

Sustainability and Active Transportation at Universities: Case Study of Fort Garry Campus, University of Manitoba in Winnipeg, Canada

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Abstract

The environmental and health implications of Active Transportation (AT) strategies at the University of Manitoba's Fort Garry campus in Canada were investigated, focusing on walking, biking, and public transit use of students and staff. We analyzed connectivity, planning, and campus-city integration through mapping, observation, and transportation plan analysis. We found large gaps in connectivity of AT routes within the campus, a lack of AT planning, and poor AT city-campus integration, which explain why AT is decreasing rather than increasing, undermining sustainability on campus. Investing in biking, walking, and bus infrastructure and programs can be a practical, educational, and economical solution to negative environmental, safety, and health impacts posed by vehicles. Universities like the University of Manitoba (UM) have the potential to be leaders in creating an AT ecosystem that mitigates climate change through transportation and turns around the global problem of youth inactivity.

Keywords

Active Transportation, Sustainability, Planning, Environment, Accessibility, Connectivity

1. Introduction

Greenhouse gas emissions and pollutants are emitted from most vehicles as private cars, vans, and other vehicles continue to use fossil fuels (International Energy Agency (IEA), 2023). Private cars and vans burned more than 25% of global oil and produced around 10% of global energy-related carbon dioxide (CO₂) emissions in 2022 (IEA, 2023). To reduce this pollution, cycling and walking to

schools, including to universities, have been found to make a major impact (Goodman et al., 2019). Active transportation (AT) includes walking, biking, and using public transit, promoting sustainability and a healthy lifestyle for students in post-secondary education (Castillo, 2019). Active transportation (AT) reduces fossil fuel dependence (Government of Manitoba, 2018; Kumar et al., 2019). Using an active mode of transportation reduces the negative environmental impacts of motorized vehicles while integrating physical activity into daily routines (National Center for Environmental Health, 2011; World Health Organization (WHO), 2022). Reducing vehicle use mitigates greenhouse gas emissions (Hong, 2018; Song et al., 2017).

The United Nations Sustainable Development Goals (UNSDG) promote AT and public transit in SDG 11 to make human settlements “more inclusive, safe, resilient, and sustainable” (UN, 2022). Target 11.2 aims to provide access to safe, affordable, accessible, and sustainable transport systems for all by 2030, which is in line with AT. Active and green transportation infrastructure reduces traffic and emissions, directly addressing climate change. By reducing motorized vehicles, which cause air pollution and climate change, AT decreases premature mortality and morbidity rates (Jaramillo et al., 2022; WHO, 2020). Pollution from the transportation sector results in more than four million premature deaths annually (WHO, 2020). Mortality from air pollution could be reduced by AT.

People’s health improves by participating in AT. The physical activity of AT reduces noncommunicable disease (NCD) risks, including cancer, depression, and diabetes (WHO, 2024a). For example, regular cycling can reduce mortality risk by about 10% (WHO, 2022). The WHO recommends at least 150 minutes of moderate physical activity per week for adults and at least one hour per day for children (WHO, 2022). Stress reduction, mental well-being enhancement, and improved academic performance occur from AT (Pitt et al., 2021). However, 80% of youth in schools, including universities, do not meet current recommendations for at least one hour of physical activity per day globally (WHO, 2024b). Active routes to schools provide an antidote to ensure youth participate in fitness (Hagel et al., 2019; WHO, 2019, 2024a). Globally, physical inactivity causes the death of over three million people every year (WHO, 2024b).

Safe routes for pedestrians and bicyclists are part of AT (Lowry et al., 2016). Safe AT routes are typically dedicated bike lanes and sidewalks, physically separated from roads (Lowry et al., 2016). Motorized vehicles sharing the same space as pedestrians, bicyclists, and those in wheelchairs impose risks, barriers, and decreased perception of safety for active users (Von Stülpnagel & Rintelen, 2024). Youth are particularly at risk without safe AT routes, as this group has the greatest risk of death by traffic accidents. Traffic accidents are the leading cause of death for people under 29 years of age of the million who die each year (WHO, 2023). As large numbers of youth attend university and college sites, transportation risks are heightened.

This study investigates the environmental and health implications of AT strategies at the University of Manitoba's Fort Garry campus in Canada, focusing on walking, biking, and public transit use of students and staff. Three different factors of AT, namely connectivity, planning, and campus access, are discussed (Baobeid et al., 2021; Gadwa Nicodumus, 2012; Kristianova, 2016). We explore three factors through mapping, observation, and transportation plan analysis. After analyzing the AT factors at UM, we identify gaps and propose solutions to facilitate and increase AT rates. This paper fills an important research gap as most infrastructure analyses and evaluations of universities focus on the streets' functionality for drivers, overlooking AT in research, studies, and planning processes (Lefebvre-ropars et al., 2021).

1.1. Case Study Description: The Fort Gary Campus at the University of Manitoba, Considering Active Transit

The University of Manitoba (UM) is located in the suburbs of the City of Winnipeg in Manitoba, Canada. The University of Manitoba has expansive grounds, starting as an agricultural university in 1877 (Narin, 2018). The UM grounds cover approximately 600 acres, hosting over 60 major buildings (Narin, 2018). Vast green spaces separate the UM from the main roads and community neighbourhoods.

Most of the UM's greenhouse emissions are from transportation. Transportation generally accounts for 38% of the GHG emissions at the University of Manitoba (Seddon et al., 2021). Transportation includes deliveries. Currently, commuting accounts for 22% of carbon emissions at the University of Manitoba. In 2023 and all years, 40% drove alone, and with carpooling, over half of people drove to UM (University of Manitoba (UM), 2023). Although most UM staff and students reside in the sprawling Winnipeg metro area, with a population of 910,240 in 2023, others reside in rural communities some distance from Winnipeg (Statistics Canada, 2024). Due to its low density and car culture, transportation is the leading contributor to GHG emissions in Winnipeg, making up almost 50% of the city's total emissions (City of Winnipeg, 2024). This car culture and sprawl applies to the University of Manitoba as well.

