effective wayfinding tools. Before the plaza lights turn on, cyclists were observed travelling diagonally across the plaza rather than following the cycle route. After plaza lights were lit, by rule cyclists moving more quickly, possibly cycling for purpose rather than leisure, followed the lit cycle route.

It was observed that the consistency of luminance in pole height and stagger coupled with the spread of illumination helps reinforce the routes and paths chosen by plaza users. Cyclists travelling into pedestrian areas, for example to cross the pedestrian bridge, have to reduce their speed in order to safely traverse these areas at night. The intervals between luminaires help to determine a user’s interpretation of space. For example, engineering standards based on the RP-8 design guide dictate the required illumination levels and distance between streetlight poles (Vancouver, 2011a). The height and spread of streetlights create a uniformed glow that facilitates vehicle use; so to in pedestrian areas, the height and stagger of the luminaires reinforces its intended pedestrian purpose.

The indirect pole-mounted luminaires lining the cycle path contrast with the low bollards and recessed ground luminaires found along the pedestrian routes. The differentiation of pole height helps to distinguish the cycle route from the pedestrian spaces. The indirect pole-mounted luminaire along the cycle path also have a larger spread of luminance (determined by the pole height) and as a result supports the faster speed that a bicycle travels. Ground and vertical
recessed luminaires along pedestrian routes are low to the ground. The spread of illumination is short, so shadows are created between light sources. This contrast between shadowed and lit spaces facilitates the safe passage of a pedestrian while creating visual interest.

The majority of luminaires within pedestrian areas in SEFC have white light producing metal halide or LED lamps. However along major streets, streetlights have high-pressure sodium lamps that produce an amber glow. This amber light is common to most of the City's public streets. The streetlights in SEFC also project white light from a pedestrian-scale attachment along the public sidewalk, however the amber illumination from the streetlights along Athletes Way dominate the study area (Figure 5-6). Despite the high efficiency of the amber glow to light the public street, it may have deterred plaza patrons from utilizing the adjacent public sidewalk. Although the public sidewalk is more brightly lit and the terminus of the sidewalk is more evident in both directions, it was largely underutilized. Plaza users from residences and parked cars were observed crossing the public sidewalk and hopping over rain gardens and planted boulevards to access the pedestrian path lined by the rusted indirect pole-mounted luminaire closer to the water. Observation points to over lighting of the public sidewalks as a contributing cause for underuse.
Although the streetlights are on average the tallest luminaires in SEFC, at its tallest point the steel rib luminaires rise above all other lights (Figure 5-8). These luminaires grow in height towards the centre of Shipyard plaza and draw the eye up towards the lamp as well as down along the stream of coloured light projected on the ground. The steel rib luminaires bind the west edge of Shipyard plaza. This row of luminaires extends past the edge of the plaza into Shipyard promenade where observations were concentrated. Even though these two spaces are separated by a city street, Athletes Way, the lights link the two spaces together.

The steel rib luminaires attracted the most interest of all the luminaire types. The changing colours drew people towards the plaza. Plaza patrons would stop and look up towards the luminaires, and some patrons were observed waiting for the lights to change colour. Children in particular, were drawn to these luminaires, and would play within the streams of light.

Urban lighting can take on a variety of shapes and sizes, and their luminance can take on a variety of strengths and spreads, but each luminaire produces the same illumination as the next of the same variety. Although illumination levels remain consistent, the melody created by illumination, as discussed by Kevin Lynch as a ‘time series’, is embodied in the use of colour to illuminate Shipyard plaza. A young man in his 20s was observed trick biking within the plaza, hopping from concrete ledge to ledge. During a brief conversation, he reported that he preferred using the plaza at night because the steel rib lights made him feel as if he were on stage. He particularly noted the
colour change as an element that he enjoyed, linking the changes in colours to improvements in his mood.

The steel rib luminaires were observed shining in green, red, yellow, and blue. There did not seem to be a clear pattern to the changing colours. The light would remain a constant colour for half an hour change and then change back within 5 minutes. The colour changes were not frequent enough to be overwhelming or even rhythmic, but would allow some plaza user to witness multiple colour changes. The changing colours of the light cast by these luminaires impacted the movement and reaction of users by creating visual interest to draw users into the plaza and, in some instances, encouraging patrons to explore other features within the plaza.

From the centre of Shipyard plaza luminaires generally follow a gradient of height becoming shorter as they near the water, beginning with the steel rib luminaires to the pole-mounted luminaires, bollards and finally to the bull rail and ground luminaires. Lighting low to the ground helps to define the shape and slope of a landscape (Figure 5-10, Figure 5-11, and Figure 5-12). Recessed ground and vertical luminaires embedded into steps and ledges emphasize a change in grade by creating contrast between light and shadow.

Shorter luminaires, having a smaller spread of illumination, reduce glare into the water and protect views of the city. The wooden decks serve as strategic viewports to the city and mountains. The bull rail, encompassing the deck luminaires, acts as a full cut-off shield restricting light from penetrating the water or escaping skyward. The controlled illumination of Shipyard plaza and promenade allows for the light sparkling in the water from Science World, BC Place and the Plaza of Nations across False Creek to be visible from SEFC. Although moderately used during the day, at night
these decks served as the primary draw along the water. It was common for people to enter the plaza and walk directly towards the decks to look out and take photos.

Although the east deck is directly visible from Shipyard plaza, the majority of users were attracted to the center deck, slightly obscured from view behind landscaping. There is a single 180° bollard on the center deck not found on the other decks, strategically placed to light the wooden deck but not the water behind (Figure 5-14). This type of lamp is not common in the
observation area, and seems to serve a defined purpose. The partial cut off that created a 180° spread of light was effective in containing light to in front of the luminaire. The reason for the additional luminaire on the center deck may be owing to the length of the centre decks or the dark void along its west border of Shipyards inlet. The additional 180° bollard did not detract from the views available from the center deck, nor did it deter use of the deck (see Figure 5-13 for a summary of plaza use). A professional photographer was observed on the center deck at dusk taking photos towards Science World. He noted that the illumination on the deck did not inhibit his photographs, even with the additional illumination produced by a 180° bollard light. This bollard type also lines the east entrance of the pedestrian bridge and functions to restrict glare into the water and acts as a beacon to draw users towards the bridge (Figure 5-15).

Heritage elements serve to tie the design components of the site together and form a cohesive and coherent neighbourhood identity. Beyond the most obvious name association, Shipyards plaza, the physical shape of many of the luminaires in SEFC are reminiscent of the area’s former industrial uses. The half moon shape of Shipyards plaza and the steel rib luminaires were created to mimic the shape of a ship, harking back to one of SEFC major industries, shipbuilding (Figure 5-17) (Roger Bayley Inc., 2009). The wooden decks with the bull rail luminaires speak to the former lumber industry that once flourished in False Creek. The rusted indirect pole-mounted luminaire also seem to speak to a former time, owing to their patina. These luminaires reflect heritage elements while maintaining aesthetic quality and functionality.
5.3 Form and Use Analysis Summary

The observed movement, actions and responses of plaza users inform how design components planned for public spaces translate to real use. The study area in Shipyard plaza is adequately and interestingly lit. The mix of heights and styles of fixtures and spread, colour and strength of illumination facilitates use and increases the legibility of the site.

