McMAHON
TRANSPORTATION ENGINEERS & PLANNERS

City-wide Critical Sums Analysis

Envision Cambridge

McMahon Associates

Prepared for the City of Cambridge

November 15, 2018

City-wide Critical Sums Analysis

City-wide Critical Sums Analysis Methodology

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Attachments

City-wide Critical Sums Analysis

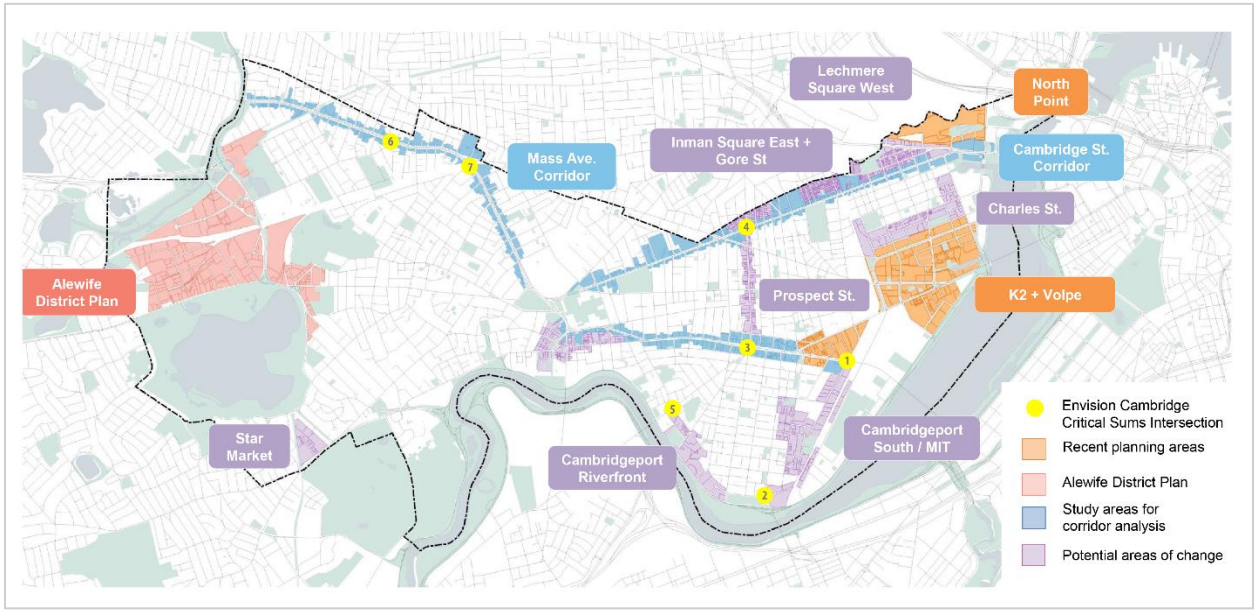
Section A: Overview

The City of Cambridge's Critical Sums Analysis (CSA) methodology served as the basis for this analysis. The process is based on methodology previously used by City of Cambridge for the 2001 *Eastern Cambridge Planning Study* (ECaPS), 2001 Citywide Rezoning, and 2005 *Concord-Alewife Plan*, refined in 2011-2012 for the *Kendall Square-Central Square (K2C2) Study,* and used for *the Alewife Critical Sums Analysis* (2017) as part of the Envision Cambridge project. The methodology used in these studies is largely based on the 1985 Highway Capacity Manual (HCM) for calculating critical lane movements (critical sums).

Critical movements are the sum of the northbound left and southbound through/right compared to the southbound left and the northbound through/right. The same is done for the eastbound and westbound intersection approaches. The greater of the northbound/southbound is added to the greater of the eastbound and westbound to calculate the critical sum for the intersection. The highest total of the approaches is the critical sum. The following pages explain the methodology.

Seven intersections were selected in consultation with City staff, with a goal of identifying key intersections within the context of the subareas to reflect impacts of future development. The selected intersections were based on a list of previously analyzed intersections, roadway geometry, and prior work completed as part of the *K2C2* study and *Alewife Critical Sums Analysis*, so as not to duplicate efforts. The seven intersections evaluated for the City-wide Envision Cambridge critical sums analysis are indicated in Figure 1 below.

Figure 1: Study Area Intersections



Section B: Existing Traffic Volumes

Existing PM peak hour traffic volumes for all seven intersections were documented from recent traffic impact statements (TIS) and reports for projects in the study area. The traffic count data source for each intersection is listed in Table 1.

Table 1: Existing Traffic Volumes Sources

Intersection	Date Counted	Data Source
1. Mass Ave & Albany St	September 4, 2017	MIT Vassar Dorm
2. Sidney St & Putnam Ave	September 13, 2012	240 Sidney St
3. Central Square (Mass Ave & Prospect St)	May 18, 2016	Mass + Main
4. Cambridge St & Prospect St	January 26, 2017	Inman Square
5. Western Ave & Putnam Ave	May 10, 2016	Western Ave Post Construction
6. Mass Ave & Rindge Ave	May 2016	Mass Ave Study
7. Mass Ave & Upland Rd	2015	Porter Square Study

Traffic volumes were adjusted to reflect an average month in spring 2018.[1] A background growth rate of 0.5% was applied based on the number of years needed to bring count data to the year 2018.[2]

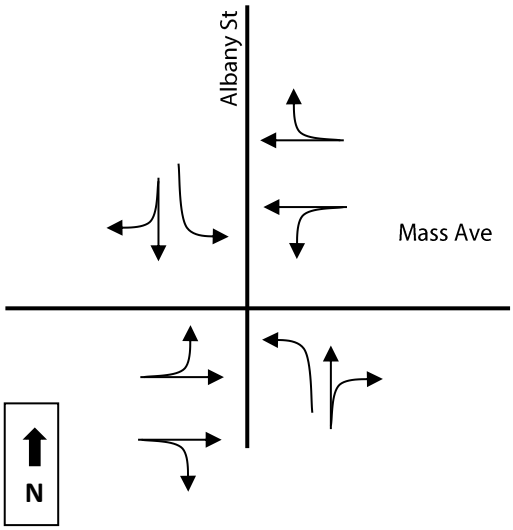
Section C: Critical Lane Movement Calculations

The formulas applied to each intersection are listed below. Intersection #1 Mass Ave at Albany St was calculated based on the existing roadway configuration as well as the proposed configuration in the South Mass Ave Safety Improvements Study.[3]

1 Adjustments based on MassDOT count station H8495 on interstate 93 in Somerville, MA. September data was adjusted upward 2% and January data was adjusted upward 11% to reflect May counts.
2 Background growth not applied to Mass Ave at Rindge Ave as ATR station #84 on Concord Avenue from Cambridge website indicates that traffic counts in the vicinity of the area have not increased between 2012 and 2016. Growth rate of 0.5% based on KSURP 10 Report, Kendall Square Critical Sums Analysis and Inman Square Intersection Improvement Project.
3 Plans for preferred alternative intersection configuration at Mass Ave at Albany St sent by City Staff via email on August 7, 2018.

City-wide Critical Sums Analysis

Intersection 1: Massachusetts Ave at Albany St [Existing configuration]



Highest Of:

EB:

$[EBL] + \left[\frac{WBL+T+R}{2}\right]$ or

WB:

$[WBL] + \left[\frac{EBL+T+R}{2}\right]$

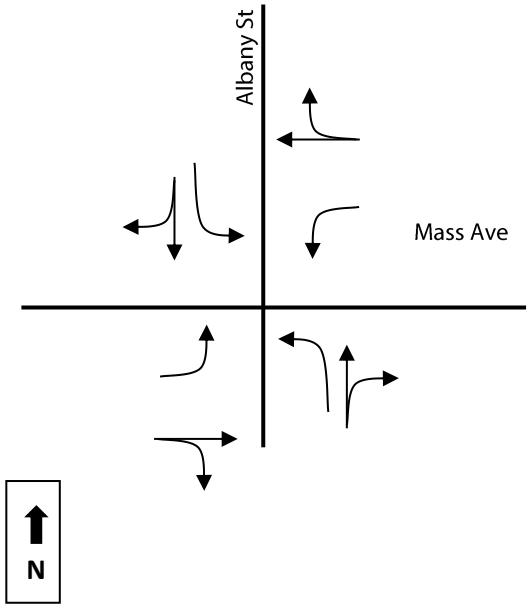
NB:

$NBL + SBT + SBR$ or

SB:

$SBL + NBT + NBR$

Intersection 1: Massachusetts Ave at Albany St [Proposed configuration]



Highest Of:

EB:

$[EBL] + [WBT + WBR]$ or

WB:

$[WBL] + [WBT + WBR]$

NB:

$NBL + [SBT + SBR]$ or

SB:

$SBL + [NBT + NBR]$

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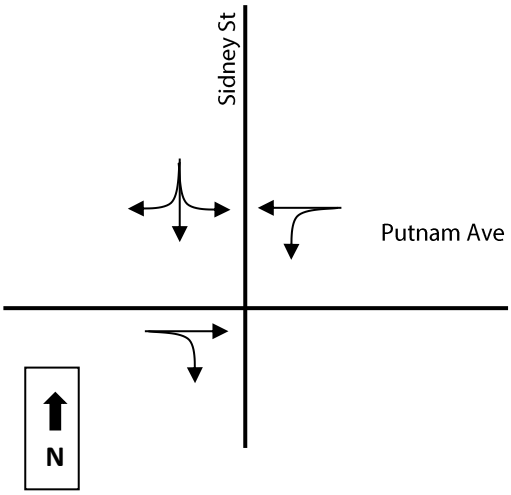
Intersection 2: Sidney St at Putnam Ave



Highest Of:

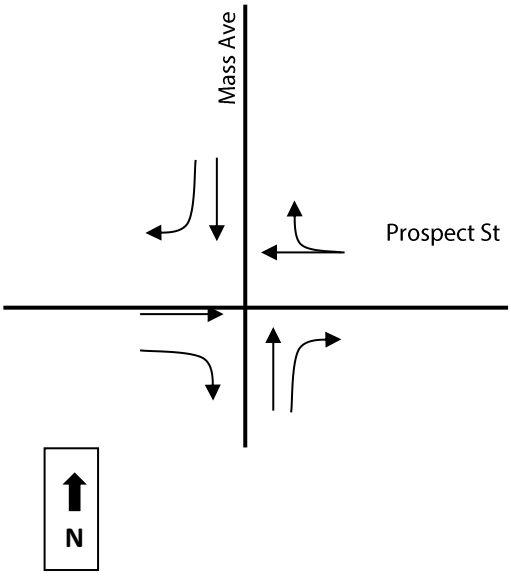
NB:
$SBL + SBT + SBR$ or

SB:
SBL

EB:
$WBT + WBL$ *or*

WB:
$WBL + EBT + EBR$

Intersection 3: Central Square – Massachusetts Ave at Prospect St



Highest Of:

NB:
SBT or

SB:
NBT

EB:
$WBT + WBR$ or

WB:
EBT

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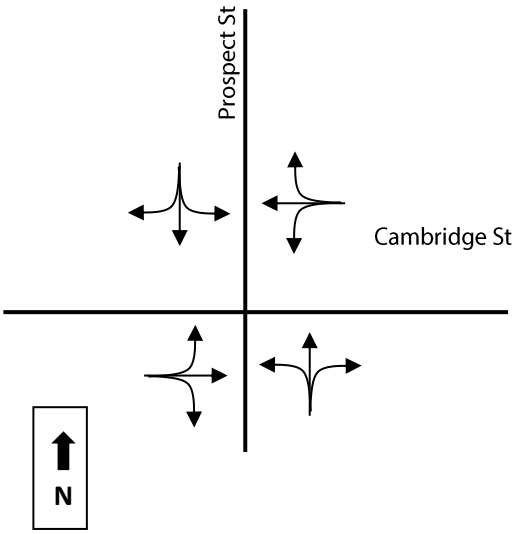
Intersection 4: Cambridge St at Prospect St



Highest Of:

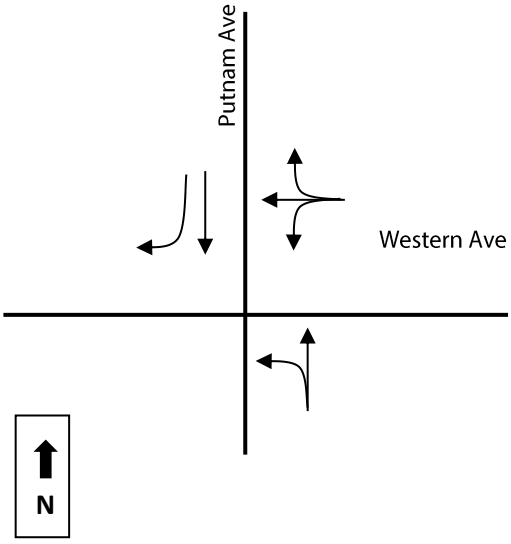
NB:
[NBL] + $[SBL + T + R]$ or

SB:
$[SBL] + [NBL + T + R]$

EB:
$[EBL] + [WBL + T + R]$ or

WB:
$[WBL] + [EBL + T + R]$

Intersection 5: Western Ave at Putnam Ave



Highest Of:

NB:
$NBL + SBT$ or

SB:
$NBT + NBL$

EB:
$WBL + WBT + WBR$ or

WB:
WBL

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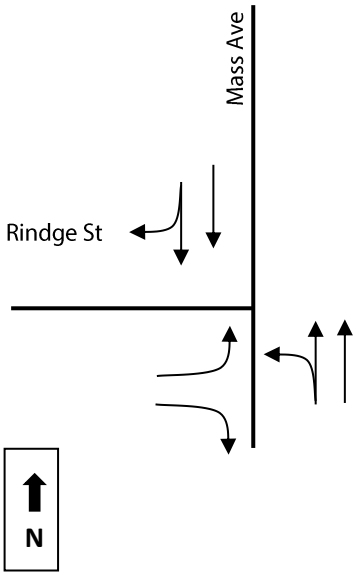
Intersection 6: Massachusetts Ave at Rindge St



Highest Of:

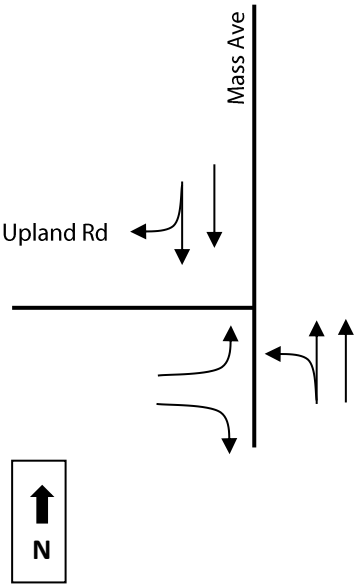
NB:
$[NBL] + \left[\frac{SBT+R}{2}\right]$ or

SB:
$\left[\frac{NBT + L}{2}\right]$

EB:
EBL or

WB:
EBR

Intersection 7: Massachusetts Ave at Upland Rd



Highest Of:

NB:
[NBL] + $\left[\frac{SBT+R}{2}\right]$ or

NB:
$\left[\frac{NBT + L}{2}\right]$

EB:
EBL or

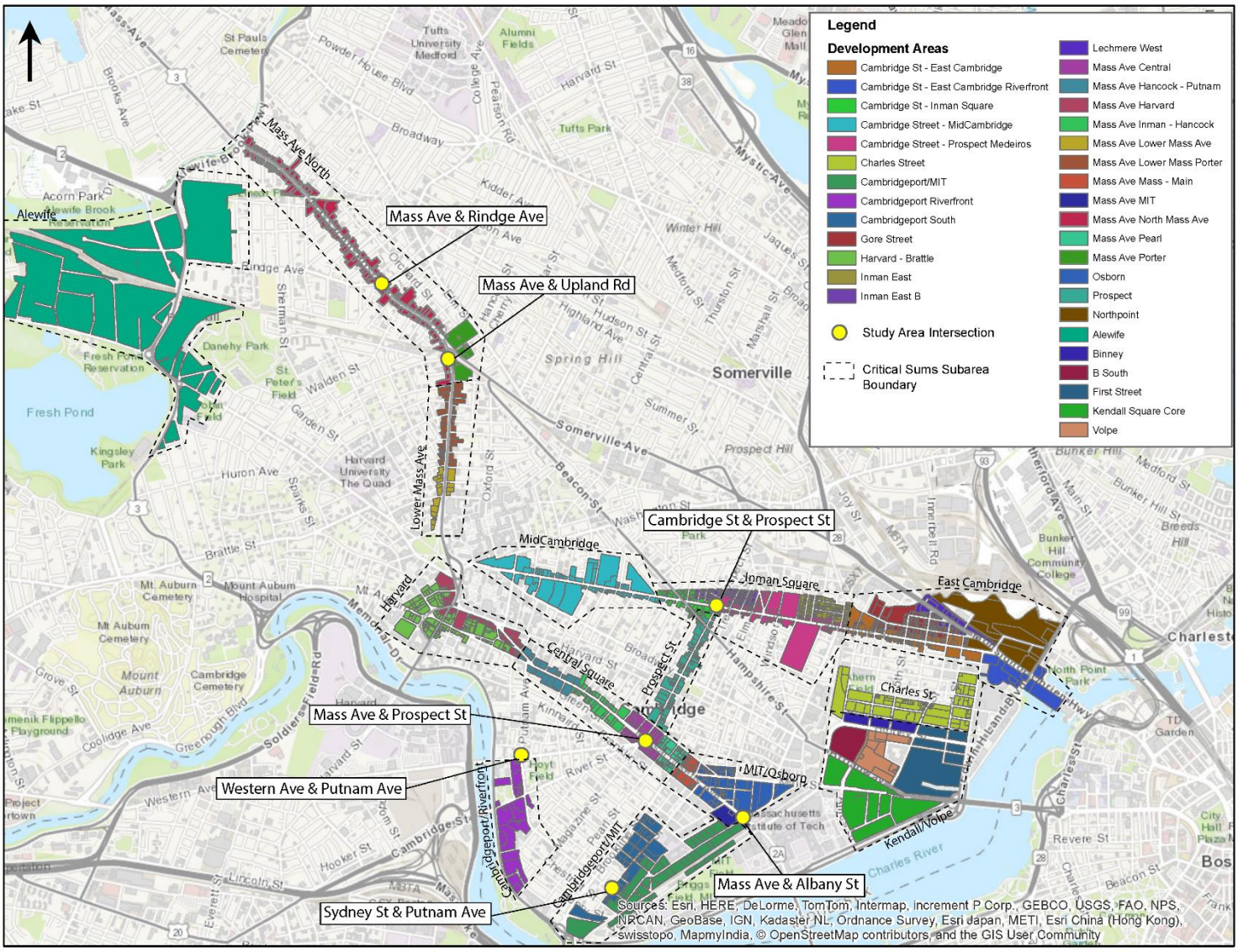
WB:
EBR

City-wide Critical Sums Analysis

Section D: Trip Generation Rates

The study area was divided into fourteen subareas to evaluate trip generation based on four future land use scenarios. The fourteen subareas are comprised of 33 development areas (see Figure 2) that were defined by the Envision Cambridge project team. The grouping of each development area into the 14 subareas for the critical sums analysis is documented in Attachment A.

