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## **The Built Environment in a Winter Climate: Improving University Campus Design for Student Wellbeing**

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Like urban environments, the campus built environment can influence general wellbeing of students. At the same time, campuses are their own unique form and need to be analyzed in their own way. This study identifies elements of the campus built environment that contribute to student wellbeing, including urban design qualities, considerations of safety and accessibility, and winter design strategies. Using the University of Alberta North Campus as a case study, evaluation criteria synthesized from a literature scan are used to assess Quad. This research identifies key design interventions and policy recommendations that are broadly applicable to northern university campuses. By exploring relationships between the university campus built environment and student wellbeing, we are able to gain insight into how to create an environment that promotes a sense of positive wellbeing for students. Such environments can contribute to better student success rates through higher academic performance, student retention, and graduation rates.

*Keywords:* urban design qualities, winter city design, campus planning, landscape design, northern campuses

### **1. Introduction**

The built environment can have a significant impact on how we use and perceive a space. While considerable scholarship has sought to understand the relationship between various elements of the urban environment and health (Wolch, Byrne, & Newell, 2014; Nutsford, Pearson, & Kingham, 2013), behaviour (Ewing & Handy, 2009), and safety (Brown, Clarke, Gortmaker, & Robinson-Keilig, 2004), there has been less academic research on the urban environment in winter climates. Further, there is little research about university campus planning and design in winter climates, and how the built environment of a campus influences student wellbeing. While there are similarities between university campuses and cities or neighbourhoods, a campus is its own unique entity and must be examined as such.

Indeed, similar to cities and neighbourhoods, the built environment of a university campus can influence students' lives (Hajrasouliha & Ewing, 2016; Hipp, Gulwadi, Alves, & Sequeira, 2016). Physical qualities of the university campus environment, such as the availability of green spaces and campus connectivity, have been found to improve aspects of student wellbeing (Peker & Ataov, 2020). Many factors contribute to an individual's wellbeing including mental and physical health, stress levels, social connectedness, environmental quality, perceptions of safety, and access to services and amenities (White, 2010). Attending university can be a very stressful period in many students' lives, with the struggle of balancing academic and social demands in addition to the stressors of day-to-day life (Regehr, Glancy, & Pitts, 2013). Improved wellbeing can help students to better cope with the challenges of academic studies.

By exploring the relationships between the university campus built environment and student wellbeing, we are able to gain insight to how to create an environment that promotes a sense of

positive wellbeing. Much of the literature concerning urban design strategies and tools is targeted to the city or neighbourhood-scale. Although it shares similarities with communities of various scales, a university campus is its own distinctive form and thus needs to be analyzed and described in a unique way. This study seeks to better understand which elements of the built environment of a university campus contribute to student wellbeing. While wellbeing encompasses many elements of individual and community health, this study focuses specifically on elements that promote mental and social wellbeing, such as improved perceptions of safety, reduced stress levels, feelings of social connectedness, access to services and amenities, and overall satisfaction with environmental quality. Using the University of Alberta as a case study, this research adapts urban design best practices to the university campus context, with an emphasis on winter city design, to promote student wellbeing. Through a literature scan of a wide range of design and related disciplines from academic and grey literature, a set of evaluation criteria was developed in order to assess the university campus context. The findings are then applied to the University of Alberta to determine how to improve the built environment to promote student wellbeing.

### ***Background***

The University of Alberta is an internationally-recognized research-intensive institution located in Edmonton, Alberta, Canada. With 40,000 students and 15,000 employees, the University has a significant population base (University of Alberta, 2019a). The University is comprised of five campuses, with the first campus (North Campus) established in 1908 (University of Alberta, 2019a). The campus is located in the centre of Edmonton, with the North Saskatchewan River to the north and residential neighbourhoods on all other sides. With 150 buildings, North Campus covers approximately 50 city blocks and remains the hub of administrative, academic, and research activities for the University (University of Alberta, 2019a). The campus is well-connected to the rest of the city, serviced by two LRT stations and several bus stops.

North Campus Main Quad (Quad) is the focus of this study. The space was chosen due to its lasting significance to campus; the original 1912 Campus Block Plan called for all buildings to be oriented around the “great quadrangle” and this feature still exists today. The buildings surrounding Quad have significant variations in age, with one hundred years between the oldest and newest buildings. Indeed, measuring roughly 3 hectares, Quad is the largest greenspace on North Campus and serves as a major pedestrian thoroughfare from the University Transit Centre, while also providing some spaces for lounging. From September to April, Quad is home to fundraisers, concerts, and pancake breakfasts. During the summer, many spend their lunch breaks in Quad and children’s day camps use the space for outdoor activities. While it is an active, well-manicured space during the warm summer months, Quad does not attract as many users during the winter. In Edmonton, the winter season stretches from mid-October to April, which is also when campus population is at its highest.

