

**Industrial Land Intensification:  
What is it and how can it be measured?**

by

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## **Abstract**

The Metro Vancouver region is experiencing high levels of population and employment growth within a strictly limited land base. With increasing competition for land, industrial land in particular is under considerable pressure to be converted to other uses, such as residential and commercial, with the current supply of industrial land is expected to be exhausted within 15 years. Without the ability to expand the industrial land base to meet the region's future industrial needs, more efficient use of existing industrial lands must be achieved. In recognition of this, the region is investigating intensification policies to encourage better utilization and intensification of industrial lands for industrial activities. The early work on industrial land intensification highlighted a gap in planning literature and practice with respect to how the intensity of industrial land use is defined and measured. A better understanding of intensification in the industrial land context is required for the region to develop industrial land intensification policies. This research practicum explores expanded definitions and measures of intensification. The inquiry develops a prototype analytical tool designed to communicate these definitions and measures and to facilitate the evaluation of industrial land intensification. The prototype tool is based on sustainability assessment tools used in sustainable development planning. Through semi-structured interviews with industrial land stakeholders, expanded definitions and measures of industrial intensification were considered and the prototype tool was refined. The project concludes with a discussion of future directions for the prototype tool, including the development of multiple versions of the tool at different scales and for different industrial sectors; the creation of an intensification rating system; and the adaptation of the tool into a checklist to be integrated into municipal development application processes. These evolutions of the prototype tool anticipate how it could be integrated into planning and development practices and inform industrial land intensification policies in areas such as the Metro Vancouver region.

**Keywords:** City planning; industrial land; industrial intensification; Industrial densification; sustainable development; sustainability assessment tools; Metro Vancouver.

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## 1 | Introduction

The Metro Vancouver region has experienced high levels of population and employment growth in the post-war period, evolving from a city-region focused on downtown Vancouver and heavily oriented towards the provincial resource economy to what is now a service-led economy and a thriving gateway region. This growth is expected to continue in the coming decades, with the projected addition of approximately 1 million people and 600,000 new jobs by 2040 (Metro Vancouver, 2011a). Accommodating this level of growth would be a formidable task for any metropolitan area, but it is particularly challenging in Metro Vancouver given the geographic constraints of the region. Constricted by mountains to the north, the ocean to the west, the USA border to the south, and the Agricultural Land Reserve, the region's ability to expand outwards is severely limited.

In 2011, the region's 23 local authorities<sup>1</sup> adopted the *Metro Vancouver 2040: Shaping Our Future*, the latest regional growth strategy, visioning and land use plan. One of the priorities of *Metro 2040* is to support a sustainable economy by ensuring that land use planning provides for the long-term economic and employment needs of the region. Protecting the supply of industrial land and promoting its efficient use are identified as the strategies for achieving this goal. As Metro Vancouver continues to grow, demand for industrial land is increasing, as is the importance of these lands as a source of employment and engine of the regional economy. Simultaneously however, there is increasing competition for land and considerable pressure in the marketplace to convert industrial land to other uses such as residential, office and retail. These pressures are not a new phenomenon, having been present for decades, and having resulted in a significantly diminished supply of industrial lands in the region (Port Metro Vancouver, 2014).

*Metro 2040* introduced a degree of protection for the remaining industrial land in the region. However, studies of the industrial land inventory have projected that the supply of vacant industrial land will be exhausted sometime in the 2020s, based on existing patterns of usage and rates of absorption (Metro Vancouver, 2012; NAIPOP, 2014). In order to meet the needs of the regional economy in the coming decades, more efficient use of industrial lands must be achieved. In recognition of this, *Metro 2040* also included requirements that the

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<sup>1</sup> 23 Local Authorities: 21 municipalities, one Electoral Area, and one Treaty First Nation.

region's municipalities develop policies to encourage better utilization and intensification of industrial areas for industrial activities (Metro Vancouver, 2011a, p. 27).

Metro Vancouver defines industrial land intensification as the more productive and efficient use of industrial land, including but not limited to, “optimizing industrial land potential by allowing sites to achieve higher density forms of industrial development, and by facilitating new growth through the re-development of existing underutilized sites” (Metro Vancouver, 2012, p. 1). Metro Vancouver has supported this regional priority by undertaking intensification analyses, stakeholder workshops, discussion papers, multi-level industrial building feasibility studies, market readiness reports, and ongoing monitoring of industrial land supply, utilization and demand.

## **1.1 Problem Statement**

Given the numerous challenges facing cities and regions today, industrial land use and industrial needs are too often under-considered in planning theory and practice. However, employment lands<sup>2</sup>, including industrial land, are a critical piece of the urban sustainability equation. In Metro Vancouver, planners, elected officials, and industrial land developers, investors, and tenants have recognized the importance of industrial lands to the overall sustainable development of the region. A sustainable and diversified economy is an essential component of a prosperous region and an adequate supply of land is needed to accommodate industry over the long-term.

The work that Metro Vancouver has done to support industrial intensification has highlighted a gap in literature and practice with respect to how the intensity of industrial land use is defined and measured. In discussions of industrial land intensification, intensity and density are often used interchangeably and it is common for industrial land use “intensity” to be described using standard measures for built-form density, such as floor area ratio (FAR), building height, and site coverage. What’s more, it is these density measures that commonly appear in the language of industrial zoning bylaws. Such density measures are practical, however they fail to adequately capture the distinct needs of industrial users and the diversity of activities that occur on industrial lands. Intensity of built form (density) is not necessarily a strong indicator of

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<sup>2</sup> In *Metro 2040*, Metro Vancouver introduced three distinct urban land use designations that support regional employment – General Urban, Mixed Employment, and Industrial.

“intensity of use” for many industries. In the context of industrial land, while density measures are useful for building-intensive industries, many industries are not building-intensive, but rather are job-intensive or land-intensive. Intensification for these industries will look very different and may not require larger buildings at all. In fact many industries can intensify by making more productive use of outdoor space, by investing in new technology, or by adding additional shifts of workers, all of which make more productive use of a given site, but do not require higher-density built-form.

Interpreting industrial land intensification using only density criteria may lead to unintended consequences, in some cases potentially working counter to the region’s sustainability and economic development goals. For example, if industrial land intensification policies were introduced that exclusively promoted higher density built-form, the result could be adverse impacts on the operations of ground floor users due to multi-storey building structural requirements; displacement of existing land-intensive industries and jobs; increased development costs; and higher industrial land prices. Such policies could also result in the influx of non-industrial users and jobs to industrial areas, which would work against the region’s priority of concentrating jobs in Urban Centres<sup>3</sup> and in Frequent Transit Development Areas<sup>4</sup>. Therefore, relying exclusively on density criteria as the basis of industrial land intensification policies, regulations and incentives, is inadequate. While many industrial land stakeholders recognize that “intensity” in industrial settings is more complicated than realizing this notion in residential and commercial development, this understanding is not yet reflected in municipal industrial land use policies, zoning or direction strategies. Planners and decision-makers therefore require more nuanced definitions and methods for measuring industrial land use intensity.

To ensure that individual businesses, industrial sectors, or industrial sub-regions are not disadvantaged by new intensification policies, the concept of industrial land intensification and how it is measured needs to be better defined and measured, and communicated. Developing this enhanced understanding of intensification and a new method of communicating these concepts is the focus of this research practicum. In addition to exploring an expanded definition

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<sup>3</sup> Metro Vancouver has 26 designated Urban Centres. Urban Centres are dense, transit-oriented areas with employment opportunities, public space and other social and cultural amenities and are expected to accommodate a majority of the region’s population and employment growth (Metro Vancouver, 2011a).

<sup>4</sup> Frequent Transit Development Areas (FTDAs) are high frequency transit corridors that have been identified as priority locations for high-density development and growth (Metro Vancouver, 2011a).

and new methods of measuring industrial land intensification, this research also develops a prototype multi-variable analytical tool that will help communicate these concepts to industrial land stakeholders and facilitate the evaluation of industrial land intensification. This prototype tool is based on and adapted from applications of circular histograms or rose-diagrams developed for sustainability planning (e.g. sustainability roses or sustainability assessment tools). It is hoped that this tool can be utilized and adapted by planners, decision-makers, and industrial land stakeholder to assist in the development of industrial land use intensification policies that ensure that different industrial sectors are treated fairly.

## 1.2 Research Objectives & Questions

This research practicum had two objectives:

**Objective A** was to develop a broader definition of intensification and additional measures of intensification in the industrial context. The intention is for these enhanced definitions and measures to inform the development of Metro Vancouver industrial land policies that both meet regional intensification objectives and ensure that different industrial sectors are treated fairly.

**Objective B** was to develop a prototype analytical tool to help planners and decision-makers better understand, measure, and communicate industrial intensification and utilization.

The two objectives are addressed by the following research questions, which guided this research project:

### A. Understanding and Evaluating “Intensity” in Industrial Lands:

1. How can industrial land intensification be defined and measured differently to reflect the diverse needs of industrial users? What alternative or additional measures can be used to evaluate industrial land intensity?
2. In what ways might an enhanced understanding of industrial land intensity help to shape industrial land policy and efficiency of land use in the Metro Vancouver region?
3. What lessons can be learned from other cities and regions dealing with limited industrial land supply issues that could be applied in Metro Vancouver?

## B. Developing a Prototype Multi-Variable Analytical Tool:

1. *Alternative Measures:* What measures of industrial land use intensification merit being included in a multi-variable analytical tool? How should these variables be determined; what evaluation scale should be used for each variable; and how should each variable be scored?
2. *Scale of Application:* At what scale should a multi-variable analytical tool be applied? (i) site/building, (ii) industrial areas/district, and/or (iii) industrial sector?
3. *Stakeholder Engagement:* In what ways can the needs and priorities of diverse industrial land stakeholders be incorporated into the alternative intensification measures and ultimately the tool? What role can the various stakeholders – planners, industrial real estate brokers, industrial developers, industrial users, and other experts – play in developing the multi-variable tool?
4. *Utility:* How will a multi-variable analytical tool aid in the understanding, communication, and evaluation of industrial land use issues between stakeholders? How can such a tool help to better shape industrial land use policy and address regional industrial land use objectives? In what other ways can the tool be applied and adapted for the industrial land context? How can the multi-variable tool help to promote fairness and ensure that no one sector is affected more than another by industrial intensification policies?

## 1.3 Scope of Work

This practicum attempts to develop an enhanced understanding of how land use intensity is defined and measured in the industrial context. In addition, it aims to develop a prototype multi-variable analytical tool that will aid planners, decision makers and other stakeholders to better understand, evaluate, and communicate industrial land intensity. The research objectives have been addressed through a review of relevant literature and the use of qualitative research methods. The prototype multi-variable tool was developed based on the literature and through consultation with the practicum committee. The prototype tool was then presented to key stakeholders as part of a semi-structured interview process. Interview participants provided expert views on industrial land intensification and on the prototype multi-

variable tool. The resulting findings have been used to refine the tool and make recommendations for future adaptations and applications of the prototype tool at different scales.

#### **1.4 Significance of Project**

The project findings will help inform the development of equitable industrial land use policies intended to support a sustainable region economy in Metro Vancouver. The refined multi-variable tool resulting from the research process can also be adapted by planners and other industrial land stakeholders to evaluate industrial land intensification.

#### **1.5 Assumptions and Biases**

##### *Assumptions:*

This research accepts the projections that the Metro Vancouver region will continue to grow in both population and employment, and that the already threatened industrial land supply will one day reach depletion, therefore requiring more aggressive development and redevelopment of existing industrial areas in more efficient and intense ways. Anticipating this future reality, this research supports the development of policies that can facilitate this necessary intensification in a way that meets the diverse needs of industrial users while also allowing for the continued innovation and evolution of the region's economy.

##### *Biases:*

I am a former employee of Metro Vancouver, the regional organization that is conducting research on the topic of industrial land intensification in the Metro Vancouver region. Metro Vancouver is an organization that represents the region's 23 local authorities<sup>5</sup> and delivers regional services, policy, and political leadership. Within this large organization, I worked with the Metro Vancouver Housing Corporation as a Technical Analyst in the summer of 2012 and again as a project consultant in the summer and fall of 2013. In these positions I did not work directly with Regional Planning, Policy and Environment Department, the group responsible for Metro Vancouver's work on industrial lands. Nor did I work on any projects related to industrial lands while working with Metro Vancouver. For these reasons I do not feel

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<sup>5</sup> Metro Vancouver, formally the Greater Vancouver Regional District (GVRD), is composed of 21 municipalities, 1 Electoral Area, and 1 Treaty First Nation.

that my employment history compromises the integrity of this research or its outcomes in any way.

Eric Aderneck, the external member of the MDP Practicum committee, is a Senior Regional Planner with Metro Vancouver and has been responsible for much of the work undertaken on industrial land intensification by Metro Vancouver. Mr. Aderneck's expertise has been valuable to this project and his input was an important resource during the development of the multi-variable tool as well as with recruiting interview participants.

It should also be noted that this project is an independent study and not funded or endorsed in any way by Metro Vancouver.

## **1.6 Chapter Outline**

Chapter 2 establishes a broad understanding of intensification through a careful exploration of the literature. The literature review begins with an investigation of the concept of intensification in planning theory and practice, and then explores how intensification concepts can be applied to the industrial land context.

Chapter 3 investigates various the forms of multi-variable tools that informed the development of the prototype multi-variable analytical tool. This chapter also details the process of developing the prototype tool, including the selection of measures and development of evaluation scales.

Chapter 4 introduces the qualitative research methods used to address the research questions. This research used a detailed literature review and iterative process with the practicum committee to develop the prototype multi-variable analytical tool. The prototype tool was subsequently reviewed and refined using semi-structured interviews with industrial land stakeholders and experts.

Chapter 5 presents an analysis of the findings from the semi-structured interview process. The analysis is organized by the five major themes that emerged from the analysis 1) Defining Intensification; 2) Developing the Tool and Tool Graphic; 3) Intensification Measures; 4) Scores and Targets; and 5) Application and Utility.

Chapter 6 presents a synthesis of the research results and reflects on how the research questions were addressed by the research methodology. The central findings of the research project are presented as three distinct sections – Conclusions, Tool Refinements, and Future Directions.

## 2 | Literature Review Industrial Land Intensification

The following chapter presents a summary of the literature on industrial land intensification. It begins by setting the context for regional planning and industrial land intensification in Metro Vancouver. The idea of intensification is explored in planning literature, attempting to draw connections to the industrial land context. Lastly, industrial land intensification is discussed, including an exploration of industrial land intensification measures.

### 2.1 Regional Context: Metro Vancouver

Metro Vancouver contains more than 50% of the Province of BC's population and generates more than half of the Province's economic activity in an area of approximately 2,865 sq. kilometers (Metro Vancouver). The Metro Vancouver region has experienced high levels of population and employment growth in the post-war period, evolving from a city-region focused on downtown Vancouver and heavily oriented towards the provincial resource economy to what is now a service-led economy and a thriving gateway region. This growth is expected to continue in the coming decades with estimates projecting an additional 1 million people and 600,000 new jobs by 2040 (Metro Vancouver, 2011a).

#### METRO VANCOUVER GROWTH PROJECTIONS

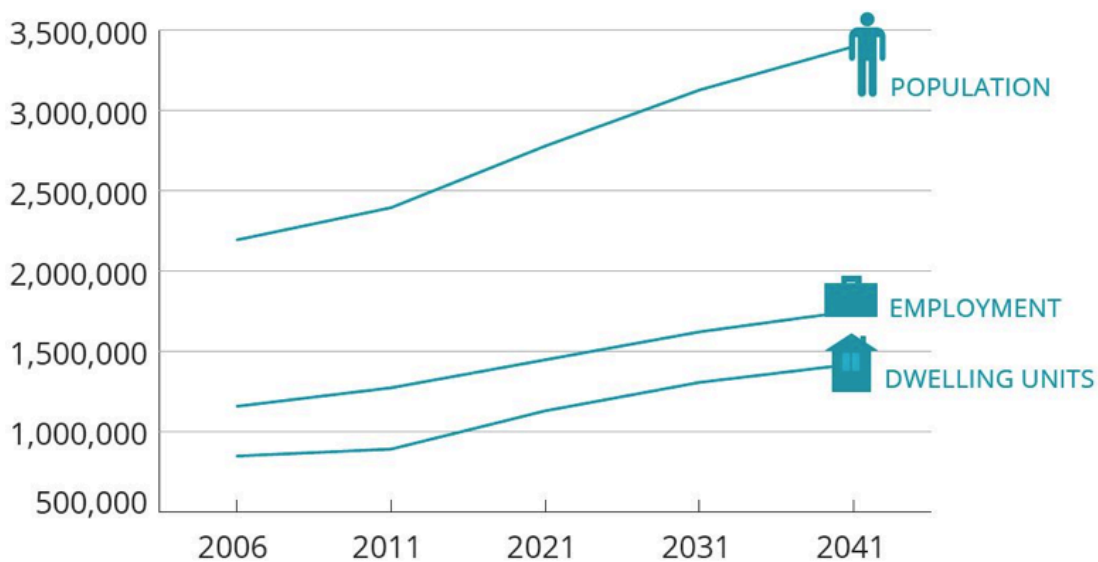


Figure 2.1: Metro Vancouver Growth Projections (Source: Metro Vancouver, 2012a). Used with permission.

By 2040, Metro Vancouver is projected to have 3.4 million residents, 1.4 million dwelling units and 1.7 million jobs (Metro Vancouver, 2011a). Accommodating this level of growth would be a formidable task for any metropolitan area, but it is particularly challenging in Metro Vancouver<sup>6</sup> given the geographic constraints of the region. Constricted by mountains to the north, the ocean to the west and the USA border to the south, and the Agricultural Land Reserve, the region's ability to expand outwards is severely limited.

Metro Vancouver (previously known as the Greater Vancouver Regional District or GVRD), is a regional organization made up of a partnership of 21 municipalities, one Electoral Area, and one Treaty First Nation (see Figure 2.2). Metro Vancouver is a larger umbrella organization created in 2007 and is composed of four separate entities: the Greater Vancouver Regional District (GVRD), the Greater Vancouver Sewerage & Drainage District (GVS&DD), the Greater Vancouver Water District (GVWD) and the Metro Vancouver Housing Corporation (MVHC). Each of these entities has its own history. The GVRD was established in 1967, following the creation of the GVS&DD in 1914 and the GVWD in 1924. Metro Vancouver performs many functions, but it is primarily a wholesaler for municipal services. The organization is governed by a Board of Directors, composed of elected officials from each of the member municipalities. The Local Government Act empowers Metro Vancouver (GVRD) to undertake regional planning on behalf of member municipalities and to develop and implement a Regional Growth Strategies. Through the development of Regional Context Statements, local municipalities ensure that their Official Community Plans are in alignment with the Regional Growth Strategy (*Metro Vancouver 2040: Shaping Our Future*).

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<sup>6</sup> The Metro Vancouver region is organized under a regional district system comprised of 23 local authorities, including 21 municipalities, 1 electoral area, and 1 treaty First Nation.

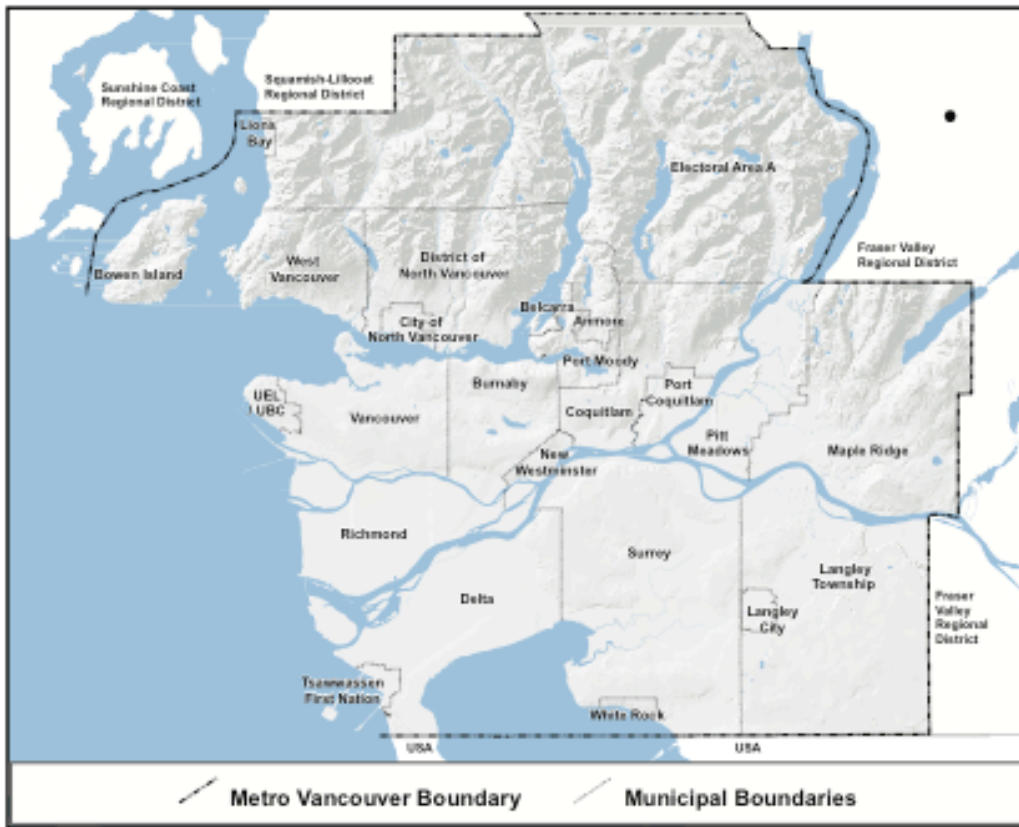


Figure 2.2: Map of Metro Vancouver and its Municipalities (Source: Metro Vancouver). Used with permission.

### 2.1.1 Regional Economy

#### *History and Trends*

The regional economy of Metro Vancouver has undergone significant transformation and structural change over the last half century, evolving from a traditional resources-based economy to a modern service-oriented economy. In many ways this evolution mirrored processes seen in other medium-sized cities throughout North America during the same period. However, a combination of unique features of the region's industrial past and the steady population growth experienced by the region contributed to the industrial land supply challenges facing the region today.

The earliest European settlement in the Metro Vancouver region was at Fort Langley, a Hudson's Bay Company trading post. In the second half of the 19<sup>th</sup> century, the balance of economic activity began to shift from the fur trade towards resource industries such as lumber/sawmills and fish canning (Hutton, 1994, p. 220). The completion of the Canadian

Pacific Railway in 1886 brought rapid economic expansion and population growth that continues to this day. The growth was initially predicated on the region's resource processing industries, superior port and rail facilities, and growing trade with Asia (Hutton, 1994). The industrial capacity of the Vancouver region surged during the Second World War and in the post war period due to increased demand, both domestic and international, for the province's resource commodities (Hutton, 1994). While a great deal of this growth occurred within the City of Vancouver proper, industry also took hold in other areas of the region.

Unlike many other North American cities, Vancouver's manufacturing sector remained relatively underdeveloped even during periods of rapid growth. In fact Vancouver and the surrounding region failed to achieve industrialization on the same scale as other major Canadian cities such as Toronto, Montreal, or Winnipeg (Hutton, 1994, p. 221). Hutton attributes this pattern to a number of factors. First, the small local market and the long distances to larger markets curbed the growth of manufacturing and industry in the region. Second, beginning in the early post-war years, a restructuring of the region's economy began to occur as the service economy grew significantly while the already truncated manufacturing sector was shrinking. At the same time this restructuring was underway, the region also experienced familiar patterns of decentralization of manufacturing and industry from the core to the suburbs. Finally, the region saw a shift in its relationship with international markets as the influence of national and global economies exerted more and more influence (Hutton, 1994, p. 228). The result was a declining role of the traditional resource economy in favour of a more diversified economy that is part of "extra-regional and international urban networks, trade systems, and cultural relationships" (Hutton, 1994, p. 221).

These factors helped to shape the regional economy into what we see today. In addition, the underdeveloped manufacturing sector and the long-term presence of a strong service-tertiary sector also influenced the spatial configuration of Vancouver and the surrounding region. Rather than being influenced by industrialized manufacturing, the development patterns in the region were shaped significantly by the region's control and distribution functions as a port city (Hutton, 1994). As a result, the region does not have the large swaths of former industrial lands that can be retained and redeveloped for contemporary industry, contributing to the industrial land use supply challenges being experienced today. The continued expansion of the service sectors and the continued decline of manufacturing have also contributed to a perception that industrial lands are declining in importance. However, as

population and employment in the region continue to grow, demand for industrial land is growing as well, making it important that there is sufficient land available to support the future growth of the local and regional economies.

#### *The Metro Vancouver Economy Today*

Even as the service sector's share of the regional economy and employment steadily grows, industrial land continues to support a significant portion of the Metro Vancouver economy. While only 13% of the region's urban land is designated for industrial uses, 25% of the region's jobs and 24% of all businesses are located on these lands (Metro, 2011b; Metro, 2013, Summary). Metro Vancouver has a very diversified economy and therefore is not defined by a single sector. Eric Vance & Associates (2011) describe the region as being the "administrative and service centre for BC's resource industries, a major transportation gateway and goods distribution centre, a world-renowned tourism destination, home to an array of emerging technology-focused industries, and has highly-developed education, health care, recreation and many other industries that serve the region's residents" (Eric Vance & Associates, 2011, p. 6). The long-term economic trend in the region has been towards a service-oriented economy (Hutton, 1994; Eric Vance & Associates, 2011). However, British Columbia remains a net exporter of raw materials (NAIOP, 2014) and the continued growth of the region's port functions means that industrial lands will continue to play an important role in the regional economy.

The dominant employers in industrial areas – manufacturing, wholesale trade, and transportation/warehousing – are also the most concentrated in industrial areas and the greatest consumers of industrial land as measured by land area (Metro, 2013, Summary). These land-intensive industrial sectors are also growing, albeit at a slower rate than the rest of the economy (Eric Vance & Associates, 2011). Continued growth in port related container traffic would result in increasing demand for warehousing, distribution, and transportation, sectors already identified as significant consumers of industrial lands. As the region's port functions continue to expand, there is evidence to suggest that the goods handling and distribution needs of the region will drive the future demand for industrial land (Eric Vance & Associates, 2011).

Industrial lands are not evenly distributed between the region's municipalities. Of the region's 22 municipalities, sixteen have supplies of industrial land and six do not. Those municipalities that do not have an industrial land supply are generally smaller municipalities and

are part of a larger sub-region that *does* have a supply of industrial land (Metro Vancouver, 2011b). Not only are industrial lands not evenly distributed, the majority of the region's supply is concentrated in municipalities south of the Fraser River (see Table 2.1 and Figure 2.3). These municipalities are newer, more suburban in character, fast growing, and are expected to accommodate most of the region's population growth in the coming decades. Approximately 61% of the region's industrial land supply is located south of the Fraser River. These lands also represent 57% of the *developed* and 75% of the *vacant* industrial lands in the region (Metro Vancouver, 2011b). These figures underline the importance of managing industrial lands at a regional level.

Sub-region	Developed Industrial Land (Acres)	Vacant Industrial Land (Acres)	Total Industrial Land (Acres)	Regional Share
North Shore	955	59	1,014	3.6%
Vancouver	1,510	67	1,577	5.6%
Burnaby / New West	3,241	349	3,590	12.7%
Northeast Sector	2,870	183	3,053	10.8%
Richmond	3,552	935	4,487	15.9%
Ridge - Meadows	754	1,008	1,762	6.2%
South of Fraser Municipalities				
Delta / TFN	2,860	1,066	3,926	13.9%
Surrey /White Rock	4,041	2,293	6,334	22.4%
Langley	1,829	674	2,503	8.9%
<b>Metro Vancouver</b>	<b>21,612</b>	<b>6,634</b>	<b>28,246</b>	<b>100%</b>

Table 2.1: Metro Vancouver Industrial Land Distribution by Sub-Region (Source: Metro Vancouver 2010 Industrial Lands Inventory, p. 15)

### 2.1.2 Sustainable Development and Industrial Lands in Metro Vancouver

Metro Vancouver has a long history of pursuing regional sustainability and sustainable development. The first Official Regional Plan was approved in 1966; followed by The Liveable Region plan in 1976; Creating Our Future: Steps Towards a More Liveable Region in 1990, and the Liveable Region Strategic Plan in 1996. Since the launch of the Sustainable Region Initiative in 2002, sustainability has been the guiding force behind Metro Vancouver's operating and planning philosophy. In 2008, Metro Vancouver adopted the Sustainability Framework which acts to ensure that sustainability principles are integrated into all regional management plans, including the most recent regional growth strategy, *Metro 2040: Shaping Our Future (Metro: 2040)*.

Due in part to the expected growth and limited ability to expand outward, much of Metro Vancouver's regional planning efforts focus on land use planning and managing the scarce land resources to ensure that there is sufficient supply to support the region's needs. *Metro 2040* is essentially a land use planning framework that supports sustainable regional growth and provision of services. The plan lays out 5 key goals:

1. Create a Compact Urban Area
2. Support a Sustainable Economy
3. Protect the Environment and Respond to Climate Change Impacts
4. Develop Complete Communities
5. Support Sustainable Transportation Choices

It is the second of these goals – *Support a Sustainable Economy* – from which the concept of industrial land intensification flows and which is the focus of this research project. *Metro 2040* supports economic sustainability through the introduction of strategies that promote development patterns that concentrate employment opportunities close to where people live, and that protect the supply of industrial land (Metro Vancouver, 2011a). *Metro 2040* helps to create the preconditions for a sustainable economy by introducing the idea of industrial land intensification to help ensure the most efficient use of the region's remaining industrial land. *Metro 2040* also establishes a degree of protection for the region's remaining industrial lands. However, it also goes a step further, requiring municipalities to develop strategies to “encourage better utilization and intensification of industrial areas for industrial activities” (Metro Vancouver, 2011a, p. 27). Since the adoption of *Metro 2040* in 2011, Metro Vancouver staff have advanced the idea of industrial land intensification through intensification analyses, stakeholder workshops, discussion papers, multi-level industrial building feasibility studies, market readiness reports, and ongoing monitoring of industrial land supply, utilization and demand. This research project builds on this work and expands the discussion of industrial land intensification.

### *2.1.3 Importance of the Industrial Sector*

Howland (2011) explains that industrial activities remain central to the economic sustainability of metropolitan areas, despite the structural changes seen in the metropolitan economies – deindustrialization, dispersal of industry, and a growing service sector. Howland lists a number of reasons for this enduring significance. First and foremost, industrial businesses

continue to be important sources of employment, providing jobs that are often relatively high-paying when compared to the service sector for individuals with comparatively low levels of formal education. Many industries are essential to the operation of government as well as critical sources of support for other sectors of the economy, through functions known as PDR – production, distribution and repair. Industrial lands also provide low-cost locations that enable incubator space for innovative start-up businesses. Finally, industrial activities are often the most appropriate use for land that has previously been used as industrial, due to factors such as environmental contamination that make the land either unsuitable or prohibitively expensive to convert to commercial or residential uses (Howland, 2011, p. 43). While sufficient industrial lands are essential to regional economic sustainability, industrial users can be crowded out by residential and commercial development. The potential effects of this crowding out can be a rise in unemployment, fiscal challenges, and strains on service and consumers that depend on inputs from local industry (Howland, 2011).

Industrial lands, and the industry that they support, play an important role in the regional economy of Metro Vancouver. There is crucial link between the region's industrial sectors, such as manufacturing and distribution, and the expanding service sector. Many local service businesses derive significant portions of their income from serving industry, and in turn, industry serves these sectors (Eric Vance & Associates, 2011, p. 1). Industry in the region not only has a role to play in the local and regional economies, but also in the provincial and national economies, due to the region's strategic location and the rail and port facilities that connect BC and Canada to international markets. It is the critical role that industrial lands play in economic sustainability that is the impetus behind industrial land intensification and the push to make efficient use of the region's remaining industrial land base. *Metro 2040* states that "meeting the needs of a growing regional economy and an expanding international gateway for trade requires an adequate supply of industrial lands" (Metro Vancouver, 2011a, p. 25). With competing land use interests and limited room to expand outward, many believe that the regional economy could be negatively impacted in the long-term if industrial lands are not protected from conversion to other uses (Eric Vance & Associates, 2011).

#### *2.1.4 Industrial Land Intensification in Metro Vancouver*

The purpose of industrial land intensification is to make efficient and effective use of the region's industrial land base, while also supporting regional economic and employment growth

in industrial sectors (Eric Vance & Associates, 2011). Metro Vancouver has identified numerous benefits to industrial land intensification for the region, including:

- Increased economic activity and employment activity on a limited land base;
- Efficient use of land and resources;
- Reduced impact on the environment;
- More efficient use of transportation infrastructure;
- Extending the lifespan of available industrial lands; and
- Reduced pressure to convert agricultural lands to industrial uses.

While the benefits of industrial intensification are numerous, it is important to acknowledge that there are some unintended consequences of intensification that work counter to the goals of the Metro Vancouver Regional Growth Strategy. For example, increased density and intensity on industrial lands will lead to increases in employment, resulting in increased traffic volumes and demands for services outside of urban centres (Metro Vancouver, 2012). It is possible that this increased activity may lead to conflict between industrial activities and other uses, putting pressure on some industrial users to relocate. Increased commercial office and retail functions may also impact land values for industrial users, further destabilizing industrial areas for industrial users (Metro Vancouver, 2012).

## **2.2 Industrial Lands in Metro Vancouver**

This section discusses the industrial lands in Metro Vancouver, including definitions of industrial land, the current industrial land inventory, industrial land supply protection, and industrial development constraints and building trends.

### ***2.2.1 Defining Industrial Lands***

The term ‘industrial land’ can be interpreted in a number of ways and the uses that are deemed to be industrial may vary from region to region, municipality to municipality. Given that this research focuses on industrial land in Metro Vancouver, the definition of industrial land provided by Metro Vancouver will be used. In *Metro 2040*, Industrial land is identified as one of three ‘urban’ land use designations that support the region’s employment functions.

A key objective of *Metro 2040* is to ensure that the majority of new jobs in the region are located in Urban Centres and in close proximity to transit, and policies were introduced to

advance this objective. The three distinct land use designations were created to help ensure industrial lands are retained for industrial uses. The three land use designations are *general urban*, *mixed employment*, and *industrial* (see Figure 2.3). The focus of this research practicum will be the lands designated as *industrial*.

The *general urban* designation is the broadest of these land use designations and is applied to residential neighbourhoods and mixed use centres that support shopping, services, institutions, recreational facilities and parks. General urban areas are mixed-use areas that are well connected to transit and other sustainable modes of transportation (Metro Vancouver, 2011a). Of the three urban land use designations, general urban is the only one where residential uses are permitted.

*Mixed employment* areas support a diverse mix of employment uses including industrial and commercial office and retail uses. These areas are intended to accommodate a variety of employment functions that support industrial areas while also potentially being locations for future industrial intensification (Metro Vancouver, 2011b). The designation permits large and medium format retail where these uses are not in conflict with the objectives of *Metro 2040* (Metro Vancouver, 2011b). The vision of *Metro 2040* is to have all significant office and retail developments situated in Urban Centres and Frequent Transit Development Areas (see Figure 2.4). Mixed employment areas that are located *within* Urban Centres and Frequent Transit Development Areas are considered suitable for a diverse range of employment activities including intensive commercial development. Mixed employment lands located *outside* of Urban Centres and Frequent Transit Development Areas are appropriate for lower density industrial and commercial uses (Metro Vancouver, 2011a).

Areas identified under the *industrial* designation are limited to heavy and light industrial uses. Appropriate accessory uses are permitted, as are limited commercial uses that support industrial activities (Metro Vancouver, 2011a). Industrial users typically have unique needs that are often not compatible with other uses due to space requirements, transportation needs, noise issues and other externalities. The focus of this research is the lands designated as *industrial*.

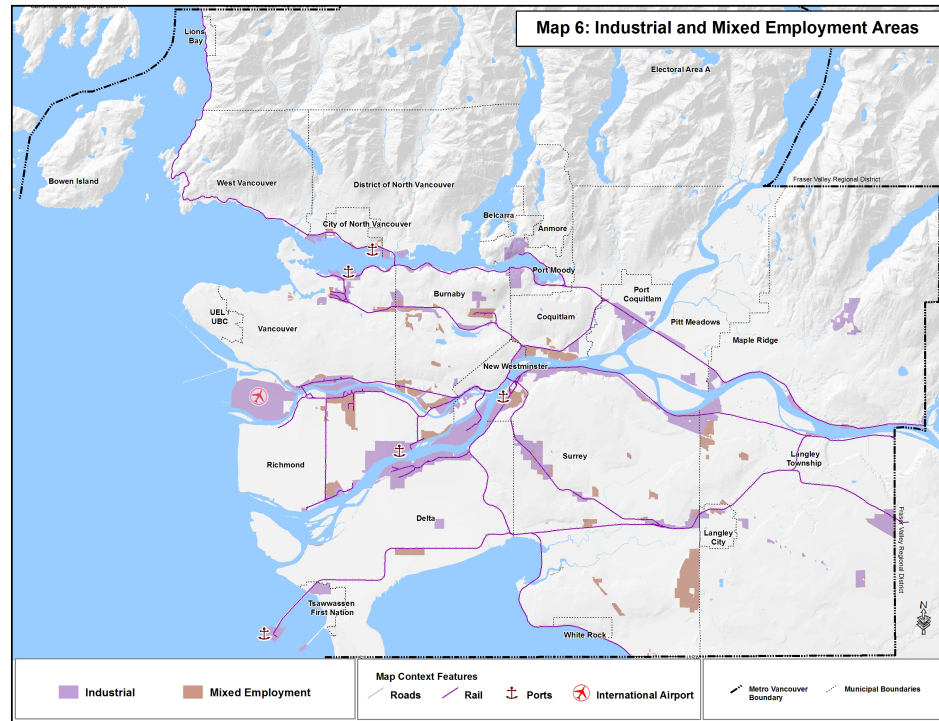


Figure 2.3: Industrial and Mixed Employment Areas (Source: Metro Vancouver). Used with permission.

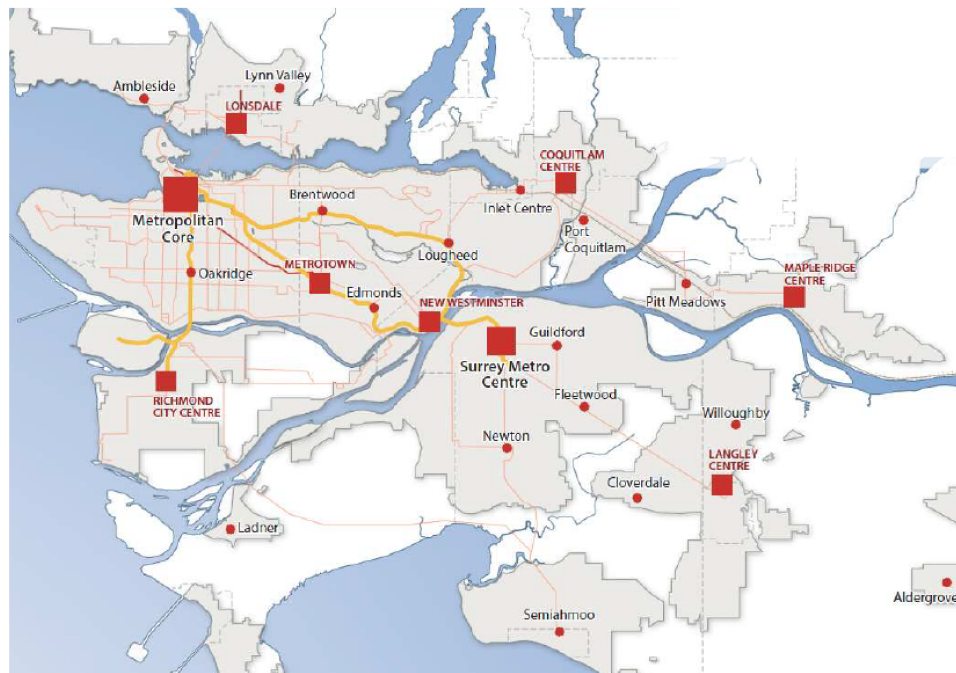


Figure 2.4: Urban Centres and Municipal Town Centres (Source: Metro Vancouver). Used with permission.

### 2.2.2 Industrial Land Inventory

To better understand the industrial land supply challenges facing the region, Metro Vancouver conducted industrial land inventories in 2005 and 2010. The inventories quantified the supply and mapped the location of industrial land in the region. The 2010 inventory identified 28,246 acres of industrial lands, of which 21,612 acres (76%) were developed<sup>7</sup> and 6,634 acres (24%) were vacant<sup>8</sup> (Metro Vancouver, 2011b). The inventory of vacant industrial lands was subsequently adjusted to 6,509 in 2012.

Building upon this inventory, a preliminary 'market readiness' analysis was conducted to assess development timing and potential of the vacant industrial lands (Metro Vancouver, 2012b). The conclusion was that of the 6,509 acres of vacant industrial lands, 4,521 acres were considered to be 'market ready' within the short/medium-term (within 5 years, from January 2012 / before 2017). The remaining 1,988 acres were classified as being developable in the long-term (after 2017). The National Association of Industrial and Office Properties (NAIOP) conducted a more in-depth analysis of market readiness that factored in the potential development constraints facing these vacant industrial lands. NAIOP concluded that of the 4,521 acres that were identified as 'market ready' before 2017, 792 acres should be excluded from this category because they were isolated and unlikely to be developed in the short term, while 241 acres should be added to the vacant land inventory based on new data, bringing the revised total to 3,970. NAIOP's analysis determined that 1,527 acres faced one or more development constraints, leaving 2,443 acres of vacant industrial land available for development in the short-term (NAIOP, 2013).

In 2014, NAIOP conducted a similar analysis of those lands identified as 'market ready' in the *long-term* or after 2017. This portion of the inventory was adjusted to 2,313 acres, from 1,988 based on new data. The analysis determined that 1,838 acres were faced with one or more development constraint, leaving only 476 acres market ready industrial lands in the long-term (NAIOP, 2014). In their analysis, NAIOP notes that the development constraints that potentially keep these vacant industrial lands from being developed could be mitigated through

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<sup>7</sup> Developed industrial land is defined by Metro Vancouver as land that is partially or entirely used for industrial purposes, including all uses permitted within municipal industrial zones such as outdoor storage, office, retail, or institutional (Metro Vancouver, 2011b).

<sup>8</sup> Vacant industrial land is defined by Metro Vancouver as land that is not currently used for industrial purposes, including sites that are completely vacant as well as sites that are zoned for industrial uses but are currently utilized for non-industrial uses (Metro Vancouver, 2011b).

improved access to industrial sites, investments in infrastructure, and potentially by trends that create more favorable development economics (NAIOP, 2014). The various industrial land inventories and forecasts conducted by Metro Vancouver and NAIOP are summarized in Table 2.2 below.

<b>Summary of Industrial land Inventories and Forecasts (Acres), 2005-2014</b>					
	<b>Metro Vancouver Inventory 2005</b>	<b>Metro Vancouver Inventory 2010</b>	<b>Metro Vancouver Market Readiness Summary 2012</b>	<b>NAIOP Market Readiness Analysis 2013</b>	<b>NAIOP Long- Term Forecast and Analysis 2014</b>
Total Industrial Land	27,020	28,246			
Developed Industrial Land	20,370	21,612			
Vacant Industrial Land	6,650	6,634	6,509		
Market Readiness: Short-Medium Term, 2012-2017			4,521	3,970	
- 1 or more Development Constraints <sup>9</sup>				1,527	
- Serviced, Privately Owned, No Constraints				2,443	
Market Readiness: Long-Term, 2017 and After			1,988		2,313
- 1 or more Development Constraints					1,838
- Serviced, Privately Owned, No Constraints					476
Total Metro Vancouver Market Ready Industrial Lands			6,509		2,919

Table 2.2: Summary of Metro Vancouver Industrial Land Inventories and Forecasts (Sources: Metro, 2006; Metro, 2011; Metro, 2012b; NAIOP 2013; and NAIOP, 2014).

### *Projected Depletion*

Metro Vancouver and NAIOP's studies of the industrial land inventory confirm that the supply of industrial land in the region is very limited. There are two key trends that are precipitating this shortage of industrial lands – a growing demand for industrial land due to continued regional population and employment growth; and loss of industrial land base through the conversion to other uses, primarily residential and commercial office/retail. In an attempt to project how long it would take before the industrial land supply is depleted, Metro Vancouver created demand-led scenarios. The projections assumed a rate of industrial land absorption of 250 acres per year based on the historical rate of absorption from 2005-2009. These scenarios estimated that without intensification, the remaining land supply will be absorbed sometime in

<sup>9</sup> The development constraints used in NAIOP's analysis were: Government/quasi-government owned; dedicated as road; current industrial use; current non-industrial use; environmentally-sensitive area; unsuitable topography; non-industrial designation; servicing restrictions; and isolated lots under 1.0 acre (NAIOP, 2013; NAIOP, 2014).

the early to mid-2020s, and that with intensification occurring at a rate of 20%-40%<sup>10</sup> the supply could be extended to the late 2020s or early 2030s (Metro Vancouver, 2012a, p. 5). NAIOP reached similar conclusions, estimating that the combined 'market ready' (short, medium and long-term) vacant industrial lands in the region represents a little more than 11 years of supply (from 2014). These estimates are based on current trends in industrial land development and current development economics. Designating new industrial lands, redevelopment of under-utilized lands, and intensification policies could extend the life of this supply (NAIOP, 2014).

### *Development Constraints*

Not all industrial lands are created equal and the development potential of industrial lands can be affected by a number of factors including location, current uses, accessibility, lot assembly, market considerations, soil conditions, need for pre-loading, high development costs, or various environmental constraints (Metro Vancouver, 2011b). In a study of barriers and opportunities for industrial land intensification in Metro Vancouver, Stantec Consulting (2013) cited several categories of constraints that affect the re-development and intensification potential of industrial lands – site-specific constraints, design constraints, regulatory constraints, and financial constraints. Site-specific constraints include factors such as challenging topography, small sites, and poor locations and site access. Design constraints identified included floor area ratio (FAR) and ceiling height maximums. The regulatory constraints facing industrial land include large building setbacks, and excessive landscaping and parking requirements. Finally, the financial constraints listed were high land costs, relatively low lease rates, and site assembly challenges. (Stantec, 2013; Eric Vance & Associates, 2011). Both Stantec (2013) and Eric Vance & Associates (2011) point to the development economics in the region, specifically the high land costs and low lease rates, as the limiting factor on multi-storey industrial development. These financial constraints have contributed to low-density industrial development patterns in the region (Stantec, 2013). Finally, to the list of development constraints, NAIOP adds government/quasi-government ownership, environmentally sensitive areas, current non-industrial uses, non-industrial designation, and servicing restrictions (NAIOP, 2014).

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<sup>10</sup> "For every 10% of total new floor area constructed through expansion or redevelopment on existing developed industrial lands, about 150 hectares of the vacant industrial land would be preserved" (Metro Vancouver, 2012a, p. 7).

The combination of the limited industrial land supply and the development constraints on the remaining inventory restrict the ability of existing businesses and industries from expanding while also deterring new businesses and industries from locating in the region. Intensification policies can help to mitigate these challenges and help to retain industry and employment in the region.

### *Industrial Building Trends*

Industrial development is unique when compared to residential and commercial development, and within industrial development there exists a great variability based on the different requirements of industrial users. However, there are some clear patterns and trends in the region's buildings. The typical industrial building in the region is a single-level structure that occupies approximately 30% of the site (Vance, 2011; Metro Vancouver, 2012a). The typical FAR is 0.3 and the highest FARs being achieved in new developments are in the 0.5 – 0.6 range (Vance, 2011; Metro Vancouver, 2012a). Metro Vancouver found through stakeholder workshops that a gradual intensification of industrial lands is taking place as industry and developers respond to the higher land prices and supply constraints. There is a trend towards greater ceiling heights in excess of 34 ft and site coverage of approximately 40% (Eric Vance & Associates, 2011). Data from Colliers International (2015) tells us that the typical industrial building ceiling higher in the 1970s and 1980s was 20ft, and that new developments today commonly reach and exceed 32ft (see Figure 2.5). This trend may be an indication that intensification is occurring through building volume, rather than through greater floor area or multiple storeys (Metro Vancouver, 2012a).

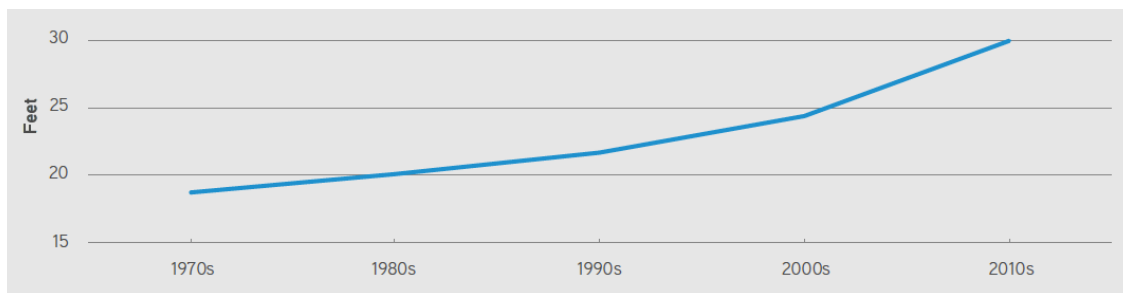


Figure 2.5: Historical Trend in Building Heights in Metro Vancouver (Source: Colliers International, 2015). Used with Permission.