The luminaires serve a variety of purposes including creating visual interest and facilitating the ease of movement within Shipyard plaza and promenade. The steel rib luminaires function primarily as an aesthetic component by attracting users to the space through changing colours and patterns of illumination. The light produced by these luminaires had the greatest perceptible impact on plaza users’ movement and responses to plaza design.

The pedestrian bridge fulfills both aesthetic and functional purposes. Plaza users benefited from the increased porosity of the site added by the bridge, demonstrated by its frequent use. The deliberate decision of cyclists to depart the cycle path to traverse the bridge and of pedestrians to take pause on the bridge speaks to the visual appeal of its shape and design amplified at night by well positions luminaires.

The bull rail luminaires are the most functional determined by fixture location corresponding to plaza patronage (Figure 5-13). These luminaires facilitate the movement of users on the decks while restricting glow into the natural environment. Views across False Creek to the city and

Figure 5-18: Intended view ports from Southeast False Creek
Source: Official Development Plan, 2007
North Shore mountains are a main draw to Shipyard plaza. The strategic placement of the luminaires along the decks preserves these views and facilitates the intended purpose of the decks as view ports (Figure 5-18).

The majority of luminaires in SEFC function harmoniously, acting as individual pieces to create a unified, nocturnal image for Shipyard plaza. Reflection of light from the residential buildings along Athletes Way onto the water is limited to into Shipyard inlet behind that pedestrian bridge. Coupled with the ground luminaires along the water’s edge, the placement and strength of luminaires ensures that the light escaping from SEFC does not dilute the reflection from the Vancouver landmarks along the north shore of False Creek (Figure 5-20, Figure 5-21).

![Figure 5-19: Reflections into Shipyard inlet](image1)  ![Figure 5-20: BC Place reflecting into False Creek](image2)  ![Figure 5-21: Science World reflecting into False Creek](image3)

Certain luminaires in SEFC compete with, and consequently dominate the area’s visual landscape. The amber light produced by the high-pressure sodium streetlights uniformly illuminates the public street and in doing so, facilitates vehicle use. However, the wide spread of illumination produced by these lamps interferes with the pedestrian-scale luminaires lining the public sidewalk. As a result, the sidewalk appears over lit and was seldom used. The majority of plaza patrons were observed bypassing the public sidewalk, preferring to walk on the pedestrian path parallel.

Shipyard promenade was most frequently used by walkers and joggers travelling the seawall. Utilized at all times of day and in both wet and dry weather, the continuous seawall is undoubtedly an asset to Vancouverites. The luminaires along the seawall facilitate its use and add an additional element of visual interest which may have contributed to the preference of patrons to travel along the water’s edge rather than the public sidewalk.

Illumination from the private businesses surrounding Athletes Way also dominate the plaza. Light from Terra Breads, on the corner of Athletes Way and Manitoba Street, shines onto the
sidewalk and road. The bright light coming from the Terra Breads’ shop windows is highly perceptible, drawing plaza users towards the shop and inside. Many pedestrians observed walking along the seawall would cut across the plaza moving directly towards Terra Breads, as the bright lights within the bakery clearly indicate that the establishment is open. Many of the shops surrounding Shipyard plaza are currently unoccupied. However, as the community becomes fully built-out, increased illumination from store windows may compete with the existing lighting plan, resulting in an over lit public realm.

When development of SEFC is complete, it would be interesting to observe how movement patterns are affected by increased use of Shipyard plaza by local residents. Observations also demonstrate that in the late evening the study area was largely underused. Research results may be impacted by further residential development in the area, coupled with warmer weather.
6 SUMMARY OF FINDINGS AND RECOMMENDATIONS

Drawing upon a review of lighting master plan best practices, City of Vancouver policy and systematic self-observation of Southeast False Creek (SEFC), this report explores the physical and perceptual qualities of urban lighting in Vancouver. Three research questions were identified at this beginning of this study:

- What qualities of urban lighting are critical to establish an inviting public realm at all hours of the day?
- How are lit elements perceived and interpreted by users of public space?
- What recommendations can be offered to the City of Vancouver for the development of future lighting strategies?

The first two research questions will be addressed within the summary of findings. Section 6.2: Recommendations will speak to the third research question.
6.1 Summary of Findings

A good street may be functional but a great street is superior in character and quality (Jacobs, 1993). Superior urban lighting also contributes to creating dynamic, safe and engaging environments. Urban lighting adds value to a public space by supporting the purposes of the space, such as the safe passage of users, but also by adding interest to attract users. Creating value from urban lighting begins early in the development review process for neighbourhood community plans, public realm plans and urban design initiatives. Instituting detailed design objectives for urban lighting at the planning stage improves the likelihood of successfully meeting plan objectives as well as patron needs.

Eight common components emerged from a review of the three selected international lighting master plans. These components address plan themes, technical considerations, aesthetic innovations, functionality and the advancement of the field of urban lighting, and are key considerations for creating a robust lighting plan that draws users to a public space after dark. All eight components impact an applied plan by controlling the type, technologies and placement of luminaires that direct the movement and shape the perception of local residents and plaza users.

Not all plan components are easily observable. Aesthetic innovations were the most recognizable, such as the coloured luminance from the steel rib luminaire that drew the most attention by users. The functionality of lighting, however, was observed through measure of repeated, fluid use. The bull rail luminaires created appropriate and well-directed light for the deck surfaces and as a result maintained the most frequent use. The indirect pole-mounted luminaire along the cycle path or the bollard luminaires in the pedestrian areas allowed for the continuous movement of plaza users and were also critical to maintaining an inviting public realm.

The majority of lit components in SEFC were well received by plaza users, determined by frequent use, length of stay and perceived efficiency of movement. The public sidewalk lining Athletes Way was the most under-used lit space in SEFC. The public sidewalk differs only by illumination from the preferred pedestrian route that runs parallel. The wide spread of
illumination produced by the streetlight lamps interferes with the pedestrian-scale luminaires lining the public sidewalk and as a result, the sidewalk appears over lit.

The study analysis and summary of findings provide insight into the strengths and weaknesses of public lighting policy in Vancouver. Learning from SEFC, recommendations will address urban lighting at a municipal level.