Figure 2: Study Area Subareas



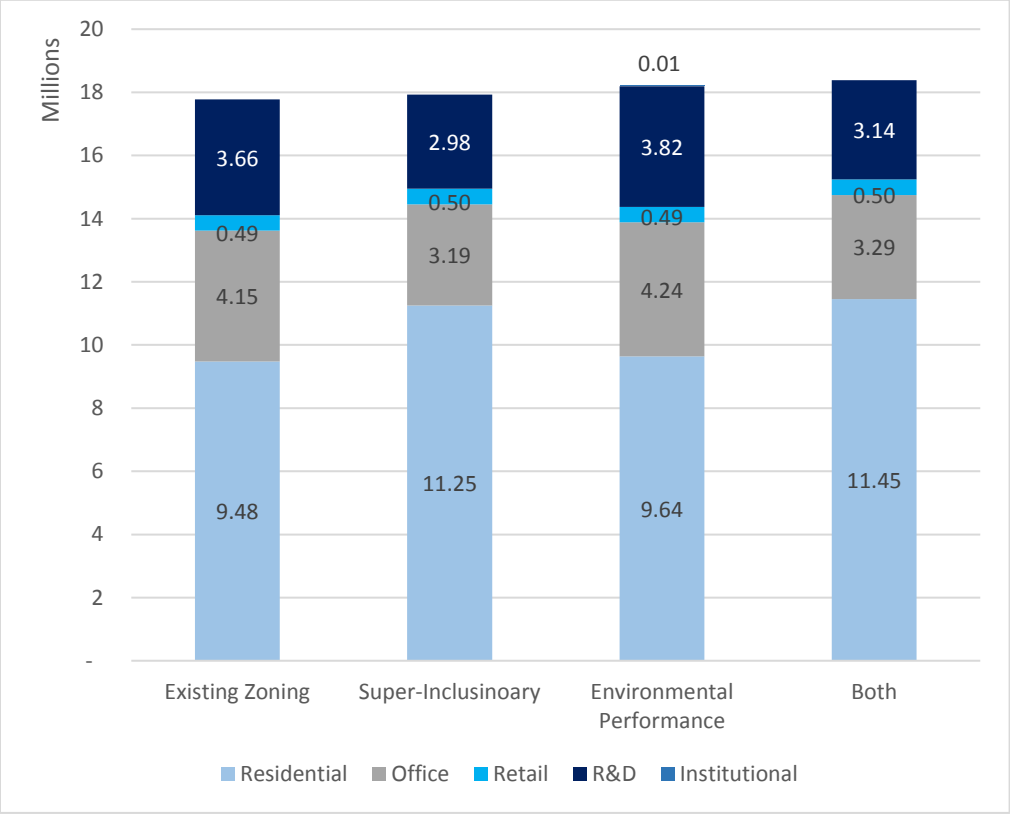
City-wide Critical Sums Analysis

The net new square footage of each land use type for each scenario was provided by the Envision Cambridge project team for each development area,[4] and summarized by subarea. Four future scenarios were evaluated:

1. Existing Zoning Buildout
2. Super-Inclusionary Buildout
3. Environmental Performance Buildout
4. Hybrid Super-Inclusionary & Environmental Performance Buildout (referred to as "Both")

The scenarios represent buildout to the year 2030, with the percentage buildout varying by study area. Trip generation was determined by applying ITE trip generation rates by land use to the additional square footage of new development by land use type and applying a mode share provided by the City of Cambridge. Methodologies for trip generation and trip distribution were reviewed by City of Cambridge staff through interim updates. The land use by square footage is summarized in Figure 3.[5]

Figure 3: Total Millions of SF by Land Use

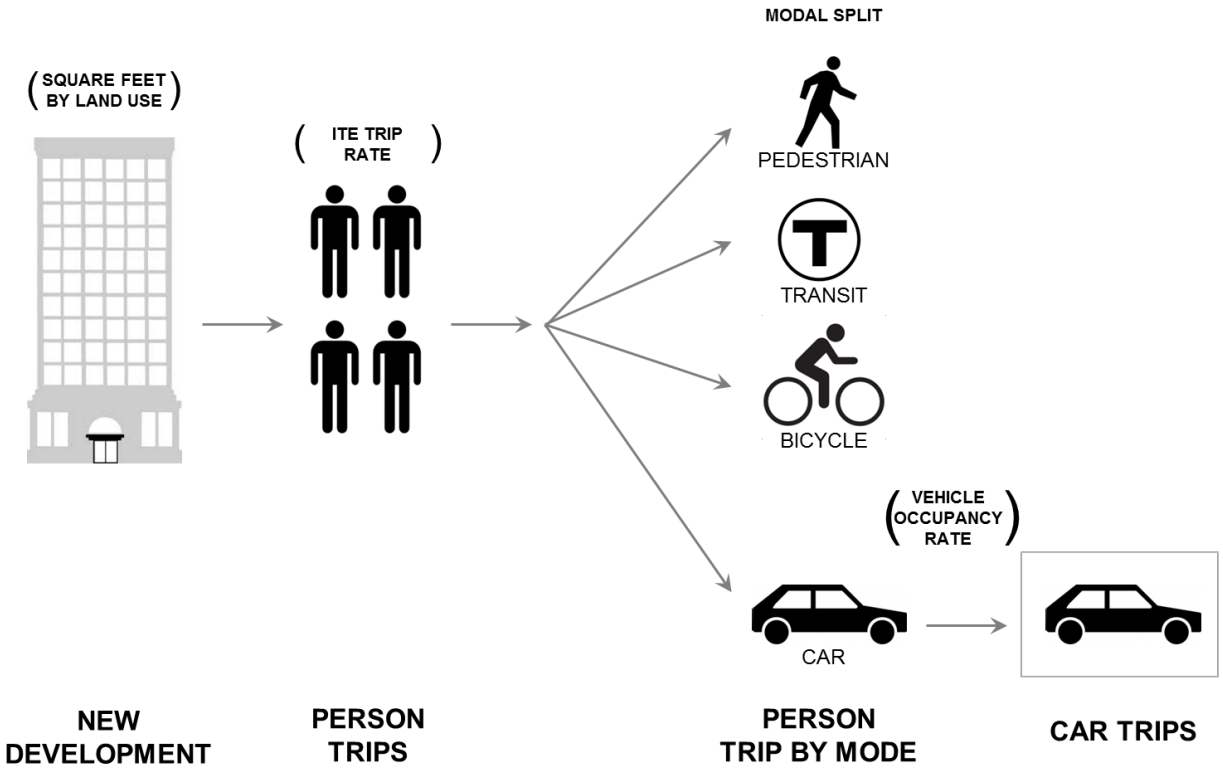


[4] Land use figures for each scenario provided by Utile on September 11, 2018 via email.

[5] Other land use was excluded from analysis due to low change in square footage, which results in low number of additional trips. Land uses with a decrease in square footage (due to decrease in development) were also excluded from the analysis to provide a conservative approach and not credit a reduction in trips.

General Procedure

- The PM peak period was used for the analysis, as this is the period when traffic volumes tend to be the highest. This also reflects the methodology used in prior City of Cambridge studies where critical sums analysis was used. New trips were generally calculated as follows:



- Associated trip generation rates are from the ITE Trip Generation Manual 10th Edition – these rates were used to calculate trips generated by land use, and are summarized by land use and ITE Code in Table 2. Attachment B documents the selection of trip generation rates and alternatives considered.

Table 2: ITE Land Use Codes and Trip Rates

Land Use	ITE Code	Average Daily Trip Rate (per 1000 SF GFA)	Average AM Trip Rate (per 1000 SF GFA)	Average PM Trip Rate (per 1000 SF GFA)
R&D	760	11.26	1.22	1.11
General Office	710	9.74	1.47	1.42
Retail	820	37.75	3.00	4.21
Residential (Per Dwelling Unit)	221	5.44	0.32	0.41
Institutional	550	26.04	1.10	1.19

- Square footage by land use and subarea was used to calculate base trips, per the ITE methodology.
- The ITE trips were then converted to person-trips based on a factor of 1.07[6], provided by the City of Cambridge, based on data from U.S. Census.
- Based on prior direction from the City for other critical sums analyses, an average apartment size of 1,000 SF per dwelling unit was used for calculating residential trips.
- A mode share representing the City's goal for reducing vehicle trips was applied for residential and employee trips.[7] The mode share goal for future development was based on the mode share target developed as part of the Alewife District Plan Critical Sums Analysis. The following mode shares were applied across all subareas and scenarios:
    - 37% Cambridge employees [Office, R&D, and Institutional land uses]
    - 24% Cambridge residents [Residential land use]

  Existing mode shares for each subarea based on Census data were also provided by the City. The mode shares and their application to each subarea are documented in Attachments A and C. The existing mode shares were used for comparison purposes and not input into the analysis.
- A vehicle occupancy factor of 1.1 was then applied to determine the total PM vehicle automobile trips. These vehicle occupancy factors were calculated[8] based on U.S. Census data.

The total PM vehicle trips were split into arrival and departure trips using the ITE distribution percentages for each land use. They were then categorized into residential and commercial trips based on the generating land use. This analysis was performed for the four future buildout scenarios.

Section E: Trip Distribution

The trip distribution was comprised of two parts: (1) determining the percentage of trips exiting and entering the City along major corridors, and (2) applying those percentages through intersections within the network for each subarea (see Figure 2). This was done for both employee (commercial) and residential trips.

[6] National average from the American Community Survey 2005-2009.
[7] Goal mode shares used in analysis provided by City Staff via email on September 11, 2018
[8] American Community Survey 2006-2010 U.S. Census data. Residence place information is from CTPP2000 Table 1-002 and 2006- 2010 ACS Table B08301 and workplace information is from CTPP2000 Table 2-002 and 2006-2010 ACS Table B08406.

Study Area Trip Distributions

- Trip distributions are based on 2010 U.S. Census data for County to County flows. Flows for the Cambridge workforce are used for employee trips and flows for the Cambridge laborforce are used for residential trips.

- In instances where additional trip distribution data was available, such as traffic impact studies from a development in a subarea, City Parking and Transportation Demand Management (PTDM) Data, or recent critical sums analysis, these sources were used to inform trip distributions. Additional information on trip distribution percentages and data sources are documented in Attachment D.

- Percentages by municipality or origin from the Census data were assigned to the network proportionally based on approximate roadway volumes for that movement, with greater weight on direct access routes to/from a subarea. Access points and percentages for the network are documented in the series of maps provided in Attachment D.

- All streets were considered in the analysis. The streets depicted in the attachments tend to be the most likely travel corridors and generally represent trips going to/coming from the subarea from each major direction. The study area intersections were selected as a snap shot to evaluate the level of traffic increase that may be created by new development in the subarea. Actual traffic increases in the subarea will vary.

Intersection Trip Distributions

- The total number of trips entering and exiting each subarea were dispersed throughout the network to determine the percentage of trips moving through each study intersection, as documented in Attachment E.

- Access points to each study area were reviewed based on probable vehicle paths to and from the study area subareas given the trip distributions and roadway network for each area.

- Local travel routes were identified through a desktop analysis. All streets were considered in the analysis in order to provide a realistic distribution network. This results in a portion of trips not passing through study area intersections.

Section F: Critical Sums Calculation

- The resulting critical sum calculated for each intersection during the PM peak period for the existing condition and the four future scenarios are listed in Table 3 and depicted in Figure 4. The threshold at which operations begin to deteriorate is 1,500 vehicles for typical intersections. Intersections over these thresholds are noted in red. No intersections exceed the threshold with existing traffic volumes, and only one, Cambridge Street at Prospect Street, exceed the threshold under all future scenarios.

- Total volume at each intersection during the PM Peak period was also compared for the existing condition and four future scenarios. Table 4 and Figure 5 show the total volume at each intersection, which increases from the existing condition in all future scenarios.

City-wide Critical Sums Analysis

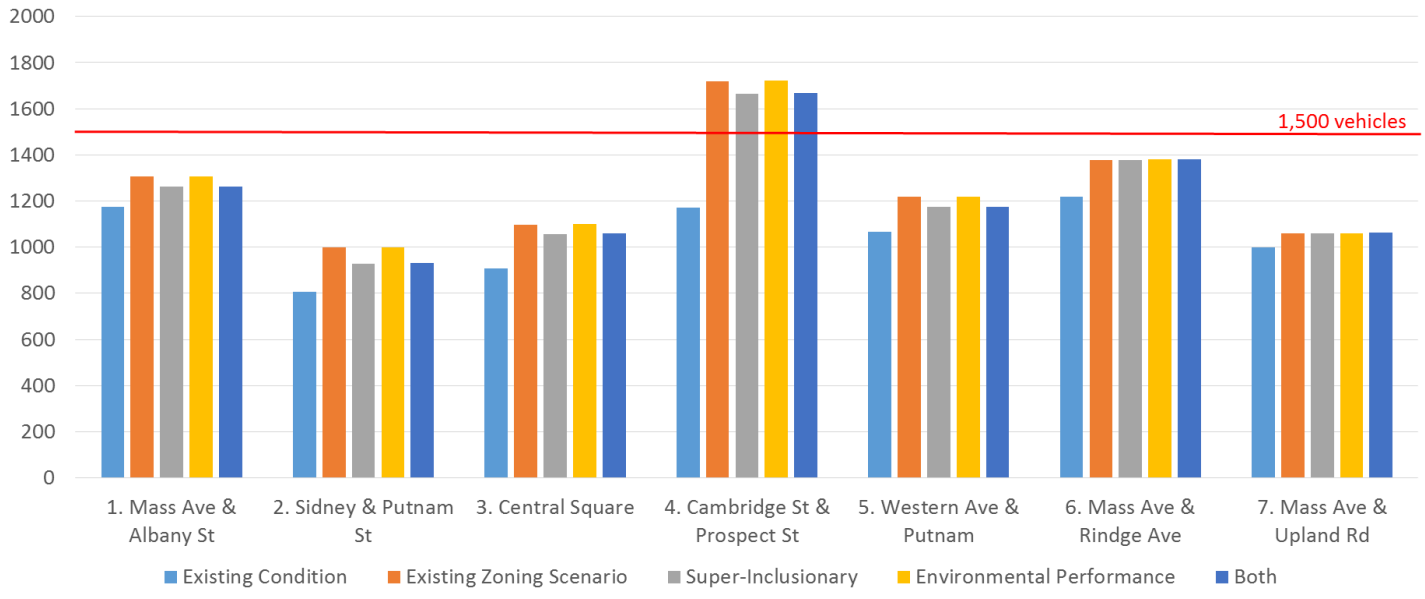
Table 3: PM Peak Hour Critical Sums Analysis Results

	Existing Condition (2018)	*Existing Zoning (2030[9])*	*Super-Inclusionary (2030)*	*Environmental Performance (2030)*	*Both* (2030)*
1. Mass Ave & Albany St	1176	1305	1261	1306	1262
2. Sidney & Putnam St	808	999	929	1000	930
3. Central Square	909	1098	1056	1101	1059
4. Cambridge St & Prospect St	1172	1719	1664	1721	1667
5. Western Ave & Putnam	1065	1218	1173	1219	1174
6. Mass Ave & Rindge Ave	1219	1377	1378	1381	1382
7. Mass Ave & Upland Rd	1000	1059	1061	1060	1062

**Both is a hybrid of Super-Inclusionary & Environmental Performance buildout scenarios*

Red = over critical sums threshold of 1,500 vehicles per hour

Figure 4: PM Peak Hour Critical Sums by Intersection



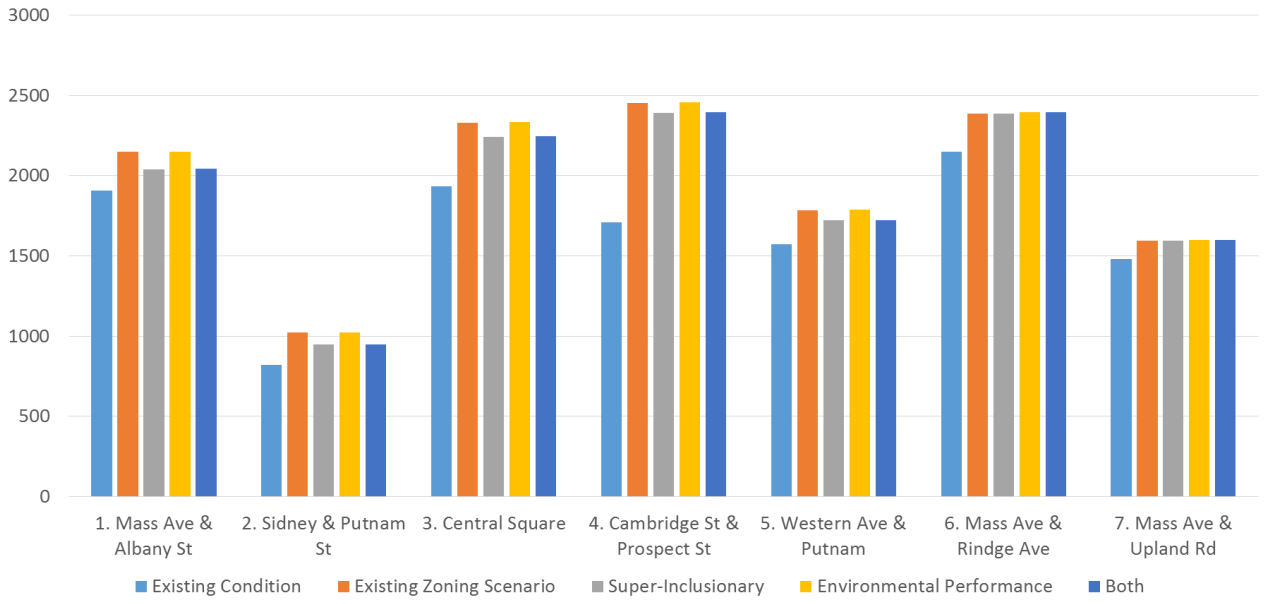
[9] For all 2030 buildout scenarios the buildout percentage varies by development area. Percentages are documented as part of the Envision Cambridge process.

Table 4: PM Peak Hour Total Volume

	Existing Condition (2018)	*Existing Zoning (2030[10])*	*Super-Inclusionary (2030)*	*Environmental Performance (2030)*	*Both* (2030)*
1. Mass Ave & Albany St	1907	2149	2040	2150	2042
2. Sidney & Putnam St	821	1022	947	1023	948
3. Central Square	1935	2328	2240	2333	2246
4. Cambridge St & Prospect St	1708	2454	2391	2457	2394
5. Western Ave & Putnam	1574	1784	1721	1786	1723
6. Mass Ave & Rindge Ave	2147	2386	2387	2393	2394
7. Mass Ave & Upland Rd	1480	1594	1595	1598	1599

**Both is a hybrid of Super-Inclusionary & Environmental Performance buildout scenarios*

Figure 6: PM Peak Hour Total Volume



[10] For all 2030 buildout scenarios the buildout percentage varies by development area. Percentages are documented as part of the Envision Cambridge process.

City-wide Critical Sums Analysis

Section G: Conclusion

- No intersections exceed the critical sums threshold with existing traffic volumes, and only one, Cambridge Street at Prospect Street, exceeds the threshold under all future buildout scenarios.
- The relatively large increase in critical sum and total volume at the Cambridge Street and Prospect Street intersection is due to the high concentration of development in the Kendall Square and East Cambridge subareas. Compared to other study area intersections, traffic flows at this intersection are most influenced by development in these subareas.
    - The majority of development in both of these subareas is already planned or permitted, or part of the "development pipeline." This means the projected new development as part of each scenario has a relatively low impact on the total volume and critical sum.
    - The net new increase in projected development based on each scenario has little impact overall on PM peak period critical sums at study area intersections.
- The Alewife subarea also has a large portion of new development relative to other subareas; however, the majority of trips to/from this area do not pass through study area intersections (see critical sums analysis for the Alewife District Plan).
- The critical sums analysis reflects the City's future mode share goal. If mode shares are able to be further reduced in the East Cambridge and Kendall Square areas, this presents an opportunity to reduce the critical sum at Cambridge and Prospect Street. With planned transportation enhancements adjacent to these areas, such as the Greenline Extension, reconstruction of Lechmere Station, Inman Square Intersection Safety Improvements Project, and Grand Junction path connection, further reductions in mode share can be realized to reduce the number of vehicle trips in the peak hour traveling through Cambridge Street and Prospect Street.

