TRIP GENERATION MANUAL

SUMMARY REPORT

December 2020

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TABLE OF CONTENTS

TABLE OF CONTENTS

STUDY PARTICIPANTS

The TRANS Committee is comprised of the following member agencies: National Capital Commission (NCC), Ontario Ministry of Transportation (MTO), City of Ottawa (including OC Transpo), le Ministère des transports du Québec (MTQ), la Ville de Gatineau and la Société de transport de l'Outaouais (STO).

This study was conducted under the direction of a TRANS Steering Committee that included representation from the following agencies:

— **City of Ottawa:** Transportation Planning Service

— **Ville de Gatineau:** Section Planification des transports

— **Ministère des Transports du Québec**: Direction de l'Outaouais and Modélisation des systèmes de transport

— **Société de transport de l'Outaouais**: Stratégies et développement

A joint Project Manager Team from TRANS led the study progress – Ms. Jennifer Armstrong, Senior Project Manager, City of Ottawa and Ms. Nadine Lafond, Responsible – Planification des transports, Ville de Gatineau. The Sub-Committee also included M. Éric Robert, Ministère des Transports du Québec and M. Michael Nowakowski, Société de transport de l'Outaouais.

The practical guidance, local knowledge, expertise and assistance of the above-mentioned organizations and team members is appreciatively acknowledged and recognized.

The TRANS Trip Generation Study has been documented in two separate reports:

— TRANS Trip Generation Manual - Summary Report

— TRANS Trip Generation Manual - Background Report

1 INTRODUCTION

TRANS, a joint technical committee on transportation systems planning in the National Capital Region (NCR), has played a key role in coordinating area-wide transportation modelling and data collection efforts in Ottawa-Gatineau. An update to the 2009 *TRANS Trip Generation Residential Trip Rates Study Report* and corresponding *TRANS Trip Generation Summary* is being carried out to provide practicing transportation planning professionals in the NCR with updated data for conducting Transportation Impact Assessment (TIA) and similar studies. Like the previous edition, the 2020 *TRANS Trip Generation Manual Background Report* and *TRANS Trip Generation Manual Summary Report* blend locally collected data with non-local databases to establish residential trip rates and mode share. The current update also identifies mode shares for non-residential sites including schools, employment generators and commercial generators based on data available from local surveys and the TRANS Origin-Destination Survey. Additional elements that were reviewed include potential influencing factors in a person's trip decision-making and the impacts of mixed-use development as part of the trip generation process. The contents of this report have direct implications on site planning, development approvals, and overall planning activity in the NCR.

This 2020 *TRANS Trip Generation Manual Summary Report* summarizes the trip generation rates and mode shares recommended for use by consultants and other practitioners to estimate trip generation for Transportation Impact Assessments and other traffic studies within the NCR. A recommended practice for calculating trip generation rates within mixed-use development and a summary of known influencing factors on travel behaviour are also included for consideration when developing trip generation estimates. The methodology for developing the recommended trip generation rates and mode shares, along with the analysis of influencing factors and recommendations for future data collection are detailed in the 2020 *TRANS Trip Generation Manual Background Report.*

2 DATA SOURCES

The trip rates and mode shares developed for the Ottawa-Gatineau region are based primarily on three data sources: locally observed trip generation studies (traffic counts), reported travel from the 2011 TRANS Origin-Destination (OD) Survey and the ITE *Trip Generation Manual* (10th Edition). The *2009 TRANS Trip Generation Study* was also referenced to validate the findings and identify any large changes in local behaviours throughout the NCR.

2.1   2009 TRANS Trip Generation Study

The 2009 TRANS Trip Generation Study is the latest update in a series of NCR trip generation studies carried out since 1977. The 2009 study provided residential trip generation rates based on a blended trip rate from specific generator site counts, the 2005 TRANS Origin-Destination Survey, and the ITE *Trip Generation Manual* (8th Edition). Trip rates were defined by dwelling type and geographic area to capture differences in trip generation throughout the NCR. While mode shares from the 2005 TRANS OD Survey were considered, the focus was on the development of vehicular trip rates, with reductions applied to account for proximity to rapid transit. With the transition to a multi-modal approach to transportation systems planning, the focus has shifted from vehicular trips to person trips, and application of the 2009 TRANS Trip Generation Manual requires a cumbersome back-calculation process to convert vehicular trips to person trips using mode share estimates from the 2005 OD Survey.

Since 2009, the various data sources used in the 2009 study have been updated and new information is available. Accordingly, an update to the 2009 study was undertaken to incorporate this new data and adopt a more multi-modal approach to trip generation in line with current practice. A key difference from the previous version of the TRANS Trip Generation Manual is a focus on person trips instead of vehicle trips. By combining person trip rates with modal shares, the number of trips by mode can be estimated, supporting the development of multi-modal traffic forecasts.

This study develops blended residential trip rates and mode shares based on the following updated data sources and refinements to best practices.

2.2   Local Generator Surveys

Local generator surveys were carried out from 2008 to 2012 within the NCR. All person-trips entering and leaving the sites were recorded and classified by mode over 8- to 12-hour periods. In addition to conducting traffic counts at each site entrance, data on the characteristics of each site were obtained (such as the number of dwelling units) for estimating local trip rates. While the surveys included various types of land use, they primarily focused on residential sites. In total, 49 local generator surveys were available for use in updating the residential trip rates. While these local surveys provide perhaps the best indication of local trip generation activity, the sites surveyed represent only a small sampling of residential developments within the NCR, and additional data sources are necessary to augment the local generator data and produce reliable trip rates.

2.3   2011 Trans Origin-Destination Survey

The most recent TRANS Origin-Destination Survey was conducted in the Fall of 2011 and captured 5% of households in the NCR. As part of the survey, respondents provided detailed information on all trips made by household members age 5 and older during the

previous day. The resulting dataset provides a rich snapshot of existing travel behavior including trip patterns, travel mode choices and socio-economic characteristics, which are critical inputs in developing long-range planning tools aimed at understanding and identifying future transportation demands associated with longer-term regional growth strategies. The 2011 TRANS Origin-Destination Survey represents the most comprehensive source of travel and trip data for the region, allowing trends to be analyzed by trip purpose, household/person attribute, and geographic area. However, unlike the local generator surveys, is does not capture commercial trips which are an important part of a site's trip generation potential. Therefore, a commercial vehicle factor, presented in **Table 1**, was applied to all residential person-trip rates.

<p align="center">**Table 1: Commercial Vehicle Adjustment Factor**</p>

Factor	Application	Apply To	Period	Value
Commercial Vehicle Factor	To account for **commercial travel** related to residential land uses, such as service vehicles making calls to residential homes, deliveries, garbage collection, home-based child care, etc. Applicable to TRANS Origin-Destination Survey residential trip rates to address the exclusion of commercial trip purposes not captured in the survey.	Residential person-trip rates	All	1.03

2.4 ITE Trip Generation Manual

The Institute of Transportation Engineers (ITE) *Trip Generation Manual* (10th Edition) is a widely-used document that compiles observed trip generation rates for a wide range of land use categories based on trip generation studies submitted voluntarily to ITE by public agencies, developers, consulting firms and associations primarily located in the US but also in Canada. The *ITE Trip Generation Handbook (3rd Edition)* provides guidance on the proper use of the data presented in the *ITE Trip Generation Manual* as well as dealing with related aspects of trip generation including internal capture rates at mixed-use facilities.

The Trip Generation Manual's expansive set of trip generation studies are carried out primarily in the US but also include some studies carried out in Canada. However, the majority of trip generation rates included in the manual are based on vehicle trips, and many represent suburban land uses or areas with lower transit usage than observed in the NCR. Therefore, a person-trip conversion factor, presented in **Table 2**, was applied to all vehicle trip rates. A factor was also applied to convert from hourly trip rates to peak period trip rates for consistency with other data sources. Despite these limitations, the ITE Trip Generation Manual remains a valuable resource due to its large dataset. The use of blended trip rates allows TRANS to make use of this resource while considering

the local land use context and trip characteristics for all travel modes through local and regional data.