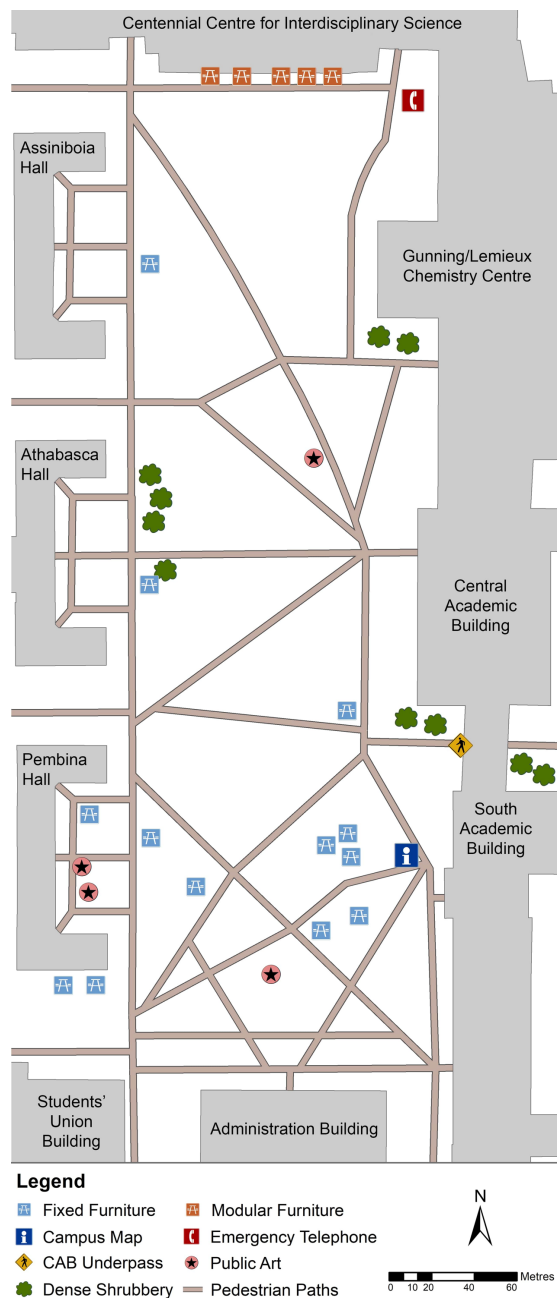


Figure 1. Map of North Campus Main Quad with pedestrian pathways and key areas marked.

## 2. Methodology

This study uses a sequential exploratory design, which involves the collection and analysis of data in a linear sequence (Creswell & Plano Clark, 2007), to examine how the built environment of a university campus can contribute to positive student wellbeing. Because there are no universally accepted university campus design standards (Hajrasouliha, 2017), the exploratory component of this approach was necessary to develop the Evaluation Criteria used to evaluate Quad. Initially, a literature scan was completed to determine key themes and best practices. This included a combination of keyword searches and snowballing (including relevant literature from the citations in previously reviewed literature). The relationship between university campus design and student wellbeing, issues of safety and accessibility in urban and campus contexts, and winter urban design strategies were the key themes investigated. Keyword searches included: urban design qualities, campus design plans, campus planning, pedestrian oriented design, built

environment and wellbeing, student wellbeing, campus safety, winter design strategies, and urban design accessibility. Academic articles from a wide range of disciplines including urban design, public health, landscape architecture, transportation behaviour, criminology, and university campus planning were reviewed.

The data from the review of the literature were then analysed and synthesized to develop a set of evaluation criteria applicable to the university campus environment in order to evaluate the study site and suggest appropriate design interventions. The Evaluation Criteria were organized into a framework of eight key elements and used to evaluate Quad at the University of Alberta.

A survey of the study site was completed to collect data on the built environment, using the evaluation criteria as a checklist to assess Quad.

### **3. Literature**

#### ***Student Wellbeing and University Campus Design***

There has been extensive research into the relationship between the built environment and the health, mood, and general wellbeing of individuals and communities (Wolch et al., 2014; Nutsford et al., 2013). Generally, communities that are diverse and walkable contribute positively to both individual and community health. While significant research has focused on the relationship between the built environment and health, less has focused on the study of university campus planning and design, and specifically how the campus built environment impacts student wellbeing in winter climates. However, previous studies have shown that the built environment of a campus can influence student wellbeing (Ratnayake, 2017; Hajrasouliha, 2017; Lau & Yang, 2009). Physical qualities of the university campus environment, such as the availability of green spaces and campus connectivity, have been found to improve student retention, quality of life, academic performance, and graduation rates (Hipp et al., 2016; Hajrasouliha, 2017).