Critical Sums Sub Areas & Application to Development Areas

Purpose:	**Critical Sums Subarea - Trip Distribution & Generation**	**Development Subarea - Net New SF by Land Use**	**Development Area - Mode Share**	**Notes**
Source:	**McMahon**	**Utile**	**Cambridge**	
	1. Cambridgeport/Riverfront	Cambridgeport/Riverfront	Cambridgeport Riverfront	
	2. Cambridgeport/MIT	Cambridgeport/MIT	Cambridgeport MIT	*Took average of two mode shares*
		Cambridgeport South	Cambridgeport South	
	3. Central Square	Mass Ave Central	Central Square	
		Mass Ave Hancock/Putnam		
		Mass Ave Inman/Hancock		
		Mass Ave Pearl		
	4. MIT/Osborn	Mass Ave Mass/Main		
		Mass Ave MIT		
		Osborn	MIT Osborn	
	5. Charles Street	Charles Street	Charles St	
	6. East Cambridge	Cambridge St East Cambridge		
		Cambridge St East Cambridge Riverfront		*Took average of three mode shares*
		Gore Street	Gore St	
		Lechmere West	Lechmere Sq. West	
		North Point	North Point	
	7. Prospect Street	Prospect Street	Prospect St	
	8. Inman Square	Cambridge Street Inman Square		
		Cambridge Street Prospect-Medeiros		
		Inman East		
		Inman East B	Inman Sq. East B	
	9. Mid Cambridge	Cambridge Street MidCambridge	Cambridge St	
	10. Harvard	Harvard - Brattle	Harvard/Brattle Squares	
		Mass Ave Harvard		
	11. Lower Mass Ave	Mass Ave Lower Mass	North Mass Ave (HARPO)	
		Mass Ave Lower Mass Porter		
	12. Mass Ave North	Mass Ave North mass Ave	North Mass Ave (north)	
		Mass Ave Porter		
	13. Alewife	Alewife	*N/A	
	14. Kendall/Volpe	Kendall Square Core		
		B South	*N/A	
		Volpe		
		First Street		
			South Mass Ave	*Not applied - Central Sq. to Memorial Drive*
			Star Market	*Not evaluating this subarea*
			Citywide	*Not applied*

- McMahon grouped 33 development areas provided by Utile (column C) into 14 subareas (column B) for the critical sums analysis. This grouping was used for trip distribution and is based on the development areas' proximity to each other and surrounding road network determining how trips would enter/exit each area.

- To evaluate development scenarios, the development figures provided by Utile (identified via labels in column C) were summarized into the 14 subareas (in column B) to complete the trip generation portion of the critical sums analysis.

- The Star Market subarea was not included due to its location far from study area intersections and low net new square footage.

- Mode shares at the census tract level for labor force and workforce were provided by the City of Cambridge by development area (identified in column D) and applied to the appropriate sub area (column B) based on geographic location, as listed in the table. After reviewing results from an initial analysis with these mode shares, the City adopted a future goal mode share to use in the analysis, and those listed here were not used.

- The application of work foce and labor force mode shares to each sub-area is depicted in the attached series of maps.

*Subarea added after initial analysis with current mode shares completed

The following trip generation rates in Table 1 were proposed for the Envision Cambridge Critical Sums Analysis. Several factors were considered:

- The trip generation rates used for the 2017 Alewife Critical Sums Analysis are updated from the *ITE Trip Generation Manual 9th Edition* to the *ITE Trip Generation Manual 10th Edition.*
- The 10th edition provides a new option to analyze a land use code based on a "Dense Multi-Use Urban" environment. This environment may be appropriate for Cambridge, but it is only available for general office and residential land uses (as seen in Table 2). Because of this, the "General Urban/Suburban" category was used to remain consistent with previous critical sums analyses and apply the same type of trip rate across all land uses.
    - As trip rates are generally lower for "Dense Multi-Use Urban" this results in a conservative approach to the analysis.
- The 10th edition provides a new option to use a person trip rate (vs. a vehicle trip rate that is used in previous editions). The person trip rate results in a higher trip generation rate per day/peak hour, and is not available for R&D and industrial land uses (as seen in Table 3). To remain consistent with previous critical sums analysis and apply the same type of trip rate for all land uses, the vehicle trip rate was used and a person trip factor will be applied as was done in previous critical sums analyses.
- The peak hour of generator was used for all land uses to remain consistent with 9th Edition methodology and previous critical sums analyses.

Table 1: Proposed ITE Trip Rates by Land Use (General Urban/Suburban Environment)

Land Use	ITE Code	Average Daily Trip Rate (per 1000 SF GFA)	Average AM Trip Rate (per 1000 SF GFA)	Average PM Trip Rate (per 1000 SF GFA)
R&D	760	11.26	1.22	1.11
General Office	710	9.74	1.47	1.42
Industrial[1]	130	3.37	0.41	0.40
Retail	820	37.75	3.00	4.21
Residential[2] (Per Dwelling Unit)	221	5.44	0.32	0.41
Institutional[3]	550[4]	26.04	1.10	1.19

1 Assumes Industrial Park
2 Multifamily Housing (Mid-Rise) LUC used to reflect Cambridge environment
3 Includes class rooms, offices, or research space
4 "University/College" LUC used

Table 2: Proposed ITE Trip Rates for General Urban/Suburban Environment (black) compared with Trip Rates for Dense Multi-Use Urban Environment (red)

Land Use	ITE Code	Average Daily Trip Rate (per 1000 SF GFA)	Average AM Trip Rate (per 1000 SF GFA)	Average PM Trip Rate (per 1000 SF GFA)
R&D	760	11.26	1.22	1.11
General Office	710	9.74 (N/A)	1.47 (.91)	1.42 (.87)
Industrial[1]	130	3.37	0.41	0.40
Retail	820	37.75	3.00	4.21
Residential[2] (Per Dwelling Unit)	221	5.44 (2.59)	0.32 (.15)	0.41 (.18)
Institutional[3]	550[4]	26.04	1.10	1.19

1 Assumes Industrial Park
2 Multifamily Housing (Mid-Rise) LUC used to reflect Cambridge environment
3 Includes class rooms, offices, or research space
4 "University/College" LUC used

Table 3: ITE **Person Trip Rates** for General Urban/Suburban Environment (black) compared with Trip Rates for Dense Multi-Use Urban Environment (red)

Land Use	ITE Code	Average Daily Trip Rate (per 1000 SF GFA)	Average AM Trip Rate (per 1000 SF GFA)	Average PM Trip Rate (per 1000 SF GFA)
R&D	760	N/A	N/A	N/A
General Office	710	14.87 (13.68)	1.49 (1.44)	1.56 (1.46)
Industrial[1]	130	N/A	N/A	N/A
Retail	820	N/A	5.03	7.49
Residential[2] (Per Dwelling Unit)	221	N/A	0.32 (.59)	0.50 (.62)
Institutional[3]	550[4]	N/A	2.27	2.37

1 Assumes Industrial Park
2 Multifamily Housing (Mid-Rise) LUC used to reflect Cambridge environment
3 Includes class rooms, offices, or research space
4 "University/College" LUC used

Journey to Work Modes: Cambridge Laborforce

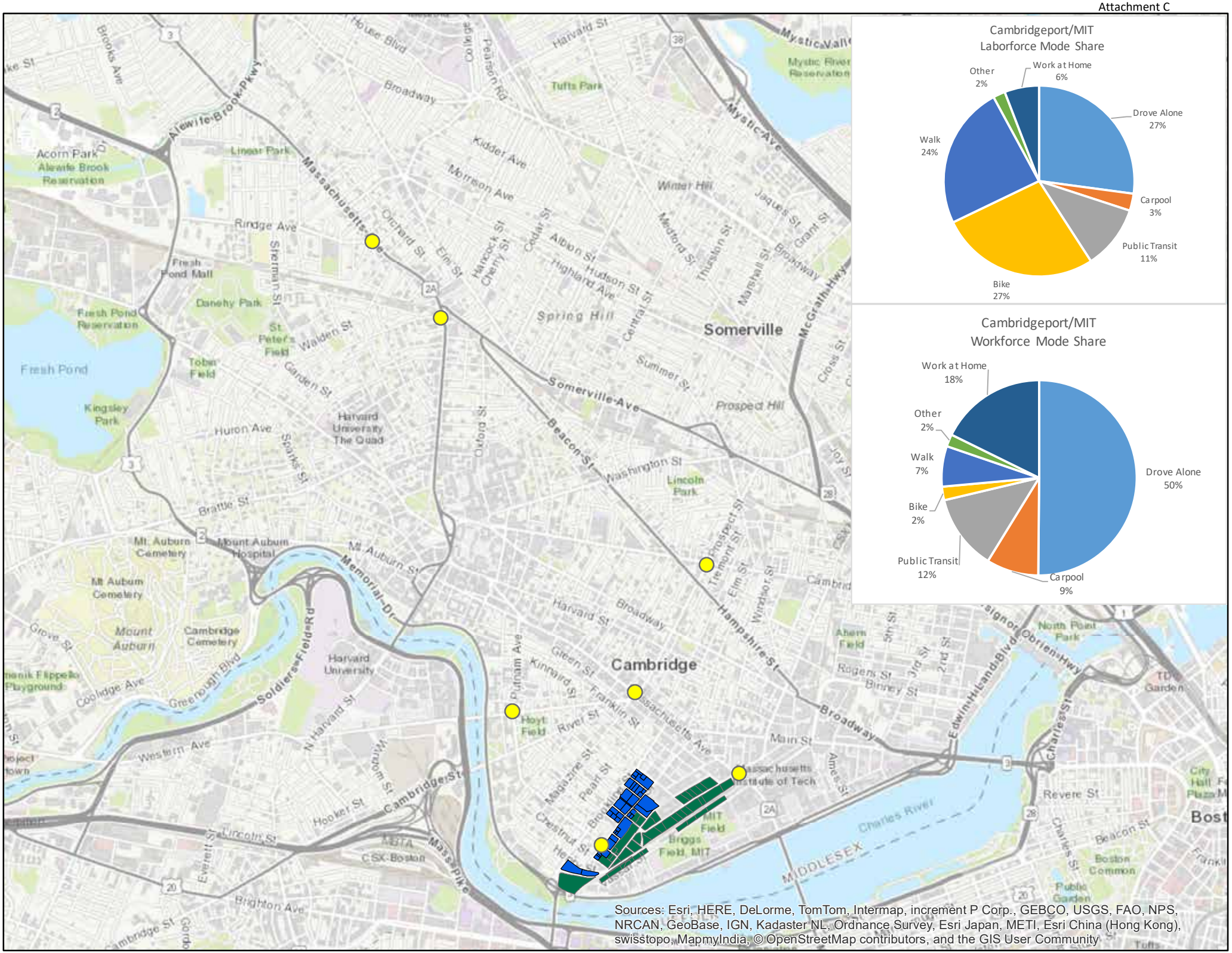
Development Area	Critical Sums intersection	Drove Alone	Carpool	Public Transit	Bike	Walk	Other	Work at Home	Total
Cambridge St	1	19%	3%	6%	20%	41%	0%	10%	100%
Cambridgeport MIT	3	22%	2%	10%	27%	32%	2%	5%	100%
Cambridgeport Riverfront	7	20%	6%	5%	38%	22%	2%	7%	100%
Cambridgeport South	3	32%	4%	12%	27%	16%	2%	7%	100%
Central Square	4	24%	1%	9%	41%	17%	1%	8%	100%
Charles St	-	19%	5%	2%	34%	34%	1%	5%	100%
Gore St	1	22%	2%	8%	39%	24%	1%	4%	100%
Harvard/Brattle Squares	8	13%	2%	5%	23%	49%	1%	7%	100%
Inman Sq East B	6	35%	3%	11%	24%	20%	1%	6%	100%
Lechmere Sq West	1	39%	6%	2%	28%	17%	1%	6%	100%
MIT Osborn	2	16%	1%	5%	34%	36%	0%	7%	100%
North Mass Ave (HARPO)	10	24%	4%	5%	24%	34%	1%	8%	100%
North Mass Ave (north)	9	37%	3%	5%	40%	8%	1%	6%	100%
North Point	1 +/-	39%	6%	2%	28%	17%	1%	6%	100%
Prospect St	5	28%	3%	11%	33%	17%	1%	8%	100%
South Mass Ave	2-4	21%	2%	7%	33%	27%	0%	9%	100%
Star Market	-	53%	7%	10%	20%	7%	1%	2%	100%
Citywide	-	28%	3%	7%	29%	25%	1%	7%	100%

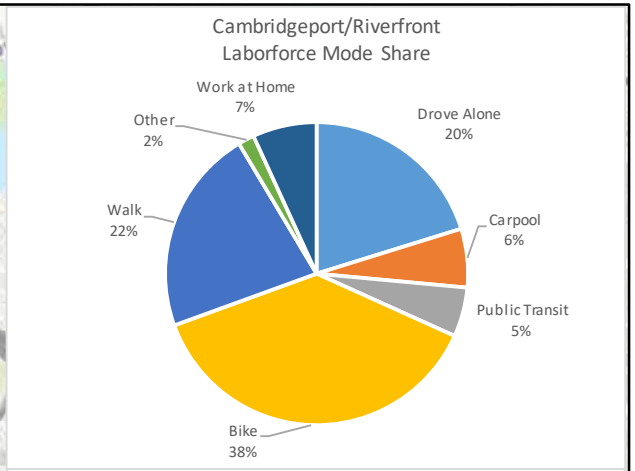
Source:
American Community Survey 2012 - 2016 Five Year Estimates,
https://factfinder.census.gov/bkmk/table/1.0/en/ACS/16_5YR/B08301/1400000US25017352101|1400000US25017352102|1400000US25017352200|1400000US25017352300|1400000US25017352400|1400000US25017352500|1400000US25017352600|1400000US25017352700|1400000US25017352800|1400000US25017352900|1400000US25017353000|1400000US25017353101|1400000US25017353102|1400000US25017353200|1400000US25017353300|1400000US25017353400|1400000US25017353500|1400000US25017353600|1400000US25017353700|1400000US25017353800|1400000US25017353900|1400000US25017354000|1400000US25017354100|1400000US25017354200|1400000US25017354300|1400000US25017354400|1400000US25017354500|1400000US25017354600|1400000US25017354700|1400000US25017354800|1400000US25017354900|1400000US25017355000|1600000US2511000

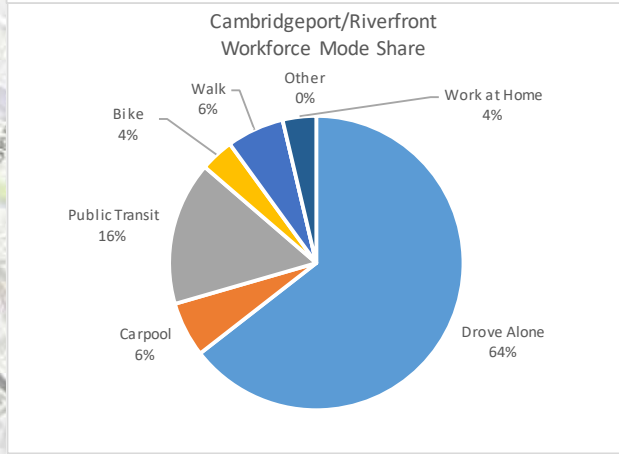
Journey to Work Modes: Cambridge Workforce

Development Area	Critical Sums intersection	Drove Alone	Carpool	Public Transit	Bike	Walk	Other	Work at Home	Total
Cambridge St	1	45%	8%	29%	3%	11%	1%	2%	100%
Cambridgeport MIT	3	57%	14%	13%	3%	8%	0%	5%	100%
Cambridgeport Riverfront	7	64%	6%	16%	4%	6%	0%	4%	100%
Cambridgeport South	3	43%	3%	12%	1%	5%	4%	30%	100%
Central Square	4	44%	7%	28%	4%	13%	0%	4%	100%
Charles St	-	56%	8%	22%	3%	8%	2%	1%	100%
Gore St	1	41%	5%	14%	13%	17%	0%	10%	100%
Harvard/Brattle Squares	8	33%	8%	31%	5%	19%	0%	3%	100%
Inman Sq East B	6	60%	7%	14%	3%	12%	1%	5%	100%
Lechmere Sq West	1	62%	3%	2%	2%	3%	6%	22%	100%
MIT Osborn	2	51%	9%	26%	4%	8%	1%	1%	100%
North Mass Ave (HARPO)	10	30%	7%	27%	5%	26%	1%	4%	100%
North Mass Ave (north)	9	61%	5%	15%	0%	10%	1%	8%	100%
North Point	1 +/-	62%	3%	2%	2%	3%	6%	22%	100%
Prospect St	5	50%	6%	23%	4%	13%	0%	4%	100%
South Mass Ave	2-4	44%	8%	29%	4%	12%	1%	2%	100%
Star Market	-	53%	4%	19%	1%	7%	3%	13%	100%
Citywide	-	45%	8%	26%	4%	13%	1%	3%	100%