Table 2:   Person-Trip Conversion Factor

Factor	Application	Apply To	Period	Value
Person-Trip Conversion Factor	**Vehicle to person-trip conversion**, to normalize the measure of trip rates to account for all modes. Applicable to the ITE trip generation rates, which are mainly reported as vehicle trip rates.	Vehicle trip rates	All	1.28

3 RESIDENTIAL TRIP GENERATION RATES

3.1 Development of Residential Trip Rates

The residential trip generation rates in this manual reflect the number of **person-trips per household** during the **peak period**. The morning peak period is from 7:00 AM to 9:30 AM, while the afternoon peak period is from 3:30 PM to 6:00 PM.

A geographic review of trip generation rates found that rates varied by dwelling type but not significantly by the geographic sectors and districts used in the 2009 TRANS Trip Generation Study[1]. As such, residential trip generation rates in this manual are defined for the following three dwelling types:

— Single-Family Detached Housing

— Multifamily Housing (Low-Rise)

— Multifamily Housing (High-Rise)

Low-rise housing refers to any building that houses multiple families that is two storeys or less (e.g. semi-detached homes, townhouses). High-rise housing refers to any building that houses multiple families that is three or more storeys (e.g. apartments and condo buildings). These dwelling types are from the TRANS Origin-Destination Survey but are organized to be equivalent to the categories of the ITE *Trip Generation Manual* and local generator surveys.

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[1] While person trip rates were not found to vary significantly with geographic area, location does have an impact on mode share as discussed in Section 4.2. As a result, vehicular trip rates do vary by geography as reflected in previous versions of the manual. The variation by dwelling type, in part, reflects differences in the number of persons per dwelling.

3.2 Recommended Residential Trip Generation Rates

A blended trip rate was developed from the three data sources through application of a rank-sum weighting process, considering the strengths and weaknesses of each dataset for the dwelling type in question. The recommended blended **residential person-trip rates** are presented in **Table 3**. All rates represent person-trips per dwelling unit and are to be applied to the **AM or PM peak period.**

Table 3:   Recommended Residential Person-trip Rates

ITE Land Use Code	Dwelling Unit Type	Period	Person-Trip Rate
210	Single-detached	AM	2.05
		PM	2.48
220	Multi-Unit (Low-Rise)	AM	1.35
		PM	1.58
221 & 222	Multi-Unit (High-Rise)	AM	0.80
		PM	0.90

3.3 Adjustment Factors – Peak Period to Peak Hour

The various trip generation data sources required some adjustment to standardize the data for developing robust blended trip rates. While the blended trip rates correspond to the peak period, the factors in **Table 4** may be used where applicable to develop trip generation rate estimates for the peak hour.

Table 4: Peak Period to Peak Hour Adjustment Factors for Residential Trip Rates

Factor	Application	Apply To	Period	Value
Peak Period Conversion Factor	**Peak period to peak hour conversion.** Because the 2020 TRANS Trip Generation Study reports trip generation rates by peak period, factors must be applied if the practitioner requires peak hour rates. In practice, the conversion to peak hour trip rates should occur **after** the application of modal shares.	Person-trip rates per peak period	AM	0.50
			PM	0.44
		Vehicle trip rates per peak period	AM	0.48
			PM	0.44
		Transit trip rates per peak period	AM	0.55
			PM	0.47
		Cycling trip rates per peak period	AM	0.58
			PM	0.48
		Walking trip rates per peak period	AM	0.58
			PM	0.52

4 RESIDENTIAL MODE SHARE

4.1 Development of Residential Mode Shares

The 2011 TRANS Origin-Destination Survey was used to develop mode share estimates for existing conditions. Auto driver, auto passenger, transit, cycling and walking mode shares are defined based on the modes reported in the Origin-Destination Survey. To remove non-residential trips and reflect the mode share of the households within each district, only outbound trips for the AM Peak (where the trip origin traffic zone equals the household traffic zone) and inbound trips for the PM Peak (where the trip destination traffic zone equals the household traffic zone) were considered. In calculating the mode shares, both trips within, and trips between districts were included.

Multi-modal trips were considered in the mode shares according to the mode used when departing from or arriving at the household. For example, for trips involving transit, the trip was classified based on the mode used to travel between the place of residence and the transit stop/station (auto driver, auto passenger or bicycle). However, trips involving a person walking to/from a transit stop/station were classified as transit trips.

4.2 Recommended Residential Mode Shares

Mode shares in this manual correspond to the observed **person-trips** traveling in the **peak direction** during the **peak period** (i.e. outbound during the AM peak period (7:00 to 9:30 AM) and inbound during the PM peak period (15:30 to 18:00 PM)). TRANS divides the Ottawa-Gatineau geographic area into 26 districts which represent four geographic sectors, as depicted in **Figure 1**. While the trip rates do not vary by geographic area, there are differences in the mode shares. The mode shares are also observed to vary by type of dwelling. As such, auto driver, auto passenger, transit, cycling and walking mode shares are to be applied for the appropriate geographic area and dwelling type.

The recommended mode shares by TRANS district for all dwelling types combined are summarized for each peak period in **Table 5.** Recommended mode shares for single-detached, low-rise multifamily and high-rise multi family dwelling types are summarized in **Table 6** to **Table 8**.

It should be emphasized that the mode shares presented in these tables represent existing conditions for the district as a whole. Different modal shares may be applicable for specific development sites depending on the local context (proximity to transit, quality of pedestrian and cycling connections, mix of land uses, etc.). Further, in most cases, the mode shares will not apply to future conditions, although they may provide a good starting point for estimating future changes.

»TRANS
Trip Generation Manual
Summary Report

wsp
December 2020
Page 6
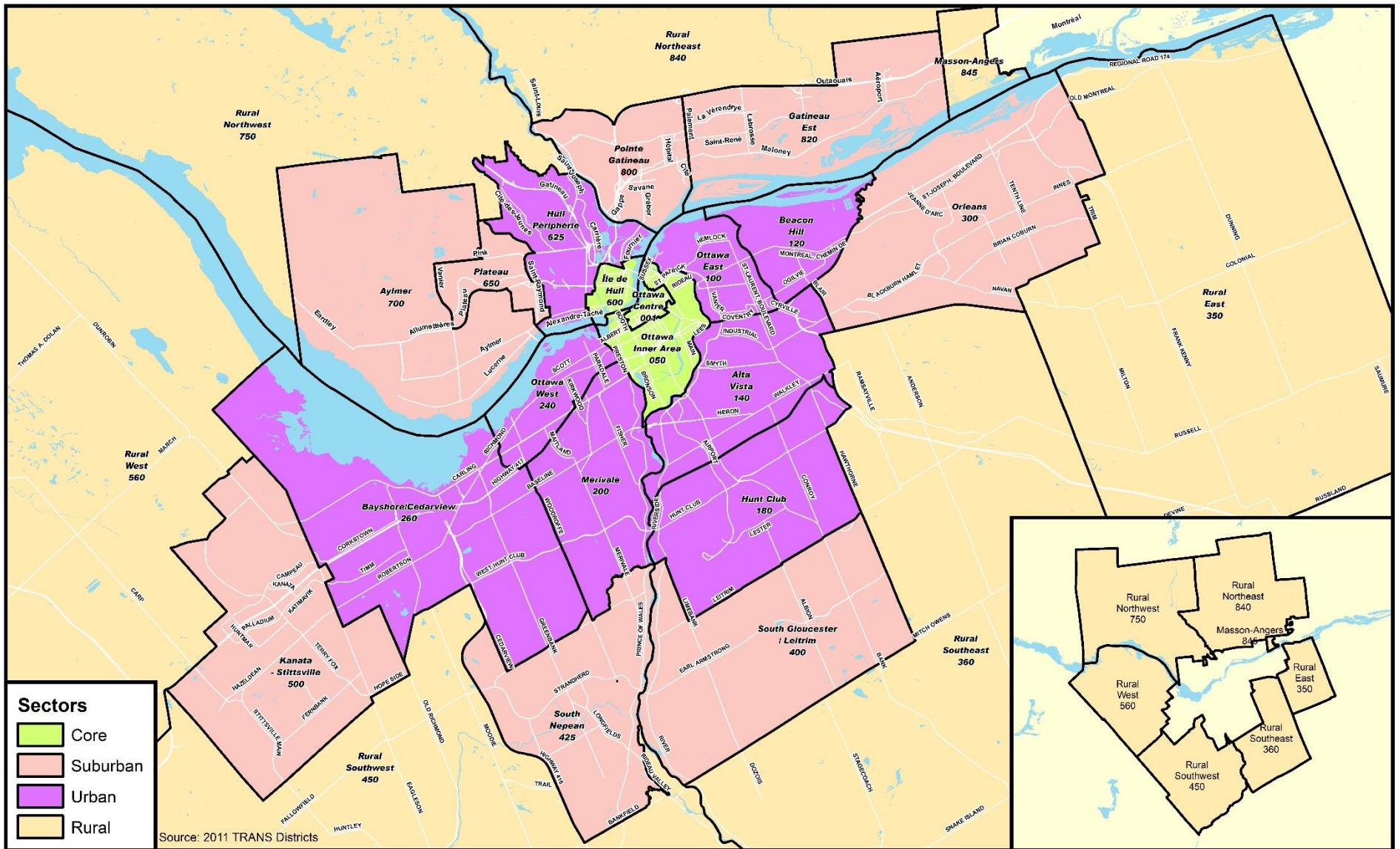
Figure 1: National Capital Region by Sector

