MEASURING THE "AGE-FRIENDLINESS" OF A COMMUNITY: EVALUATION OF AUDIT GUIDES FOR SUPPORTING ENGINEERING DECISION-MAKING

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1 Introduction

"Age-friendly Communities" is an initiative led by the Public Health Agency of Canada (PHAC) to support healthy aging in communities through the provision of a built environment (including active transportation) and programming that helps foster the inclusion of older adults in society. It is a part of a broader global campaign for Age- Friendly Cities led by the World Health Organization (WHO) (WHO, 2007). One of the key features of an Age-Friendly Community is for roads and walkways to be accessible (Public Health Agency of Canada, 2025) with "Transportation" as one of the Community Domains (Public Health Agency of Canada, 2015) with indicators to measure progress in achieving "age-friendliness". Communities can have age-friendly infrastructure development goals but may lack metrics to establish benchmarks and monitor progress. There are multiple suggested audit guides to assist with the evaluation of walkability and transportation, but it is unclear how these tools may be applied to support planning for age-friendly transportation infrastructure at an operational level, as they have not been deployed in a city-wide context. This research involved piloting multiple guides and audit tools, including some PHAC-recommended, on 62 selected road segments in Fredericton, NB to determine their usefulness for engineering decision-making, including their ability to differentiate among different levels of perceived age-friendliness. Furthermore, a GIS-based analysis approach was piloted by identifying attributes from an audit tool most likely to be available from city open data sources and using this to propose an approach for city-wide age-friendly community evaluation.

2 Background

The initiative known as "Age-friendly Communities" is being driven by the Public Health Agency of Canada (PHAC) to assist communities in supporting healthy ageing by providing a built environment (including active transportation) and programming that helps encourage the inclusion of older adults (aged 65 years and older) in society. PHAC describes an age-friendly community as one where "the policies, services and structures related to the physical and social environment are designed to help seniors "age actively." In other words, the community is set up to help seniors live safely, enjoy good health and stay involved" (Public Health Agency of Canada, 2025). It is a part of a broader global initiative for age-friendly cities being led by the World Health Organization (WHO) within eight domains: 1. Outdoor spaces and buildings; 2. Transportation; 3. Housing; 4. Social Participation; 5. Respect and Social Inclusion; 6. Civic Participation and Employment; 7. Communication and Information; and 8. Community Support and Health Services (WHO, 2007). Within those eight domains, there are multiple areas which intersect with the responsibilities of engineers, including the built environment and transportation. Built environment and transportation attributes to foster older adult inclusion are typically associated with fostering accessibility for persons with a disability (e.g. gentle slopes, presence of sidewalks, curb cuts), independent mobility

without a car (e.g. transit stops), feelings of safety and security (e.g. sidewalk lighting, ability to cross a street) and ability to meet one's need for food, health, and social/recreation in one's neighbourhood.

PHAC created an 'Age-Friendly Communities Evaluation Guide: Using Indicators to Measure Progress' as part of its continuous mission to promote the adoption of the Age-Friendly Communities (AFC) model across Canada (Public Health Agency of Canada, 2015). This guide is intended to help communities track their progress on their age-friendly initiatives, which would be developed through a community needs assessment involving the participation of older adults, organized into an action plan, then evaluated later in terms of whether the goals were met or what progress was made. Some age-friendly initiatives, such as recreational or social engagement initiatives, can be straightforward for community groups to mobilize. Other initiatives to improve the availability of transit, the walkability of communities, and the presence of health and shopping amenities, can require considerable municipal and government resourcing and coordination to effectively operationalize. PHAC suggests several approaches to help understand baseline conditions for the eight domains; Domain 1: Outdoor Spaces and Buildings, Domain 2: Transportation, are the most relevant for transportation planning (Table 1).