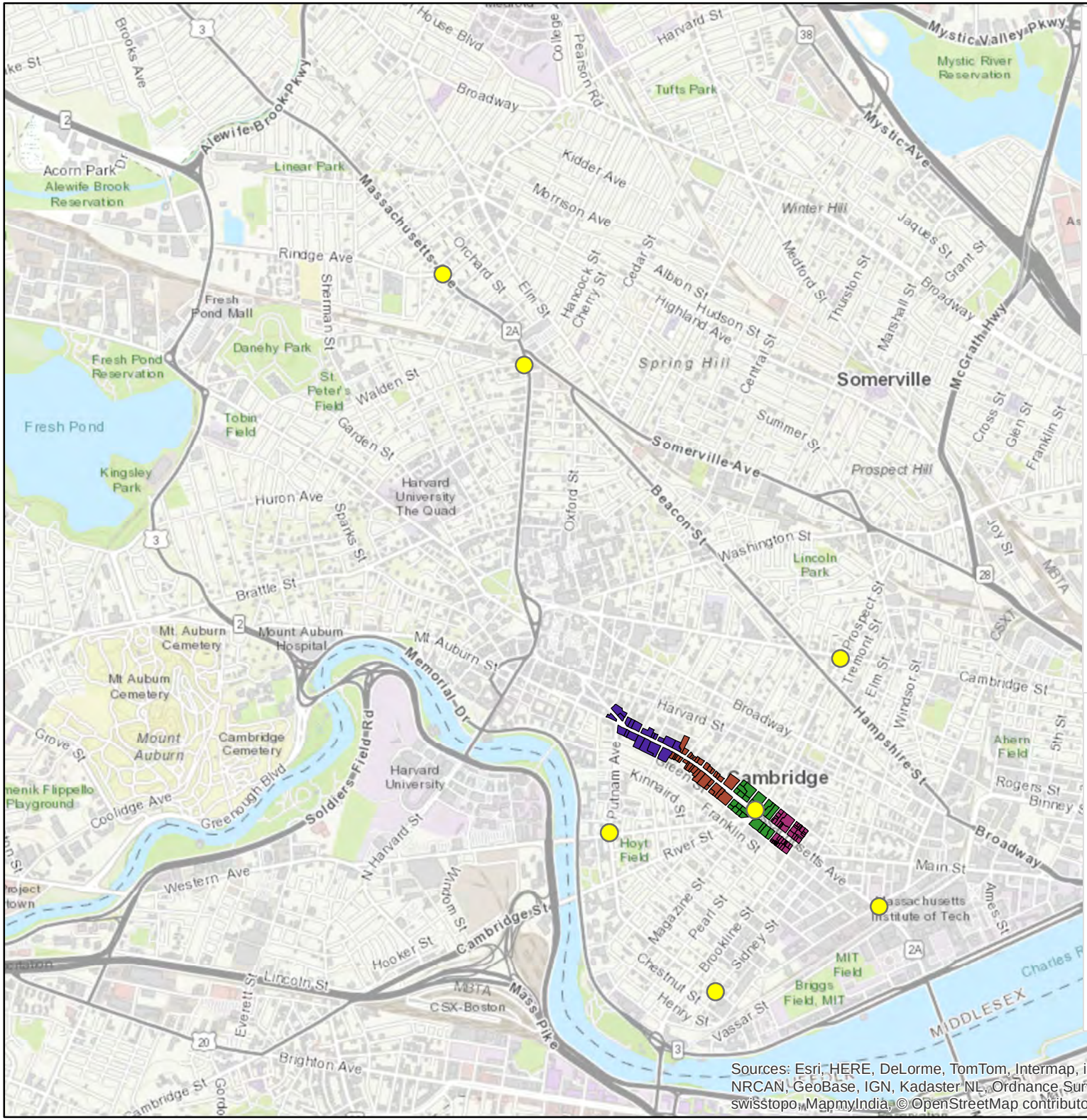
Source:
2006 - 2010 Central Transportaion Planning Products (CTPP) File
https://ctpp.transportation.org/ctpp-data-set-information/5-year-data/

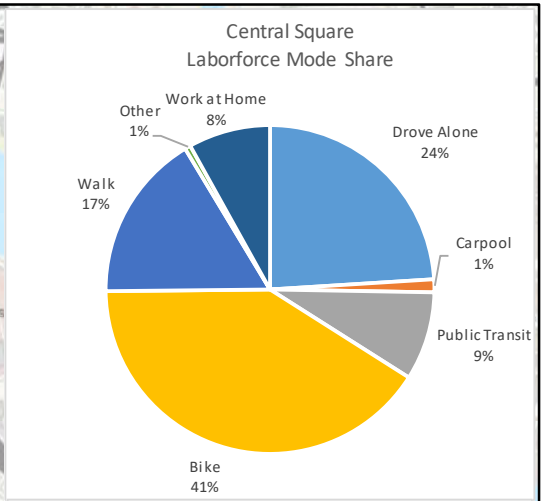

Cambridgeport/MIT
Laborforce Mode Share
Work at Home 6%
Drove Alone 27%
Carpool 3%
Public Transit 11%
Bike 27%
Walk 24%
Other 2%
Cambridgeport/MIT
Workforce Mode Share
Work at Home 18%
Drove Alone 50%
Carpool 9%
Public Transit 12%
Bike 2%
Walk 7%
Other 2%
Somerville
Cambridge
Harvard University
Massachusetts Institute of Technology
Fresh Pond
Mount Auburn Cemetery
Charles River
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