6.2 Recommendations

Monitor and evaluate existing lighting strategies

<table>
<thead>
<tr>
<th>Summary Table: Recommendation #1</th>
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<tbody>
<tr>
<td><strong>Monitor and evaluate existing lighting strategies</strong></td>
</tr>
<tr>
<td>• Evaluate the effects of urban lighting on the nocturnal landscape and on the end users of lit space</td>
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<tr>
<td>• Correct improperly placed or directed light to promote a positive public perception of lighting initiatives</td>
</tr>
<tr>
<td>• Gain a deeper understanding of lighting installations to strengthen future applications and to create better and more inviting public spaces</td>
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</table>

To date, the City has not conducted a post-implementation assessment of illumination in the public realm (Hein, personal communication, 19 October 2011). It would be valuable for the City to evaluate the effects of their urban lighting strategies on the nocturnal landscape and on the end users of the space. Evaluation of existing lighting installations allows the city to correct improperly placed or directed light, such as pole mounted luminaires that do not have full or partial cut off fixtures that allow light to spill into the sky. Correcting inappropriate illumination shining into residential buildings or inefficiently illuminated public spaces would improve the visual and functional performance of luminaires and could help promote a positive public perception of urban lighting initiatives in the future.

Site observations in SEFC uncovered a number of strengths and identified some weaknesses of the existing lighting plan. A deeper understanding of lighting installations would strengthen future applications of urban lighting by the City for the purpose of creating better and more inviting public spaces.
Seek opportunities for additional illumination

<table>
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<th>Summary Table: Recommendation #2</th>
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<tbody>
<tr>
<td>Seek opportunities for additional illumination</td>
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<tr>
<td>• Utilize lighting improvements as a cost-effective and environmentally sustainable investment</td>
</tr>
<tr>
<td>• Continue the commitment to public realm improvements by enhancing existing public spaces valued by local residents</td>
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<tr>
<td>• Recognize the unique opportunity to impact the safety and functionality of the seawall through illumination</td>
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</table>

Recognising the ability of improved urban lighting to enhance public spaces, this report recommends that the City examine existing public spaces and landscapes that could benefit from increased or improved illumination. In SEFC it was observed that the seawall was used throughout the day regardless of poor weather. The seawall is an important feature of Vancouver’s public realm, and essential to a Vancouverite’s sense of place. Although the seawall is a continuous route around the downtown peninsula and into Vancouver proper, it is not continuously lit, noting in particular the route around Stanley Park. Given the extensive use of the seawall, this route presents a unique opportunity for the City to invest in the existing public realm. As demonstrated by the bull rail luminaires and recessed ground luminaires in SEFC, adding ground or pedestrian scale luminaires to the seawall around Stanley Park would improve safety and functionality, in support of the already present activity, as well as add visual interest attracting increased nocturnal use (see lighting concepts in Figure 6-3 and Figure 6-4).

![Figure 6-1: Unlit Stanley Park seawall (Vancouver, BC)](image1)  ![Figure 6-2: Glare from Lost Lagoon plaza (Vancouver, BC)](image2)

There are a number of parks and public spaces that would also benefit from increased illumination. Compared to other engineering and infrastructural projects such as the refurbishment of existing streets and plazas, lighting improvements are among the most cost-effective and environmentally sustainable measures (Brandi, 2002; Melbourne, 2002). Long-
term investments are profitable within a relatively short time span. Savings are gained by low power consumption and shorter maintenance intervals for the replacement of lamps.

The illumination of SEFC demonstrates the City’s commitment to functional, inviting, secure and fun public spaces. Site observations proved that the area is well used, and conversation highlighted that it is well liked. This study calls upon the City of Vancouver to continue their commitment to public realm improvements by enhancing existing public spaces valued by local residents.

Explore innovative luminaire technologies from best practice case studies

<table>
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<tr>
<th>Summary Table: Recommendation #3</th>
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<tbody>
<tr>
<td>Explore innovative luminaire technologies from best practice case studies</td>
</tr>
<tr>
<td>- Implement permanent utility services to host short-lived light displays</td>
</tr>
<tr>
<td>- Explore intelligent lighting fixtures allowing for lights to be turns off and on, or dimmed as necessary to reduce energy consumption</td>
</tr>
<tr>
<td>- Consider implementing controlled laser light as a method of lighting clouds or air particles in overcast weather</td>
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</table>

The illumination of public spaces presents an opportunity for innovation. The City can utilize tested concepts from international installations for future design. For example, to encourage short term installations, the Melbourne and Lyon lighting master plans suggest implementing permanent purpose-built outlets or utility services in select public spaces that can host short-lived light displays (Lyon 2009; Melbourne, 2002). By creating permanent infrastructure, the City facilitates these short term installations, while also demonstrating a municipal commitment to the illuminative arts.

Both the City of Melbourne and Jyväskylä highlight the importance of exploring intelligent lighting fixtures allowing for lights to be turns off and on, or dimmed as necessary to reduce energy
consumption (Jyväskylä, 2000; Melbourne, 2002). As these technologies become more affordable, the City of Vancouver should investigate the potential for implementation in local projects.

In Jyväskylä’s plan, skyward laser light is cited as an innovative means of creating visual interest in public spaces. Noting the predominance of overcast weather, Jyväskylä views laser light as a method of lighting clouds and air particles during long spans of darkness in the winter (Jyväskylä, 2000). Although organizations such as the International Dark-Sky Association (IDA) condemn laser light for causing skyglow, technological advancements have allowed skyward light to be controlled using intelligent lighting fixtures that illuminate overcast skies but prohibit illumination on clear nights (IDA, 2012; Jyväskylä, 2000). Observations demonstrate that changing lighting patterns, such as those produced by the steel rib luminaires in SEFC, are the strongest determinant of plaza user’s actions. These findings suggest that increased colour and pattern of luminance elsewhere in Vancouver would also be warmly received.
Investigate performance-based standards for streetlights

<table>
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<th>Summary Table: Recommendation #4</th>
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<tr>
<td><strong>Investigate performance-based standards for streetlights</strong></td>
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<tr>
<td>- Set parameters for urban lighting projects through goal-oriented criteria</td>
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<tr>
<td>- Consider a hierarchy of street lighting, where the illumination required for public streets is determined by the formal composition and the use of a street</td>
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<tr>
<td>- Consider alternating streetlights with street tree luminaires</td>
</tr>
<tr>
<td>- Collaborate with the municipal engineering department to explore the visual and functional opportunities of performance-based standards for streetlights</td>
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</table>

The illumination from the high-pressure sodium lamps along Athletes Way in Southeast False Creek overpowered the white light along the public sidewalk. Engineering standards ensure streetlight illumination is maintained on all city streets to ensure road safety, however these standards do not consider the functional hierarchy of streets. Research demonstrates that continuous illumination in residential areas, or parallel public spaces encourages higher speeds and reinforces the dominance of the automobile (Brandi & Geissmar-Brand, 2002; Phillips, 2002). The engineering standards used to determine adequate illumination levels for streets should be challenged.