### 2.2.3 Industrial Land Protection and Intensification

As Metro Vancouver continues to grow, demand for industrial land is increasing, as is the importance of these lands as a source of employment and engine of the regional economy. Simultaneously however, there is increasing competition for land and considerable pressure in the marketplace to convert industrial land to other uses that has resulted in a significantly diminished supply of industrial lands. It is this land use planning problem that is at the heart of this practicum. This limited land base has implications for economic sustainability and liveability in the region. Ultimately, there are three approaches that the region can take to begin to address this industrial land supply problem – 1) expand the industrial land base, 2) protect the existing/remaining land base, and 3) intensify the use of the remaining land base.

As discussed earlier, expanding the industrial land base is not a viable solution due to the geographic constraints of the region. Realistically, any expansion could only come at the expense of other land uses, specifically agricultural. Converting Agricultural Land Reserve (ALR) lands to industrial uses would be politically challenging, given the high level of public support for agricultural lands that exists, while also being strictly limited by *Metro 2040* policies. It is also arguably a questionable planning decision to convert productive agricultural lands into industrial use. Converting residential, commercial, or mixed use lands to industrial uses is equally difficult as it is these uses that threaten the existing industrial land supply, consistently out competing industrial uses. In fact, it is these uses that pose the greatest threat to the industrial land supply. Additionally, any long-term assessment of industrial land supply must acknowledge the possibility that lands designated as *Mixed Employment* and *General Urban* could potentially be converted to other land uses, further limiting supply (Metro Vancouver, 2012a). Therefore, expanding the region's industrial land base is not a viable solution to the industrial land supply shortage.

Since expanding the industrial land base by any significant amount is not a viable solution, it is critical that the remaining industrial land base be protected. *Metro 2040* introduced a degree of protection for region's existing industrial land base. In addition to designating and mapping all of the region's industrial land, *Metro 2040* introduced a requirement of a 50% +1 vote of the Metro Vancouver Board to re-designate industrial lands to other urban land uses (Metro Vancouver, 2011a). Prior to the adoption of *Metro 2040* as the region's growth strategy there was no protection in place for industrial lands. By preserving the supply of industrial lands, businesses are less likely to be forced to relocate or be deterred from

starting up or expanding operations in the region due to spatial constraints or land use conflicts from the encroachment of other uses. This protection is valuable, but protection alone will not ensure that there will be an adequate supply of industrial land to meet the needs of a growing region, nor does it guarantee that the industrial land base will not continue to shrink.

The limited potential of expansion and protection efforts to address industrial land supply constraints highlights the importance of making more efficient use of the remaining industrial land through intensification. The challenge facing the region is to identify ways of intensifying that respect the operational needs of the region's diverse industrial users. Intensification is not a silver bullet solution to the supply challenges facing the region, but it does offer the opportunity to prolong the life of the industrial land supply.

It is important to note that the threat to industrial land is a relatively new phenomenon and is not as severe as the decades long threat to agricultural land. In BC, concerns over farmland loss predate those of industrial land by several decades with the Province introducing protective measures for agricultural land in the early 1970s. In addition, the forces driving the creation of these protective measures are different. The protection and conservation of agricultural land stemmed from concerns over continued urbanization and encroaching development and the threat that these trends posed to productive agricultural land and local food security. The concerns about industrial land supply on the other hand are being driven largely by economic development interests, as industry and regional planners seek to ensure that there is sufficient industrial land supply to support a growing and sustainable regional economy and employment.

## **2.3 Intensification**

This section presents a broad discussion of 'intensification', drawing on sustainable urban form and spatial productivity literature.

### ***2.3.1 Defining Intensification***

What is intensification and what does it mean in the context of industrial lands? Before any discussion of measuring or evaluating industrial land intensification, it is important to first attempt to understand what is meant by intensification. There is no standard definition of intensification or intensity because the term has different meanings and implications in different

land use and development contexts. For example, the definition of intensity for residential or commercial development does not necessarily translate into the industrial land use context.

In planning literature and practice, the terms 'density' and 'intensity' are often used interchangeably to describe the same phenomena. Planners use the term *density* to refer to a number of concepts. It can describe the concentration on a given amount of land. For example, indicators such as *persons per hectare* or *dwelling units per hectare* are often used in residential development contexts (Hodge, 2008). Density is also synonymous with the concept of "bulk", which is a measure of the volume of a building. In other words, density could be described as intensity of built form.

*Intensity* on the other hand is a broader concept that arguably encompasses density. Intensity can refer to the amount of building or activity on a given piece of land. Scoffham and Vale (1996) explain that "density is a quantitative measure of number within a prescribed area, whereas intensity reflects a more subjective measure of built-up-ness or urbanity. Density, in itself, is of little importance unless it is related to built-form" (p.66). For Williams et al. (1996) defining 'intensification' is challenging, as a common definition does not exist. The term "generally relates to the range of processes which make an area more compact" (Williams et al., 1996, p. 84). Intensification of built-form can involve the redevelopment of buildings and sites at higher densities, infill development, rehabilitating and extending the life of existing structures, and development on previously undeveloped land (Williams et al., 1996, p. 84). Lock (1995) defines intensification as a process that ensures the fullest use of existing urbanized land before expanding into green field areas (Lock, 1995, p. 173, as cited in Williams et al, 1996). Roseth (1991) characterizes urban intensification "in terms of urban consolidation", an increase of both population and/or dwellings within an urbanized area (p. 30, as cited in Williams et al., 1996, p. 84).

Definitions of intensity and intensification in planning literature typically describe the density of people and/or buildings. Intensification, however, can also involve describe the intensity of activity. The intensification of activity includes "the increased use of existing buildings or sites', changes of use, which lead to an increase in activity, and increases in the numbers of people living in, working in, travelling through an area" (Williams et al., 1996, p. 84). Distinguishing between density and intensity is important in the context of industrial land use and development because many industrial activities cannot be intensified through more intense built-form (density).

In the context of industrial land use, Metro Vancouver defines intensity or intensification as follows:

“Industrial intensification optimizes the industrial land potential by allowing sites to achieve higher density forms of development, and by facilitating new growth through the re-development of existing underutilized sites.” ; and

“Industrial intensification means more productive and efficient industrial activities” (Metro Vancouver, 2012a, p. 1).

These definitions allows for both intensification of built-form *and* industrial activity.

There is also a distinction to be made when measuring density or intensity of industrial land use. When discussing measures of intensification Metro Vancouver distinguishes between density and intensity as follows:

“Industrial land intensity is described as “the amount of activity on a given amount of land, measured as: jobs per acre / hectare of land, volume of goods produced / processed / stored per unit. Industrial land density is the amount of building on a given amount of land. Density can be measured as floor area ratio, site coverage, and building heights” (Metro Vancouver, 2012a, p. 19).

It is common for greater measures of intensity to be associated with greater density, but this is not always the case. An example of this would be an industry that has high throughput activity on a given site while using a small amount of building as measured by area or volume (Metro Vancouver, 2012a). There are many industrial users that require large areas of land for loading, parking, and outdoor storage, and therefore the relationship between intensity of use and density of built-form on a site is often weak (Metro Vancouver, 2012a). Furthermore, it is possible to increase intensity without increasing built-form, through investments in technology or adding additional shifts of workers (Metro Vancouver, 2012a). Some industries are land-intensive, some are building-intensive, and others are job-intensive. It is therefore important to develop multiple measures of industrial intensification to ensure that the various forms of intensification are captured.

### *2.3.2 Sustainable Urban Form*

Much of the planning literature that refers to the idea of “intensification” does so in the context of sustainable urban form, or achieving sustainable development through urban form. Metro Vancouver’s operating and planning philosophies are guided by a Sustainability

Framework, which informed the regional growth policies from which the industrial land use discussion flows. Therefore, the region's efforts to protect and intensify industrial lands are firmly grounded in sustainability principles and the desire to develop a sustainable regional economy. The following sections will explore sustainable development and sustainable urban form literature in an attempt to relate these concepts to industrial lands.

For many experts, the physical form of contemporary urban areas is the very source of the multitude of challenges city-regions are experiencing. Urban form has a direct impact on environmental, health, and social functions. Jabareen (2006) argues "urgent changes are needed not only in our behaviour but also in the design of our built form" (p. 38). Sustainable urban form is one response to the challenges facing urban city-regions and the literature seeks to understand what forms of development are more sustainable, contribute to sustainability goals, result in lower energy consumption, lower pollution and have fewer negative impacts on ecosystems. Sustainable urban form represents a policy response intended to help achieve sustainability.

The compactness of the built environment is one strategy by which sustainable urban form might be achieved as it has the capacity to contain and reduce sprawling development patterns (Jabareen, 2006, p. 39). The concept of compactness refers to the connectivity and continuity of urban areas, suggesting that new urban development should occur in close proximity to existing urban development (Wheeler, 2000). To achieve compactness, city-regions employ strategies that use land more efficiently "by increasing the density of development and activity" (Jabareen, 2006, p.39). Intensifying urban areas in this way can involve the development of previously undeveloped urban areas; redevelopment of existing buildings or sites; and conversions, additions and extensions that result in increased built density or intensification of the use (Williams et al., 1996). This is the type of intensification envisioned by Metro Vancouver for the region's industrial lands. The benefits of compactness include protection of rural and agricultural lands; promotion of quality of life and social interaction through proximity to service and amenities; potential to reduce energy consumption through shared heating and power systems; and reduced GHG emissions through reduced dependence on fossil fuel dependent modes of transport (Jabareen, 2006). For many, compactness represents the critical urban form typology necessary for achieving sustainable development (ibid.).

Milder (2012) finds that the main characteristics that define and differentiate the various urban form typologies are density; land use and urban containment; car dependency and level of public transportation; and economic dependency (Milder, 2012, p. 267). Through a survey of European policy and literature on sustainable urban form, Milder found a reoccurring theme to be the pursuit of denser, mixed use urban development. Milder also noted that the merits of dense, mixed-use development are often described in terms of their environmental benefits, however, the literature suggests numerous social and economic benefits as well. Milder's review of sustainable urban form policy and literature also revealed the common rationales for managing urban form were to enhance accessibility to jobs and services, promote energy savings and resource conservation, and pursue climate protection objectives.

### *Compact City Theory*

The ideas of compactness and intensity are central to Compact City theory. The concept of *compact city* can be traced back to the 1970s and responses to modernist designs, and is consistent with the principles of sustainable development of today (Dantzig & Saaty, 1973; Jabareen, 2006). Burton (2000) puts forward three characteristics of compact city settlements – high density, mixed use, and intensified. Burton distinguishes intensification from other dimensions of the compact city, highlighting that it is a process that it is ongoing rather than being static (Burton, 2000). For Jenks et al. (1996) achieving compactness in the built environment is the path to sustainable urban form. Jabareen (2006) shares this view, arguing that “compactness of the built environment is a widely acceptable strategy through which more sustainable urban forms might be achieved” (p. 39). Compact city literature tells us that compact urban development can help ensure rural protection; promote quality of life and social interaction through proximity to services and amenities; reduce energy consumption by making various district and combined heat and power systems viable; and reduce GHG emission through the reduction of modes of transport dependent on fossil fuels (Jabareen, 2006, p. 40).

Milder's (2012) review of European planning and policy documents revealed that development that equates to 'compact city' is viewed as the preferred alternative to the status quo or unplanned growth. Milder notes that policy documents in recent decades call for stronger land use planning and denser, mixed use development (p. 269). Proponents list the many environmental, social, and economic benefits of compact city and how it supports sustainable development objectives. However, the policy and literature deals almost exclusively

with residential and mixed-use settlements, with little mention of industry or how industrial lands fit into the compact city.

Policies that promote intensification are seen as critical to the implementation of compact city ideas and sustainable urban form. Intensification strategies call for land to be used more efficiently by increasing the density of development and activity. The product of intensification is increased activity in the form of building use and the activity of people living, working and recreating. Williams (2000) found that intensification policies do result in land being managed in more sustainable ways, such as enhancing the viability of derelict land, steering development to brown field sites, and protecting green space. In addition, Williams also concluded that intensification policies could improve the economic viability of urban centres (p. 45). Here industrial lands are referenced, but only in the context of their redevelopment potential.

Burton et al. (1996) discuss the importance of location and context to achieving intensification, arguing that the potential “depends on the relationship between the form and location of intensification, the extent of intensification, and the policy, management and wider socio-political and economic context” (p. 244). This could imply that the benefits of intensification and the compact city could be adapted to the industrial land context in areas such as Metro Vancouver. Jenks (2000) states, “the existing character and quality of an area is highly significant in how intensification is received” (p. 246). He concludes that the acceptability of intensification will depend on the context, and hinges on processes that engage stakeholders, discuss the alternatives, and that are not prescriptive (Jenks, 2000). These conditions for acceptance are important considerations as Metro Vancouver looks to develop industrial land intensification strategies.

The basis for compact city theory is the intensification and containment of urban development to protect valuable natural and agricultural areas thus combating sprawl and meeting sustainable development objectives. The literature is largely supportive of compact city principles, however, these positions are supported primarily by reasoning rather than evidence. A common criticism is that many of the arguments in favour are based on assertion and theory, with very little in the way of monitoring, evaluation, or empirical measures to support the case (Williams, 2000). Each city has unique characteristics and challenges, and therefore may require unique solutions grounded in practice and the local context. Research suggests, “the impacts of intensification vary from place to place and between the different groups involved, and that

acceptability was dependent on a range of local factors” (Jenks, 2000, p. 243). There is no consensus that the compact city is the panacea for the challenges created by sprawling development patterns. In addition, there is no agreement on the precise form of the compact city. According to Milder (2012), the literature indicates that the compact city is the most sustainable urban form, but that this claim is not yet proven. However, this may be changing, as “more and more research has been done on the compact city and now it seems that those claims could prove right” (p. 270).

Much of the literature on the compact city deals with the social and environmental pillars of sustainability, with the economic aspect getting less attention. The economic rationale of intensification policies under the compact city is that by improving urban areas, business and residents will be attracted, thus aiding in the restoration of these area and populations. By improving the vitality of urban areas, employers will be attracted to these locations to set up and expand their businesses. Williams (2000) finds that intensification policies have had success in improving the economic vitality in urban centres – often achieved simultaneously with improvements to quality of life and to the environment (Williams, 2000). Green (1996) argues, “the compact city can be achieved only if statutory planning policies are supported by economic and social measures” (Green, 1996, p. 151).

In general, the literature on sustainable urban form fails to discuss industrial lands, focusing primarily on residential and commercial mixed-use development. Where discussion of the importance of economic factors in sustainability and sustainable urban form is occurring, industrial lands are rarely included in the conversation. While not all elements of sustainable urban form and compact city can be applied to industrial areas, many could be adapted to fit industrial land contexts. For example, the idea of containing urban growth in compact settlements to conserve land could be interpreted as protecting the supply of industrial land to ensure industry is not pushed to the periphery. Milder (2012) argues that if the compact city is indeed the ideal form of development, then elements of the compact city should be applied to non-compact cities so as to take steps towards sustainable development. The same argument could be extended to industrial lands within a city-region: by adopting elements of the compact city, such as intensification, industrial lands can be part of a sustainable region and economy.

### *Urban Containment and Growth Management*

Sprawling, low-density growth patterns are an energy and land intensive form of development. Urban containment and growth management are policy responses aimed at arresting unsustainable growth patterns through the introduction of geographical limits on growth (Jabareen, 2006). The goals of urban containment can vary depending on the context, but include the preservation and protection of green space and agricultural land from the encroachment of other land uses; cost efficient infrastructure provision; urban revitalization; and the promotion of high-density development patterns that facilitate a mixing of uses and sustainable transportation (Pendrall, Martin, & Fulton, 2004 as cited in Jabareen, 2006).

Urban containment can take a variety of forms, including establishing growth boundaries, restricting utility and infrastructure extensions to peripheral areas, creating greenbelts, protecting agricultural land, controlling development patterns, and establishing density controls (Nelson et al., 2002; Jabareen, 2006). Metro Vancouver municipalities make use of all of these tools to some degree to control land use and development in the region.

Growth management programs that incorporate urban containment ideals are employed by cities and regions and integrate planning, regulatory, and fiscal tools to influence growth patterns (Jabareen, 2006, p. 45). Smart Growth is an example of a growth management scheme that tries to balance growth with economic, social, and environmental needs by promoting compact development (Leigh & Hoelzel, 2012). Leigh and Hoelzel describe smart growth as the “most prominent planning approach for sustainable land use and urban development”, however they criticise the movement for failing to incorporate industrial development (p. 90). A common view in smart growth discourse is that urban industrial areas are unproductive, unattractive, and generally a hindrance to future growth and sustainability efforts (Bronstein, 2009; Leigh & Hoelzel, 2012). Critics argue that smart growth fails to acknowledge the positive influence of industrial development on urban revitalization and the important role that industrial land can play in limiting sprawl in urban areas (Bronstein, 2009; Leigh & Hoelzel, 2012)

In British Columbia, Smart Growth BC acknowledges the importance of economic development for the health and vitality of metropolitan regions; however, they do not address industrial lands directly. The organization asserts that economic development must be balanced with “social and environmental considerations in order to achieve sustainable communities”, and smart growth goals of compactness and density can help achieve long-term economic

sustainability for metropolitan regions (Smart Growth BC). This position is supported by a number of authors. Ciccone and Hall (1996) measured the economic benefits of density, concluding that greater density results in reduced transportation time and cost, brings workers in closer proximity to employers and employment opportunities, and promotes agglomeration economies, which are the valuable interactions between workers and industry. Cevrero (2001) explored the economic relationship between density and transportation, finding that compact urban regions with sound transportation links had greater productivity and higher output per worker than more spatially dispersed areas (as cited in Muro & Puentes, 2004). In *Metro 2040*, Metro Vancouver attempted to move beyond the limitations of smart growth to incorporate protection of industrial land uses and to encourage policies to redevelop and intensify underutilized industrial lands, thus helping to ensure the long-term economic sustainability of the region.

The Metro Vancouver region is recognized as having well-developed growth management policies and plans. These policies are aimed at addressing the problems associated with rapid growth, preserving the region's ecological assets, and maintaining a high quality of life (Tomalty, 2002, p. 432). Growth management in Metro Vancouver operates at different scales, involving a number of levels of government with overlapping jurisdiction. Municipalities exert control over growth at the local level through community plans, zoning, urban design and infrastructure decisions. The federal and provincial governments are involved at the bioregional level, promoting public awareness and developing sustainability action plans through the Georgia Basin Ecosystem Initiative (Tomalty, 2002). The provincial government is also responsible for the province's Agricultural Land Reserve. However, the most expansive growth management framework exists at the regional level, led by Metro Vancouver.

Hutton (2011) tells us that planning in the Metro Vancouver region has evolved over the past half century from "relatively primitive development control instruments to the seminal urban containment programs of the post-war period, and then to the innovations in growth management of the 1970s and 1980s, and finally to the new era of sustainability planning" (p. 252). Regional growth management efforts have focused on creating compact development by directing growth into existing urban areas and protecting green space and natural areas. Over the years, regional plans have attempted to achieve compact development by creating growth targets, with limited success. Tomalty (2002) is critical of these efforts, finding that the growth targets tended to be diluted as they moved through the planning process with the resulting

settlement pattern over time being virtually indistinguishable from the historical trends (p. 443). Metro Vancouver is often held up as an example of a region that has been successful in introducing dense urban development and encouraging compact growth in its urban centers. While it is true that there have been some successes in this regard, it is also true that most of the developed residential land in Metro Vancouver remains low density, single-family housing (Metro, 2007). In addition Hutton (2011) tells us that growth in the dispersed business parks within the region has significantly exceeded that in the Regional Town Centres, a trend that runs counter to the policy and objectives of the regional strategies.

Metro Vancouver has had more concrete success with respect to protecting natural areas and agricultural land. The region has had a form of 'green belt' in place since the 1970's, and in 1996, the 'Green Zone' became a principal component of the Livable Region Strategic Plan (Tomalty, 2002). Tomalty attributes this success largely to high levels of public support for maintaining natural areas as "recreational and aesthetic refuges" from the city (p. 442). Another contributing factor to the success of the Green Zone concept was that the majority of the land in the Green Zone already had some form of protection through public ownership, provincial, regional, or municipal park status, or as part of the Agricultural Land Reserve (ibid.). The Agricultural Land Reserve (ALR) was created by the Provincial Government in 1973 to protect the province's supply of productive agricultural land from encroaching 'higher' uses and continued urbanization that was threatening agricultural land (Stobbe, Cotteleer & Kooten, 2011). The ALR uses a regulatory and zoning approach that strictly limits uses and development. There are some who dispute the effectiveness of the ALR as a protective tool (Katz, 2009) and others who take issue with the restrictions on use, development, and conversion to other uses, particularly for lands in close proximity to urban areas.

As discussed earlier, *Metro 2040* established a level of protection<sup>11</sup> for industrial land in the region, although these protective measures are not as strong at those for agricultural land. Agricultural protection policies supplemented the Agricultural Land Reserve created in 1972, whereas the industrial land protection policies were new for the 2011 Regional Growth Strategy. The impetus for these new protective measures was the declining supply of industrial land in the region as well as the rising industrial land prices due to development pressure and competing

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<sup>11</sup> In order change the regional land use designation of 'industrial' land to another designation, the regional growth strategy (*Metro 2040*) must be amended, requiring a 50% +1 vote of the Metro Vancouver Board and support of the local Council.

uses. The protective measures are designed to reduce speculation and to exert some downward pressure on industrial prices. As part of their ongoing work in support of industrial land and the implementation of *Metro 2040*, Metro Vancouver continues to work with stakeholders to explore the idea of an 'industrial land reserve' that would expand the protection for industrial lands in the region.

### *2.3.3 Spatial Productivity*

The previous section explored the idea of intensification in planning theory, particularly the idea of sustainable urban form. As noted in that section, industrial land is largely absent from sustainable urban form literature. The following section attempts to discuss intensification as it applies specifically to industrial lands. Once again, the literature related to intensification and industrial lands is relatively scarce. The following section focuses on spatial productivity literature.

Research on spatial productivity extends from the field of economics and is set in the context of pursuing the sustainable development of land. Louw and Betokening (2004) articulate an important dilemma faced by planners, that "economic growth is an almost necessity to implement sustainable development, while on the other hand economic growth almost automatically increases the demand for industrial land" (p. 2). Therefore, the pursuit of sustainable development of land does not mean halting the development of land, but rather making the most efficient and productive use of land spatially. The pursuit of sustainable development has resulted in renewed interest in land as a production factor and has led to attempts to understand and measure industrial land productivity.

There is limited interest in *land* in modern economics with most theory focusing on other production factors, as inputs shifted to capital and labour (Louw, van der Krabben, & van Amsterdam, 2012). In recent years, land as a production factor has received more attention with the growing interest in sustainable development. Relative to labour and capital, land may not be as important a factor in production. However, all industries need space and there are other compelling social and environmental reasons to use space more efficiently (Metzemakers & Louw, 2005). To achieve sustainable development of land, land must be used efficiently as a production factor (Metzemakers & Louw, 2005).

Metzemakers and Louw (2005) describe spatial productivity as the output or added value produced per area of land. The spatial productivity of industry becomes more and more

important when the supply of industrial land is limited as it is in Metro Vancouver. This definition of spatial productivity is at the heart of what Metro Vancouver is attempting to achieve with its intensification objectives. Metro Vancouver defines industrial land intensification as making more productive and efficient use of industrial land (Metro, 2012a).

The latest research on spatial productivity focuses on the benefits of industrial “density” or spatial efficiency and on ways that spatial productivity can be measured. In a study of industrial estates in the Netherlands, Louw and Bontekoning (2004) note that differences in spatial productivity have a positive correlation with urban densities, concluding that “industrial land in urbanized regions is used more efficiently than in other areas, indicating that agglomeration effects are observable in spatial productivity” (p. 1). A later study by Louw et al. (2012) investigated the factors that can influence spatial productivity. Their findings suggested that the spatial productivity of Dutch industrial estates was shaped by urbanization rates, the share of employment by industrial sector, and land development policies (p. 137). Spatial productivity was found to be higher in urbanized areas and lower in peripheral areas (p. 146). With respect to the share of employment by industrial sector, industrial regions with greater concentrations of industries with higher employment densities relative to their land requirements are more spatially efficient. For example, the service sector has relatively low land requirements and can be accommodated in multi-level buildings, whereas sectors such as manufacturing or transport/logistics tend to have lower employment densities, higher land requirements, and preference for single-storey structures (Louw et al., 2012). Finally, land development policies that determine the availability of industrial land can influence spatial productivity. The work by Louw et al. suggests that high levels of industrial and supply results in lower levels of spatial efficiency, meaning when there is abundant, cheap land, industry tends to be less spatially efficient.

In a study of US states Ciccone and Hall (1996) examined spatial densities and their effect on economic returns. Here, density was defined as the intensity of labour and capital relative to physical space. Their findings indicated that density of capital affects productivity in a number of ways – transportation efficiencies, externalities associated with physical proximity of production, and higher degrees of specialization (p. 54). However, capital accounted for only a small fraction of the differences in productivity, with the majority of the productivity effects resulting from labour (Ciccone & Hall, 1996, p.55). Their study, which was based on US data,

found that a doubling of employment density results on average in a 6% increase in labour productivity (ibid., p. 55).

Ciccone and Hall's work described the externalities of density or clustering, also known as agglomeration economies. Agglomeration economies are one example of the benefits of intensification for industrial users "that come when firms and people locate near one another together in cities and industrial clusters" (Glaeser, 2010, p. 1). Graham (2007) distinguishes between two types of agglomeration effects – localization economies and urbanization economies. Localization economies are economies of industry concentration and result from "labour market pooling, the sharing of intermediate inputs, and knowledge sharing or 'technological spillovers'" (Graham, 2007, p. 4). An example of this would be when multiple businesses in a particular sector choose to locate close to one another (e.g. Silicon Valley). Urbanization economies are the benefits that arise from "the existence of local public goods, the scale of markets, the proximity of input-output sharing, and other kinds of inter-industry interactions" (Graham, 2007, p. 4). With urbanization economies industry is more productive when in close proximity to urban areas and other industry.

The literature suggests that the benefits of localization economies are greater than that of urbanization economies (Ciccone & Hall, 1996; Martin, Mayer, & Mayneris, 2011). In a study of French industry, Martin et al. (2011) found strong benefits of localization economies, but less evidence to support urbanization economies. Their results also indicated localization economies tend to be a short-run phenomena, while urbanization economies are more important over the long-term (ibid.)

In general, the literature supports the view that industrial density or clustering enhances spatial productivity. Malmberg and Maskell (2001) argue that the advantages of spatial clustering are well established in the literature and cite numerous benefits including, "shared costs for infrastructure, the build-up of a skilled labour force, transaction efficiency, and knowledge spillovers leading to firm learning and innovation" (p. 2). Clustering occurs at different geographical scales (Malmberg & Maskell, 2001), affect industrial regions differently (Louw, et al., 2012), and impact different industrial sectors to different degrees (Graham, 2007).

Industrial density, clustering and agglomeration are not without their downsides. In a study of French industrial plants, Martin et al. (2011) found that at a certain level of agglomeration, congestion costs appear (p. 183). Therefore, more agglomeration is not always better.

### *Measuring Spatial Productivity*

Numerous researches in Europe and Asia have sought to develop methods of measuring spatial productivity of industrial land. Louw et al., (2012) argued that measuring spatial productivity is useful because it helps to better understand how to allocate production factors more efficiently and take steps towards sustainable development (p. 146).

Malmberg and Maskell (2001) discuss some the difficulties with measuring agglomerations or benefits associated with clustering and spatial density. Specifically they note the difficulties of measuring or comparing agglomerations across industrial classifications or sectors (p. 15). Louw and Bontekoning (2004) attempted to develop a method to determine the productivity of industrial land by measuring 'added value per hectare of industrial land'. Their method combined GIS analysis of employment data from industrial estates with spatial data on value added. In Germany, Erhl (2013) employed total factor productivity (TFP) analysis to evaluate productivity effects. TFP analysis measures productivity by focusing on how efficiently and intensely inputs are used. This work concluded that other measures tend to underestimate the magnitude of productivity effects and that labour market pooling has the largest impact on productivity, a finding consistent with Ciccone and Hall (1996). This research also found that agglomeration economies differ greatly between industrial areas and industrial sectors experience their effects differently and to varying degrees (Erhl, 2013).

In China, research into measures of spatial productivity has been driven by a rapidly growing population and economy, and a desire to minimize conflicts between industry and agriculture. In a study of industrial land use efficiency and planning in Beijing, Meng et al. (2008) used three different measures to evaluate land use efficiency – gross output per area, investments (total inputs, labour, capital etc.) per area, and employees per area. Like many other researchers, Meng et al. concluded that land use efficiency is highly variable between industrial sectors depending on the production characteristics (p. 47).

In an evaluation of economic-technological development areas in Beijing, Huang et al. (2011) employed a similar total factor productivity (TFP) analysis as Erhl. The researchers argue that this method of measuring spatial productivity is superior to alternatives that attempt to measure overall land use intensity because TFP incorporates the inputs and therefore the production characteristics of each individual industrial sector. Therefore, the researchers

believe that this method overcomes some of the challenges associated with measuring across industrial sectors/classes.

In a study of 617 Chinese cities Ke (2010) examined the effects of industry agglomeration and congestion on urban productivity by applying Ciccone and Hall's (1996) model to Chinese cities. The results showed a positive correlation between spatial concentration of industrial production and higher production, in both large industrial cities and in neighbouring cities (p. 157). Ke concluded that industrial clustering or density and urban productivity are mutually and causally related (p. 176).

Finding a simple way to measure spatial productivity could be useful for Metro Vancouver's intensification objectives. The idea of spatial productivity represents one possible method of measuring the economic throughput and activity on industrial land. However, there are several challenges with this approach to measuring intensification. These challenges, along with the challenges and limitations of other measures of intensification are discussed in more detail in section 3.7.

## **2.4 Industrial Land Intensification**

This section explores intensification in the industrial land context, discussing factors that influence industrial land intensification, intensification by industrial sector, measures of intensification, and industrial land intensification best practices.

### ***2.4.1 Factors Influencing Industrial Land Intensification***

As part of their preliminary work in support of industrial land intensification, Metro Vancouver commissioned an industrial land intensification analysis. Among other things, this analysis attempted to understand the various ways in which the region's industrial land could be intensified and the factors that induce and inhibit intensification (Eric Vance & Associates, 2011).

From a land use planning perspective there are various forms that industrial intensification can take, including, "using industrial lands for industrial purposes; increase building floor space; increase building site coverage; intensify outdoor storage or production; and increase industrial employment on industrial land" (Eric Vance & Associates, 2011, p. 4).

The report stressed the importance of understanding the perspective and needs of industrial land users with respect to intensification. Businesses operating on industrial land are in business to generate a profit, and therefore changes to their operations such as increasing employment, moving to a larger building, or making more efficient use of land will only be considered if they make economic sense (Eric Vance & Associates, 2011). As is the case with all inputs, industrial users have a natural interest in making the most efficient use of land and buildings. Business will always be interested in gaining efficiencies by making more efficient or intense use of inputs if the result is increased productivity. Therefore, there is common ground where planning and land use policy intersect with business interests.

The report identified 20 separate factors that can influence industrial land intensification in Metro Vancouver:

Factors Affecting Industrial Land Intensification in Metro Vancouver			
Intensification Factor	Relative Degree of Importance		
	High	Medium	Low
Type of industrial use	X		
Location and land values	X		
Floor area ratio regulations		X	
Building site coverage regulations		X	
Building setback regulations	X		
Building height regulations		X	
Outdoor storage regulations	X		
Physical site features		X	
Parking requirements	X		
Loading requirements			X
Driveways and road standards		X	
Accessory use regulations - office and retail	X		
Lot size / shape		X	
Land ownership and assembly		X	
Pre-zoning			X
Building size			X
Building age		X	
Building construction costs		X	
Landscaping standards		X	
Building design guidelines / green buildings			X

Table 2.3: Relative Importance of Factors Affecting Industrial Land Intensification (Source: Eric Vance & Associates, 2011, p. 48)

The degree of influence for each of these factors varies considerably. Each factor was ranked low, medium, or high based on its potential impact on intensification. While these

rankings are somewhat subjective, the factors identified as having the greatest potential to influence industrial land intensification were *type of industrial land use, land values and location, building setback regulations, outdoor storage regulations, parking requirements, and accessory uses* (Eric Vance & Associates, 2011).

In addition to the *Industrial Land Intensification Analysis* Metro Vancouver conducted a series of stakeholder workshops as part of a discussion paper on best practices for industrial land intensification. There were a number of key lessons learned from these workshops. Industrial developers reinforced the importance of understanding that the high costs associated with some forms of intensified industrial development challenge the viability of these projects, referring specifically to multi-level industrial development. Ultimately, any new, innovative or intensified building designs must work for industrial users. The form of industrial intensification varies for each industrial subsector, as does the quality of industrial lands throughout the region. Therefore it is important that intensification policy and strategy acknowledge these differences. Participants articulated that gradual intensification will, and is currently, occurring through market forces as a result of evolving land prices, development economics, and the limited supply of industrial lands. Examples of this gradual intensification include increasingly higher ceilings, new equipment/technology, and increased shifts of workers (Metro, 2012a, p. 34).

Obstacles were identified with regard to land assembly in the region, which is seen as an impediment to redevelopment of industrial sites and intensification efforts overall. There was interest expressed in incentives for developers, tenants, and landlords to encourage land assembly and redevelopment. The relationship of the regional economy to the larger provincial, national, and global economies was acknowledged, as was the continued growth and strategic importance of the region's ports as a driver of economic activity. A variety of challenges were highlighted with respect to building to higher densities and mixing uses and users on industrial sites. Finally, it was agreed that industry, along with all levels of government, must work in cooperation to develop intensification policies and strategies that incorporate both regulation and incentives (Metro Vancouver, 2012a, p. 41). At the same time, Metro Vancouver recognizes the fact that due to the limited supply and high costs of the region's industrial land, the design, development and operation of industrial buildings and businesses will have to evolve to make more efficient use of land (Metro Vancouver, 2012a, p. 42).

### *Intensification by Industrial Sector*

The discussion of spatial productivity highlighted the fact that the potential for spatial efficiency varies between industrial sectors based on industry characteristics and production inputs. The operational needs of industries determine their built-form requirements and therefore also define the limitations of intensification of built-form. In the section that follows, a brief summary of the characteristics of select industrial sectors is provided, including a discussion of their preferred built-form and intensification potential.

Metro Vancouver (2012a) summarized some key industrial building characteristics for several important Metro Vancouver industrial classes:

#### *Warehouse Distribution:*

- Typically large rectangular buildings
- Ceiling Heights of 20-40ft
- Site Coverage of 40% to allow for truck loading, manoeuvring, and parking
- Relatively low employee per area ratio
- A small office component requirement is typical
- Warehouses with higher ceilings often incorporate advanced racking systems
- The businesses require easy access for trucks and generally locate near highways and major roads

#### *Freight Forwarding / Logistics:*

- Buildings tend to be minimal for rail and port dependent businesses. Buildings for truck dependent businesses are also smaller, typically 50,000-80,000 sq ft with many docks/loading bays.
- Ceiling heights are low, 12-16ft
- Site Coverage is typically around 20% to allow for truck loading, manoeuvring, and parking
- Relatively low employee per area ratio
- Minimal office space required
- This sector requires access and close proximity to various modes of transportation – air, rail, port, highway

#### *Manufacturing / Assembly:*

- The size of the building is highly dependent on what is being manufactured
- Ceiling heights are typically in the range of 16-24 ft.
- Site Coverage is typically 40% for light manufacturing
- This sector has the potential for higher employment densities, thus requiring more employee parking
- Typically 30 % of the building is required for accessory office, warehousing, and R&D.

*Flex Facilities / Multi-Tenant:*

- Buildings are generally smaller in size (under 120,000 sq ft) and are divided up into small and medium size units.
- Ceiling Heights range from 10-18ft
- Site Coverage is typically 30-40%
- These buildings typically have higher employment densities than other types of industrial buildings, thus requiring more parking
- Accessory uses are generally high, ranging from 20-80%.

Metro Vancouver also investigated some additional factors that can influence industrial intensification *potential* for the region's industrial users beyond simply industry characteristics. They found that the potential for an industrial site to intensify is influenced by three main factors:

- Market Readiness – development economics
- Type of Sector – needs and characteristics of the business
- Location – land use, accessibility, site characteristics

These three factors also influence the *form* that intensification could potentially take. Metro Vancouver defines three categories or forms that industrial intensification can take – *Business Processes, Building Design, Land Uses* (Metro Vancouver, 2013c). To intensify business processes means to modify business processes to enhance operational efficiency. These improvements could include investing in new equipment or technology and increasing the number of shifts of workers. Intensifying through building design means to modify the design of industrial buildings to facilitate more intense production. Forms of more intense building design include larger buildings, higher ceilings, providing parking above or below grade, and multi-storey industrial buildings. Finally, land uses can be changed to facilitate greater operational efficiency. Allowing more flexibility with respect to land use enables related industrial uses to co-locate, and allows for related and un-related accessory uses to operate in multi-storey industrial buildings (Metro Vancouver, 2013c).

Metro Vancouver drew several conclusions from this analysis. First, intensification is possible for each industrial sector; however it will take different forms and be achieved by different means. Secondly, different measures of intensity apply to different forms of intensification. In addition, the potential to intensify varies by sector depending on what forms of intensification are possible. Finally, intensification is already occurring, often in areas with high land values and locations in close proximity to transportation infrastructure.

#### 2.4.2 Measuring Industrial Land Intensification

As discussed earlier, there are multiple *definitions* of intensification, and therefore multiple *measures* of intensification are required. Measures of built-form intensity (density) are widely used and understood. Common measures of density include floor area ratio (FAR), site coverage, and building height, and they are used in zoning bylaws to control the density in residential, commercial, and industrial land uses. In Metro Vancouver, some municipalities use FAR to define maximum densities in industrial zones; however, the trend in the region is to control industrial density through building height, site coverage and setback requirements (Eric Vance & Associates, 2011).

While density measures are appropriate for building-intensive industries, in the industrial land context, many industries are not building-intensive and rather are land-intensive or job-intensive. Intensification in the form of increased industrial activity or economic throughput cannot be measured with standard measures of built-form/density. In planning practice at present, adequate measures do not exist to account for the variety of forms that intensification can take on industrial lands. For example, in Metro Vancouver, municipalities manage and ultimately measure density through zoning bylaws that specify some combination of maximum FAR, building height, site coverage, and setbacks. In contrast to density, there are no tools to control or measure intensity of industrial *activity*. Furthermore, given the diversity of activities that occur on industrial lands, multiple measures of intensity are needed. This research has not uncovered any municipalities in Canada that attempt to measure any forms of industrial land intensification other than built-form (density) or to quantify the intensity of activity on industrial land. In fact, there are numerous cities and regions in North America that have an excess supply of industrial land and are *encouraging* non-industrial development on these lands.

For a region attempting to create policies that promote industrial land intensification and more efficient use of industrial lands, density measures alone are not sufficient. Industrial land intensification strategies that promote only higher density built-form using narrow definitions and measures of intensity may have unintended consequences for the regional economy and the region's industrial users. These negative consequences could include higher development costs, impacts on the flexibility or usability of industrial spaces and sites, and inadvertently encouraging non-industrial uses on industrial land (Metro Vancouver, 2012a).

Ultimately the objective of industrial land use intensification is to ensure that the limited industrial land base in Metro Vancouver is used as productively and efficiently as possible. To achieve the desired forms of industrial intensification and to ensure that policies do not unfairly disadvantage one industrial sector or sub-region over another, using multiple measures of intensification is desirable. This idea of fairness extends to the differences in intensification potential between industrial sectors. The types of businesses occupying industrial lands have diverse operational requirements and what any particular business or industry demands from a site or building can vary considerably. Consequently, the potential to boost industrial intensity can be different for each industry and industrial user (Metro Vancouver, 2012a). Therefore, rather than seeking to increase industrial densities across all industrial areas, Metro Vancouver policy makers argue that specific measures and targets of intensity should be developed for each industrial subsector (Metro Vancouver, 2012a, p. 37).

Through consultation with industrial land stakeholders, Metro Vancouver compiled a list of potential measures of industrial intensity that could be used to measure industrial intensification in the region. This preliminary list distinguishes between measures of density and activity and it is this list that formed the starting point for the measures to be included in the prototype multi-variable tool (see tables 2.4 and 2.5 below).

Measures of Intensity
○ Employee per land acre/hectare or per building sq ft / m <sup>2</sup> (labour intensity)
○ Business revenue / profit per unit (value generated per unit of land, or building floor area).
○ Volume of goods produced / processed / stored per unit (per building floor space, amount of land employee,
○ Vehicle movement per hour (trucks or loading)
○ Quality and pay of jobs (education and pay levels)
○ Number of businesses per land area
○ Diversity of businesses per land area
○ Multiplier job impacts of different types of businesses (secondary and induced impact on wider economy)
○ Value of lands and improvements (higher values may indicate higher intensity use on the site)
○ Value or level of equipment / technology investment (such as automation, racking warehouses)
○ Level of building specialization
○ Building lease absorption period, vacancy rates, rental rates
○ Transportation infrastructure (port, airport, rail yards, highways), utilization rates (goods / trips per unit).

Table 2.4: Measures of Industrial Land Intensity (Source: Metro Vancouver, 2012a)

Measures of Density
○ Building floor area ratio (building floor space divided by lot area)
○ Building site coverage (building floor plate/coverage divided by lot area)
○ Number of floors (with upper floors potentially being used for other uses)
○ Building height/volumes (such a higher ceiling 'high bay' warehouses).

Table 2.5: Measures of Industrial Land Density (Source: Metro Vancouver, 2012a)

The ease of application of each of these measures differs widely, with some more easily calculated or visualized than others. For example, measures of density, typically involving calculations of area, are relatively simple to determine. However, intensity measures that involve tracking business activity or throughput such as 'volume of goods produced' are far more difficult to count or even estimate due to availability of data.

Being able to quantify or measure a phenomenon is an important part of the implementation of any policy, and intensification policies are no exception. Adequate measures of intensification are needed to both understand current levels of industrial intensification as well to track changes over time. The various potential measures of intensification are discussed in more detail in Chapter 3 as part of the prototype tool development process, including the challenges and limitations of each.

### *2.4.3 Industrial Land Intensification Best Practices*

The industrial land supply situation facing Metro Vancouver is not a problem encountered by all cities and regions. In fact, there are numerous metropolitan regions in North America that arguably have too much industrial land capacity and rather than seeking to protect all industrial lands, they are seeking to develop strategies and methodologies to decide which lands to protect and which to release for redevelopment or alternative uses (Dempwolf, 2010; Howland, 2011). However, there are other cities and regions that share similar concerns to those of Metro Vancouver.

As part of its ongoing work in support of industrial land use intensification, Metro Vancouver conducted a thorough review of industrial land use best practices. Their work studied 13 city-regions in Canada, USA, Asia, and Europe. This research revealed some common themes across the jurisdictions examined and these same themes can also be observed in Metro Vancouver's industrial lands. First, industrial land intensity in most North American cities is relatively low in comparison to Metro Vancouver. This finding is consistent with the work of Eric Vance & Associates (2011) who in an investigation of six North American metropolitan areas

found that Metro Vancouver had a higher overall level of intensity of industrial lands than most other jurisdictions (p. 39).

Secondly, all of the city-regions profiled are experiencing pressure to convert industrial lands to non-industrial uses. The response in all cases has been to introduce industrial land protection through various policy and planning measures – plans, strategies, and zoning. While the motivations for the protection differ slightly between jurisdictions, one consistent priority is to ensure that there is sufficient land for industry to expand and generate economic growth and employment opportunities.

Supporting industrial intensification and developing intensification policies can be difficult given the unique needs and characteristics of each industrial area and industrial sector. In addition, economies continue to change and evolve over time, which means land use demands and building requirements of industry are always shifting. For these reasons protection is typically the first step and often the only step. Protection is enforced through various policy and planning mechanisms including zoning, infrastructure investment, creation of special industrial districts, controls on accessory and office use, and policies that encourage adaptive reuse (Metro Vancouver, 2012a).

The continuous encroachment of non-industrial users is problematic for all jurisdictions facing industrial land supply challenges, and office and accessory uses are of particular concern as these uses have the potential to destabilize industrial land prices and push out true industrial users. High land prices in many of the city-regions have forced out some industries that cannot afford to operate at current price levels. This phenomenon is one that has been observed in Metro Vancouver. Each jurisdiction attempts to control the level of office and accessory uses permitted in industrial lands as a way of mitigating this threat.

The degree to which city-regions have pursued intensification varies depending on their unique circumstances. The Metro Vancouver study looked at two Asian cities, Hong Kong and Singapore. Both of these city-regions confront extreme land use constraints that have stimulated industrial intensification. In Hong Kong both policy and development economics support multi-storey industrial buildings, which has resulted in high FAR development, with a typical permitted FAR of 8.0 in new developments (Metro Vancouver, 2012a, p. 27). Intensification efforts in Singapore are characterized by a high level of government intervention and investment, and this top-down control of development allows for high degrees of land

efficiency, productivity, agglomeration economies, land use synergies, and shared services and amenities between businesses (Metro Vancouver, 2012a).

The study provided two examples from Europe. In London, the focus has been on facilitating high density, mixed used developments, specifically where industry can be “stacked” vertically. A matrix was developed to help identify uses that are compatible with one another and suitable for vertical intensification. In the Netherlands, the Port of Rotterdam has focused its intensification efforts on clustering and efficient land use in order to leverage its strategic location as a gateway city. The port functions and related business of Metro Vancouver are expected to continue to grow in the coming decades. There could be lessons to be learned from other spatially constrained port cities like Rotterdam with respect to mixing uses and co-locating and clustering related business in close proximity to key port and transportation infrastructure.

Finally, the best practice review investigated seven North American cities. By and large these city-region contexts are more relatable to Metro Vancouver’s industrial land use situation. In general, industrial intensification in North America is supported through high-level plans with some jurisdictions introducing implementation tools like district plans and zoning (Metro Vancouver, 2012a). Many of the North American cities reviewed have large inventories of older, obsolete industrial buildings, which has resulted in a trend towards adaptive re-use of these buildings in the hopes of converting them to modern industrial uses rather than non-industrial uses.

Two US cities from the Cascadia region are taking unique steps to pursue industrial land intensification. The City of Seattle initiated a process to identify pilot project sites where industrial intensification and policies that encourage intensification could be tested (Metro, 2012a). In 2012 the City of Portland conducted an Industrial Land Supply Analysis, which included a discussion of measuring the efficiency of industrial land use. The analysis concluded that many existing measures of land use efficiency such as jobs per acre, real market value, and FAR are not appropriate for industrial land purposes. The study suggested two alternative measures – value added and tonnage of cargo – and that these measures of output efficiency would help to support protection efforts and relieve pressure from competing commercial uses (City of Portland, 2012). Of all of the jurisdictions examined by Metro Vancouver, Portland was the only one to explore measures of industrial land intensification.

This chapter outlined the current status of industrial lands in the Metro Vancouver region, including ongoing efforts to protect and encourage the intensification of industrial land use in response to the limited supply of these lands. The literature is supportive of the concept of intensification, specifically sustainable urban form literature. Absent in the discussion of sustainable urban form is any mention of industrial lands or the intensification of industrial lands. It is possible to draw connections between references to intensification in sustainable urban form literature and industrial lands, and to attempt to apply these principles in the industrial land context. However, industrial lands have unique needs and challenges when compared to mixed-use urban areas. Industrial land intensification was located in economics literature and discussions of spatial productivity. The concept of spatial productivity is closely related to Metro Vancouver's intensification objectives; however, it only focuses on economic productivity, which is only one aspect of industrial intensification. In sum, the literature has provided a strong basis from which to explore definitions and select measures of intensification for the prototype multi-variable tool. The next chapter discusses the development of the prototype multi-variable tool in detail.

### 3 | Multi-Variable Tool

#### 3.1 Introduction

This research project develops a prototype multi-variable analytical tool that can communicate and evaluate industrial land intensification. Such a tool has the capability to aid planners, decision-makers and other stakeholders to better measure and evaluate industrial land intensity. The prototype multi-variable tool is expressed as a variation and adaptation of a circular histogram or rose-diagram, a form of pie-chart used for graphical representations of data. These diagrams provide a visualization of multiple interrelated variables that helps users to better understand the relationships between variables as well as to communicate complex ideas and concepts. Diagrams like these are ideal to better understand and communicate the complex definitions and measures of industrial land intensification.

There are numerous examples of multi-variable tools and they share some common characteristics. As Robson (1994) points out, the terms circular histogram and rose-diagram are often used interchangeably, however subtle differences exist. Circular histograms “represent frequencies of classes by developing a series of concentric circles around a similar origin, with data measurements (class frequency) represented by divisions extending from the origin. The divisions vary in length as a result of changes between values among the classes” (Robson, 1994, p. 1039). By comparison, “the rose diagram is developed by plotting radii or areas, made proportional to the class frequencies, from the origin of a circle (Rock (1988), as cited in Robson 1994, p1039). Another variation of this type of circular graph is known as a polar area diagram. The first documented application of this form of graphical representation was by Andre-Michel Guerry in 1829 to illustrate wind direction variability and to chart births and deaths (Friendly, 2008). However, it is Florence Nightingale who is credited with pioneering this form of graphical representation (see Figure 3.1). In 1858, Nightingale developed the diagram for military applications, tracking patient mortality in a field hospital and referring to her collections of these diagrams as “coxcombs” (Cohen, 1984; Friendly, 2008). While Nightingale did not invent this form of data representation, she was the first to fully grasp its communicative and persuasive power. The power of this form of data display was referred to by Tukey (1990) as “interocularity: the graphic message hits you between the eyes.”(as cited in Friendly, 2008, p. 509). Such diagrams are a form of “visual language” that can facilitate the communication of complex data (Friendly, 2008, p. 509).