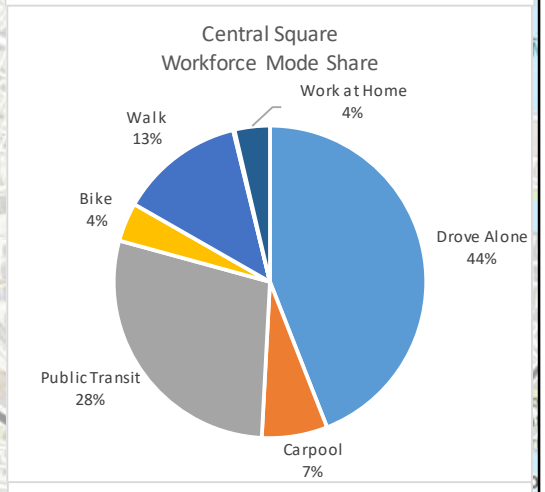


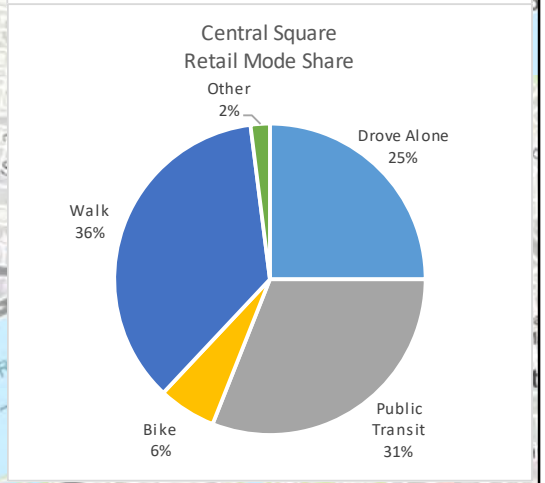


Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

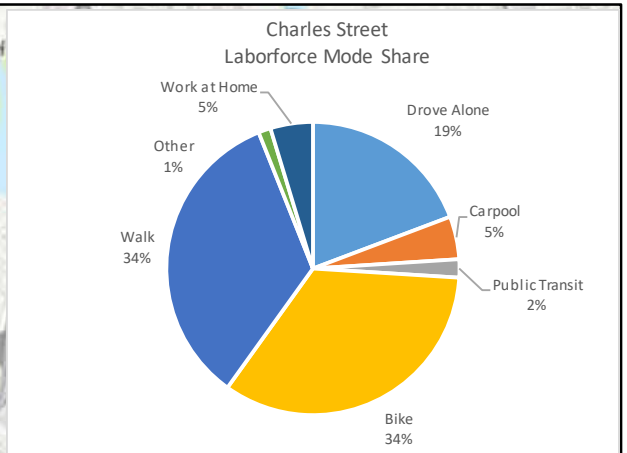


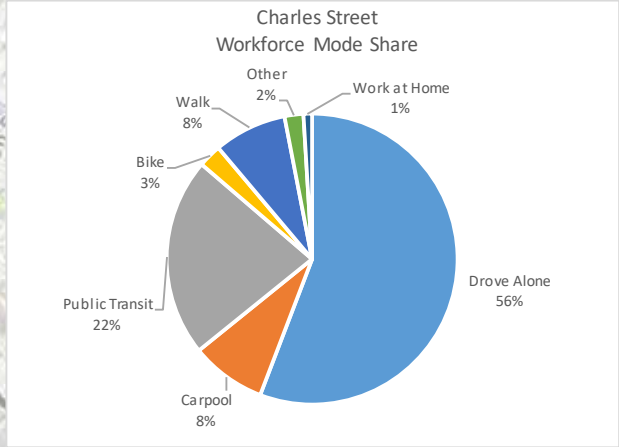


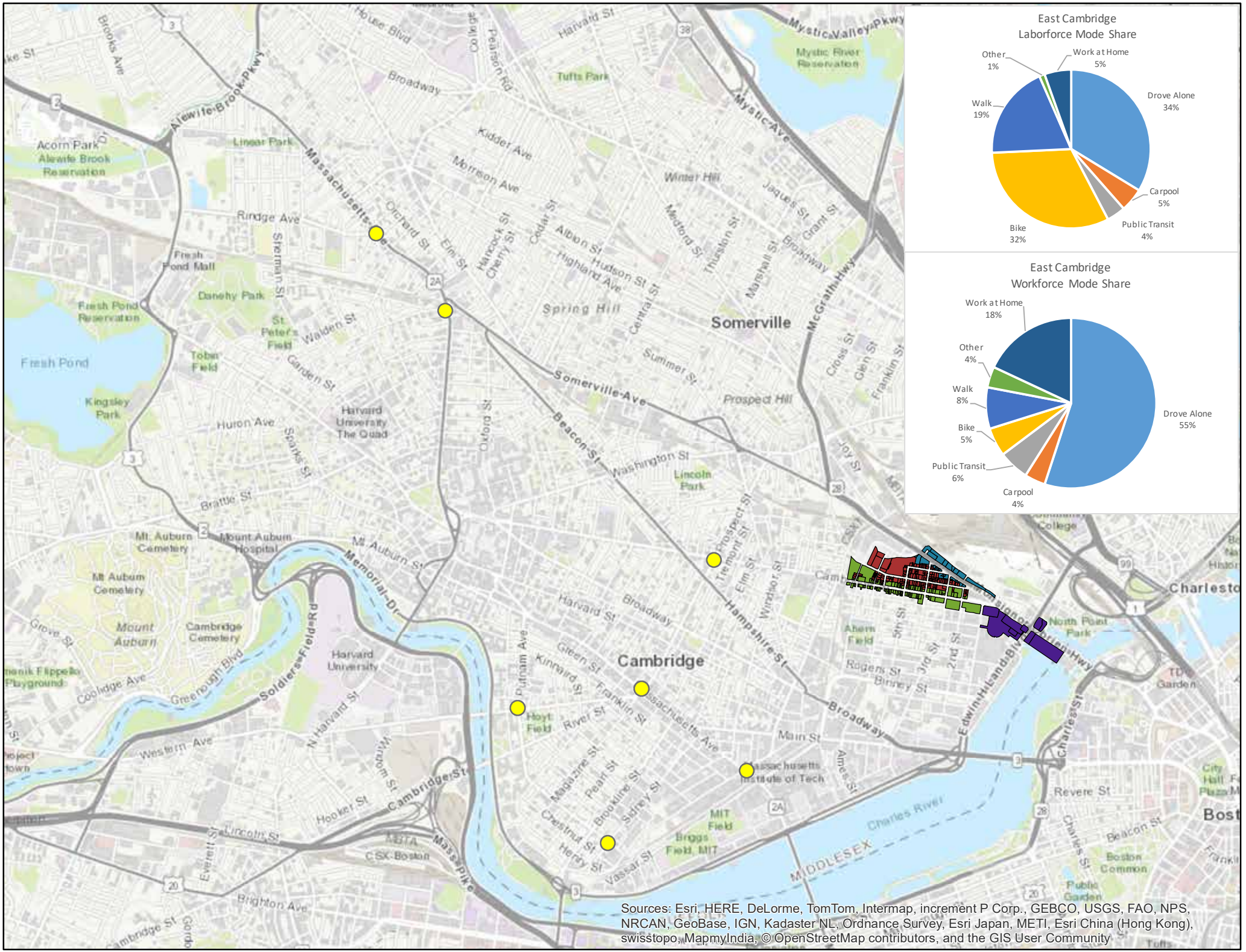


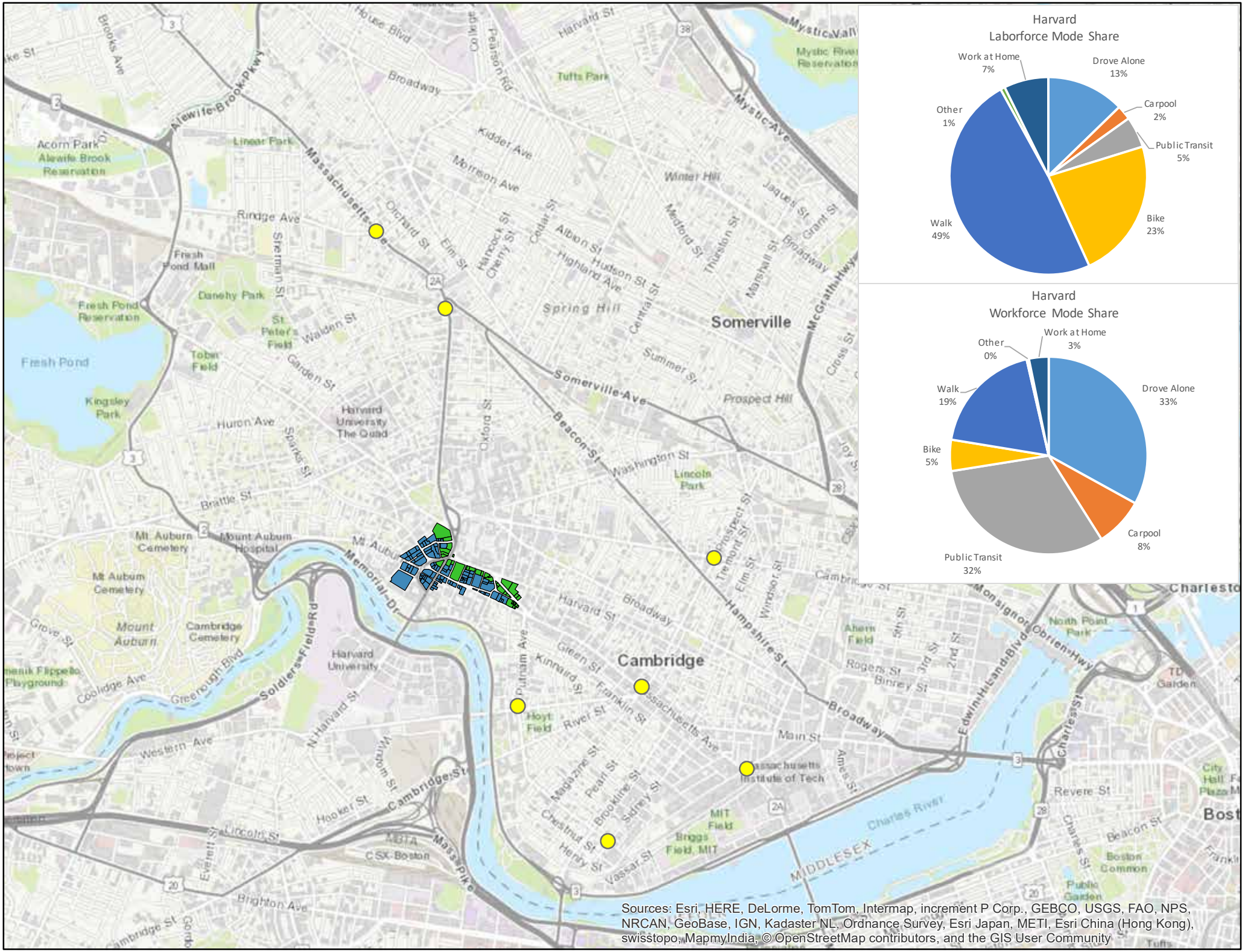


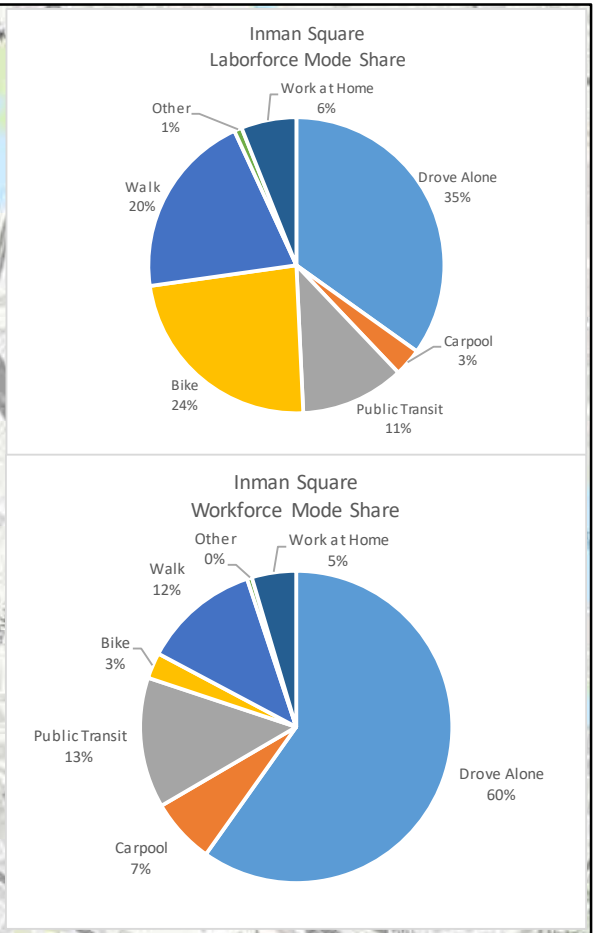
Retail mode share applied from K2C2

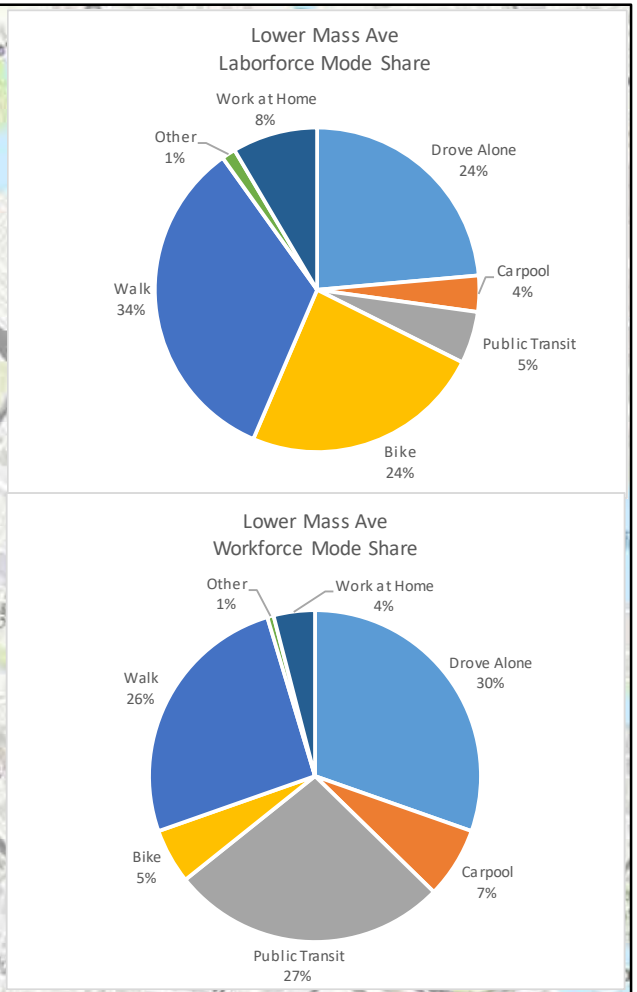




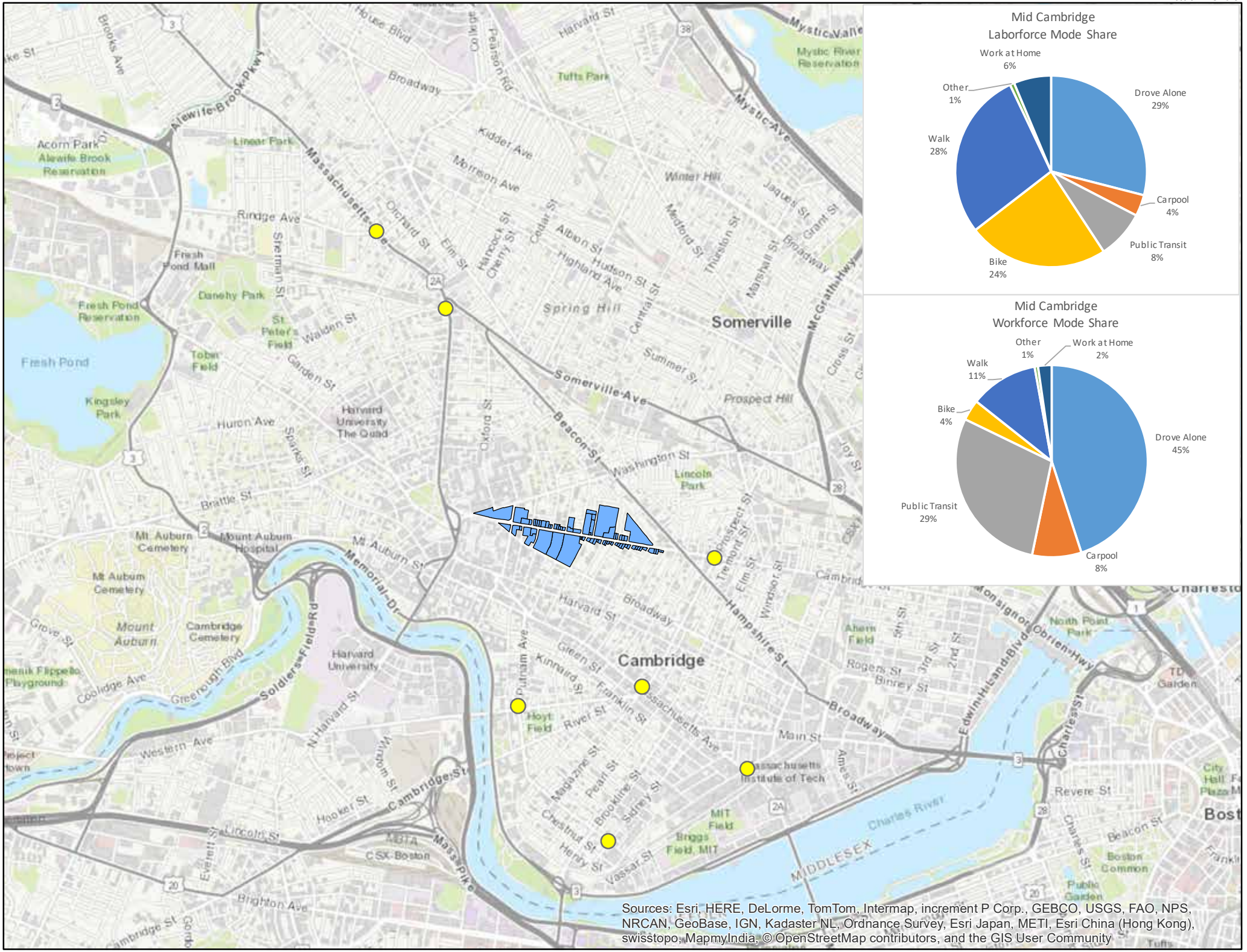

East Cambridge
Laborforce Mode Share
Other 1%
Work at Home 5%
Drove Alone 34%
Walk 19%
Carpool 5%
Public Transit 4%
Bike 32%
East Cambridge
Workforce Mode Share
Work at Home 18%
Other 4%
Walk 8%
Drove Alone 55%
Bike 5%
Public Transit 6%
Carpool 4%
Somerville
Cambridge
Harvard University
Massachusetts Institute of Technology
Fresh Pond
Mount Auburn Cemetery
Harvard University The Quad
Charles River
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

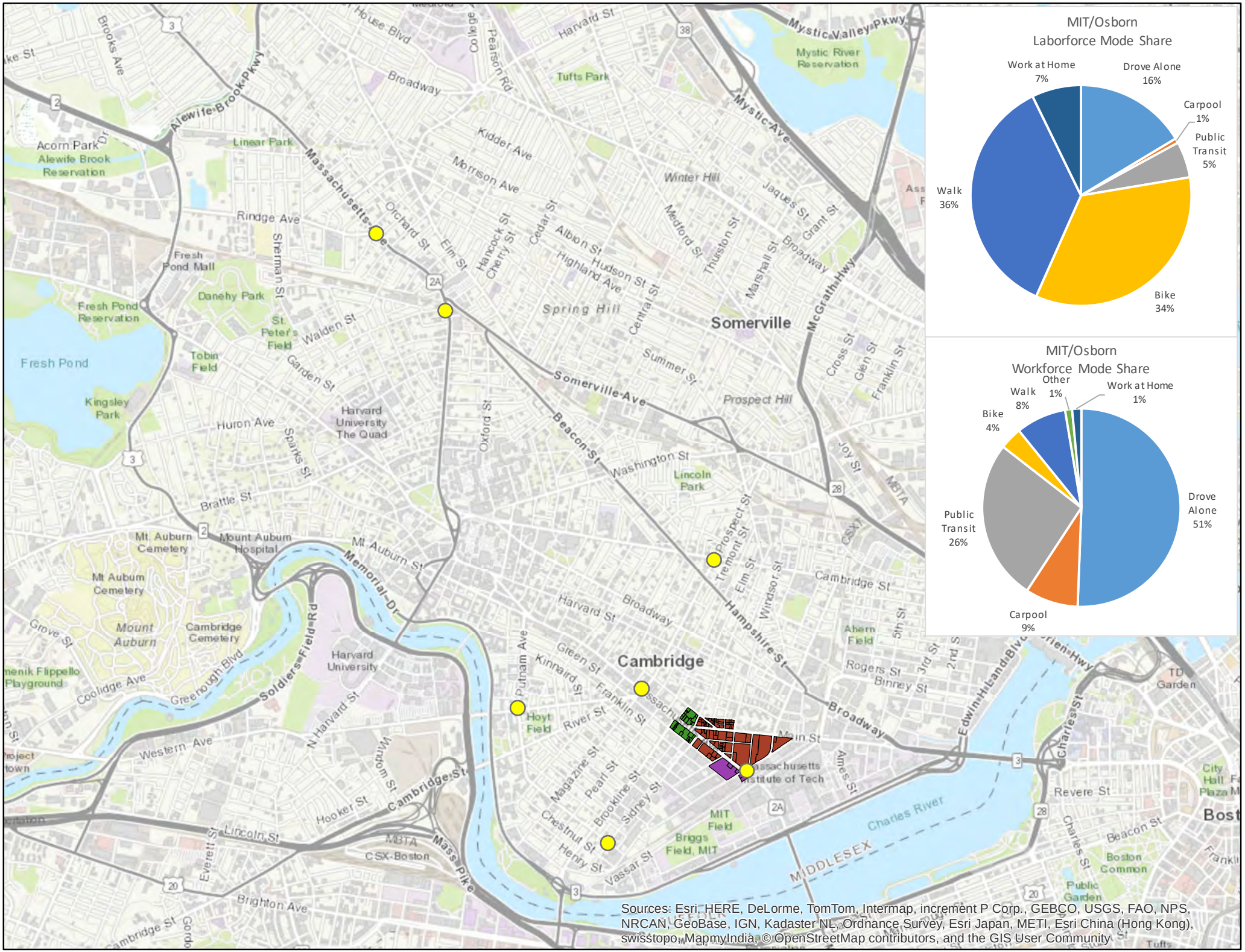

Harvard
Laborforce Mode Share
Work at Home 7%
Drove Alone 13%
Carpool 2%
Public Transit 5%
Bike 23%
Walk 49%
Other 1%
Harvard
Workforce Mode Share
Other 0%
Work at Home 3%
Drove Alone 33%
Carpool 8%
Public Transit 32%
Bike 5%
Walk 19%
Somerville
Cambridge
Harvard University
Mount Auburn Cemetery
Fresh Pond
Alewife Brook Reservation
Tufts Park
Lincoln Park
Boston Common
Public Garden
Charles River
MIDDLESEX
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



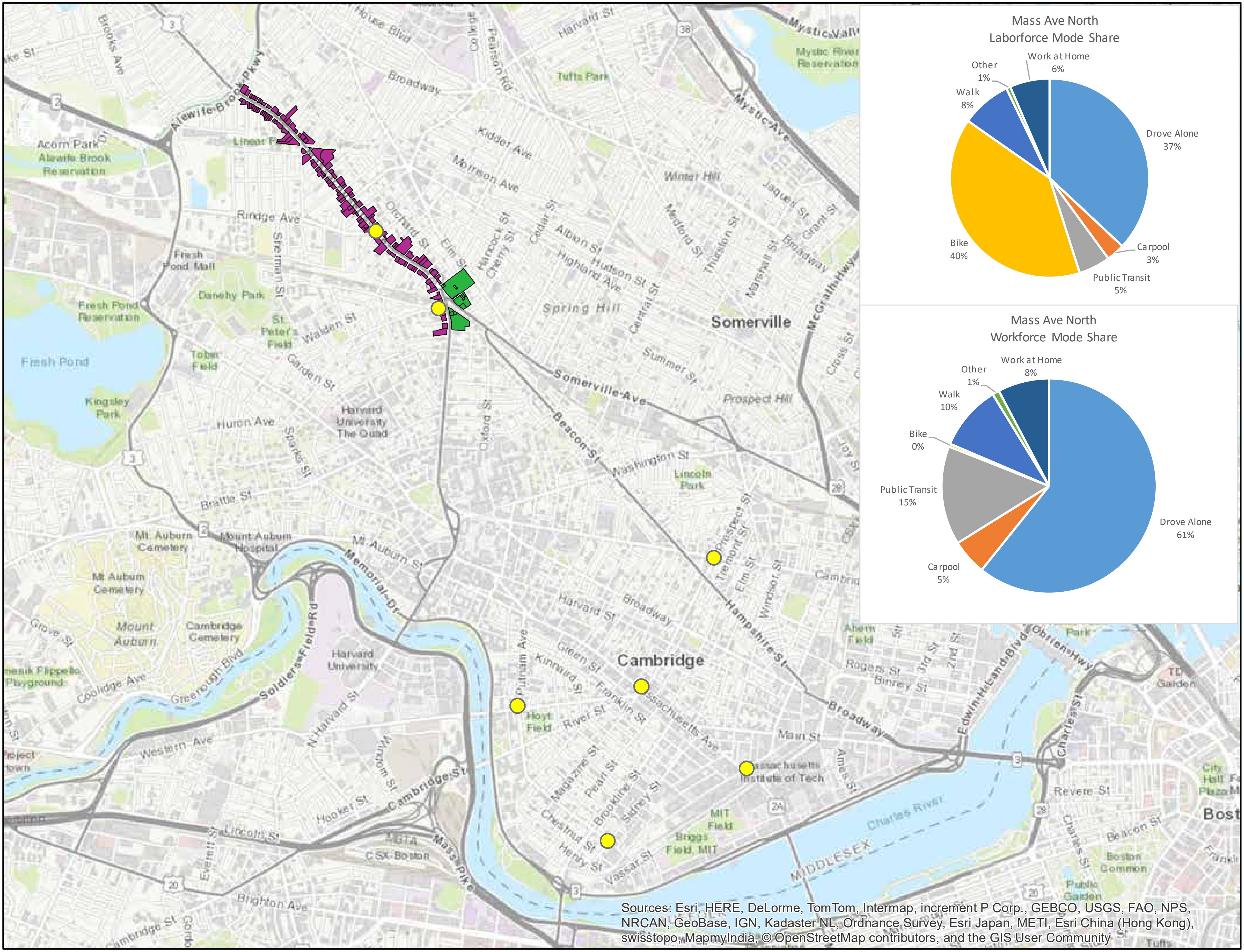


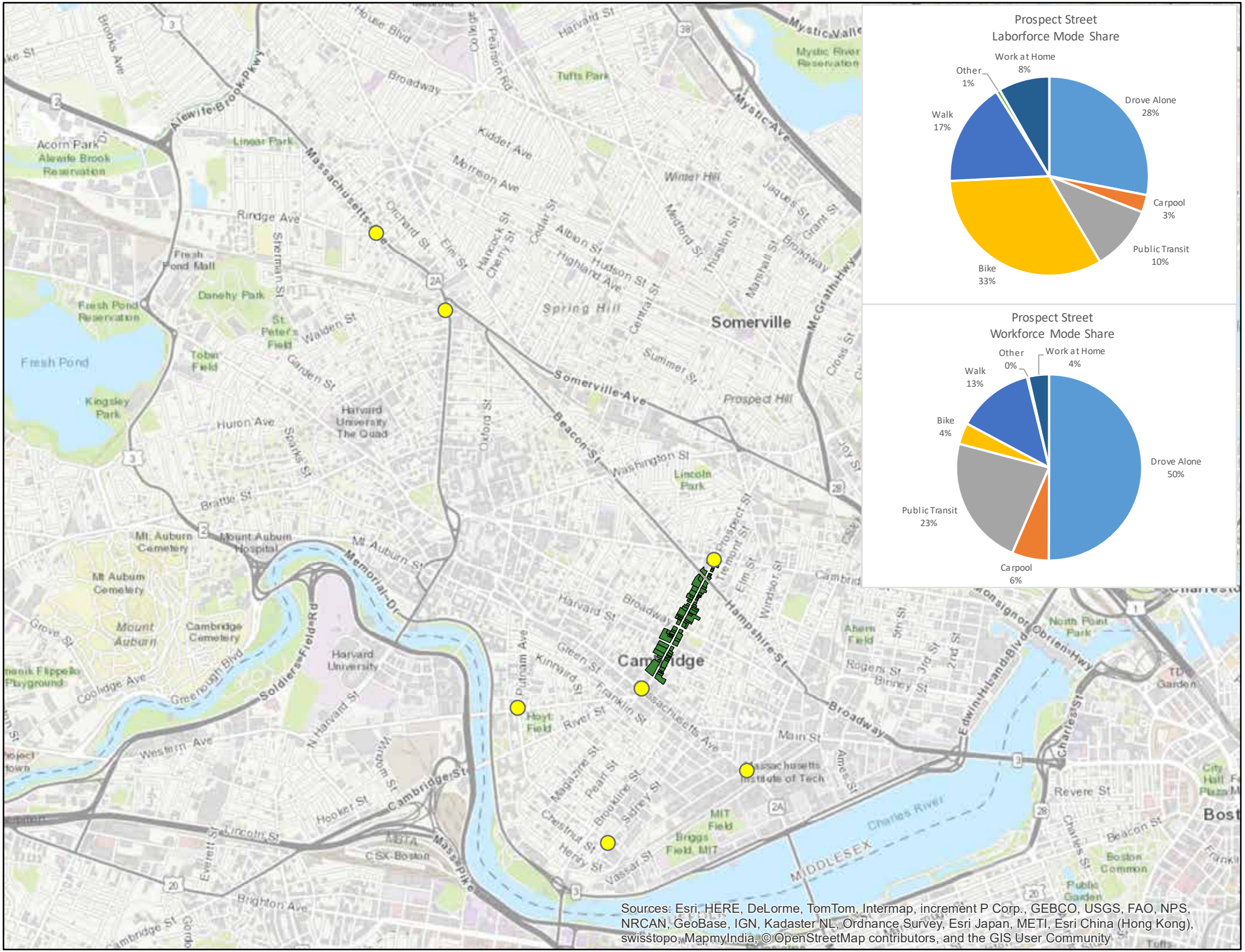
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


Mid Cambridge
Laborforce Mode Share
Work at Home 6%
Other 1%
Drove Alone 29%
Walk 28%
Carpool 4%
Public Transit 8%
Bike 24%
Mid Cambridge
Workforce Mode Share
Other 1%
Work at Home 2%
Walk 11%
Bike 4%
Drove Alone 45%
Public Transit 29%
Carpool 8%
Somerville
Cambridge
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


MIT/Osborn
Laborforce Mode Share
Work at Home 7%
Drove Alone 16%
Carpool 1%
Public Transit 5%
Walk 36%
Bike 34%
MIT/Osborn
Workforce Mode Share
Walk 8%
Other 1%
Work at Home 1%
Bike 4%
Drove Alone 51%
Public Transit 26%
Carpool 9%
Somerville
Cambridge
Fresh Pond
Fresh Pond Reservation
Alewife Brook Reservation
Mystic River Reservation
Tufts Park
Winter Hill
Spring Hill
Prospect Hill
Lincoln Park
Danehy Park
Tobin Field
Kingsley Park
Harvard University The Quad
Harvard University
Mount Auburn Cemetery
Cambridge Cemetery
Hoyt Field
MIT Field
Briggs Field, MIT
Ahern Field
Massachusetts Institute of Tech
Charles River
MIDDLESEX
Public Garden
Boston Common
TD Garden
Alewife Brook Pkwy
Massachusetts Ave
Mystic Valley Pkwy
McGrath Hwy
Somerville Ave
Beacon St
Broadway
Harvard St
Hampshire St
Memorial Dr
Soldiers Field Rd
Cambridge St
Western Ave
Mass Pike
MBTA
CSX-Boston
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Attachment C




Prospect Street
Laborforce Mode Share
Work at Home 8%
Other 1%
Drove Alone 28%
Walk 17%
Carpool 3%
Public Transit 10%
Bike 33%
Prospect Street
Workforce Mode Share
Other 0%
Work at Home 4%
Walk 13%
Bike 4%
Drove Alone 50%
Public Transit 23%
Carpool 6%
Somerville
Cambridge
Fresh Pond
Harvard University
Mount Auburn Cemetery
Massachusetts Institute of Technology
Charles River
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Envision Cambridge City Wide Critical Sums Trip Distribution

Overview

This technical memo provides an overview of the methodology used to create the trip distributions for residential and employee land uses.

Employee Distributions

- Based on 2010 U.S. Census data for County to County flows for the Cambridge workforce. This data documents the place a residents for workers in Cambridge, city-wide (except where further information was available – see assumptions heading).
- The top 25 results were used to compile a regional trip distribution to/from Cambridge. The results were grouped into regions and with a total percent of trips for each, as seen in Table 1.

Table 1: Cambridge Worker Flows, U.S. Census 2010

Region to/from	Percent of Total Trips
Cambridge	30%
Somerville	11%
Arlington	5%
WWNB (Watertown, Waltham, Newton, Brookline)	10%
Boston	19%
NE (east of I-93)	14%
NW (pie slice from West corridor to I-93)	8%
West (Convenient to Turnpike and Worcester line)	1%
SW (pie slice from West corridor to Route 24)	0%
SE (East of Route 24)	2%

Residential Distributions

- Based on 2010 U.S. Census data for County to County flows for the Cambridge labor force (except where further information was available – see assumptions heading). This data documents the place of work for residents of Cambridge, city-wide
- The top 25 results were used to compile a regional trip distribution to/from Cambridge. The results were grouped into regions and with a total percent of trips for each, as seen in Table 2.

Table 2: Cambridge Resident Flows, U.S. Census 2010

Region to/from	Percent of Total Trips
Cambridge	49%
Somerville	2%
Arlington	1%
WWNB (Watertown, Waltham, Newton, Brookline)	7%
Boston	32%
NE (east of I-93)	2%
NW (pie slice from West corridor to I-93)	4%
West (Convenient to Turnpike and Worcester line)	2%
SW (pie slice from West corridor to Route 24)	0%
SE (East of Route 24)	1%

The employee and residential trip distributions by region are provided in Attachment A.

Additional Assumptions

- In the conference call 8/6/18 it was decided to use 2010 census data county to county flows to inform trip distribution patterns for all subarea, unless additional data is available.
    - It was decided not to use city-wide PTDM data for all subareas because of its geographical bias towards Kendall Square. It was decided to use PTDM data for Kendall Square only Kendall Square. This was used to inform trip distribution in the Charles Street subarea.
    - Other additional sources include trip distribution from relevant Traffic Impact Studies.
- The Alewife and Kendall/Volpe subareas were added to the critical sums analysis based on a conference call on September 11, 2018. The trip distributions were determined as a composite of subarea trip distributions from recent critical sums analyses in these areas.