Hajrasouliha & Ewing (2016) examined the relationship between student retention and graduation rates and the physical environment of a university campus, one of the first projects to research and quantify this relationship. The research examined student retention and graduation rates with respect to various dimensions of campus form. In the end, only three variables were found to have a significant interaction with student retention and graduation rates: *Urbanism*, *Campus Living*, and *Greenness* were all associated with increased freshman retention rate and 6-year graduation rate. The researchers also found that while greenness and urbanism are negatively correlated with each other, both are associated with improved student experience (Hajrasouliha & Ewing, 2016). While a greener university campus can promote more socialization on campus, campuses in urban environments can increase the perception of social connectedness both within the campus and with the wider community. Additionally, urban university campuses without sufficient greenspaces of their own can leverage greenspaces within the community to improve their greenness. Similarly, McFarland, Waliczek, & Zajicek (2008) found that students who frequented campus greenspaces more often perceived a higher quality of life than those who used greenspaces less frequently. Further, undergraduate students who frequently used campus spaces were more likely to experience positive interactions with other students (McFarland et al. 2008).

#### ***Safety and Accessibility in Planning***

In the planning practice, humans are often seen as neutral; this means that the different traits and experiences each person has are not considered in the planning process. For example, fear is a subjective experience and different people will experience varying levels and types of fear in any given space. When planning initiatives are implemented without considering the diverse experiences of people, these initiatives may not improve the environment for some. As a result, women often experience higher levels of fear in urban environments than men. Similarly, sexual minorities and people of colour also tend to experience more fear in urban environments (Rankin,

2005). Many studies have determined that this dichotomy is also present on university campuses: female students tend to feel more at risk for all types of crime, and especially at night, with minority groups also reporting higher levels of fear (Brown et al. 2004; Fisher & Sloan, 2003). There are also gender differences when looking at spatial behaviour (Turner Kelly & Torres, 2006). Campus crime can negatively impact the quality of the learning environment for the whole university community (Jennings, Gover, & Pudrzynska, 2007). When students do not feel safe, they will adjust their activities in order to avoid certain areas of campus. This can prevent students from participating in both social and scholarly activities and can negatively impact the quality of life.

In a similar vein, users of various abilities are often not adequately considered in the planning process (Levine, Grengs, & Merlin, 2019). For example, older buildings often have stairs to reach the main level, hindering wheelchair users, those with strollers and walkers, as well as visually impaired persons. Ramps, either built during construction or added as a later modification, have often been placed in less convenient locations, built at too steep a slope, or not adequately maintained throughout the seasons. These factors can significantly impact a person's mobility and safety.

### *Urban Design Qualities*

Urban design contributes to the creation of viable, attractive, and sustainable places and can enhance quality of life. Elements such as the physical features of a space, specific urban design qualities, and individual reactions can have a significant impact on individual behaviour, health, and wellbeing (Ewing & Handy, 2009). Because people perceive spaces differently, individual reactions to the environment (such as comfort or safety) can be subjective, but certain urban design qualities (such as scale or landscape elements) can be measured objectively. Ewing et al. (2006) examined various urban design qualities related to walkability in order to quantify the relationship between the built environment and walkability. While their research focused on streetscapes, the urban design qualities they defined are largely applicable to most public spaces and serve as the guiding framework for the urban design qualities identified in this research.

### *Legibility and Wayfinding*

Legibility refers to how easy the spatial structure of a place can be understood and navigated (Ewing et al., 2006). Tools such as wayfinding can aid in improving a place's legibility. Legibility and, in particular, effective wayfinding are important in a university campus setting because these elements allow users to orient themselves and navigate through the campus in an efficient manner (Farr, Kleinschmidt, Yarlagadda, & Mengersen, 2012). This minimizes confusion and disorientation, thus reducing stress, especially for university students who may be new to the space, unfamiliar with the language, or time-constrained (Farr et al., 2012).

### *Human Scale*

Physical elements such as building size and texture should reflect human size and function, such as average walking speed (Ewing & Handy, 2009). Features such as appropriate building height, street width, and the use of podiums, awnings, furniture, trees, and landscaping contribute to the human scale. In the campus context, considering the human scale is most important with urban university campuses, where taller buildings are more prevalent.

### *Enclosure and Comfort*

Outdoor spaces such as streets and plazas can be defined by vertical elements like buildings, trees, and furniture to produce a sense of intimacy. The width of a space should be proportionally related to its height to create the feeling of an outdoor room and draw people into the space (Ewing & Handy, 2009). In an urban setting, this can be achieved through lining the edge of a street or

plaza with buildings of similar heights and other vertical elements (Ewing & Handy, 2009). In a campus greenspace, creating a sense of enclosure will create a sense of intimacy and comfort.

### *Transparency*

When in a public space, transparency allows users to physically see or mentally perceive what lies beyond that space (Ewing et al., 2006). Windows, landscaping, and mid-block openings are elements that can contribute to transparency.

### *Connectivity*

In pedestrian environments, physical connectivity is important to users, as it shapes travel behaviour, with the potential of attracting or deterring users to an area (Stangl & Guinn, 2011). In the university campus context, especially in pedestrian environments such as a large greenspace or plaza, connectivity is crucial to allowing students, faculty, and staff to move throughout the campus with ease (Hajrasouliha, 2017).