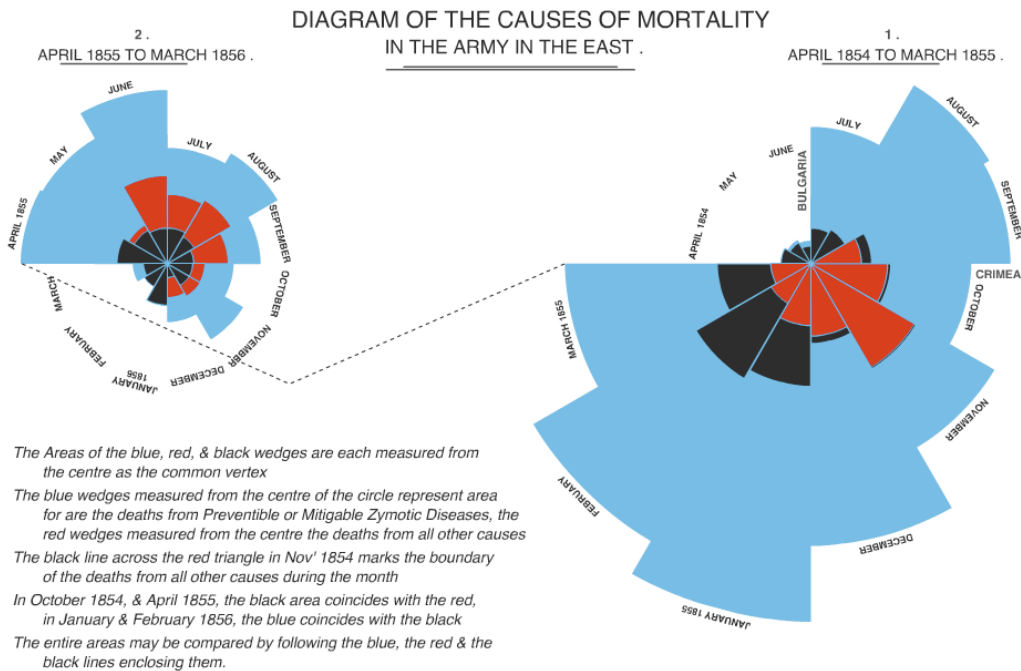


Figure 3.1: Florence Nightingale's Coxcombs (Source: Spiegelhalter, D. & Pearson, M., 2008)

While the applications of rose diagrams described above are often graphical representations of statistical data and thus have firm mathematical underpinnings, the prototype multi-variable tool does not. Rather, the prototype multi-variable tool adapts the graphic and communicative elements of these diagrams to fit the context of planning and industrial land use. In other words, the multi-variable tool is intended to be more an analytical tool than a data presentation tool; however, the research explores the idea of expanding the scope of the tool to be more of a quantitative, composite index. The prototype tool more closely resembles other applications of circular diagrams and rose-diagrams that have been developed to support sustainability and sustainable development.

The first application of circular histograms to sustainability can be traced back to the work of Anthony Clayton and Nicholas Radcliffe's development of sustainability assessment maps, which are used to compare the sustainability of developments or investment alternatives (Therivel, 2004). Clayton and Radcliffe (1996) describe their sustainability assessment map (SAM) as a "relatively simple and intuitively fairly obvious way of representing change on a number of dimensions simultaneously, which helps to identify some of the inevitable trade-offs involved in any significant change or development" (p. 14). In a SAM, each variable is

represented on an axis and “measurements of change or indications of priorities are then mapped onto these axes” (Ibid p. 14). The resulting visual representations can then be compared and used to identify the advantages, disadvantages and trade-offs of each alternative. For Clayton and Radcliffe, “the purpose of this approach is to emphasize rather than conceal trade-offs, and to do so in a way that is as accessible and intuitively obvious as possible” (ibid p. 14). A SAM seeks to make the advantages and disadvantages of a particular decision more explicit and to enable the inclusion of variables of non-equivalent scales in a single model, therefore bringing additional clarity and accessibility to the decision making process (Clayton & Radcliffe, 1996).

As sustainability has become increasingly embedded in development and investment decision-making, numerous sustainability assessment tools have emerged to help those making decisions better define, understand, and achieve comprehensive sustainability. Two of the earliest and most well-known sustainability assessment tools created are BREEAM and LEED. BREEAM, Building Research Establishment Environmental Assessment Method, originated in the UK and was originally developed to help market “green” buildings (Peach, 2011). BREEAM assigns credits to a development for achieving levels of sustainability in various areas, including design, construction, and operations, and then awards a final rating based on the total of these credits. Leadership in Energy and Environmental Design, or LEED, is the North American equivalent of BREEAM, and promotes the sustainable design, construction, and operation of buildings using a voluntary, market-driven approach. Numerous other examples exist that present multiple variables in circular diagrams that are similar to Clayton and Radcliffe’s SAM tool. In general, these diagrams are designed to communicate complex data in a simplified and easy to understand format. Several examples of sustainability assessment tools that utilize circular diagrams are discussed briefly below.

### **3.2 Sustainability Assessment Tools**

The following section briefly describes five examples of multi-variable, sustainability assessment tools. The examples presented have been chosen to illustrate the versatility of these types of diagrams and their potential to be adapted to the industrial land context. The discussion also highlights some of the similarities and differences that exist with these types of tools with respect to tool graphics, presentation style, and number of variables.

### *Sustainable Project Appraisal Routine (SPeAR):*

SPeAR, or Sustainable Project Appraisal Routine, is a sustainability assessment tool developed by ARUP, a global consulting services firm based in London, UK. SPeAR is designed to help weigh the factors impacting the sustainability of projects of a variety of scales and types (McGregor & Roberts, 2003). This tool expands the assessment of sustainability to include indicators for global warming and social responsibility (Peach, 2011). In total, 22 indicators are used and each is assigned a ranking from -3 to +3. The resulting graphical visualization (Figure 3.2) uses different colours and positions on the diagram to illustrate the degree of achievement for a given aspect of sustainability (Therivel, 2004). The makers of this tool argue that its key strengths are that it can be applied to any type of development and that it is flexible enough to demonstrate how sustainability of a project evolves over time (Peach, 2011).

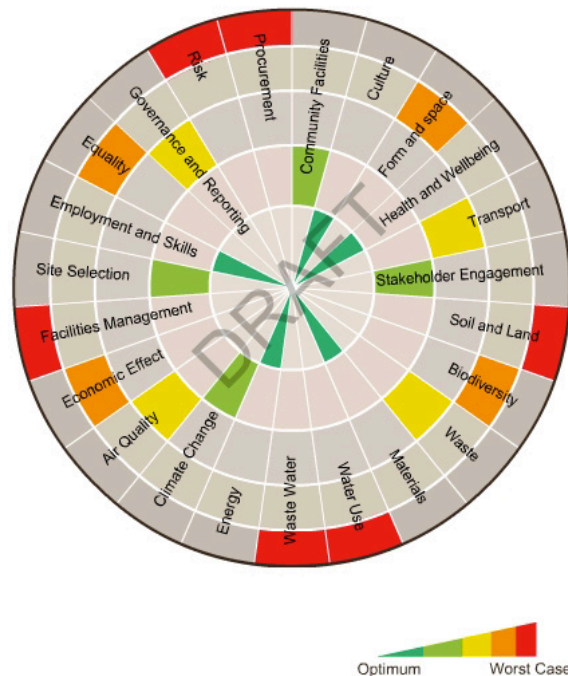


Figure 3.2: Sustainable Project Assessment Routine (SPeAR)  
(Source: [www.arup.com/Projects/SPeAR](http://www.arup.com/Projects/SPeAR)). © Arup. Used with permission

### *Response-Inducing Sustainability Evaluation (RISE):*

RISE, or Response-Inducing Sustainability Evaluation, is another assessment tool that makes use of a circular-diagram for communicative purposes. Developed at HAFL, the School of Agricultural, Forest and Food Sciences at Bern University, RISE is a method that assesses

sustainability in agricultural production. According to Hani et al. (2003), the RISE tool provides a “holistic approach for advice, education and planning”, using 12 indicators that span the ecological, economical, and social aspects of sustainability (Hani et al, 2003, p.1). RISE is an interview-based method that generates its primary data from a detailed questionnaire process conducted with farmers. Fifty parameters are scored and subsequently summarized into 12 indicators that reflect the various aspects of sustainability. Each indicator is ranked on a scale from 0-100 and the resulting evaluation is presented as a “sustainability polygon” (Figure 3.3) that facilitates communication and dialogue with stakeholders (HAFL).

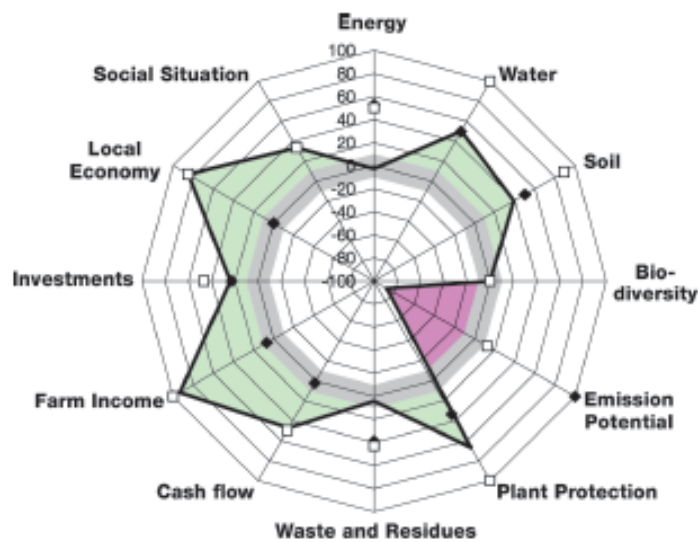


Figure 3.3: Response-Inducing Sustainability Evaluation (RISE). (Source: Hani et al, 2003, p. 8). Used with permission.

#### *Sustainability Appraisal of Land Development (SALD):*

Another assessment tool that utilizes a rose-diagram is SALD, Sustainability Appraisal of Land Development. SALD was created by the Design Research Unit of Scott Brownrigg, an Architecture firm based in the UK, as a method intended to support site analysis and decision-making by facilitating the comparison of site sustainability and presenting it in an accessible format (Scott Brownrigg, (n.d.)). The tool assesses a site utilizing *BREEAM Communities'* five main criteria for site assessment: climate change, balanced communities, place-making, accessibility, and economy and employment. Altogether, the tool uses 40 different measures to capture a site's sustainability characteristics, eight for each of the five BREEAM criteria. Each of the five criteria is then given both a hard score and a percent score and placed in a table as well

as presented graphically to facilitate comparisons between sites. The tool's creators boast that it is quick and simple to apply, provides flexibility that other methods do not (such as the ability to adapt to reflect local characteristics and needs), and presents complex analysis in an easy to understand configuration (Scott Brownrigg, (n.d.).

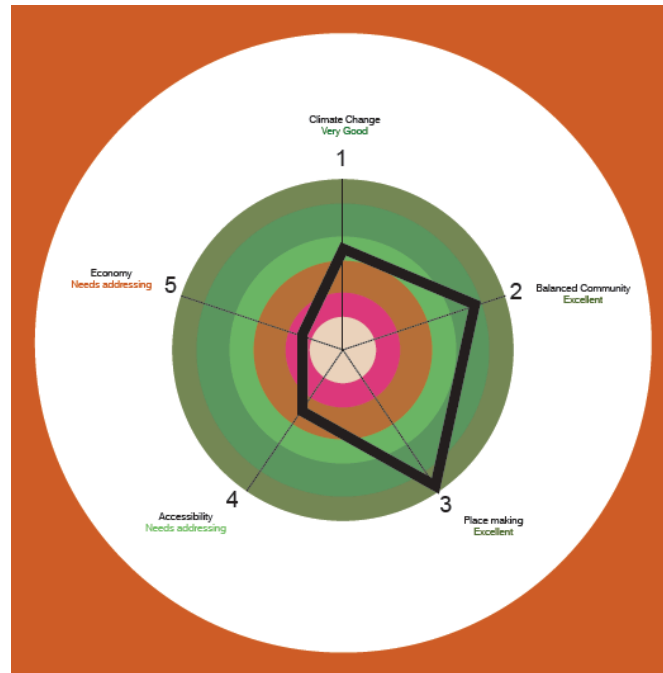


Figure 3.4: Sustainability of Land Appraisal (SALD) (Source: Scott Brownrigg, (n.d.).  
© Scott Brownrigg. Image courtesy of Scott Brownrigg. Used with permission.

#### *Sustainable Built Environment Tool (SuBET):*

Developed by UK-based engineering consultancy Hilson Moran, SuBET, or Sustainable Built Environment Tool, is a framework that enables the assessment of urban landscape sustainability at a variety of scales. Unlike other tools, SuBET offers a sustainability rating system that incorporates community participation and sustainable place-making in addition to the typical sustainability indicators (Popa, n.d, p. 2). This tool incorporates a broader range of factors into sustainability planning, using over 70 unique indicators of sustainability to assess a given project or development (Hilson Moran).

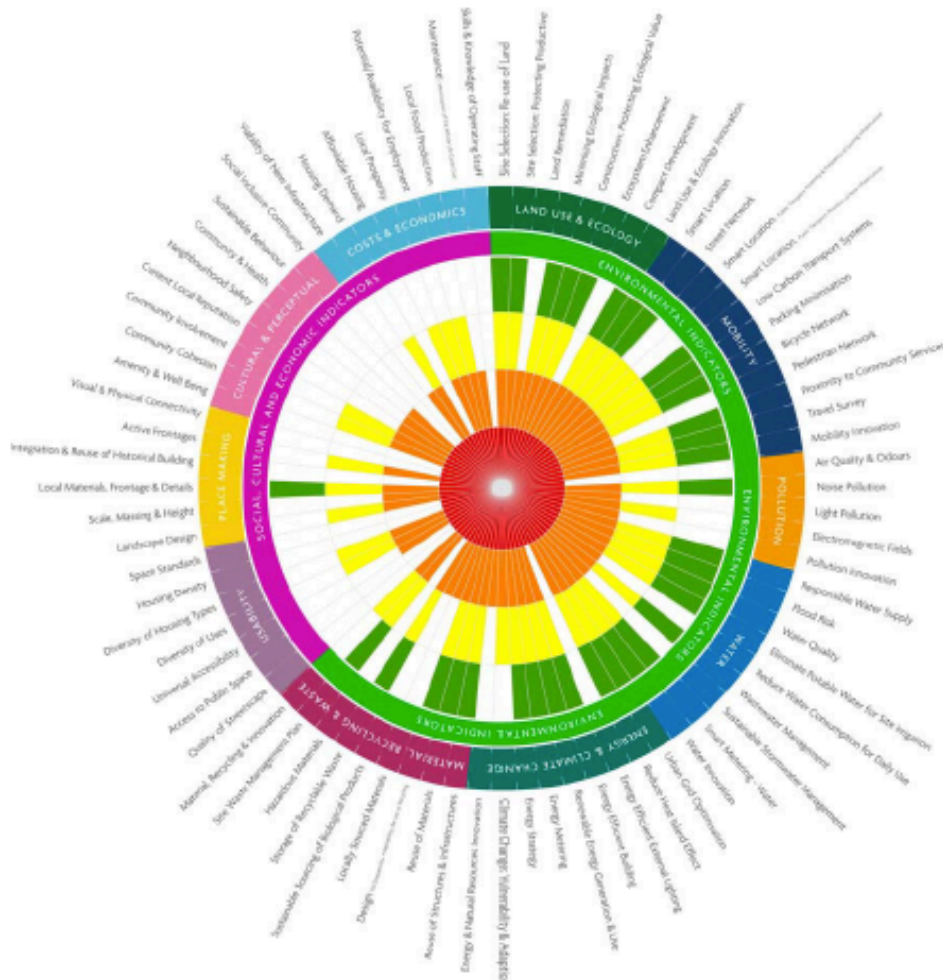


Figure 3.5: Sustainable Built Environment Tool (SuBET) (Source: Hilson Moran)  
 © Hilson Moran. Image courtesy of Hilson Moran. Used with permission

#### *Sustainability Value Map (SVM):*

The Sustainability Value Map (SVM) is a tool for evaluating the sustainability of buildings, urban development projects, and cities. It was developed by Chris Butters of GAIA Architects and can be used for “complete quantitative and qualitative sustainability assessments of a variety of different subjects” and can also be used to compare sustainability over time and between sites (Skjerve-Nielssen, 2009, p. 8). The tool uses up to 24 indicators to assess sustainability, scoring each on a 0 to 5 scale from “poor performance” to “fully sustainable” (Butters, 2004).

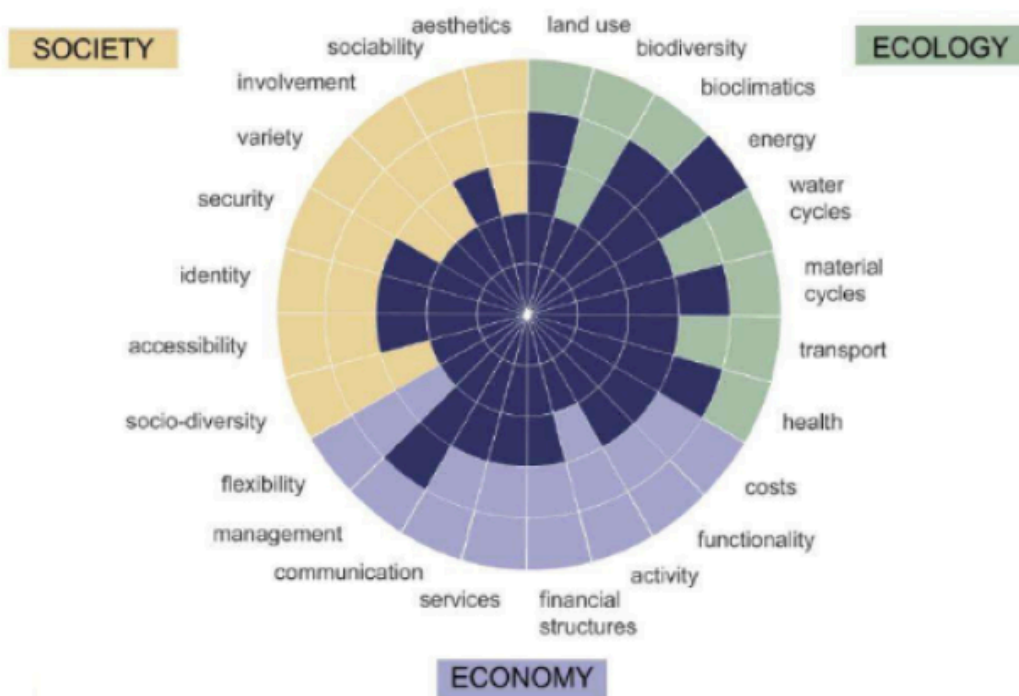


Figure 3.6: Sustainability Value Map (SVM) (Source: Butters, 2004). Used with permission.

### 3.2.1 Features, Benefits and Limitations of Multi-variable Tools

While each of the assessment tools described above is different, they share a number of characteristics that were incorporated into the prototype multi-variable tool. Specifically, each prioritizes the communicative power of the circular rose-diagram and its capacity to reduce complex phenomena into simple, readable representations as a way of improving decision-making processes. Another important feature of these tools is the diversity of variables that can be included to represent both qualitative and quantitative criteria using non-equivalent scales. The potential for these tools to illustrate advantages, disadvantage and trade-offs has value in the industrial land use context. Finally, each of the examples discussed organizes multiple measures or indicators under broader categories, which can be adapted to this research to represent different aspects or categories of intensification.

These diagrams are not abstract models, but rather are intended to be concrete tools for planning, evaluation, and comparison (Butters, 2004). They serve to assist in the defining of goals and priorities; to make decision-making processes more clear and explicit; and to provide education tools for stakeholders (Clayton & Radcliffe, 1996). According to Robson (1994), the

main purpose of such graphics tools is to distil multiple criteria into a single diagram as a way of both maximizing the data content while also eliminating the need for multiple graphical displays, with the resulting representation, being simultaneously conventional and easy to read (Robson, 1994, p. 1039). Rose-diagrams typically do not produce or result in a single overall score, but rather provide a graphical representation at a particular point in time, across multiple variables (McGregor & Roberts, 2003, p. 3). However, this research also creates an 'intensification score' for the prototype multi-variable tool in an attempt to expand the application of the tool beyond that of simply an analytical tool. The development of the 'intensification score' is discussed in detail in Section 3.5. These diagrams are evaluation tools that help stakeholders understand and visualize various aspects of complex ideas, systems and relationships by simplifying complicated data and helping the user to recognize linkages (Skjerve-Nielssen, 2009). Graphical communication tools such as these are designed to assist in the interpretation of data and highlight key messages in an easy to understand and explicit format (Therivel, 2004). Butters (2004) argues that we need tools such as these to help us to "set targets, plan, design, and evaluate" (p.1).

Creating graphical representations of multiple variables and complex data has numerous advantages. Clayton and Radcliffe (1996) tell us that these diagrams make data more accessible and therefore can enhance decision-making processes. Colour can be used to add emphasis and assist readers make faster assessments. McGregor and Roberts (2003) explain that these types of visual representations of data can help to illustrate areas of weakness or strength, thus enabling more focused policy or action, while also facilitating assessments at different points in time for comparison (McGregor & Roberts, 2003). Since many variables are inter-related, much can be learned from viewing them together, and therefore these diagrams allow numerous factors to be balanced and their inter-relationships examined (McGregor & Roberts, 2003). These tools also have the advantage of reducing complex problems into a readable format and allowing for qualitative data to be given equal weight to quantitative data (McGregor & Roberts, 2003). Incorporating different types of data in this way can help ensure a balanced approach is taken and that all aspects of a given project or problem are considered, which is an important factor in the industrial land use context. Multi-variable tools like the Sustainability Value Map (SVM) are "suitable for qualitative and quantitative assessments of a variety of different subjects" and can also be useful when looking to make comparisons over time (Skjerve-Nielssen, 2009, p. 8). These tools acknowledge the complexities of situations and concepts; recognize

that optimal outcomes do not necessarily exist; and allow that there are often trade-offs between variables. Some concepts are more nuanced, more difficult to define or measure, or more dynamic, and therefore require evaluation tools that reflect these complexities. Communicative tools such as those described and the prototype multi-variable tool enable the complementary use of quantitative and qualitative data (Butters, 2004; Skjerve-Nielssen, 2009). Therivel (2004) argues that these diagrams help to draw out key points from complex data and provide accessible representations that appeal to a broader audience than more technical methods. In the context of this study, the tool will be used to visualize, communicate, and evaluate industrial land intensification in a comprehensive manner.

It must be noted that these types of assessment tools have their limitations. Regardless of how they are applied, these diagrams must be recognized for what they are – tools, not solutions. They are tools that can aid in the understanding of complex concepts and situations, not solutions to these same complex situations. A diagram may give a clear signal where change is needed, but does not provide the solutions that can result in improvements (Skjerve-Nielssen, 2009). In addition, they are not useful for predicting future outcomes, but rather better suited for presenting a snapshot of a particular point in time (Skjerve-Nielssen, 2009).

In the development of these diagrams it can be a challenge to balance simplicity with complexity or rigour. A tool with too few variables will lack the detail needed to facilitate informed decision-making. At the same time, too many variables can impact readability and user accessibility. In some cases, potentially useful variables cannot be included in the tool for various reasons, such as availability of data. In addition, it is important to acknowledge that there are challenges when including multiple variables with different evaluation scales in the same graphical representation. Finally, for many of the sustainability assessment tools discussed above, the objective is to optimize *all* variables in the tool, not maximize just one or a few (Butters, 2004). While this may be the case for sustainable development applications, it may not be, or may be less so, for industrial land intensification. Nevertheless, assessment tools like the prototype tool developed for this research can highlight trade-offs and help determine whether gains in one area come at the expense of another.

### 3.3 Developing the Multi-variable Tool

The prototype multi-variable tool developed for this research practicum draws on elements of each of these rose-diagram applications discussed above. However, the prototype tool does not attempt to duplicate or replicate any of these models in any significant way. Tool characteristics have been borrowed and others created as needed to fit the unique needs of this project and the industrial land application of the tool. The primary intention was to create a tool that can effectively communicate and evaluate the complexity of the industrial land intensification picture.

The construction of the prototype multi-variable tool consisted of several steps: 1) identification and selection of measures to be used; 2) developing the scales for each measure; and 3) generating sample applications by applying the tool to several sites by scoring each measure and plotting it graphically. As stated earlier, the literature review helped to identify potential measures for the prototype multi-variable tool. The goal was to select measures that can be easily adapted to fit the tool using readily available data. Selection criteria for measures included practicality (i.e. availability of data) and capacity to illustrate specific types of intensity. The list of density and intensity measures developed by Metro Vancouver was the starting point for the measure selection process (see Tables 2.4 and 2.5). Measures were grouped into three intensification categories – density/built-form, site usage, and activity. The prototype tool uses segments rather than points to ensure the tool has “visually correct geometrical weighting”, with each measure represented by a segment (Butters, 2004, p. 2).

An evaluation scale was created for each measure that allows each to be scored when the tool is applied to a specific site, area or sector. The scale for each measure is independent of the other tool measures. Here, the multi-variable tool closely follows the methodology of the Sustainability Value Map (SVM). The scale of each of the tool’s axes extends outwards from the centre, meaning that the farther away from the centre that a variable scores, the higher the intensity score. The orientation of the scale was reinforced by a colour gradient, with darker colours also indicating a higher intensity score. The prototype tool uses a 3-point scale that scores the performance of each measure as low, medium, or high. The 3-point scale has the desired simplicity and practicality that is important with these types of tools. A relative weighting of the scales for each measure was not attempted as the tool incorporates a diverse array of variables that represent both qualitative and quantitative criteria that require non-equivalent scales. Following the determination of each measure’s scale, sample applications of

the tool were created for several sites by scoring each measure on its scale. The selection of measures, determination of scales, and scoring of each measure was reviewed and refined through an iterative and consultative process with the MDP practicum committee. The resulting prototype multi-variable tool and initial applications were subsequently reviewed and refined with research participants as part of the “tool refinement activity” during the interview process. The tool refinement activity is described in detail in Chapter 4.

The selection criteria for measures were practicality (i.e. availability of data) and capacity to illustrate specific types of intensity. The intention was to create a prototype tool that contains a diverse selection of variables that measure the various aspects of intensification that have been identified – density/built-form, site usage, and activity. For the purposes of this research project and for possible future applications in planning practice, it was important that the measures selected could be easily calculated using readily available data. Therefore, practicality or data availability was a primary factor for determining the measures included in the prototype tool.

### *3.3.1 Intensification Score*

As discussed above, the diagrams on which the prototype multi-variable tool is based typically do not produce or result in a single overall score, but rather provide a graphical representation at a particular point in time, across multiple variables. However, one of the key objectives of the tool refinement exercise conducted with interview participants was to assess potential applications and utility of the tool beyond simply communicating more nuanced definitions and measures of industrial land intensification. With this in mind, an “intensification score” was created to quantify the tool graphic. By quantifying intensification in this way, the prototype tool could potentially be used to develop intensification targets. The intensification score allows for easy comparison between applications of the tool across three categories of intensification (density/built form, site usage, and activity), as well as total score. Measures that score high on each evaluation scale receive a score of 3, medium 2, low 1, and nil 0. The sum of these scores produces the scores for each intensity category and the total score. See Figure 3.7 below.

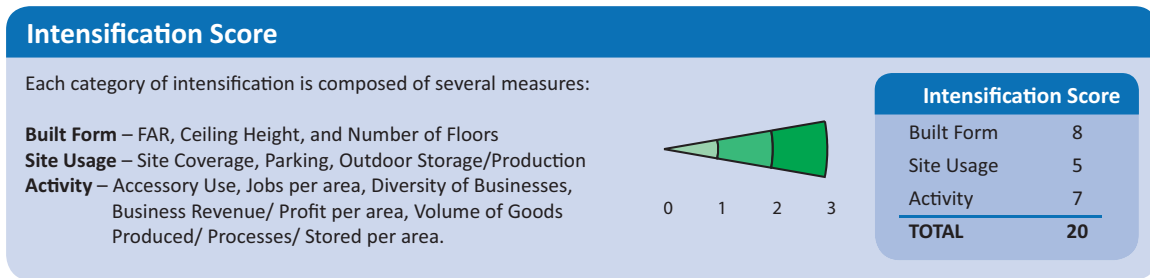


Figure 3.7: Intensification Score

The maximum possible intensification score for the prototype multi-variable tool is 33. However, achieving a perfect score of 33 is extremely difficult, if not impossible, due to the inverse relationships of some variables. For example, a site that receives a “high” score on site coverage will likely not score “high” on outdoor storage/production. Additionally, a site that scores “high” on ceiling height will likely not score “high” on number of floors. These examples show some of the trade-offs that exist in the industrial land context and demonstrate the capacity of the prototype tool to illustrate these trade-offs.

### 3.3.2 Purpose of the Tool

The prototype tool is intended to be an analytical tool that can help communicate expanded definitions and measures of intensification and facilitate the evaluation of industrial land intensity. The tool’s graphic is designed to illustrate all aspects of industrial land intensification in an easy to read graphic. The multi-variable assessment tools (described in Section 3.2) that informed the development of the prototype tool, have been taken a step further with the introduction of an ‘intensification score’ scoring system. The intensification score attempts to quantify the tool graphic, combining the measures in a standardized way, potentially creating an index of intensification. The tool has potential as an analytical tool, helping to illustrate more nuanced definitions of intensification and their measures to industrial land stakeholders. Being able to communicate and measure the multiple aspects of intensification is important as this can help ensure that as intensification policies are developed, no one industry is unfairly disadvantaged. The introduction of the ‘intensification score’ adds the potential to use the tool as part of a regional intensification targets or incentives structure, where the tool could help to establish standards or minimums for intensification. The semi-

structure interviews with key stakeholders were used to both refine the construction of the tool as well as to assess the merits of these and other potential applications of the prototype tool.

### **3.4 Measures of Intensification**

The following is an exploration and evaluation of current and alternative measures of industrial land intensification. The list of potential density and intensity measures developed by Metro Vancouver was the starting point for this discussion, with additional measures added. In the section that follows, each measure is defined and its suitability for inclusion in the tool is assessed. In addition, the process by which each measure is calculated, the data required, and the possible sources of this data are presented. Finally, the strengths, limitations, implications, and applications of each measure are briefly discussed.

Selection criteria for variables included practicality (i.e. availability of data), ease of use, and capacity to illustrate specific types of intensity. Some measures such as the density measures are already in use. However, other measures such as measures of business activity/throughput are more difficult to calculate due to the availability of data (Metro Vancouver, 2012a). The objective was to select measures which evaluate all aspects of intensification and that can also be easily incorporated into the tool using readily available data. For the below discussion, the measures were grouped based on the aspect of intensification they measure. These same categories were also used to organize the measures in the prototype tool graphic.

#### ***3.4.1 Measures Included in the Prototype Tool***

The measures discussed below are those that were chosen to be included in the prototype tool and have been grouped into broad categories based on the aspect of intensification that they evaluate. The three categories are Density/Built-Form Measures, Site Usage Measures, and Activity Measures. Density/Built-Form measures capture the intensity of industrial buildings; Site Usage measures assess the intensity of overall site usage; and Activity measures evaluate the level of industrial *activity* of a site.

### ***Built-Form Measures***

For industries that are building-intensive, density/built-form measures are strong measures of intensity. Density/built-form indicators generally relate the size or bulk of a building to the size of a site.

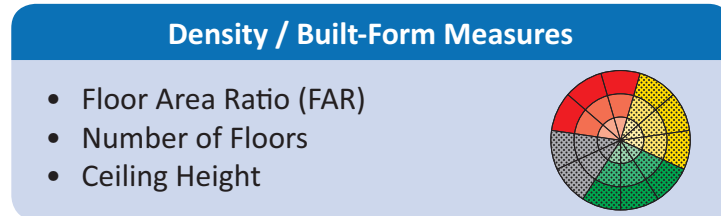


Figure 3.8: Density / Built Form Measures

### ***Floor Area Ratio (FAR):***

Floor area ratio (FAR) is a measure commonly used to manage density (built form intensity) in residential, commercial, and industrial areas. FAR is an indicator of bulk that “relates the floor area of a building to the area of the site” (Hodge, 2008, p. 154) and is a strong measure of intensity for building-intensive industries. Data to support this measure is readily available from municipal sources and FAR is easily calculated. Maximizing or achieving significantly higher FAR in industrial areas would necessitate multi-storey industrial buildings. Analysis by Eric Vance & Associates (2011) and Metro Vancouver (2013b) revealed numerous challenges with this typology, including unfavorable development economics, adverse impacts on ground floor users, potential user conflicts, and user preference for single storey, single user buildings. The upper storey spaces in multi-storey industrial developments are typically suitable for office type uses and therefore maximizing FAR in industrial areas could lead to an increase in office jobs and non-industrial users in industrial areas. The resulting increases in employment densities could work counter to regional objectives that prioritize concentrating the majority of new jobs in Urban Centres and close to the Frequent Transit Development Areas. This measure was included because it is a strong measure of built-form intensity (density) that is commonly used in industrial zoning.

### ***Number of Floors:***

This measure simply counts the number of floors a building has (i.e. does not relate the number of floors to floor space area or site/parcel area). The majority of industrial buildings in Metro Vancouver are single storey structures and where multiple storeys exist it is typically in

the form of a full or partial mezzanine level usually devoted to office use (Eric Vance & Associates, 2011, p. 43). Data for this measure could be obtained through simple visual assessments. For many buildings, mezzanine levels may have been added or expanded making it difficult to assess the number of floors visually thus requiring other data collection methods such as surveys. Pursuing policies that promote industrial buildings with multiple stories presents the same difficulties and unintended consequences as the FAR discussion above. This measure was included in the prototype tool because it provides a simple and quick assessment of relative intensification – i.e. a two-storey industrial building could be considered a more intense or efficient use of industrial land than a single-storey building.

### ***Ceiling Height:***

Ceiling height is a measure of the average ceiling clearance for an industrial building. It is an alternative measure of built-form intensity (density) that helps to capture the additional productive capacity or intensity of use for a given industrial floor plate that is made possible with higher ceilings. For industries such as warehousing that make use of greater vertical spaces, ceiling height is a much better measure of intensity than FAR. Data to support this measures is available from municipal sources. This measure is widely used in industrial zoning to control built-form and is well understood by industrial land stakeholders.

The three Density Measures included complement one another: FAR relates the floor-space of a building to the site; Number of Floors provides a quick assessment of relative density and captures multi-storey development (independent of site size); and Ceiling Height captures the productive vertical space of single storey buildings.

### ***Site Usage Measures***

The following site usage measures evaluate aspects of land use other than buildings. These measures are useful when seeking to understand the role and utility of open spaces, which is particularly important to land-intensive industries.

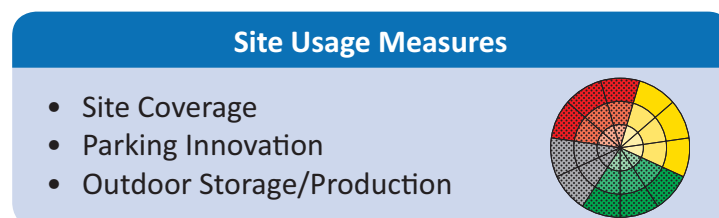


Figure 3.9: Site Usage Measures

***Site Coverage:***

Building site coverage is a land use measure used to control building density in industrial lands. Site coverage is a measure of the amount of a site covered by a building, with the remainder of the site devoted to open space for parking, storage, landscaping, driveways, etc. This relationship between the building floor-plate and the lot area and is typically represented as a percentage. As Metro Vancouver municipalities update their industrial zoning bylaws there is a trend towards eliminating site coverage limits in favour of setback requirements to control site coverage (Eric Vance & Associates, 2011, p. 42). Site coverage is well understood and the data required to calculate it is readily available. If policies were pursued that promoted maximizing site coverage the result could be the continued development of low-ceiling, single-storey industrial buildings. Widespread intensification in this way would not necessarily lead to the desired levels intensification and could have adverse impacts on some users. Industrial users that require outdoor storage and production space as part of their operations could be forced to enclose these uses, which could drive up development costs, impact operations, and cause users to consider relocation. Even though many municipalities no longer use site coverage to control building footprints, relying instead on setback requirements, it remains a useful way of measuring the relationship between building footprint and open space and the efficiency of industrial land use.

***Parking Innovation:***

The manner in which parking needs/requirements are addressed can potentially be a strong indicator of intensification. The less land taken up by parking means more land available for productive industrial activities. Parking decisions are driven by economics, user needs, and bylaw requirements. If land values are high enough, the economics of constructing either underground or rooftop parking become viable. Reduced parking on site would also be an indicator of intensification (e.g. parking provided below levels required by bylaws with municipal agreement). Parking data is readily available from municipal sources. When evaluating parking on a given site, this measure will focus on customer/employee parking as opposed to truck/trailer parking which is considered productive use of a site and measured separately (see Outdoor Storage/Production measure below).

### ***Outdoor Storage/Production:***

There are numerous business and industrial sectors that utilize outdoor storage or production as part of their operations (i.e. operations that are not enclosed inside a building or physical structure). Intensification of these activities is not captured by traditional intensity (density) measures such as FAR or site coverage that evaluate built-form only. Measuring the level or potential to increase outdoor operations (storage or production) would be a valuable measure of intensification for some industries and industrial areas. The most practical way of measuring outdoor storage or production is to create a measure similar to site coverage, relating the amount of space devoted to outdoor storage/production to the lot area. Again like site coverage this could be expressed as a percentage. Generating the data required for this measure would require surveys of industrial users, site visits, or potentially the use of aerial photography.

### ***Activity Measures***

The following measures attempt to move beyond measures of density/built-form and site usage to capture the intensity of the diverse activities that occur on industrial lands.

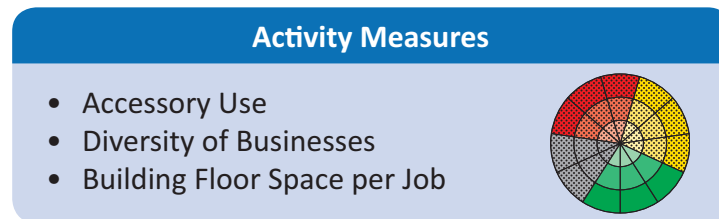


Figure 3.10: Density / Built Form Measures

### ***Accessory Use:***

The level of accessory use is a potentially useful way of measuring the efficiency of industrial land use. Accessory uses are permitted in most industrial zones, however, the type and amount allowed varies between municipality and industrial zone (Metro Vancouver, 2012a). Municipalities control the level of accessory use by setting a maximum percentage of floor space, or by simply requiring that the use be related to the primary use. Increasing accessory uses in industrial lands has the potential to significantly increase the amount of activity on a given site or industrial area. However, accessory uses tend to be non-industrial uses such as office or retail operations, which can result in higher employment densities, greater traffic volume, and increased demand for services and amenities. These factors can have a

destabilizing effect on industrial areas, driving up land prices and creating user conflicts (Metro Vancouver, 2012a). Therefore, more accessory use is not necessarily better. Data for this measure is readily available from municipal sources. While there are potential concerns with higher levels of accessory use, for this measure, a higher number, up to 49% (or the maximum allowed under the zoning) will be interpreted as positive.

***Diversity of Businesses per Area:***

Similar to the accessory use measure, Diversity of Businesses per Area could be a potentially useful measure of intensification. A higher number of businesses per acre could be an indicator of relative intensification, helping to account for smaller start-up operations or incubator spaces in industrial areas. Some building types are designed to accommodate a single user, while others provide the flexibility to house multiple industrial users and different types of industry (Metro Vancouver, 2012a). This measure can help capture the activity and high number of tenants of small flex-space strata units that can be found in industrial areas. However, similar to Accessory Use, more diversity is not always better, nor is it necessarily an indication of intensification. Larger operations can be more efficient, generating more economic throughput than multiple smaller users on a similar sized site. Calculating businesses per acre could be as simple as counting the number of businesses operating in a given building or industrial area. This data could also be acquired through surveys or from municipal business license data. For the purposes of this measure, a “business” is defined as a separate unrelated business (i.e. not simply a separate legal business or division within a larger company) and a higher number is interpreted as positive.

***Employment Density (Building floor space per job):***

One of the potential benefits of intensification is increased employment activity on the region’s limited industrial land (Metro Vancouver, 2012a). Some industries are job-intensive, employing relatively high numbers of people in a given building or on a given site. Examples may include industrial sites with relatively high office accessory functions, some types of manufacturing, multi-storey/multi-tenant buildings, and operations with multiple shifts of workers. Conversely, the transportation/warehousing sector generally has lower job-intensity while requiring more land and building space (Metro Vancouver, 2012a).

The employment density measure relates FTE (Full-time Equivalent) to the land/site

area. This measure is ideal for measuring the intensity of industries that are job-intensive and not necessarily land or building-intensive. This is an important consideration because there are numerous businesses and sectors that can intensify operations without requiring larger buildings, but rather through investing in equipment and technology, increasing the number of employees, or by adding shifts of workers. Acquiring the necessary data for this measure could prove to be difficult, as it requires cooperation from individual businesses through surveys or sharing of employment data. Another challenge will be accounting for consultants and contractors who may be working on a site but are not actually employees of the business. Promoting higher employment densities as a way of achieving industrial land intensification could work counter to regional goals that prioritize locating the majority of the region's new jobs in Urban Centres and Frequent Transit Development Areas. Nevertheless, employment density is an important measure of intensification for many industrial businesses and sectors and therefore warrants inclusion in the prototype tool. A with a higher number is considered positive, or more intense.

### ***Business Activity/Throughput***

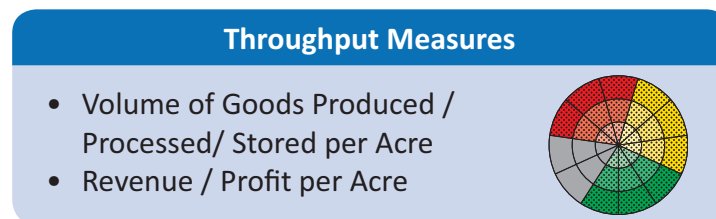


Figure 3.11: Density / Built Form Measures

Metro Vancouver distinguishes between density and intensity by defining intensity as the level of *activity* occurring in a given area. A central objective of the region's intensification efforts is to maximize the value that is generated on a given piece of land (Metro Vancouver, 2012a). Some valuable measures of the intensity or efficiency of industrial land use would be measures of the economic output, activity, and spinoffs of industrial land activity. Listed below are various potential measures of business activity and economic throughput identified by Metro Vancouver through consultation with industrial land stakeholders.

- Business revenue / profit per unit (value generated per unit of land, or building floor area)
- Volume of goods produced / processed / stored per unit (per building floor space,

- amount of land, employee, or some other measure)
- Vehicle or equipment movement per hour (trucks, loading, crane lifts)
- Transportation infrastructure (port, airport, rail yards, highways) utilization rates (goods / trips per unit)
- Multiplier job impacts of different types of businesses (secondary and induced impacts on wider economy)

The primary challenge with these measures is availability of data, as the data required is business specific, requiring close cooperation with individual businesses that are willing to share their financial and operational data.

While these measures could be extremely useful measures of intensification, they are not considered to be practical and therefore including them in the tool is difficult. However, for discussion and illustrative purposes, two business activity/throughput measures were included in the prototype tool – *Business revenue/profit per acre*, and *Volume of goods produced/processed/stored per acre*.

The idea of spatial productivity was explored in the literature review and represents one possible method of measuring the economic throughput and activity on industrial land. However, this approach to measuring intensification also has its challenges. First, measuring intensification in this way could place too much weight on economic value per area. Economic productivity is an important consideration but it is not the only aspect of industrial intensification. When included alongside other measures it could lead to essential, low-value, city-serving industries being pushed out of the region's industrial lands in favour of users with higher value outputs. Secondly, this measure does not overcome the challenge of access to data identified with other throughput/activity measures. Furthermore, planners and industrial land stakeholders may not have the expertise to conduct the spatial productivity analysis required for this measure, therefore not meeting the simplicity criteria of the prototype tool.

### *3.4.2 Measures Excluded from the Prototype Tool*

Various other potential measures were considered when developing the prototype tool. The measures discussed below emerged from the literature as factors that can influence the intensification or intensification potential of a site, area, or sector. Some indicators were not included in the prototype tool for practical reasons such as a lack of data. Others were left out because the aspects of intensification that they measure were already captured by other

measures. And still others were excluded because they were better suited for measuring intensification *potential*. Understanding intensification potential is important, however, the focus of this research is defining, measuring, and communicating industrial land intensification to support the development of intensification policies and strategies. Many of the excluded measures were discussed with interview participants as part of the tool refinement exercise.

### ***Developable Area Constraints***

The literature reveals that certain development controls and constraints limit developable area, thus influencing the land use efficiency or intensify of a site or area. These constraints include setback requirements, landscaping requirements, driveway and road standards, and lot size. These were excluded from the prototype tool because each of these are incorporated into the tool indirectly through other measures such as Site Coverage, Outdoor Storage/Production, and Parking Innovation.

### ***Quality of Jobs (education/pay levels)***

This measure emerged as part of the employment intensity discussion. Employment opportunities on industrial land provide relatively high paying jobs when compared to the service sector, particularly for those with lower levels of formal education (Howland, 2011). Having a measure of intensification that assesses the quality and pay of jobs could enable the region to develop policies that attract and retain these “quality” jobs and industrial sectors. However, this measure poses a number of challenges, including defining “quality” jobs and getting the necessary data. There are arguably numerous dimensions and indicators of job quality including pay, benefits, satisfaction with hours of work, work schedules, job security, physical well-being at work, the human/social work environment (Jackson & Kumar, 1998). Therefore, defining and developing a scale for job quality would be difficult. Business specific employment data could be obtained with the cooperation of industrial land users; however, privacy concerns with respect to employee salary details would be inevitable. In addition, the quality and pay of jobs on a single site can span a wide range, making it difficult to assess even with detailed data. Applying this measure to an industrial area or sector would be even more challenging. Data can be found for income by industrial sector at the provincial level, however using high-level data as measure of job quality in the region would not result in an accurate measure of intensification. While this measure would be of interest to municipal leaders

seeking to develop policies that attract quality employment, it is simply not a practical measure of intensification.

### ***Multiplier Effects of Different Sectors***

Understanding the spinoff or multiplier effects that different industrial sectors have on the wider economy could be a valuable measure of intensification and the economic impact of a given industrial site, area, or sector. This measure was excluded for reasons of practicality and availability of data. However, the idea of quantifying the economic output and impacts of industry was raised numerous times by interview participants and is discussed further in Chapter 5 Analysis and Findings.

### ***Level of Building Specialization***

Metro Vancouver's research into industrial lands found that there is a trend in some sectors towards greater building specialization, where multiple functions of a business are housed in the same building (manufacturing, storage, and distribution for example), which makes for an efficient operation and relatively intense use of industrial land (Metro Vancouver, 2012). However, defining exactly what building specialization is and getting the necessary data made it difficult to include this measure in the prototype tool.

### ***Value of Lands and Improvements***

High land value generally correlates with more intense industrial land use as measured by floor area ratio (FAR) (Eric Vance & Associates, 2011) and therefore could be a good indicator of intensification potential. For example, for multi-storey industrial buildings to be viable, land values have to be very high to justify the additional development costs (Eric Vance & Associates, 2011; Metro Vancouver, 2013b). High value improvements could be an indication that developers/users are investing more in buildings in one area relative to another, which could be a strong indicator of intensification potential for a given area. The value of land, improvements and the relationship between these indicators could be ideal measures when seeking to assess the intensification *potential* of a site or area. However, these measures are not particularly useful for assessing or communicating *current* intensification or when seeking to develop intensification policies.

### ***Building Lease Absorption Period, Vacancy Rates, and Lease Rates***

Data on industrial lease absorption, vacancy rates, and lease rates are readily available in the Metro Vancouver region. These indicators tell us about demand for various types of industrial properties and within various industry subsectors. Combining data on annual lease data (revenue) with land value data to generate the capitalization rate (cap rate) could be an indicator of areas with greater intensification potential. However, similar to the land value and improvement value discussion above, these indicators are best suited for assessing intensification potential, which is not the focus of the prototype tool.

### ***Value or level of equipment/technology investment***

When businesses invest in new equipment and/or technology it is with the intention of increasing production levels, generating efficiencies, and raising revenues and profit. Such investments can increase the productivity on a given site without the need for larger buildings. Investments in racking systems, for example, can help distribution centres take advantage of the vertical space provided by higher ceilings. However, acquiring the data required to support this measure would be extremely difficult, making its inclusion in the multi-variable tool impossible. In addition, the variability in the value of equipment or technology would make the development an evaluation scale a significant challenge. This measure was discussed as part of the tool refinement exercise with interview participants and will be explored further in Chapter 5 Analysis and Findings.

### ***Locational Factors***

The location of an industrial site is an important determinant of intensification potential. The proximity of industrial land to transportation infrastructure such as ports, rail, and highways can be an important factor in determining intensification potential. Location is also a key determinant of industrial land prices and lease rates. Once again, this is another measure that is best suited for measuring intensification potential. The idea of location also emerged during the interview process and is discussed in Chapter 5.

### ***3.4.3 Types of Tool Applications***

This research project initially envisioned three potential scales of application for the prototype multi-variable analytical tool – industrial site; industrial area; and industrial sector.