The University of Manitoba has a longitudinal survey that shows most people drive to UM and measured AT from 2016 to 2023 (UM, 2023). The number of people working and taking classes from home increased in 2023 due to the COVID-19 pandemic (Greaves et al., 2024). Remote learning was used when in-person learning was not possible during the COVID-19 pandemic due to lockdowns. This trend that started with COVID-19 continues with many meetings occurring online and more classes being offered by distance or remote learning, which allows people to stay at home and access their classes online. Those on campus, either walking, biking, or using motorized vehicles, were dramatically reduced during COVID-19, but only driving solo increased afterward, with drops in carsharing, public transit, and AT.

Over time, the UM community has reduced biking, walking, car sharing, and

transit, according to surveys. **Figure 1** shows how, over time, the UM community has reduced biking, walking, car sharing, and transit. In 2023, 40% drove alone, and with carpooling, the numbers were over half of people driving to UM, up 8% from 2018 and 13% from 2022 but 6% lower than 2016. In 2016, a survey (n = 4,384) of the UM community showed that the UM's AT is limited. Transit use also decreased from 2018 to 2023 after increasing from 2016 to 2018 (UM, 2023). The opposite trend is true for driving alone, which increased from 2018 to 2023 but decreased from 2016 to 2018 (UM, 2023). Surveys show AT either decreased or remained the same from 2016 to 2023 (UM, 2023), as shown in **Figure 2**.

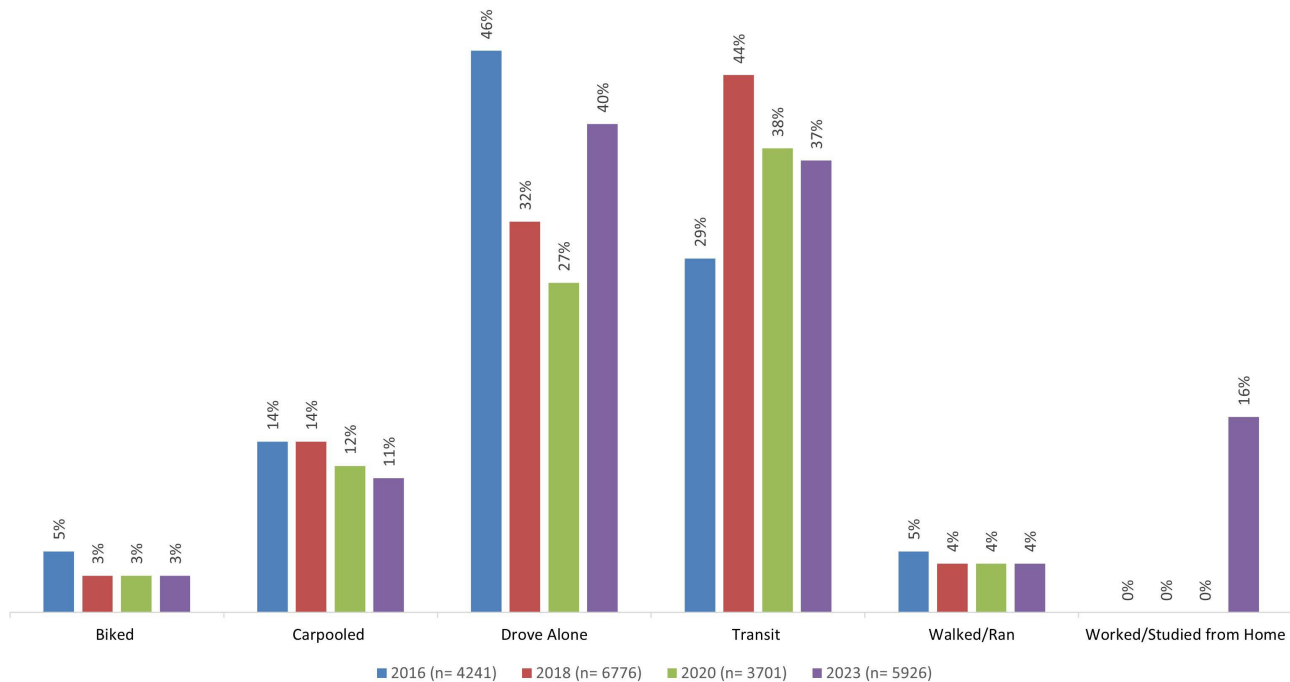


Figure 1. Transportation of University of Manitoba's students from 2016-2023 (University of Manitoba, 2023).

A discrepancy between preferred and actual transportation modes exists, according to the 2016 survey (University of Manitoba, 2017). Only 5% of people biked, as shown in **Figure 2**. This rate is significantly lower than the 35% wanting to bike in 2016. While 14% of people prefer walking to campus, only 5% did. People may live some distance away and in the country and have to drive. However, only 1% of people drove to a park-and-ride location to take transit. One-third (32%) of travelers took the bus in 2016, while only 26% want to. Many people criticized the bus system's long waits, lack of bus shelters, overcrowded buses, and insufficient transit services.

The University of Manitoba has a car-dependent culture. Transportation data from the Fort Garry campus for 2016 revealed that 42% of respondents drive alone, but only 36% want to drive. Only 14% of people carpooled to the campus, although 38% wanted to carpool. A high percentage of people prefer to drive alone and actually do, which contradicts UM AT's goals. To shift this behavior, measures could include disincentives for driving, such as increased

parking costs, along with incentives for AT. Additionally, enhancing infrastructure and launching community programs and campaigns could further encourage the adoption of AT.