Research also suggests that existing streetlight standards are based on inaccurate measures of vision at night. The Mesopic Optimisation of Visual Efficiency (MOVE) project is a light brightness evaluation project, governed by the European Commission. In this study, an international research team conducted performance-based testing to explore traditional standards of optimal illumination for the purpose of reducing inappropriate lighting, energy wastage and improving traffic safety. The study found that the human eye perceives light differently at night than during the day, therefore standards grounded on daytime vision may be inaccurate (Helsinki University of Technology, 2005).

Just as performance-based zoning allows the planning community to set parameters for proposed development projects through goal-oriented criteria rather than through prescriptive requirements (Alexander & Tomalty, 2002), performance-based standards for streetlight would allow for a spectrum of luminance on city streets.

Lighting master plan best practices suggest a variety of methods of reducing the illumination of streetlights. Light reinforces the intended purpose, mode and speed of travel along a street through fixture height and spread of illumination. The Melbourne Lighting Strategy suggests a hierarchy of street lighting, where the illumination required for public streets is determined by the formal composition and use of a street (2002). In an effort to combat over lighting from...
streetlights combined with urban lighting interventions, the City of Jyväskylä is exploring alternating streetlights with street tree luminaires (2009). The white birch tree common to Finland presents an opportunity to reflect light off its bark to illuminate the adjacent street. Finland’s dark winters mean that trees are mainly illuminated when they bare no leaves. Street trees in Vancouver’s climate may respond differently to seasonal changes, reducing the functionality of combining street and tree luminaires. However, Jyväskylä proves an interesting case study for challenging conventional engineering standards for the betterment of the public realm.

The City of Vancouver has endeavoured to incorporate interesting and innovative lighting design into new development; however streetlight standards can compromise these innovations. Investigating performance-based engineering standards for areas with low vehicle traffic would reinforce the intentions of the lighting plans and place the public and pedestrian realm at the forefront of planning and development. An investigation of streetlight standards by both Vancouver’s engineering and planning departments is needed in order to fully explore the visual and functional opportunities of performance-based standards.
Develop a lighting master plan

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<th>Summary Table: Recommendation #5</th>
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<tr>
<td><strong>Develop a lighting master plan</strong></td>
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<tr>
<td>• Coordinate public and private illumination at the development permit approval stage</td>
</tr>
<tr>
<td>• Identified buildings as canvases for illumination to better their visual appeal and improve neighbourhood quality</td>
</tr>
<tr>
<td>• Use illumination to build neighbourhood character and enforce a coherent image for the city</td>
</tr>
<tr>
<td>• Clarify and expand on individual lighting components found in City plans</td>
</tr>
<tr>
<td>• Construct a lighting master plan to coordinate players and projects to ensure maximum, local benefit</td>
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</table>

The primary purpose of a lighting master plan is to establish functional and aesthetic criteria to improve the quality, consistency and efficiency of urban lighting. Focusing on enhancing people’s experience in the city after dark, a lighting master plan outlines strategies to ensure that aesthetics are balanced with public safety, amenity and concern for energy efficiency.

Over lighting is a concern in all communities, especially in downtown areas where luminance from private establishments can compete with public lighting sources. The Melbourne *Lighting Strategy* emphasizes that both public and private luminaires need to be addressed simultaneously (2002). A lighting master plan would guide the coordination of public and private illumination, ensuring that light consistency is assessed at the development permit approval stage.

A lighting master plan could also improve the visual presence of existing built landscapes. Lighting is often used to draw attention to architecturally significant buildings. Light, however, can better the visual appeal of all types and styles of buildings. Within a lighting master plan, buildings with less visual appeal, such as industrial buildings, could be identified as canvases for illumination to improve neighbourhood quality. The City of Vancouver is built upon a small land area, and a lighting master plan would reinforce urban lighting as a tool to improve wayfinding, present neighbourhood character and enforce a coherent image for the city.

A citywide lighting master plan would allow for the clarification and expansion of individual lighting components found in existing City plans. For example, it would be useful for concepts such as luminaire *differentiation* called for in the *Southeast False Creek Public Realm Plan* to be clarified. On a small scale, such as within SEFC, differentiation of luminaires adds to the interest and brilliance of the site. However, luminaire differentiation may become overwhelming in areas where a number of projects are being carried out separately but in close proximity, such as in the downtown core.
As Vancouver is aiming to become the world’s Greenest City by 2020, express detail of environmental considerations for all urban features should be provided for (Green City Action Plan, 2012). This information could be made available in supplementary documents, but would be more accessible in an overarching document applicable to all new development. A lighting master plan would serve this purpose.

A review of lighting master plans case studies clarifies that a lighting master plan does not dictate design, but rather it is a tool to guide development toward balanced, appealing and organic lighting design. Because of the diversity of players involved in urban lighting projects, coordination is necessary to ensure that maximum, local benefit is achieved and a unified image of the city is presented. The City of Melbourne proves a valuable case study for analysis with the City of Vancouver, as both cities embrace urban design as a municipal tool and place the public realm at the forefront of planning and development. The City of Melbourne views urban lighting as an element to make the city an “even more liveable and attractive city” linking urban lighting to increased personal safety and economic prosperity (Melbourne, 2002).

Vancouver’s overcast climate presents an additional opportunity to use colour and illumination to improve the visual quality of

Figure 6-10: Section of the Lyon New Lighting Plan
Source: Lyon, 2009
the public realm. A lighting master plan would allow the City of Vancouver to best realize the benefits of urban lighting.

6.3 Next Steps

Time and capacity constraints restricted the scope of this research to observations over a two week period in winter. This limited time horizon presents an opportunity for further investigation of urban lighting in Vancouver. Expanding on this research and comparing wintertime to summertime plaza use would produce more robust findings. Also, analysis of plaza users after the Southeast False Creek community is fully built-out and occupied would also strengthen research findings and serve to confirm the results and recommendations of this report.

In order for report recommendations to be realized, the City of Vancouver will need to assess its commitment to lighting in the public realm. To successfully develop a lighting master plan, the City of Vancouver will need to conduct an analysis of existing public luminaires. Deeper investigation of the roles and responsibilities of the engineering and planning department towards urban lightings needs to be explored to determine opportunities for cooperation and collaboration.

The reviewed lighting master plans cite urban lighting as a viable tool for urban development. According to the Charter of the Lighting International Community Association (LUCI, 2002, p.1), of which Lyon is the founding member:

… urban lighting, with its capacity to organize and stimulate urban activities, to enhance cities and their urban spaces and to increase the quality of life of its inhabitants, can indeed contribute positively to building sustainable cities.

As other municipalities have done before, the City of Vancouver has the opportunity to improve urban liveability, economic vitality and the perception of public security by improving the illumination of our public spaces.


Vancouver, City of. (2012). *Green city action plan*. Planning Department: City of Vancouver


——. (2007a). *Under the Granville bridge neighbourhood commercial centre policies and guidelines*. Planning Department: City of Vancouver


——. (2007c). *Southeast False Creek official development plan*. Planning Department: City of Vancouver.