### *Complexity and Activity*

Various elements such as architectural diversity, landscaping, street furniture, colour, lighting, signage, and human activity contribute to the complexity, or visual richness, of a place such as a campus plaza (Ewing & Handy, 2009). Complexity adds interest and liveliness to an area, drawing users in and inviting them to stay. At a pedestrian speed and scale, more complexity or interest is needed to draw people in.

### ***Winter Design Strategies***

Many of the urban design qualities discussed can be implemented in a variety of contexts, climates, and scales. However, communities located in cold climates often need plans and design treatments targeted to those specific climates. These ‘Winter Cities’ are urban centres that experience extended periods of below-freezing temperatures, limited hours of daylight and sunshine, and precipitation in the form of snow.

Gaining popularity in the 1980s, the ‘Winter City’ movement aims to reduce the negative effects of winter and emphasize the positive aspects of living in a cold climate (Davies, 2015). Many plans and designs implemented in more temperate regions will not work for a winter climate (Stout et al., 2018). Further, some architectural styles and treatments designed for temperate areas can amplify the poor winter conditions experienced in more northern areas (Davies, 2015). For example, high rise towers can exacerbate winter conditions for pedestrians by creating wind funnels and increasing shade (Davies, 2015). While this can be a problem in warm climates as well, the additional wind can sterilize urban areas in the winter by making it too uncomfortable for users to remain outside for extended periods. In a similar vein, some paving materials can also become very slippery when exposed to snow. Without proper consideration of the local climate, certain designs, materials, and treatments can make being outside uncomfortable and unsafe for pedestrians. Because of these complexities, winter cities should incorporate winter into the core of planning policies and the design of their public spaces, and plan for year-round use.

Located north of the 53 parallel in the winter city of Edmonton, the University of Alberta typically experiences temperatures below 0°C from October to April. Although the city is one of the sunniest in Canada, on average, Edmonton receives 123.5 centimetres of snow annually and experiences short, dark winter days due to its latitude, with only approximately 7.5 hours of daylight on the winter solstice. Despite Edmonton’s winter climate, municipal and campus planning efforts have focused on the summer months; planning and design measures have largely ignored the extended winter, opting to focus on bringing people inside (e.g. creating networks of pedways) rather than creating outdoor spaces that are tolerable during the winter season (e.g.

sheltering walkways from wind and snow). Recognizing this problem, the City of Edmonton published the Winter Design Guidelines (2016) to act as a tool for effective winter design strategies.

While the University of Alberta is a separate entity from the City of Edmonton, these guidelines can still be applied to the university campus to improve the student experience. Incorporating winter design in university campus planning is especially important because the majority of students attend classes between September and April, and Edmonton’s winter can last from October to April. Few students get to experience campus during the summer, when it is in its prime (O2 Planning + Design Inc., 2014).

Key winter design recommendations applicable to the university campus context can be grouped into four themes: pedestrian accessibility and safety, building form, landscaping, and activity. Developments should consider the human-scale, incorporating pedestrian-scaled colour and lighting to add complexity, ensuring all paths, ramps, and stairs are free of ice and snow, and lining walkways with shrubs and trees to minimize exposure to the wind (City of Edmonton, 2016). In addition, buildings should be oriented in a way that impedes prevailing winds and maximizes the amount sunlight received, especially during the cold winter months. Another key feature of winter cities is the focus on choosing vegetation that is native to the area (City of Edmonton, 2016). This ensures that plants are hardy and can likely withstand winter conditions such as heavy snow loads and extended periods of freezing temperatures, requiring less maintenance throughout the year (City of Edmonton, 2016). Landscaping can also be used to improve weather conditions experienced by users, through planting deciduous trees on the southern side of a building to maximize sunlight in the winter while still providing shade from the sunlight in the summer.

### ***Evaluation Criteria***

The evaluation criteria are divided into eight design elements based on the findings of the literature scan: Legibility and Wayfinding; Safety and Accessibility; Enclosure and Comfort; Human Scale; Transparency; Connectivity; Complexity and Activity; and Landscaping. Winter design strategies are dispersed throughout the checklist to avoid redundancy due to their broad applicability. Table 1 provides rationale for the criteria included in the site analysis checklist.