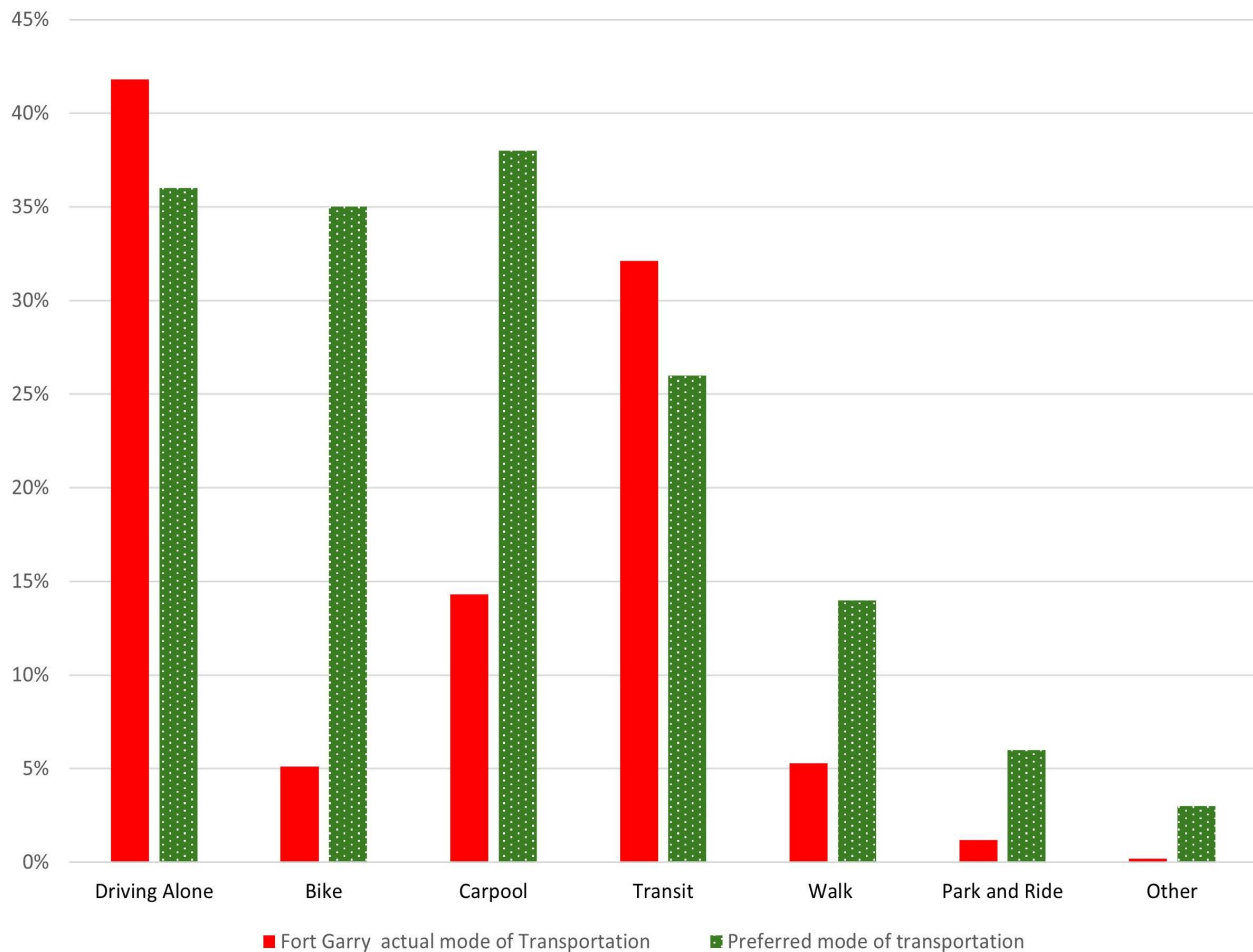


Figure 2. The primary method(s) for commuting to and from the Fort Garry campus based on 2016 transportation survey (University of Manitoba, 2017).

Employing AT reduces fossil fuel use and its resulting climate change impacts. Computing in vehicles results in gasoline and diesel consumption, which has large environmental impacts. Transportation, in general, accounts for 38% of the GHG emissions at the University of Manitoba (Seddon et al., 2021), including commuting and deliveries. Commuting accounts for 22% of carbon emissions at the University of Manitoba (Seddon et al., 2021). The 2017 “Moving Forward: Sustainable Transportation Strategy” focused on developing efficient transportation networks to reduce GHG emissions; however, more actions, including policy changes, need to take place (University of Manitoba, 2017).

1.2. Active Transport Key Factors for Post-Secondary Campuses

Three active transport factors on post-secondary campuses are connectivity, planning, and access (Baobeid et al., 2021; Gadwa Nicodumus, 2012; Kristianova,

2016). Many subfactors cross-cut these factors, as shown in **Figure 3**. For example, aspects such as bike and sidewalk systems create connectivity and access but also have to be planned.