The prototype tool and sample applications developed as part of this research were site-level applications. Developing applications of the tool that can be applied to larger industrial areas or to specific sectors could involve adding or removing measures and developing different evaluation scales. These additional scales of application were discussed with interview participants as part of the tool refinement exercise and are examined more in Chapter 5 Analysis and Findings.

As discussed above, the focus of this research project and prototype multi-variable tool is to better define, measure and communicate industrial land intensification. This means understanding and assessing the level of intensification that exists currently. However, it is acknowledged that understanding the intensification *potential* of a given industrial site, industrial area, or industrial sector would also be valuable to a variety of industrial land stakeholders. The idea of developing a version of the multi-variable tool that could assess intensification potential was raised by numerous interview participants and is also discussed further in Chapter 5.

#### *3.4.4 Measure Evaluation Scales*

An evaluation scale was created for each measure selected for inclusion in the prototype multi-variable tool. The scales were developed based on a review of literature and current practices and have been used to score each measure in the sample applications as either low, medium, or high. This 3-point scale has the desired simplicity and practicality that this tool requires. It is acknowledged that there is a high degree of subjectivity in both the development of the evaluation scales and scoring of each measure. The intention was that both the scale development and scoring for each measure would be discussed and refined with interview participants as part of the tool refinement exercise. Presented below are the prototype evaluation scales developed for each of the measures that were included in the prototype tool. Accompanying each evaluation scale is a brief summary of the supporting material used to develop the scale.

### Floor Space Ratio (FAR)

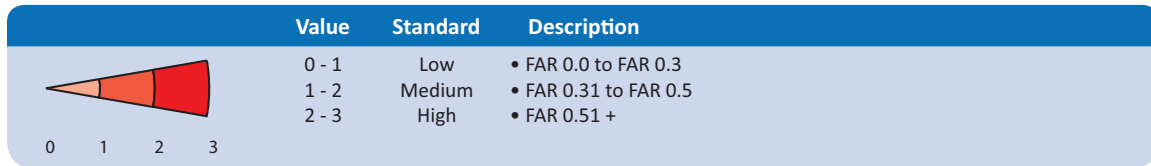


Figure 3.12: Floor Space Ratio (FAR) evaluation scale

Floor Area Ratio (FAR) is commonly used to control density (built form), relating the floor area of a building to the area of the site. The typical industrial building in Metro Vancouver has an FAR of approximately 0.3; however, FARs vary by sector and location. In a review of selected metropolitan regions (Calgary, Edmonton, Seattle, Portland, and Los Angeles) Eric Vance & Associates (2011) found that the average FAR was 0.3 and that buildings that exceeded 0.5 FAR were rare. In Metro Vancouver, FARs of 0.5-0.6 are considered to be on the high end of what is being achieved (Eric Vance & Associates, 2011). Where FAR maximums exist in zoning bylaws they are typically set at 1.0, although there are industrial areas with higher maximums.

### Ceiling Height

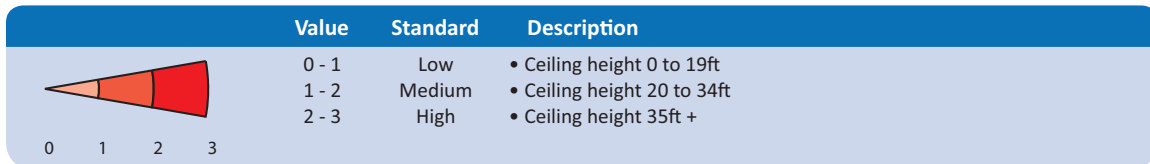


Figure 3.13: Ceiling Height evaluation scale

Ceiling Height is a measure of the average ceiling clearance for an industrial building. Higher ceilings permit more efficient or intense use of a given industrial floor plate and the trend in Metro Vancouver for some sectors is towards higher ceilings in industrial buildings. Ceilings of 36ft are typically the highest seen in Metro Vancouver based on current development economics (Stantec Consulting, 2013). The average ceiling heights by industrial subsector in Metro Vancouver are as follows: flex space/multi-tenant (10-18 ft), freight forwarding (12-16ft), light manufacturing (16-24ft, warehouse distribution (20-24ft) (Metro Vancouver, 2012a).

### Number of Floors

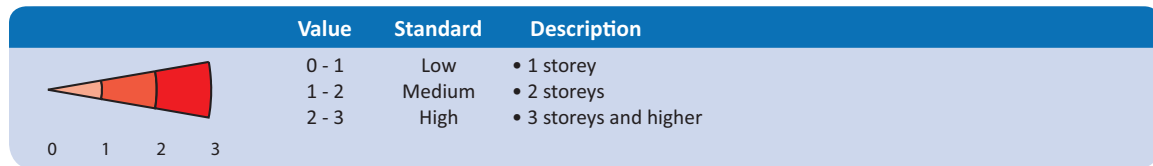


Figure 3.14: Number of Floors evaluation scale

This is simply a measure of the number of floors in a building. The typical industrial building in Metro Vancouver is 1-storey. Buildings with multiple floors most often have an accessory component, often in the form of a partial or full mezzanine level (Metro Vancouver, 2012a). Where partial mezzanine levels exist, they will be counted as fractions of a floor. Industrial buildings of 3 or more storeys remain rare in Metro Vancouver.

### Site Coverage

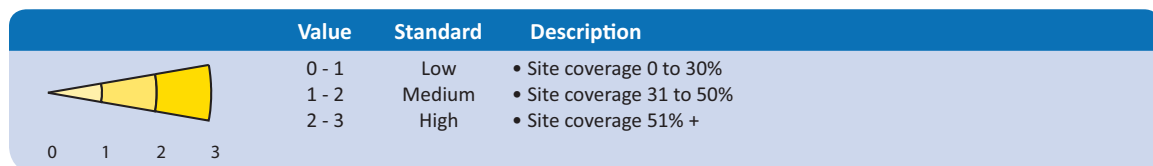


Figure 3.15: Site Coverage evaluation scale

Site Coverage measures the amount of a site that is covered by a building, with the remainder of the site devoted to open space for storage, setbacks, landscaping, parking, and driveways. The typical industrial building in Metro Vancouver is 1-storey and covers 30% of the site. Newer industrial developments in the region are achieving site coverage of 40%-50% and there are a few examples of 60% or higher (Eric Vance & Associates, 2011; Metro Vancouver, 2012a). There are also examples in parts of Vancouver where site coverage of up to 100% has been achieved. The typical site coverage ratios by industrial subsector in Metro Vancouver are as follows: freight forwarding (20%), warehouse distribution (40%), light manufacturing (40%), and flex space/multi-tenant sites (30-40%) (Metro Vancouver, 2012a). The District of Mission located in the neighbouring Fraser Valley Regional District, sets both a minimum and maximum in two of its industrial zones: minimums 25% and 33%, and maximums 50% and 60%.

### Outdoor Storage/Production

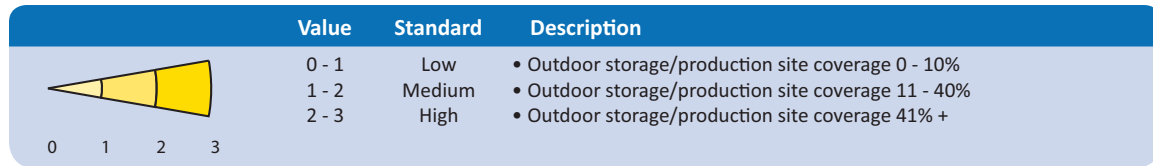


Figure 3.16: Outdoor Storage/Production evaluation scale

Many industrial sectors use outdoor space productively, for loading, maneuvering, storage, and production. This measure attempts to quantify the amount of a given industrial site that is devoted to productive outdoor storage and production (excluding private vehicle parking). There are no precedents in the literature for such a measure. To develop the evaluation scale, numerous sample industrial sites in the Metro Vancouver region were used.

### Parking Innovation

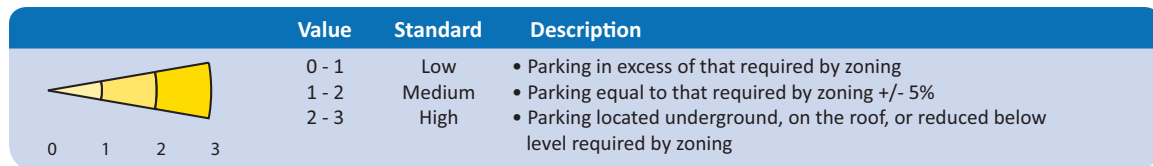


Figure 3.17: Parking Innovation evaluation scale

The Parking Innovation measure attempts to evaluate the amount of given industrial site that is devoted to personal vehicle parking. This measure operates on the premise that personal vehicle parking is not the optimal use of industrial land. Therefore, any steps taken that reduce the land devoted to parking, either through reductions to required parking or the incorporation of parking into the design of the building (underground or rooftop parking), were considered more intensive use of industrial land by this measure. There are no precedents in the literature for a measure such as this.

### Building Floor Area per Job or Jobs per Acre

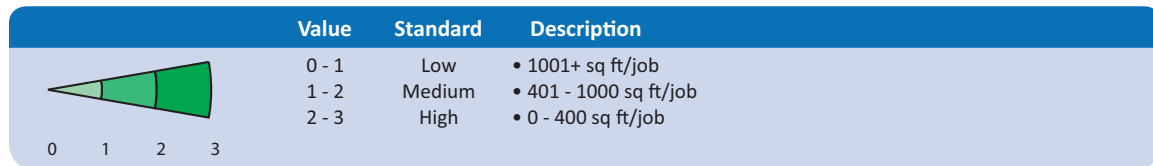


Figure 3.18: Building Floor Area per Job or Jobs per Acre evaluation scale

This measure evaluates the employment density of a given industrial site by measuring the amount of building floor space or site area per FTE (full-time equivalent). The evaluation scale was developed based on a review of relevant literature on industrial employment densities and sector specific employment densities from Metro Vancouver municipalities.

### Accessory Use

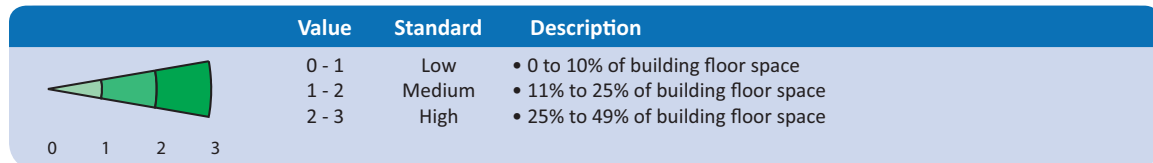


Figure 3.19: Accessory Use evaluation scale

The Accessory Use measure evaluates the amount of building floor space of a given industrial building that is devoted to accessory or ancillary uses. In Metro Vancouver, the level of accessory use for a typical industrial ‘box’ building is 10% (Metro Vancouver, 2012a, p. 37). For a manufacturing space with a design and sales component, accessory use might begin to exceed 20% (Metro Vancouver, 2012a). The “maximum” accessory use for this measure has been set at 49% as this represents the typical maximum permitted by most Metro Vancouver municipalities. Additionally, if floor space for accessory use were to exceed that of the primary industrial use, it would then arguably no longer be accessory or ancillary to the primary industrial use. However, there are industrial zones in the City of Vancouver that permit up to 66% accessory/other use, provided that the ground floor is occupied by industrial uses.

### *Diversity of Businesses per Building*

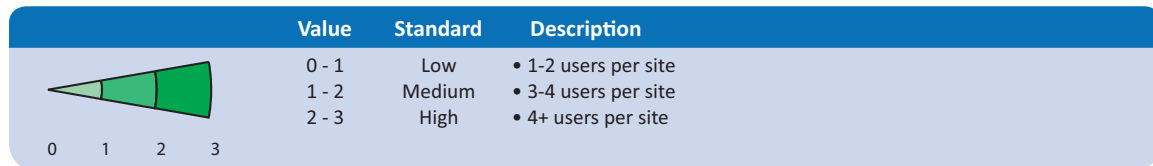


Figure 3.20: Diversity of Businesses per Building evaluation scale

This measure simply quantifies the number of businesses on a given site. For the purposes of this measure, a “business” is defined as a separate, unrelated business (i.e. not simply a separate legal business or division within a larger company). There are no precedents in the literature for a measure such as this.

### *Business Activity and Throughput Measures*

A good measure of intensity or efficiency of industrial land use would be measures of the value or volume of goods manufactured, processed, stored, shipped through a site, or measures of economic output, activity, or spinoffs of industrial land activity. Two measures of business activity or throughput were included in the prototype multi-variable tool – *Business revenue/profit per acre* and *Volume of goods produced/processed/stored per acre*. Unfortunately, data for these measures is difficult to acquire and the values for each measure are very industry specific. Additionally, the evaluation scales for these measures would vary greatly by industrial activity. However, these measures could potentially be practical if the tool is adapted and applied to a specific industrial sector and used for comparisons within that sector. It is for this reason and for discussion purposes that they were included in the prototype tool. However, no attempt was made to develop evaluation scales for these measures.

## **3.5 Interpreting the Prototype Tool Graphic**

Each measure included in the prototype multi-variable tool is represented by a wedge in the circular graphic. The evaluation scale of each measure extends outwards from the centre, meaning that the farther away from the centre that a measure scores, the higher the intensity score (See Figure 3.21 below). The prototype tool uses a 3-point scale that scores the performance of each measure as low, medium, or high. The scales for each measure are not equivalent and are independent of one another. In addition, the tool incorporates both qualitative and quantitative data. Comparisons of different applications of the tool can be made

in two ways – by comparing the tool graphics side-by-side or by comparing intensification scores.

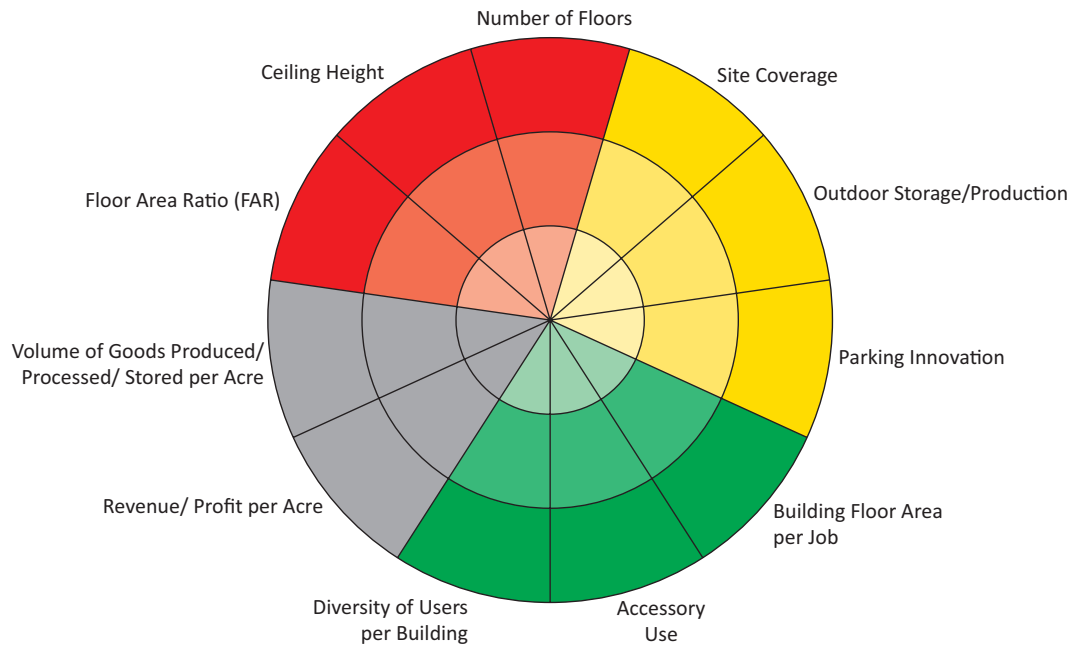


Figure 3.21: Sample prototype tool graphic

## 4 | Research Methods

### 4.1 Introduction

The sections that follow describe how my chosen research methodology endeavoured to address the research objectives:

- *Objective A:* develop a broader definition of intensification and additional measures of intensification in the context of industrial land.
- *Objective B:* develop a prototype analytical tool to help planners and decision-makers better understand, measure, and communicate industrial intensification and utilization.

The research objectives were addressed primarily through the use of qualitative research methods. As described in Chapter 3, the prototype multi-variable tool was developed based on the literature and through an iterative consultation process with the practicum committee. The tool was then presented to key stakeholders as part of a semi-structured interview process and tool refinement activity. Interview participants provided expert views on industrial land intensification and on the prototype multivariable tool. The tool refinement activity generated data that helped to refine the construction and potential applications of the multi-variable tool.

### 4.2 Semi-Structured Interviews

The primary method of inquiry for this research was semi-structured interviews with key stakeholders. Semi-structured interviews offered the opportunity to generate primary data from industrial land experts to help refine the prototype tool. The interviews targeted participants from the following stakeholder groups: planners, industrial real estate brokers, industrial real estate developers, and other experts including land economists, consultants, design professionals, and academics.

Semi-structured interviews are a form of inquiry described by Gilchrist (1992) as a kind of research listening where “a key informant provides information through formal interviews and informal verbal exchanges or conversation” (p. 71). This research approach enables the researcher and respondent to examine an issue together and it is a way for the researcher to gain insight into an expert's view of a problem. Lune, Pumar, & Koppel (2010) describe an

interview as “a conversation with a purpose” and a process that is “more about discovery than recording facts” (p. 241). This style of focused interview has the ideal mix of structure and flexibility that enables the researcher to uncover in detail how individuals define, perceive, and react to a particular situation and how they feel about it (Zeisel, 2006, p. 227). The resulting analysis can help better understand complex concepts and the often conflicting perspectives of a diverse group of stakeholders, which was important for this research project.

One of the strengths of semi-structured interviews is their openness and flexibility to focus on what the interviewee deems to be most relevant, which can result in a richer understanding of the research subject (Alvesson, 2011). A more flexible approach like this makes it possible to tap into the knowledge and experiences of those involved in the topic being investigated (Alvesson, 2011). An important objective for the researcher is to search for patterns in participants’ answers and in the conversation rather than merely summarizing the content (Lune et al., 2010). This approach enables the researcher to examine key themes that emerge while also allowing participants to focus on what they consider to be most important. This is precisely what is required for industrial land use intensification research given the diverse stakeholders, the changing environment, and limited data and research on the subject.

#### *4.2.1 The Multi-variable Tool Evaluation Activity*

In advance of each interview, participants were presented with a “participant package” containing<sup>12</sup>:

- A description of the prototype tool and the tool evaluation activity;
- A explanation of each measure and the evaluation scale developed for each measure;
- An explanation of how to read the tool graphic;
- An explanation of the intensification score;
- Four sample applications of the tool;
- Several examples of other multivariable tools and comparative prototype tool graphic;
- The interview guide, which included the questions that guided each interview.

The participant package explained the tool’s construction, intended purpose, and provided sample applications of the prototype tool. Participants were asked to review and provide comments on the tool, specifically on the selection of variables, the development of the evaluation scales, the scoring of each variable on the scale, and other potential applications of the tool. Interviewees were also asked for their thoughts on the utility of such a tool and its

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<sup>12</sup> See Appendix B for full participant package.

capacity to evaluate industrial land intensity and advance the region's industrial land intensification objectives.

#### *4.2.2 Participants*

Participants were selected based on their experience and expertise with industrial lands in Metro Vancouver. Alvesson (2011) suggests that two principles be considered when choosing participants – representativeness and quality. Representativeness was achieved by seeking a variety of perspectives, including those of planners, industrial real estate brokers, industrial real estate developers, and other experts such as land economists, consultants, design professionals, and academics. Quality refers to “paying considerable attention to what is assessed to be rich, perceptive and insightful accounts” and which participants have the qualifications and experiences to provide such responses (Alvesson, 2011, p. 50). Many participants had previously participated in regional industrial land intensification studies, discussions and workshops and have a vested professional interest in the topic.

#### *4.2.3 Ethics*

The subject matter of this research is neither sensitive nor controversial. The participants targeted for this research were not considered to be vulnerable (based on under the vulnerable group category as outlined by the Research Ethics Board at the University of Manitoba). Interview participants were identified and contacted through publicly available information or with the assistance of Eric Aderneck (External Advisor and Metro Vancouver Senior Regional Planner). Participating key informants also referred additional participants based on their expertise and potential interest in the research subject matter. All interviews were conducted in person and all interviewees participated voluntarily and without compensation. Informed consent was obtained from each interviewee in writing prior to each interview and participant confidentiality was maintained by using pseudonyms and general job descriptions in the analysis and conclusion chapters. All data generated during the interviews including audio recordings, transcripts, and notes were stored according to the University of Manitoba Research Ethics Board guidelines.

#### 4.2.4 Interview Guide

Participants were provided with the questions that guided the interview and tool refinement activity prior to each interview (see Appendix A). However, the interviews were intended to be semi-structured, allowing for a flexible and spontaneous conversation with participants, making it easier to uncover new and unexpected perspectives (Alvesson, 2011). The interviews guide contained the key research themes and acted as the conceptual map for the interviews. The main themes of the interview guide were the construction of the tool, including the measures and scales, and the tool's applications and utility. Alvesson reminds us that qualitative research is an ongoing learning process, and therefore the interview-guide evolved during each interview and throughout the interview process in response to interviewee answers and as lessons were learned from each interview. Interview recordings were transcribed and reviewed along with interviewer notes between interviews to evaluate emerging themes. The data generated during the interview process was subsequently analyzed using qualitative approaches.

#### 4.2.5 Scope of Interviews

A total of 15 interviews were carried out between April and June 2014. The interviews on average lasted approximately 30-60 minutes in duration. The participants targeted for these interviews were industrial land experts representing the key industrial land stakeholder groups:

Key Informant	# of Participants	Acronym Use in Reporting
Municipal Planners	3	MP
Regional Planners	2	RP
Planning & Development Consultants	4	PDC
Developers	2	DEV
Brokers	2	BR
Academics	1	ACA
Design Professionals	1	DP

Table 4:1 Interview Participants

An attempt was made to include at least two participants from each of the identified stakeholder groups. However, due to timing and scheduling limitations, only 1 academic and 1 design professional were included in the participant sample. Numerous attempts were made to engage additional participants from these professional groups without success. In addition,

industrial land users or tenants were not included in the research. These users of industrial land are an important industrial land stakeholders; however, finding industrial user participants for this study proved to be a challenge. It was hoped that other participants would be able to refer industrial land users that would be willing to participate in the research, but this did not happen. It also proved impossible to find a *single* user or reasonable sized sample of users that is representative of the diversity of industrial land users in the Metro Vancouver Region. The absence of the industrial user perspective is partially addressed through the perspectives of developers, brokers, and development consultants. These professionals work closely with industrial land users and understand the needs and concerns of this diverse stakeholder group. Despite these limitations, the researcher believes that the data generated by the participants is representative of the views of the region's diverse industrial land stakeholders.

### **4.3 Working with Data**

The key informant interviews were recorded digitally and subsequently transcribed. Pseudonyms were assigned to participants to maintain their confidentiality. Written notes were also taken throughout the interviews to document non-verbal cues and other information not captured in the recordings and transcripts.

When beginning the analysis of the data generated, three separate approaches to reading data were employed as described in Mason (2000). First, a literal reading was used, focusing on the language, structure and literal content of the conversations (Mason, 2000, p. 149). The purpose of semi-structured interviews is to move beyond the literal facts of the situation towards a more comprehensive understanding, and a literal reading alone would not achieve this. This was followed by an interpretive reading, where the researcher focused on meanings and relationships, determining what the data means or represents, and what the interviewee's "interpretations and understandings" of the research subject are (Mason, 2000, p. 149). The final approach to reading the data was a reflexive reading, which is intended to help the researchers locate themselves in the data that has been generated and consider their role in asking questions, conducting the interview, and interpreting interview notes and transcripts (Mason, 2000). This step acknowledges that the researcher is "inevitably and inextricably implicated in the data generation and interpretation processes" (Mason, 2000, p. 149).

The content of the interview transcripts and notes was coded by organizing the data into conceptual categories and themes guided by the research questions (Neuman, 2000). Neuman tells us that the coding process is an integral part of data analysis that not only reduces the data to a manageable quantity, but also “frees the researcher from entanglements in the details of the raw data and encourages the highest level of thinking about them” (Neuman, 2000, p. 420). The data was coded following the three types of qualitative data coding described by Neuman – open, axial, and selective coding. The first phase of coding assigned general codes to the data as a way of arranging the data by themes to make the quantity of data manageable. Themes emerged from the data as a result of the coding process rather than being pre-determined and can also evolve throughout the subsequent stages of reading (Neuman, 2000). The second phase of coding was axial coding, where the focus was on the initial coded themes generated in the open phase of coding, rather than on the data itself (Neuman, 2000). In this phase the researcher looked for linkages and relationships within and between themes. Selective coding was the final phase of the coding process in which the data was examined selectively for instances that highlight the major themes that have already been identified (Neuman, 2000). Findings from this phase of coding were compared with existing themes, interviewer notes, and previous codes and readings of the data and the emerging analysis began to focus around key themes or generalizations. This final stage was also an opportunity to select specific examples or quotations from the interview transcripts that illustrate a particular idea or theme. The themes that emerged will be discussed in the next chapter, Chapter 5 – Findings and Analysis.

## 5 | Analysis and Findings

### 5.1 Introduction

As discussed in Chapter 4, the qualitative analysis (reading and coding) of the interview transcripts generated several important themes. The data generated from the interviews was distilled into five themes that loosely follow the research questions and the interview guide:

- Defining Intensification
- Developing the Tool and Tool Graphic
- Intensification Measures
- Scores and Targets
- Application and Utility

The following chapter presents the findings from the interview process and is organized according to the above themes.

### 5.2 Defining Intensification

Each interview began with a discussion of industrial land intensification where participants were asked to articulate their views on intensification and how they “define” industrial land intensification. These discussions were broad in scope; however, several common threads emerged.

#### *5.2.1 The Intensification Discussion in Metro Vancouver*

Metro Vancouver and NAIOP have been the groups raising the alarm on the region’s industrial land supply challenges and have also been leading the conversation on industrial land intensification. However, not all industrial land stakeholders are convinced that the situation is as dire as these organizations would have us believe. Several participants felt that the industrial land supply problem and the urgency for intensification have been overstated somewhat. The most recent industrial land inventories discussed in Section 2.2 would seem to support Metro Vancouver and NAIOP’s perspective. Digging deeper revealed several layers to this participant perspective on Metro Vancouver’s role in the intensification discussion.

First is the view that Metro Vancouver is overstepping in its role of regional planning authority. Metro Vancouver has been successful at raising the profile of the industrial land discussion and introducing protection for industrial land in the regional growth strategy.

However, municipal autonomy remains a strong force in the region, so while municipalities appreciate the supporting research, they begin to resist when Metro Vancouver attempts to force action on land use decisions generally, and industrial intensification specifically. Moreover, the region's municipalities are facing a host of other growth related challenges, such as affordable housing and sustainable transportation, and industrial land intensification is not a urgent concern for many councils.

PDC 1: "For most municipalities industrial intensification is not a pressing issue, not a top priority".

The second aspect of this view of Metro Vancouver's role is that not all industrial land stakeholders do accept intensification as the only or best way to address the industrial land supply challenges facing the region. PDC 1 and RP2 expressed the sentiment that the perceived need for industrial land intensification is not urgent. Alternatively, RP2 argued that getting the *protection* of industrial land supply right and focusing on doing intensive residential and commercial better is more important and will go a long way towards supporting industry in the region and mitigating the pressure on industrial lands. The view that intensification is not the only and best solution to the region's industrial land supply challenges stems from the fact that not all industrial land stakeholders are completely clear as to the objectives of Metro Vancouver's intensification agenda, which is to reduce demand for new supplies of industrial lands and associated pressures on agricultural land through the more productive and efficient use of existing industrial lands.

### *5.2.2 Objectives of Intensification*

The topic of industrial land intensification has received a great deal of attention in the Metro Vancouver region in recent years; however, the ultimate objective of intensification remains unclear to many stakeholders. Part of the confusion stems from how the discussion of industrial intensification started and has evolved over time. Several participants recalled that the earliest conversations with Metro Vancouver on industrial land intensification were focused on multi-storey industrial development. The response to the idea of multi-storey industrial development, then and now, was that the development economics generally do not support it. While the conversation has evolved since, many participants still view "intensification" through this lens. When the topic of industrial intensification is raised, they hear "multi-storey industrial" and initially take a defensive position in the discussion.

The consensus from participants was that multi-storey industrial development is not the solution to the region's industrial land supply challenges. Land values and lease rates in Metro Vancouver simply do not support the higher development costs associated with this form of development. In addition to the high development costs, multi-storey industrial building forms can impact and limit the operations of ground floor users due to the additional structural requirements of multi-storey construction. Making multi-storey industrial economically viable would mean adding significant accessory office and retail users (i.e. non-industrial users) to industrial lands.

PDC1: "The only way you're going to get multi-storey is to add office, but Metro Vancouver says 'no, that's not the way we are going, we only want office as an ancillary use'. That's the dilemma".

The introduction of significant numbers of non-industrial users to industrial lands would be contrary to the region's land use policies and designations. To be in line with regional land use policies, multi-storey developments incorporating significant office or retail components would need to be located in Mixed Employment or General Urban areas, not Industrial. Without multi-storey industrial on any significant scale, single-storey industrial development will continue to be the dominant building typology in Metro Vancouver's industrial areas, which has important implications for the region's intensification efforts.

The intensification discussion has since moved beyond this narrow interpretation of industrial intensification as solely multi-storey development. However, the definition of intensification still remains unclear to many stakeholders. There was a consensus among participants that industrial land intensification is more than just built-form (and FAR) and that intensification means different things to different sectors depending on user needs and characteristics. There was also agreement that the expanded definitions and measures of intensification included in the prototype tool were a good addition to the intensification discussion. Some participants advocated for an even broader definition of intensification.

DEV 2: "You've gone a little bit beyond FAR, site coverage, but I believe that intensification can go significantly beyond that".

DEV 2 advocated for expanding the measures in the tool to include more qualitative measures of intensification, moving beyond just measures that are more easily quantified.

For some industrial land stakeholders, the objective of industrial land intensification is about jobs – creating more opportunities for more jobs on industrial lands. RP 1 stated that

Metro Vancouver's perspective is that jobs are not a priority of industrial land intensification efforts. The goals of *Metro 2040* seek to locate the majority of new jobs in the other urban land designations, close to urban centres and frequent transit. Rather, he noted that the objective of intensification is to optimize the potential to intensify industrial activity on industrial lands.

RP 1: "A lot of politicians think jobs, jobs, jobs. That's what drives them, and of course they are thinking about jobs for their community and that's an appropriate thing, but then that often leads to the types of uses that are taking up the industrial land base that could actually be located somewhere else".

One of the challenges with industrial land intensification is that its objectives are quite broad and can mean different things to different groups. What is the goal of intensification? Is it more jobs or economic output? Is it more spatially efficient use of industrial land or bigger industrial buildings? Or is it a framework that makes all of the above possible? DEV 2 noted that some of the objectives of intensification and the form they take could conflict with one another. For example, bigger buildings with higher site coverage reduce the spaces available for loading, manoeuvring, and parking of trucks and trailers; multi-storey buildings can limit ground floor uses; higher employment densities can put additional demands and pressures on industrial lands; and investments in technology to boost economic throughput can potentially eliminate jobs. The intention of the prototype multi-variable tool is to highlight some of these contradictions and trade-offs so that industrial land stakeholders and decision-makers can better understand the implications of policy decisions.

### *5.2.3 Industrial Land Stewardship and Protection*

There was broad support among interview participants for the protection measures introduced by Metro Vancouver in *Metro 2040*. Some thought that the measures went a little too far, others not far enough. Overall, participants saw this as a positive step towards stabilizing the region's industrial land supply. Without this kind of protection industrial uses will be outcompeted by other land uses. Several participants noted the continuous struggle that municipalities face trying to keep commercial users out of industrial areas. Commercial uses bring more activity to industrial area; however, this activity also brings traffic, demands for services and amenities, and creates conflicts with actual industrial users, which can work counter to intensification and broader regional sustainable development objectives. In addition, incursion and competition from commercial users can raise industrial land rents and land values. Metro Vancouver continues to explore the idea of greater degrees of industrial land protection.

However, several participants expressed their opposition to the creation of any type of industrial land reserve akin to BC's Agricultural Land Reserve. Opposition to this idea was strongest from the developers, development consultants, and brokers interviewed.

There are some uses that need to be located in industrial land for compatibility and operational reasons, and if non-industrial users infiltrate industrial lands these uses can be displaced. Participants also referred to city-serving industries as being particularly vulnerable to the limited industrial land supply. These are industries that need to be located in the region for one reason or another and cannot simply pick up and move if land prices or lease rates get too high as they serve a specific location or function. Protection and intensification efforts are particularly important for these types of industries. RP 1 contrasted these city-functioning industries that need to be in certain strategic locations with enterprises that can locate anywhere in the region or elsewhere. If these city functioning industries are forced out of the region, the result can be operational inefficiencies and extra-traffic in the region.

RP 1: "...that's why it is so important to have industrial land in Vancouver [Metro Core], because downtown has to function, and if distribution, logistics etc. are forced out, then they have to go out to outer areas in the region, and that creates inefficiencies and a lot of extra traffic. So location becomes important, and access to transportation"

Many of these city-serving industries are truck dependent and the operations of truck dependent industries are difficult to intensify through larger built form.

DEV 1: "Some industrial land will always be low intensity [built form] and there will always be a need for these types of industries – city serving industries".

Similarly, many of the industries associated with the port and Metro Vancouver's role as a gateway cannot intensify through larger built-form. Intensification for these industries means more activity, more trucks, more TEUs<sup>13</sup>, but not larger buildings. As the region's gateway function grows, so too will transportation, distribution, and logistics functions, more uses that cannot easily intensify through higher FARs.

BR 1: "We are going to be largely a gateway to Canada for the foreseeable future. We are going to need some distribution space".

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<sup>13</sup> TEU stands for Twenty-Foot Equivalent and is a standard measure of cargo capacity based on the size of a standard shipping container.

Industry in Metro Vancouver must serve both local needs as well as the requirements of the regional, provincial, and even national economies. How the region defines, measures, and regulates industrial land intensification will have implications beyond the just Metro Vancouver.

#### *5.2.4 Industrial Competitiveness*

Part of Metro Vancouver's motivation to protect industrial land and to pursue intensification policies is to ensure that the region's industrial lands can support a sustainable economy. Many of the apprehensions that stakeholders have over the protection measures and intensification policies often come back to concerns about competitiveness. The perspective of these stakeholders is that industry in the region already struggles to stay competitive and the introduction of additional policies or regulation could potentially further impact that competitiveness. Policies that protect the industrial land supply give stability to industrial land prices and rents and help industry in the region remain competitive. However, there is concern that the introduction of industrial land intensification policies could potentially add additional requirements and costs that could negatively impact the competitiveness of industry.

Participants also expressed concerns over the flight of industry to areas outside of Metro Vancouver, such as the Fraser Valley, Alberta, and the USA, where industry does not confront the same high land prices of Metro Vancouver. One participant stated that the priority for many industrial users is efficiency, so they don't care where they set up operations.

PDC 2: "They can go to Long Beach, SeaTac/Port of Seattle, they can go to other ports along the west coast, they can keep goods inside containers and ship them to Calgary".

If the cost of having operations in Metro Vancouver begins to impact their competitiveness, some users will simply move their operations. Some participants were more concerned about this pattern than others.

PDC 1: "It's cheaper for them and what's wrong with that? By them leaving it is not like you have a bunch of [excess] land or that you are losing business. Different businesses will come in and take up the space because they are prepared to pay the higher dollars for it".

MP 2 and 3 noted that the same pattern can be seen *within* the region, where industry moves from the older, more urban areas of the region to the newer more suburban areas, with the vacated urban industrial locations subsequently being filled by new opportunities.

The primary concern that participants expressed in this discussion was that the introduction of additional protection and intensification policies could further impact the competitiveness of industry in the region. For example, poorly designed intensification policies could directly or indirectly raise development or operating costs, resulting in more industrial users having to leave the region for cheaper locations.

DEV 1: “You have to be careful about the types of policies you bring in. Ultimately you are dealing with end tenants. They dictate what they need. You can only mould them so much before they move on”.

Industrial users are cost sensitive and many are also mobile and will move if the costs of development or operations in certain locations become prohibitive or impact their competitiveness.

#### *5.2.5 Market Forces, Developer Expertise and the Role of the Planner*

As was noted earlier, some participants felt that local governments do not necessarily see industrial land intensification as a priority. Several participants indicated that the development community is not scrambling to intensify industrial land use either.

PDC 2: “If there was money in it [intensification], they would be doing it. Always remember that. The market will always catch up”.

PDC 2 went on to state that there is not any rapid movement towards intensification among developers, as the market doesn’t currently support it. Another reason for this is that municipalities do not have much to offer in the way of incentives for industry to intensify.

However, at the same time, numerous participants believed that intensification is already happening to a certain degree. A statement commonly heard from participants was that industrial intensification is already occurring naturally, and several argued that development trends support this claim.

BR 1: “The typical building ceiling height 20 years ago was 20ft. The latest building being built in Boundary Bay is 36ft. So in essence, in 20 years we have doubled our intensification. Industry itself has been intensifying on its own”.

The prevailing view of participants involved in industrial development was that industrial land will become more intensely used over time, provided that municipalities do not do something to make this impossible, such as rezoning industrial lands to other uses. Several planners also acknowledged the potential of market forces to drive industrial land intensification.

MP 3: “One would think that with the high cost of land that a strong incentive to intensify already exists – high land costs resulting in more intensive development”.

Many participants stressed the role of market forces on industrial land intensification, arguing that the market will respond with more intense industrial development if the demand for such forms of development exists.

PDC1: “As the price [of land] goes up, as land becomes in shorter supply, a couple of things are happening: it is forcing industry to become more efficient, to make better use of what we’ve got; [and it is] forcing out some low-grade users. As time goes on those uses will go away in favour of productive uses”.

Participants that are directly involved in industrial development (developers, brokers, and consultants) had more confidence in the ability of the market to respond to the industrial land supply challenges facing the region.

PDC 1: “I have a little more faith in the market than Metro Vancouver does, that over time, there will be more efficient use of the land through market forces”.

Conversely, the regional and municipal planners interviewed were more supportive of policies and regulation that help to *push* the market towards more intensive use of industrial land.

#### *Developer Expertise*

A common theme heard from participants of all professional backgrounds was that when it comes to industrial development, developers know what they are doing. Developers are the experts in this area and will nearly always attempt to build as much leasable space (building) as possible based on the site constraints, zoning bylaws, and users’ needs and preferences.

DEV 1: “We tend to build as much building as possible”; “Tenant requirements dictate development...can’t put a square peg in a round hole”.

Participants that work in development or with developers felt that developers and industrial users are often in a better position to know how to maximize the utility of an industrial site than planners or municipal decision-makers.

PDC 2: “Sometimes the developers and the end users know far more than the City ever will about how to build an industrial building – what is appropriate [for a given site], what will make the most money, what will generate the most taxes, what will create the most jobs”.

The planners and planning consultants interviewed also agreed that developers are experts that know how to maximize the use of industrial land based on the development economics and the constraints that they face.

RP 1: “Most businesses are pretty conscious of these things because of the cost of land. If they are wasting anything [land], then that is often just an extra cost or potential revenue lost. So, most developers are pretty savvy with how they use a piece of land”.

PDC 1: “When you talk to industrial developers, they know how to lay out industry. If there was a better way to do it, they would know about it”...Developers are not idiots. They don’t need to be told to make efficient use of the land. They get that, and they do it down to the square inch”.

Nevertheless, the developers interviewed expressed concern that the introduction of intensification policies or requirements could push for specific forms of development or intensification that may not work for end users.

#### *Role of planners*

The planners interviewed appreciated the expertise of the development community but were also quick to defend the important role planners and planning play in industrial land development and intensification.

RP 1: “Yes, developers try to be efficient, but our role [as planners] is to provide some further context and let them know what we would expect”.

Planners can help anticipate trends, shape policy, and advance progressive planning practices. While the development community believes that market forces will produce intensification, planners feel that policies and regulation could help the region move towards achieving intensification objectives faster.

Several participants cautioned against planners getting too far ahead of developers or trying to force the market through policy and regulation. These participants referred to historical examples from Burnaby where planners failed to understand the market and the needs of industrial users, with the result being poor outcomes from both planning and development perspectives.

### *5.2.6 Unique Needs and Characteristics of Industry and Industrial Development*

The unique needs and characteristics of industry and industrial development was a reoccurring theme in these discussions. Industrial development differs a great deal from residential and commercial development. Some industrial developments can be very user specific or customized, which makes the future adaptability of some buildings difficult. This also means that a site that is configured to maximize intensity for one user may not work at all for another user. There are building-intensive industries that make use of more building, and others that don't require much in the way of building at all. It was noted by several participants that the industries in the region that are growing and expected to continue to grow are those related to the region's port functions – transportation, warehousing, logistics – and these sectors also happen to be quite land-intensive.

PDC 3: “The difficulty is that we have so many of these types of uses [warehousing, logistics]. I mean that's our economy. Transportation, port related sectors are growing and these sectors also tend to be land intensive”.

Industrial developments are also unique in that some users plan for future expansion on-site, meaning that in the short-term, the intensity of built-form and activity relative to the size of the site may be relatively low. The option of growing in place is important to some users because moving is very expensive. Finally, several participants made the point that within Metro Vancouver there are a number of industrial sub-regions that are each distinct and cannot be painted with the same brush. The key message from this discussion was that it is difficult to develop intensification policies, measures, and tools that support intensification efforts when the needs of industry are so diverse.

## **5.3 Developing the Tool and Tool Graphic**

Participants were asked to comment on the measures that were selected for the tool and on the evaluation scales that were developed for each. Also, since the tool was designed to communicate intensification visually using a graphic, feedback was sought from interviewees on the design of the tool graphic. The following sections summarize what was heard from participants on the development of the tool and the tool graphic.

### 5.3.1 Tool Practicality and Getting Data

As discussed in Chapter 3, the criteria for selecting measures for the prototype multi-variable tool were practicality and the capacity to illustrate different aspects of intensification. The prototype tool is intended to be easy to use by all industrial land stakeholders. This means the tool must be easy to understand and to populate with data. Several participants commented that the prototype tool as it is currently constructed is quite data intensive.

PDC 1: “[It is a] helpful tool, but it is data intensive. Municipalities will ask, ‘how are we getting all of this [data]’”.

PDC 1 added that industrial land stakeholders would be interested in the tool if the data could be obtained easily.

Some of the data required by the prototype tool is readily available from municipal sources or through simple visual surveys. Municipalities will have good data on parcel size, FAR, site coverage, ceiling height, and number of floors from building permit data and development applications. Municipalities would also have good data on parking and it would be relatively easy to determine whether sites have provided excess parking, have been permitted to provide less parking than that required by zoning, or if parking is structured (underground or rooftop). Determining the parking for older industrial sites could be more difficult as it may be challenging to differentiate between employee/customer parking and loading/storage areas on some sites.

PDC 1: “Many businesses will have their designated parking but they will also have areas for outdoor storage, loading, etc. and it can be difficult to tell the difference, particularly for older sites. For newer developments it is more straight-forward”.

Data for the Outdoor Storage/Production measure could also be obtained from permits and applications. However, much like the parking measure, distinguishing outdoor storage/production areas from other areas of the site could be difficult for older sites. In addition, since this measure is a combination of site usage and activity, determining what actually qualifies as outdoor storage/production *usage* is a challenge.

PDC 1: “Outdoor storage can sometimes have nothing to do with the actual business. Landowners and business owners are entrepreneurial and may lease this space to others. This [level of usage] can also fluctuate, depending on the time of year etc.”.

The challenge of determining the level of outdoor usage/production could potentially be addressed through a visual survey or through aerial photography. However, determining the

quality or efficiency of outdoor usage would require an additional assessment and scale. This is discussed later in this chapter in Section 5.4.

Getting data for the remaining measures is not as straight forward. Information for the Diversity of Businesses measure could be obtained from business license data. However, participants pointed out several challenges with this. First, business license data may not correspond with what is actually occurring on the site.

PDC 1: “They [municipalities] will know the uses [from business licences]; however, this data might not be consistent with what is happening on the ground. It is difficult to track non-conforming uses in industrial areas. [You] would have to do site inspections”.

This same participant also pointed out that a particular business might operate multiple business entities out of one site, which could skew the results of this measure for certain sites.

Participants flagged Employment Density and Throughput as measures for which getting quality data is particularly difficult. One participant pointed out that some municipalities require businesses to provide employment figures as part of their business license applications. However, this same participant noted that this is not done consistently across the region’s municipalities and that the figures reported may not be accurate or representative of actual employment levels. Alternatively, employment data could be obtained through surveys of individual businesses. This approach would require the cooperation of individual businesses that may be reluctant to provide detailed information on their staffing.

Generating data for the throughput measures included in the tool would prove to be even more challenging. There was a consensus among participants that getting data for the throughput measures would be very difficult and in some cases impossible. It was suggested that the primary barrier to getting this data was privacy and the reluctance of businesses to share operational or financial details.

RP 1: “Business specific data [employment, throughput] will be hard to get, primarily for privacy reasons”.

Another participant pointed out that even if some businesses were willing to cooperate, it is likely that there would be too few to allow for adequate comparisons.

PDC 1: “Business throughput figures – you will never get these on a wide enough scale to allow for comparisons”.

MP 1 also noted that different businesses and industries measure their ‘throughput’ differently, so even if it could be obtained the data may not be comparable. While participants were in

agreement that getting some of the business specific data required for throughput measures would likely prove impossible, most also noted that including these measures in the tool for discussion purposes has value.

### *5.3.2 Difficulties with Measures*

Getting the data necessary to support the tool was not the only challenge that participants identified with the construction of the prototype tool. First, several participants felt that there was some duplication or overlap with some of the measures. Specifically, they were referring to three measures – FAR, Ceiling Height, and Number of Floors. In the view of these participants the Number of Floors measure was redundant. FAR measures the floor area of any multi-level building and Ceiling Height captures the additional productive space of higher ceiling buildings. While Number of Floors is a quick way of assessing relative intensity of built form, it is ultimately measuring the same aspects of intensity that are evaluated by FAR and Ceiling Height. Some participants were concerned that including all three would give too much importance to measures of built-form intensity relative to other measures of intensity.

Secondly, most participants were quick to notice that the measures in the multi-variable tool are not weighted in any way. In the prototype tool each measure has equal weight. The tool was initially developed to be an analytical tool that could help to communicate the multiple definitions and dimensions of industrial land intensification. As discussed in Chapter 3, with these types of tools the variables are not typically assigned relative weights. However, with the addition of the intensification score to the tool, a strong case was made for requiring each measure to be weighted in some fashion.

PDC 2: “You are going to have to weight them in my opinion because there is no comparison between that and that [referring to two different measures]”

The relative importance of measures varies widely. For example, FAR and Ceiling Height are arguably stronger indicators of industrial land intensification than is Parking Innovation. One participant commented that recognizing that different measures of intensification have varying degrees of importance is only the first step. The next issue is that the relative importance of each measure differs between industrial sectors. For example, Outdoor Storage/Production is important to truck dependent industries, whereas Ceiling Height is of higher importance for warehousing.

Participants agreed that developing relative weights for each measure would be extremely challenging, and getting agreement on these weights from industrial land stakeholders would be even more difficult. Alternatively, RP 2 suggested that a simpler way of indicating relative importance could be developed by assigning measures deemed to be ‘more important’ double the area in the tool graphic to show relative importance. Another suggestion was to assign each of the intensification categories – built form, site usage, and activity – equal weight or visual space in the tool graphic. These are intriguing ways of adjusting the tool to show relative importance without taking on the challenge of weighting each measure relative to one another. However, these alternative methods of weighting the tool would be far from perfect and it would not solve the issue of fairness between sectors. Developing a tool for each industrial sub-sector – a sector specific tool – was suggested by numerous participants as a way of retaining the intensification score but also allowing for more equitable comparisons. This is discussed in more detail in Section 5.5

### *5.3.3 Developing Evaluation Scales for the Measures*

As discussed in the tool development section, the measures and the evaluation scales for each were developed through a review of the literature and an iterative process with the MDP project committee. However, if the prototype tool were to be used by industrial land stakeholders as part of the region’s industrial land discussion and intensification effort, then a different approach to developing the scales would be required. Participants agreed that the scales would have to be developed in collaboration with stakeholders, but also that there would likely be divergent views in such a process.

RP 1: “There would likely be significant disagreement between stakeholder groups if deciding what is low, medium, or high, or even whether low should be high and high should be low”.

RP 2 proposed the use of the Delphi technique or a roundtable process to develop the scales and to get buy-in from stakeholders.

Several participants commented that a finer-grained scale, such as a 5-point scale rather than a 3-point scale, would capture more detail and better illustrate differences between sites. As discussed in Section 3.5, the 3-point scale was chosen for its simplicity. Future versions of the tool could certainly make use of an expanded, finer-grained scale.

It was also suggested that some scales could benefit from the addition of a qualitative element. For example with Outdoor Storage/Production, it may be relatively easy to identify the amount of *area* on a site that is dedicated to outdoor storage/production. However, it is much more difficult to measure the quality or efficiency of this use. Some outdoor areas are heavily used, others lightly used, and some used only at certain times of year. Developing a qualitative scale to supplement the quantitative scale could help capture this additional information and better assess the efficiency of site usage. The scales of each measure are discussed in more detail later in Section 5.4.