Sectors
- Core
- Suburban
- Urban
- Rural

Source: 2011 TRANS Districts

Table 5:   Residential Mode Share by District (All Dwelling Types)

District	Period	Mode				
		Auto Driver	Auto Pass.	Transit	Cycling	Walking
Ottawa Centre	AM	18%	3%	26%	1%	52%
	PM	18%	10%	21%	1%	51%
Ottawa Inner Area	AM	29%	8%	25%	7%	31%
	PM	29%	9%	19%	7%	36%
Île de Hull	AM	32%	7%	30%	8%	23%
	PM	32%	10%	23%	8%	27%
Ottawa East	AM	40%	11%	33%	6%	11%
	PM	42%	15%	26%	5%	13%
Beacon Hill	AM	48%	11%	28%	2%	11%
	PM	50%	18%	21%	2%	9%
Alta Vista	AM	43%	14%	30%	3%	10%
	PM	47%	17%	23%	3%	11%
Hunt Club	AM	45%	12%	35%	1%	6%
	PM	48%	16%	27%	1%	7%
Merivale	AM	47%	12%	29%	4%	8%
	PM	49%	15%	23%	3%	10%
Ottawa West	AM	38%	13%	27%	6%	16%
	PM	39%	13%	18%	7%	24%
Bayshore/Cedarview	AM	45%	13%	31%	2%	9%
	PM	47%	16%	25%	1%	11%
Hull Périphérie	AM	48%	15%	25%	3%	9%
	PM	48%	16%	21%	3%	11%
Orleans	AM	48%	14%	28%	1%	9%
	PM	53%	17%	22%	1%	6%
South Gloucester / Leitrim	AM	56%	23%	13%	1%	7%
	PM	57%	23%	11%	1%	8%
South Nepean	AM	50%	14%	26%	1%	9%
	PM	51%	17%	20%	1%	10%
Kanata - Stittsville	AM	52%	15%	21%	1%	12%
	PM	56%	19%	15%	1%	9%
Plateau	AM	48%	15%	29%	4%	5%
	PM	53%	15%	24%	2%	6%
Aylmer	AM	52%	17%	23%	2%	7%
	PM	52%	20%	18%	2%	8%
Pointe Gatineau	AM	50%	15%	23%	2%	10%
	PM	54%	16%	19%	2%	9%
Gatineau Est	AM	54%	15%	21%	1%	10%
	PM	59%	18%	16%	1%	7%
Masson-Angers	AM	61%	13%	18%	1%	7%
	PM	62%	17%	15%	1%	5%
Other Rural Districts	AM	60%	14%	24%	0%	2%
	PM	66%	17%	14%	0%	2%

Trans
Trip Generation Manual
Summary Report

wsp
December 2020
Page 8

Table 6: Residential Mode Share for Single-Detached Housing

District	Period	Mode				
		Auto Driver	Auto Pass.	Transit	Cycling	Walking
Ottawa Centre	AM	37%	13%	17%	9%	25%
	PM	36%	12%	13%	8%	30%
Ottawa Inner Area	AM	36%	13%	17%	9%	25%
	PM	35%	12%	13%	9%	30%
Île de Hull	AM	46%	13%	13%	0%	28%
	PM	53%	12%	11%	0%	24%
Ottawa East	AM	45%	15%	20%	9%	11%
	PM	48%	15%	17%	9%	12%
Beacon Hill	AM	51%	15%	20%	2%	12%
	PM	52%	21%	16%	4%	8%
Alta Vista	AM	49%	15%	21%	4%	11%
	PM	52%	18%	16%	3%	12%
Hunt Club	AM	48%	15%	29%	1%	7%
	PM	51%	19%	23%	1%	7%
Merivale	AM	52%	16%	21%	3%	8%
	PM	54%	18%	17%	3%	9%
Ottawa West	AM	43%	15%	19%	6%	16%
	PM	43%	13%	15%	6%	23%
Bayshore/Cedarview	AM	49%	15%	27%	2%	7%
	PM	52%	18%	21%	2%	7%
Hull Périphérie	AM	49%	17%	22%	4%	8%
	PM	51%	18%	18%	4%	9%
Orleans	AM	48%	14%	27%	1%	9%
	PM	54%	17%	22%	1%	6%
South Gloucester / Leitrim	AM	54%	24%	12%	1%	9%
	PM	55%	25%	9%	1%	10%
South Nepean	AM	51%	14%	25%	1%	9%
	PM	53%	19%	18%	1%	10%
Kanata - Stittsville	AM	52%	15%	20%	1%	12%
	PM	56%	19%	14%	1%	9%
Plateau	AM	47%	17%	24%	4%	7%
	PM	49%	19%	21%	3%	9%
Aylmer	AM	53%	17%	23%	2%	6%
	PM	55%	21%	17%	2%	5%
Pointe Gatineau	AM	55%	15%	22%	2%	7%
	PM	55%	17%	19%	2%	7%
Gatineau Est	AM	54%	16%	20%	0%	10%
	PM	60%	18%	14%	1%	7%
Masson-Angers	AM	62%	13%	13%	11%	1%
	PM	62%	18%	12%	8%	1%
Other Rural Districts	AM	60%	14%	24%	2%	0%
	PM	67%	17%	14%	2%	0%

Table 7: Residential Mode Share for Low-Rise Multifamily Housing

District	Period	Mode				
		Auto Driver	Auto Pass.	Transit	Cycling	Walking
Ottawa Centre	AM	27%	9%	25%	9%	30%
	PM	31%	10%	20%	9%	30%
Ottawa Inner Area	AM	27%	8%	26%	9%	30%
	PM	31%	9%	20%	9%	31%
Île de Hull	AM	27%	9%	25%	9%	30%
	PM	34%	22%	16%	5%	22%
Ottawa East	AM	36%	11%	38%	7%	8%
	PM	39%	16%	29%	5%	11%
Beacon Hill	AM	45%	9%	35%	1%	10%
	PM	48%	16%	24%	1%	11%
Alta Vista	AM	38%	15%	35%	1%	10%
	PM	38%	19%	31%	2%	10%
Hunt Club	AM	44%	11%	38%	1%	6%
	PM	47%	15%	29%	1%	8%
Merivale	AM	44%	11%	32%	6%	7%
	PM	44%	12%	29%	4%	11%
Ottawa West	AM	36%	12%	24%	10%	19%
	PM	35%	12%	16%	10%	27%
Bayshore/Cedarview	AM	43%	11%	31%	1%	13%
	PM	44%	14%	25%	1%	15%
Hull Périphérie	AM	46%	22%	22%	4%	6%
	PM	46%	17%	22%	3%	11%
Orleans	AM	47%	15%	29%	1%	9%
	PM	51%	19%	24%	1%	6%
South Gloucester / Leitrim	AM	59%	20%	16%	1%	4%
	PM	62%	18%	17%	1%	3%
South Nepean	AM	49%	13%	26%	2%	9%
	PM	49%	13%	24%	2%	12%
Kanata - Stittsville	AM	52%	14%	22%	0%	11%
	PM	58%	17%	17%	0%	8%
Plateau	AM	44%	18%	28%	4%	6%
	PM	47%	17%	26%	2%	8%
Aylmer	AM	52%	18%	23%	0%	7%
	PM	52%	16%	20%	1%	12%
Pointe Gatineau	AM	46%	17%	23%	0%	14%
	PM	52%	16%	19%	1%	12%
Gatineau Est	AM	54%	17%	20%	1%	8%
	PM	56%	21%	16%	0%	7%
Masson-Angers	AM	60%	15%	21%	4%	1%
	PM	63%	15%	17%	3%	1%
Other Rural Districts	AM	66%	13%	21%	1%	0%
	PM	62%	19%	16%	3%	0%