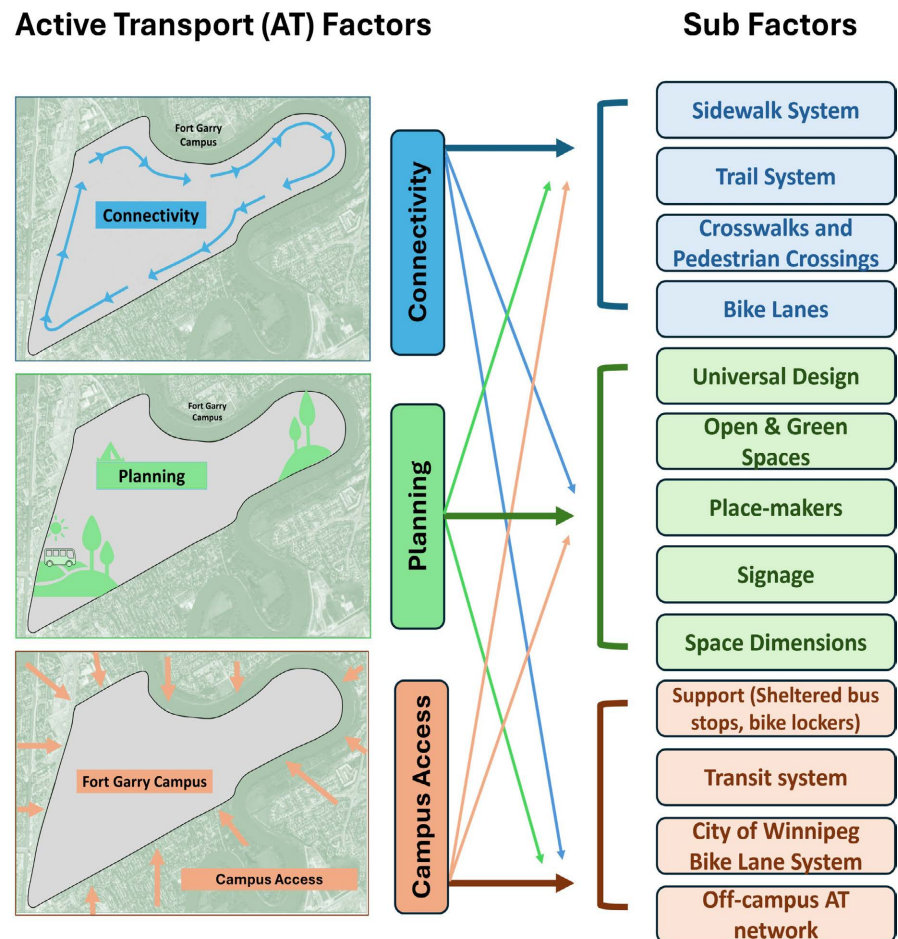


Figure 3. Factors in active transportation on post-secondary campuses. Sources: Congiu et al., 2019; McCormack, Koohsari et al., 2019; McIlroy et al., 2020; Meerow & Newell, 2017; Rasouli, 2013; Gadwa Nicodumus, 2012; Government of New Zealand, 2005; Hamilton-Baillie & Jones, 2005; Howard, 2019; Markevych et al., 2017; Chaix et al., 2014; Congiu et al., 2019; Hamidi et al., 2019; Lowry et al., 2016; McIlroy et al., 2020.

Connectivity refers to the network of physical and built environments to support people’s ability to move around post-secondary campuses safely and efficiently. Aspects for consideration include walking and cycling infrastructure, tunnels, crosswalks, and pedestrian crossings (Meerow & Newell, 2017). Bike lanes and sidewalks increase the use of AT by enhancing safety and the ease of walking (Reynolds et al., 2010; Slater et al., 2020; Von Stülpnagel & Rintelen, 2024). Campuses’ connectivity link street layouts for direct and continuous routes for pedestrians and cyclists but also incorporates destinations, art pieces, and public spaces to enhance AT and recreational activities (McCormack et al., 2019).

Planning for green spaces and beautiful experiences motivates people to walk,

bike, and spend time outdoors (Markevych et al., 2017). Beautiful areas equipped with seating and shade/shelter attract more users. A positive correlation was found between AT behavior and open spaces planned for social interaction (Government of New Zealand, 2005). Open green spaces and placemakers encourage people to engage in physical activities (Gadwa Nicodumus, 2012). Placemakers in nature draw people towards environments that offer comfort, significance, and safety, influencing peoples' transportation choices (Akbar & Edelenbos, 2021; Habibah et al., 2013). Public art, flora and local services provide destinations for people.

Planning for AT access requires ensuring that services and infrastructure to facilitate AT are available. For example, planning for bicycles requires certain infrastructure, including the city's bike lanes and bicycle racks (Congiu et al., 2019; Hamidi et al., 2019). Sidewalks are needed to facilitate walking. Public transportation to post-secondary campuses is also key (McIlroy et al., 2020). Public transit is sustainable and complementary to AT. People get exercise going to bus stops and reduce GHGs by not using vehicles. Less cars on the road also means less risk to pedestrians and bikes from cars and more space for nature and other activities than parking and car use.

Accessibility of campuses influences individuals' decisions to walk or cycle. The availability of sidewalks and cycling paths to campuses increases AT behaviors (McIlroy et al., 2020; Rasouli, 2013). Inclusive access occurs when individuals of all ages and abilities can travel to key destinations easily (Lowry et al., 2016). People at every stage along their lifespan, whether in baby carriages, walkers, wheelchairs, or blind people, need to be considered in planning (Baobeid et al., 2021). To be inclusive, universal design principles for AT require areas to be walkable and cyclable for people of all ages and abilities.

2. Methods

A spatial analysis of the Fort Garry Campus and observation were undertaken to evaluate AT aspects.

2.1. Digital and Physical Data Collection and Data Visualization

We used ESRI software, GIS online, and ArcGIS version 2.9 to evaluate the AT factors of connectivity, planning, and accessibility. Campus maps were reviewed. Eleven map layers provided inputs on Traffic Lights, Pedestrian Malls and Sidewalks, Parking Spaces, Green Spaces, Art Pieces, Street Outlines, Campus Forms (e.g., gateways), Bike/Active Lanes, and Roadways. Maps were made to identify sidewalks and bike trails using spatial analysis in ArcGIS Pro version 2.9.0 and GIS Online. Areas lacking sidewalks or bike trails were pinpointed using spatial analysis in ArcGIS Pro version 2.9.0 and GIS Online.