### 5.3.4 The Tool Graphic

For the multi-variable tool to be effective as an analytical tool or composite index using the intensification score, it needs to be as accessible as possible so that all stakeholder groups and the general public can utilize it. It also needs to be able to illustrate intensification data in a clear and easy to understand manner. Participants were asked to explain the aspects of the tool graphic that they found difficult to understand, that they misinterpreted, and that they felt could be improved. (See Figure 5.1 for a sample of the tool graphic). What follows is a discussion of this feedback, which was subsequently used to develop a refined tool graphic (presented on Chapter 6).

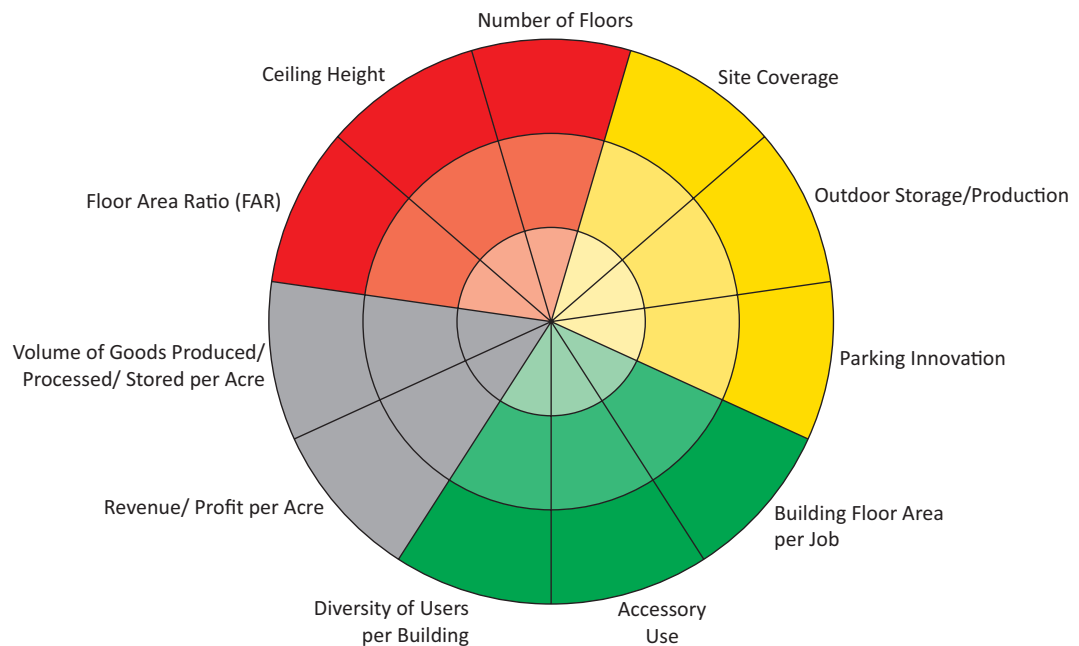


Figure 5.1: Prototype tool graphic

### *Intuitiveness and Legibility*

When creating the tool graphic, an effort was made to make the tool as simple and easy to read as possible. As discussed in Chapter 3, when constructing multi-variable tools it is important to balance simplicity and rigour. The tool is intended to serve a diverse group of industrial land stakeholders and the ability to read graphical representations varies between individuals and professionals. RP 1 made the point that not everyone is graphically oriented. Some will just not be able to easily interpret the graphic, and others may read it in unintended ways.

RP 1: "In my experience, a lot of people get really confused when they look at visuals like this. Some people are really graphically oriented, others aren't. Some people will look at this and not get it. Or like me, might view it backwards".

This participant believed this lack of graphical literacy not only exists within the general public, but also extends to planners and other professionals involved in industrial land development.

RP 1: "And for the most part, a lot of planners aren't very technical in their thinking, in terms of modelling, and interpretations of graphics. So many would look at this and back away because it may look too complicated."

The sample multi-variable tool applications reviewed by interview participants included a short description on how to read the tool graphic. Approximately half of interview participants immediately understood the tool intuitively, and others only after reading the description of the tool. Participants who did not find the tool graphic intuitive, interpreted the graphic in ways that were not intended. Most participants understood the graphic after having read the "Reading the Tool" instructions. However, to be effective the tool needs to be more easily interpreted on its own, without a detailed description or instructions on how to read it. Revised versions need to make the tool more intuitive and less ambiguous.

### *Orientation*

One way that participants differed in their interpretation of the tool graphic was with the orientation of the data or evaluation scales that indicate a high or low intensification score. The scale for each measure extends outwards from the centre, meaning that the farther away from the centre that a measure scores, the higher the intensity score. The orientation of the scale was reinforced using a colour gradient, with darker colours indicating a higher intensity score. Some participants interpreted the orientation as designed. (See Figure 5.2).

RP 2: “No, the [orientation] is the right way. The more intense scores have larger areas and therefore more visual impact”.

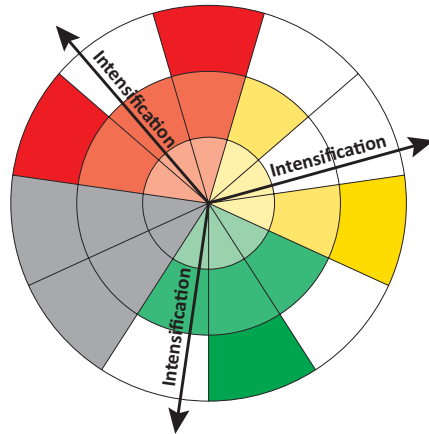


Figure 5.2: The intended way to view the tool graphic

Several participants viewed the graphic in reverse (or the opposite to how intended), with higher intensification scores in the middle, like a bulls eye. (See Figure 5.3).

RP 1: “I tend to think more like a dart board, where the higher scores are on the inside and more concentrated around the centre. So, intuitively, I go the opposite direction. In this way it is kind of metaphoric: it is on target”.

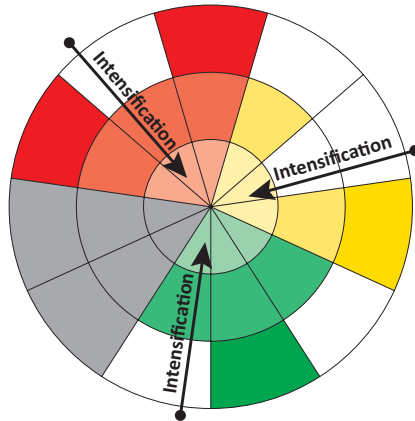


Figure 5.3: The Incorrect way to view the tool graphic

BR 1 also did not read the tool as intended:

BR 1: “To me it didn’t work visually. I couldn’t gauge what out-performed or not. Visually, it did not have the impact that I think that it should have. Needs to be clear”.

Several interviewees offered suggestions as to how the orientation of the intensification scales could be made less ambiguous. One participant proposed running text or labels out from

the centre of the graphic to give a clear indication which direction and which measures are more intense. Alternatively, arrows or numbers could be used.

Another participant also recommended making the three intensification categories within the graphic more explicit using labels. Several participants appreciated the secondary graphic that showed the intensification score (Figure 5.4). However, as noted some participants found it difficult to match the two graphics since the circular visual did not have corresponding labels, relying only on colour to indicate the intensification categories. A refined tool should make this relationship more clear with consistent use of colour and labels (Figure 5.5).

Intensification Score	
Built Form	8
Site Usage	4
Activity	7
<hr/>	
<b>TOTAL</b>	<b>19</b>

Figure 5.4: Original secondary graphic – Intensification Score




Intensification Score	
 Built Form	8
 Site Usage	4
 Activity	7
<hr/>	
<b>TOTAL</b>	<b>19</b>

Figure 5.5: Sample modified secondary graphic – Intensification Score

One participant suggested an imaginative way of presenting the intensification score. MP 1 felt that with the secondary intensification score graphic, one's attention is drawn to the total score rather than the scores of each of the intensification categories, thus losing some of the impact and detail of the multiple measures. This participant suggested that the scores could be presented as a 'profile' rather than a total score so that the finer-grain of the intensification sub-category scores would be preserved. This profile could be presented as a unique triangle graphic, borrowing from a type of graphic used in geology. (See Figures 5.6 and 5.7 below).

MP 1: “So instead of a score [of 16], it might be a kind of profile. So a 6/7/3 profile is different than a 7/4/7 profile. There could even be a separate visual, a triangle visual...The result of the ‘profile’ is a unique signature as opposed to something that is a blended score”.

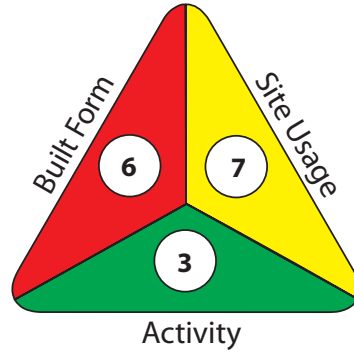


Figure 5.6: Alternative Secondary Graphic – Intensification Score

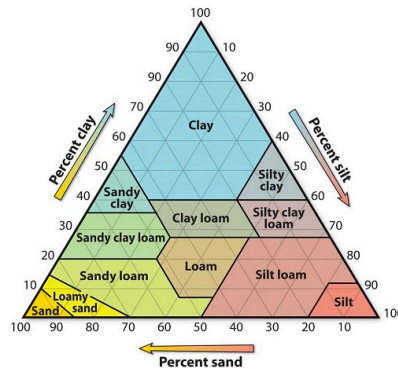


Figure 5.7: Soil Texture Triangle Graphic (Source: <http://soils4teachers.org/physical-properties>)

This approach could be very useful as patterns could be recognized within specific industrial sub-sectors, which could be used to set targets.

#### *Tool Graphic Colour and Intensification Categories*

For several participants, it was the use of colour that caused them confusion. MP 2 and MP 3 thought that each division of colour had a different meaning or value because of the colour gradient. These participants and several others agreed that this problem could be addressed by having a solid colour from the centre to the outside. This would bring the tool in line with the graphic for the SVM model discussed in Section 3.2.

Colours were used to differentiate between the three intensification “categories”. Bold primary colours were chosen – red, yellow, green. (See Figure 5.8).

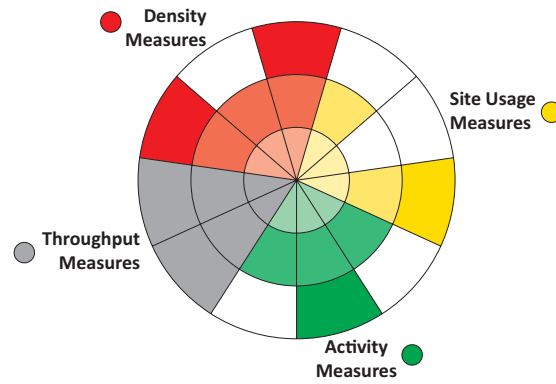


Figure 5.8: Prototype tool intensification categories and corresponding colour

No consideration was given to the ‘meaning’ of each colour, other than to differentiate between the different categories of intensification. However, BR 1 pointed out that colours have meaning, and the colours that were used, red, yellow, and green, carry specific meaning that significantly impacts how the tool is interpreted. For example, red can mean stop/bad and green can mean go/good. Reds can draw one’s eye and can indicate relative importance when set next to yellows and greens. Green even has environmental or “green” connotations that were not intended to be part of the tool graphic.

This oversight can be corrected in future versions of the tool by choosing just one colour family, with different shades to represent the three intensification sub-categories. As mentioned, some participants found the use of colour gradient confusing. However, this was a minority view and colour gradient remains a useful way of reinforcing the orientation of the intensification scales. The gradients are also important when considering how the tool will look when printed in black and white.

One challenge faced when developing the prototype tool graphic was how to illustrate and differentiate between measures that score zero or nil and measures for which there is no data available. In the prototype tool, an intensification score of zero was represented by blank, white space. Two measures were included in the tool for discussion purposes for which there was no data to generate an intensification score – *Volume of Goods Produced/ Processed/ Stored per Building Area* and *Revenue/ Profit per Building Area*. For these measures without data the entire space was greyed-out. The measures without data were explained in the tool description but were not labelled as having no data in the prototype tool graphic.

For some participants it was not immediately clear that the grey-areas in the tool were the measures for which I did not have any data. (Figure 5.9).

PDC 3: “I look at this [the tool] and I would get rid of the grey and leave it totally white, because, when I look at that [the greyed area] I think that is the important thing”.

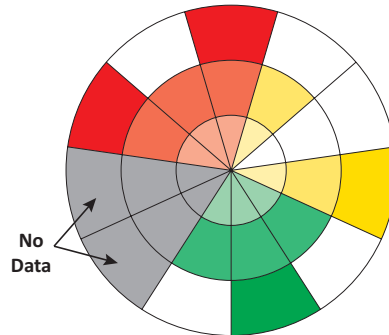


Figure 5.9 Intensification Graphic - No Data

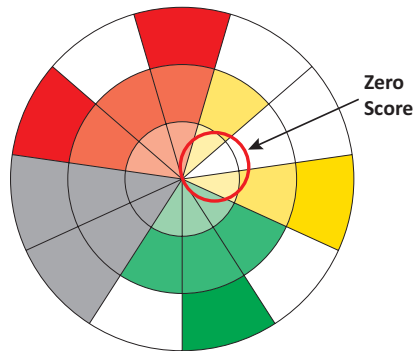


Figure 5.10: Intensification Graphic - Zero Score

The white space in the tool was intended to help illustrate where sites scored zero on a measure (Figure 5.10). However, this comment highlights the importance of clearly differentiating between measures that score zero and measures for which there is no data available. Retaining the white space to indicate zero or nil scores is important. However, clear labels could be added to the measures without data to clearly distinguish these measures from the others.

## 5.4 Intensification Measures

Participants were asked to comment on the measures that were included in the prototype multi-variable tool and on the potential of these measures to evaluate and communicate the various forms of intensification. Some of the measures selected for the tool were widely accepted, while others were more contentious. While there were divergent views

on some of the measures included in the tool, overall those interviewed were supportive of the idea of using multiple measures to evaluate the various aspects of intensification. Some participants believed that in the past, discussions of industrial land intensification were too fixated on built-form and multi-storey industrial. The consensus was that there is no single measure for industrial land intensification, because the form of intensification will look different depending on the industry. RP 1 commented that the tool helps stakeholders look beyond just the built-form aspects of intensification and that the multiple measures provide a way of systematically thinking about intensification. RP 2 stressed the importance of finding a way to quantify and track what is happening in industrial lands:

RP 2: “The idea of actually trying to quantify or describe what is going on in industrial areas is really important, and the tool is one way of doing it. Overall I really like the tool and I really like trying to uncover what it is that happens on industrial land”.

Participants were also invited to suggest alternative and additional measures of intensification for consideration. The sections that follow summarize what was heard from participants.

#### *5.4.1 Density Measures*

##### *Floor Area Ratio (FAR)*

All participants were in agreement that the Floor Area Ratio (FAR) measure was an essential part of the multi-variable tool. FAR is a measure that is universally accepted as a measure of built-form intensity (density) and it is a density control tool that many municipalities include in their industrial zoning bylaws.

FAR does effectively measure density and is best suited for multi-level buildings. However, FAR fails to account for building volume and specifically the additional productive space created by higher ceilings. For example, the FAR of two buildings with identical footprints will be the same even if one building has 20ft ceilings and the other has ceilings that reach 36ft. In reality, the building with a 36ft ceiling is a significantly larger building and arguably makes more intense use of the site. DEV 2 stated that with the ability to build up to 36ft and beyond makes the economics of building higher FAR buildings (multi-storey) even more difficult. Why would a user or developer pay the extra expense for a multi-storey structure when the same amount of productive space can be had within a larger volume of a single-storey building? BR 2 argued that for many industries FAR is a non-statistic, stating that for sectors that cannot

operate in multi-storey buildings, ceiling height and site coverage are much more important measures when seeking to maximize the built-form on a site.

Several participants, while acknowledging that FAR is not necessarily the most important measures of industrial intensification, argued that it continues to be a relevant measure since mezzanine levels are increasingly common in industrial developments. DEV 2 noted that in almost all new developments, any office components are two storey or mezzanine as the ground level productive space is too valuable as parking, storage, or outdoor storage/production to use as office space.

FAR is used in industrial zoning bylaws to control density, but industrial developments in the region rarely meet or exceed these maximums. Eric Vance & Associates (2011) found that FAR maximums were not a constraint on industrial land intensification currently. Additionally, there is a trend in the region towards controlling industrial built-form through setbacks and building heights (Vance, 2011). To encourage higher density industrial development, the District of Mission introduced FAR *minimums* in two of its industrial zones. PDC 1 cautioned against going this route as minimum FARs could potentially drive development and certain industrial uses to neighbouring municipalities. RP 2 added that it is important for municipalities to not try to engineer higher FARs when the development economics don't support the density or the form does not suit the end user.

Participants agreed that while FAR is an essential component of the tool, it is not the best measure of intensity for industrial land. This view underscores the importance of additional measures of intensity.

RP 1: "FAR is important, but it is also important to look at things systematically by including other measures".

FAR cannot be the only measure of industrial land intensity, especially if the goal is to bring greater balance to the understanding of intensification by including concepts beyond the built-form. Participants shared the view that when thinking about industrial intensification, using a range of measures is useful, and including FAR in that list is essential.

### *Ceiling Height*

The current trend in industrial development in the Metro Vancouver region is towards higher ceilings, particularly for warehouse operations (Eric Vance & Associates, 2011; Metro, 2012a). Historically, the typical ceiling height was 20-24 feet, but now up to 36 feet is the norm

and 40-50+ feet is now possible (Eric Vance & Associates, 2011). BR 1 argues that intensification through higher ceilings is already occurring and has been for many years.

BR 1: “The typical building height 20 years ago was 20ft. The latest building being just being built in Boundary Bay is 36ft. So in essence, in 20 years we have doubled our densification [intensification]. So industry itself has been densifying on its own”.

This trend is due in large part to advancements in racking and storage systems and the resulting increase in volume means more intensive use of a site for a given level of site coverage. Numerous participants commented that higher ceilings are a way to maximize the use of a given floor plate.

PDC 1: “Even with a 1-storey building form you can get a lot of intensification by just building up”.

Higher ceilings are particularly important for sectors such as warehousing that cannot realistically intensify through multi-storey buildings.

ACA 1: “I think the one thing to think about with the number of floors is that high ceilings that are used for storage, where they have lots of advanced pickers and stackers [racking systems] and that sort of thing, that can be very intense”.

The barrier to higher ceilings in the past has always been cost. It has always been possible to go higher, but the materials, engineering, building foundations, and racking equipment were not always economical for all developers or industrial users beyond a certain height. In recent years the development economics have shifted in favour of higher ceiling structures. As costs have changed, tenants have been more willing to take advantage of the additional vertical space. To access the additional space expensive new racking, stacking, and retrieval systems are required. The higher development and equipment costs are offset by the additional economic throughput potential of the building.

The shifting development economics that are making higher ceiling structures more economical are at the same time making it even more unlikely that multi-storey developments will become commonplace.

DEV 2: “Why would you do that [build multi-storey] when you can now build to 36 ft high and you’ve got equipment and automation that allow for less jobs, less parking”.

The combination of higher ceilings and specialized equipment to access the higher vertical space provides equal or more opportunity for intensification than multi-storey industrial buildings for many sectors.

One challenge with higher ceiling industrial buildings is that not all users need to or are able to make use of the additional vertical space created by higher ceilings. If the additional space is not being utilized, the higher costs associated with higher ceiling buildings – development costs, higher rents, higher heating costs, etc. – are not being offset by higher economic throughput. Therefore, like FAR, higher ceiling buildings are not the way for all sectors to intensify.

DEV 1 suggested that the scale for the Ceiling Height measure could be adjusted to ensure sufficient credit is given to developments that are really pushing the limits of ceiling heights and maximizing vertical space. BR 1 also suggests altering the scale to bring it in line with how the real estate industry tracks industrial vacancies

BR 1: “The only issue I have with Ceiling Height...we track in our vacancy reports ceiling heights under 21 ft and vacancy above 21ft. So what we have been saying in the past is that, how many of these buildings that are vacant are under 21ft, and we have found that 50% of our overall industrial vacancy is under 21ft”.

As mentioned, specialized equipment and technology is often required to make productive use of the additional space created by higher ceilings. These investments are significant, with several participants noting that the technology/equipment is often more expensive than the buildings themselves (PDC2, BR 2). The possibility of measuring investment in equipment and technology was discussed in Section 3.4.2. This measure was excluded from the tool for reasons of data availability and comparability. However, an argument can be made that higher ceilings, particularly those that are in the 30 ft + range can be considered a proxy for investment in specialized equipment and technology because without the equipment, the additional space could not be accessed.

### *Number of Floors*

The Number of Floors measure was designed to be a quick and easy assessment of relative intensity of built-form. Numerous participants commented that the Number of Floors measure equates to multi-storey industrial and it was stated repeatedly by participants from all stakeholder groups that multi-storey industrial is simply not feasible from a development

economics standpoint for most areas of the Metro Vancouver region. In addition, the operations of many of the region's industrial users are not compatible with multi-storey development.

BR 1: "With respect to Number of Floors, we're looked at it and I've run a bunch of financial models with different developers with actually constructing legitimate 2-storey warehouses, or having parking on the roof, and it just doesn't make economic sense right now because as I mentioned our land costs are the highest in Canada, but our lease rates [are the same as Calgary]".

Not all participants believed that multi-storey was so unrealistic in Metro Vancouver. DP 1 argued that there are areas in the City of Vancouver where multi-storey industrial is on the threshold of viability. However, this participant conceded that there are only a few small pockets of strategically located land where this would be possible and that such developments would likely rely on a mixing of uses.

Some participants felt that this measure treated high-ceiling, single-storey buildings unfairly, arguing that buildings with high ceilings should get credit for additional stories, since the additional vertical space effectively adds additional storeys to the building.

PDC 2: "Whenever you have a ceiling height over 24ft, you should count it as a second storey – 24ft-36ft weighted the same as a 2-storey building".

BR 1 commented that it is particularly unfair to assign a low Ceiling Height score to a high-ceiling structure because it is already receiving a low FAR score.

PDC 1 understood that this measure was intended to be a straight-forward assessment of relative intensity but noted that it could get more complicated once mezzanine levels are factored in (i.e. fractions of floors). Many mezzanine levels are installed and expanded after the completion of the original structure and it would be impossible to learn this from a simple drive-by visual survey.

BR 1: "What we are finding is that a lot of groups/users out there are mezzanining the whole level in there, so you look at a given building and you think that it is a 1-storey but it is actually two".

Numerous participants commented that between the FAR, Ceiling Height, and Number of Floors measures there may be some duplication or double counting. MP 1 and DEV 1 argued that Number of Floors is closely related to FAR and is going to be captured largely by the FAR measure. RP 2 expressed concern that including all three of these measures in the tool may

place too much importance on built-form and take away from the other aspects of intensification that the tool is trying to illustrate.

RP 2: “Something I think about is whether these altogether give too much attention to this aspect of density or intensity”.

PDC 4 agreed that there was some overlap between FAR, ceiling height, and number of floors, but also commented that that some overlap is not necessarily a bad thing.

PDC 4: “I think you need to break it out; you’re always going to have that [overlap]”.

However, overall, participants made a strong case for removing the Number of Floors measure from the prototype tool.

### *Other Measures of Density*

One measure related to industrial density and built-form that came up repeatedly in discussions was the value of land and improvements. Several participants suggested that land value and the value of improvements should be incorporated into the tool in some way. There is generally a positive correlation between land value and industrial intensification potential – when land values are higher, lease rates are also generally higher and thus can support higher intensity, more expensive investment in built form. Also, with higher land values there is an incentive to find every way to maximize the use of a site to justify the land costs.

MP 3: “Where land is cheap, people will build less intense, and where land is more expensive it forces people to intensify. It’s just the basic economic relationship”.

These participants felt that land value could be useful to determine intensification potential of a site or industrial area.

MP 1 suggested that the ratio of improvement value to land value could be a good indicator that a site is being used efficiently.

MP 1: “If somebody is willing to pay \$8 million for one of these sites and \$1 million for another site, maybe this is a reflection of what can be done or is being done on that site”.

Both MP 1 and PDC 2 felt that these figures would be valuable when seeking to track intensification over time to determine which industrial areas are intensifying faster than others.

MP 1: “If you have a site that is trending faster than its neighbours in terms of improvement value or land value, it is probably an indication of intensity of use”.

DP 1 noted that analysing the relationship between land value and the capitalization rate<sup>14</sup> could help to reveal the tipping point where certain forms of intensity or built-form are economically feasible. However, there could be multiple reasons for the increase in the relative values of industrial lands, with intensity of use being only one possible explanation.

MP 1 suggested exercising caution before including any measures of intensification in the tool that are linked in any way to assessed value. If the tool were to be used to support policies or linked to intensification incentives, a measure tied to assessed value could result in increased pressure from non-industrial users.

“This issue around incentives linked to assessed value is that the easiest way to jump your assessed value is to put uses that aren’t industrial on the site...[and this is not desirable] (MP 1).

#### *5.4.2 Site Usage Measures*

##### *Site Coverage*

Much like the FAR measure, the inclusion of Site Coverage in the prototype tool was not contentious. There was consensus among all stakeholders that this measure should be included in the tool as it is commonly used in municipal industrial zoning bylaws to control built-form intensity and is well understood by industrial land stakeholders. In addition, data for this measure is readily available and straightforward to calculate. However, RP 2 noted that due to the prevalence of single-storey industrial buildings in the Metro Vancouver, site coverage and FAR are often equal to one another.

Several participants discussed current industrial development trends, stating that in newer industrial developments in the region, 45-50% site coverage is generally the highest currently being achieved. When developments achieve greater than 50% site coverage it is usually due to lower or more flexible landscaping and setback requirements. There are a few locations in Vancouver, specifically in Mt. Pleasant, where site coverage ratios approaching and equal to 100% are being achieved. However, these remain an exception and are the result of high land values, urban location, limited surface parking, and high levels of accessory office/retail that support multi-storey developments. The developers and brokers interviewed

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<sup>14</sup> Capitalization rate, or Cap Rate, is the “unleveraged initial yield on the investment expressed as the annual Net Operating Income divided by the property price (or asking sales price)” (NAIOP, 2012).

stressed that the goal is always to maximize the built-form on site based on the user's needs and municipality's requirements.

DEV 1: "We tend to build as much building as possible. There are times that we will leave [room] for expansion, but very seldom would we take a 5 acre parcel, have someone build a 40,000 sq ft building on it at 20% site coverage. That's not something we do".

BR 2: "Because of the high land prices...to make the numbers work, you need more leasable space".

After probing a little deeper, RP 2 suggested that site coverage should be considered along with everything else that is happening on the site. For example, some industrial users make productive use of outdoor space while others do not, and some industrial zoning bans outdoor storage and production areas altogether.

RP 2: "What goes on in the outdoor storage areas often looks like nothing but it is very important to [some industries]".

So, this participant acknowledged that the Site Coverage measure is useful, provided there is also a measure to account for any productive use of the outdoor space. This is precisely what the Outdoor Storage/Production measure attempts to achieve.

### *Outdoor Storage/Production*

The site coverage discussion above helped to underscore the importance of including a measure in the prototype tool that can evaluate the intensity of outdoor and open space usage in industrial areas. For many industries, these areas are productive spaces that are integral to industrial operations. Numerous participants stressed that intensification is about more than built-form.

PDC 4: "Outdoor storage is essential for many industrial users, period. They need it for transportation use, warehouse use, trailer storage, container storage".

RP 1 commented that there are often more important considerations with respect to intensification than getting more building or employees on a site. In the view of this participant it is the types of uses, relevant sectors, and strategic locations that are more important, not how more building or people can be fit on a site.

DEV 2 pointed out that the region's historic heavy industries, such as lumber mills, were very intense but had very little in the way of built-form. PDC 3 made a similar comment about some of the remaining heavy industry in the region, citing the example of the Ocean's concrete

plant on Granville Island that makes very productive use of their outdoor space while having minimal building. PDC 2 argued that these heavy industry sites are better described as facilities, not buildings. These functions cannot be contained inside buildings and their facilities are customized to their specific needs. However, these heavy industries are no longer representative of the region's industrial users. All sectors have different needs, but most require a combination of building and outdoor space to support their operations.

Several participants pointed out that like density measures, the Outdoor Storage/Production measure only captures the intensity of site usage for some sectors.

"This [measure] only really applies to logistics and purpose built production buildings" (PDC 2).

The measure is particularly relevant to truck dependent industries that require outdoor space to park, load, and manoeuvre trucks and trailers, as well as other businesses that have storage and production requirements that cannot be housed within a structure. Industrial zoning bylaws distinguish clearly between outdoor and indoor uses and functions. However, for industrial users the distinction between indoor and outdoor productive space is less defined. PDC 2 described outdoor storage/production areas as extensions of the indoor operations:

PDC 2: "Outdoor storage simply makes the indoor storage [function] more useful".

ACA 1 described truck manoeuvring, loading, and parking areas as extensions of the warehouse:

ACA 1: "The turning area, backing in area [loading and manoeuvring] to me that is really just an extension of the warehouse".

DEV 2 also noted the strong relationship between outdoor areas and industrial buildings:

"When you start thinking in these terms, well it is not outdoor storage any more is it? It's quite an intense use of space. Your building is on wheels for a moment in time" (DEV 2).

Both BR 1 and DEV 2 commented that parking, loading, and manoeuvring needs are often overlooked in these discussions or are under-considered by planners.

DEV 2: "Planners don't like outdoor storage, they don't like to see truck trailer parking"

When these uses are not permitted, businesses go elsewhere. BR 1 commented that if there is not adequate space on site for trucks to wait or park, then trucks will be forced to take up space on local roads, which can lead to other problems.

Overall, participants supported the inclusion of the Outdoor Storage/Production measure in the prototype tool because it helps to shift the focus of the intensification discussion away from built-form. It is a signal to stakeholders that intensification is not all about FAR and built-form.

ACA 1: “I think it is a really good point to bring in the whole site usage and get away from the building only”.

Interview participants were supportive of this measure, but they also highlighted numerous practical challenges with it. Multiple participants agreed that it could be difficult to measure or adequately evaluate relative outdoor storage/production. For the prototype tool it was proposed that data for this measure would be generated through site visits or aerial photography. Participants pointed out that this approach could be problematic as the degree to which outdoor areas are used productively varies widely through the region. The degree of outdoor space usage varies between industries and can also fluctuate throughout the year. For example, some users make very active, intense use of outdoor areas while others use this space passively or only occasionally. PDC 1 added that the use of outdoor space on a site might not be at all related to the operations of the business using the building.

PDC 1: “Outdoor storage can sometimes have nothing to do with the actual business. Landowners and business owners are entrepreneurial, [and] may lease this space to others”.

This measure as it is currently designed is a site coverage measure for outdoor storage/production. It measures the area taken up by outdoor storage/production functions. However, the message from numerous participants was that for it to be useful, the measure must also score the quality or efficiency of outdoor storage/production by differentiating between varying degrees of outdoor space usage. To address this concern, MP 1 suggested that a more qualitative assessment of outdoor storage/production could be included to account for this variability of use.

MP 1: “I know that it is subjective, but is there a way in which you could capture [the level of efficiency of outdoor space] somehow? An efficiency measure?”.

RP 1 agreed, stating that this measure should stress the “productive” use of the outdoor space, not just the space itself. If the efficiency of productive use is not assessed properly, sites that are not actually making productive use of outdoor space may receive a high score. The current measurement scale could be adapted to make qualitative assessments as well. This approach,

however, does not solve the challenge that use and degree of use can fluctuate throughout the year.

There is a view by some stakeholders that very passive use of outdoor space for storage is common in the region. Several participants disagreed with this assessment. PDC 4 argued that there are very few examples of passive storage on outdoor portions of sites. BR 1 commented that due to the region's high land costs, very little land is "wasted" and any *new* industrial development is making use of outdoor space while also maximizing the building.

BR 1: "Any new development that you see that has outdoor storage, I guarantee that is productive use of space. Because of our land costs every developer is now trying to push the site coverage [maximize], because they are paying so much for the land. How much can we get on it".

One of the challenges with outdoor storage/production, and a topic that arose during discussions with participants, was municipal requirements to enclose outdoor uses. PDC 1 commented that some municipalities get fixated on the visual and noise impacts of outdoor uses. As a result, these uses are often prohibited, restricted, or are required to be enclosed. PDC 1 believed that these enclosure requirements are primarily about aesthetics, since there are already noise bylaws and air quality regulations in place to regulate these externalities.

These requirements are not necessarily put in place to restrict industry. In fact, some municipalities have used them to provide greater flexibility for industrial users. For example, the City of Richmond chose to modify their industrial bylaws to allow more flexibility by loosening the requirements on 'use' and simply requiring industrial activities to be enclosed. While this approach enables industrial users more flexibility with respect to their operations and use of a site, these requirements can also raise development costs and constrain the operations of some sectors. Generally speaking, industrial developers and users welcome flexibility, however, several participants questioned whether requiring activities to be enclosed is really a form of intensification.

DEV 2: "An enclosed storage facility where you could store material for months and months, is that intensification? Not in my books."

This participant also commented that forcing industry to enclose outdoor storage/production functions could inadvertently force industry out of the region by affecting competitiveness through higher costs and reduced flexibility. Some industries will seek out jurisdictions where they can have these outdoor functions and if they are not permitted they will locate their operations in another city or region.

The idea of maximizing the productive use of outdoor areas includes more than just outdoor storage/production spaces, but also extends to customer/employee parking and landscaping requirements. DEV 1 suggested that these factors could be combined in some way.

DEV 1: “Could some how combine parking, landscaping into some sort of outdoor space usage measure, or simply find a way of incorporating landscaping requirements [into the tool]”

These factors are discussed further in later sections.

### *Parking Innovation*

The Parking Innovation measure generated a great deal of discussion. However, several participants commented that this measure was a minor factor in industrial intensification relative to other measures. PDC 2 felt that the parking measure should receive a low weighting relative to some of the other measures in the multi-variable tool. DEV 1 argued that landscaping and building setbacks are a much bigger issues than parking when it comes to utilizing industrial lands more efficiently. Therefore, the discussion generated by this measure was disproportionate to its importance to industrial intensification.

There were some conflicting views with respect to parking requirements in the region. Parking needs are very user specific and depend on the number of employees and customers. Some industrial users believe that the parking requirements of some municipalities are too onerous and that they do not need the number of stalls required by the zoning bylaws. At the same time there are users who require more parking and therefore provide more. In addition, parking requirements differ between municipalities, with requirements tending to be higher in more suburban, car-dependent locations. PDC 1 commented that municipalities are always worried about parking requirements and tend to oversupply until they hear sufficient complaints from developers and users to warrant a review of parking standards.

BR 1 stated that most developers and users do not expect to fully utilize the parking spaces they supply; they are simply providing what is required by the zoning bylaws. This participant suggested that owners and users be given more flexibility with respect to parking requirements. BR 2 was also supportive of more flexible parking requirements but in a different way. He explained that his company intentionally “over-park” their buildings so that the owners of the building will have more flexibility in the future when seeking to attract tenants and as the needs of industry evolve. So when it comes to parking requirements, more flexibility can mean

different things depending on the user and the developer. The prototype multi-variable tool could be useful when trying to determine when flexibility with parking requirements is appropriate.

Due to the variability in parking needs of industrial sectors and between the region's municipalities, the Parking Innovation measure assigned a low score to sites that provided parking in excess of bylaw requirements; a medium score to parking equal to requirements; and a high score to sites that either incorporate parking into the building design as structured underground or rooftop parking, or that have negotiated to provide less parking than required by zoning bylaws. There was consensus among participants that the economics of underground parking or rooftop parking make this development form very unlikely in industrial lands, with a few rare exceptions in the region.

PDC 1: "As soon as you go underground you are looking at a significant additional cost per stall. Costs run \$30,000-\$50,000 per stall. [Developers] can get that back in mixed-use, high-density residential, not industrial".

There are examples in the region where it has been done successfully, but it has been due to the grade of the site or in urban locations with high land and lease rates to justify the additional costs. BR 1 noted that additional factors that make underground and rooftop parking difficult are the soil conditions and seismic considerations in the region.

Several participants saw more potential with the 'parking reduced below requirements' element of the Parking Innovation measure. PDC 1 commented that parking reductions for industrial developments in the region would be rare in current practice. One reason this practice is uncommon is that going through the process it is costly for developers.

PDC 1: "[This is a] rare occurrence for industrial, most can't be bothered. Many are leasing so what they get is what they get [in terms of parking]. To go through the process of getting a variance on your parking only makes sense if you own or want to own the building".

PDC 1 also noted that municipal planners can be reluctant to recommend parking reductions and Councils reluctant to grant reductions because while the reduction may work well for the current user, if that user moves on, the reduced parking may not be as suitable for subsequent users.

While parking reductions in industrial lands are rare, they do occur. MP 1 gave an example from Campbell Heights in Surrey where a creative solution to parking was achieved between the developer and the municipality.

MP 1: “The applicant felt that the parking requirement was too high, so what they ended up negotiating was, hey, we don’t think we need all of this parking, so let us put in a green-paver-permeable surface on a portion of the site, and if it turns out that we do need the parking, we have it. If we don’t need the parking it will be part of the landscaping/permeable surfaces requirements. So they were basically able to double-dip on the site. It was counted towards their onsite permeable surfaces *and* their parking, and they convinced us that they didn’t need the parking”.

This example was described to all subsequent interview participants and there was consensus that this type of innovation could lead to more efficient and productive use of a site. PDC 4 described another type of innovation parking innovation that is seen in practice in Metro Vancouver. When developing a site for a specific user that has low parking needs, steps can be taken to demonstrate how the outdoor space and parking areas could be reconfigured for future users with higher parking needs.

PDC 4: “So what we do is we typically show that if the use ever changed into say a more typical warehouse, show how staff parking could be located up against the loading bays and so on. So convertibility of the paved area. So we would get a parking relaxation. It may be a 50% parking relaxation for staff or customer parking”.

Numerous participants pointed out that the key difficulty with the Parking Innovation measure is that most industrial areas in Metro Vancouver are poorly connected to public transportation. DEV 2 commented that it is difficult to justify parking reductions in auto-dependent industrial areas since there are no alternatives available. This participant also made the point that if industrial intensification begins to occur, industrial areas will see additional users, more shifts, and more activity, all of which means more people demanding more parking.

RP 2 commented that the location of an industrial site would play a primary role in determining whether parking reductions or any parking innovations are possible. In the more car dependent areas of the region it could be very difficult to earn a ‘high’ Parking Innovation score. Some participants wrestled with the idea of linking this measure in some way to proximity to transit. Public transit and other transportation alternatives such as car sharing, car pools, employee shuttles, and shared parking are all things that municipalities could factor into their decisions to grant parking variances. However, so long as a site is not oversupplying parking it would not be penalized. Nevertheless, fairness is an important consideration with this measure.

RP 2: “I don’t necessarily want to give a site/area a bad score just by virtue of its location...and I don’t want warehousing for example to be penalized just by the nature of their operations and their needs.

To make this measure more equitable, MP 2 suggested separate urban and suburban scales that could account for the variability in land prices and the different types of industrial sectors that operate in these different contexts.

RP 2 cautioned against being too aggressive or “progressive” with parking reductions, arguing that first and foremost, parking must match the use and the expected parking requirements associated with that use. RP 2 offered this example as a case-in-point:

RP 2: “In the Big Bend area, the underlying zoning was M2 Heavy Industrial, and the way that they rezoned for each one of those offices [business parks] they did individual CD zoning, and then they would leave the underlying parking from the heavy industrial, so the end result was not enough parking for the office users that came in, to the point that all of the streets that weren’t designed for it are being used for parking. So this made me think, well, what is progressive? The zoning change structure represented a significant reduction in parking requirements because the parking was wrong for the land uses. So it is not automatically progressive to have reduced parking...if the zoning isn’t progressive”.

RP 2 also cited examples where commercial users locate in industrial lands and were granted the reduced parking requirements of industrial lands, but the parking supply ends up not being adequate for the use. Parking reductions offer some potential to make more productive use of a site for industrial uses; however, parking must still match the use and reductions are only suitable when viable alternatives to automobiles exist.

#### *Other Site Coverage-related Measures: Location and Access*

The topic of location came up repeatedly in discussions with participants. Location is a key determinant of land value, lease rates, intensification potential, and what forms intensification can take. The optimal site location differs between industrial sectors based on their needs and characteristics. Employment-intense industries may value public transportation more as it will improve access for their employees. Logistics and other truck-dependent industries may prioritize proximity to highway access. Port related industries want to be located close to rail and port facilities. On the other extreme, industries that are particularly cost sensitive may prefer industrial locations with low rents or land values; land which may not be well connected to regional transportation networks or may have other development

constraints. While location plays an important role in the location preference of industry and in the intensification potential of a site or area, translating this into a measure of intensification for the prototype tool is problematic. At the same time, explicitly including location as a measure in the tool may not be necessary as these factors are already internalized into each industry and each user's location decision.

#### *Other Site Coverage-related Measures: Mitigation Spaces*

The vast majority of an industrial site's outdoor space is taken up by outdoor storage/production areas and parking. The remaining space is typically landscaping and setbacks, referred to here as mitigation spaces. The prototype tool did not explicitly incorporate measures of landscaping and setbacks. However, interview participants repeatedly raised these topics when discussing the efficiency of site usage. Eric Vance & Associates (2011) identified landscaping and setbacks as having medium to high levels of importance as factors that affect intensification potential in Metro Vancouver (p. 48). It was the view of several participants that landscaping and setback requirements reduce the overall developable land on a site and that these requirements are too high in some industrial zones.

RP 2: "It is important not to have excessive barriers in terms of landscaping and setbacks or excessive anything for that matter".

RP 1 explained that many developers argue that they could use this space more effectively as either more building or more productive outdoor space, or both. DEV 1 commented that landscaping requirements are a much bigger issue than parking when it comes to reducing developable land. BR 2 stated that the downsides of setbacks and landscaping are threefold:

BR 2: "It decreases your net usable area, the installation gets expensive, and then maintenance is high".

However, PDC 3 argued that landscaping has value and can serve important functions. He stressed the importance of landscaping and that it should not automatically be considered unproductive land.

PDC 3: "It is there for a reason. There is something to be said for aesthetics. There is a need for buffers, wildlife habitat".

ACA 1 noted that these mitigation spaces can have value if they are designed well and with a purpose. They can contribute to a more pedestrian friendly realm and provide environmental

services. The counter argument to this view is that these values are not a priority of industrial land or of industrial intensification.

#### *Other Site Coverage-related Measures: Environmental Considerations*

Environmental factors were not explicitly included in the prototype multi-variable tool since the focus of the tool was to define and measure industrial land intensification with the objective of making more efficient use of industrial land for industrial purposes. However, it was suggested by MP 1 that as it is currently designed, the tool penalizes environmental protection since it does not explicitly consider things like treed areas, wetlands, natural drainage, filtration, or onsite retention systems. This participant stressed the importance of finding a balance between maximizing industrial land usage and preserving the limited natural areas and green spaces that exist in industrial areas.

Conversely, several participants expressed concerns about efforts to pursue higher environmental or green standards in the region's industrial areas. These participants cited the example of the City of Port Coquitlam that introduced a green-roof policy a number of years ago. This policy resulted in developers and industry being driven away due to the higher costs of the green-roof requirements. These participants cautioned against incentivising these types of policies by including environmental factors in the tool, as it will likely not result in industrial land use intensification.

### *5.4.3 Activity Measures*

#### *Accessory Use*

Metro Vancouver's urban land designations are designed to discourage significant commercial office and retail in areas designated Industrial, striving to locate these uses in Mixed Employment and General Urban land use designations that are located close to frequent transit. Not all stakeholders completely agree with Metro Vancouver's stance on office and retail uses in industrial lands. PDC 1 stated that many industries require more accessory office and retail than is permitted in Metro Vancouver land use designations and under municipal bylaws. When possible, industrial users prefer to have all of their operations on one site, rather than having to break up their operations by moving office components off-site. The participants that were

critical of Metro Vancouver's land use designations felt that the designations do not have the flexibility to account for the wide range of industrial user needs.

There was agreement among participants that accessory use is perhaps the easiest way to introduce more "activity" into industrial lands, and arguably making more efficient use of these lands. Intensification of activity through more accessory uses typically takes the form of higher employment densities.

PDC 2: "If municipalities are targeting employment density as a measure of success or intensification, then more accessory is the way to do this. We try to jam more office and retail into it".

Accessory use has a greater effect on employment densities than any of the other variables in the tool. This is potentially problematic since generating more jobs in industrial areas is not the primary objective of intensification efforts. The ultimate objective of intensification is to make the more efficient use of industrial land for industrial uses and users, not to maximize jobs.

This is not to say that a certain level of accessory use is not beneficial to industrial functions, such as associated office or retail uses, or workforce-serving commercial (i.e. restaurants). Adding more jobs/employees in industrial areas can help to make the best use of existing infrastructure such as roads, water, wastewater, and public transit. Accessory uses enable business to house multiple functions of their business – production, distribution, retail, office – all in one location. PDC 4 commented that allowing accessory in the form of office and retail provides more flexibility for locating industrial users in a given industrial site or area. However, the trade-off when this flexibility exists is that these zones can be abused. Businesses will acquire business licences for industrial operations, when in reality their operations are more commercial in nature. Participants cited high levels of office use as being particularly problematic in industrial zones. Once office is introduced to industrial lands as a use, there is the potential for significant portions of the area to convert to office use. Over time, office uses can come into conflict with industrial uses, pushing out industrial users for reasons of compatibility, access, and cost. This process can have a destabilizing effect on industrial lands, putting upward pressure on land costs and lease rates.

As discussed in Chapter 3 many industrial land stakeholders are not supportive of non-industrial uses on industrial lands because of the destabilizing effects that these uses can have. Participants expressed some concerns that this measure may reward the wrong types of activities on industrial lands.

MP 1: “In some ways it [accessory use measure] prioritizes or ranks highly what may not be supportive of industry”... “I worry about accessory uses driving out industrial uses that can’t compete on a value per square foot basis”.

Commercial users have the ability to outcompete industrial users. The protection measures introduced by *Metro 2040* help to reduce some of the speculative pressure on industrial lands, but accessory uses continue to be a potential threat. PDC 3 agreed that there is a fundamental conflict between the region’s industrial land use policies and increased accessory use.

PDC 3: “From a policy perspective, you have a problem there. We want more intensity, so more office use. But office will push out [industrial users]”.

If strict limits are not put on the level of permitted accessory use, the result will be continued speculation and rising prices, and industrial users will be displaced. PDC 4 added that not only can the introduction of high levels of office have negative, destabilizing effects on industrial lands and users, but this can also draw users out of urban offices attracted by lower rents, resulting in vacant urban office locations.

Another effect of increased accessory use is more employees and customers needing to access industrial areas.

RP 2: “One person’s job is another person’s service, so who is it that has to go out to these areas, so having doctors, lawyers etc. in these industrial areas is not city-building from my point of view. So I don’t like office as an outright use in industrial areas”.

This activity creates more traffic, additional burdens on roads, parking concerns, and potential user conflicts. BR 1 commented that office users also require transit and other services and amenities, so locating too much office in inaccessible industrial lands is not ideal for office employees, industry, or regional policy objectives. RP 2 argued that doing a better job creating commercial-mixed use could take the pressure off industrial lands from commercial users, and that this approach is better than promoting higher levels of accessory use in industrial lands

Context is very important when considering accessory use. Several participants commented that higher accessory use is more appropriate for certain industries and in certain industrial areas than others. MP 1 pointed out that the potential for accessory use is higher in urban contexts than in more suburban locations. MP 2 and 3 agreed, citing a recent change to the City of Vancouver’s industrial zoning in Mount Pleasant to allow up to two-thirds (66%) accessory as a way of retaining the ground floor industrial use.

MP 3: “It is a way to *get* the industrial. This recognizes that this is an inner urban area, serving the secondary office market”.

RP 1 introduced the idea of complementary accessory uses. There are some accessory uses that are complementary to bonafide industrial activities and there are many that are not. The challenge would be finding a way to reflect these “good” and “bad” accessory uses in the prototype tool. DP 1 advocated strongly for the mixing of uses in urban industrial settings. His perspective was that introducing more users to these areas would help support sustainable transportation and other city-region objectives. However, he stressed that mixing uses, industrial and commercial, is only appropriate for very specific urban contexts and not for all industrial areas. BR 1 agreed, arguing that it is only in certain areas of the region where introducing more accessory use would be a benefit. He listed several locations in the region based on their proximity to dense residential areas that have sufficient population density patronize the commercial/industrial without putting additional burden on transportation networks or demanding additional transportation links. BR 1 also noted that higher levels of accessory use might fit better in areas where industrial sites are smaller.

BR 1: “You have these smaller site sizes that don’t really have a higher and better use, but could make use of a mix of accessory uses. These smaller sites are also more likely to be located in more dense urban areas, where these functions could be supported”.

Participants’ concerns about the Accessory Use measure flowed into discussions of how the measure’s scale could be modified to address some of the challenges that were identified. It was suggested that the measure should require that the accessory use be related to the primary industry on site. Another suggestion was for the maximum percentage of accessory use to be lowered or the scale modified in such a way that would result in a lower score if accessory use exceeded a certain percentage. For example, a low score would be assigned to accessory use of 0-10% and greater than 50%.

### *Diversity of Businesses*

The Diversity of Business measure was meant to capture the number of users or operators on a given site or in a given industrial area. A good example of a ‘high’ score on this measure would be a multi-tenanted building. However, many participants initially understood or interpreted this measure to mean “diversity of users”, or the mixing of uses in industrial lands.