Table 1:PHAC Built environment indicators and measurement methods

WHO Domain	Relevant built environment/ transportation indicator	Suggested measurement method
Domain 1: Outdoor Spaces and Buildings	• Walkability (4 indicators) • Actual and Perceived Accessibility (1 indicator)	• Walking assessment • Measuring perceived walkability • Accessibility checklists (actual accessibility)
Domain 2: Transportation	• Transportation Options and Public Transit (4 indicators) • Age-Friendly Streets and Parking (2 indicators)	• Program inventory and/or existing municipal data • Walking assessment

PHAC directs readers to four different walking assessment tools: The Seniors Walking Environmental Assessment Tool-Revised (SWEAT-R), the Centers for Disease Control and Prevention's Healthy Aging Research Network (CDC-HAN), which is designed separately for intersections and segments of the street, and a tool for assessing perceived walkability called the Neighbourhood Environment Walkability Survey (NEWS). The intent would be for communities to assess themselves with these tools, with the results presumably being used to measure the elements of the built environment and transportation network important to an age-friendly community. However, PHAC also recognizes these walking assessment tools are only intended for understanding the age-friendliness of a limited area. This approach presents challenges for transportation planning. The development of an age-friendly "community" suggests progress needs to be made on a community-wide basis, though the suggested measurement approaches for active transportation are neighbourhood-based.

2.1 Review of age-friendly audit tools

One of the primary methods of auditing the age-friendly elements of a specific location is a walking assessment tool. These can be checklists that include measurable items (e.g. number of vehicle lanes) and observable items (e.g. do homes have bars on their windows). They typically have been developed through considerable engagement and research with older adult participants, primarily through a public health or social science lens, with the goal of the audit results informing age-friendly public policy and infrastructure development. Each tool covers similar but not identical content. There are other age-friendly walkability

audit tools that were not profiled by PHAC including the Objective Walkability Index (OWI) and the Walking Routes Audit Tool for Seniors (WRATS). The OWI is based on an objective data inventory utilizing Computerized Neighborhood Environmental Tracking (ComNET), a tool developed by the Fund for the City of New York's Center on Municipal Government Performance (CMGP) (Weiss *et al.*, 2010). WRATS evaluates a walking route's attractiveness, comfort, directness, safety, coherence with 20 criteria evaluated on a points scale.

2.2 Comparing attributes of age-friendly audit tools

The six identified audit tools were compared based on four key attributes extracted from the literature: time (how long to conduct the audit); GIS-based variables (e.g. the potential to extract relevant audit items from GIS data); end result (what the audit tool provides in terms of an output for analysis); and auditing needs (how the audit is conducted). These are summarized in Table 2 below:

Table 2:Comparison of age-friendly audit tools, as per the literature

		Comparable attributes			
		Time	**GIS based variables**	**End result**	**Auditing needs**
Audit Tools	**OWI**	N/A	All the variables are GIS based	census blocks are classified into quartiles (bottom quartile- low OWI, top quartile- high OWI)	ComNET is not available for Canada
	SWEAT-R	7.4 minutes per segment	All the variables are GIS based	the quantity or percentage of segments in a neighborhood that have a specific indicator	The audit form (paper-based)
	CDC-HAN	20 minutes per segment/ block	The mixture of objective (GIS-based) and subjective (non-GIS-based) variables	Percentage of supportive and problematic features among audited segments of a route or LWS	The audit form (paper-based)
	WRATS	N/A	Non-GIS-based	A total score of 0 to 40 for all the indicators along a route, with score of 70% (28 out of a possible 40 points) should be viewed as a minimal level of provision overall	The audit form (paper-based)
	NeDeCC	N/A	The mixture of objective (GIS-based) and subjective (non-GIS-based) variables	The auditing of a section of a route using this tool does not result in a total score, but the scoring system can be determined based on the objectives of each study	The audit form (paper-based)
	OPECR	8.9 and 10.1 minutes per segment	Mostly GIS-based with a few non-GIS-based items	Utilizing latent class analysis (LCA) three classes are identified for this tool's variables. But it does not provide a total score or class for the entire segment or LSOA.	There are two versions. One is foot-based, while the other is GSV-based. The GSV version of that is not accessible online, although paper documents are available.