Relevant GIS digital data from different sources were collected to understand AT at UM. The data for the layers were collected using both digital and physical data collection methods. Datasets and maps were collected from many sources, including observation of AT factors, as referenced in **Table 1**.

Table 1. Data sources for active transportation assessment at fort garry campus.

Type of data	Source
Digital Data Layers	University of Manitoba GIS Library Office (Vermeulen, 2023; Miller, 2022)
	Online Atlas/ Arc GIS Online
	Active Transportation Network Winnipeg (Paul, 2022)
	Traffic Signal Locations of Winnipeg (Chalajour, 2023)
	Cycling Facilities Network (City of Winnipeg, 2017)
	Traffic Signal Inventory Locations (City of Winnipeg, 2019)
Site Observation (data collection by authors)	Students Behaviors
	Routes and Tunnel System
	Attractive and Outdoor Elements (such as open spaces and art pieces)

2.2. Site Observation

Site observation involved walking throughout the Fort Garry campus and its tunnels. These walks were at different times and seasons to observe traffic, people’s behavior, interactions, activities, and infrastructure. These observations were the basis for assessing accessibility, planning, interactions, activities, crosswalks, sidewalks, street networks, and routes, including tunnel systems. Observations were supplemented by photos or videos.

3. Findings

The built environment natural spaces replace ecosystems with roads and infrastructure in the Fort Garry campus. Despite efforts to preserve natural spaces, the growing demand for development pushes nature aside, emphasizing the need for more sustainable campus planning that integrates green spaces into the built environment. The University of Manitoba 2024 strategic plan highlights societal, cultural, economic, health, and environmental issues and is devoted to addressing them in the next 25 years. One goal is to build sustainable futures for learners by increasing opportunities for innovative and meaningful learning experiences. Another goal is to identify sustainable and high-impact solutions through increased collaboration and connection across our campuses. We used mapping and observation to help UM reach the sustainability goals, which yielded results in three areas.

3.1. Connectivity

Significant barriers to connecting walking and biking paths exist at UM. We believe all the UM transportation surveys lack data regarding connectivity within the campus. Many areas leading to UM and inside the campus lack sidewalks, crosswalks, and bike paths. Where bike lanes and sidewalks are missing, a mixed flow of active users and cars results in safety risks, with Manitoba having an increase in car crashes involving pedestrians in 2024 (Loverin, 2024).

Many key areas on this UM campus are not connected by walking or bike trails. The campus trail, marked in pink in **Figure 4**, is only partially accessible and does

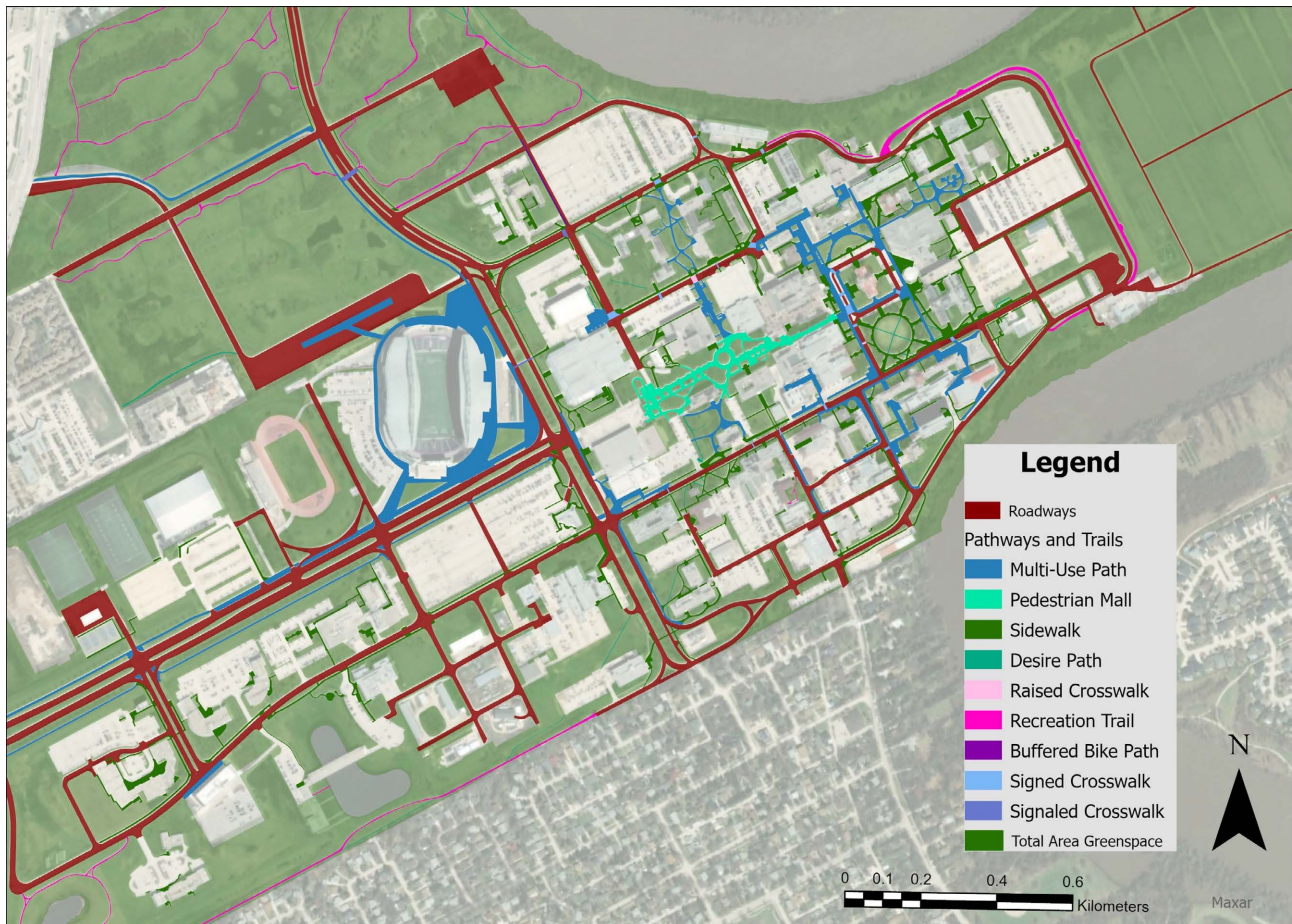


Figure 4. Connectivity of sidewalk and pedestrian routes on campus (Adapted from Vermeulen, 2023; Miller, 2022).