PDC 2 understood that the measure was trying to capture the intensification of multi-tenanted buildings, but did not agree that business diversity on a site necessarily equates to intensification. This participant argued that it is the type of *uses* that matters not the diversity or number of *users*. RP 1 agreed, noting that introducing more non-industrial users to industrial lands makes more efficient use of these lands from an activity standpoint, but it is not consistent with the spirit of industrial land use policies and intensification efforts. PDC 4 questioned whether there was necessarily a relationship between the diversity of users on a given site and employment density and intensification, arguing that this relationship would depend largely on the types of industries involved as employment densities vary widely across sectors. RP 2 also did not agree that business diversity is an indicator of intensification. This participant traced the origins of this measure to the preoccupation of some planners and policy makers with mixing uses.

RP 2: “Some thought it was progressive to get everything on one site, but to me, diversity on a site doesn’t mean anything per se, unless there are some synergies of the businesses involved”.

This is an important point that relates to the discussion of complementary uses from the accessory use discussion. Diversity for diversity’s sake does not help intensify industrial land use. It is more important to ensure that users are actually industrial or at least complementary to industrial uses. ACA 1 made a similar point:

ACA 1: “Planners do like to think that if you mix uses that you get better outcomes...we know that the non-mixed version is pretty unpleasant as well, but it is a good debate... I think it is a diversity of fully compatible uses that would be the ideal case”.

DEV 1 questioned the need for this measure in addition to the Accessory Use measure, but at the same time noted that a multi-tenant building would be a good example of intensification and using a site more efficiently. ACA 1 felt that the Business Diversity measure could be a good way of capturing the different entry points for industrial users and the different scales and sizes of operations. Finally, PDC 1 noted some practical challenges with this measure, particularly with determining how many businesses are operating on a site. Municipalities will have data from business licenses, but this will get complicated because a business could potentially be involved in multiple businesses all operating out of the same space, which could skew results. Finding a fair and accurate way of determining the number of users on a site is important.

### *Jobs/Employment Density*

It has been mentioned numerous times already in the discussion that increased employment densities are not the priority of Metro Vancouver's industrial intensification efforts. However, more intense use of industrial land will mean more jobs on industrial lands. Overall, participants agreed that jobs are an important consideration and a measure of intensification that should be included in the tool.

While most participants agreed that Employment Density belongs in the tool, many also cautioned against giving this measure too much weight. PDC 1 commented that it is politicians that tend to be preoccupied with jobs.

PDC 1: "Some local councils have become fixated on jobs; jobs per acre, per 1000 sq ft, jobs jobs jobs".

BR 2 noted that the motivation for many municipalities is to create a tax base and jobs in their industrial lands. RP 1 agreed that politicians tend to think about jobs and that it is this preoccupation that often leads to the wrong types of uses locating in industrial lands.

RP 1: "A lot of politicians think about jobs jobs jobs, and that is what drives them, and of course they are thinking about jobs in their community and that's an appropriate thing, but then that often leads to the types of uses that are taking up the industrial land base that actually could be someplace else".

RP 1 added that employment intensity is not particularly relevant from the perspective of Metro Vancouver. Industrial intensification does not necessarily mean more jobs, in fact more jobs can actually work against regional sustainable development and city-building objectives.

RP 1: "We [Metro Vancouver] always have issues with Number of Jobs, and from my perspective that is not necessarily relevant... This is something that we have to fight against constantly – that more intensification means more jobs, rather than the uses we need [for a functioning region]. Many uses that are practical and necessary are not job or building intensive".

RP 1 is referring to the city-serving industries referenced earlier that are essential to the regional economy. RP 2 noted the importance of an industry like warehousing that has low employment densities but plays an important role in the functioning of the region and the economy. Both regional planners stressed the importance of not putting too much weight behind this measure because jobs are not the whole picture.

Several participants pointed out that some forms of industrial intensification could actually *reduce* the number of jobs. For example, investments in technology or automation can

boost productivity and economic throughput and without the need for more employees and could potentially displace jobs. BR 1 and PDC 3 commented that there are examples of very large sites with few employees that generate enormous economic output. One example cited by was the emerging LNG sector.

Several participants discussed practical challenges with this measure. PDC 1 thought that it would be difficult to get FTE information from businesses, particularly in significant enough numbers to allow for comparisons and aggregations. The data would have to be provided by individual business, likely through surveys, and many businesses may not want to disclose this information to municipal or regional authorities. It was suggested that this data could be gleaned from business license data, but PDC 1 felt that this data might not accurately reflect actual employment numbers. PDC 2 agreed that getting the cooperation of businesses would be difficult, suggesting instead that the tool could use industry averages to estimate employment densities by sector. PDC 3 suggested that another way of quantifying this measure would be to count the number of shifts on a given site, giving a higher score to operations that utilize multiple shifts of workers. PDC 2 highlighted the challenge of comparing employment densities between industrial sectors since employment densities vary considerably across sectors. Some sectors would score poorly by virtue of their sector characteristics alone, which would be unfair. Comparison challenges such as this help to make the case for sector-specific versions of the prototype tool.

#### *5.4.4 Throughput Measures*

Two throughput measures were included in the prototype tool for discussion purposes. In the sample applications of the tool these measures were not scored due to a lack of data. All participants agreed that measuring the throughput and activity of an industrial site or area would be a valuable way to measure intensification. However, all interviewees also acknowledged that getting the data for such measures would be difficult if not impossible. The overall view was that the tool would be more valuable if this data could be captured somehow.

Throughput measures are particularly important for industries that do not require much in the way of a building for their operations.

MP 1: "Some industrial sites have no building whatsoever, yet they are vitally important to the operation of the port [for example], and there is an awful lot of

economic throughput [on these sites], whether it is trucks or storage or whatever, it is vitally important and that should be recognized”.

PDC 2 agreed, arguing that for a business like commodity processing or container handling, the measure of intensification that is most appropriate would be its productivity or throughput, since these industries tend to have very minimal built-form. He went on to argue that these types of industries defy the other kinds of measurements contained in the tool. BR 1 stressed the importance of acknowledging that many of the most significant industries from a regional and provincial economy standpoint, such as port-related industries, have minimal buildings but very high throughput.

While participants were in agreement on the potential value of measuring the economic throughput on a given site, they were also in agreement that getting the data to support such measures would likely not be possible. PDC 1 commented that getting business-specific figures on economic throughput simply would not happen. Some businesses may be willing to cooperate, but there will not be enough to allow for comparisons. He added that consultants or private firms might have more success getting this type of data than municipal governments. RP 1 agreed that the primary challenge to getting this data would be privacy concerns – businesses would be very reluctant to divulge sensitive operational and financial data. In the event that data was made available, several participants raised concerns about the comparability of this data across industrial sectors. The operations and the value of outputs vary a great deal between industrial sectors. Therefore, even with data it would be difficult to develop a scale to score the measure, and then making comparisons would not be fair. As with Employment Density, this discussion is making the case for sector-specific versions of the tool.

Participants appreciated the inclusion of the placeholder Throughput measures in the prototype tool. Having these measures in the tool ensured that an important aspect of industrial intensification was part of the larger discussion.

MP 1: “It is good to have it, even though you don’t have the data, I thought that was a good innovation”.

RP 2 agreed, stating that the throughput measures are important part of the discussion, effectively shining a light on what industry contributes to the local and regional economies. PDC 1 added that industrial throughput is difficult to measure quantitatively, but that it is important to be able to discuss these ideas, even if only in a qualitative way.

### *Other Potential Throughput Measures*

After acknowledging the difficulty of getting data to measure throughput, numerous participants offered suggestions of alternative ways of assessing this dimension of intensification. One idea put forward by PDC 1 and RP 2, was to use input-output analysis. Input-output (IO) analysis uses industry multipliers to assess economic impacts. Using this type of analysis the tool could estimate the economic contribution of a given sector and assign it an intensification score relative to other sectors.

RP 2: "...basically trying to figure out what contribution a given sector is having, the GDP of a business, sector, and the analysis produces multipliers to quantify the spinoffs. What does a given industry contribute to the municipality, regional economy, spinoffs, multiplier effects".

Several other participants were also interested in the possibility of using broad, sector-level economic data to assign a throughput score. This data is available and is generally in a format that can be compared across sectors.

DEV 1: "Could use broad based comparisons of industries, using provincial economic development/output data, use to score a particular industry relative to another".

BR 1 agreed that using sector-level economic data or multipliers to represent the economic contribution of each sector could be a way of incorporating throughput into the tool. PDC 3 also felt that sector-level data on economic impact could be used as a proxy of throughput relative to other sectors. The value of this measure would be in evaluating the relative economic efficiency of industrial land use by distinguishing between low-value economic uses and high-value economic uses.

This idea of measuring economic impacts or spinoffs was something that also emerged from Metro Vancouver's initial stakeholder engagement on industrial intensification and it was included in the preliminary list of measures developed by Metro Vancouver (see Table 2.4 and 2.5). The inputs and multipliers factor in the employment, tax revenue contribution, inputs, and outputs to give a well-rounded picture of the contributions of the sector to the economy. Not all participants saw value in this approach, however. ACA 1 and PDC 4 were not convinced that broad economic data would be meaningful in a tool like this as it would be too general to apply to specific sites or areas. ACA 1 also made the point that there are some low-value industries operating in the region that are essential to city-region functioning and that reducing these industries to just their economic contribution may not be fair or wise.

ACA 1: “You can produce numbers, but they probably aren’t that accurate or meaningful. There is also this trap of saying that high value goods are necessarily better,[when there are low value goods and services] that are also important to the functioning of the city” (ACA 1).

Several participants suggested that throughput could be estimated by tracking truck movements. This was another potential measure that came out of Metro Vancouver’s consultations. The number of truck movements in and out of a site could be tracked as a way of estimating throughput. This measure is appealing because it is more practical than some other throughput measures, as business could be more inclined to provide basic information like this rather than more detailed operation or financial information. The data could also be collected through visual surveys. However, the measure is really only applicable to truck dependent sectors. In addition, the value of the goods can vary significantly even within truck dependent sectors, making comparisons using the measure difficult.

## **5.5 Intensification Score**

The ‘intensification score’ generated a significant amount of discussion with interview participants. As discussed earlier in Section 3.3.1 the intensification score was added with the intention of exploring additional applications of the tool beyond just an analytical function. By quantifying the tool and the tool graphic, the tool could potentially become a piece of a regional intensification scheme that uses incentives and targets to advance industrial land intensification objectives.

### ***5.5.1 Intensification Targets and Incentives***

Metro Vancouver is *not* currently working towards a system of targets or incentives to promote industrial land intensification. However, as the supply of industrial land continues to decrease and the demand for industrial land continues to increase, such a scheme may be necessary in the future. During the interviews, most participants first expressed their views on a system of intensification targets and incentives. Some participants also engaged in a more hypothetical discussion of what these targets and incentives might look like and what effect they may have on industrial land development.

The planners interviewed were supportive of the idea of targets generally, as a way to advance planning priorities.

RP 2: “I’m all for targets in any kind of planning, it gives parameters”...“Targets and performance measures, anything that helps in measuring progress is helpful in planning. We [planners] are not nearly rigorous enough in evaluating what we do and how it contributes to what we achieve. It’s all a little too fuzzy”.

DP 1 agreed that targets or benchmarks could be useful as they can help cities move forward, advance change, make progress on policies and priorities. RP 1 urged caution when considering targets of any kind.

RP 1: “We’ve done lots of plans where we’ve set some sort of target and we put it in the plans and we think it sounds good, only later we realize that we’re stuck with this number, and whenever we do we have to revolve around this number. There are a number of practical things that can be done, but this number then becomes an impediment to trying to do good things, practical things”.

This underlines the importance of carefully considering the implications of targets to ensure that they do not remove flexibility and become barriers to innovative, progressive work.

Participants involved in industrial development – developers, brokers, and planning consultants – were also cautious, but not entirely against the idea of targets. They expressed concerns about the effect that intensification targets could have on industrial development and development economics. PDC 3 made the point that one of the risks with pursuing targets and regulation is that it can chase business away. PDC 3 posed the question: ‘What happens if a development doesn’t meet the target? Do you turn it away?’. DEV 2 stressed how important it is that intensification targets and the prototype tool do not become a barrier to development or to industry in the region. These participants also made it clear that intensification targets must come with appropriate incentives.

All participants were in agreement that if the prototype tool were to evolve to become part of a system of regional intensification targets, then there would need to be incentives in place for this to work.

PDC 2: “If it is to be used to revise zoning, fine. If it is to be used to create a target, great. But you don’t have a carrot”...“If targets are in place and you don’t have a carrot, where is development going to go? Somewhere else”...“targets are largely toothless without incentives”.

Incentives would be necessary to offset the higher development costs that would likely come with some forms of intensive development. Incentives would also help ensure that the targets do not simply drive businesses out of the region to less expensive cities or regions.

PDC 3: “I think one of the things we have to think about is what this actually means for planning. Can we use it, and how would business respond to things like targets, or would these things just drive industrial users to Calgary”.

PDC 4 also suggested exercising caution when considering the introduction of targets. Any targets and policies need to respect the realities of industrial land development and operations.

Municipalities are quite limited in what incentives that could be offered. However, two potential incentives that emerged from this discussion were density and tax incentives. As was noted earlier, density is an effective incentive in residential, commercial, mixed-use development contexts, but it has limited appeal in the industrial context. PDC 2 suggested that lower tax rates for intensive developments that meet certain standards could potentially drive the desired intensification. The tool could be used to establish these standards and to measure development against them.

PDC 4 commented that having incentives is not unreasonable, but any incentives offered by government always skew the market, and planners and policy-makers must be aware of the real-world effects of any incentives offered. This participant cited examples where poorly designed incentives had been abused and failed to achieve their objectives.

Instead of a ‘carrot’, municipalities could also use a ‘stick’ to spur the desired forms of development. RP1 suggested that municipal mechanisms that make it less attractive or more difficult for landowners to hold large tracts of underutilized industrial land could help intensify industrial land use.

RP 1: “If you could make it less attractive or more difficult for people to have large tracts of land that aren’t being used. A little more pressure on that kind of land holding, because the land is so precious, be it a taxation mechanism or something that can put pressure on them”.

PDC 2 also proposed adjusting how industrial property is taxed by reducing the tax rate on buildings and raising the tax rates on land. He contrasted this with the current tax regime that effectively penalizes more expensive, higher-quality buildings through higher tax assessments.

PDC 2: “[Presently] if you build an intensive, high-quality building, your tax bill is higher. So you are penalized for building quality buildings”.

### *5.5.2 Weighting Measures vs. Sector-Specific Tools*

For the multi-variable tool to be more than an analytical tool and to develop into a composite index that could be the basis of a regional intensification target scheme, the various measures need to be weighted in some fashion. The importance of relative weights and

difficulties associated with weighting the measures was discussed in detail in section 5.3. Participants agreed that the measures would need to be weighted if applications of the tool are to be compared across industrial sectors. Without such weights these comparisons would not be fair. Alternatively, it was suggested that instead of developing weights for each measure, that separate sector-specific versions of the tool could be developed for each major industrial sectors.

RP 1: “So something like this [referring to the tool] perhaps is more sector relevant, than it is generally applicable. Because, if we have two very different types of uses potentially being evaluated then our scores could be quite different. Meanwhile, they could both be quite viable uses, or one might be a use that is much less conducive to the industrial land base that we have than the other, but it might score higher because of its building form and the number of employees and other things. Meanwhile, it might not be an appropriate type of industrial use”.

Developing separate tools for each industrial sector could avoid these problems and facilitate comparisons within industrial sectors.

This approach would require unique targets or benchmarks for each sector. MP 1 suggested developing benchmarks for each major industrial sector for each of the three intensification categories – built form, site usage, and activity – and using these to evaluate the performance of a site based on this sector profile.

MP 1: “This idea of benchmarks also avoids the apples and oranges comparisons. So if you look at the typical [intensification] signature for this class of use, it then allows you to set that as a benchmark against which other projects might be judged”.

### *5.5.3 Multiple Ways to Achieve a Score*

One potential strength of the tool and the intensification score is that industrial sites or areas would be able to achieve an intensification score or meet an intensification target in a variety of ways. For example, two separate sites with users from different industrial sectors could both potentially achieve high scores, but could do so by maximizing different measures in the tool. The tool gives a developer the flexibility to achieve a target in the way that best suits the needs of the user characteristics of the site. PDC 2 and DEV 1 liked the idea of the tool providing a developer or user the flexibility to achieve a certain level of intensification in a number of different ways. However, both participants cautioned against introducing any targets or benchmarks that could alter development economics. MP 1 also agreed that having more

than one way to reach a target or benchmark score was a potential strength of the tool, but noted that to be fair, the tool would have to be weighted or separate tools developed for each sector. ACA 1 expressed concern that generating the intensification score could potentially be a zero-sum activity. For example, it is difficult to get above a certain score and equally difficult to score very poorly. This lack of differentiation between scores could be addressed by developing finer-grained scales or by adding more qualitative elements to help differentiate between optimum examples of intensification and the types of site usage that we are hoping to eliminate.

#### *5.5.4 Merits of the Intensification Score*

All participants appreciated, to varying degrees, the attempt of the tool to recognize the different types of intensification that exist and to measure relative intensification. However, views on the 'intensification score' element were not unanimous, with some supportive of the score and others very much against the idea. MP 3 indicated that he was immediately drawn to the intensification score, saying that it helped to quantify the graphic. However, he also noted that the score is problematic for reasons of fairness of comparison that have been discussed. RP 1 was supportive of the multiple measures of the tool and the way in which they help to ensure the various aspects of intensification are taken into account. Having multiple measures and bringing them together in a cohesive way is good and is useful for discussion purposes and when evaluating industrial land development. However, RP 1 did not like the addition of the intensification score.

RP 1: "That is where this list [of measures] comes in, to ensure that in our assessment we think about all of these things, or to have it sitting out there so that every time something comes in we think about all of this stuff. But we don't come up with a score [for intensification that is either good or bad]".

RP 1 and MP 1 each expressed concerns that the intensification score could become the focal point rather than just one piece of the intensification discussion and analysis.

RP 1: "The numbers might be somewhat helpful, but you would have to be really cautious not to take them too seriously, especially when we are dealing with politicians. When they see a number they latch onto it. This is especially true if people aren't thinking deeply about this. They will go through it and see the number and, okay, away you go. That is the danger with the number".

MP 1 envisioned the intensification score being used to oppose otherwise sound development proposals.

MP 1: “[The intensification score] runs the risk of an unpopular project or a project that has community opposition for any reason...it gives ammunition that may or may not be germane to the real issue. People may be opposed to a project because they are worried about a loss of property value, but it [the project] might be a good thing from the regional economy perspective, and if a project scored low it would give people ammunition”.

RP 1 agreed with this, commenting that in his experience, bad developments will find ways to meet targets and good developments sometimes fail to. There may be multiple reasons that a project is unable to achieve a high score that are out of the control of the developer or user – location, site conditions, nature of the business – but these details will not be apparent from just the intensification score. The intensification score fails to account for the specific context of a development.

Several other participants noted that scoring schemes like that proposed in the prototype tool can be manipulated. Industrial developers and users could potentially find ways to meet a certain score without necessarily realizing the underlying intensification objectives. RP 1 stressed that it is the process that is important; the analysis that stems from bringing all of these measures together and understanding the relationship between them. The score may not reflect the overall analysis or what is actually appropriate for the location or land use.

## **5.6 Applications and Utility**

One of the research questions and central research objectives of this project was to understand the potential utility of the prototype multi-variable tool. Discussions with participants focused on determining how the tool can help to shape industrial land use policy; how it can address regional intensification objectives; how the tool can best be applied; how it can help ensure fairness; and whether the prototype is an analytical tool or if it could be more quantitative.

### ***5.6.1 Purpose and Function of the Tool***

Prior to conducting the semi-structured interviews, the prototype tool was envisioned having two potential applications. First, the tool was initially intended to be an analytical tool that could communicate a broader definition and multiple measures of intensification. The

second application emerged with the addition of the ‘intensification score’. The intensification score quantifies the intensification measures and the tool graphic, and created opportunities for the prototype tool to be integrated with a regional scheme of intensification targets and incentives. Participants were asked for their views on the prototype tool’s utility and specifically how the tool could fit into current planning practice and advance industrial land intensification objectives. The following section summarizes what was heard from participants.

#### *An Analytical and Communication Tool*

There was a general consensus that the prototype tool could have some utility as a tool for communicating the different aspects of intensification to diverse audiences and stakeholders. Participants liked that the tool includes multiple measures of intensification, expands the definition of intensification beyond simply built-form, and shows the relationships and trade-offs between certain forms of intensification. PDC 4 commented that the tool has value as analytical tool because it recognizes the multiple forms of intensification that exist. PDC 2 agreed that the tool could be useful for communicating a more holistic view of the idea of intensification. ACA 1 commented that a key strength of the tool was its communicative power. By bringing together multiple measures of intensification to represent the different definitions and aspects of intensification, stakeholders are able to see the whole picture and better understand the relationships between different forms of intensification.

ACA 1: “In principle, the idea of saying that you want to somehow bring these [measures] together is useful. You want to try to get people to think about the whole package”.

DEV 1 acknowledged that the tool could be useful as a way of bridging any gaps between developers and planners with respect to intensification goals, policies and the potential implications of intensification for industrial land stakeholders.

#### *A Composite Tool with an Intensification Score*

The intensification score was designed as a way of quantifying the measures in the tool and the tool graphic so that the expanded definitions and measures of intensification could be more easily translated into regional industrial land intensification strategies, policies, and land use bylaws. Taken a step further, the intensification score or composite index of intensification could be integrated into a regional industrial intensification targets and incentives scheme.

As a composite index of intensification, the combined multi-variable tool and intensification score was likened by some participants to LEED. What LEED is to sustainable development, the multi-variable tool could be for industrial land use intensification. DP 1 liked the idea of having a target or classification system like LEED for industrial land. However, he also made the point that the objectives and benefits of intensification may not be as clear to developers and tenants as they are for LEED.

DP 1: “Yes, I can see cities being interested in that. The question would be that, unlike LEED, which is clearly trying to reduce carbon and promote sustainability, the goal of intensification may be less clear to developers and tenants. So I think you need to link that to something, and maybe it is sustainability, but something that is directly causal from achieving intensification”.

MP 1 and DEV 2 also saw similarities between the prototype tool and LEED, but they both also expressed concerns regarding the potential for the score to be manipulated.

MP 1: “LEED has been criticised because there are consultants that are very good at knowing where the low-hanging fruit is...you can pile up 37 points just by doing this...and is that truly the kind of green building that we want to see? So there is a risk there [with this tool as well].”

For an application of the tool like this to be effective, users need to understand, ‘what is in it for me?’ or, ‘why should I intensify?’. The answer to these questions could lie in the incentives offered by municipalities. PDC 2 commented that there would have to be incentives in place for the tool to be more than an analytical tool. For example, the tool could potentially be used as a negotiating tool by developers to justify variances or by municipalities to push for more intensive development. However, the idea of negotiation presumes some incentives for developers to engage in discussions with the municipality about what possible.

Overall, participants were not convinced of the utility of the ‘intensification score’ or of the multi-variable tool as a composite index similar to LEED. While many appreciated the attempt to quantify the multiple measures and the tool graphic in some way, there was consensus that the intensification score has some practical challenges. These challenges were discussed in detail in Section 5.5. The main challenges identified were a lack of data and the difficulties associated with ensuring fairness. For several measures, getting data was deemed to be difficult if not impossible. With respect to fairness, the view of participants was that the measures would first need to be weighted in some way based on the relative importance or impact of the measure on industrial intensification. Without weights the scoring system may inadvertently encourage some forms of intensification over others. Determining relative

weights would be difficult enough, but doing so while also accounting for the diverse needs and characteristics of industrial sectors would be nearly impossible. Secondly, even with weighted measures, comparing applications of the tool across industrial sectors with different operational requirements and abilities to intensify would not be fair. Participants were very concerned about the potential for the tool and the intensification score to unfairly represent or disadvantage some industrial sectors over others. The theme of 'fairness' is explored further in Section 5.6.4. BR 2 commented that designing a tool that can factor in all of the complexities of industrial land development and intensification and do so in an equitable fashion is a very difficult prospect. So while such a tool might be useful, it may also not be practical or possible to create it. One solution to this challenge put forward by participants was to create multiple versions of the tool to reflect the characteristics and intensification potential of the various industrial sub-sectors. This idea was discussed in section 5.5.

Another factor that could prevent the tool from being useful in practice as a composite index was a general lack of interest in pursuing intensification targets or incentives. While there are some industrial land stakeholders, namely Metro Vancouver and NAIOP, who are concerned about industrial land supply and the intensification discussion, most others do not see the same urgency. Municipalities are not scrambling to impose industrial land intensification targets or to develop a host of incentives for industrial intensification for the development industry. Developers and industrial land users are content not having intensification targets and are not pressuring municipalities to offer incentives. Without a system of targets and incentive, and given the lack of interest pursuing such a system, industrial land stakeholders do not consider a composite index for industrial intensification necessary.

#### *The Tool as a Process*

In the view of interview participants, the difficulties identified with the intensification score and fairness of the tool were too much to overcome for the tool to be useful as a composite index. Participants agreed that the tool has value as an analytical tool, but some still felt that it could do more than simply help to communicate a broader definition of intensification. A number of participants envisioned the prototype tool itself as a 'process' or part of decision-making or evaluation processes. In particular, the two regional planners saw a place for the prototype tool in planning processes.

RP 1 argued that the process of discussing the tool, its measures, and relative intensification might be more valuable than the results of the tool, or the intensification score. In other words, the 'product' of the tool is not necessarily as valuable as the 'process'. So, while it is tempting to want to quantify the tool in some way, this should not necessarily be the end goal. RP 1 maintained that if the intensification score is to be used it should only be *part* of decision-making and evaluation processes, not the central feature.

RP 1: "The number [intensification score] can be manipulated just by the characteristics of that site, so the number to me doesn't become something that is useable, but it is the process [that is valuable/has value]... the number that comes out of this same analysis may not be relevant in terms of the qualitative analysis that comes through the process of just looking at each one of these factors [measures in the tool]".

RP 1 stressed a number of times that the tool's primary strength and potential role in planning practice is an analytical one. He stated that the value of these types of tools or models is how they can help us think about complex issue and ideas and sort through lots of data to recognize relationships. This participant believed that the tool's value lies in its ability to introduce a systematic way of thinking about industrial land intensification that can move the discussion and analysis beyond built-form. To play this role he did not feel the intensification score was necessary.

RP 1: "The other point that I think is important is this [the tool] is really useful as a systematic way to think through a whole range of factors, but I think it is difficult to try to standardize it, to say here is the standard, here's the score we should try to achieve, this is high, this is low. It is really hard to attach those numbers to specific instances and have it apply generally across the board".

The tool is good for thinking about industrial land intensification systematically, but should not seek to standardize or quantify the tool using the intensification score.

RP 1: "As soon as you start assigning numbers and scores to it, it can be helpful as part of the process, but it is not necessarily giving you the answer, it's just a process to help to really look at a number of factors".

RP 2 shared a similar perspective to RP 1, but framed the prototype tool somewhat differently, describing the types of tools that planners have at their disposal that could potentially influence intensification – fiscal tools, regulatory tools, and advocacy tools. Planners can use fiscal tools such as incentives to promote intensification. On the regulatory side, planners can remove barriers that impede desired forms of intensification, such as outdated

bylaws. Finally, advocacy is about promoting the important role of industry in city-functioning. RP 2 saw a potential role for the prototype tool in each of these planning processes.

As the discussion above revealed, numerous participants believed that the tool could help to support intensification policies and advance progressive practices on industrial lands. However, some participants felt that the tool could potentially be a barrier to progressive development. DEV 2 worried that the tool could have the opposite effect than it is intended to, arguing that it could be limiting as intensification is only one aspect of industry and development economics.

DEV 2: “I think from a planning perspective, in terms of what we do and what Metro Vancouver is trying to achieve with respect to industrial land use intensification, to be successful in this business, you have to look beyond the parameters of this model. You can come up with a model, but is it applicable? If you only use this model to evaluate a certain type of industrial product, I think that is limiting your potential”.

This participant felt that the tool does not adequately capture all of the elements involved in industrial land intensification nor adequately factor in other important industrial land development considerations. Furthermore, he argued that if the tool is too narrow or prescriptive, it could get in the way of innovative and intensive industrial development. He worried that planners might rely too heavily on it, thus getting in the way of innovation. So, instead of helping to advance intensification and promote progressive industrial development practices the tool itself becomes a barrier to creative solutions rather than a catalyst.

### *Municipal Applications*

In discussion with participants, numerous specific applications and uses of the tool emerged beyond the two broad applications that were initially envisioned. Many of the potential applications identified were related to municipal processes and decision-making. PDC 1 anticipated interest at the municipal level for the tool. At the same time he expressed concern regarding the data-intensive nature of the tool.

PDC 1: “Most of my municipal clients would look at this [the tool] and say ‘this is interesting; if you come up with data, great!’.

In his view, municipalities will use tools like this if data is readily accessible or is provided to them. However, if they are being asked to spend staff time and resources generating the data, they will be less inclined to adopt such tools.

The addition of the intensification score created a potential opportunity for the tool to play a role in negotiation between developers and municipalities. The tool, in combination with intensification targets and incentives could be used to negotiate higher levels of industrial intensification or to justify variances that advance intensification objectives. MP 1 suggested that the tool could be useful as part of a rezoning application and review process or to encourage certain preferred practices. Specifically he identified the temporary use permit application review process as one where the tool could be valuable from a municipal perspective. In this participant's municipality, temporary use permits are frequently granted for underutilized industrial lands and then reviewed and renewed periodically. The municipality has aspirations for this land to be developed into more formal industrial uses.

MP 1: "[The] applicant is using the site for storage of some kind and is looking to renew a temporary use permit, but they have been using the site in a very slack, low intensity manner. [Applying the tool] this user scores low on outdoor productive use, so Council can say, 'No, we are not going to renew the temporary use permit because [they] have not been using that land effectively and efficiently'".

MP 1 envisioned similar applications of the tool in the context of parking requirements, where the tool could be used to justify a parking variance. This participant felt that the tool could help to push industrial development towards greater intensification incrementally.

MP 1: "We are always trying to push them [developers] towards more formalized, higher-order kinds of uses"... "So if there was a way for us to measure and reward the efficient, even somewhat intensive use of land for these kinds of uses, it would give us a bit of a stick".

MP 1 also likened the prototype tool to the Sustainability Checklist that is used as part of the development review process in his municipality. He suggested that the prototype tool, or a modified version of it, could play a similar role as the checklist in the development application and review process.

MP 1: "We also have a sustainable development checklist, so for multi-family, single-family, commercial, there is a bunch of [standards]...this could be a similar tool that is particular to industrial uses, and rewards [good behaviour, developments, applications]".

Like the checklist, the tool could be integrated into the process as a way of ensuring certain benchmarks or minimums are met, while at the same time allowing flexibility as to how these standards are achieved. This is an interesting way of reframing the tool to make it part of a process.

Not all participants, however, saw the merits of the tool as part of municipal-developer negotiations or application and review processes. PDC 1 could not envision the tool as part of a negotiated development process primarily because unlike residential and mixed-use development, negotiations in the industrial land context are not common.

PDC 1: “Negotiating really comes into play when you have a developer that wants to rezone”...“What is being negotiated?”...“When councils say no to an application, it is usually use, something noxious for example. Sometimes the outdoor [use] issue is a problem for municipalities, but beyond that, to start negotiating some of these other issues...well we don’t do this in commercial, so why would we do this with industrial?”.

The multi-variable tool could also be used to defend municipal decisions or justify expenditures. There was broad-based agreement that the tool could be used to track the impact of an investment in infrastructure or to support the recommendations for a future expenditure.

MP 1: “We spent a lot of money on a new sewer system and the intent of that sewer system was to encourage the intensification of these lands, so there may be a call in the future for even more investment in infrastructure, so we may want to show progress [and the tool may help to this]”.

MP 1 also argued that the tool could be used by planning staff to support recommendations to Council, particularly when asking for exceptions or variances. The tool could help provide evidence that could give Council the confidence to move ahead in the face of opposition or to advance progressive policies.

MP 1: “If you were able to measure this in advance of the building being constructed, measuring it off the application, again it could give council good information that allows them to steam ahead in the face of opposition to a development application, or might give support for parking relaxation, or for some other relaxation, whatever it might be. So I think it does have value”.

Numerous participants representing various stakeholder groups – planners, consultants, developers – stated that the tool could be useful to track intensification trends over time. PDC did not agree that the tool could be integrated into municipal development application and review processes, but supported the tool as a way of tracking intensification over time.

PDC 1: “I wouldn’t use this as a negotiating tool. I see the value being to measure intensification using a number of measures, how intensely the land is being used, tracking it over time, for the things you can get data for”.

Participants saw potential for the tool to be useful for municipalities seeking to understand and monitor the changes in intensification, track efficiency of industrial land use, and understand trends in industrial land intensification.

DEV 1: “One of the things that could come out of this from a broader perspective, would be for municipalities to continue to monitor [industrial land intensification] ...is it becoming more intensive, are we better utilizing lands, or is it going the other way, and if it is going/trending the other way, are there policies that we can bring in? What is causing the trends?”.

This information over time could be used to evaluate and adjust municipal and regional industrial land intensification policies and help ensure progress towards intensification objectives.

DEV 1: “The results of the tool could be used to shape, tweak, improve industrial land policies, bylaws etc., track trends over time, ensure intensification continues to move in the right direction, and if not, bring in policies that address this. That’s where I would see this as having the most potential benefit”.

MP 1 was the most enthusiastic about the potential municipal applications of the tool, but he was also quick to point out that realistically, municipalities will not necessarily be scrambling to be the first to introduce a tool like this into their decision-making process.

MP 1: “In terms of how this is going to be used, I think it has value...[but] I’m not saying that cities are going to jump all over it and start ranking all of their industrial properties”.

#### *Development Professional Perspective on the Tool*

As noted above, participants involved in industrial land development (developers, planning consultants, and brokers) favoured using the tool to track intensification over time. Similarly, these stakeholders saw an opportunity for the tool to be used to understand intensification potential. BR 2 commented that understanding industrial land intensification potential would be useful for when developers and users are looking for new locations, and the prototype tool incorporates many of the factors that are already used in these decision-making processes. However, the challenge is that each sector and each business has different priorities.

BR 2: “If this [the tool] was available and had some credibility, it might be something that people use, because it does answer a lot of questions that people ask”.

In other words, industrial users, developers, and brokers would use a tool like this if it helped them to make investment and location decisions and if it also worked within their existing decision-making processes.

The two developers interviewed expressed interest in the tool being used to enhance the discretionary decision-making of municipal staff. DEV 1 commented that discretionary decision-making exists within municipalities, however, it is generally restricted to high levels, such as managers and directors. A tool like this could help to bring this decision-making and flexibility down to lower levels of staff. DEV 1 appreciated that the tool allows users and developers the flexibility to reach an intensification target in a number of ways. DEV 2 also liked the idea of the tool being used to enhance the discretionary decision-making of planners. In his view this would give planners more flexibility that could not only help achieve intensification objectives but also respond better to the diverse needs of industrial users. Conversely, DEV 2 also commented that the development community could use the tool to make their case for exceptions or variances to policies. The prototype tool could potentially allow for flexibility to be built into application review processes that could both improve intensification outcomes and better meet the diverse needs of industrial users.

### *5.6.2 Scale of Application*

#### *Site-level Application*

The tool was initially envisioned as having multiple scales of application – site-level, area or district level, and sector-level. The four sample applications developed for the semi-structured interviews were each site-level applications of the tool. Site-level applications were chosen for the sample applications based on the availability of data and were developed using data from site-specific industrial building case-studies undertaken by Metro Vancouver. The site-level application of the tool was an effective way to present the prototype tool to participants. There was consensus among participants that the site-level application of the tool was practical and relatable.

#### *District/Area-level Application*

Several participants agreed that there would be value in applying the tool to an industrial area or district. To achieve this, the prototype tool would have to be adapted to allow

for aggregate scores for each of the measures to represent the entire industrial area. PDC 3 thought the tool could be potentially more useful at this larger scale, particularly if it could be paired with a mapping function. He argued that by understanding intensification trends at this scale and being able to see where in the region certain forms of intensification were occurring, that Metro Vancouver would be better able to plan infrastructure investments to support intensification and make the most efficient use of industrial land. DEV 1 also agreed that the district-level application might be useful to plan and support municipal infrastructure investments in industrial lands.

MP 1 and DEV 1 commented that the district-scale application would be useful for comparing industrial areas within and between municipalities.

MP 1: "We may want to compare...there may be an industrial area where we have a lot of problems with rogue users or whatever...we may be able to compare one to another".

By measuring the relative intensity of industrial areas it may be possible to better understand how policies and investments impact intensification.

#### *Developing Multiple Versions of the Tool*

All participants made reference in some way to the diversity of industrial sectors and users. There are many different industrial sectors that operate on industrial lands and each has unique needs. The different operational characteristics of each industrial sector and user mean that intensification will look different for each. What helps one industry intensify does not necessarily help another. The prototype tool can show these differences between sectors and illustrate how intensification looks for each sector. The tool can also highlight the trade-offs that occur between the various forms of intensification when one form of intensification is achieved. However, while understanding these trade-offs could be useful, as was pointed out earlier, comparisons between industrial sectors are difficult, primarily for reasons of fairness.

It was suggested by several participants that a way of overcoming the comparison challenges between industrial sectors would be to develop separate versions of the tool for each industrial sector. Separate scales could be developed for each measure to more accurately score intensification and to allow for fair comparisons within each sector. One challenge with this approach however is that a significant amount of time and effort would be required to develop individual scales for each industrial sub-sector, and this may not be practical or realistic.

Another suggestion put forward by participants as a way to avoid extreme comparisons between very different industrial sectors was to develop two tools, one for urban industrial areas and one for suburban industrial areas. The rationale was that these different industrial contexts, urban and suburban, attract specific types of users that share similar characteristics, thus making comparisons easier. The advantage of taking this approach is that only two tools are required. However, the problem is that in practice, it is difficult to distinguish between what is urban and what is suburban industrial. There are “suburban”, truck-based industries located that operate in urban areas, and there are more “urban”, employment-intensive industries that operate in suburban areas of the region.

BR 1 agreed that differentiating between urban and suburban industrial development poses practical challenges. As an alternative, he suggested that two separate tools could be developed based on site size.

BR 1: “The characteristics and needs of a smaller industrial sites are much different than a larger industrial site. So different tools for smaller, different tools for larger”.

According to BR 1 site size correlates well with the requirements and characteristics of industrial uses.

BR 1: “The smaller users have different needs than the larger users when it comes to infrastructure, and infrastructure spending is different for the smaller than it is for the larger”... “your infrastructure needs are totally different – sewer, water, storm water, roadways, electrical needs – will all be different and more expensive for one than the other”.

In addition, industrial real estate brokers already track industrial land inventories according to site size.

BR 1: “The way we break things down and have done so for Metro [Vancouver] is that you have 5 acres and under, 5 to 20, and 20 plus. That is how we have segregated how the market fits in. The needs of those [users requiring] 15-20 acres or more are way different than this MP lighting example [small site users].

### *5.6.3 Scope of the Tool*

There were also divergent views with respect to the scope of the tool’s application. MP 2 and MP 3 felt that due to the difficulties obtaining data for some of the measures, particularly the activity and throughput measure, the scope of the tool should be limited to land use and built form measures of intensification. They also stated that planners should focus on land use and leave the economics of what is going on in the buildings to industrial users.

MP 3: “The more I learn, the more I feel that it [the tool] should be a land use only tool. If the tool is for planners, it should be a land use thing. Generally planners do not concern themselves with what is happening in the buildings, rather it is more about regulating the land and the building size, parking [physical things]. The other stuff is all market stuff and it is the brokers and developers that manage this stuff”.

DEV 2 however, took the opposite view, arguing that the prototype tool, with all of the measures that were included, was still too narrow in scope. This participant felt that the tool could be expanded to include more variables, more forms of intensification. He recognized that any attempts to expand the measures included in the tool would make it even more difficult to quantify and compare applications. However, he felt that rather than trying to be more specific and quantitative with the measures, the tool could be more general and qualitative.

#### *5.6.4 Fairness*

The theme of fairness surfaced over and over throughout the interview process with all participants. Many of the concerns that participants expressed about the tool’s construction, measures, evaluation scales, and applications came back to the idea of fairness. Participants from all professional backgrounds wanted to be sure that intensification policies and the prototype tool do not unfairly disadvantage some industrial users over others.

The idea of fairness is an important concern and it was factored into the tool’s initial development. One of the primary intentions of the prototype tool was to expand how industrial intensification is defined and measured so as to ensure that some industries are not negatively impacted by intensification policies. However, participants pointed out that simply including broader definitions and measures in the prototype tool does not automatically guarantee fairness.

Participants agreed that because intensification can look so different for different industrial sectors, that care must be taken when developing and applying a tool like this. With respect to choosing measures and developing scales for each of the tool’s measure, participants wanted to be sure that the different aspects of intensification were fairly represented, so that when the tool is applied it does not favour built-form intensity over outdoor space usage intensity for example. As was discussed earlier, there are city-serving industries that cannot easily intensify through built-form, but which are essential to the local and regional economies.

It is important that intensification policies and the prototype tool do not promote intensification in a way that could inadvertently force these users to less efficient locations in the region.

Participants were also worried about the fairness of comparing applications of the tool between different industrial sub-region's within Metro Vancouver. MP 1 envisioned a situation where multi-storey industrial developments in Vancouver would be compared to land-intensive, truck-dependent industrial developments in Surrey and the result of the tool would show one development as "good" and the other as "bad", when in fact both could be good examples of intense industrial development. Others shared this view that un-reasonable comparisons should be avoided. It was from these concerns and discussions that the idea of developing multiple tools for each sector, or for urban and suburban contexts, or by site size emerged. By tailoring the tool to more closely match the industrial context, more equitable comparisons are possible.

DEV 2 pointed out that some areas of the region are unlikely to support high intensity industrial development for a variety of reasons including location, site access, and soil conditions. In his view, these challenging sites should not be further penalized by intensification policies or the prototype tool just by virtue of their development constraints. DEV 1 agreed, stating that it is important that the policy work of planners and the tools they use to achieve planning objectives need to respect the realities of industrial land users and the economics of industrial land development.

Some participants were also concerned about the potential impacts of intensification policies and the prototype tool on the competitiveness of region's industry relative to competing industrial areas such as Calgary. Participants acknowledged the industrial land supply challenges facing Metro Vancouver and that intensification is one solution. However, it was stressed that new policies or planning tools should avoid unfairly disadvantaging the region's industrial users through potentially costly intensification targets or standards.

## 6 | Synthesis of Results

### 6.1 Introduction

This practicum represents a small contribution to industrial land intensification efforts that are ongoing in Metro Vancouver. This research sought to address a gap in planning literature and practice with respect to how industrial intensification is defined, measured, and evaluated. Industrial land use and industrial intensification are not well represented in planning literature. This inquiry also sought to develop and refine a prototype multi-variable analytical tool to help communicate enhanced definitions and measures of intensification and facilitate the evaluation of industrial land intensification. The prototype tool builds on the work that Metro Vancouver has done to support the region's industrial lands intensification goals and broader sustainable development objectives. The prototype tool helps to better define, measure and evaluate industrial land intensification to support the future development and implementation of equitable and effective industrial land use policies in areas such as Metro Vancouver

To develop enhanced definitions and measures of industrial land intensification an extensive literature review was conducted that explored planning and related literature for references to intensification, attempting to draw connections to the industrial land context. The literature review also informed the development of the prototype multi-variable analytical tool. Finally, semi-structured interviews were conducted with industrial land stakeholders and experts. The interviews helped to evaluate potential definitions and measures of industrial land intensification in practical terms. The interview process was also used to refine the construction of the prototype tool and evaluate the potential practical applications of the tool in the region's industrial land use planning.

The research methodology addressed the practicum's research questions and helped to generate the research findings that have been synthesized into three sections – *Conclusions*, *Tool Refinements*, and *Future Directions*. The *Conclusions* section presents the key conclusions derived from the literature review, prototype tool development and refinement, and semi-structured interviews, and is organized by the five themes that emerged during the analysis. The *Tool Refinement* section presents a refined version of the site-level application of the prototype tool developed for this research that resulted from the tool refinement exercise

conducted with interview participants. Finally, the *Future Directions* section presents possible evolutions and adaptations of the tool and the steps necessary to achieve them.

## 6.2 Responding to Research Questions

This research project had two broad research objectives that were addressed by seven research questions. Responding to these questions throughout the course of this research informed the practicum's final conclusions and the refined prototype tool. Discussed below are the general responses to the two research objectives and how the research methodology addressed the research questions.

**Research Objective A:** To develop a broader definition of intensification and additional measures of intensification in the industrial context.

1. How can industrial land intensification be defined and measured differently to reflect the diverse needs of industrial users? What alternative or additional measures can be used to evaluate industrial land intensity?
2. In what ways might an enhanced understanding of industrial land intensity help to shape industrial land policy and efficiency of land use in the Metro Vancouver region?
3. What lessons can be learned from other cities and regions dealing with limited industrial land supply issues that could be applied in Metro Vancouver?

### *Defining and Measuring Intensification*

This research helped to confirm that multiple measures of intensification are required in order to fairly evaluate industrial land use intensity. The unique characteristics of each industrial sector mean that the method by which one industrial sector can intensify can differ from the next depending of the operational needs of that sector. Some sectors can intensify their operations in large, multi-storey buildings or by taking advantage of the additional vertical space provided by higher ceilings. Other sectors require minimal buildings and large outdoor spaces to operate, so intensification for these industrial users will be the more efficient use of these outdoor areas. And for some sectors, industrial land intensity is best measured by evaluating industrial activity, be it jobs, number of users, or economic throughput.

### *Alternative Measures of Industrial Intensity*

Metro Vancouver, in consultation with industrial land stakeholders, compiled a list of potential measures of industrial intensity. This preliminary list was evaluated in the literature review and measures were selected from this list to be included in the prototype multi-variable analytical tool. The prototype tool also includes several measures of intensity not included in this preliminary list to help better represent the multiple aspects of intensification. Through the semi-structured interview process, participants provided additional practical insights into the merits of each measure while also suggesting other potential measures of intensification that could be included in future versions of the tool.

### *Ensuring Fairness in Industrial Land Policies*

Both the literature review and semi-structured interviews highlighted the importance of developing more nuanced definitions and measures of industrial intensification. To develop industrial land intensification policies without acknowledging the diversity of industrial uses and the multiple definitions and measures of industrial intensification would ultimately result in policies that unfairly disadvantage certain industrial sectors and industrial sub-regions. The interview process provided practical input on which measures best evaluate industrial land intensity and which are most practical for industrial land policy, planning, and development.

### *Learning from Other City-Regions*

Industrial land intensification is not well represented in planning literature or in planning practice. The land use constraints facing Metro Vancouver, particularly for industrial lands, makes the region somewhat unique in North America. The literature review revealed that while there are some cities and regions that are struggling to protect important strategic industrial areas, few are seeking to pursue policies to actively intensify existing industrial areas. Furthermore, there were even fewer examples of other jurisdictions attempting to measure or quantify industrial land intensification using alternative measures (i.e. measures other than FAR, ceiling height, or site coverage). With little to draw on from other city-regions, Metro Vancouver can be a leader on this topic.

**Research Objective B:** To develop a prototype analytical tool to help planners and decision-makers better understand, measure, and communicate industrial intensification and utilization.

1. *Alternative Measures:* What measures of industrial land use intensification merit being included in a multi-variable analytical tool? How should these variables be determined; what evaluation scale should be used for each variable; and how should each variable be scored?
2. *Scale of Application:* At what scale should a multi-variable analytical tool be applied? (i) site/building, (ii) industrial areas/district, and/or (iii) industrial sector?
3. *Stakeholder Engagement:* In what ways can the needs and priorities of diverse industrial land stakeholders be incorporated into the alternative intensification measures and ultimately the tool? What role can the various stakeholders – planners, industrial real estate brokers, industrial developers, industrial users, and other experts – play in developing the multi-variable tool?
4. *Utility:* How will a multi-variable analytical tool aid in the understanding, communication, and evaluation of industrial land use issues between stakeholders? How can such a tool help to better shape industrial land use policy and address regional industrial land use objectives? In what other ways can the tool be applied and adapted for the industrial land context? How can the multi-variable tool help to promote fairness and ensure that no one sector is affected more than another by industrial intensification policies?

#### *Alternative Measures*

The semi-structured interview process generated valuable data on what alternative measures of intensification should be used to evaluate industrial land intensity. Participants suggested several alternative measures to those included in the prototype tool, often to address gaps in data or to evaluate an aspect of intensification not captured in the prototype tool. Some of the suggested measures were already considered as part of the tool development process. Others were new suggestions that warrant further exploration as part of future research and future versions of the tool.

#### *Scale of Application*

The initial prototype tool and the sample applications developed for this practicum were site-level applications. This scale of application is ideal for comparing one site to another; however, there was considerable interest expressed in seeing other scales of the tool developed. First, participants believed that multiple, sector-specific tools should be developed to address fairness of comparison concerns. The prevailing view was that due to the diversity

among industrial users, comparing different sectors using the same scales was thought to be unfair, since a high score for one sector might be considered low for another (and vice versa). In addition, there was interest from stakeholders to track trends and compare intensification between industrial areas or districts. To achieve this scale of tool, the scores of individual sites would have to be totalled up or a different methodology developed. This is discussed in more detail in Section 6.5 Future Directions.

### *Stakeholder Engagement*

The prototype tool and the process by which this research project sought to refine the tool are examples of how the interests and involvement of the region's diverse industrial land stakeholders can be incorporated into the intensification discussion and future policy, planning, and development discussions. These stakeholders are experts in their field and their input is invaluable when developing planning policies and the tools planners use to guide policy implementation. Quality engagement with these experts can help ensure that the real world results of policies match the intentions of planners and decision-makers. All future research on intensification and on this tool will require a collaborative approach that incorporates the views of all of these stakeholders.