<b>Design Element</b>	<b>Criterion</b>	<b>Case Study Evaluation</b>	<b>Rationale</b>
<b>Legibility and Wayfinding</b>	Clear and consistent wayfinding system present.	No	Implementing a straightforward wayfinding system allows users to find their way in an efficient manner, minimizing confusion and disorientation and thus reducing stress, especially for users who may be new to the space, unfamiliar with the language, or time-constrained (Farr et al., 2012). Effective signage must be consistent in size, colour, font, placement, and symbols.
	Clearly designed, well-lit campus maps are provided along major pedestrian routes and other prominent locations. Adequate directional signs to all major building.	Inadequate	Consistent directional signage and clear, well-lit maps, in addition to the design of the built environment, can greatly improve wayfinding (Farr et al., 2012). Clearly-marked paths, the presence of landmarks, and sightlines are elements of the built environment that contribute to efficient wayfinding.
	Pedestrian routes are direct and potential desire lines are considered.	Yes	Pedestrians are more likely to follow a straight path to their destination rather than taking an indirect or curved path (Izaki & Derix, 2017). It is important to consider desire lines when creating pedestrian routes for this reason, as users will likely stray from the path if they perceive it as being a less direct route.
<b>Safety and Accessibility</b>	Area is well-lit, especially along pedestrian routes.	Inadequate	Regardless of individual demographics, individuals walking alone tend to experience fear in areas with low visibility and where there are potential hiding spots (Ratnayake, 2017; Jorgensen et al., 2013). Ample lighting improves users’ sense of safety and comfort (Ratnayake, 2017). This is especially important during the dark winter months in Alberta, when the daylight only lasts eight hours.
	Emergency phones are easily-located.	No	Visible emergency phones can improve sense of safety (Jennings, Gover, & Pudrzynska, 2007).

	Paths, ramps, and stairs are covered and maintained.	Inadequate	Walking on paths covered with snow or debris can be an inconvenience to able-bodied users; further, these factors inhibit the mobility of wheelchair users or those with walkers or strollers (Bromley, Matthews, & Thomas, 2007). To accommodate a wide range of abilities and users, all paths, stairs, and ramps should be paved and maintained to be clear of snow, ice, gravel, and other debris.
<b>Enclosure and Comfort</b>	Main entries of buildings have a “front porch” with outdoor furniture. Buildings open out to the space.	Inadequate	Like the front porch of a house, the “front porch” of a university building can offer an important place for socializing or studying. When buildings open out to the space and address the area around them, the sense of enclosure can create the feeling of an “outdoor room,” increasing user comfort (Ewing & Handy, 2009).
	Seating areas are designed to form a sun trap in colder months. There are shaded and sunny areas for sitting.	Yes	Especially in cooler climates, maximizing the amount of sun received can greatly improve user comfort (City of Edmonton, 2016). At the same time, it is important to provide adequate shade for the summer months. Post-construction, an efficient way to provide a variety of sunny and shaded areas is through landscaping.
	The various forms of seating accommodate a variety of uses.	Inadequate	Providing a range of seating options allows for a variety of uses in a space, adding to the visual complexity and richness of the area. Furniture that can be moved provides more flexibility in use, attracting users to a space and increasing user comfort.
	The space can accommodate large gatherings but does not seem empty when few people are present.	Inadequate	A campus gathering space should be designed so as not to feel barren when there are few users present. Greenspaces will ultimately feel less empty than a space that is completely paved over and attract more people to the space.
<b>Human Scale</b>	Building lighting enhances visibility. Colour and lighting are incorporated into design, specifically at the pedestrian-scale.	No	In addition to improving sense of safety, lighting can be used to add interest and make a space more inviting, especially in the darker winter months (City of Edmonton, 2016; Ewing et al., 2006).
	Buildings incorporate podiums and stepbacks to minimize downdrafts and improve pedestrian comfort. Buildings are oriented in a way that maximizes sunlight year-round and open spaces are framed and sheltered.	No	Especially in winter climates, it is important to design outdoor spaces in a way that take the local climate into account and reduce the impacts of negative weather. By minimizing wind and maximizing sunlight, it is possible to improve user comfort and attract people to stay outside later into the autumn and earlier in the spring (City of Edmonton, 2016).
<b>Transparency</b>	Clear windows allow users to see into and out of buildings. Mid-block openings allow users to see or perceive what is happening outside of the space.	Inadequate	Windows and mid-block openings provide the opportunity for users to see into and out of a public space (Ewing & Handy, 2009). This allows users to engage with the space as well as provides a sense of safety by providing natural surveillance.
<b>Connectivity</b>	There are major pedestrian routes into and through the campus. Major paths paved and maintained.	Yes	In pedestrian environments such as university campuses, connectivity is crucial to attracting users to a space (Stangl & Guinn, 2011). A campus with good connectivity allows users to move through the campus with ease as well as provides connections to the outside community, which contributes sense of community within campus (Hajrasouliha, 2017).
	Pedestrian connections are lined with mitigating treatments such as trees and barriers to protect from the wind.	No	In a winter climate, connectivity extends to mitigating treatments such as planting vegetation or installing other barriers to protect pedestrians from the wind and ensuring paths are free of snow and ice buildup (City of Edmonton, 2016).
<b>Complexity and Activity</b>	Unique features, such as public art and sculptures, provide a visual focal point and an easily-recognisable meeting place. There is a variety in building age, architectural style, and finishes.	Inadequate	At a pedestrian speed and scale, more complexity or interest is needed to draw people into a public space. Diverse architectural styles, landscaping features, colour, lighting, and human activity can add complexity to draw people into a campus plaza (Davies, 2015; Ewing & Handy, 2009).
	Surrounding buildings generate a lot of use throughout the day and evening.	Inadequate	Human activity adds complexity to a space (Ewing & Handy, 2009). Spaces lined by buildings that generate more traffic will ultimately receive more use throughout the day.
	Outdoor seating is protected from the elements and located along south-facing areas to maximize sun exposure.	No	Furniture also attracts users to a space. In a winter climate, effort needs to be taken to make outdoor spaces more comfortable. This can be done by protecting outdoor seating areas from wind and snow and locating seating areas in south-facing areas to maximize sun exposure (Stout et al., 2018; City of Edmonton, 2016).
<b>Landscaping</b>	Vegetation is native to area, can withstand snow loads. Design and landscaping treatments are climate-appropriate.	Inadequate	In winter climates, landscaping should incorporate vegetation that is native to the area and that can withstand the winter climate, reducing the required maintenance throughout the year and improving sustainability.
	Vegetation placement maximizes sunlight, especially in winter months. Vegetation is used to reduce wind.	No	With proper choice and placement, landscaping has the ability to improve the weather conditions experienced (City of Edmonton, 2016). Placement of landscaping should consider the local climate, with vegetation planted in a way that maximizes sunlight in the winter months and minimizes wind exposure year-round. For example, planting deciduous trees along the southern face of the area and coniferous trees along the north and west sides maximize sunlight in the winter and provide shade in the summer.