Figure 5. The missing sidewalks at different buildings on the University of Manitoba's Fort Gary Campus. (Left: Wallace building. Middle: Sinnott Building in St. Paul College. Right: Max Bell Center on Sidney Smith St. Source: author).

not fully integrate with other AT resources. **Figure 5** illustrates the shortage of sidewalks, showing paths that become inaccessible for people with disabilities and others during inclement weather due to muddiness or snow. The absence of clear paths is noticeable, with worn paths through snow or grass indicating desired routes. Limited crosswalks further complicate active movement across campus. Limited crosswalks further complicate active movement across campus (World Health Organization Regional Office for Europe, 2022).

3.2. Planning

The Fort Garry campus at the University of Manitoba is planned for car transport without considering the impact of cars on AT. Much more land is used for parking lots and roads than AT. Almost 14% of UM's built environment is parking lots. Parking lots and roads create large spatial barriers to get to and from campus and to nature, including the riverbank. As **Figure 6** shows, pedestrians and bicycles lack crossings and bike lanes, putting them in the path of cars. The campus' curvilinear road layout blocks access to the Red River. The roadways circling the university lack sidewalks or bike lanes in most places on this ring to allow access to active users.

Roads and parking lots block access to the riverbanks, public artworks, gardens, and squares. No access to the riverbanks is available, with busy streets, riprap on riverbanks, and parking lots blocking access, without any access pathways or docks. **Figure 7** shows the lack of signage or a riverbank trail. As a result, students rarely see the river.

Planning needs to consider that students and staff need housing near campus to facilitate AT (University of British Columbia, 2023; Hall & Ram, 2018). Although bus and car sharing is available in the City of Winnipeg, access to AT is challenged if students and staff live far away and AT is not available from home (Hamidi et al., 2019; Mix et al., 2022). On-campus or near-campus affordable housing can significantly help the students and staff to engage in this AT initiative promoted by UM. On-campus housing is part of the infrastructure that prioritizes campus AT strategies. With the need for affordable housing for students, a variety of rental housing within a 15-minute walk to campus is recommended to be reserved for students and staff (University of British Columbia, 2023).

Planning AT at universities is supported by the Bicycle Friendly University (BFU) program (Townsend, 2024). The BFU assists higher education institutes in promoting and providing a bikeable campus for students, staff, and visitors (Townsend, 2024). The BFU program improves campuses for cycling with its roadmap and technical assistance. For example, the University of Utah is one of the gold medal holders of the BFU program, as 30% of students walk or bike to get to class and other destinations (University of Utah, 2024). The University of Utah has developed educational programming for safe cycling and healthy programming, connecting the campus to routes off-campus (University of Utah, 2024).

Other cultural attractions lack signage or maps to showcase these amenities. This research identified more than 20 exterior art pieces highlighted with green dots in

Figure 7. These art pieces are frequently not accessible by trails or sidewalks but rather have many barriers for people to get to these crossing roads and parking lots.



Figure 6. Planning roads for cars, not people without bike lanes or crosswalks (Left: People without crosswalks on Dafoe Rd. Middle: Bicyclists on Sydney Smith Street with cars, Left: Bicyclists on Dafoe Rd with buses and cars. Source: author).