  - The Alewife trip distributions combined those of the five subareas from the Alewife District Plan.
  - The Kendall Square/Volpe trip distributions combined trip distributions for subareas 2, 3, and 4 that match the boundaries of the current Kendall/Volpe subarea.
  - The K2C2 analysis was completed prior to the installation of the third street connector; however, this additional connection does not impact trip distribution as it is internal to the subarea.
- The sources of trip distribution for all subareas are listed in Table 2.

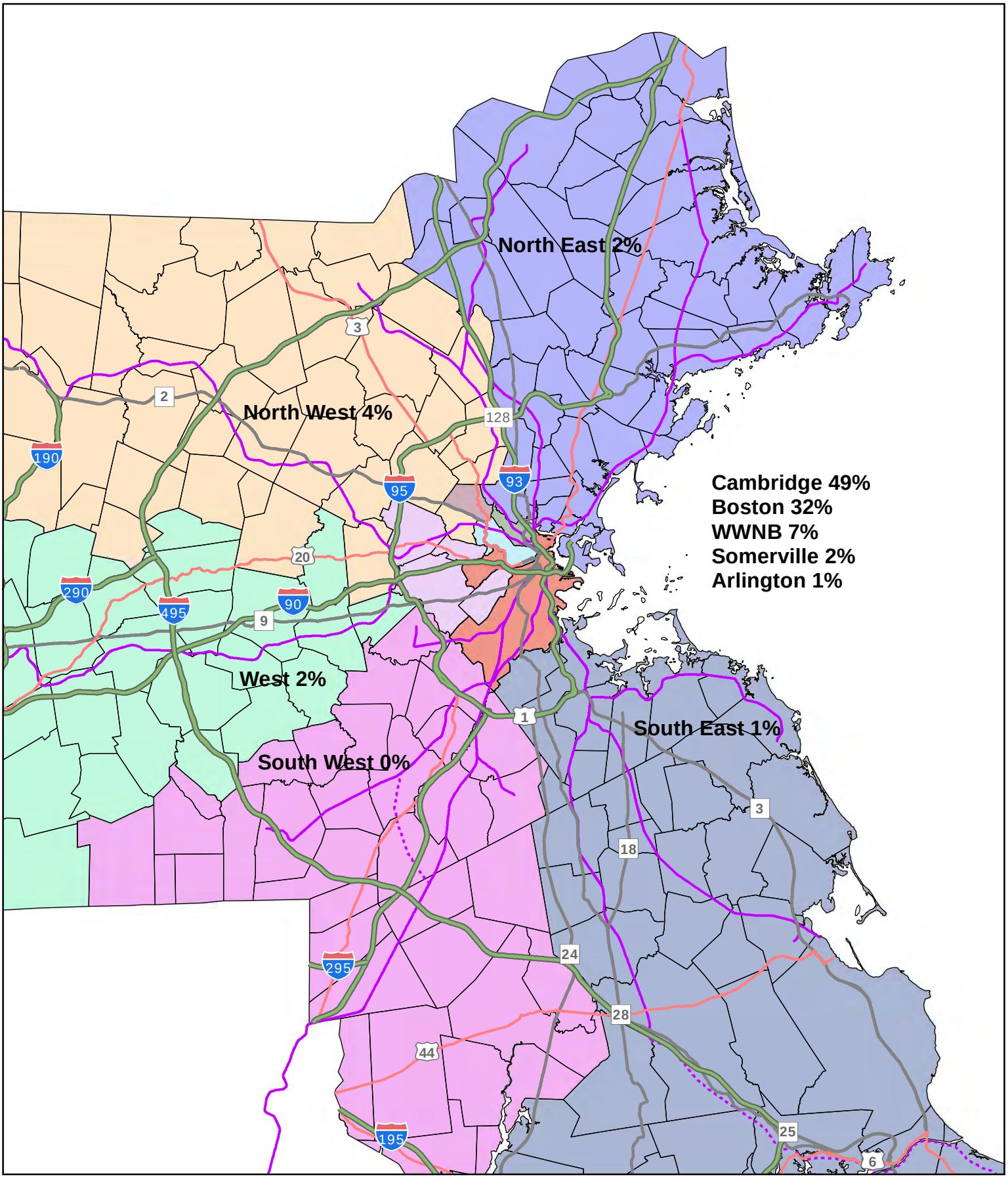
Table 3: Trip Distribution Sources by Subarea

Subarea	Trip Distribution Source	Trip Distribution Source
	Residential	***Commercial***
North Mass Ave	Census Data	Census Data
Lower Mass Ave	Census Data	Census Data
Harvard Square	Census Data	Smith Campus Center TIS
Mid Cambridge	Census Data	Census Data
Inman Square	Census Data	Census Data
Prospect Street	Census Data	Census Data
East Cambridge	Census Data	Census Data
Kendall Square	PTDM Data	PTDM Data
MIT/Osbourne Triangle	Mass + Main TIS	Mass + Main TIS
Central Square	Census Data	Census Data
Cambridgeport/MIT	240 Sidney St TIS	Census Data
Cambridgeport Riverfront	Census Data	Census Data
Alewife	Alewife District Plan Critical Sums Analysis (Dec 2017)	Alewife District Plan Critical Sums Analysis (Dec 2017)
Kendall/Volpe	K2C2 Critical Sums Analysis (June 2012)	K2C2 Critical Sums Analysis (June 2012)

Subarea Distribution

- Access points were determined city-wide based on probable vehicle paths to and from all subareas along major roadways, as seen in Attachment B.
- Percentages by municipality or origin from the census data were assigned to the network proportionally based on approximate roadway volumes for that movement, with greater weight on direct access routes to/from a subarea.

- Access points and percentages for the network are documented in Attachments C and D. All streets were considered in the analysis. The streets depicted in the attachments tend to be the most likely travel corridors and generally represent trips going to/coming from the subarea from each major direction.
- The study area intersections were selected as a snap shot to evaluate the level of traffic increase that may be created by new development in the subarea. Actual traffic increases in the subarea will vary.



0 3.757.5 15 22.5 30

Miles

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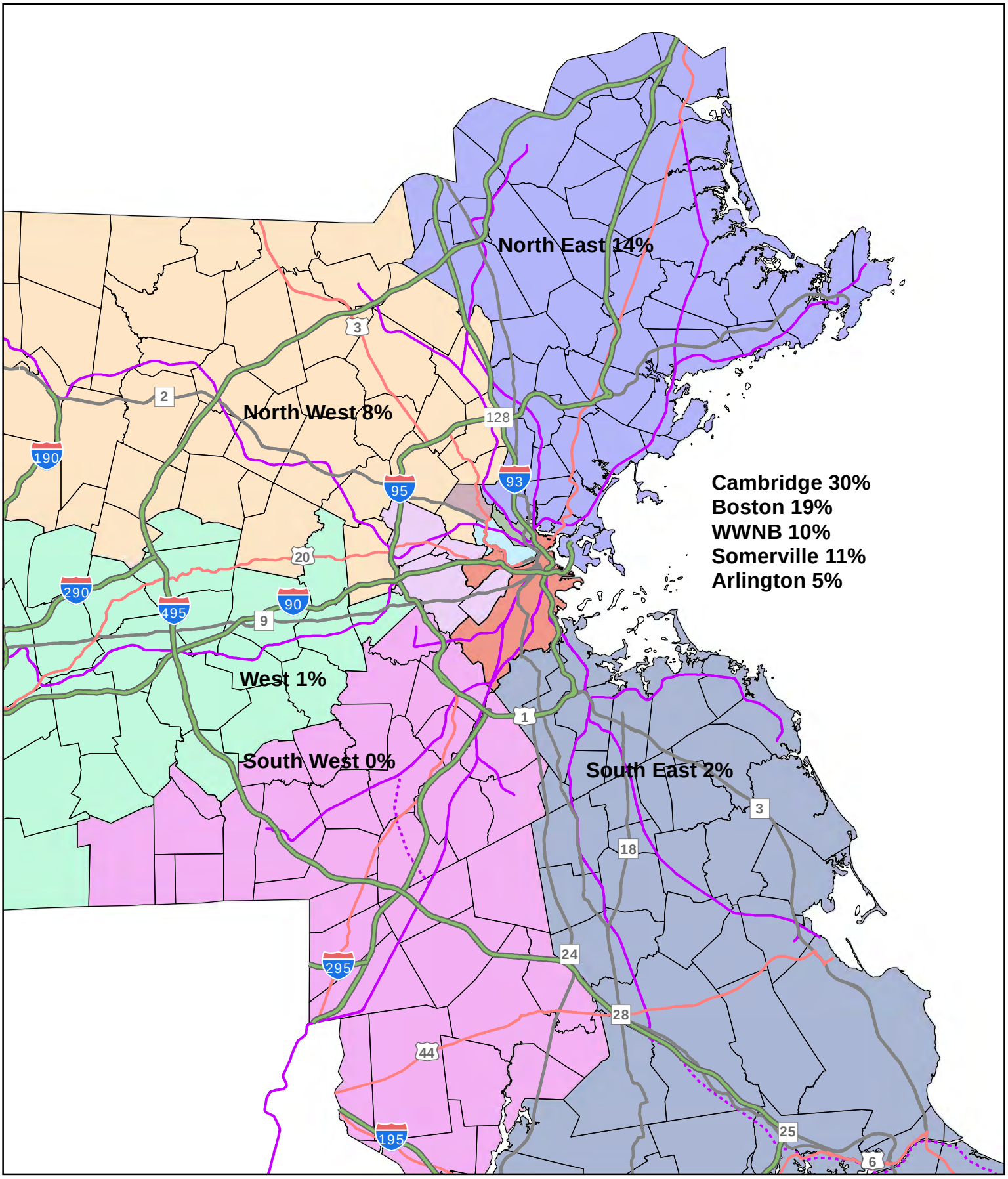
City-wide Trip Distribution - Cambridge Laborforce
Envision Cambridge - City Wide Critical Sums
Cambridge, Massachusetts

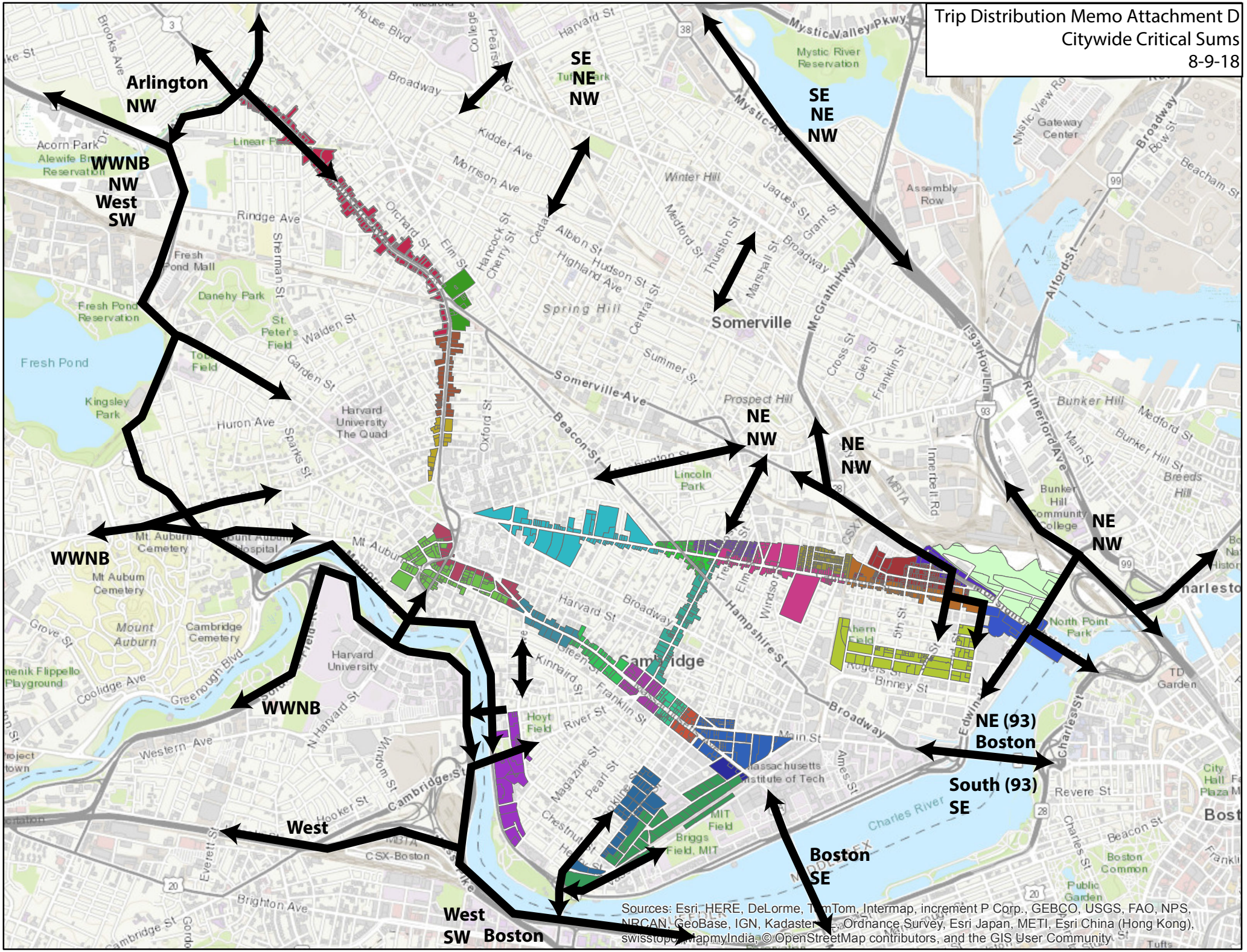
Data source: 2010 US Census Top 25 County to County Flows to/from Cambridge, MA

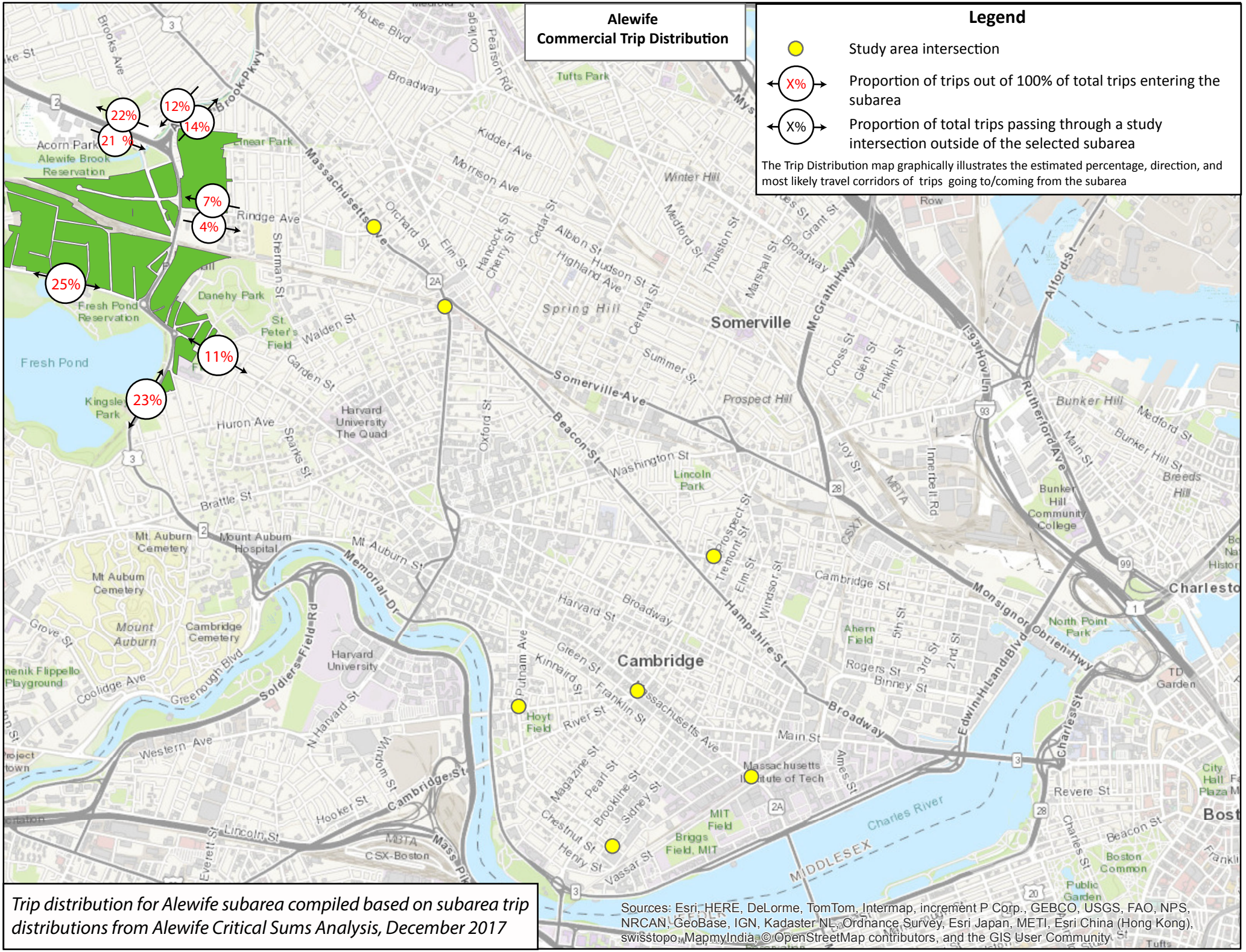


DRAFT

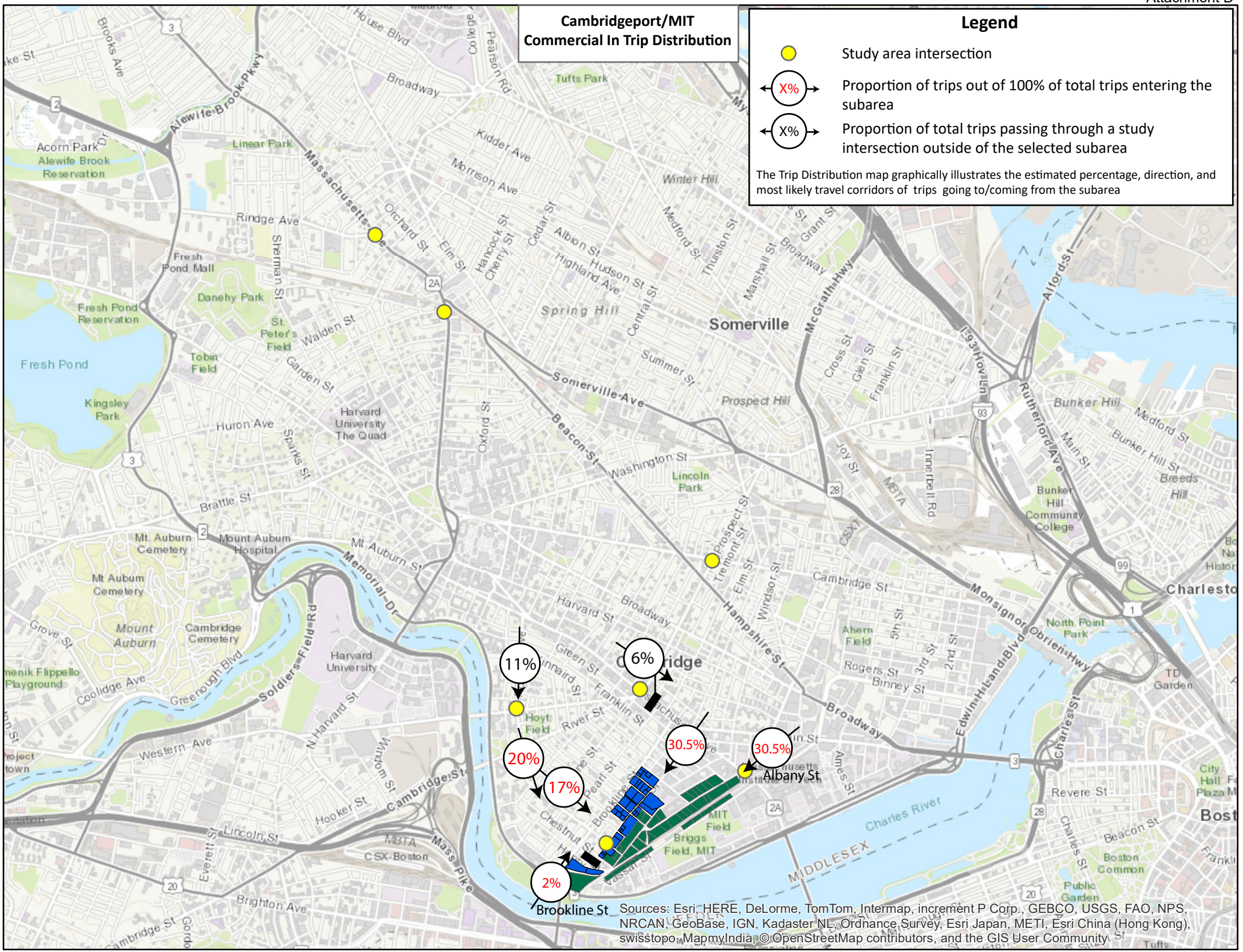
City-wide Trip Distribution - Cambridge Workforce
Envision Cambridge - City Wide Critical Sums
Cambridge, Massachusetts