Despite the PHAC-supplied guidance, there does not appear to be published examples of applying these audit tools in practice in Canada. In New Brunswick, for example, the Government of New Brunswick has an age-friendly community recognition programme which is aligned with the WHO age-friendly domains. A community can be recognized as "age-friendly" by the Government of New Brunswick (Department of Social Development) if it passes a municipal resolution and completes an action plan developed based on the needs identified by older adults through a community needs assessment. In this case, the designation of

"age-friendly community" is primarily a function of the recognition of the need to support older adults and is not a recognition of a community reaching measurable thresholds for accessibility in its built environment or transportation, for example. This appears to be the case among most other provinces as well, which focus primarily on the social components of age-friendliness informed through consultations with older adults, with limited objective assessments to compliment the qualitative data. Consequently, research that applies the audit tools in practice may have value in supporting the uptake of these tools for objectively monitoring progress on the built environment and transportation indicators that require longer term planning and prioritization.

3 Methodology

Each audit tool was reviewed for its potential to quantify "age-friendliness". The initial finding was that each tool did not quantify age-friendliness, rather they provided a means to create an inventory of age-friendly attributes in the built environment along a specific road segment, ranging from 20 attributes (WRATS) to 165 (SWEAT-R) per segment. The shortlist of four audit tools to pilot (SWEAT-R, WRATS, NeDeCC, and the foot-based version of OPECR) was chosen based on: anticipated time to apply a selected tool, the potential ability of the tool to adapted to using GIS, the outcome achieved through the application of the tool, inclusion of objective variables in the tool, online availability of the tool, and intended users of the tool. Given the audit tools were intended to create an inventory of objective (and sometime subjective) attributes without resulting in a measure of degree of age-friendliness, the next step was to pilot the tools on road segments within neighbourhoods that appear to have characteristics of "low", "medium", and "high" levels of age-friendliness, as interpreted from the literature. Applying an audit tool to these areas was expected to result in a summary of attributes that could be sorted by a subjective age-friendly level, then investigated to see if there were measurable attributes or observable trends that would correspond with these levels. Three areas were selected in the City of Fredericton, New Brunswick corresponding to a subjective assessment of low, medium and high levels of age-friendliness.

Figure 1:Subjective assessment of age-friendliness levels

		
Low: Few pedestrian amenities, high road traffic, exclusively commercial (Regent St.)	Medium: Some sidewalks but no benches, mostly residential (Saint John St.)	High: Many pedestrian amenities, mixed residential & retail, flat topography (Queen St.)

3.1 Pilot test results

The attributes of the study are summarized below, including a summary of WRATS scores (the only tool that returned results as a score).

Table 3: Pilot study attribute summary

	Hypothesized Level of Age- friendliness								
	Low			**Medium**			**High**		
Study Area	Regent St. (Regent Mall)			Saint John St.			Queen St (one way)		
Segment	102 m	251 m	379 m	85 m	85 m	122 m	202 m	204 m	205 m
Land use (zoning)*	RC COR-2 INF MR-2	COR-2 I-2	RC I-2	TP-2 P	TP-2 P	TP-2	CC CCI	CC CCI	CC CCI
Bus Stop	Yes	Yes	Yes	No	No	No	Yes	No	No
Street Type	Street, 50 km/h, 4 lanes			Street, 50 km/h, 2 lanes			Street, 50 km/h, 2 lanes		
Class	Major Arterial			Residential			Major Collector		
Grade	1.9			0			0		
WRATS output									
Seg. #	1	2	3	1	2	3	1	2	3
Score	19	19	18	26	26	25	28	28	28
*Land use (zoning): CC, CCI = City Centre; TP-2 = Residential; P = Park; RC: Commercial; COR-2 = Commercial; INF = Industrial; MR-2 = Residential; I-2 = Institutional									