Trans

Trip Generation Manual
Summary Report

wsp

December 2020
Page 10

Table 8: Residential Mode Share for High-Rise Multifamily Housing

District	Period	Mode				
		Auto Driver	Auto Pass.	Transit	Cycling	Walking
Ottawa Centre	AM	18%	2%	26%	1%	52%
	PM	17%	9%	21%	1%	52%
Ottawa Inner Area	AM	26%	6%	28%	5%	34%
	PM	25%	8%	21%	6%	39%
Île de Hull	AM	27%	3%	37%	12%	21%
	PM	26%	8%	27%	11%	28%
Ottawa East	AM	39%	7%	38%	2%	13%
	PM	40%	14%	28%	3%	15%
Beacon Hill	AM	48%	9%	30%	3%	10%
	PM	52%	16%	28%	0%	4%
Alta Vista	AM	38%	12%	42%	2%	7%
	PM	45%	16%	28%	2%	9%
Hunt Club	AM	39%	6%	44%	1%	9%
	PM	44%	11%	35%	2%	9%
Merivale	AM	41%	6%	42%	2%	8%
	PM	41%	11%	33%	2%	13%
Ottawa West	AM	28%	11%	41%	3%	16%
	PM	33%	11%	26%	7%	23%
Bayshore/Cedarview	AM	40%	12%	38%	2%	8%
	PM	40%	15%	33%	1%	11%
Hull Périphérie	AM	48%	11%	30%	1%	10%
	PM	47%	15%	23%	3%	13%
Orleans	AM	54%	7%	29%	0%	10%
	PM	61%	13%	21%	0%	6%
South Gloucester / Leitrim	AM	50%	15%	25%	1%	9%
	PM	53%	17%	21%	1%	9%
South Nepean	AM	58%	6%	30%	2%	4%
	PM	54%	15%	25%	0%	7%
Kanata - Stittsville	AM	43%	26%	28%	0%	4%
	PM	55%	19%	21%	0%	5%
Plateau	AM	53%	9%	35%	3%	1%
	PM	65%	7%	25%	2%	1%
Aylmer	AM	45%	17%	25%	0%	13%
	PM	31%	21%	23%	4%	20%
Pointe Gatineau	AM	44%	15%	24%	3%	14%
	PM	52%	15%	20%	2%	11%
Gatineau Est	AM	53%	10%	25%	0%	12%
	PM	61%	10%	25%	0%	4%
Masson-Angers	AM	63%	15%	19%	0%	3%
	PM	64%	18%	16%	0%	1%
Other Rural Districts	AM	63%	15%	19%	0%	3%
	PM	64%	18%	16%	0%	1%

iTrans
Trip Generation Manual
Summary Report

wsp
December 2020
Page 11

5 RESIDENTIAL DIRECTIONAL SPLITS

After calculating the total person trips generated by the development and applying the appropriate modal shares, directional factors can be applied to estimate the number of inbound and outbound trips by vehicle. The vehicle trip directional splits were developed for both the AM and PM peak periods[2]. The vehicle trip directional splits, as shown in **Table 9**, have been developed for the NCR based on a review of the local trip generator surveys as well as the latest published data in the ITE *Trip Generation Manual* (10th Edition).

Table 9:   Recommended Vehicle Trip Directional Splits (Peak Period)

ITE Land Use Code	Dwelling Unit Type	Period	Inbound	Outbound
210	Single-detached	AM	30%	70%
		PM	62%	38%
220	Multi-Unit (Low-Rise)	AM	30%	70%
		PM	56%	44%
221 & 222	Multi-Unit (High-Rise)	AM	31%	69%
		PM	58%	42%

6 NON-RESIDENTIAL MODE SHARE

Mode shares were developed for three types of non-residential development: schools (elementary and high school); employment generators; and commercial (retail) generators. These mode shares were developed through data provided by the Ville de Gatineau from local school surveys as well as the TRANS Origin-Destination Survey. The non-residential mode shares presented below are limited and do not capture all development types. For data on the travel characteristics associated with colleges and universities, transportation terminals, and sports and entertainment venues in the National Capital Region, practitioners should refer to the various reports for the TRANS *Special Generators Survey* (2013), which are posted on the TRANS website. For other development types, practitioners may need to carry out their own local generator data collection where necessary.

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[2]A directional split for active transportation was calculated based on the local generator surveys for low-rise and mid-rise land uses. The splits are mostly in-line with the vehicle directional splits in Table 9, which could be used as a rough approximation for other modes of transportation in cases where the non-auto directional split is required.

6.1 Elementary and High Schools

Ottawa

In the case of Ottawa, elementary schools were defined as those that include students from the age of 5 to 13 (Grades SK to 8) and high schools were categorized as having students between the ages of 14 to 17 (Grades 9 to 12). The mode shares for elementary and high schools in Ottawa are summarized in **Table 10**. These mode shares are based on the 2011 TRANS Origin-Destination Survey and are included to provide a general benchmark for schools in Ottawa. However, for transportation planning purposes, it is recommended that mode shares for Ottawa schools be developed on a site-specific basis by obtaining data from the school principal, school board, or student transportation authority; conducting local surveys; or consulting other sources.

Table 10: Elementary and High School Mode Shares for Ottawa[3]

Level	Mode Share					
	Auto Passenger	School Bus	Transit	Walk	Bike	Other
Elementary School	22%	48%	6%	20%	2%	2%
High School	17%	19%	38%	18%	3%	5%

Gatineau

For Gatineau, elementary schools include students from the age of 6 to 11 (Grades 1 to 6) and high school students are those aged 12 to 16 (Grades 7 to 11). The Ville de Gatineau has conducted many in-school surveys with a response rate higher than the 2011 TRANS Origin-Destination Survey, therefore the recommendation is to carry these mode shares forward, as shown in **Table 11**. Note that the Gatineau school travel survey did not distinguish between school bus and transit trips, so they are combined in the table below.

Table 11: Elementary and High School Mode Shares for Gatineau[4]

Level	Mode Share				
	Auto Passenger	School Bus / Transit	Walk	Bike	Other
Elementary School	43%	26%	27%	4%	0%
High School	19%	61%	17%	3%	0%

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[3] Source: 2011 TRANS O-D Survey
[4] Source: Plans de déplacements scolaires between 2006 and 2018 (elementary schools). Rapport Enquête En Forme, 2018 (high schools).

6.2 Employment Generators

Mode shares for trips to employment generators were developed from the 2011 TRANS Origin-Destination Survey by isolating the 'travel to work' trips. However, with the way the data is collected, employment related trips departing the workplace could not be isolated to identify mode share. As a result, peak direction mode shares could only be calculated for the AM peak period. **Table 12** provides the mode share by district during the AM peak period for employment trips in the peak inbound direction. These trips represent trips to the workplace and do not include work-related trips (e.g. for business meetings) or trips classified as working on the road (e.g. delivery trips). Multi-modal trips for employment generators were classified by the mode used to arrive at the workplace (e.g. a park-and-ride trip would be classified as a transit trip since the person arrived at the workplace on transit). Considering the strong tendency of employees to use the same mode of transportation when leaving work, it is fair to approximate the PM peak period employment generator mode shares with the AM peak period values.