——. (2002) *Gastown heritage management plan (draft)*. Planning Department, Heritage Branch: City of Vancouver.


## Appendix A: Field Observation Template

<table>
<thead>
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<th>Date</th>
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<th>Couple</th>
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<th>Group More</th>
</tr>
</thead>
<tbody>
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<td>Jog</td>
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<tr>
<td>Walk and Dog or Baby (D) (B)</td>
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<td>Jog and Dog or Baby (D) (B)</td>
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<td>Pause</td>
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<tr>
<td>Cycle</td>
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<tr>
<td>Other</td>
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</table>
Appendix B: Lamp Technologies and Measures

Incandescent Lamps

**Incandescent** lamps are commonly used for exterior lighting in residential areas because of their low cost and ability to turn off and on immediately without a warm-up period. These lamps have a short life (less than 2000 hours) and are extremely inefficient. Only 10% of energy input is used to produce light, while the remainder is converted into heat.

Incandescent lamps are no longer used by municipalities to illuminate public spaces and are becoming less common for residential use, possibly due to rising energy costs. In public open spaces where lights flicker, switch off-and-on or dim, halogen **incandescent** lamps are more often used. These lamps have a longer life (2000 – 10 000 hours) and are slightly more efficient than the standard incandescent lamp (Karlen & Benya, 2004; IDA 2002).

High Intensity Discharge Lamps

A high-intensity discharge (HID) lamp is the most common outdoor lamp found along roadways, parking areas and public places. This type of lamp produces light by passing an electric current through a gas or vapour property. The most common types of HID lamps used for outdoor illumination are mercury vapour, metal halide and high-pressure sodium lamps.

**Mercury vapour** lamps produce a bluish-green light and have a moderately long life (24 000 hours), but offer low luminous efficiency, poor colour retention, and produce potentially hazardous mercury waste. It is difficult to filter and control the dispersion of light from mercury vapour lamps, which results in light pollution. Also when reaching the end of their life, rather than quickly burning out, illumination levels for mercury vapour lamps diminishes while energy is consistently consumed (IDA, 2002).

**Metal halide** lamps were developed to correct some of the short comings of mercury vapour lamps. Metal halide lamps give off a white or white-blue light, improving colour rendition, are twice as efficient as mercury vapour lamps and have high luminous efficiency. However, metal halide lamps offer a shorter lamp life and their white light tends to attract insects (Karlen & Benya, 2004; IDA 2002).
High-pressure sodium is currently the most widely used HID lamp for roadways and parking areas. Owing to their popularity, luminaires and fixtures are readily available at low costs. This lamp offers a longer lamp life and greater luminous efficiency than metal halide lamp. However, the orange or pink hue results in poor colour rendition and quality (IDA, 2002).

Low-Pressure Discharge Lamps

Low-pressure discharge (LPD) lamps, while functioning under the same gas transfer principle as high-intensity discharge lamps, require less energy to produce light. The most common outdoor LPD lamp is low-pressure sodium. These lamps are most commonly found in areas with high energy costs, such as in Europe because they produce the highest luminous efficiency with the lowest energy consumption. However, these lamps have a shorter life than high-pressure sodium and have exceptionally poor colour rendition, completely inhibiting the human eye from distinguishing colour when no other light source is present (IDA, 2002).

Light-Emitting Diode Lamps

Light-emitting diode (LED) lamps are an emerging outdoor lighting source valued for their extremely long life (50 000 – 100 000 hours) and extremely low energy consumption. LED lamps can come in a variety of colours, light up quickly and are more efficient than an incandescent bulb (Protzman & Houser, 2006). Because the light produced from LED lamps is directed, it reduces light pollution and light trespass. In Vancouver, LED lamps are being implemented in public places through public art and also in test projects for laneway lighting and streetlights (Vancouver, 2011a).

Aesthetic and Temporary Light Sources

Neon light is created by the gasification of neon among other gases glowing within small-diameter, glass tubes. Neon is most commonly used for decorative purposes and signage, because of the variety of possible tube shapes, light colours and illumination patterns. A neon luminous tube can last for 20 000 to 40 000 hours, but consumes high levels of energy (Karlen & Benya, 2004).
Sweeping **laser lights** and search light beams are often found in short term outdoor displays, and are a powerful tool to draw attention because projected light into the sky can be seen for many kilometres. Because of the high degree of visibility, the International Dark-Sky Association (IDA) discourages the use of lasers in urban centres (IDA, 2002). However, laser light can add interest and spectacle for short term, or special events, such as during the 2010 Winter Olympics in Vancouver. The controlled use of sweeping laser light has been implemented in some Nordic countries where heavy cloud cover offers an opportunity to use light to enhance air particles of precipitation in the sky (Jyväskylä, 2000).

**Luminance Measure**

There are two primary measures of light produced by luminaires. A lumen is the unit of measure used to quantify the amount of light produced by a lamp or emitted from a luminaire. Lux is the standard measure of luminance cast onto a surface. The term foot candle has also been used to quantify this measure, where 1 foot candle equals approximately 10 lux (IDA & IES, 2011). The efficiency of a light source is determined by a lamp’s product life, economic life and energy output measured in lumen/watts. A highly efficient lamp is able to illuminate a large surface area with low energy input. However there is conflict between the efficiency of a lamp and the quality of the light emitted (Brandi & Geissmar-Brandi, 2009). Light quality refers to light temperature and colour rendition, defined as the ease in which the human eye can perceive true colours in lit spaces. White light has the highest colour rendition, and therefore the highest quality. White light has been identified as a Crime Prevention through Environmental Design (CPTED) feature because it allows the eye to capture a more accurate perception of size and shape (Gehl, 2010). The better the light quality the lower the luminous efficacy, for that reason it is essential to find the right balance between quality and efficiency to effectively illuminate a public space.
Appendix C: City and Master Plan Profiles

City of Lyon *Le nouveau Plan Lumière*

The City of Lyon is internationally recognized as an exemplar for urban lighting. This provincial city in France pioneered the first lighting master plan in 1989 combining politics, art and technology to create a unified plan for municipal lighting design, and promoted themselves as “pioneer[s] of the nighttime urban landscape” (Lyon, 2009). The original *Plan Lumière* (Lighting Plan [Trans.]) called for the illumination of 250 sites showcasing the latest advancements in light technology to draw tourists, instill local pride and serve as a economic catalyst (Lyon, 2009).

Moving beyond a local mandate, Lyon works to build and promote urban lighting as a viable tool for urban development. The City created partnerships within the Rhône-Alpes region to encourage collective research and development within the lighting sector and increased regional economic attractiveness (Lyon, 2009). In founding the LUCI Association, the City council spearheaded the *city.people.light* award in partnership with the Professional Lighting Designers’ Association and Philips Lighting to recognize efforts made by other cities and towns to create livable urban environments through the implementation of innovative lighting strategies (Philips, 2012).