While WRATS scores seem to align with the subjective categories, the indicators themselves have considerable subjectivity and would be nearly impossible to automate for citywide analysis. For example, under the "Attractiveness" audit category, a maximum score of 2 is given to "Traffic noise and pollution do not affect the attractiveness". OPECR was inventory-based, but it was not clear how the results should be interpreted in terms of age-friendliness as there were many contradictory measures. For example, if an area has a "neighbourhood watch" sign, is this positive (e.g. a community is organized) or negative (e.g. a community is concerned about crime). The form documenting the Built Environment measures appears to organize attributes from left to right as poor or non-existent to excellent or crowded; presumably a one-way road is more age-friendly from a pedestrian perspective, but is in the same column as other attributes that would not be considered age-friendly. Due to time constraints, the Neighbourhood Design Characteristics Checklist (NeDeCC) was not applied in practice as it could not be associated with a road segment, rather it is intended for application within a 300 m radius of a participant's home.

SWEAT-R appeared to be the audit tool that had the most objective measures that could potentially be assessed with a GIS and had attributes that were most focused on transportation and the built environment. However, it did not result in an age-friendly score (contrary to the assertion of the PHAC documentation) and took far longer to audit a segment than the literature suggested (1 hour vs. 8 minutes). The main reason for this was there were 165 measurable attributes per segment; the expectation is that an auditor (or whoever is commissioning the audit) would select the relevant attributes to inventory.

Chaudhury, *et al*. (2011) used SWEAT-R to distinguish between high-density and low-density neighbourhoods in Portland and Vancouver, respectively. They presented results in terms of percentage of audited road segments with the measured attributes (e.g. what percentage of road segments had 4+ lanes of traffic). This aggregation method and form of comparison by levels (low vs. high) suggested that SWEAT-R may be able to be used to differentiate among different levels of age-friendliness.

3.2 Application of the SWEAT-R audit tool

The SWEAT-R audit tool was the basis for additional data collection on an expanded sample of roads in Fredericton. A total of 62 segments were audited using the SWEAT-R tool, including those already audited in the pilot test: 18 segments were selected as high age-friendly, 24 segments as medium age-friendly, and 20 segments as low age- friendly. The goal was to obtain approximately 20 segments per age-friendliness level. Roads and neighbourhoods were sampled from throughout the south side of Fredericton. Due to time constraints, many audits were completed using Google Streetview. The collected data from the audit were entered into an Excel database, enabling qualitative analysis and comparison of the presence of the items across different levels of age- friendliness in the study area.

The method used to analyze the results of the observation involved aggregating by the major categories in SWEAT-R in the same manner as Chaudhury *et al* (2011): functionality, destinations, aesthetics, safety and comfort, and data collection conditions. To apply this method, each segment was coded based on the major categories in SWEAT-R, then, the percentage of each item in the categories of functionality, destinations, aesthetics, safety and comfort, and data collection conditions are calculated for each street, and summarized by the subjective age-friendliness categories (Table 4).

Table 4: Summary of SWEAT-R attributes as per Chaudhury, *et al.* (2011)