**Table 1. Evaluation Criteria**

After synthesizing the Evaluation Criteria from the literature, the criteria were applied to the case study. The Case Study Evaluation column shows whether a specific criterion is present in the case study. If an element was present but not effective, it was marked ‘Inadequate.’



#### **4. Discussion**

Key observations from the site analysis were synthesized to inform a set of proposed design interventions for specific areas of Quad as well as policy recommendations that are more broadly applicable to other winter university campuses.

##### ***Key Design Interventions***

Quad is not only the largest greenspace on North campus, but it also serves as a gathering space and a major pedestrian thoroughfare for students, staff, and faculty. It is an important area to study due to its significance to the campus as a whole.

Based on the evaluation criteria, four key issue areas emerged from the site evaluation.

##### ***Legibility and Wayfinding***

Wayfinding was one of the most significant problems identified in the site evaluation. With little directional signage along paths, building signage in varying formats and locations, and only one campus map displayed, it is an area that can be difficult to navigate if a user is unfamiliar with the space (Farr et al., 2012). Legible, consistent building signs should be posted at all building entrances, not solely the main entrance. Pathways should have signage pointing to important buildings to provide direction for new users. The Sector Plan specifies the development of a hierarchy of pathways to improve wayfinding, but this hierarchy is not evident when visiting the site. To make the hierarchy more visible, the University could incorporate varying sidewalk materials or colours to delineate the different paths and include the names of paths on campus maps. Because Quad is such a large area, a singular map is not adequate for users to effectively navigate the space. Campus maps should be displayed near all entrances to further aid in wayfinding; users must be able to check that they are travelling in the correct direction to effectively orient themselves (Farr et al., 2012). By adopting and enforcing one consistent wayfinding system, as outlined in the University of Alberta's Open Space Plan and the Sector Plan, the University can minimize stress, confusion, and disorientation for new visitors (Farr et al., 2012). Further, wayfinding technologies such as mobile applications should be considered to provide a more interactive experience for campus users.

The above design interventions are not restricted to this case study, nor to university campuses. Implementing a consistent wayfinding system with clear signage allows visitors to any space to orient themselves more quickly, aiding in the overall connectivity within and between spaces (Farr et al., 2012; Raubal, 2001). Wayfinding can be useful in spaces of varying sizes to improve user experience, reducing the confusion and stress experienced while navigating a new space.

##### ***Safety and Accessibility***

Another key issue identified in the site evaluation is a lack of lighting and sense of security. The lighting available is not sufficient in the nighttime or during dark winter days, especially near areas of dense vegetation as shown in Figure 1. Improved lighting helps users of varying demographics feel safer in the darkness (Ratnayake, 2017; Jorgensen et al., 2013). Similarly, there is only one emergency phone in the area. The University should install more emergency phones in highly visible areas to improve user sense of safety and thus social wellbeing (White, 2010; Jennings et al. 2007). Features such as more adequate lighting and easily-located emergency phones can improve visitors' sense of safety and overall comfort when occupying a multitude of open spaces, such as public parks and plazas (Ratnayake, 2017; Jorgensen et al., 2013; Jennings et al. 2007).