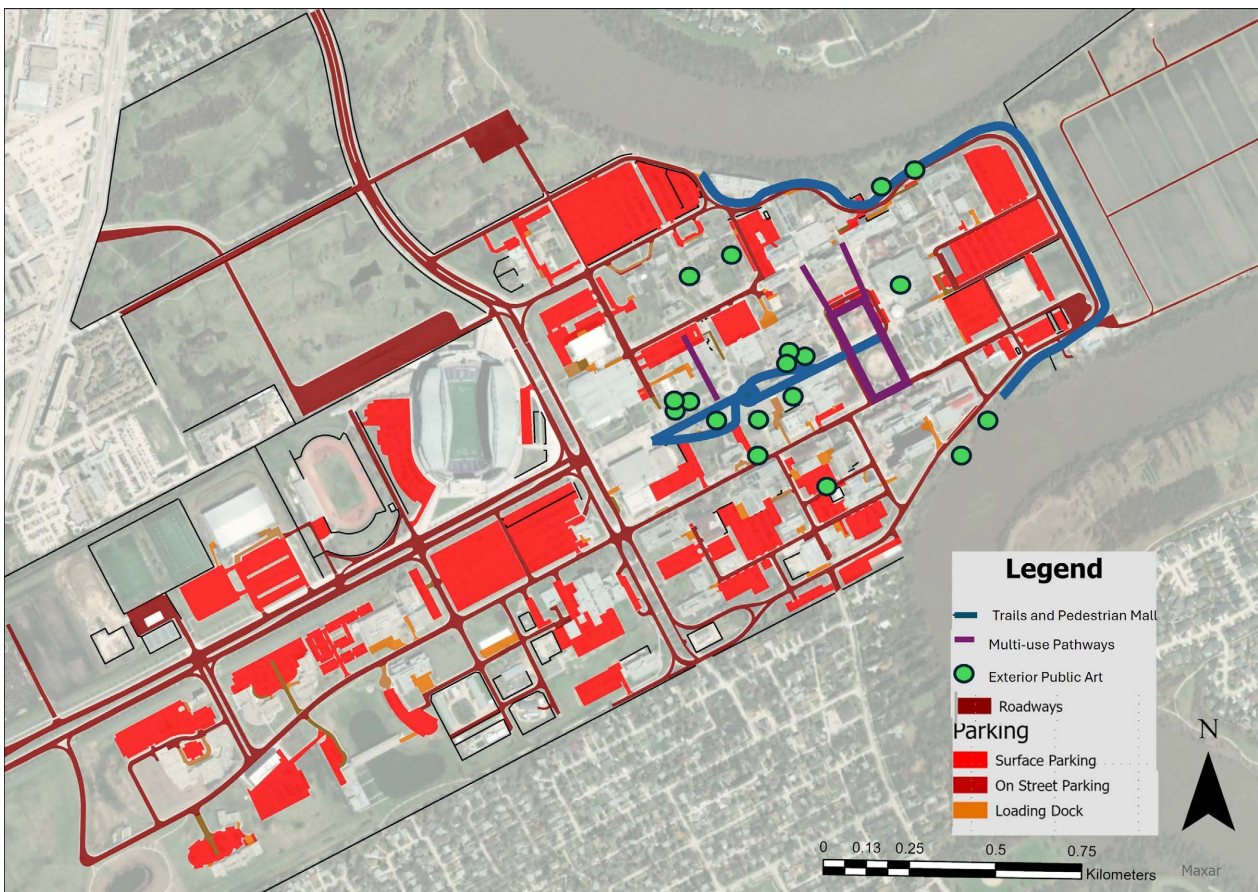


Figure 7. Planned for cars, not active transport, Fort Gary campus, University of Manitoba (Adapted from Vermeulen, 2023; Miller, 2022; University of Manitoba, 2023).

3.3. City-Campus Active Transport Access

This suburban university is separated from the City by a large divide of parking lots, research facilities, and green spaces. This spatial separation, rather than integration, of the campus from the city creates barriers to walking and biking. To walk from the gates of the UM at Pembina Highway to any campus building requires more than 20 minutes, being approximately 1.5 km. This large distance between the City and campus is a barrier, particularly with the cold climate in Winnipeg.

Access to amenities at the Fort Garry Campus should be less than 15 minutes (Barratt & Swetnam, 2022). An urban planning concept considers that all essential services, such as food stores, banks, health care, and other amenities, should be accessible within a 15-minute walk from a person's home, school, and workplace (Barratt & Swetnam, 2022). The UM's Fort Garry campus considers that most amenities, such as food stores, are not accessible on campus and cannot be reached off-campus within 15 minutes. Without nearby essential services, people rely on cars. The UM lacks rental/shared bikes or scooter systems on campus or in the City of Winnipeg. Although there is a shuttle on campus, most people are unaware of their schedules. As a result, accessing needed services is difficult without a car service to reach.