### *Utility of the Prototype Tool*

An important part of this research practicum was to determine what, if any, utility the prototype multi-variable tool could have in planning practice. The intention of the tool was to aid in the development of equitable industrial land intensification policies in the Metro Vancouver region. Interview participants provided invaluable feedback on how the prototype tool, or future versions or adaptations of the tool, could be incorporated into planning and development practices. Section 6.5, discusses the potential future directions of the tool in more detail, however they include – developing multiple, sector specific tools; developing an area/district-level application of the tool; exploring the development of the tool into a composite index of intensification akin to LEED; and adapting the tool into a checklist format to be integrated into municipal development application review processes

## 6.3 Conclusions

This section presents the key conclusions based on the literature review, prototype tool development and refinement, and semi-structured interviews. The following conclusions will help to determine how the prototype multi-variable tool could support Metro Vancouver's efforts to promote industrial intensification. The discussion is organized by the same five themes that emerged during the analysis – *Defining Industrial Land Intensification; Tool Development; Measures and Scales; Scores and Targets; and Application and Utility*.

### 6.3.1 Defining Industrial Land Intensification

#### *Addressing the Industrial Land Supply Problem Through Intensification*

Before intensification can be defined and measured, getting a common understanding and agreement from the region's industrial land stakeholders that intensification is the way forward for the region's industrial lands is critical. The interview process revealed that while there is strong support for the protection of the remaining industrial land supply, not all industrial land stakeholders are convinced that intensification is the only or most effective solution to the region's limited industrial land supply problem.

There were two aspects to this perspective. First, "intensification" is viewed by some as just an additional layer of regulation that could become a barrier to industrial development and ultimately raise costs for industrial users. Participants involved in industrial land development generally believe that the market should be left to address the problem. From their perspective, if and when the industrial land supply becomes severely limited, the market will respond with more intensive forms of development, increased infill and redevelopment of under-utilized sites, and industrial users will become more efficient both operationally and spatially. In support of this view, these participants point to the trend towards higher-ceiling warehouse buildings, which has effectively resulted in a doubling of the productive space for some industries in the last 20-30 years. This was achieved in response to market forces and user needs, and without intensification policies.

While it is true that these larger volume buildings are an example of industrial intensification, building volumes and built-form represent only one aspect of intensification that not all industries or industrial users can capitalize on. It is also true that markets will respond to the need to make more intensive use of industrial land. The question is when and how?

Markets are by their nature, reactive and will rarely get ahead of a problem. The series of industrial land supply inventories and analyses over the past decade has painted a very clear picture of the industrial land supply constraints facing the region. Metro Vancouver is in a position now to anticipate the inevitable industrial land supply depletion and mitigate this shortfall by pursuing more intense industrial land development now. Therefore, there is a role for intensification policies to help advance intensive development and to shift the market towards more intensive development sooner rather than later. Getting ahead of the problem rather than waiting for the market to react could help retain the industry currently operating in the region and ensure adequate space for new industry in the future.

Secondly, many stakeholders expressed the view that the answer to both the industrial supply problem and some of the challenges associated with intensification is more flexibility in terms of permitted uses. The rationale is that by loosening the restrictions on permitted uses on industrial lands, developers would be able to build more innovative and intense developments. More flexibility with respect to uses would enable more commercial office/retail uses, which in turn could support the higher development costs associated with these more intense forms of industrial development. It is true that more flexibility in land use designations and zoning bylaws could facilitate some innovative mixed-use industrial developments. In certain locations within the region this may be good policy. However, such developments would likely take the form of higher FAR, multi-storey structures that would not be suitable for the operations of many industrial users. Permitting more types of uses on industrial land can also drive up land prices and result in possible land use conflicts. Furthermore, these types of structures would generally be more job-intensive and therefore more appropriately located in the Mixed Employment or General Urban land designations (or in Urban Centres or Frequent Transit Development Areas) rather than Industrial. The regional land use designations that are in place help to focus jobs near transit, services, and amenities while also ensuring that industrial lands are available for industrial users. The flexibility that some participants seek would undercut these important policies that support the larger sustainable development objectives of the Metro Vancouver region.

Overall, there remains more work to be done to communicate how limited the industrial land supply is and to illustrate that intensification – the more efficient and intense use of existing industrial land – is indeed a viable solution to the industrial land shortage facing the region.

### *Definitions and Objectives of Industrial Land Intensification*

A key objective of this research practicum was to expand the definition of industrial land intensification and how each aspect of intensification is measured. Metro Vancouver has worked to introduce a broader definition of intensification that acknowledges that intensification can be both buildings and activities. Metro Vancouver also developed a list of potential measures of the various aspects of intensification. However, the semi-structured interviews revealed that, while participants are aware of the different aspects of industrial intensification, many still view intensification exclusively in terms of built-form. The analysis of the semi-structured interviews suggested three possible explanations for this.

First, the earliest discussions in the region about this topic led by Metro Vancouver took a very narrow view of intensification, focussing on the feasibility of multi-storey industrial buildings. The message from industry and developers, then and now, is that this typology is not currently viable in most areas of Metro Vancouver. Furthermore, given the trends in land costs and lease rates, it is not likely to be economically viable in the foreseeable future. Regional planning and policy efforts have since expanded the scope of intensification beyond just multi-storey developments; however, the mention of “intensification” elicits a defensive response from some stakeholders because they still view it through this multi-storey lens.

Secondly, even though Metro Vancouver has worked to develop a more nuanced definition of industrial land intensification, land use planning policy and controls in the region remain geared exclusively towards built-form – FAR, Site Coverage, and Ceiling Height. Measures of other aspects of intensification such as site usage, activity and throughput are not incorporated into local zoning or development application processes. In other words, the broader, more nuanced definition of intensification has not yet been integrated into planning processes. For intensification policies that acknowledge the multi-faceted definition of industrial intensification to be implementable, *all* aspects of intensification must be incorporated into planning tools and processes. The status quo works fine for industries that are building-intensive; however, for those industries that are land-intensive or job-intensive, the current framework does not serve them as well. To be fair, finding a way to introduce this broader definition into zoning bylaws and planning processes is no easy task. Nevertheless, for any future policies that seek to promote intensification in all its forms, incorporating this broader interpretation of intensification is critical.

Finally, numerous participants expressed concern that the ultimate objective of industrial intensification efforts remains unclear. For Metro Vancouver, the objective of intensification is defined as the more productive and efficient use of industrial land for industrial uses. While many industrial land stakeholders may understand this in principle, in practice, when it comes to creating policies to promote such 'productive and efficient' use, the objectives are less clear. The existing tools in industrial zoning – FAR, Site Coverage, Ceiling Height – are only useful for facilitating larger buildings. However, there are no explicit mechanisms in place to promote intensification for industries that are not building-intensive or that cannot intensify through larger buildings. The objectives of industrial land intensification extend beyond just larger buildings and include promoting greater site coverage and usage, more outdoor storage/production, more jobs per acre, more industrial users per acre, and greater economic throughput. The form that intensification can take depends on the use, location, and the specific industrial user. The objective of intensification, like the definition, is multi-faceted. The difficulty is that some industrial land stakeholders are seeking a simplified explanation of intensification objectives (along the lines of density) rather than a multi-dimensional one.

From the discussions with participants it is clear that there is still more work to be done to clearly define and articulate the objectives of industrial land intensification. Doing so is critical before any intensification policies can be created. For any future intensification policies to be equitable for all industries and industrial users, it is important that the definitions and objectives of intensification allow all types of industries to intensify according to the aspects of intensification that best match their operational characteristics.

### *Fairness and Competitiveness*

The theme of fairness was mentioned above and was a reoccurring theme throughout the interview process. Participants expressed virtually unanimous support for the protective measures that have been put in place for industrial lands. However, there is reluctance on the part of some stakeholder groups to embrace any policy or regulatory framework related to intensification. This reluctance is based on a fear that such policies would limit the ability of industrial developers to respond to the evolving needs of industry, thus impacting the competitiveness of industry. These participants see potential for intensification policies to raise development costs and reduce operational flexibility for some industries, which could impact the competitiveness of some business and potentially drive some industries out of the region. It

is certainly true that ill-conceived intensification policies that do not factor in the needs and characteristics of industrial users could have detrimental effects and could impact the competitiveness of the region's industrial users. However, ensuring that any new intensification policies incorporate all aspects of intensification – built-form, site usage, and activity/throughput – will help protect the region's industrial users from any adverse impacts of intensification efforts.

The above difficulties – defining intensification and its objectives; integrating intensification into planning practices; and concerns about competitiveness – were precisely what the prototype multi-variable tool set out to address. The prototype tool recognizes the different definitions and aspects of industrial intensification and helps to advance the discussion beyond the narrow multi-storey focus of the past. The tool also can facilitate the introduction of this broader interpretation of intensification into planning processes in a way that does not unfairly disadvantage one sector over another. The tool can be part of a framework that makes all forms of intensification possible, giving developers and users the flexibility to achieve forms of industrial intensity that suit the characteristics of specific sites and users.

### *6.3.2 Tool Development*

#### *Obtaining Data*

Simplicity and practicality were central objectives when developing the prototype tool. However, despite the concerted effort to create a practical and easy-to-use tool, participants felt that the prototype tool was too data-intensive. The data required for some of the measures is readily available from municipal sources – FAR, Ceiling Height, Site Coverage, and Accessory Use – although, not all municipalities maintain this data in current, easy-to-use formats. For other measures data would have to be supplemented or generated from surveys, site visits, or aerial photography – Number of Floors, Outdoor Storage/Production, and Parking Innovation. Finally, for other measures data can only be sourced from individual industrial users, requiring the cooperation of business owners – Employment Density, Diversity of Businesses, and any throughput measures. Participants noted that acquiring business-specific data would be very challenging because businesses are reluctant to provide sensitive operational data to municipal or regional authorities. The two throughput measures included in the tool for discussion were

considered particularly problematic and participants agreed that getting this data on any significant scale would be extremely difficult, if not impossible.

Participants also noted that some of the measures require data that would only be available once a building or site is occupied – Employment Density, Diversity of Users, and any throughput measures. Therefore, if the intention were for the tool to be used as part of development application processes, this data would not yet exist (although it could be estimated based on the type of building and the permitted uses). Additionally, the occupant of a given industrial space can change numerous times over the life of a building, with each occupant potentially utilizing the space differently. With each change of use the data for each of these measures also changes.

Overall, the simplicity sought by the initial tool was not achieved. Participants offered two alternative solutions to these data challenges. First, the tool could be stripped down to the measures for which data can be easily obtained – FAR, Ceiling Height, Site Coverage, Parking, and Accessory Use. However this is not advisable, as the tool would then be reduced to primarily built-form measures of intensity, thus failing to account for the other aspects of intensification. The resulting tool would not add much to the discussion or to planning practice. The other suggestion was to allow for more qualitative assessments for some measures where data is not readily available. This option provides the opportunity to expand the tool far beyond the measures included in the prototype tool. These and other alternatives are explored further in Section 6.5 Future Directions.

#### *Weighting and Comparisons:*

In addition to the challenges associated with acquiring data to complete the tool, participants also noted that comparisons of different sites and sectors might not be fair given the huge diversity among industrial users across all measures. This is particularly true of the activity and throughput categories of measures. As discussed in Section 3.3 Tool Development, there was no attempt made to weight the tool's measures relative to one another. This was done for reasons of simplicity and practicality, as developing relative weights for each measure would be very difficult. However, not all of the measures included in the tool have the same potential to influence intensification levels. For example the potential for increased ceiling heights to boost industrial land use intensity is arguably greater for some sectors than having a

greater diversity of users on a given site. As the tool is currently constructed, these two measures are equal.

Developing relative weights for each measure could help the tool more accurately represent the influence each measure has on intensification. However, weights would not overcome the equity challenges associated with comparing applications of the tool across industrial sectors. The intensification potential of each sector is different and the relative impact of different measures of intensification differs for each sector. Therefore the relative weights would be different for each industrial sector. This means that it would be extremely difficult to develop a single tool to measure, evaluate, and compare intensity across all industrial sectors.

Participants offered some suggestion for alternatives to weighting the tool measures (discussed in Ch 5), but each of these proposals failed to address the fairness challenges posed by comparing across industrial classes. The consensus from interview participants was that it would be best to develop separate tools for each industrial sector rather than attempting to develop a single tool that is representative of all “industry”. The conclusion was that pursuing the development of multiple, sector-specific tools is the only way to ensure any degree of fairness with the tool. The trade-off of this approach is that while it would allow for fair and accurate assessments *within* a sector, comparisons *between* different industries would no longer work. In addition, the development of multiple, sector-specific tools poses difficulties when seeking to apply the tool at the area/district scale, since site-level applications could no longer simply be totalled to generate a score for an industrial area. The development of multiple, sector-specific tools is explored further in Section 6.5 Future Directions.

### 6.3.3 Measures and Scales

A central feature of the semi-structured interviews was a tool refinement exercise where participants were asked for feedback on the various elements of the prototype tool, including the measures and their evaluation scales. There was a broad consensus among participants that there is no *single* measure for industrial land intensification and that measuring intensification using multiple measures is the best approach. Participants felt that using multiple measures was important for several reasons. First, it acknowledges that there is more to industrial intensification than built-form and larger buildings. Second, it ensures that the intensification conversation in the region permanently shifts away from a narrow focus on multi-

storey industrial buildings. Finally, it recognizes that there are several different aspects to industrial intensification – built-form, site usage, activity/throughput – and that the potential for each industrial site, sector, and user to intensify is different.

In terms of the specific measures that were included in the prototype multi-variable tool, participants were in agreement on some measures and divided on others. The following section presents a synthesis of the research findings on each of the measures included in the prototype tool, including a discussion of how some measures could be improved as part of future research or versions of the tool.

#### *Built-Form Density Measures*

- *Floor Area Ratio (FAR)*: While participants were in agreement that FAR was an essential ingredient in the tool, they were also unanimous in their view that there is more to industrial land intensification than just density or built-form.
- *Ceiling Height*: Like FAR, Ceiling Height was considered to be an essential measure for the tool. It is an important measure of intensity given the trend in industrial zoning towards the use of ceiling height and site coverage to control density and the trend in some industrial sectors towards higher ceiling, higher volume buildings. Future versions of the tool could explore measuring cubic capacity or volume of industrial buildings. Measuring the potential productive capacity of industrial buildings in this way is arguably superior to both FAR and Ceiling Height measures.
- *Number of Floors*: The majority of participants felt that the Number of Floors measure was redundant, duplicating a measure of intensification that is already captured by FAR. By duplicating other measures of density in this way, participants were concerned that too much emphasis would be placed on built-form intensity, and specifically on multi-storey industrial development.

#### *Site Usage Measures*

- *Site Coverage*: Participants were unanimous that Site Coverage should be included in the tool. Participants involved in industrial development asserted that new industrial developments are always seeking to maximize the amount of building on a site within the constraints of the site, zoning bylaws, user needs, and development economics. The literature and feedback from participants indicated that in some instances there are

opportunities to increase site usage through updates of zoning bylaws and reductions to building setback and landscaping requirements. It was suggested that in future versions of the tool that Site Coverage could be calculated as a percentage of developable land, net of setbacks and landscaping requirements, to better recognize the different requirements of various industrial zones in the region.

- *Outdoor Storage/Production:* There was broad support for this measure because it acknowledges the important role that outdoor areas play in industrial operations (a role that is often underestimated). However, participants also made it clear that this measure, as it is currently defined, is not adequate because it simply captures the “area” available for productive outdoor uses, rather than assessing the *quality or efficiency* of the use. As the tool is currently constructed, a site that makes very active and efficient use of outdoor areas could receive the same score as a site that makes very passive use of this space. It was suggested that in future versions of the tool a more qualitative evaluation scale could be introduced to address this concern by scoring both the area and the efficiency of use. Similar to Site Coverage, it was suggested that future versions of this measure should be calculated based on net developable land (i.e. net of setbacks and landscaping requirements).
- *Parking Innovation:* For a measure that many participants felt has only a minor role to play in industrial land intensification, Parking Innovation generated a great deal of discussion. The potential for Parking Innovation to impact industrial intensification was generally considered to be low. Participants noted two key obstacles to a site receiving a “high” score on this measure: the prohibitively high costs of structured parking and the lack of alternatives to automobile use to make parking reductions viable. Based on the level of discussion and the important connection to sustainable development and transportation, this measure will be retained in the tool. However, more work needs to be done to refine the evaluation scale to allow for more differentiation between sites and a wider range of potential scores.

#### *Activity Measures*

- *Job/employment density:* The key take-away from the research process for this measure was that jobs, while important, are not the priority of the region’s industrial intensification efforts. More jobs per acre may mean greater intensity of use, but not

necessarily of an industrial uses, and thus should not always be maximized. The region prioritizes locating the majority of new jobs in Urban Centres and close to frequent transit. There was agreement that an employment density measure warrants inclusion in the tool, so long as it is one of multiple measures and considered accordingly. It was also noted that while it is common to express employment density as jobs per sq foot of a building, that because industrial land intensification is about making more efficient use of industrial land, and not necessarily the more productive use of industrial floor space, that this measure should be expressed as jobs per acre.

- *Accessory Use:* This measure was controversial because of the potential conflict with regional land use designations and sustainable development objectives. Increasing accessory uses on industrial land is generally accepted as the easiest way to increase “activity” in industrial areas. However, accessory office and retail uses bring more people (employees and customers) to industrial areas, which not only goes against regional policies but also has the potential to destabilized industrial lands and land values. With this measure, location and context are important, since some locations are better suited for higher levels of accessory use than others. Also, careful attention must be paid when developing the evaluation scale for this measure in order to ensure that accessory levels, beyond those considered optimal or appropriate, are not rewarded with a high score. A potential solution is the development of a more qualitative scale that can better account for context and the type of accessory use.
- *Diversity of Businesses:* There was some confusion among participants as to the definition and purpose of this measure. The intention was to recognize sites that incorporate multiple, separate businesses on one site (e.g. multi-tenant sites) and to evaluate the relative intensity of sites that accommodate smaller users, start-up enterprises, and the different entry points for industry. Having more users on site in this way is arguably a form of intensity of industrial activity. However, feedback from participants made it clear that additional work needs to be done to differentiate this measure from Accessory Use and to develop an evaluation scale that draws a stronger connection between business diversity and intensity. Future definitions of this measure should also be consistent with regional land use planning and land use designations, since the *type* of use is more important than the *number* of users.

The three Activity measures discussed above – Jobs per Area, Accessory Use, and Business Diversity – were contentious. The disagreement surrounding these measures was primarily related to the potential for these measures to promote activities in industrial areas that conflict with regional land use designations and land use planning. Participants had diverging views on the merits of higher employment density, accessory use, and business diversity, but there was agreement that promoting each of these indicators of intensification could conflict with regional land use planning and sustainable development goals. These concerns could potentially be overcome with more refined, qualitative evaluation scales that better reflect the larger sustainable development policies in place. Participants articulated two additional challenges with the activity measures – getting data and comparability of data across industrial sectors. In the view of participants, access to data will always be a difficulty with these measures; however, the comparability challenge could be addressed by developing multiple, sector specific tools.

#### *Throughput Measures*

The throughput measures included in the prototype tool were included for discussion purposes, as data was not available for the sample applications of the tool. Participants were in agreement that including throughput in the tool adds value to the tool and helps to keep this important aspect of intensification as part of the larger intensification conversation. Depending on the application and availability of data, throughput measures could be retained or removed from future versions of the tool. For example, if the tool is being used for communication or discussion purposes, then retaining these measures, even if data is not available, may continue to have value. Similar to the activity measures, a key concern that participants raised with measures of throughput was that of comparability. Even if data were available for such measures, the types and values of throughput vary widely between industrial sectors, making comparisons between sectors difficult and unfair. Again, for reasons of fairness, participants advocated for the development of sector specific tools that allow for fair comparisons.

#### *6.3.4 Intensification Score, Targets and Incentives*

The Metro Vancouver region is not currently pursuing a system of intensification targets or incentives. Overall, there does not appear to be sufficient urgency on the part of the region's industrial land stakeholders to warrant such a system. While this may not be a priority now, it

does not mean that intensification targets will not be required in the future or that industrial developers would not respond to incentives in the short-term.

Interview participants were split on the idea of intensification targets. Overall, the planners interviewed were generally more supportive of targets as a tool to advance progressive industrial development practices faster than the market would achieve on its own. However, they still recommended exercising caution when going down this road. Targets have a tendency to become the dominant focus and sometimes even an impediment to achieving progressive policy and practice because they can lack the flexibility to recognize the specifics of each development context.

Those involved in industrial development were also uncertain about intensification targets, but not entirely against the idea. They were clear that for any system of targets to be put in place, that a corresponding system of incentives would be required to ensure fairness. In their view, imposing targets without offsetting incentives could be a barrier to industrial development. The fear is that efforts to meet intensification targets could drive up development costs and potentially impact competitiveness of the region's industrial users. There was also concern that industrial users not able to meet the targets would be effectively pushed out of the region, regardless of their contribution to the local and regional economies.

Participants also noted that developing effective incentives would not be easy because municipalities have few options available. The two main municipal tools identified by participants were density bonuses and tax incentives. As has been discussed, bonus density has limited appeal in industrial development contexts in Metro Vancouver, as existing FAR limits are not considered to be an impediment to industrial intensification. In addition, higher FAR only facilitates intensification for some industrial sectors, not all. It should be noted that incentives could be introduced without targets to reward those who push limits and advance progressive development practices that help the regional work towards its intensification objectives.

There was agreement among the participants that if targets and incentives are to be pursued in the future, that the implications of each must be carefully considered to ensure that they do not reduce flexibility and become barriers to innovative, progressive work. Both must be carefully thought out to ensure that all industries and users have equal opportunities to meet targets and access incentives. The multi-variable tool could help to achieve this fairness by ensuring that all aspects of intensification are represented and by giving developers and industrial users the flexibility to achieve targets in the way that best suits the characteristics of

that industry. This flexibility was popular with most stakeholders, particularly those involved in development.

Intensification targets and incentives may require intensification to be quantified in some way. The intention of the intensification score was to do just that. The prototype tool's intensification score quantifies the various aspects of intensification and allows for sites to be compared to one another or against a target or benchmark. A key strength of the tool is that it is results-focused, allowing sites to reach an intensification score in a number of different ways depending on the features of the site or the characteristics of the industry. If the tool is to be quantified using an intensification score, then the consensus view among participants was that separate tools should be developed for each industrial sector to ensure that in the process of assigning scores, industrial sectors or users are not unfairly disadvantaged over others due to their varying potential to intensify. The various industrial sub-sectors in the region are: warehouse / distribution centres; freight forwarding / cross-docks; manufacturing / assembly; flex-space / multi-tenant.

Not all participants were supportive of the intensification score. Some felt by assigning a single number to the tool that it simplified the process and the analysis too much, resulting in the loss of the tool's nuance and detail. The 'score' or the 'number' becomes the focal point for opponents. Scores can also be manipulated to the point where 'bad' developments can achieve the score while 'good' developments fail to. The message from these participants was that with a simple score it is difficult to account for the specific context of a development. The idea of benchmarks was introduced as an alternative to a single intensification score or target. Benchmarks could be developed for each measure or category of measures and used to determine eligibility for incentives. So rather than having to meet a single target, a development would be weighed against multiple intensification benchmarks. This approach would allow for a more comprehensive analysis and would integrate well with sector-specific applications of the tool.

#### *6.3.5 Applications and Utility*

The tool was initially envisioned as an analytical tool that could help to communicate and evaluate industrial land intensification. The addition of the intensification score allowed the measures in the tool to be quantified and opened up the possibility of additional applications.

Each participant brought their own perspective to this discussion of utility, trying to imagine how the tool could be integrated into their current professional practice. These discussions highlighted many of the difficulties with the tool and helped to identify areas for further research.

Participant views diverged on the applications and utility of the prototype tool. Overall there was consensus that the tool has utility as an analytical tool for communicating and evaluating intensification and serving to educate industrial land stakeholders and decision-makers on the expanded definitions and measures of industrial land intensification. In this capacity the tool could also support the pursuit of industrial land intensification policies in the region. The inclusion of multiple measures reinforces the different aspects of intensification and shows that industrial sectors intensify in different ways. Overall, as a communication tool it helps stakeholders see the whole picture and understand the relationships and trade-offs between different forms of intensification. This helps to bridge some of the gaps that exist between the perspectives of the various industrial land stakeholders.

Overall participants were not convinced of the utility of the tool as an index of industrial intensification using the intensification score. The idea of combining the various measures into a single score to provide a way of 'standardizing' intensification appealed to many. However, participants felt that there were two main obstacles that would prevent this from being achieved – a lack of data and comparability challenges. Both of these challenges have been discussed in the above sections. There is some work that could be done to clarify and improve the sources of data for some of the measures, but in the view of participants, getting data for throughput will remain unlikely. The challenge of fairness of comparison could be overcome by developing sector-specific tools.

#### *Other Applications of the Prototype Tool*

Interview participants were invited to suggest alternative applications of the prototype tool beyond those originally envisioned. Participants suggested numerous adaptations of the tool, most of which involved integrating the tool into municipal decision-making and application review processes.

Several participants felt that the tool's utility as an analytical tool could be extended by incorporating it into municipal decision-making and application review processes. Specifically, it was suggested that the tool could be adapted to serve a similar function to the Sustainability

Checklists that are used by some of the region's municipalities in development application processes. These checklists are composed of a series of questions that allow the applicant to demonstrate how they have met certain criteria. These checklists allow municipalities to introduce benchmarks, advance best practices, and to exercise some discretionary decision-making. A more detailed discussion on adapting the tool into a Checklist format can be found in Section 6.5 Future Directions.

In general, the proposed municipal applications of the tool were aimed at pushing industrial development towards greater intensity and supporting the implementation of future intensification policies. The tool also appealed to participants for its potential to support staff recommendations and aid municipal decision-making. Some specific examples that were given included justifying municipal infrastructure investments and tracking changes to intensity over time to assess the performance of an investment or policy.

The prototype tool is very much a planning tool. However, participants involved in industrial development also saw potential for the tool to help improve development outcomes. First, these participants welcomed the potential of the tool to introduce additional flexibility and discretion into development application processes. This flexibility could help to offset what they perceive to be rigid bylaws and regulation that fail to appreciate specific development contexts or user needs. Secondly, these participants were hopeful that the tool could evolve in such a way as to aid in public and private sector investment decisions by evaluating the intensification potential of sites and areas.

### *Scale of Application*

In general, participants were open to applications of the tool at a variety of different scales – site-level, area/district-level, and sector specific – since each would allow for different types of comparisons and inform industrial land policies, planning, and development in different ways. The sample applications of the prototype tool that were developed were all site-level applications. Site-level applications were selected to illustrate the capabilities of the tool primarily because there was readily available data to support such applications. However, many of the potential applications of the tool *are* site-level, particularly those related to development application review.

Several of the potential uses of the tool that were envisioned by participants require the tool to be applied on a larger scale, by industrial area or district. For example, participants

expressed interest in seeing intensification levels of an industrial area tracked over time as a way of understanding the impacts of policies or investments. An area or district-level application could potentially be achieved by totalling up the individual site scores to generate an average score for the area.

Finally, the development of sector-specific versions of the tool was seen as the way to overcome the problems of comparing applications of the tool across different industrial sectors. Separate tools for each sector with unique evaluation scales that acknowledge the specific characteristics and limitations of that sector would make comparisons within sectors possible and equitable. This scale of application could also facilitate the development of intensification best practices and benchmarks for each industrial sector, which would be a more practical approach than attempting to do the same for *all* industrial users.

### *Scope of the Tool*

Participants were divided on what the scope of the multi-variable tool should be. Some felt that due to the data availability and comparison challenges that were identified, that the tool should be limited to built-form and site usage – measures for which there is readily available data. Others argued that the tool should be expanded to include more measures that evaluate more aspects of intensification, even if this means creating a tool that is less quantitative and more qualitative.

The advantage of limiting the tool to built-form and land use measures is that since data for these measures is readily available, the tool would be more quantitative and could more easily be standardized into an index of intensification. The problem with this approach is that it does not advance intensification policy or practice beyond where it is now, because it does not capture all aspects of intensification. There was consensus among participants that it is important to incorporate all aspects of intensification into the analysis – built-form, site usage, and activity/throughput – because the form that intensification takes varies between industrial sectors.

The idea of expanding the tool to include more measures than were included in the prototype would ensure that all aspects of intensification are covered. To overcome the data constraints, this tool would necessarily have to be more qualitative and less quantitative. Furthermore, this approach could allow some measures to be broken down into multiple measures. For example, Outdoor Storage/Production could be split into numerous measures to

account for the efficiency or degree of use for all outdoor uses – storage, production, trailer manoeuvring, etc. There are examples of sustainability assessment tools in the literature discussed in Chapter 3 that incorporate many variables and use qualitative scales. For example, the Sustainable Built Environment Tool (SuBET) uses 70 unique indicators. This approach would require more work to understand each new measure and to develop an evaluation scale, either quantitative or qualitative.

## **6.4 Tool Refinement**

This section presents the refined *site-level* application of the prototype tool that resulted from the research process and the analysis of participant input. Refinements include adjustments to the measures in the tool, the evaluation scales, and the tool graphic. Final examples of the refined tool are shown at the end of the section in Figures 6.4 and 6.5. A discussion of additional applications, scales of application, and other adaptations of the prototype tool are discussed in detail in Section 6.5 Future Directions.

### ***6.4.1 Measures & Scales***

Discussed below are the refinements to each of the tool's measures and evaluation scales based on the research findings and participant feedback on the prototype multi-variable tool. The adjustments to the measures and scales are for a single, site-level version of the tool. Developing multiple, sector-specific tools and a tool to assess industrial land at different scales (i.e. area/district-level application) will require measures and evaluation scales to be redefined to more accurately reflect the characteristics of each sector and the scale of application.

#### ***Floor Area Ratio (FAR)***

There was unanimous support for including FAR measure in the tool. FAR is used in the industrial zoning of numerous municipalities to control density and it is a strong measure of built-form intensity.

#### ***Ceiling Height***

The importance of Ceiling Height as a measure of industrial land intensity is growing due to trends in industrial development towards higher ceiling structures and in industrial zoning

towards controlling density through ceiling height and setbacks rather than FAR. It was suggested during the tool refinement exercise that the evaluation scale for Ceiling Height should be adjusted to bring it in line with how the industrial real estate industry tracks industrial building inventories – ceiling heights of 0-20ft and ceiling heights of 20ft and over. This represents only a very small change to the measure’s evaluation scale (see Figure 6.1 and 6.2). The findings revealed that there may be merit in exploring a new measure related to ceiling height – building volume – to measure the additional cubic capacity or vertical productive space unlocked by higher ceilings.

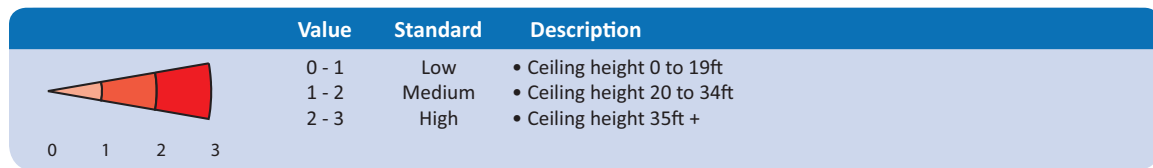


Figure 6.1: Original Ceiling Height Scale

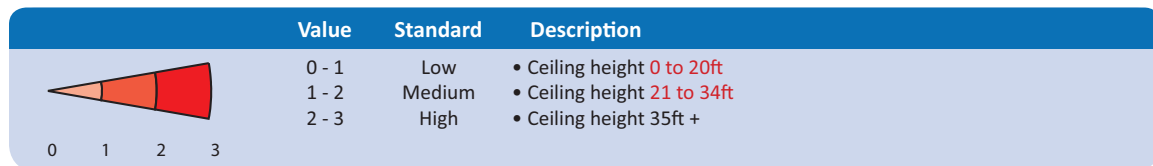


Figure 6.2: Adjusted Ceiling Height Scale

### *Number of Floors*

Based on strong feedback from interview participants, the Number of Floors measure has been removed from the prototype tool. The key aspects of built-form intensity (density) are already captured by the FAR and Ceiling Height measures – FAR already captures the additional floor space of multi-storey buildings and Ceiling Height captures the additional vertical productive space of higher ceiling buildings. The Number of Floors measure, while a quick assessment of relative density/built-form intensity, duplicates what FAR already measures and ultimately puts too much emphasis on multi-storey industrial development, something that this tool and research project have endeavoured to move away from. This reduces the number of measures in the prototype tool from 11 to 10.

### *Site Coverage*

The site coverage measure will remain in the tool without any alterations to the definition of the measure or to the current evaluation scale for the site-level application. As mentioned above, the trend in industrial zoning is to control density through ceiling height limits and setback requirements rather than specifying site coverage. Nevertheless, Site Coverage remains a good measure of the ratio of industrial building to land area.

### *Outdoor Storage/Production*

This measure was intended to evaluate and assign an intensification value to productive outdoor industrial areas. In the prototype tool, the evaluation scale and intensification score were based on the space available for Outdoor Storage/Production. However, interview participants noted that this measure should do more than simply assess the space *available* for outdoor storage/production, and instead evaluate the *quality or efficiency* of this usage. Future versions of the tool should incorporate a more qualitative evaluation scale that better measures the level or efficiency of outdoor storage/production. In the interim, the measure and scale remain unchanged.

### *Parking Innovation*

This measure generated a great deal of discussion and debate in the tool refinement exercise. While the potential for this measure to impact industrial land intensification was considered to be low, the parking innovation measure provides an opportunity to insert sustainable transportation considerations into the tool and the industrial land intensification discussion. As discussed in Section 6.3, additional work is required on this measure to develop an evaluation scale that can better differentiate between industrial sites and allow for a wider range of scores. As it is currently constructed, it is very difficult for a site to receive a 'high' score and it would be rare for a new development to receive a 'low' score, with the result being that the majority of sites would receive score 'medium'. In addition, future evaluation scales for this measure must consider the important connection between parking and public transportation. In the interim, the measure and scale remain unchanged.

Employment Density

The Regional Growth Strategy *Metro 2040* clearly prioritizes locating the majority of the region’s new jobs in Urban Centres and in Frequent Transit Development Areas. Nevertheless, industrial lands are intended to support regional employment, and intensification of industrial land use will result in higher employment densities in these areas. Employment Density remains an important measure, provided it is one of multiple measures of industrial land intensification. In future versions of the tool, the scale could be adjusted to express employment density as *jobs per acre* rather than *jobs per building area*. This adjustment would enable more equitable comparisons between sites and that the measure evaluates land use efficiency.

Accessory Use

The potential downsides to high levels of accessory use have been discussed. While not appropriate for all locations and contexts, higher levels of accessory use can introduce more activity to industrial lands and make more productive use of these areas. It will continue to be important for municipalities to control the levels of accessory use and the types of uses that locate to industrial lands. The initial scale developed for the prototype tool stopped at 49% accessory use. The implication was that accessory uses beyond 50% of the FAR on a site is not consistent with regional land use and employment land designations. To clarify this, the evaluation scale has been updated to illustrate the accessory use of 50% or higher would receive a ‘Low’ score (see Figure 6.3). In future versions of the tool, this scale could be adjusted to reflect the optimal accessory levels for a particular site or industrial sector and could incorporate a qualitative element that better acknowledges context and type of use.

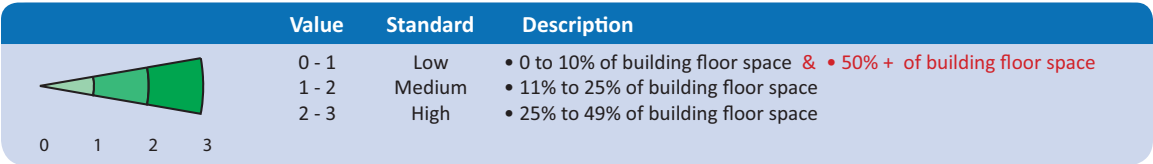


Figure 6.3: Adjusted Accessory Use Scale

### *Diversity of Businesses*

This measure has been retained in the tool. As discussed earlier, the intention of this tool was to capture the intensity of sites that house multiple industrial users, small-scale users, and different entry points for industry. Additional work needs to be done to better define this measure and the relationship between multiple users on site and industrial land intensification. Similar to Accessory Use, the *type of use* is more important than the *number of users*. In the interim, the measure and scale remain unchanged.

### *Throughput Measures*

Throughput is an important aspect of intensification; however, from a practical standpoint, getting data and being able to compare this data for these measures was prohibitive in the view of most participants. Nevertheless, participants felt that the inclusion of these measures in the tool was important to keep this aspect of intensification front of mind and part of the discussion, even without data. Future applications of the tool can choose to include throughput measures for discussion purposes or when data is available.

## *6.4.2 Tool Graphic*

The prototype multi-variable tool's graphic is central to its capacity to analyze and communicate industrial land intensification. Participants provided valuable input to help refine the tool graphic and ensure that it presents the analysis as intended. The following section presents the refinements to the tool graphic.

### *Colour*

The original prototype tool's circular graphic incorporated three colours – Red, Yellow and Green – to differentiate between the three categories of intensification. Input from participants noted that colours have meanings, and the choice of Red, Yellow, and Green could influence how the tool graphic is interpreted. In the updated graphic, a single colour family was selected. The colour chosen was purple, to match the colour used by Metro Vancouver in maps of the region's industrial lands.

### *Data Orientation and Labels*

For several participants, the original tool graphic was not intuitive, meaning that they did not read the orientation of the data (intensity) in the way that was intended. In the refined tool graphic below, the following adjustments were made: (See Figures 6.4 and 6.5).

- The labels for each measure were extended outward from the centre of the tool, in-line with the intensification measure or score;
- The measures with no data (throughput measures) were clearly labelled to avoid any confusion with measures that receive a '0' or nil score.
- Arrows were added to the tool to make the direction of the intensification score clear, from low to high;
- A simple legend was also added to reinforce the arrows and colour gradient that indicate the direction of intensification;
- Labels for the three intensification categories were added to make it clear which aspects of intensification that each measure addresses, and to ensure consistency with the secondary graphic of the intensification score.

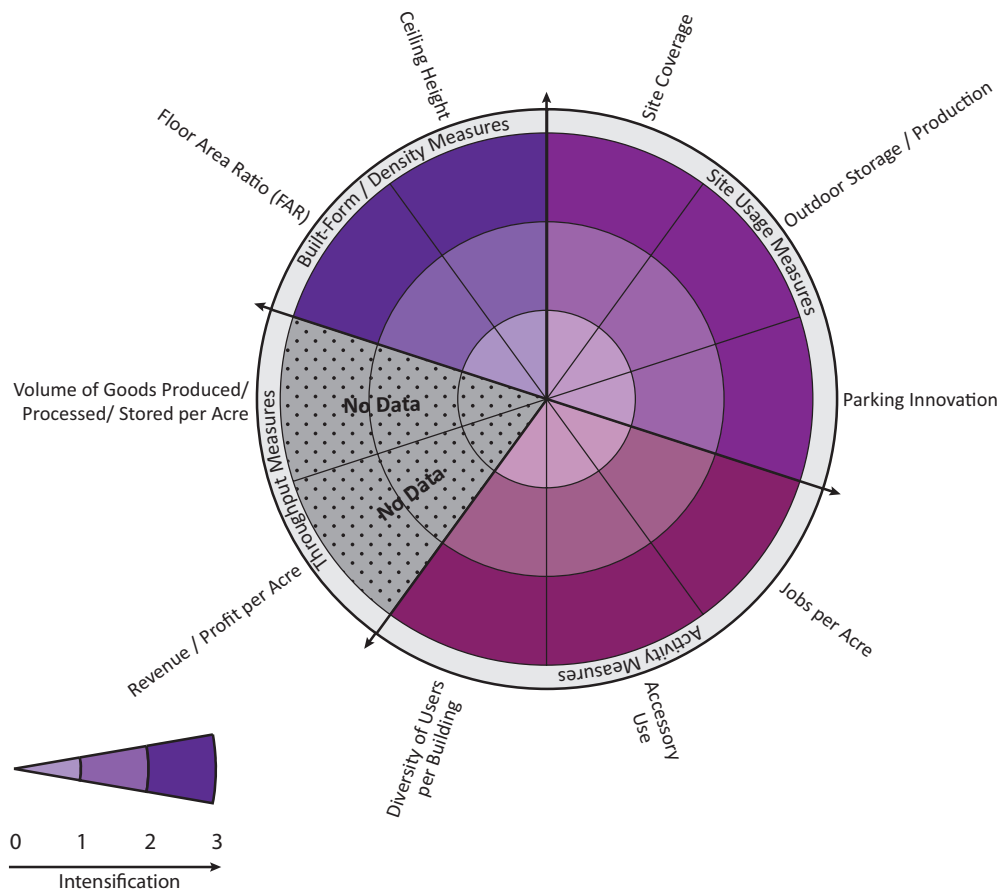


Figure 6.4: Refined Tool Graphic, All Measures

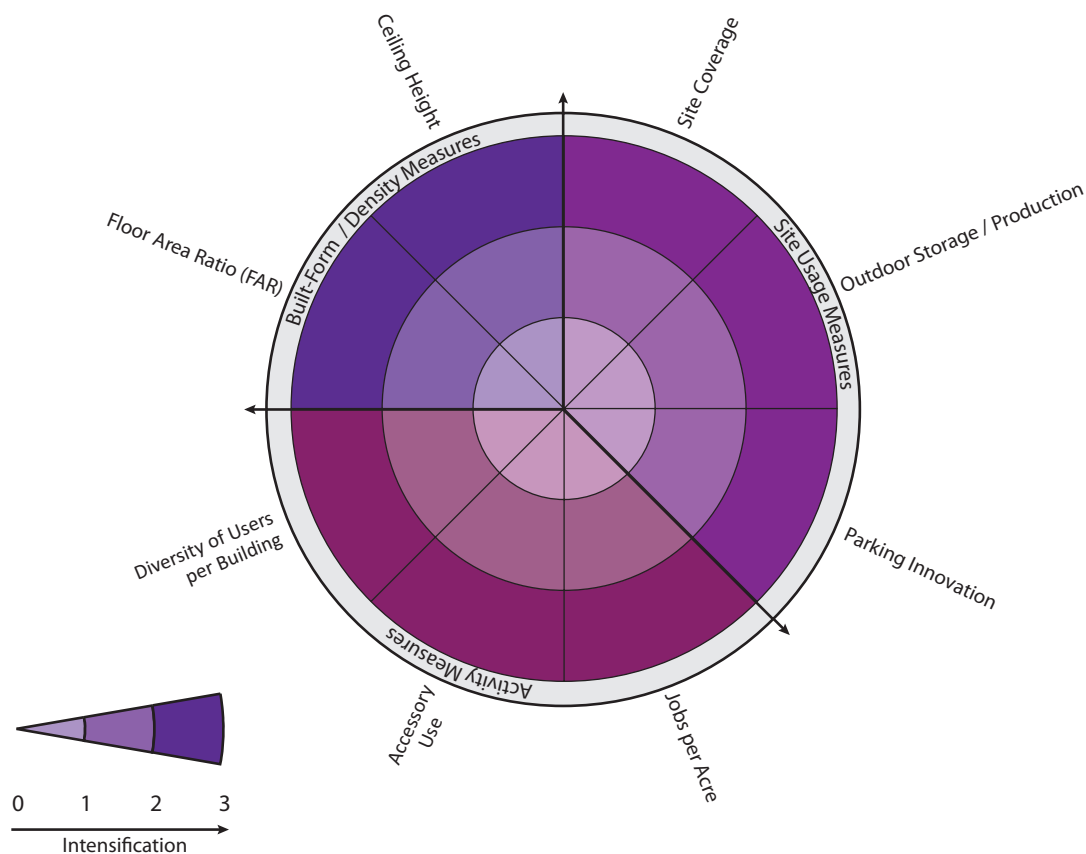


Figure 6.5: Refined Tool Graphic, without Throughput Measures

### Secondary Graphic

The secondary graphic accompanied the primary graphic and illustrated the intensification score for each category of intensification as well as the total score. The new version (Figure 6.6) has been updated to reflect the new colour scheme of the primary graphic. As mentioned above, labels for each of the intensification categories were added to the primary graphic to more clearly link the two tool graphics. An alternative way of presenting this data was suggested during the tool refinement exercise (see Figures 5.5 and 5.6 in Section 5.3.4). This alternative version of the secondary graphic presents the intensification category scores as a 'profile' and does not incorporate a 'total score'. An updated sample of the proposed *alternative* graphic is provided below (Figure 6.7).

Intensification Score		
●	Built Form	8
●	Site Usage	4
●	Activity	7
<b>TOTAL</b>		<b>19</b>

Figure 6.6: Updated Secondary Graphic, Intensification Score

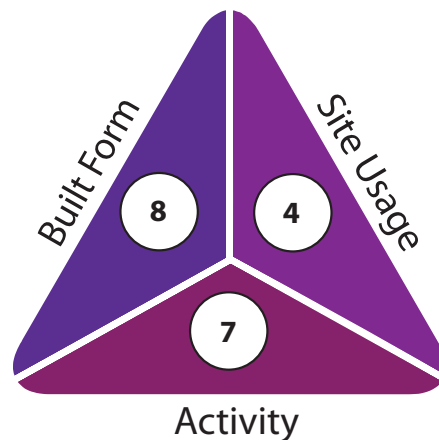


Figure 6.7: Alternative Secondary Graphic, Intensification Score

## 6.5 Future Directions

The following section discusses some of the elements of the tool that were raised in the *Conclusions* and *Tool Refinement* sections of this chapter and describes the next steps for the prototype tool. The section focuses on what would be necessary for future versions of the tool to have practical applications and for these versions of the tool to be integrated into planning and development practices. In addition to identifying what the potential future directions of the prototype tool are, this section also suggests which stakeholders might take up the challenge of developing the future iterations of the tool.

### 6.5.1 Developing Multiple Tools

#### *Sector Specific Tools*

One suggestion from interview participants to address the comparability challenges associated with a single tool was to develop multiple tools that better acknowledge

development context and industrial sector characteristics. Several different ideas for how the prototype tool could be developed into separate tools were put forward that would allow for more equitable comparisons between different industrial sectors with varying potential to intensify:

- Urban – Suburban
- Large site – Small site
- Sector-specific

The *urban-suburban* version of the tool would develop two separate tools, one with evaluation scales that represent typical urban industries/forms and one for suburban industries. Similarly, the *large site-small site* version would develop separate scales for industrial sites of different sizes. The intention of both of these suggestions was to find a simple way to avoid comparing industries or industrial contexts that are very different. While the *urban-suburban* and *large site-small site* tools provide a simpler solution because only two tools have to be developed for each, they would likely fail to adequately account for the important differences between industries and facilitate the fair comparisons that industrial land stakeholders require. There was consensus among participants that developing separate tools for each industrial sector would be the best approach. While this approach requires more time and effort to develop the multiple tools, it is a more effective way to acknowledge the unique characteristics of different industries.

Part of the process of developing sector-specific tools would be to determine how many versions of the tool are required and for which industrial sectors. The number of tools could be based on broad classifications of industrial buildings, for example:

- Warehouse / Distribution Centres
- Freight Forwarding / Cross-docks
- Manufacturing / Assembly
- Flex-space / Multi-tenant

The total number of different tools would need to be determined by industrial stakeholders as part of a collaborative approach to ensure that all industrial uses and users are captured. Similarly, for each sector-specific tool to have credibility the process of developing each must take a collaborative, multi-stakeholder approach. An important first step would be to define what ‘intensification’ means to each industrial sector. These definitions could then be used to determine the measures best suited to assess intensification for that particular sector and to identify data sources to support each measure. This step would be an opportunity to

explore additional measures not included in the prototype tool. New evaluation scales would need to be developed for each measure in each version of the tool to reflect the characteristics and intensification potential for that measure in that sector. There would also be an opportunity to expand the scales, adding a finer-grain to allow for more differentiation between sites. For example, the scale could be a 5-point scale rather than the current 3-point, low-medium-high scale. Finally, depending on the measures selected and the data sources identified, both quantitative and qualitative evaluation scales could be developed.

#### *Area/District-Level Application:*

A significant take-away from the interview process was that an area/district-level application would be valuable to regional decision-making, policy-making, and plan implementation. This scale of application is an important evolution of the tool that could help planners and decision-makers assess progress and effectiveness of intensification policies. Some of the potential uses of an area/district-level application of the tool include: tracking progress of intensification, evaluating the success of intensification policies, comparing the intensification levels of industrial areas within the region, and evaluating or justifying infrastructure investments.

More work needs to be done to determine how the site-level version of the tool can be scaled-up to a larger area. One option could be as simple as tallying up all of the individual site measures within a specified area to provide a per acre average assessment of a larger area. For this approach to be effective there would need to be complete data for all of the individual sites within the defined area. This approach also assumes that there is a single tool to evaluate all types of industrial sites and sectors (i.e. not multiple, sector specific tools).

Another option would be to develop a version of the tool specifically adapted to the area/district scale. This approach may be most appropriate if a multiple-tool approach is applied to site-level evaluations or if there is incomplete data for the industrial area/district being evaluated.

#### *Intensification Potential*

The prototype tool developed for research project was designed to evaluate *current* intensification. However, the prospect of measuring the intensification “potential” of industrial land came up repeatedly during the research process. Being able to evaluate the intensification

potential of industrial areas relative to one another and tracking this over time would enable local governments to more effectively plan infrastructure investments and would also help industrial developers and users with location and investment decisions.