One area that requires attention is the tunnel under Central Academic Building (CAB) that connects Quad to the east of campus. The underpass creates a barrier to campus connectivity due to its safety and accessibility issues. This area is also identified in the North Campus Open Space Plan as a key intervention needed (O2 Planning + Design Inc., 2014). The internal pedway from South Academic Building (SAB) to CAB has created an unattractive environment for pedestrians and cyclists trying to access the rest of campus. Even in the afternoon on a sunny day, the underpass is dark and cramped, with no artificial lighting or attempts to make the space more inviting. The small space, poor lighting, and dense vegetation on either side of the underpass contribute to reduced sightlines, making the area feel unsafe at times, especially during the evening when it is dark and there are fewer people on campus. The Open Space Plan recommends removing the underpass to open up the space and create a safer and more accessible environment for pedestrians and cyclists. If this cannot be completed, other interventions are required to improve the pedestrian experience. Simple interventions such as installing lighting and directional signage would improve wayfinding, accessibility, and sense of safety for users.

### *Complexity and Activity*

A key component of the complexity of a space is human activity (Ewing et al., 2006). Students who frequent campus spaces are more likely to experience positive interactions with other students, improving social wellbeing (McFarland et al. 2008). The University can attract more users to Quad by making it more comfortable for people to spend time in Quad (Stout et al., 2018; City of Edmonton, 2016). Although there are a small number of tables and benches throughout Quad, a larger variety of moveable furniture available may allow more people to sit down and study, eat, or socialize.

As Hajrasouliha and Ewing (2016) found in their research, university campus greenness and urbanism are associated with increased freshman retention rate and 6-year graduation rate. While greener universities tend to promote more socialization on campus, urban university campuses can experience more social connectedness. The University of Alberta is unique in the availability of greenspace within the campus, despite its urban location, allowing for increased socialization and social connections. Further, McFarland et al. (2008) found that students who frequented campus greenspaces more often reported a higher quality of life than those who did not frequently use greenspaces.

With Edmonton's winter temperatures, it will not be feasible for people to spend extended periods of time outside the whole winter; however, it will increase usability later in the fall and earlier in the spring (City of Edmonton, 2016). Warming huts would allow people to stay outside for longer periods and ensuring furniture is clear of ice and snow may further incentivize outdoor use. For the winter months in particular, the University should incorporate interesting lighting and colour, through the addition of public art and climate-appropriate vegetation (Davies, 2015). These strategies can be widely adapted to other areas of the campus as well as outdoor public spaces in winter climates. It is important to design outdoor spaces in a way that reduces the impacts of negative weather (Pressman, 1988). By minimizing wind and maximizing sunlight, it is possible to improve comfort, allowing people to enjoy outdoor spaces for more of the year (Pressman, 1995, 1988).

### *Landscaping*

Lastly, the University should incorporate winter design into its landscaping. The space can be very dull during the winter months because much of the vegetation planted are not perennials native to Edmonton's climate. The University should choose plant species that are native to the area and can withstand the winter climate with little maintenance, thus improving sustainability (City of Edmonton, 2016). Further, landscaping should focus on incorporating as much colour as

possible during the winter, through colourful branches or berries. To improve the winter conditions experienced, vegetation should be planted strategically to maximize sunlight in the winter and minimize wind.

Building materials must take the local climate into account. Most paving materials and other finishes used are appropriate for Edmonton's climate, with the exception of the Alumni Walk sidewalk plaque at the southwest corner of Quad. Throughout the winter months, a caution sign is placed on top of the plaque due to the extremely slick surface created with the snowfall. In future developments, the University should ensure that all materials for design treatments are appropriate for the climate.

Again, these design interventions are not specific to the University of Alberta context; climate-sensitive design can be adapted to use in outdoor spaces in many northern climates. While municipalities and other university campuses can integrate winter design strategies to encourage people to spend more time outside during the colder months, these strategies can also be used in privately-owned outdoor spaces, such as restaurant patios and cafés (Stout et al., 2018).

### ***Policy Recommendations***

#### ***Frequent Sector Plan Renewal***

A key recommendation for winter campuses is to establish a timeline for plan renewal. For example, the University of Alberta's Long-range Development Plan (LRDP) was last updated in 2002, with a more recent amendment for North Campus adopted in 2014. Prior to this, the LRDP had not been updated since 1969 (University of Alberta, 2002). While the 2002 LRDP was created to be a 30-year planning framework, guiding development and redevelopment of all University of Alberta campuses, the Sector Plans provide more specific guidelines for land use planning and design initiatives in a given area. Because Sector Plans guide planning and development in finer detail, these documents should be reviewed and revised more frequently to remain up-to-date for the whole campus. For example, the Plan for Sectors 3 and 4 has not been updated since 2004. Major changes to the campus have occurred since this time. The development of a new building significantly changed the look of Quad, opening up more space on the north side. Further, the 2014 North Campus Amendment to the LRDP brings forward the principles of smart growth and planned communities but this is not yet included in the Sector Plans.