In 2004 the City of Lyon developed a new plan, *Le nouveau Plan Lumière*, moving away from aesthetic lighting to emphasize the importance of working with the City’s natural topography. This plan expands on sustainable, innovative lighting concepts focusing on City entrances and gateways, active transportation routes, architectural and historic monuments, and major transit arteries.
Finland is regarded as a forerunner in urban lighting for designing lively, inviting spaces to counteract long periods of darkness in the winter months (LUCI, 2012). As the northernmost LUCI member, the City of Jyväskylä was the 2009 recipient of the city.people.light award, recognized for instituting urban lighting as an integral component of the City’s identity. The City of Jyväskylä developed the Valaistuksen Yleissuunnitelma (Lighting Master Plan [Trans.]) in 2000, focusing on improving energy efficiency, reducing light pollution, increasing public safety and enhancing the quality of the urban environment. The main objective of the plan is to link urban planning, infrastructure and luminaires to create interesting urban landscapes that add value to local residents and spur economic growth by attracting tourists.

In the Valaistuksen Yleissuunnitelma, the City emphasizes the opportunity to view darkness not as a problem, but as an opportunity for innovation. Traditional lighting techniques seek to imitate daylight through street lighting, which is noted as a “physically impossible and visually inappropriate”† lighting objective (Jyväskylä, 2000). Darkness is positioned as an opportunity to emphasize new landscapes and landmarks through organized lighting strategies, and in so doing create a new way to see and experience the urban environment. Regarding lighting as a design tool rather than an engineering requirement, the plan explores using light to enhance the City’s modern identity. For example, where typically historically important architecture or elements are illuminated, in the Valaistuksen Yleissuunnitelma the City identifies opportunities to illuminate plain buildings as canvases for permanent light, sound and video installations.

† Translated from the original text
City of Melbourne *Lighting Strategy*

The City of Melbourne, Australia is consistently celebrated as one of the most liveable cities in the world. Much of the City’s success is owed to a strong foundation of urban planning rooting back to the cities initial layout and design. Melbourne has gained international recognition for their use of ‘light as art’ (Gehl, 2010). In 2002, Melbourne created a comprehensive *Lighting Strategy* in response to a municipal mandate to create a series of performance criteria for urban lighting to support the City’s goals of create an “even more livable and attractive city” (Melbourne, 2002).

The primary objective of the *Lighting Strategy* is to improve the quality, consistency and efficiency of urban lighting by mixing concepts of safety and amenity to enhance people’s experience and increase use of the city after dark. This plan explores the problems caused by over lighting recognizing that “brighter is not always better” (Melbourne, 2002). The plan acknowledges an opportunity to use shadow to add texture and drama in appropriate spaces, and also encourages the installation of permanent purpose-built outlets and infrastructure to accommodate temporary installations. The *Lighting Strategy* describes the characteristic *brand* of Melbourne lighting, one which is simple, elegant and functional. The plan elaborates on techniques for improving way-finding, visual comfort, road safety and personal security. The City plans to use Illumination to create a night-time scene that is cohesive and familiar, while also highlighting elements not apparent during the day.

**PLAN HIGHLIGHTS**

- **Hierarchy of luminaires:** guidelines for the number, type and location of lights decreasing in illumination from local retail strips, tram routes connecting neighbourhoods to the downtown core, streets in commercial or mixed-use areas, to residential areas that necessitate the lowest levels of illumination
- **Cooperation:** illumination of plazas and accessible, privately-owned open spaces to prevent privately lit spaces from undermining the effectiveness of lit routes
- **Upgrades:** conversion of streetlights to metal halide lamps producing a white light rather than yellow light, conversion to full cut-off lanterns to reduce glare and light escaping skyward, and magnify surface light
- **Energy efficiency:** renewable sources, introducing timers or dimmers to control illumination and investigating other advanced technology
- **Evaluation:** before and after evaluations of new lighting installations to better understand a pedestrian’s perception

(Melbourne, 2002)
Appendix D: Abbreviated Transcript of Field Notes

Saturday January 7, 2012


It is moderately busy for a Saturday afternoon in the rain. 4 degrees continuous showers.

There are a number of kayaks in the water today. Two boys in their twenty's round Shipyard plaza. They do not stop at any point. Two teenagers finish off a bottle of wine while walking through the area, along the seawall. A jogger goes around the water’s edge rather than over the pedestrian bridge, choosing a longer route. There is very little activity today, and the rain is still constant.

Two dog owners meet in the plaza. This seems to be a prearranged meeting, as neither of them seem surprised to see the other. A woman in nurse’s clothes walking toward the Main Street/Science World Skytrain station smiles at me. This is the first acknowledgement I have received. Judging by the direction she is walking I assume she lives in SEFC.

A middle aged man and woman stand outside the Creekside Community Center and share a cigarette. On the opposite side of the Plaza, an older woman stretches on the center deck. This is the first person I can seen utilizing the decks so far. The group of kayakers I saw earlier in the water are coming up the Aquabus float dock and moving into Creekside Community center. They look very wet and cold, but are mostly smiling. I am also wet and cold.

A family is slowly walking along the west side of Shipyard Inlet. Two children are playing on the spinning chairs. The chairs must be wet from the rain, but no one seems to mind. A couple uses a garbage bin behind me. These bins are interesting; they seem to have a solar power compacter. A woman in her early thirty’s walks from the direction of the Main Street/Science World Skytrain station with grocery bags from Choices. She enters the Village through Shipyard plaza. A young couple with a dog stop to take photos of Science World and BC Place Stadium. I will assume they are locals because of their clothing and that they own a dog.

There has been no activity by the Aquabus yet today. No one seems to be sitting or spending time in the Plaza. Most likely because of the benches are all wet.

A man with a small dog makes a loop of the Plaza and then continues on the south, the direction of which he came. A group of 20 year olds, holding umbrellas, make a tour of the Plaza. There is one man leading the group. He does not have an umbrella and seems to be explaining something about the Plaza. Perhaps this is a guided tour, although that seems unlikely because all the group members are the same age. Perhaps it is an English school trip.

Notably, there is very little car traffic. The pedestrians walking along the seawall seem to prefer the pedestrian bridge to the route around Shipyard Inlet. Is the pedestrian bridge preferred because the timber deck is slippery in the rain? Is the pedestrian bridge drawing user because of its visual interest?

A jogger returns, completing a circuit starting from Shipyard Plaza and returning an hour later. There is someone moving underneath the center deck. She does not seem to be the squatter, judging by her new looking rain coat. She is collecting something from between the rocks and placing it in a plastic bag.

1:20 pm. Time to leave.
Sunday, January 8, 2010

4:30 pm. Steady rain. 7 degrees. Observations taken from the east edge of Shipyard plaza.