Metro Vancouver, specifically the Planning, Policy, and Environment Department, has been leading the regional discussion on industrial land intensification. Their work in this area has included intensification analyses, stakeholder workshops, discussion papers, and ongoing monitoring of industrial land supply, utilization and demand. They are also exploring ways to measure current and potential industrial intensification. Metro Vancouver is the natural stakeholder to take up the challenge of bringing the prototype tool to the next level by developing some or all of the proposed versions of the tool – sector-specific, area/district, and intensification potential.

### *6.5.2 Integrating the Tool into Planning Practice*

An important next step in the evolution of this tool will be transitioning from an academic exercise to a practical planning tool. In addition to the applications discussed in the section above, two other adaptations of the tool emerged from the research process – an intensification rating system and an intensification checklist.

#### *An Industrial Land Intensification Rating System*

During the tool refinement exercise, several participants drew parallels between the prototype tool and LEED (Leadership in Energy & Environmental Design). In the view of these participants the multi-variable tool could potentially be to industrial land intensification what LEED is to sustainable development. LEED was also referenced in the discussion of sustainability assessment tools as part of the Chapter 3 Tool Development section.

There are some important differences between LEED and the prototype multi-variable tool. First and foremost, LEED is a voluntary, market-driven tool. Conversely, the industrial land intensification equivalent would likely only be possible as part of a regulatory framework that incorporates some combination of targets and incentives for intensification. As was noted earlier, no such framework exists, nor are there any efforts underway to create one.

Secondly, as one participant noted, the objectives of LEED (to promote the design, construction and operation of sustainable buildings) are more clearly defined than the objectives of industrial land intensification. That intensification means different things to

different industrial sectors and users would be problematic when attempting to adapt the tool in this way.

These challenges aside, there could be merit to pursuing this adaptation of the tool. Pursuing a LEED-like tool would allow for more measures to be included and for the introduction of more qualitative evaluation scales for some measures of intensification. Like LEED, the tool could be organized by broad categories (intensification categories – built-form, site usage, activity) and then broken down into sub-categories, with each sub-category or measure receiving a score. The numerous sustainability assessment tools reviewed when developing the prototype tool each utilize broad categories made up of numerous sub-categories or indicators that are then scored (See Figure 6.8). For example, RISE uses 50 parameters summarized into 12 indicators; SALD uses 40 indicators organized under 5 broad categories; SuBET uses 70 indicators arranged under 10 categories; and SVM uses 24 indicators to score three broad areas of sustainability. By comparison LEED uses 7 categories to score a site. The initial prototype multi-variable tool incorporated 11 measures (revised to 10) representing 3 intensification categories.

Sustainability Assessment Tools	Criteria	Categories
<b>LEED</b> (Leadership in Energy & Environmental Design)	53	7
<b>RISE</b> (Response-Inducing Sustainability Evaluation)	50	12
<b>SALD</b> (Sustainability Appraisal of Land Development)	40	5
<b>SuBET</b> (Sustainable Built Environment Tool)	70	10
<b>SVM</b> (Sustainability Value Map)	24	3
<b>Prototype Multi-Variable Tool</b>	<b>10</b>	<b>3/4</b>

Figure 6.8: Sustainability Assessment Tools Criteria and Categories

In this adaptation of the tool, the same weighting, comparison, and fairness concerns emerge; however, these could be addressed by developing sector specific tools. Ultimately, the objective would be to create a rating system that integrates with a regulatory framework for intensification and ultimately rewards progressive industrial development that helps achieve the region’s intensification goals. Awarding certifications to developments that meet certain benchmark scores could also have value, similar to LEED’s Silver, Gold, and Platinum certifications.

Adapting the tool in this way would require a great deal of work. Choosing measures and defining measurement scales would need to be done through a collaborative, consensus-based approach with all industrial land stakeholders. NAIOP has taken a prominent role in the

region's intensification discussion, conducting industrial land supply research and other activities to support the region's industrial users and developers. NAIOP could be the natural choice to take on the challenge of adapting the tool in this way.

#### *An Industrial Land Intensification Checklist for Municipalities*

As discussed earlier, participants saw numerous uses for the prototype tool in municipal settings. The most promising of these suggestions was the idea of adapting the tool to perform a similar function as the Sustainability Checklists that are used by some of the region's municipalities in development application processes. The tool could be adapted into a series of questions that help staff assess the level of intensity of a proposed industrial development, and give the applicant opportunities to demonstrate how the development helps meet intensification objectives. An industrial land intensification checklist could help municipalities introduce benchmarks, advance industrial development best practices, and to exercise some discretionary decision-making. Figure 6.8 shows an example of what part of a checklist could look like.

4. Responsible Transportation				Yes	No	N/A	Comments	Staff Rating
o. Is located within proximity to an existing transportation node								
p. Minimizes the amount of surface parking								

Figure 6.9: Sample Questions from a Sustainable Community Development Checklist (Source: City of Port Moody, A Checklist for Sustainable Community Development). Image courtesy of the City of Port Moody. Used with permission.

Several participants felt that if the tool were to be adapted in this way, that the analysis should avoid using a total score for intensification, instead allowing for a more qualitative assessment of intensification that factors in the specific context of the site and the industrial user. Adapting the tool into this format would require significant work should follow a multi-stakeholder approach.

The City of Surrey currently utilizes a Sustainability Checklist as part of development application review processes and also happens to be home to approximately one-third of the region's remaining vacant industrial land. The City of Surrey could be the municipality to adapt the multi-variable tool into a checklist.

## **6.6 Assessment of Research Methodology**

This research methodology of this practicum employed a combination of literature review and semi-structured interviews to help inform the project's conclusions, refine the multi-variable tool, and develop future directions for research and the prototype tool.

The literature review was an integral part of developing the prototype multi-variable tool, helping to establish the measures, evaluation scales, and the tool graphic. Preliminary versions of the tool were first refined through an iterative process with the practicum committee before being presented to industrial land stakeholders and experts as part of a semi-structured interview process and tool refinement activity. The semi-structured interviews generated high quality data from a diverse group of participants that would otherwise have been difficult to attain using alternative methods. The free-flowing nature of the interviews allowed for candid responses and enabled participants to focus on the areas that they felt were most important. The interviews ranged in duration from 30-60 minutes. The diverse views represented by the interview participants were instrumental in developing a refined tool. Participants provided practical feedback on the construction (measures and scales) and utility of the tool, which was invaluable when attempting to find ways to integrate the tool into current planning practices.

While the data generated was excellent, due to the broad scope of the project and the complexity of the tool (scales and measures), not all participants were able to address the research questions evenly. Additionally, while interview participants were provided with the interview package well in advance of each interview, the degree to which participants familiarized themselves with this content prior to the interview varied considerably. These varying degrees of engagement affected the level of input detail received, particularly with respect to refining the tool's measure and scales. Another difficulty of the semi-structured interview format was that new ideas or themes raised by participants were only raised in

subsequent interviews, which prevented some participants from having the opportunity to comment on some of the new ideas or themes raised by others.

Overall, the research methodologies used to explore definitions and measures of intensification and to refine the prototype multi-variable tool were successful in addressing the research questions, informing the conclusions, refining the tool, and developing future directions for the tool. Semi-structured interviews were an effective method for generating preliminary expert feedback on the prototype tool. However, for any subsequent research or efforts to refine or adapt the prototype tool, it is suggested that alternative research methods, such as focus groups, be utilized to allow for a focused discussion and the sharing of ideas between the same diverse industrial land stakeholders included in this research.

## **6.7 Final Thoughts**

The objective of this research practicum was to develop expanded definitions and measures of industrial land intensification, and to refine a prototype multi-variable tool that could serve to communicate these definitions and measures and also facilitate the evaluation of industrial land intensification. The resulting analysis produced a refined prototype tool as well as suggested future directions for the evolution and application of the tool.

The research findings make it clear that multiple definitions and measures of industrial land intensification are necessary in order to achieve equitable industrial intensification policies for the Metro Vancouver region. However, it was also apparent from the research that developing these definitions and measures, obtaining the necessary data to support them, and ultimately integrating these concepts into planning practice will continue to pose challenges.

The tool refinement exercise helped to produce an improved prototype tool, including enhanced measures, evaluation scales, and tool graphic. In addition to improving the site-level application of the tool developed for this research, this process also identified additional areas where the tool (or versions of the tool) could be practical and what might be required for these adaptations of the tool to be realized. The comparison and fairness challenges that were articulated in the research can be addressed in part by developing multiple, sector-specific versions of the tool. In addition, the findings underscored the value of developing an area/district-level application of the tool to help facilitate the evaluation of industrial areas, rather than just industrial sites.

The research also sought to uncover how the prototype tool could be integrated into current planning and development practices. Two potential adaptations of the tool emerged – an intensification rating system and the adaptation of the tool into a checklist to be integrated into municipal development application processes. There is no single *measure* of industrial land intensification, nor does there seem to be a single *tool* to evaluate industrial land intensification.

Overall, this research practicum achieved its objective of advancing the industrial land intensification discussion in the Metro Vancouver region and informing future intensification policies in the region. The potential adaptations of the prototype tool present additional opportunities to shape the development of industrial land in Metro Vancouver and beyond.

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## Appendix A | Interview Guide

### Interview Guide

#### Defining & Measuring Intensification

1. Drawing on your professional experience, how do you define industrial land intensification?
2. What are some of the forms that industrial land intensification can take, and how can these forms of intensification be measured?
3. How can alternative definitions and measures of intensification be incorporated into industrial land policies and bylaws to ensure that the diversity of industrial land users' needs are considered?

#### Prototype Multi-Variable Tool Revision Exercise

##### *Tool Construction - Measures, and Scales*

1. Please Comment on the measures selected for inclusion in the prototype multi-variable tool and their potential to evaluate and communicate various forms of intensification.
2. A scale has been developed for each measure of intensification included in the tool. Please provide comments on the construction of these scales, including any suggested improvements.

##### *Tool Application and Utility*

3. Discuss some of the strengths and limitations of the prototype multi-variable tool.
4. In your opinion can the multi-variable tool help to communicate a broader definition and understanding of industrial land intensification?
5. In your opinion how could this tool be used to help achieve intensification goals and to inform industrial land intensification policies?
6. The sample application of the prototype tool is a site-level application. Do you see value in applications at other scales, such as industrial districts, industrial sectors, or to evaluate industrial intensification potential of a given site, district, or sector?
7. The prototype multi-variable tool is designed as primarily an analytical tool to help better communicate a more complete picture of industrial land intensification. The tool also has the potential as a composite index that provides an overall intensification rating based on a "total score", which may more easily facilitate comparisons between applications. Do you see merit in the tool as a composite index, and in what ways could the tool be improved to achieve this function?

## Appendix B | Interview Participant Package

### Prototype Multi-Variable Tool - Introduction

#### Tool Objective

The goal of industrial land intensification is to make more productive and efficient use of industrial lands. Intensification refers to both density (built form) and intensity (activity) on a given area of land. One of the objectives of this research project is to develop and refine a prototype tool that can help planners, decision-makers, and industrial land stakeholders better understand, measure, and communicate industrial land intensification. The intention of this multi-variable tool is to inform the development of policies that can facilitate the required intensification of industrial lands in Metro Vancouver in ways that meet the diverse needs of industrial users while also allowing for the continued innovation and evolution of the region's economy.

#### Tool Description

The prototype multi-variable tool developed as part of this research project attempts to introduce a new method of measuring and communicating the various forms of intensification that exist in the industrial land context. The tool is based on and adapted from applications of circular histograms or rose-diagrams used in sustainability planning. The tool is comprised of multiple variables or measures that assess the various forms of intensification found in industrial lands. When these measures are viewed together, a more complete picture and understanding of industrial land intensification can be achieved. It is hoped that the multi-variable tool advanced as part of this research can be utilized and adapted by planners and decision-makers to assist in the development and communication of industrial land intensification policies.

#### Tool Review and Refinement Exercise

The purpose of the following exercise is to refine the prototype multi-variable communication tool that has been developed as part of this research. Attached you will find a sample application of the multi-variable tool and a description of the scale used for each measure. This sample will be used to illustrate the potential of the tool and to guide the tool refinement exercise and subsequent discussion.

Your input is being sought on the tool's construction and application – including the measures selected and the scales developed for each measure. In addition, you will be asked for your feedback on the potential utility of the tool in industrial land use planning, other potential applications, and adaptability to other jurisdictions.

#### Tool Limitations

It is acknowledged that the prototype multi-variable communication tool has limitations in practice. It is expected that these limitations will be a central part of the discussion and tool refinement exercise. Some of these limitations include:

- No single measure can adequately evaluate industrial land use intensification.
- Not all measures are suitable for all industrial users or industrial sub-sectors.
- The availability of data was influential in determining which measures were included in the tool and which were not.
- There was a high degree of subjectivity in the development of each scale and scoring of measures on the scales for the sample application.
- The sample tool and application have been developed specifically for the Metro Vancouver industrial land use context.
- In some instances, a "high" score for a particular measure may not result in "desirable" forms of intensification.

#### Contact

Researcher: Ryan J. Gilmore, University of Manitoba

Research Supervisor: Dr. David van Vliet, University of Manitoba

April 2014 Not for distribution

# Prototype Multi-Variable Tool - Reading the Tool

## Reading the Tool

The prototype multi-variable tool is based on and adapted from applications of circular histograms or rose-diagrams frequently used in sustainability planning. The tool is comprised of multiple variables or measures that assess the various forms of intensification found in industrial lands. When these measures are viewed together, a more complete picture and understanding of industrial land intensification can be achieved.

Each variable or measure is represented by a wedge on the circular diagram. The scale of each measure extends outwards from the centre, meaning that the farther away from the centre that a variable scores, the higher the intensity score. The prototype tool uses a 3-point scale that scores the performance of each measure as low, medium, or high. The scales for each measure are not equivalent and are independent of one another. In addition, the tool incorporates both qualitative and quantitative data.

Comparisons of different applications of the tool can be made in two ways – by comparing the tool visuals side-by-side or by comparing intensification scores.

## Intensification Score

The intensification score allows for easy comparison between applications of the tool across three categories of intensification, as well as total score. The three categories of intensification are *built form*, *site usage*, and *activity*. Measures scoring high on each evaluation scale receive a score of 3, medium 2, low 1, and nil 0. The sum of these scores produces the scores for each intensity category and the total score.

Each category of intensification is composed of several measures:

**Built Form** – FAR, Ceiling Height, and Number of Floors  
**Site Usage** – Site Coverage, Parking, Outdoor Storage/Production  
**Activity** – Accessory Use, Jobs per area, Diversity of Businesses, Business Revenue/ Profit per area, Volume of Goods Produced/ Processes/ Stored per area.

Intensification Score	
Built Form	8
Site Usage	5
Activity	7
<b>TOTAL</b>	<b>20</b>

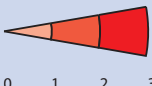
Note: The maximum possible intensification score for the prototype multi-variable tool is 33. However, achieving a perfect score of 33 is extremely difficult due to the inverse relationships of some variables. For example, a site that scores “high” on *site coverage* will likely not score “high” on *outdoor storage/production*. Additionally, a site that scores “high” on *ceiling height* will likely not score “high” on *number of floors*. These are examples of the trade-offs that exist in the industrial land context and the capacity of the tool to illustrate these trade-offs.

## Prototype Multi-Variable Tool - Measurement Scales

A scale was developed for each measure selected for inclusion in the prototype multi-variable tool. The scales were determined based on a review of literature and current practices and have been used to score each measure of intensity as either low, medium, or high. It is acknowledged that there is a high degree of subjectivity in both the development and scoring of each measure. The intention is that both the scale development and scoring for each measure will be discussed and refined as part of this exercise.

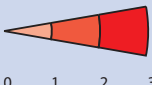
### Floor Area Ratio (FAR)

Floor Area Ratio (FAR) is commonly used to control density (built form), relating the floor area of a building to the area of the site. The typical industrial building in Metro Vancouver has an FSR of approximately 0.3.

	Value	Standard	Description
	0 - 1	Low	• FAR 0.0 to FAR 0.3
	1 - 2	Medium	• FAR 0.31 to FAR 0.5
	2 - 3	High	• FAR 0.51 +

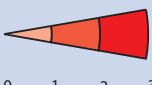
### Ceiling Height

Ceiling height is a measure of the average ceiling clearance for an industrial building. Higher ceilings permit more efficient or intense use of a given industrial floor plate. Ceilings of 36ft are typically the highest seen in Metro Vancouver based on current development economics.

	Value	Standard	Description
	0 - 1	Low	• Ceiling height 0 to 19ft
	1 - 2	Medium	• Ceiling height 20 to 34ft
	2 - 3	High	• Ceiling height 35ft +

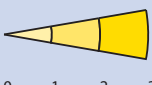
### Number of Floors

This is simply a measure of the number of floors in a building. The typical industrial building in Metro Vancouver is 1-storey. Buildings with multiple floors most often have an accessory component, often in the form of a partial or full mezzanine level. Industrial buildings of 3 or more storeys remain rare in Metro Vancouver.

	Value	Standard	Description
	0 - 1	Low	• 1 storey
	1 - 2	Medium	• 2 storeys
	2 - 3	High	• 3 storeys and higher

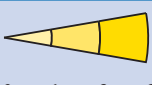
### Site Coverage

Site coverage measures the amount of a site that is covered by a building, with the remainder of the site devoted to open space for storage, landscaping, parking, and driveways. The site coverage of a typical industrial building in Metro Vancouver is 30%.

	Value	Standard	Description
	0 - 1	Low	• Site coverage 0 to 30%
	1 - 2	Medium	• Site coverage 31 to 50%
	2 - 3	High	• Site coverage 51% +

### Outdoor Storage/Production

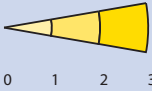
Many industrial sectors use outdoor space productively, for loading, manoeuvring, storage, and production. This measure attempts to quantify the amount of a given industrial site that is devoted to productive outdoor storage and production (excluding private vehicle parking). The scale was developed using numerous sample industrial sites in the Metro Vancouver region.

	Value	Standard	Description
	0 - 1	Low	• Outdoor storage/production site coverage 0 - 10%
	1 - 2	Medium	• Outdoor storage/production site coverage 11 - 40%
	2 - 3	High	• Outdoor storage/production site coverage 41% +

## Prototype Multi-Variable Tool - Measurement Scales

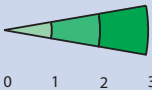
### Parking Innovation

The parking innovation measure attempts to evaluate the amount of given industrial site that is devoted to personal vehicle parking. This measure operates on the premise that personal vehicle parking is not the best use of industrial lands. Therefore, any steps taken that reduce the land devoted to parking, either through reductions to required parking or the incorporation of parking into the design of the building, would be considered more intensive use of industrial land by this measure.

	Value	Standard	Description
	0 - 1	Low	• Parking in excess of that required by zoning
	1 - 2	Medium	• Parking equal to that required by zoning +/- 5%
	2 - 3	High	• Parking located underground, on the roof, or reduced below level required by zoning

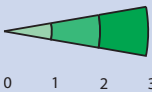
### Building Floor Space per Job

This measure evaluates the employment density of a given industrial site by measuring the amount of building floor space per FTE (full-time employee). The scale was developed based on a review of relevant literature on industrial employment densities.

	Value	Standard	Description
	0 - 1	Low	• 1001+ sq ft/job
	1 - 2	Medium	• 401 - 1000 sq ft/job
	2 - 3	High	• 0 - 400 sq ft/job

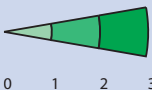
### Accessory Use

The accessory use measure evaluates the amount of building floor space of a given industrial building that is devoted to accessory or ancillary uses. The scale was developed through a review of relevant literature. The "maximum" accessory use for this measure has been set at 49% as this represents the typical maximum allowable. Additionally, if floor space for accessory use were to exceed that of the primary industrial use, it would then arguably no longer be accessory or ancillary to the primary industrial use.

	Value	Standard	Description
	0 - 1	Low	• 0 to 10% of building floor space
	1 - 2	Medium	• 11% to 25% of building floor space
	2 - 3	High	• 25% to 49% of building floor space

### Diversity of Businesses per Site

This measure simply measures the number of businesses on a given site. For the purposes of this measure, a "business" is defined as a separate unrelated business (i.e. not simply a separate legal business or division within a larger company).

	Value	Standard	Description
	0 - 1	Low	• 1-2 users per site
	1 - 2	Medium	• 3-4 users per site
	2 - 3	High	• 4+ users per site

### Business Activity and Throughput Measures

Ideal measures of intensity or efficiency of industrial land use would be measures of the value or volume of goods manufactured, processed, stored, shipped through a site, or measures of economic output, activity, or spinoffs of industrial land activity. Two measures of business activity or throughput have been included in the multi-variable tool:

- *Business revenue/profit per acre*
- *Volume of goods produced/processed/stored per acre*

Unfortunately, data for these measures is difficult to acquire and the values for each measure are very industry specific. Additionally, the scales for these measures would vary greatly by industrial activity. However, these measures could potentially be practical if the tool is adapted and applied to a specific industrial sector and used for comparisons within that sector. It is for this reason and for discussion purposes that they have been included in the prototype tool.

## Prototype Multi-Variable Tool - Sample Application

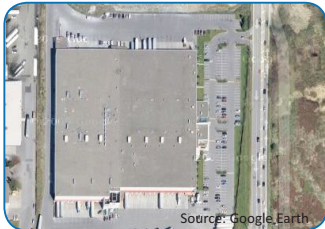
### Colebrook Business Centre

15110 54A Avenue, Surrey, BC

The Colebrook Business Centre is located in a I-B (Business Park) zone that allows for a variety of light industrial, office, and service oriented uses. The building houses a FedEx distribution and vehicle repair centre on the lower floor and a number of flex space units on the upper floor. The unique grade of the site enabled the construction of a multi-level building that is accessible on two separate levels. The flex spaces can be reconfigured to up to 6 separate units (Metro Vancouver).

Measure	Value	Score
Floor area ratio (FAR)	0.63 FAR	High
Site coverage	35%	Medium
Ceiling height	26ft	Medium
Number of floors	2	Medium
Outdoor storage/production	not permitted	nil
Parking innovation	154 spaces	Medium
Building floor area per job	1917 sq ft/job	Low
Accessory use	43%	High
Diversity of users per building	4 users	High
Revenue/profit per building floor area	data not available	-
Volume of goods produced/processed/stored per building floor area	data not available	-

Source: Metro Vancouver



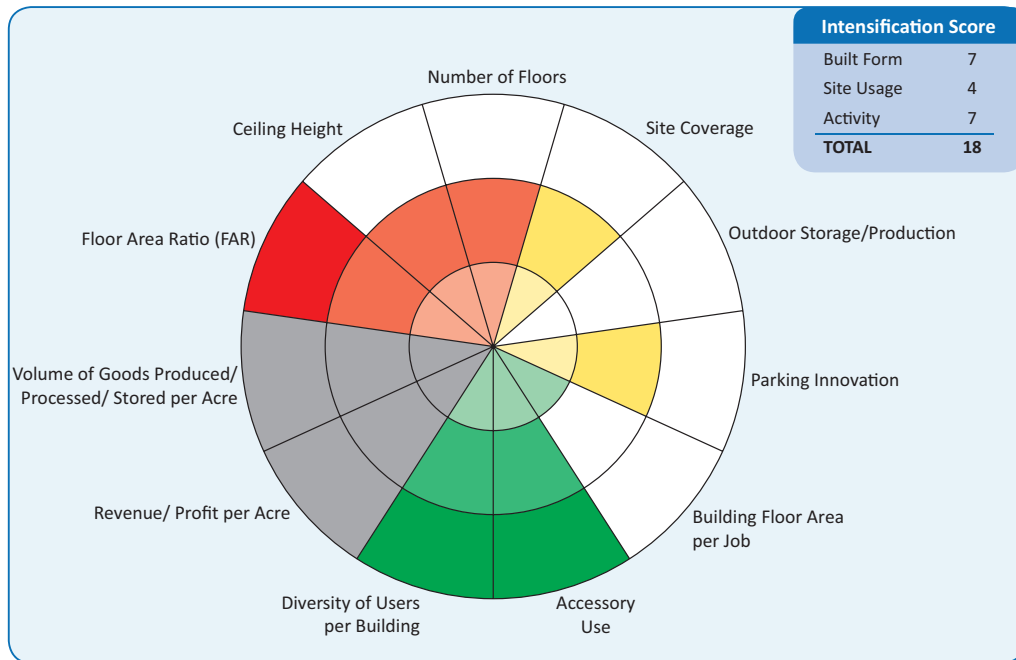
Source: Google Earth



Source: Metro Vancouver



Source: Metro Vancouver



## Prototype Multi-Variable Tool - Sample Application

### HBC Logistics Distribution Ctr.

18111 Blundell Rd, Richmond, BC

HBC Logistics is located in an I Industrial zone that permits a broad range of general and heavy industrial uses. The building houses a large logistics / distribution centre. There are loading bays on three sides of the building with an office component located at the front. The perimeter of the site provides for truck and trailer parking. This site is an example of a high volume warehouse / logistics / distribution operation. (Metro Vancouver)

Measure	Value	Score
Floor area ratio (FAR)	0.35 FAR	Medium
Site coverage	35%	Medium
Ceiling height	35ft	High
Number of floors	1	Low
Outdoor storage/production	Trailer Parking/Loading	High
Parking innovation	376 space	Medium
Building floor area per job	1315 sq ft/job	Low
Accessory use	Small Office Component	Low
Diversity of users per building	1 user	Low
Revenue/profit per building floor area	data not available	-
Volume of goods produced/processed/stored per building floor area	data not available	-

Source: Metro Vancouver



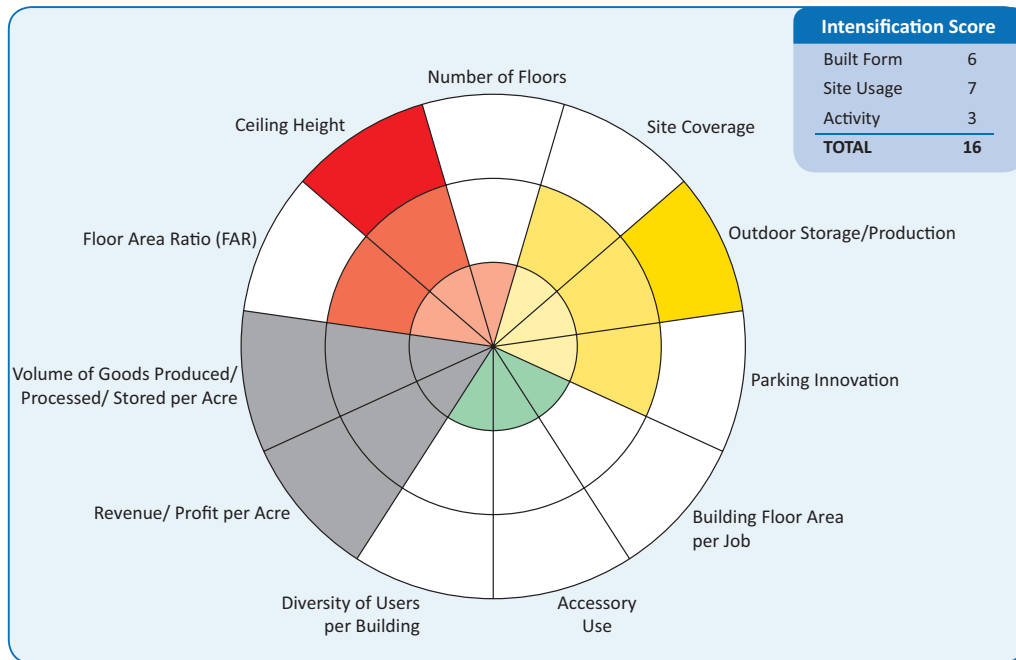
Source: Google Earth



Source: Metro Vancouver



Source: Metro Vancouver



## Prototype Multi-Variable Tool - Sample Application

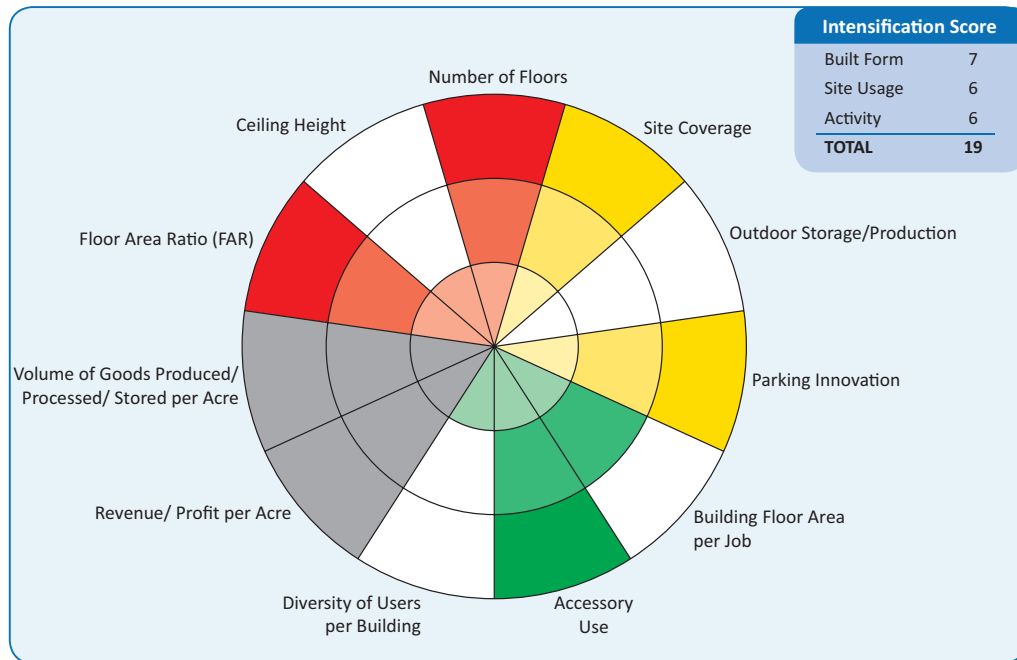
### MP Lighting

16 West 4th Ave, Vancouver, BC

MP Lighting is located in an I-1 zone that permits light industrial uses as well as accessory office. The building has three levels with parking located underground. There is a small reception area on the ground floor with storage and loading at the rear of the building. The upper two floors house the company's design, manufacturing, administration, and sales operations. The site is an example of an intensely used site that combines multiple functions for a single user in multi-level building. (Metro Vancouver)

Measure	Value	Score
Floor area ratio (FAR)	2.98 FAR	High
Site coverage	99%	High
Ceiling height	12-15ft	Low
Number of floors	3	High
Outdoor storage/production	None	nil
Parking innovation	Underground	High
Building floor area per job	513 sq ft/job	Medium
Accessory use	up to 1/3	High
Diversity of users per building	1 user	Low
Revenue/profit per building floor area	data not available	-
Volume of goods produced/processed/stored per building floor area	data not available	-

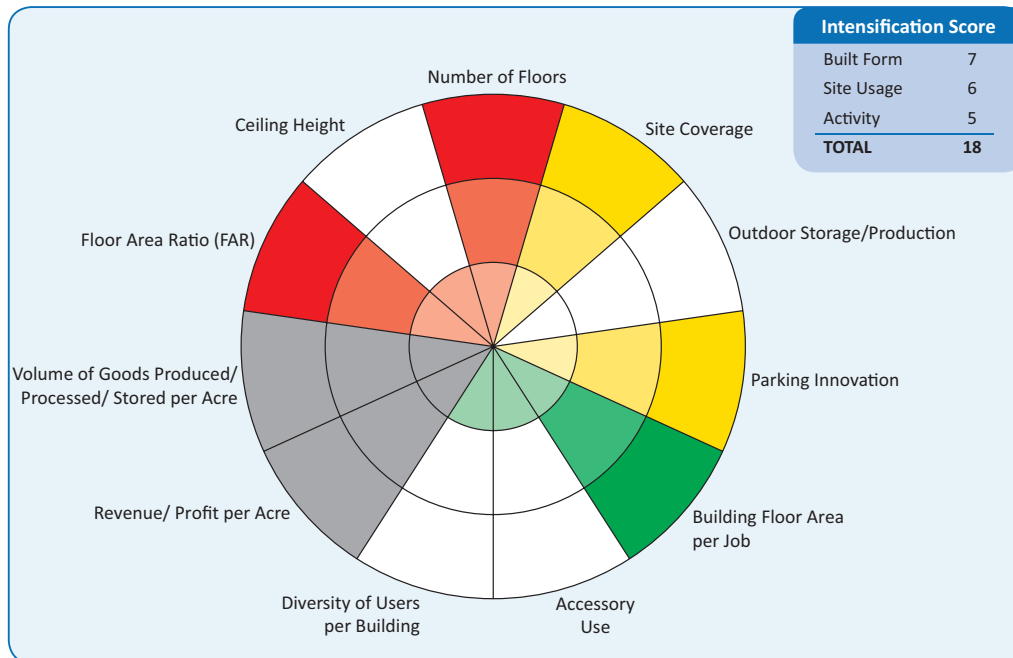
Source: Metro Vancouver



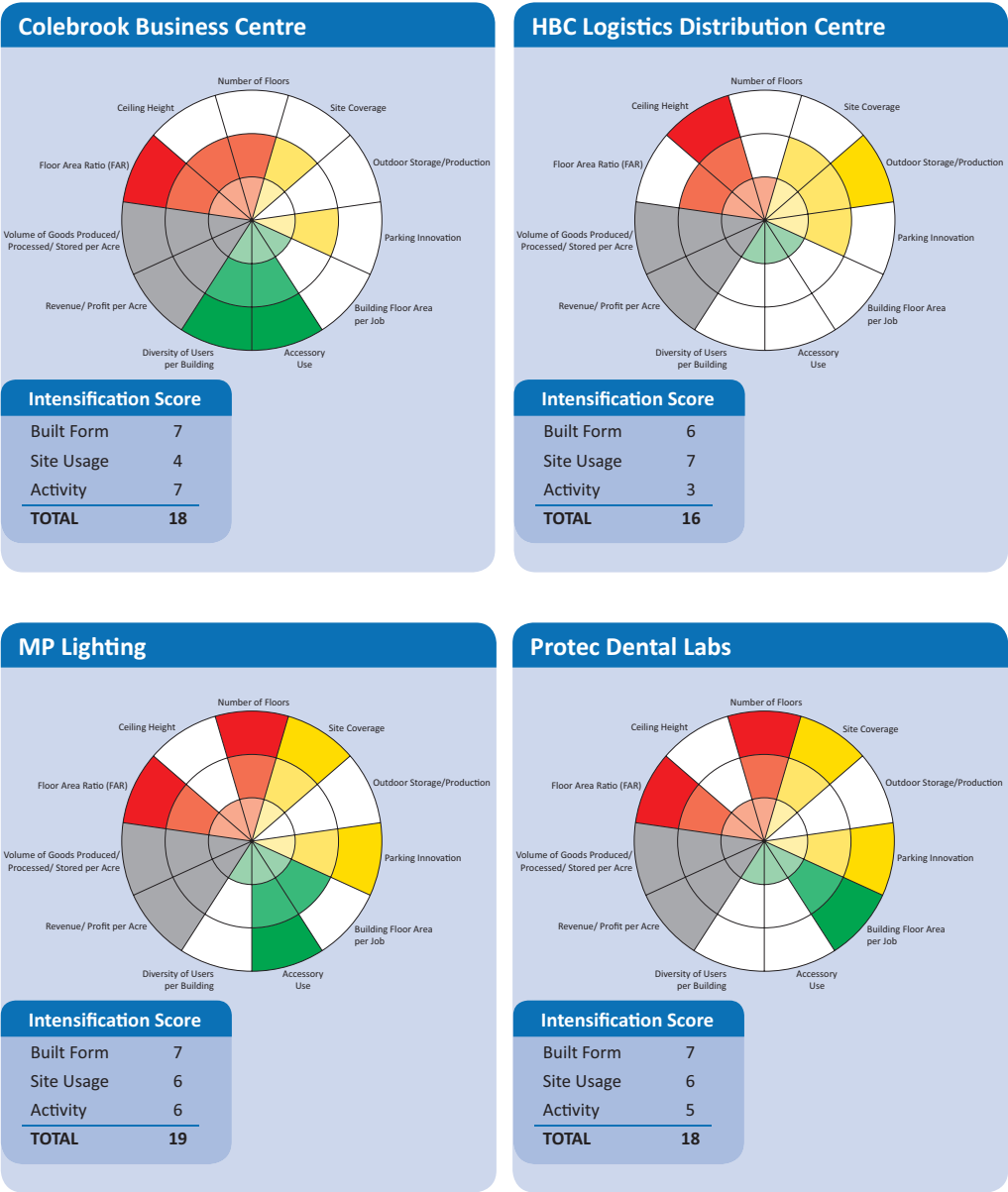
## Prototype Multi-Variable Tool - Sample Application

<b>Protec Dental Labs</b> 34 East 2nd Ave, Vancouver, BC  Protec Dental Labs is located in an I-1 zone that permits light industrial uses as well as accessory office. The building has three storeys with parking located underground. On the ground floor there is a reception area and limited accessory use. Dental manufacturing operations occupy all three levels of the building. The site is an example of an intensely used urban site with high-density manufacturing operations. (Metro Vancouver)	Measure	Value	Score
	Floor area ratio (FAR)	2.22 FAR	High
	Site coverage	74%	High
	Ceiling height	12-15ft	Low
	Number of floors	3	High
	Outdoor storage/production	None	nil
	Parking innovation	Underground	High
	Building floor area per job	135 sq ft/job	High
	Accessory use	Limited	Low
	Diversity of users per building	1 user	Low
	Revenue/profit per building floor area	data not available	-
	Volume of goods produced/processed/stored per building floor area	data not available	-

Source: Metro Vancouver

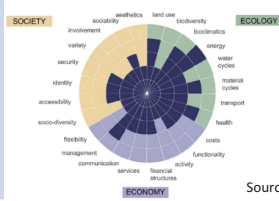


Prototype Multi-Variable Tool - Side-by-Side Comparisons



## Prototype Multi-Variable Tool - Other Multi-Variable Tool Visuals

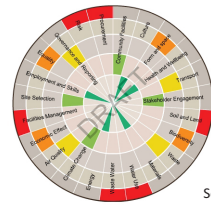
### Sustainability Value Map (SVM)



Source: Butters, 2004

The Sustainability Value Map (SVM) is a tool for evaluating the sustainability of buildings, urban development projects, and cities. It was developed by Chris Butters of GAIA Architects and can be used for quantitative and qualitative sustainability assessments and can also be used to compare sustainability over time and between sites (Skjerve-Nielsen, 2009, p. 8). The tool uses up to 24 indicators to assess sustainability, scoring each on a 0 to 5 scale from “poor performance” to “fully sustainable”.

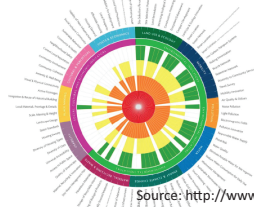
### Sustainable Project Appraisal Routine (SPeAR)



Source: www.arup.com

SPeAR, or Sustainable Project Appraisal Routine, is a sustainability assessment tool developed by ARUP and is designed to help weigh the factors impacting the sustainability of projects of a variety of scales and types (McGregor & Roberts, 2003). This tool expands the assessment of sustainability to include indicators for global warming and social responsibility (Peach, 2011). In total, 22 indicators are used and each is assigned a ranking from -3 to +3.

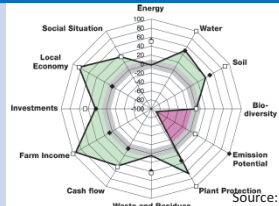
### Sustainable Built Environment Tool (SuBET)



Source: <http://www.hilsonmoran.com>

Developed by UK-based engineering consultancy Hilson Moran, SuBET, or Sustainable Built Environment Tool, is a framework that enables the assessment of urban landscape sustainability at a variety of scales. Unlike other tools SuBET offers a sustainability rating system that incorporates community participation and sustainable place-making in addition to the typical sustainability indicators (SuBET, Popa, p. 2). This tool uses over 70 unique indicators of sustainability to assess a given project or development (Hilson Moran).

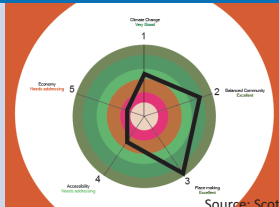
### Response-Inducing Sustainability Evaluation (RISE)



Source: Hani et al, 2003

RISE, or Response-Inducing Sustainability Evaluation was developed at HAFL, the School of Agricultural, Forest and Food Sciences at Bern University. RISE is a method “assessing the sustainability of agricultural production and trends” at the farm level (HAFL). The RISE tool provides uses 12 indicators that span the ecological, economical, and social aspects of sustainability (Hani et al, 2003). RISE is an interview-based method that generates its primary data from a detailed questionnaire process conducted with farmers.

### Sustainability Appraisal of Land Development (SALD)



Source: Scottbrownrigg.com

SALD was created by the Design Research Unit of Scott Brownrigg as a method for supporting site analysis and decision-making by facilitating the comparison of site sustainability and presenting it in an accessible format (Scottbrownrigg.com). The tool assesses a site utilizing BREEAM Communities’ five main criteria for site assessment: climate change, balanced communities, place-making, accessibility, and economy and employment (Scottbrownrigg.com).

## Prototype Multi-Variable Tool - Interview Guide

### Defining and Measuring Intensification

1. Drawing on your professional experience, how do you define industrial land *intensification*?
2. What are some of the forms that industrial land intensification can take, and how can these forms of intensification be measured?
3. How can alternative definitions and measures of intensification be incorporated into industrial land policies and bylaws to ensure that the diversity of industrial land users' needs are considered?

### Prototype Tool Revision Exercise

#### Tool Construction - Measures and Scales

1. Please Comment on the measures selected for inclusion in the prototype multi-variable tool and their potential to evaluate and communicate various forms of intensification.
2. A scale has been developed for each measure of intensification included in the tool. Please provide comments on the construction of these scales, including any suggested improvements.

#### Tool Application and Utility

3. Discuss some of the strengths and limitations of the prototype multi-variable tool.
4. In your opinion can the multi-variable tool help to communicate a broader definition and understanding of industrial land intensification?
5. In your opinion how could this tool be used to help achieve intensification goals and to inform industrial land intensification policies?
6. The sample application of the prototype tool is a site-level application. Do you see value in applications at other scales, such as industrial districts, industrial sectors, or to evaluate industrial intensification potential of a given site, district, or sector?
7. The prototype multi-variable tool is designed as primarily an analytical tool to help better communicate a more complete picture of industrial land intensification. The tool also has the potential as a composite index that provides an overall intensification rating based on a "total score", which may more easily facilitate comparisons between applications. Do you see merit in the tool as a composite index, and in what ways could the tool be improved to achieve this function?

## Appendix C | Informed Consent Form



### Department of City Planning

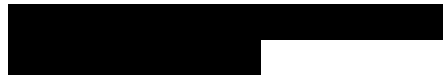
Department of City Planning  
201 Russell Building  
84 Curry Place  
Winnipeg, Manitoba  
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Tel: (204) 474-9558  
Fax: (204) 474-7533

Research Project Title: *Developing and Enhanced Understanding and Evaluation Criteria for Industrial Land Intensification in Metro Vancouver*

Researcher(s): **Ryan Gilmore**



Research Supervisor: **Dr. David van Vliet**



Please contact me if you have any questions:

**This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research project is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.**

#### 1. Project Description/ Purpose of the Research:

The purpose of this research practicum is to satisfy the major degree project requirement of the Master of City Planning Degree at the University of Manitoba. The title of the project is “Developing and Enhanced Understanding and Evaluation Criteria for Industrial Land Intensification in Metro Vancouver”. This research practicum has two primary objectives. The first is to better define intensity in the industrial land context with the aim of developing recommendations for Metro Vancouver municipalities to incorporate additional or alternative interpretations and measures of intensity in their industrial land use policies and zoning. This more nuanced understanding of industrial land intensity will help to distinguish between density and intensity in the industrial land context and determine what intensity means for different industrial sectors and users. The second objective is to develop a communication tool that can help planners and decision-makers better understand and assess industrial land intensification. To this end, this research will develop and refine a multi-variable communication tool that will aid in the measurement of industrial land use intensity and the evaluation of relative and potential intensity of industrial lands. This tool will be based on and adapted from applications of circular histograms or rose-diagrams used in sustainability planning.

This research practicum will be focused on the Metro Vancouver region due to the unique geographic constraints, growth projections, and current work in the area of industrial land intensification taking place in the region. However, it is hoped that the outcomes of this research will prove valuable for other jurisdictions wrestling with industrial land supply challenges. Ideally this research will aid in the development of sound policy that helps to facilitate the required intensification of industrial lands in Metro Vancouver in ways that meet the diverse needs of industrial users while also allowing for the continued innovation and evolution of the region's economy. It is hoped that the multi-variable tool developed as part of this research can be utilized and adapted by planners and decision-makers to assist in the development and communication of industrial land use intensification policies.

In the course of the interview, I will ask questions about your experiences related to industrial land use, development, and intensification in Metro Vancouver. While the primary purpose of this research is to produce an academic report to satisfy degree requirements, it is hoped that the multi-variable tool developed as part of this research can be utilized and adapted by planners and decision-makers to assist in the development and communication of industrial land use intensification policies.

## **2. Procedures, Location and Time Requirement:**

You are being asked to participate in an interview involving questions on industrial land use, development, and intensification, as well as to review and assess the construction and application of a multi-variable communication tool for industrial land intensification. The interviews are intended to contribute to the understanding and communication of industrial land use intensification in practice. The project will include approximately 6-12 semi-structure interviews with professionals based in Metro Vancouver with interests and expertise in industrial land use and development. Participation in this study will require approximately 45-60 minutes of your time and would take place at a time and location of your choice/convenience. In advance of the interview you will be provided with a description and sample application of the multi-variable tool. Please allow 30-60 minutes to review the material prior to the interview. I will request that you permit me to digitally record our conversation and I will also take notes during the interview.

Participation in this research project is voluntary and you may decline to answer any question or withdraw from the study without any negative consequences. The research process will conclude in June 2014 and participants are free to withdraw at any time during the course of the research project.

## **3. Risk and Benefits:**

There are no explicit risks to participants in this study. There are no risks associated with this project beyond normal everyday risk. The research is not controversial and does not deal with sensitive subject matters. The study asks only for your professional knowledge about industrial land use, development, and intensification, and recommendations for refinements to the construction and application of the multi-variable tool. Interview participants will be asked to select the location of the interview, likely their place of work, to help minimize risk and ensure privacy. Data generated will be kept confidential and participant names will not appear in the final practicum document. The potential benefits to participants include the opportunity to

learn about the various perspectives of stakeholders on definitions and measures of industrial land intensification and to have the opportunity to review the multi-variable communication tool.

#### **4. Recording Devices:**

This interview will take approximately 45-60 minutes of your time. With your permission, the interview will be recorded with a digital recording device and notes taken of the interview. All audio files and researcher interview notes generated during the research process will be stored on a password-protected computer or in a locked drawer in my home office. All interview recordings and notes will be destroyed after one year following the completion of the research project. If you do not wish for the conversation to be recorded, only handwritten notes will be taken. However, digital recording will ensure a more accurate record of your responses in the final document.

I hereby provide consent to the researcher using a voice recorder for audio recording the interview? (Please indicate your preference). ☐ Yes ☐ No

#### **5. Confidentiality:**

**Your privacy is important.** You will not be personally identified in the final practicum document. The information you provide during the interview will be coded for use in the research project. All audio files and researcher interview notes generated during the research process will be stored on a password-protected computer or in a locked drawer in my home office. All interview recordings and notes will be destroyed after one year following the completion of the research project. It is important that you are aware that the general nature and location of your place of work and the broad scope of your professional role will be recorded to provide context to your contributions. It may be possible for those with special knowledge of these contexts to infer your identity. I will only be asking questions on areas of your expertise only that relate to the subjects of this study. No information of a personal nature will be collected. If at **any** time you wish to withdraw from the interview please advise me, and your responses will not be used in the final document. If after the interview you wish to withdraw from the research project, please contact me directly (**prior to May 30, 2014**) and your responses will not be used in the final document.

#### **6. Future Contact**

Following the completion of the initial interview process, a secondary stage of research may be required to further refine the multi-variable tool. The researcher may contact original interview participants for a follow-up interview or to potentially participate in a focus group.

I hereby provide consent to the researcher to contact me regarding participating in a secondary phase of the research. ☐ Yes ☐ No

#### **7. Feedback:**

A summary of research results will be made available to research participants upon completion of the research project. This summary will be distributed via email in PDF format. Additionally,

participants will be debriefed immediately following the interview to advise how the information will be used as part of the research practicum.

#### 8. Dissemination:

A summary of research results will be distributed to all participants at the conclusion of the practicum project. For those who are interested, a copy of the full practicum will be made available via email in PDF format. Upon completion of the research practicum and graduation from the City Planning program, the finalized practicum will be made available through the University of Manitoba's Mspace function.

#### 9. Compensation or Remuneration:

Participants will not receive compensation for their participation in this research project. Research participants will be extending professional courtesy by volunteering their time for this study.

#### 10. Consent

**Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject.** In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. **You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence.** Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

**The University of Manitoba Research Ethics Board(s) and a representative(s) of the University of Manitoba Research Quality Management / Assurance office may also require access to your research records for safety and quality assurance purposes.**

**This research has been approved by the Joint Faculty Research Ethics Board. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator (HEC) at 204 474-7122. A copy of this consent form has been given to you to keep for your records and reference.**

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Participant's Signature

Date

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Researcher Signature

Date

Email or surface mail address to which a summary of findings and written reports (at your option) should be sent:

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