Table 12: Employment Generator Mode Share by District (AM Peak Period)

District	Mode				
	Auto Driver	Auto Pass.	Transit	Cycling	Walking
Ottawa Centre	24%	7%	54%	4%	11%
Ottawa Inner Area	45%	7%	29%	8%	11%
Île de Hull	40%	9%	40%	5%	6%
Ottawa East	66%	7%	20%	2%	5%
Beacon Hill	73%	6%	16%	2%	3%
Alta Vista	69%	7%	18%	3%	3%
Hunt Club	83%	5%	10%	1%	1%
Merivale	70%	7%	16%	3%	4%
Ottawa West	54%	8%	28%	5%	5%
Bayshore/Cedarview	77%	6%	10%	3%	4%
Hull Périphérie	75%	7%	12%	3%	3%
Orleans	71%	7%	13%	1%	8%
South Gloucester/Leitrim	89%	7%	2%	1%	1%
South Nepean	80%	10%	5%	1%	4%
Kanata - Stittsville	84%	4%	8%	1%	3%
Plateau	82%	6%	7%	1%	4%
Aylmer	83%	3%	5%	4%	5%
Pointe Gatineau	80%	9%	4%	2%	5%
Gatineau Est	88%	6%	4%	0%	2%
Masson-Angers	89%	3%	2%	1%	6%
Rural Districts	85%	5%	9%	1%	1%

6.3 Commercial Generators

All trips classified as "shopping, household maintenance" from the 2011 TRANS Origin-Destination Survey were analyzed to define the mode share for trips to commercial establishments. **Table 13** provides the mode share by district during the AM and PM peak periods for commercial generator trips. These mode shares do not include restaurant or recreation trips. Although the mode shares were calculated for trips to the generator, for most commercial developments, a similar mode share would apply for trips from the generator. In general, the sample size for shopping trips during the AM peak period tends to be low, and the results should be used with caution, particularly for districts with lower retail activity. Where the sample size for a district was less than the pre-defined cut-off, the mode share for the wider area has been applied.

Table 13: Commercial Generator Mode Share by District

District	Period	Mode				
		Auto Driver	Auto Pass.	Transit	Cycling	Walking
Ottawa Centre	AM	28%	3%	48%	1%	20%
	PM	19%	12%	30%	2%	37%
Ottawa Inner Area	AM	39%	2%	16%	3%	40%
	PM	22%	4%	12%	4%	58%
Île de Hull	AM	34%	2%	30%	2%	32%
	PM	22%	7%	18%	3%	50%
Ottawa East	AM	57%	10%	15%	1%	17%
	PM	55%	18%	11%	1%	15%
Beacon Hill	AM	67%	12%	8%	0%	14%
	PM	59%	18%	7%	1%	13%
Alta Vista	AM	64%	9%	12%	1%	14%
	PM	60%	20%	9%	0%	11%
Hunt Club	AM	70%	6%	7%	0%	17%
	PM	65%	19%	8%	1%	7%
Merivale	AM	71%	19%	1%	0%	9%
	PM	61%	16%	8%	1%	14%
Ottawa West	AM	55%	11%	11%	0%	23%
	PM	50%	16%	11%	5%	18%
Bayshore/Cedarview	AM	64%	15%	4%	0%	17%
	PM	62%	20%	6%	1%	11%
Hull Périphérie	AM	77%	8%	5%	0%	10%
	PM	60%	12%	9%	5%	14%
Orleans	AM	77%	14%	3%	0%	6%
	PM	71%	20%	2%	1%	5%
South Gloucester / Leitrim	AM	74%	13%	4%	0%	10%
	PM	70%	22%	2%	0%	6%
South Nepean	AM	74%	14%	1%	0%	11%
	PM	61%	27%	1%	0%	11%
Kanata - Stittsville	AM	81%	12%	5%	0%	2%

District	Period	Mode				
		Auto Driver	Auto Pass.	Transit	Cycling	Walking
	PM	73%	22%	1%	0%	4%
Plateau	AM	74%	13%	4%	0%	10%
	PM	70%	22%	2%	0%	6%
Aylmer	AM	74%	13%	4%	0%	10%
	PM	70%	15%	1%	0%	14%
Pointe Gatineau	AM	76%	17%	2%	0%	5%
	PM	72%	22%	1%	1%	4%
Gatineau Est	AM	74%	13%	4%	0%	10%
	PM	75%	21%	1%	0%	3%
Masson-Angers	AM	87%	9%	0%	0%	3%
	PM	86%	12%	1%	0%	2%
Other Rural Districts	AM	87%	9%	0%	0%	3%
	PM	80%	14%	1%	2%	4%

7 INFLUENCING FACTORS

Beyond geographic area and dwelling type, there are other factors that influence a person's trip decision-making. The demographic and built environment factors described in the proceeding sections have been found to influence travel behaviour. This section discusses the merits of these additional factors and it is up to the discretion of the practitioner whether to account for these factors in trip generation analyses.

Age

A review of the 2011 TRANS Origin-Destination Survey data demonstrated that the daily number of trips that a person makes is consistent regardless of age, the variability comes with the time of day that the trips are made. School-aged children and adults aged approximately 30 to 50 travel the most during peak periods, while adults aged approximately 18 to 25 and seniors make fewer peak period trips. In terms of mode share, auto driver use increases between age 16 and 30, then remains consistent until a person's 70s, when it declines. Younger people use significantly more sustainable transportation (i.e. active transportation and transit) until age 30, and children and seniors travel more than other ages as auto passengers. An example of when consideration of age might influence the trip generation analysis would be a seniors' residence; in this case practitioners should consider lowering the trip rates during the peak periods and adjusting the modal share to account for the fact that seniors are more likely to travel by transit or as auto passengers than the average adult. See Appendix A for additional figures and graphs.

Proximity to Rapid Transit

Data from the 2005 TRANS Origin-Destination Survey shows that, for trips beginning/ending at home, the percentage of peak period transit trips relative to total motorized trips is higher the closer a neighbourhood is to a rapid transit station. These findings, reported in the 2009 TRANS Trip Generation Study Background Report, indicate that proximity to rapid transit is effective at influencing mode share at distances of up to 2.4km, with the most significant impacts observed within 400m of the station. More recent data from the City of Ottawa based on journey-to-work statistics from the 2016 census further demonstrates the impact of proximity to rapid transit on modal shares. For residents living within 800m of a rapid transit station, the percentage of work trips made by sustainable modes (walking, cycling, transit, or car-pooling) is shown to be as high as 70 to 80% in the Core sector and as high as 30 to 40% in the Suburban sector. More detailed information can be found in Appendix B. It should be noted that these results are based on existing conditions and do not reflect the impact of transit-oriented development, which is expected to result in even higher transit and active mode shares as the areas around rapid transit stations further develop.

Proximity to Frequent Transit

Though there is no data in the TRANS Origin-Destination Survey to quantitatively analyze the impact of frequent transit (i.e. frequent bus routes operating at 15-minute intervals or less and connecting to rapid transit routes) on travel behaviours, it is expected that increasing proximity to frequent transit is likely to increase residential mode share for transit. It is reasonable to assume that the proximity impacts on mode share are a function of the frequency, reliability, comfort, etc. of the transit service. While it is not expected to be as great as the effect rapid transit has on the mode share, practitioners should give consideration to the proximity of transit priority corridors in making adjustments to mode shares.

Proximity to Active Transportation Facilities

Like proximity to rapid and frequent transit, a person's proximity to active transportation facilities could influence their mode choice. From public input, the 2013 Ottawa Cycling Plan (OCP) states that the most frequently cited measure that would encourage more cycling is "additional facilities". The OCP notes that daily cycling trips increased by 40% between 2005 and 2011. Roughly during that same period (2007 to 2013), 193 km of cycling facilities were built, an increase of 49%.

Inherently, with more cycling facilities, the network will become more interconnected and people will feel more comfortable choosing cycling as a mode with facilities in closer proximity (i.e. not having to travel far distances to access a separated facility). The increased connectivity should lead to more active trips. Therefore, practitioners should consider increasing cycling mode share / reducing auto mode share for sites located

within 1km of a Cross-Town Bikeway (as defined in the 2013 OCP) or other well-defined cycling facility that is separated from vehicle traffic.