	Audited Items	**% in each type of segments**		
		High	**Medium**	**Low**
Buildings	Single-family homes (detached)	6	83	40
	Multi-family dwellings	0	38	35
	Recreational uses	28	13	25
	Commercial uses	83	21	65
	Service uses	100	0	35
	Medical facilities	39	0	30
	Vertical mixed use	78	0	15
Sidewalks	Continuous (both sides)	100	75	60
	Sidewalks (no sides)	0	0	0
	Sidewalk Width (4 + feet)	100	100	100
	Condition (good)	100	100	85
	Sidewalk Slope (gentle)	100	29	15
	Sidewalk Obstructions	0	0	15
	Benches (1 or more)	44	8	45
Street life	Porches (all/most)	0	8	10
	Buffer (both sides)	94	46	40
	Public Space (none)	28	8	40
Destinations	Restaurants	67	8	45
	Coffee shops	56	13	25
	Seniors' activities	11	0	10
	Public transit stops	50	38	90
Aesthetics (Views & maintenance)	High quality public space	56	29	5
	Buildings well maintained (all/most)	100	100	100
	Barred windows (some)	0	13	5
	Yards well maintained (all/most)	100	88	60
Safety & comfort	4 + lanes of traffic	11	4	45
	Mean no. of streetlights*	11	4	2
	Bike lanes	6	0	25
	Traffic calming devices	100	79	95
Curb cuts	Both sides (NW corner)	94	79	80
	Both sides (SE corner)	100	88	90

Road segments considered to be high age-friendliness had increased residential and commercial density, more mixed-use zoning, more sidewalks, more high-quality public space, and fewer multilane roads than medium or low age-friendly areas, while low age-friendly areas had fewer sidewalks, steeper sidewalks, more transit stops and bike lanes than medium and high age-friendly areas. Broadly speaking, if this type of aggregation were used as a basis to try and increase the age-friendliness of a community, it may lead to counter intuitive recommendations (e.g. reducing bike lanes and number of public transit stops).

4 Towards a SWEAT-R-based GIS age-friendly community assessment

Elements of SWEAT-R could be adapted for use in developing a "Level of Age-Friendliness" (LOAF) score. The initial stage involved the identification of variables among the summarized variables in SWEAT-R that were amenable to representation as either point, line, or polygon features in a GIS, and represent land use information and the transportation built environment typically available from municipal open datasets. The result was the selection of six (6) built environment attributes and one (1) composite land-use attribute that would be added together to represent a single score. The data were then imported into ArcMap and analyzed using a combination of spatial and statistical analysis tools. The scoring system was based on the percentage of road segments that contain the relevant attribute (e.g. if 1-25% of a road segment has sidewalks, it gets a score of 1, 26-50% gets a score of 2, etc).

(1) LOAF = Land Use Score + Sidewalk-equipped segments score + Gentle slope segments score + Bench-equipped segments score + Transit-proximate segments score + Narrow traffic segments score + Lit segments score

This score was aggregated by Dissemination Area (DA), a Statistics Canada geographic area of approximately 400-600 persons. The Land Use Score was intended to reflect how the literature values age-friendly land uses: areas that have mixed use (rather than residential or commercial only) were often considered to be more age-friendly. Zoning maps were used to determine what percentage of the DA had mixed use zoning, as well as a combinations of residential and "destination" (e.g. commercial, institutional) land uses, with scores broken down by quartiles; if there was only a single land use type, the Land Use Score was multiplied by 0. Table 5 shows this calculation for 4 of the 96 DA's in Fredericton.

Table 5: Assessment of age-friendliness in Fredericton utilizing geospatial data for 4 out of 96 DAs

	Pop.	Street length	Sidewalk-equipped segments		Gentle slope segments		Bench-equipped segments		Transit-proximate segments		Narrow traffic segments		Lit segments		Mixed-use factor	L O A F
DAs		**m**	**%**	**Score**	**%**	**Score**	**%**	**Score**	**%**	**Score**	**%**	**Score**	**%**	**Score**	**Score**	**Score**
168	750	5231	20	1	97	4	0	0	34	2	100	4	100	4	1	16
169	775	3033	38	2	94	4	0	0	37	2	100	4	100	4	1	17
170	1780	9009	44	2	95	4	0	0	28	2	100	4	96	4	1	17
171	590	3463	37	2	84	4	19	1	39	2	100	4	100	4	0	17