Upon arrival the steel rib lights are on, but no other street and pedestrian lights are on yet. BC Place Stadium is also lit and reflecting its red light into False Creek.

4:45 pm. The bollard lights and embedded ground lights turn on. The bollards have a 360 degrees radius of illumination in most areas. Bollards line the seawall and separate the pedestrian promenade from the bike route. The bull rail lighting on the decks are illuminated. There are also lights embedded in the cement seating shining horizontally. The same lights are also embedded into a wave shaped cement art piece that separates the pedestrian from the cycle routes. All the light used in the Plaza is white light, however certain installations have coloured film that slowly changes over time. No pattern has been detected yet. Streetlights shine with a yellow light on the roads. The overhead pedestrian lights are now warming up. Lights around the water's edge are on, including the lights surrounding the Shipyard Inlet, which are beautiful art pieces with light shining against rusted metal.

4:50. All lights are on. It is dusk. The pedestrian bridge is completely illuminated and looks very inviting. Science World is also just turning on its lights. The white lights and twinkling in the water creating a very interesting scene in combination with BC Place Stadium’s reflection and the Plaza of Nations across False Creek. At night I cannot tell if Plaza users are making a loop of the area or passing through.

Athletes Way has overhead streetlights. The light is mostly likely high pressure sodium light judging by the colour. Streetlights are noticeably brighter than the plaza lights. Attached to the streetlight poles are pedestrian scale lights as well. These lamps utilize white light to illuminate the sidewalks along Athletes Way, and are noticeably brighter than the pedestrian lights within the Plaza and along the seawall. There does not seem to be anyone using the public sidewalk. Keep an eye on the sidewalk for future observations.

The timber decks, which were underused during the day, seem more inviting at night. They are well lit and drawing pedestrians off the promenade to observe the view.

Pedestrian and cycle activity has slowed down significantly. I will assume the after work commute home, through SEFC or around the area for exercise, is over.

6:00 pm Time for home

Monday, January 9, 2012

3:20 pm. 10 degrees. No rain, but overcast slight breeze. Observation location on the west side of the Plaza beside the cycle path

No lights have been turned on yet, although the sky is very grey. A man with a dog stops on the center deck and sits looking out onto the water for about 10 minutes. He and his dog slowly stretch as though they are preparing for a jog. The man and the dog then move in the direction they came. Now a man in his 30s walks over to the center deck with his dog. The likelihood of someone using a space is higher if someone is vacating it as s/he approaches. He has a small camera and takes a few pictures of Science World from the deck.

A woman on her lunch break stops on a bench in Shipyard Plaza facing the water. She is wearing a UPS uniform. A man and a little boy stop at center deck. The man is pointing at Science World and the child eagerly listens. A family plays on the timber-deck ledges underneath the steel rib lights. There are two children who jump on and off the benches as their parents watch. Two women on a leisurely walk stop at the utility drain and try to read what is engraved on it.
3:40 pm. The steel rib lights turn on in Shipyard Plaza. They glow with a blue light. A cyclist goes over the pedestrian bridge. During the day most cyclists seem to follow the water’s edge.

Another child runs over to play underneath the blue steel rib lights. A child plays on the pedestrian bridge.

Most pedestrians walking along Athletes Way tend to turn into Shipyard Plaza and walk along the water’s edge rather than continuing along Athletes Way. Again, the public sidewalk is avoided. Athletes Way ends on the other side of the Creekside Community Centre, so both the sidewalk and the seawall lead to the same place.

The woman in the UPS outfit is joined by her girlfriend and they share lunch together. The other woman works at Terra Breads located on the southwest corner of the Plaza in the Village. She looks as if she is going to work after their lunch because she is wearing a uniform but did not come from Terra Breads.

A man in his 20s is doing bike tricks in the Plaza. He begins at the south end in front of the Salt Building and works his way along the timber and concrete ledges toward the Shipyard promenade. He is in the Plaza for about 45 minutes. I had a chance to speak to him briefly. At first he seems concerned that I am going to reprimand him and is hesitant to respond to my questions. He informs me that he is only occasionally confronted by security guards; generally they arrive by car and ask him to leave as they pass through. In regards to the Plaza lighting, he had very complementary things to say. He compared the lighting in the Plaza to a stage or arena for this tricks. He was particularly impressed by the changing colour of the lights, as he said when they change, so does his mood for the better.

A couple takes a photo on the pedestrian bridge. They leave immediately after in the same direction in which they came.

I see the first binner of these observations. It is strange that I have not seen any binners before this moment. He is a middle-aged man riding a bicycle with a large cargo box filled with bottles and cans. He stops only briefly in the Plaza, as he rides along Athletes Way. The garbage bins in the Plaza, and throughout SEFC are very interesting in that each receptacle is sided by a narrow recycle bin. The bins have two compartments with circular holes indicating that they are for bottles, but they are partially open from the top to allow bottles to be easily removed. The binner looks into one of these recycling bins along his route, but does not look into any of the others in the Plaza. He is clearly just passing through and this is not a main stop on his journey.

4:30 pm End of the day

Tuesday, January 10, 2012
4:30 pm. 8 degrees. No rain, but overcast slight breeze. Observation location on the east side of the Plaza

4:30 pm. A man stops on the center deck, just as the bull rail and embedded ground lights turn on. Three cyclists in a row do not follow the cycle route that takes a sharp left turn before the pedestrian bridge, but rather cuts a diagonal through the plaza. As the lights are only just turning on, it is difficult to distinguish the paving pattern that separates the cycle routes from the plaza. There is also, no one else in the plaza to help delineate the different spaces.

Across the water, the lights at BC Place Stadium are turned on and glow red. There are not many pedestrians or joggers along the promenade right now, and as a result almost every cyclist is using the pedestrian bridge.

4:50 pm. All remaining lights turn on. An older woman stops on the center deck to stretch. She had been speed walking westward before she stopped rather abruptly, as if she had not initially intended to stop in
the location. Two men take photos in front of the BC Place Stadium standing on the center deck.

5:15 pm. A police man on a motorcycle roll down cycle path heading towards the Main Street/Science World Skytrain station. His lights are on and he is moving very slowly. He makes a loop and returns 5 minutes later. Another couple arrives to take pictures at the water’s edge. This time they move towards the entrance of the Aquabus float dock and take photos facing Science World. A city truck stops to see if the garbage can is full. It is not.

5:30 pm. Time for home.

Wednesday, January 11, 2012

5:45 pm. Clear skies. 2 degrees, but there is no wind.

A couple poses at the Aquabus entrance deck. They stop only for a few second to take a picture before turning around and returning the direction in which they came crossing the path of two men walking towards each other. The men are in their 40s and they engage in conversation standing stationary in the Plaza for some time. It looks as they this was not a planned meeting that they happened upon each other. A couple in their 20s walk from the Village across Shipyard plaza directly towards the center deck. They stand for some time and look out onto the water without making conversation.