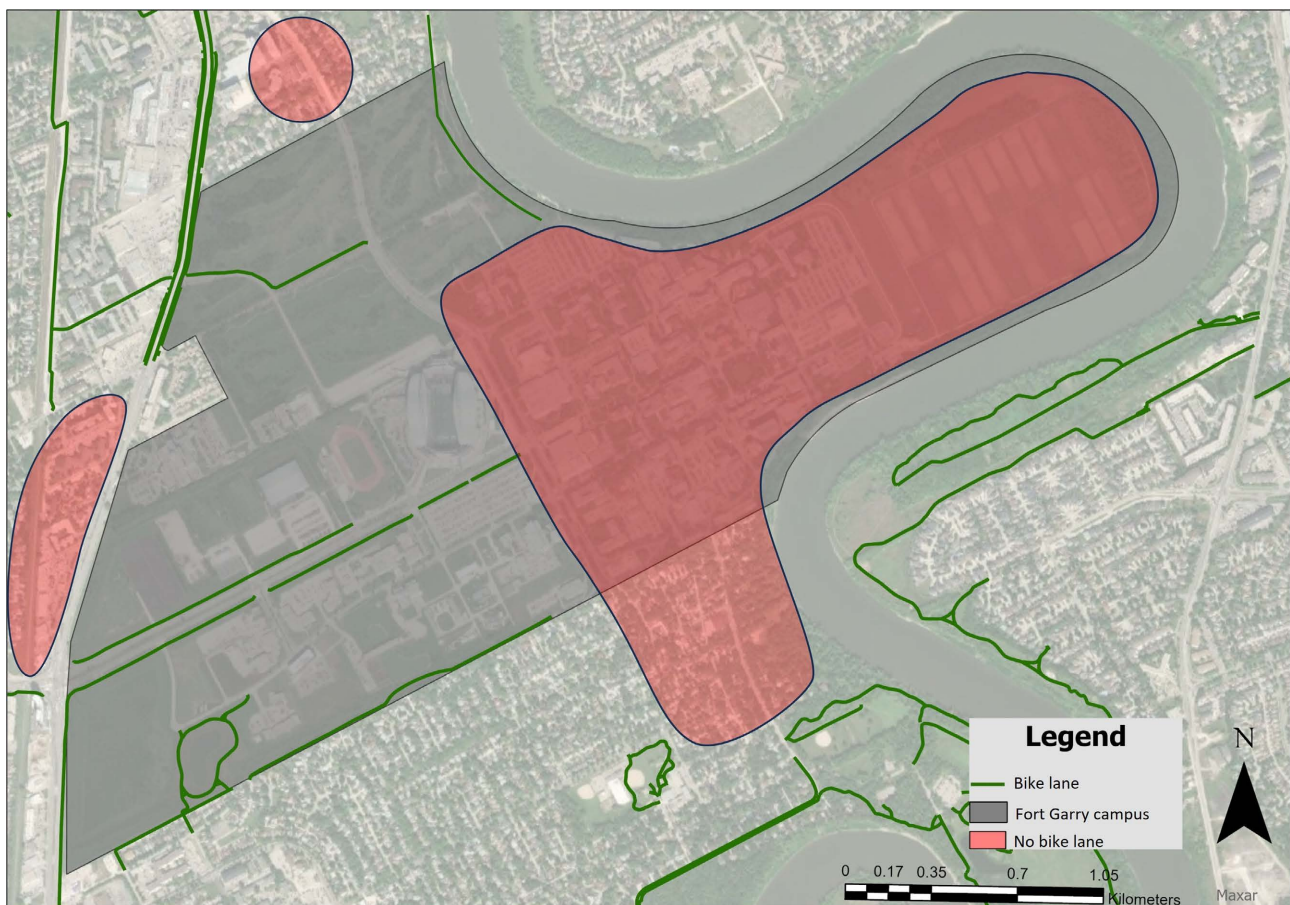


Figure 8. No connected bike lanes exist near entrances and on campus at the University of Manitoba (Adapted from Paul, 2022; City of Winnipeg, 2024).

The lack of bike paths to the campus and inside the campus hampers access to the University as shown in **Figure 8**. The Fort Garry campus lacks bicycle paths leading to campus from main access routes, including Pembina Highway, Bison Street, and King Drive. Within the campus, bike lanes are also scarce. This lack of bike lanes, both inside and outside the campus, undermines AT. Although a secure, chargeable bike parking station is available, the rate of bike theft in other locations on campus is very high. The campus lacks rental and shared bikes. Nor are bike taxi services available. While “Bike to Work Day” is celebrated, few other AT incentives or events occur.

Public transportation is complementary to AT. More people taking buses rather than cars makes the campus safer to walk and less polluted. However, the bus stops are not throughout the campus. Rather, the buses only access certain areas, with the northwest side being without bus stops, including the Wallace Building, some science buildings, and the Law Building. People in these buildings have to walk for ten or more minutes to reach a bus stop, with the temperature reaching 35 below in the winter. Further, the lack of an indoor waiting area makes public buses less accessible at UM Fort Garry. In the extreme cold, the lack of heated indoor waiting areas at bus stops makes public transportation inaccessible to many at UM Fort Garry. The lack of any indoor heated waiting area for buses on campus in the cold weather limits public bus use in this cold winter climate, where temperatures reach -35 degrees Celsius.

4. Conclusion

Transportation at the UM is not sustainable without more focus on AT. The UM campus’s car-centric nature needs to shift to prioritize AT. The largest source of GHG emissions at the UM is transportation, fueled largely by people commuting to school and work. Mitigating climate change begins when we study to ensure youth learn sustainable, healthy behaviours of AT. From an environmental perspective, reducing car reliance on campuses notably cuts carbon emissions, a critical step given the global urgency to meet climate targets. Active transportation improves air quality without creating pollution or using fossil fuels.

Much work has to be done to shift the trend at UM from driving more to less driving and more AT. Despite a high preference for cycling, carpooling, and other AT modes amongst UM community members, driving alone is increasing, and AT is decreasing. A new, updated UM strategy is needed to build on the 2017 “Moving Forward: Sustainable Transportation Strategy” to create a pedestrian-focused, healthier campus environment. The UM would benefit by joining the BFU program, not reinventing the wheel but learning from available North American models. The UM can learn from the BFU’s roadmap and technical assistance to create a bicycle-friendly campus and create educational programming. Following the University of Utah’s lead, UM could connect bike routes on campus to those living off-campus ([University of Utah, 2024](#)). The number of universities prioritizing AT is increasing every day, and UM can be part of this growing

movement. A focus on AT over cars provides many benefits. Increasing AT is more sustainable at the personal and environmental levels than driving cars. Commuting by AT reduces stress, enhances people's mental well-being and physical health, and improves academic performance.

Plans for AT that consider access and city-campus integration are needed. Walking and biking paths are needed to provide safe routes for AT both on and off campus. The UM can provide separated, safe bike and walking routes everywhere across campus, with accessible crosswalks, clear signage, night lighting, and dedicated, separated safe routes. To integrate AT across the city and campus, Winnipeg should integrate safe routes to the University into urban planning, with dedicated bike lanes and sidewalks separated from vehicle transport. This AT infrastructure needs to be seamless, without large gaps in connectivity as currently occurs, and it must include bike locking areas. To connect with the remainder of the city, the UM should offer accessible indoor heated waiting areas for bus stops.

Universities are ideal starting points for AT initiatives. The UM can become a leader in sustainability by piloting car-free zones and bike-share programs, which do not currently exist in Winnipeg. This focus on AT as a university that teaches planning could shift city planning approaches to be more livable and walkable. The UM could champion the 15-minute city approach by increasing connectivity to the city and providing diverse services to meet most needs on campus. Less parking lots and roads on the UM could create a livable UM community where many amenities replace these barren lands to allow all essential needs to be met within a 15-minute walk. If more destinations were created that bridged the campus and outskirts of campus, UM could turn into a 15-minute campus, providing all needs.

Creating an AT ecosystem requires a collaborative effort between governments, academic institutions, and private sectors. Investing in biking, walking, and bus infrastructure and programs can be a practical, educational, and economical solution to environmental and health issues posed by vehicles. Investing in AT and public transit is cheaper than investing in road projects that require costly new roads or upgrades. Universities can offer financial or academic incentives to encourage students and employees to choose active commuting, such as subsidizing public bike-sharing systems. Improving campus connectivity and encouraging AT through bike share programs, public transit, and community-driven AT events help promote active lifestyles, which results in healthier communities and climate mitigation.

Conflict of Interest

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