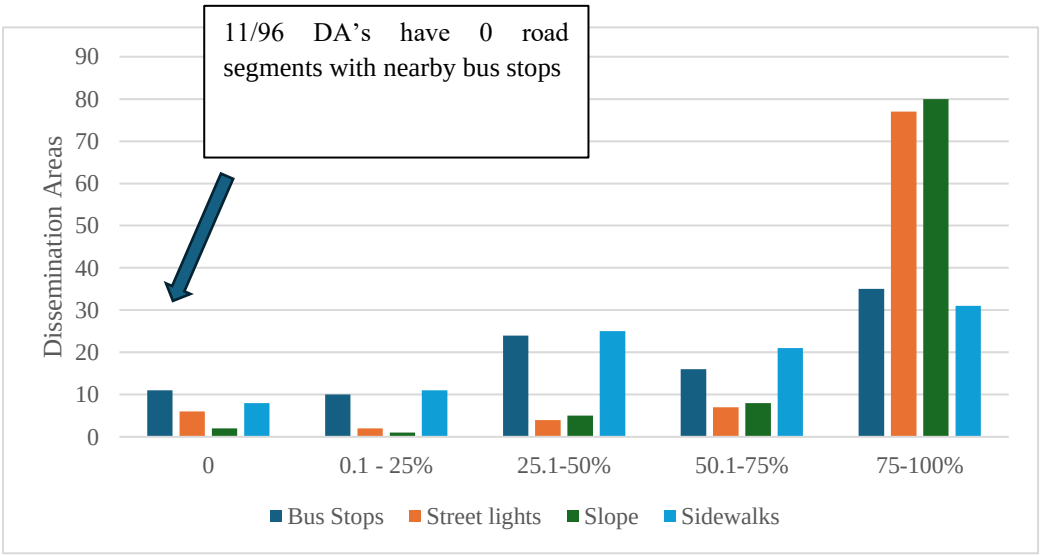
After calculating the age-friendliness index for each DA, the population of older adults and the total population in each DA were assembled from Statistics Canada census data. Using the collected geospatial data in each DA, an analysis was conducted to assess the proportion of the population living in DAs with different proportions of age-friendly features, permitting a method of tracking progress. The data in Table 6 show two examples of how attribute information could be aggregated. For example, 2000 older adults (18.8% of the population) lives in an area where 91-100% of the road segments have transit stops, compared to 21.4% of the whole population.

Table 6: Accessibility of population to areas with different percentage of age-friendliness items in Fredericton

Percentage of the assessed item	Sidewalk-equipped segments				Segments with transit stops			
	Older Adults		All age groups		Older Adults		All age groups	
	Number	%	Number	%	Number	%	Number	%
<1	395	3.7	2845	4.8	635	6.0	4255	7.1
1-11	785	7.4	2725	4.6	420	3.9	1700	2.8
11-21	380	3.6	2680	4.5	425	4.0	2470	4.1
21-31	630	5.9	3890	6.5	960	9.0	6765	11.3
31-41	1165	10.9	5310	8.9	1600	15.0	7775	13.0
41-51	1885	17.7	9915	16.6	1095	10.3	7315	12.2
51-61	1680	15.8	9790	16.4	925	8.7	3440	5.8
61-71	890	8.4	4000	6.7	815	7.7	3520	5.9
71-81	720	6.8	4090	6.8	950	8.9	4710	7.9
81-91	755	7.1	3930	6.6	825	7.7	5035	8.4
91-100	1365	12.8	10615	17.8	2000	18.8	12805	21.4
Grand Total	10650		59790		10650		59790	