6:00 pm. The steel rib lights change from blue to green and then five minutes later change back to blue. I don’t understand the pattern of change as it seems to happen at different intervals every day.

A cyclist comes across the pedestrian bridge makes a loop in Shipyard Plaza and then returns the direction he came, again crossing the bridge. There is no one else was in the area when the cyclist crosses. This only seems to occur when no one else is around, like a silent act of defiance. Also is more likely to be done by cyclists heading east, perhaps because the opening of the pedestrian bridge is clearer on the west end.

A jogging group of around 17 people head over the pedestrian bridge. There is a clear leader of the group so this looks like an organized event, like a jogging club, rather than a coincidence. A man who had been standing on the center deck leaves, as he does a cyclists riding by stopping in, taking advantage of the recent vacancy. Again the vacating of a space seems to attract more users. It is very cold tonight, and feels as if it is getting colder. Everyone entering the Plaza seems to be moving quickly through.

Another large group of joggers goes by. This may be the same group that came by the other direction, but the groups seems smaller now so I am going to assume it is different group. Also the leader of this new jogging group does not look familiar. The group does not go over the pedestrian bridge, but rather jogs around the inlet. Noticing that the timber deck surrounding the inlet is slippery, half the joggers choose to take the thinner route beside the cycle path that is paved.

A man with a tripod sets up at the center deck, which is no longer occupied by the cyclist. His camera looks to be very powerful and he remains in that location after I leave.

The steel rib lights have slowly been alternating between green and blue today, although when I first arrived they were red for a very short period of time. This is the first time I have seen the lights shine red. The blue and green colours remain for quite some time before changing. This is pleasing to the eye; too much change would be overwhelming.

6:45 pm: Time to go.
Thursday, January 12, 2012

5:50 pm. 4 degrees clear skies.

Regular after work joggers and cyclists. Remnants of beer cans from the night before on the timber-deck ledges under the steel rib lights. Interesting that the beer cans would have been found underneath the lights, implying the people were spending time and drinking within the lit space rather than in darker areas. This seems unusual.

A couple takes photos on the center deck in front of BC Place Stadium. A number of other passers-by also stop to take photos on route; one looks like a professional, as he has two cameras around his neck. A brief conversation confirms that he is a photographer for a company blog. He comments that the deck lighting does not interfere with his photography because the glow from the bull rail lights is quite dim. The film crew arrives and head for the center deck, but it is already occupied. So they wait until the users leave. The center deck seems to be the most used because it is more out of the way than the east deck which has a clear sightline from Shipyard Plaza.

With clear skies the areas seems much darker today and the lights seem to shine extra brightly. This is the first time I have noticed how intensely the red light from BC Place reflects off the adjacent buildings. One building in particular has three floors which glow completely red. I imagine that this is a concern for the occupants.

Pedestrian activity begins to die down shortly after 6:30 pm.

6:50 pm. An employee of Terra Breads comes to take in the sandwich board sign that points towards the bakery. Terra Breads must be closing. Looking into the bakery, there are about 10 people sitting inside. The shop is quite large with lots of indoor and some outdoor seating.

7:30 pm. No one has been in the area for some time. Time to leave.

Thursday, January 12, 2012

11:00 pm. Clear skies, lots of stars. 1 degree. Very cold out.

Minimal activity. Within an hour only a few pedestrians walk through the area as well as two cyclists. Everyone that is travelling through Shipyard Plaza crosses the pedestrian bridge rather than going around the Inlet. A security car circles the neighbourhood. The company is Vancouver Security.

12:00 am. Everything is covered in a layer of frost. It is too cold to be outside

Friday, January 13, 2012

3:20 pm. 6 degrees. Overcast skies and slightly windy. Observations location east side of the plaza sitting on the concrete ledge in front of the Aquabus float dock.

Upon arrivals a film crew is at the Aquabus deck. They are packing up to leave for the day. I wonder if it is the same film crew that I had seen earlier. There are only about 7 people in the group, but there are a number of camera and film equipment.

A young boy is doing tricks on a long board. He is being watched by his father who sits on the rock at the west end of the Plaza. The boy remains in the plaza for 20 minutes practicing to spin around on his board. He is wearing protective gloves, demonstrating that this is something that he does often.
A man talks on a cell phone at the center deck, he is dressed very formally, in business attire. There have not been many people in business clothes in the plaza during these observations. Today there is an event in the Salt Building. There are many people scattered around the Plaza, standing in small groups talking. All the people are quite formally dressed and are in their late 20s.

The sidewalks and the bike paths have been salted, as it was very cold last night. A woman is stretching on the center deck and a young man sets up a camera facing the Plaza aimed at the steel rib lights. Two mothers watch while their children play on the east deck. They are talking freely while the children crawl around on the timber deck.

Crows fly overhead as they do every night, heading east. A number of people in the Plaza look up pointing and comment on the crows. I like to think of it as the bird exodus.

A binner arrives on a bicycle and searches the recycle bins. I do not think this is the same binner as I had seen earlier in the week. There are only a few bottles that he takes with him before carrying on eastward.

At this time of day, a good portion of the foot traffic is made up of construction workers. Assumingly they are heading towards the Skytrain strain from the construction sites surrounding the Olympic Village. Most of the area south and west of the Village in SEFC is under construction, the final stages of the neighbourhood.

There seems to be quite a few people in electric wheelchairs today. One woman coming from the Village travels through Shipyard Plaza and then returns 10 minutes. Two others were observed in the area.

The sun just falls below the cloud line and the entire city is illuminated. Again many of the people in the plaza comment. I get the feeling the plaza patrons are students judging by their dress and conversation. They seem to setting up a reception in the Salt Building, with food stations and decorations.

A woman plays with her dogs in the Shipyard inlet, under the pedestrian bridge. This is the first use of inlet at the waterline. This is not surprising because it has been cold and slippery in the area over the past week.

4:20 pm: I leave just as the steel rib lights are turned on.
Appendix E: Plaza User Counts

Plaza users were counted during the majority of observation sessions. Although some observation periods lasted longer than one hour, user counts occurred at one hour intervals to facilitate comparison between observation sessions. User counts were conducted at a variety of times throughout the day after the time that luminaires in Shipyard plaza are lit. Only plaza users moving within the study boundaries identified in section 3.3 were counted.

Counts reflect entrances and exits of individual users within the study area. Plaza patrons passing through the site multiple times were counted multiple times, as it was difficult to recognize faces during evening observations. Children in strollers or any child not moving of their own volition were not counted.

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<th>Monday January 9, 2012 (3:20 - 4:20 pm)</th>
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Appendices
## Summary Table: Total Observed Users in Shipyard Plaza

Users (per Person)

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<th>Group 4+</th>
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Thursday January 12, 2012 (11:30 pm - 12:30 am)

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Friday January 13, 2012 (3:20 - 4:20 pm)

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