Proximity to Traditional Main Streets

Another factor that may affect both trip frequency and mode share is the proximity to Traditional Main Streets such as Bank Street in The Glebe (Ottawa Inner Area) and Richmond Road in Westboro (Ottawa West). These streets provide many retail and food options and are typically located within an existing neighbourhood.

Given their proximity to a vast number of retail options, neighbourhood residents might alter their consumer behaviour by primarily visiting the stores on the nearby Traditional Main Street rather than commercial areas further away. Additionally, neighbourhood residents may make more trips to the Traditional Main Street due to its convenient proximity, which are more likely to be taken by cycling or walking due to the short travel distance and lack of parking. Practitioners may consider using higher trip generation rates and higher cycling and pedestrian mode shares / reduced auto and transit mode shares for sites on Traditional Main Streets.

Parking Availability and Pricing

Parking availability and pricing have a significant impact on a person's mode choice for travel to work and shopping destinations. If an employer offers its employees free parking on-site, then the employees are more likely to drive to work. In contrast, if there is limited or no on-site parking, driving becomes a less convenient option, encouraging employees to find alternative ways to travel. The same is true for consumers visiting retail destinations. Additionally, if there is a cost associated with parking, there is greater incentive to use other modes, resulting in fewer trips by car. This is a more common occurrence in non-residential locations near or in the core of Ottawa-Gatineau, where transit and active transportation facilities are more accessible and connected.

8 MIXED-USE DEVELOPMENTS

Mixed-use developments are defined by ITE as single real estate projects that have two or more land uses and internal connectivity between land uses. The ITE *Trip Generation Manual* does not have a specific land use for mixed-use development, nor does TRANS have local site surveys for the variation of mixed-use developments within the NCR. Practitioners are to primarily rely on the ITE methodology for estimating internal trips, outlined in Section 6.5 of the *Trip Generation Handbook* (3rd Edition). An example is provided in **Appendix C**.
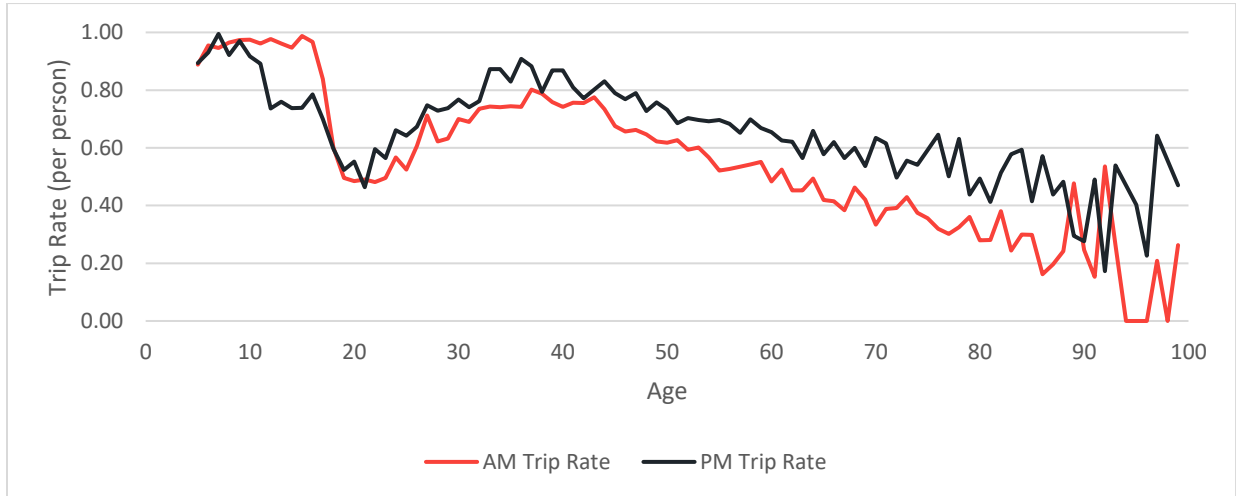
A ADDITIONAL INFORMATION – AGE
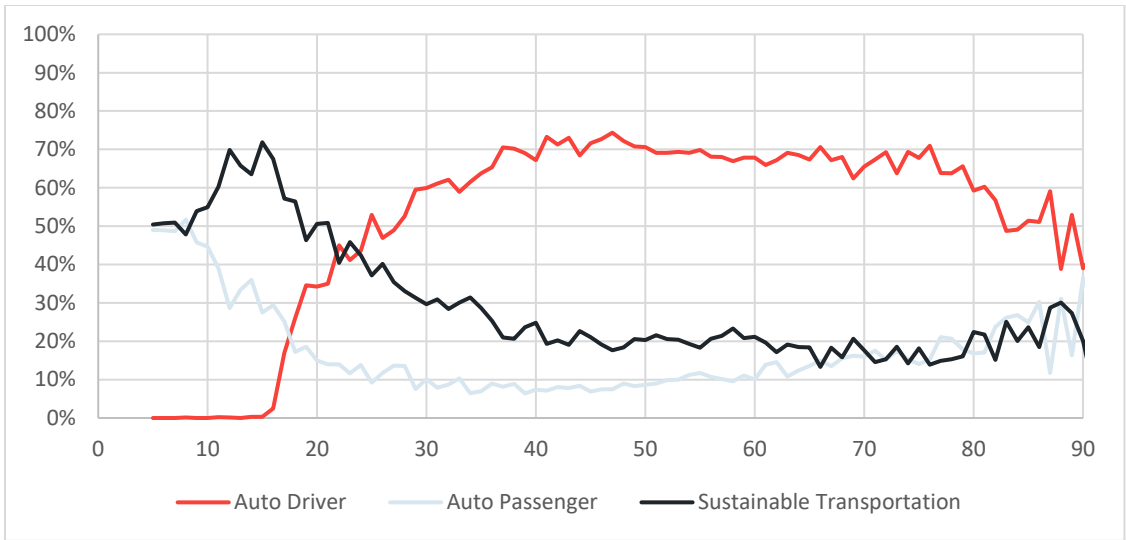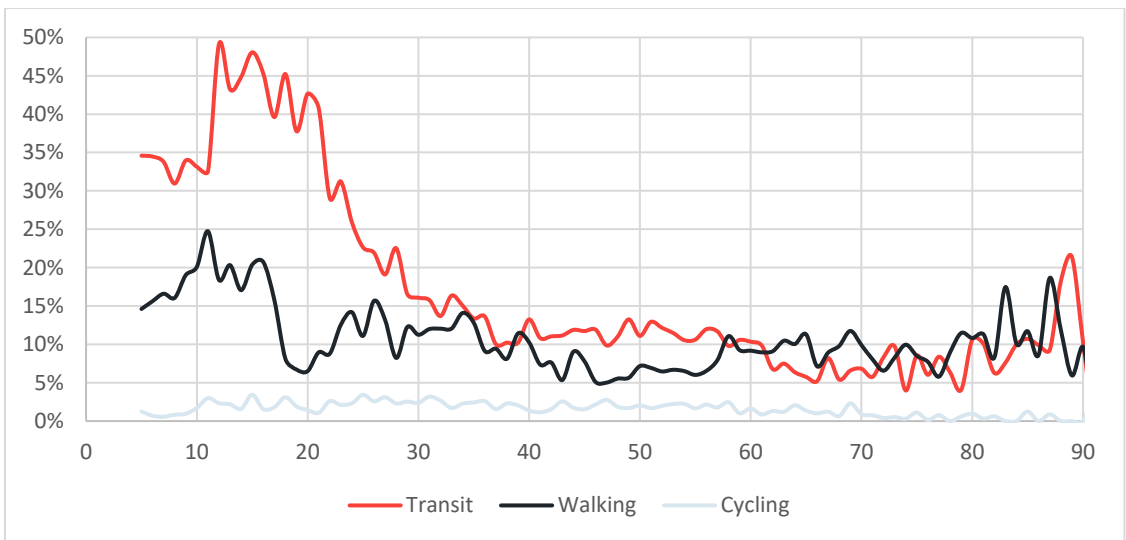
APPENDIX A.1 – AGE AS AN INFLUENCING FACTOR
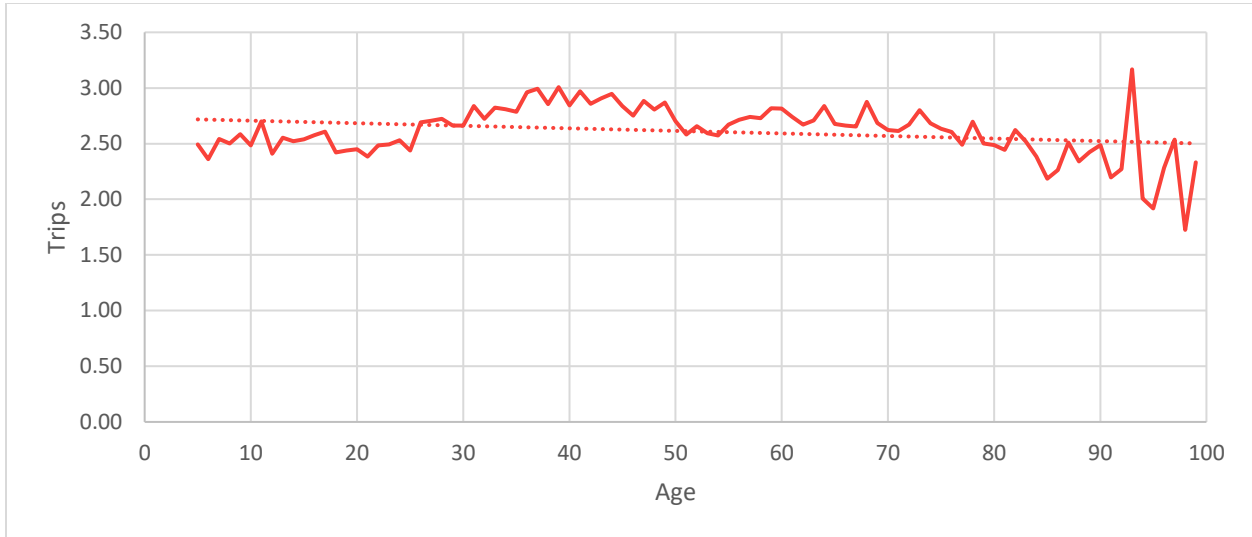
Daily Person-Trips by Age