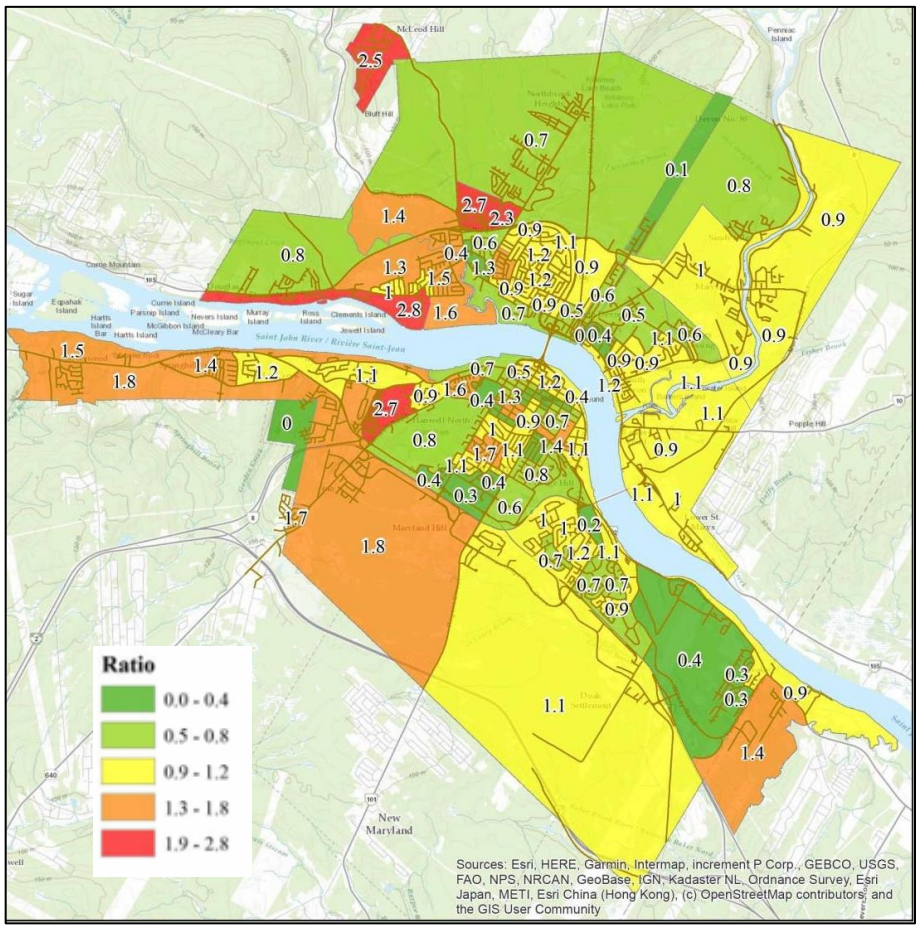
This method of geographic analysis, including the aggregation by percentage of the assessed item, provides a method to track progress by geographic area within a city, along with the alignment with the population of older adults (or forecasted population of older adults). Figure 2 shows a summary for all 96 DA's in Fredericton.

Figure 2: Summary of percentage of road segments with age-friendly attributes (all 96 DAs in Fredericton)



The ratio of the percentage of population of older adults to the Level of Age-Friendliness (LOAF) can also be used to identify geographic areas where there may be a large population of older adults with relatively few age-friendly amenities. In Figure 3, some of the highest ratios are in areas of relatively new construction, including housing specifically for older adults.

Figure 3: Map of Fredericton with a ratio of older adults to level of age-friendliness



5 Conclusions and recommendations

While the Public Health Agency of Canada (PHAC) has suggested audit tools to help communities track their progress on having their built environment and transportation become more "age-friendly", there is no technical guidance to support the use of these tools. The tools themselves do not quantify age-friendliness, rather provide a way to inventory attributes that could be considered age-friendly. While SWEAT-R was found to be the most appropriate, with 165 measurable attributes, it is too extensive a tool to be used effectively. A new method for evaluating age-friendliness across an entire city was developed, based on geospatial data that utilized the summary measurements of SWEAT-R and made them briefer in a way that could be matched with the available feature layers in the data sources. Additionally, it defined a scoring method that could be applied to determine an age-friendly index for a city based on the percentage of age-friendly items identified in the geospatial data, such as the presence of benches or sidewalks.

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