#### ***Campus User Feedback***

In order to gain a nuanced understanding of how users perceive and respond to the campus environment, universities must survey students, staff, and faculty. Without hearing from campus users, a university cannot determine how various features of the built environment impact different user groups. In Alberta, the Post-Secondary Learning Act outlines the consultation process that the University of Alberta is required to follow for the development of the LRDP and amendments to the LRDP (University of Alberta, 2014). However, because Sector Plans are not provincially mandated, universities are not required to follow a set consultation protocol.

The University of Alberta recently completed the 89 Avenue Students' Boulevard consultation project to gain insights into improving the walking and cycling experience along 89 Avenue (University of Alberta, 2019b). A similar engagement strategy can be employed to improve the user experience in Quad. While some design qualities can be quantified, other features such as sense of safety are subjective in nature (Fisher & Sloan, 2003; Brown et al., 2004; Jennings et al., 2007). These more subjective elements require community engagement to properly understand and plan for.

### *Incorporate Winter Design Strategies into Planning and Policy*

The final recommendation is for winter campuses to formally incorporate winter design strategies into planning and policies. With the majority of students attending classes on campus from September to April, adapting open spaces to the winter climate is even more important to improving the campus built environment and student wellbeing. However, despite the climate, winter design strategies are often not been well-incorporated into campus planning.

While the University of Alberta's 2002 LRDP acknowledges the harsh winter climate in Edmonton, the focus is on expanding the internal pedway system to provide sheltered circulation routes and developing internal open spaces to serve as gathering spaces during the winter. The plan specifies that outdoor spaces such as Quad should be "considered year-round open spaces that accommodate year-round activities" (University of Alberta, 2002, p. 132) but provides no process for implementation. The 2014 North Campus Amendment to the LRDP also refers to the University's support of the City of Edmonton's Winter City strategy but does not provide tangible guidelines to implementing winter design strategies on campus (University of Alberta, 2014). The North Campus Open Space Plan goes a bit further, with one of the key objectives of the project being to "provide an enhanced landscape through all four seasons, particularly the winter months when most students experience the campus" (O2 Planning + Design Inc., 2014, p. 12). The Open Space Plan provides several recommendations for encouraging activity and appropriate design for the winter months, including providing space for skating, prioritizing pedestrian and bicycle paths for snow removal, sheltering walkways and gathering spaces from the winter weather, and incorporating lighting and colour to make the space more inviting. Winter campuses such as the University of Alberta should continue to incorporate winter design strategies into planning documents across campuses.

## **5. Conclusions**

Through a scan of the literature, this study identifies elements of the campus built environment that contribute to student wellbeing, including urban design qualities, considerations of safety and accessibility, and winter design strategies. With the University of Alberta North Campus as a case study, evaluation criteria are used to assess Quad. This study identifies key design interventions and policy recommendations that are broadly applicable to northern university campuses. Design interventions focus on improved wayfinding and making outdoor spaces comfortable during winter months by incorporating local vegetation and lighting. Policy recommendations include consulting with the university community to determine how various users interpret and experience the campus environment, as well as establishing a timeline for mandatory plan renewal.

This study contributes to an area of research that has not been well-researched in the North American context. Although most Canadian and many American post-secondary institutions are located in regions with extended, harsh winters, the majority of campus planning does not reflect the winter climate. Further, these findings are not limited to university campuses. Winter design strategies are often not incorporated into municipal plans in northern regions. The above design interventions, which focus on adapting the campus built environment to winter climates, can easily be applied to public spaces such as parks and plazas in northern climates to improve the sense of comfort and safety for diverse groups of users.

By exploring the relationships between the university campus built environment and student wellbeing, we are able to gain insight into creating environments that promote a sense of positive wellbeing for students. Such environments can contribute to better student success rates through higher academic performance, student retention, and graduation rates. By investing in the campus built environment, universities can improve the wellbeing of the campus community as a whole, thus uplifting students, faculty and staff.

Biographical Note:

**Eden McDonald-Yale** completed a Master of Science in Urban and Regional Planning from the Department of Earth and Atmospheric Sciences, University of Alberta. As part of the Climate Adaptation and Resilience Lab, Eden's graduate research focused on the built environment and wellbeing in winter climates, specifically focusing on the impact of the university campus environment on students' mental health and wellbeing. Her current work involves promoting community-based strategies to improve mental health and wellbeing in rural and remote communities across the province of Alberta.

**S. Jeff Birchall** is presently an Assistant Professor in the School of Urban and Regional Planning, Department of Earth and Atmospheric Sciences, University of Alberta. Jeff's research program, while grounded in community planning, is interdisciplinary in scope, and explores the broad theme of environmental resilience at the local and regional scale. His work on environmental resilience primarily examines decision dynamics around motivational factors and extent of planning for climate change risk reduction. Specifically, Jeff is interested in localized environmental impacts and how they affect critical infrastructure and the built form, how this relates to planning decisions, and what this means for community well-being and safety. This research is largely driven by key actor and local stakeholder engagement, with the aim of (co-) producing policy relevant knowledge/ outcomes, or translating theory into practice in a useful, locally informed way.

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