Peak Period Person-Trip Rate by Age

Mode Share by Age

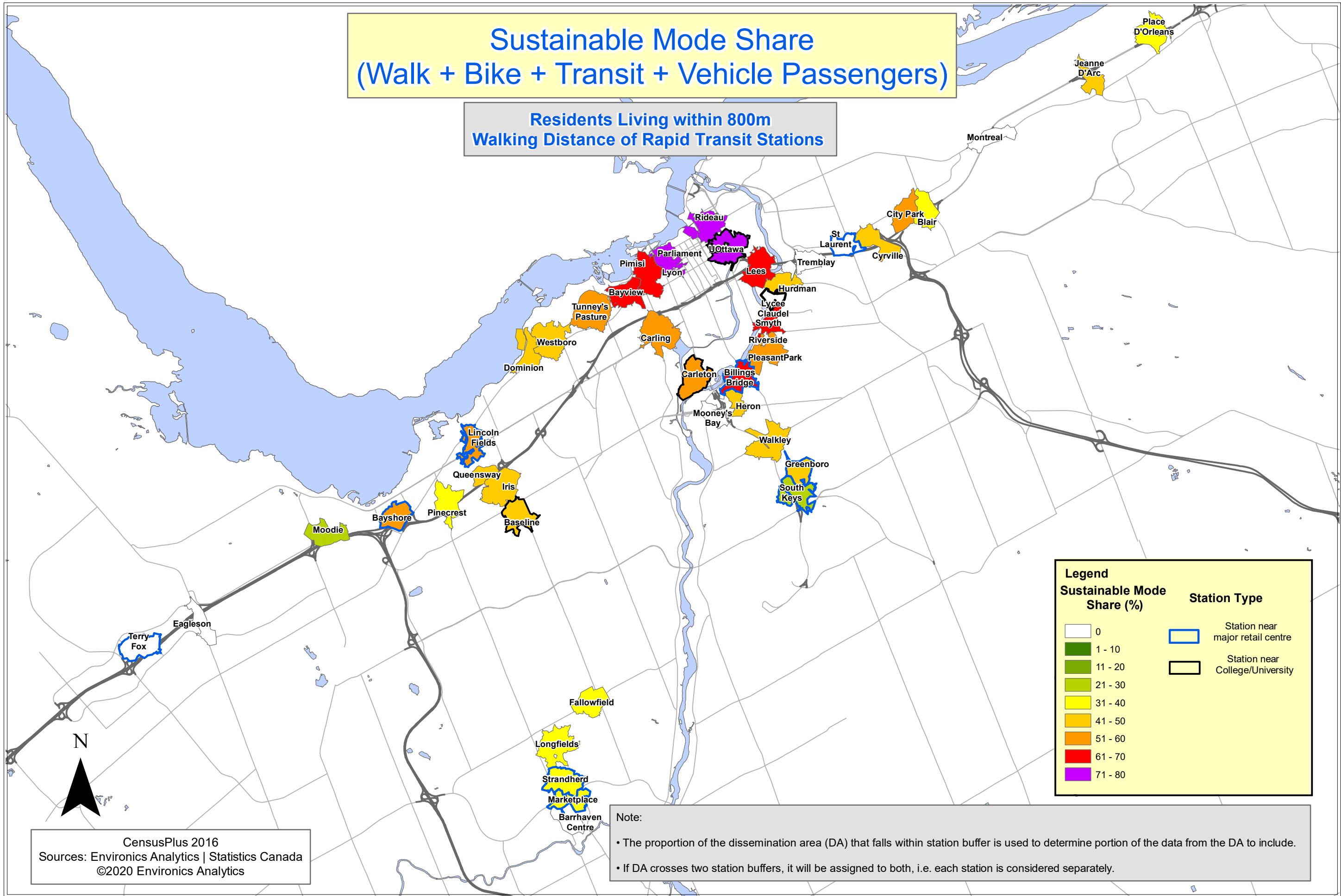**Mode Share by Age for Sustainable Modes of Transportation**

B PROXIMITY TO RAPID TRANSIT

Sustainable Mode Share
(Walk + Bike + Transit + Vehicle Passengers)

Residents Living within 800m
Walking Distance of Rapid Transit Stations

Place D'Orleans
Jeanne D'Arc
Montreal
City Park Blair
St Laurent
Cyrville
Tremblay
Rideau
Parliament
UOttawa
Pimisi
Lyon
Lees
Bayview
Hurdman
Tunney's Pasture
Lycee Claudel Smyth
Carling
Riverside
Westboro
PleasantPark
Dominion
Carleton
Billings Bridge
Heron
Mooney's Bay
Walkley
Lincoln Fields
Greenboro
Queensway
South Keys
Iris
Pinecrest
Bayshore
Baseline
Moodie
Terry Fox
Eagleson
Fallowfield
Longfields
Strandherd Marketplace
Barrhaven Centre

Legend
Sustainable Mode Share (%)

	0
	1 - 10
	11 - 20
	21 - 30
	31 - 40
	41 - 50
	51 - 60
	61 - 70
	71 - 80

Station Type

Station near major retail centre

Station near College/University

N

CensusPlus 2016
Sources: Environics Analytics | Statistics Canada
©2020 Environics Analytics

Note:
• The proportion of the dissemination area (DA) that falls within station buffer is used to determine portion of the data from the DA to include.
• If DA crosses two station buffers, it will be assigned to both, i.e. each station is considered separately.

C SAMPLE CALCULATION FOR ESTIMATING INTERNAL TRIPS

APPENDIX C.1 – DEMONSTRATION OF MIXED-USE DEVELOPMENT INTERNAL CAPTURE RATE CALCULATION FOR A MIXED-USE SITE

For demonstration purposes, an example of an internal capture rate calculation for a mixed-use site using the methodology from the *ITE Trip Generation Handbook (3rd Edition)* and the ITE spreadsheet tool (https://www.ite.org/technical-resources/topics/trip-and-parking-generation/other-resources/) is given below. The example development site has three different proposed land uses. The demonstrated calculation is for the PM peak period.