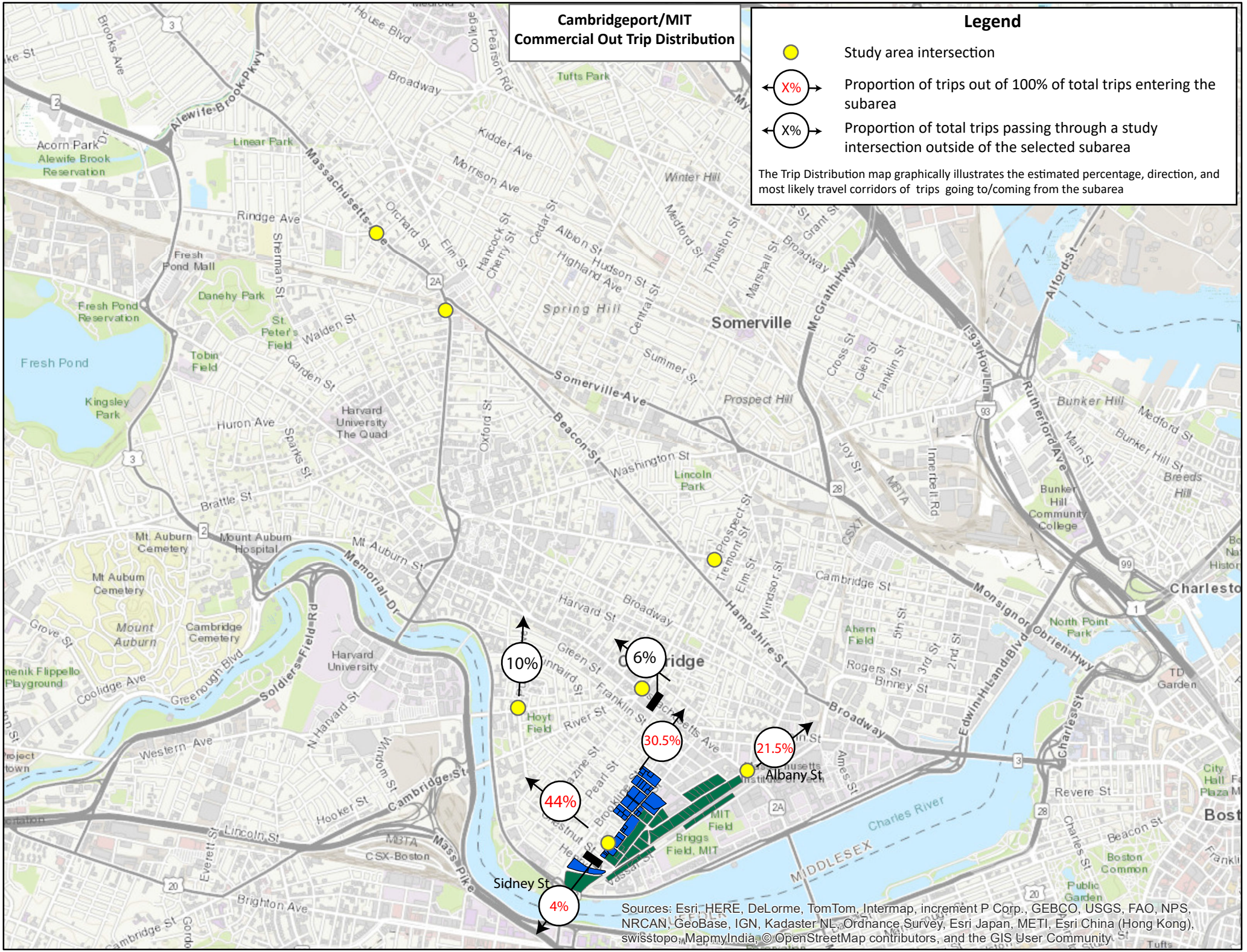
Data source: 2010 U.S. Census Top 25 County to County Work Flows to/from Cambridge, MA

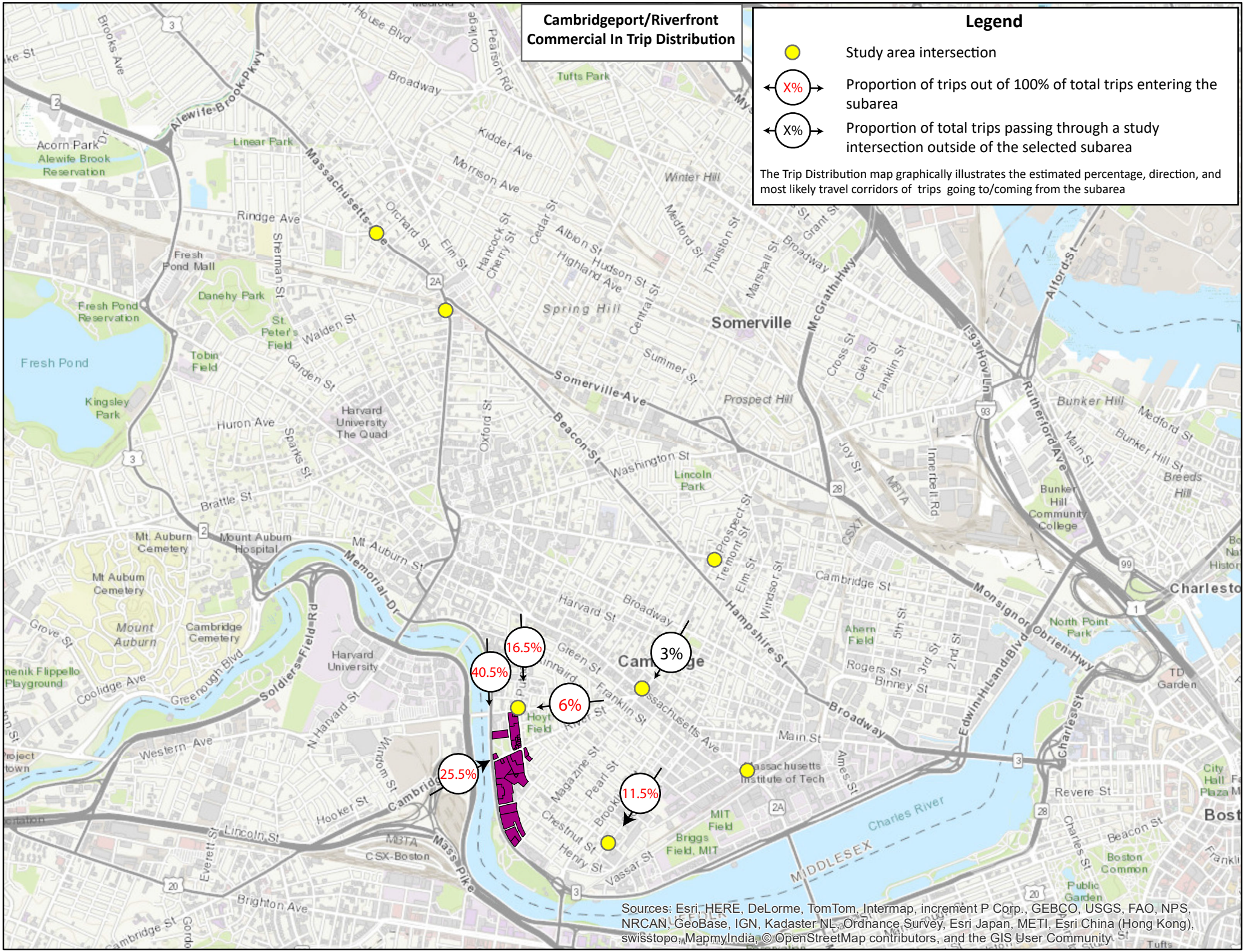

Trip Distribution Memo Attachment D
Citywide Critical Sums
8-9-18
Arlington
NW
WWNB
NW
West
SW
SE
NE
NW
SE
NE
NW
WWNB
WWNB
West
West
SW
Boston
Somerville
NE
NW
NE
NW
NE
NW
Boston
SE
South (93)
SE
NE (93)
Boston
Cambridge
Harvard University
Mt Auburn Cemetery
Mount Auburn
Cambridge Cemetery
Fresh Pond
Fresh Pond Reservation
Danehy Park
Kingsley Park
Lincoln Park
Prospect Hill
Winter Hill
Spring Hill
Assembly Row
Mystic River Reservation
Somerville-Ave
Broadway
Harvard St
Hampshire St
Main St
Massachusetts Institute of Tech
MIT Field
Briggs Field, MIT
Hoyt Field
Ahern Field
North Point Park
TD Garden
Boston Common
Public Garden
Charles River
CSX-Boston
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

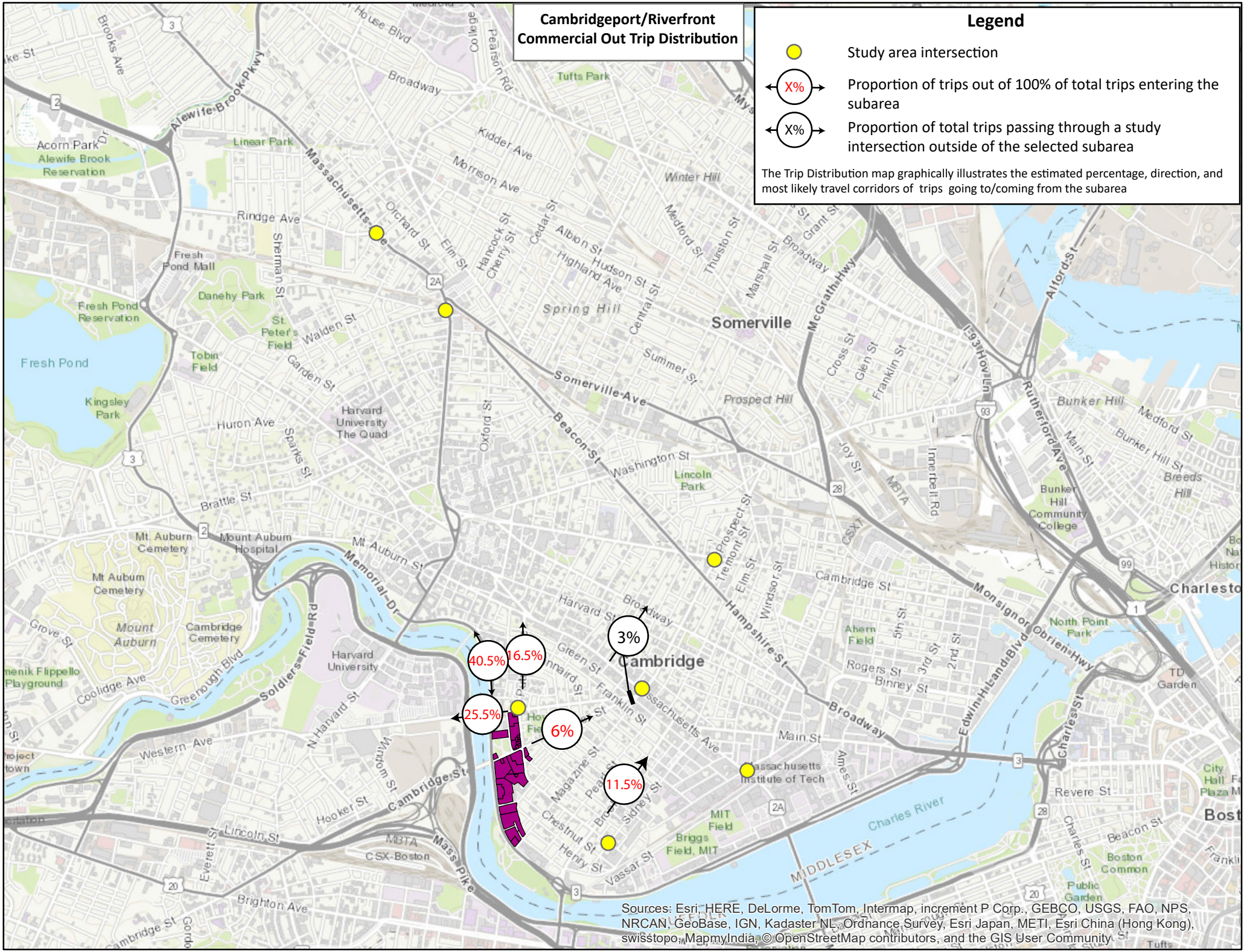


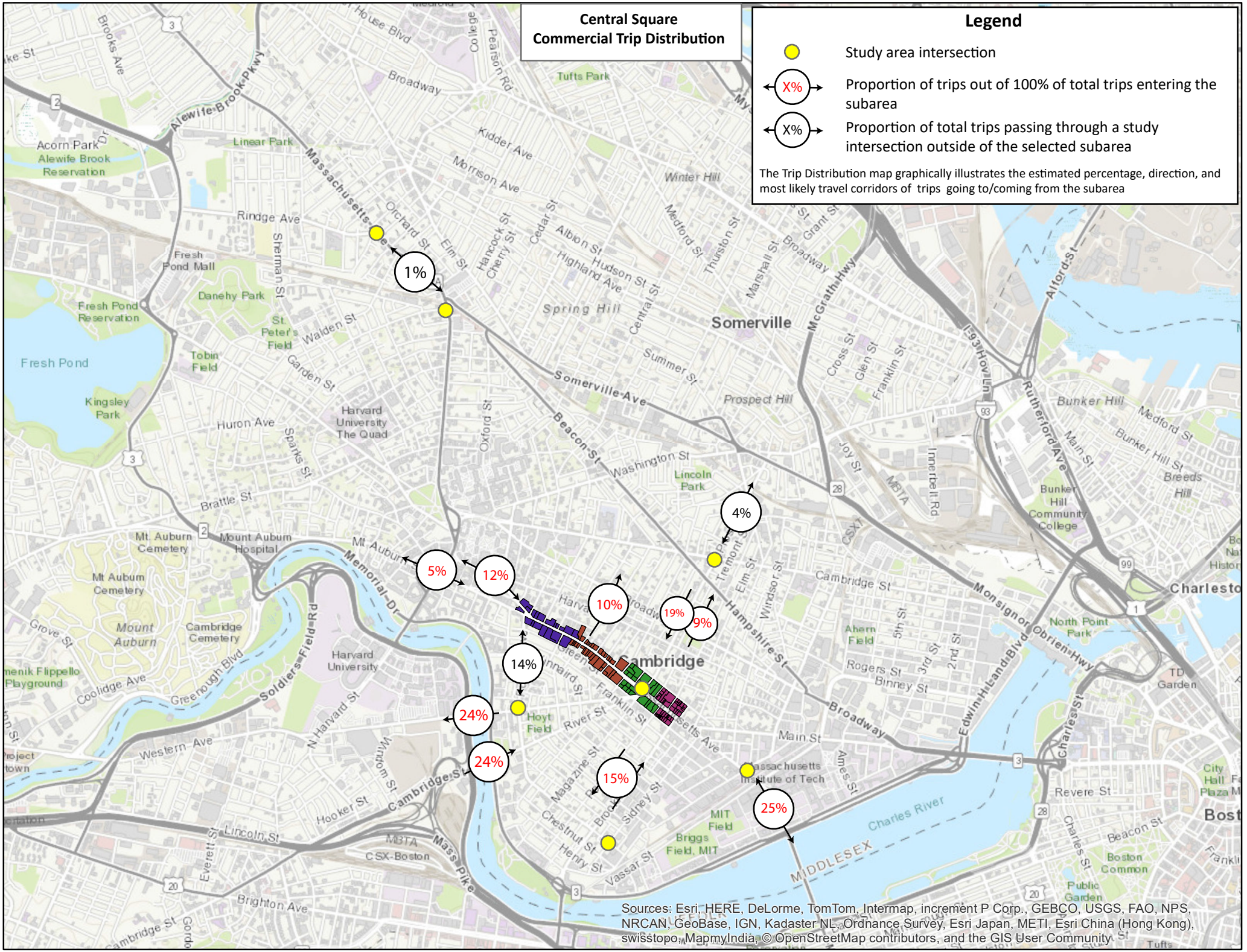
Trip distribution for Alewife subarea compiled based on subarea trip distributions from Alewife Critical Sums Analysis, December 2017