The ITE methodology is a nine-step procedure. The analyst must complete steps 1 through 3 before entering the data into the ITE spreadsheet tool (also referred to as NCHRP Report 684 Estimator), which will complete steps 4 through 9 and output the internal capture rate for the mixed-use development. The example below steps through all nine steps of the procedure.

> **Demonstration Development Proposal:**
>
> The following defines the example case on how to calculate internal trips utilizing the methodology outlined in the ITE *Trip Generation Handbook* and supplemental spreadsheet tool. The example case is an existing 500,000 square foot mixed-use development in the Beacon Hill district of Ottawa. The trips were developed from carrying out local surveys

Step 1: Determine whether methodology is appropriate for study site

Here, the analysis must identify whether the site is in fact by definition a mixed-use development. The analyst should consider at least the following factors:

— Development Type – must be a single site that is integrated for pedestrians and vehicles to travel within
— Development Location – should not be located within or adjacent to the central business district
— Development Size – must be between 100,000 and 2 million square feet
— Land Use Mix – at least two of the following land uses: retail, restaurant, office, residential, hotel, and/or cinema/entertainment
— ITE Trip Generation Manual Database – Ensure that the specific mixed-use area is not already covered in the ITE Trip Generation Manual. Sites like a shopping centre, office building with ground floor retail, and office park with retail are ITE Land Uses that already account for internal trip rates
— Time Period for Analysis – the capture rates in the ITE Trip Generation Manual are only available for AM and PM peak periods

For greater detail, please refer to Chapter 6 of the *ITE Trip Generation Handbook (3rd Edition).*

Trans

Trip Generation Manual
Summary Report

WSP

December 2020
Appendix C-1, Page 1

Demonstration Development Proposal:

For the example, the development site is confirmed to be a mixed-use development due to the following factors:

— Development Type: the mixed-use development is a single site, with internal pedestrian connectivity. The combination of retail, residential, and office is not a pre-existing ITE land-use code (e.g. office park).
— Development Location: The Beacon Hill district is not close to the central business district in Ottawa. Therefore, the location of the mixed-use development site is acceptable.
— Development Size: The development is between the sizes of 100,000 and 2 million square feet.
— Land Use Mix: There are three different land uses (retail, residential, and office) on the development site.
— ITE Trip Generation Manual Database: The combination of retail, residential, and office is not a pre-existing ITE land-use code (e.g. office park).
— Time Period for Analysis: The time period for this analysis will be the PM peak period.

Step 2-3: Estimate person-trip generation for individual on-site land uses and proximity between on-site land use pairs

These two steps include identification of the following information for the individual land uses within the mixed-use development, using ITE or other trip generation rates and vehicle occupancy and mode share from the 2020 TRANS Trip Generation Study. The following data is required:

— Vehicle trips by direction (Inbound & Outbound)
— Mode share (Inbound & Outbound)
— Vehicle occupancy (Inbound & Outbound)
— Walking distance from entrance to entrance for each land use pairing

Note that person-trips can be used in lieu of vehicle trips, if available. If this is the case, then there is no need to identify the vehicle occupancy.

Demonstration Development Proposal:

Table 1 summarizes the data identified for the demonstration site.

Table 1: Mixed-Use Example - Data Identification

Land Use	Vehicle Occupancy	Vehicle Trips (peak hour)		Distance from Other Land Use (ft)			Mode Share	
		Entering	Exiting	Retail	Office	Residential	Transit	Non-Motorized
Retail	1.15	475	514	-	500	750	20%	10%
Office	1.15	36	177	500	-	1,000	10%	5%
Residential	1.15	81	43	750	1,000	-	20%	10%

Intermediate Step: Input values to ITE Spreadsheet Tool (NCHRP Report 684 Estimator)

To complete steps 4 to 9, the data collected in steps 2 and 3 must be properly input to the ITE Spreadsheet Tool. These intermediate steps (A-D) are defined below.

There are six tabs in the ITE Spreadsheet tool:

≫TRANS
Trip Generation Manual
Summary Report

WSP
December 2020
Appendix C-1, Page 2

— Page 1-A: Editable sheet for AM peak hour internal trip rates
— Page 2-A: Non-editable sheet for AM peak hour internal trip rates
— Page 1-P: Editable sheet for PM peak hour internal trip rates
— Page 2-P: Non-editable sheet for PM peak hour internal trip rates
— Table 7.1: Non-editable sheet of unconstrained internal trip capture rates and proximity adjustments for trip origins
— Table 7.2: Non-editable sheet of unconstrained internal trip capture rates and proximity adjustments for trip destinations

The analyst is only required to enter data into Page 1-A and 1-P.

Demonstration Development Proposal:

For the example, we are calculating the PM peak hour internal trip capture rate only, therefore Page 1-P will require the data inputs. Page 1-P is formatted such that only the cells highlighted in yellow can be edited as shown in Figure (page 1-P prior to data entry.)

The data entry requirements for Page 1-P, as marked on the Figure 1 are defined as follows:

— Step A: Input defined information for project
— Step B: Input vehicle trips by direction for each land use within the proposed development
— Step C: Input vehicle occupancy, transit mode share, and non-motorized mode share for each land use within the proposed development
— Step D: Input measured walking distance from entrance to entrance for each land use pairing (from proposed development site plan)

It is noted that if person-trips were estimated instead of vehicle trips, the person-trips should be input into Page 1-P for the vehicle trips with a vehicle occupancy of 1 applied.

NCHRP 684 Internal Trip Capture Estimation Tool

Project Name:				Organization:		
Project Location:				Performed By:		
Scenario Description:				Date:		
Analysis Year:				Checked By:		
Analysis Period:	PM Street Peak Hour			Date:		

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips[3]		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				0		
Retail				0		
Restaurant				0		
Cinema/Entertainment				0		
Residential				0		
Hotel				0		
All Other Land Uses[2]				0		
				0	0	0

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.[4]	% Transit	% Non-Motorized	Veh. Occ.[4]	% Transit	% Non-Motorized
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses[2]						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Figure 1: Empty Page 1-P (Source: Institute of Transportation Engineers)

Demonstration Development Proposal:

A completed input sheet for the demonstration project is shown in **Figure 2**.

NCHRP 684 Internal Trip Capture Estimation Tool					
Project Name:	Example		**Organization:**	TRANS	
Project Location:	NCR		**Performed By:**	-	
Scenario Description:	Mixed-Use Development		**Date:**	2020	
Analysis Year:	2020		**Checked By:**	-	
Analysis Period:	PM Street Peak Hour		**Date:**	2020	

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)			Estimated Vehicle-Trips[3]		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				213	36	177
Retail				989	475	514
Restaurant				0		
Cinema/Entertainment				0		
Residential				124	81	43
Hotel				0		
All Other Land Uses[2]				0		
				1,326	592	734

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.[4]	% Transit	% Non-Motorized	Veh. Occ.[4]	% Transit	% Non-Motorized
Office	1.15	20%	10%	1.15	20%	10%
Retail	1.15	10%	5%	1.15	10%	5%
Restaurant						
Cinema/Entertainment						
Residential	1.15	20%	10%	1.15	20%	10%
Hotel						
All Other Land Uses[2]						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		500			1000	
Retail					750	
Restaurant						
Cinema/Entertainment						
Residential		750				
Hotel						

Figure 2: Completed Page 1-P (Source: Institute of Transportation Engineers)

Once all data has been input into the worksheet; Steps 4 through 9 are run by clicking the "Calculate" in the bottom left corner, the results will appear in Table 5 of Page 1-P.

Demonstration Development Proposal:

The results of the demonstration project show an internal capture trip rate of 15% which is used to adjust the trip generation forecasts for the mixed-use development as shown Figure 3.

Table 5-P: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	1,524	680	844
Internal Capture Percentage	15%	17%	14%
External Vehicle-Trips[5]	921	408	513
External Transit-Trips[6]	156	63	93
External Non-Motorized Trips[6]	79	33	46

Figure3: Table 5 of ITE Spreadsheet on Page 1-P

Trans

Trip Generation Manual
Summary Report

wsp

December 2020
Appendix C-1, Page 6