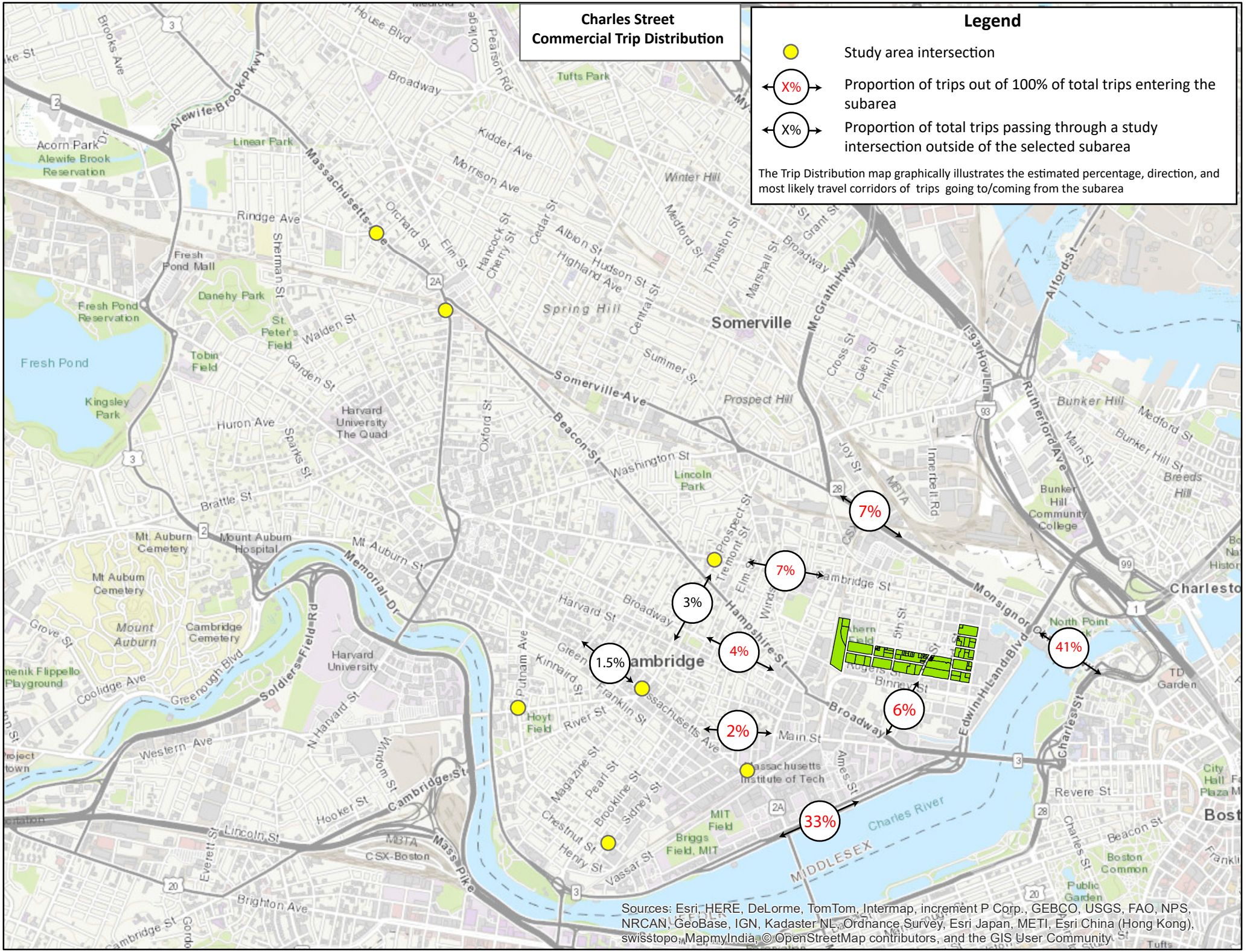

Cambridgeport/MIT
Commercial In Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
11%
6%
20%
17%
30.5%
30.5%
2%
Albany St
Brookline St
Somerville
Cambridge
Charlestown
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

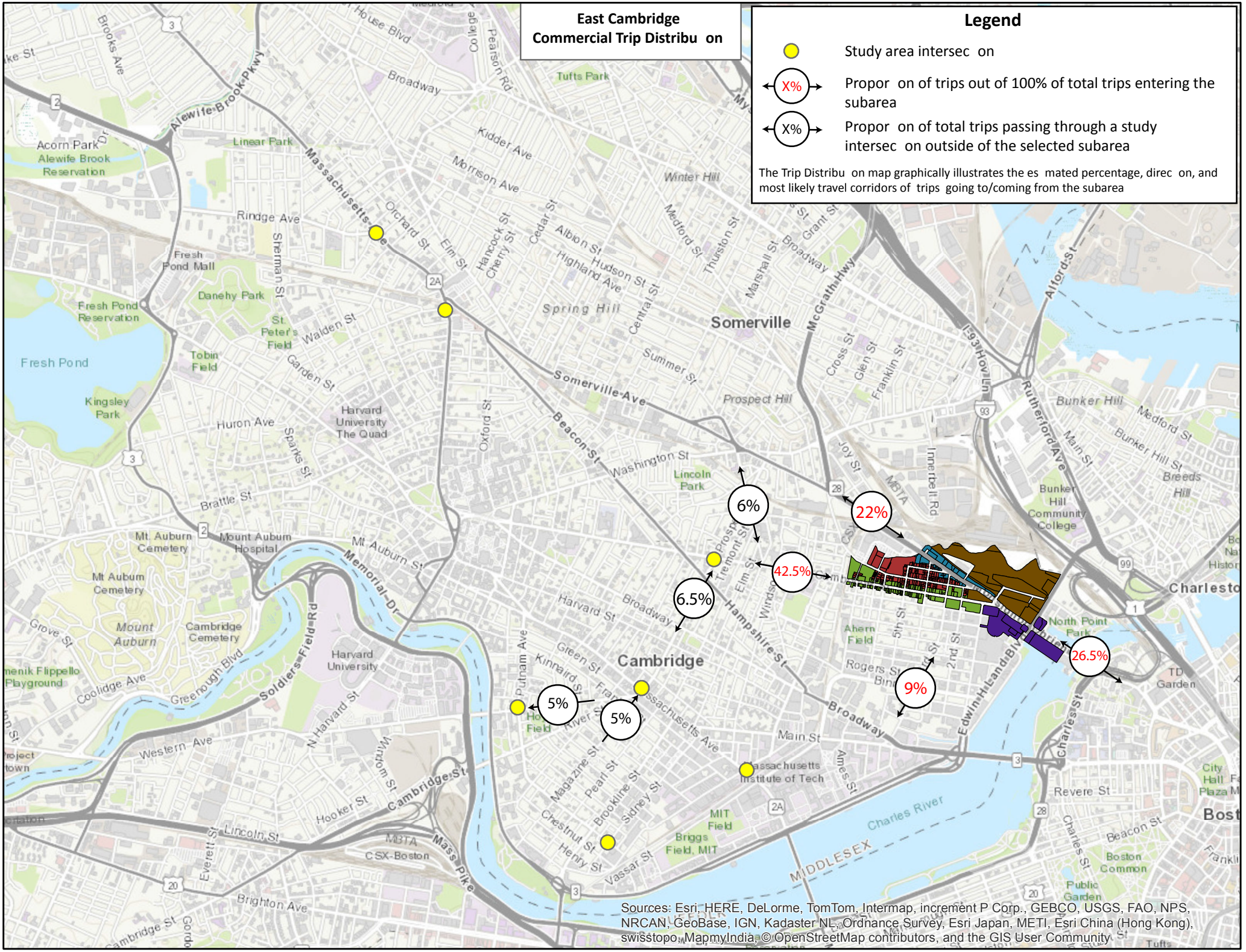

Cambridgeport/MIT
Commercial Out Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
10%
6%
30.5%
21.5%
Albany St
44%
Sidney St
4%
Somerville
Cambridge
Charlestown
Fresh Pond
Fresh Pond Reservation
Alewife Brook Reservation
Mount Auburn
Harvard University
MIT
Charles River
MIDDLESEX
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

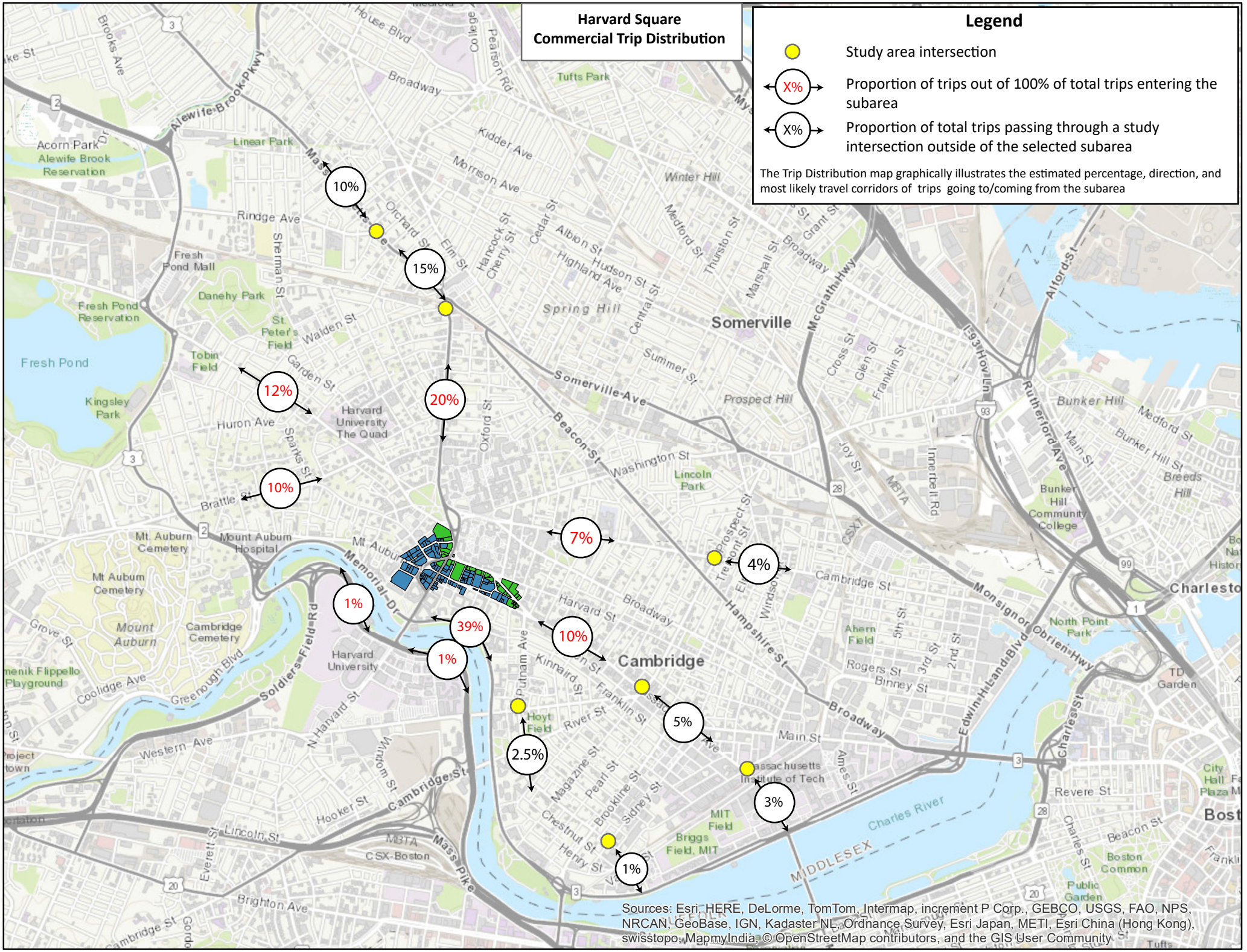

Cambridgeport/Riverfront
Commercial In Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
16.5%
40.5%
3%
6%
25.5%
11.5%
Somerville
Cambridge
Charlestown
Fresh Pond
Alewife Brook Reservation
Fresh Pond Reservation
Danehy Park
Tufts Park
Linear Park
Acorn Park
Spring Hill
Winter Hill
Prospect Hill
Lincoln Park
Harvard University
The Quad
Mount Auburn Cemetery
Mt Auburn Cemetery
Cambridge Cemetery
Hoyt Field
Ahern Field
MIT Field
Briggs Field, MIT
Massachusetts Institute of Tech
North Point Park
TD Garden
Bunker Hill Community College
Public Garden
Boston Common
City Hall Plaza
Charles River
MIDDLESEX
Alewife Brook Pkwy
Massachusetts Ave
Somerville Ave
Beacon St
Broadway
Hampshire St
Memorial Dr
Soldiers Field Rd
Mass Pike
MBTA
CSX-Boston
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

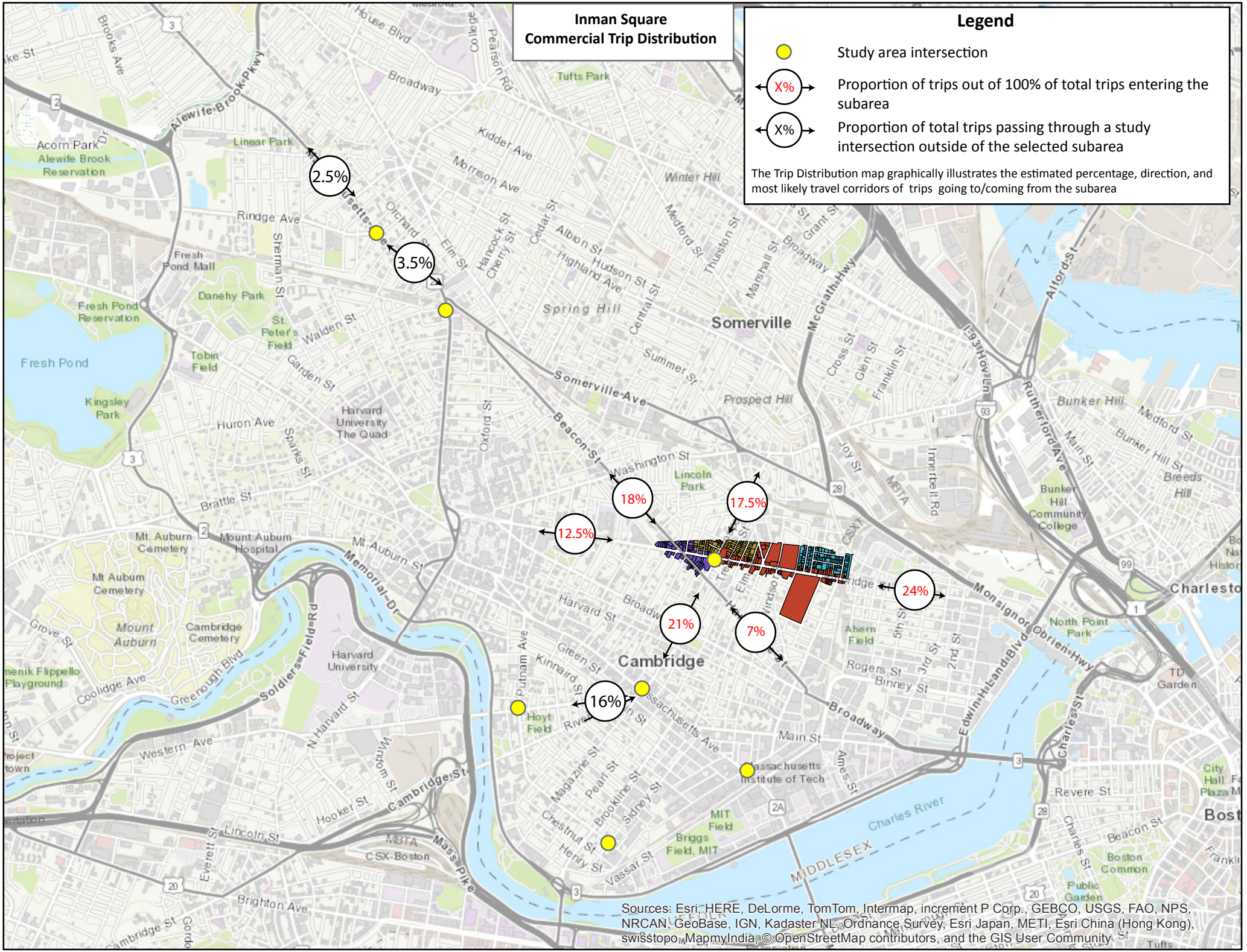

Cambridgeport/Riverfront
Commercial Out Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
40.5%
16.5%
3%
25.5%
6%
11.5%
Cambridge
Somerville
Charlestown
Fresh Pond
Harvard University
Mount Auburn Cemetery
Massachusetts Institute of Technology
Charles River
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

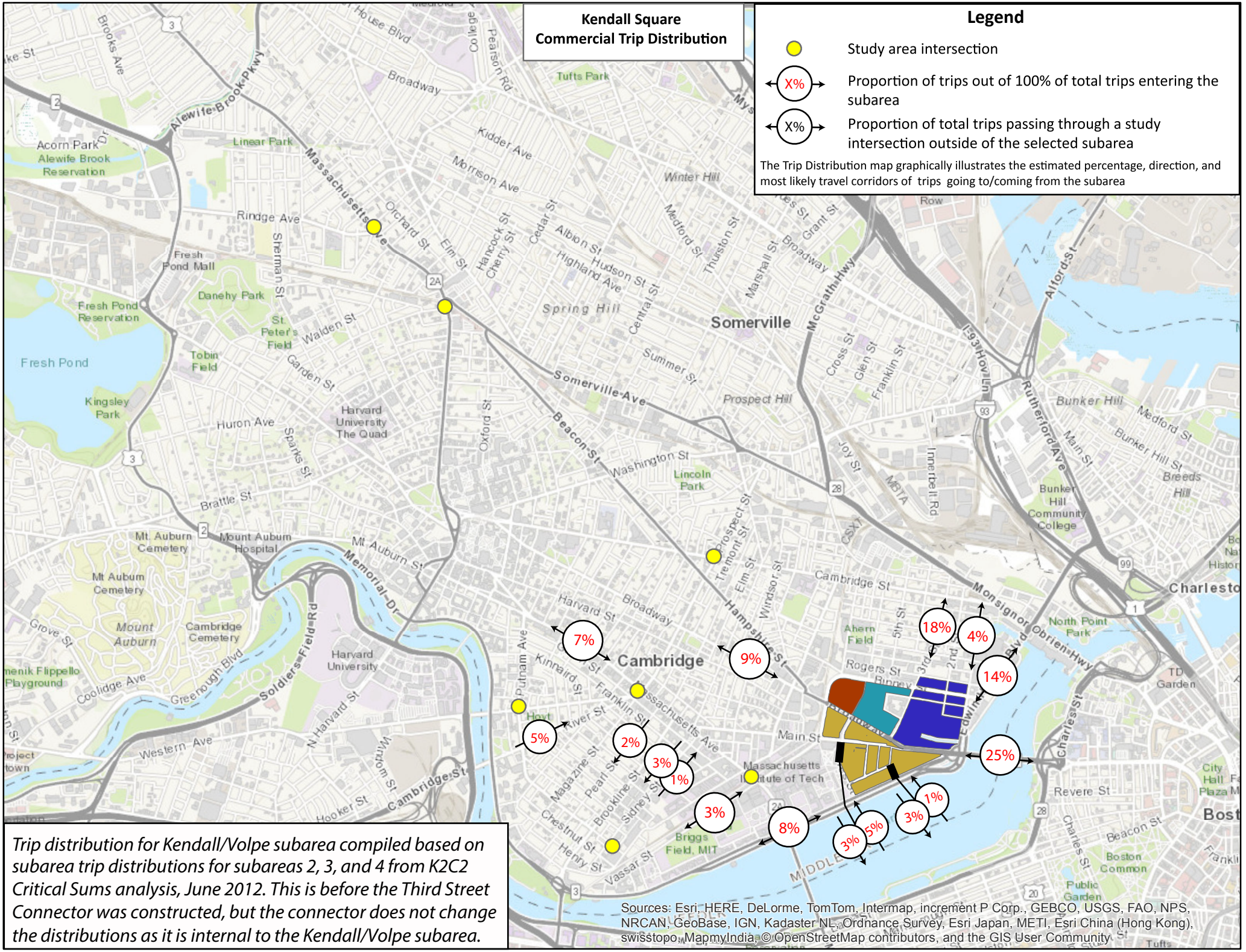

Central Square
Commercial Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
1%
4%
5%
12%
10%
19%
9%
14%
24%
24%
15%
25%
Somerville
Cambridge
Fresh Pond
Harvard University
Mount Auburn Cemetery
Lincoln Park
Tufts Park
Winter Hill
Spring Hill
Prospect Hill
Bunker Hill
Charles River
MIDDLESEX
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


Charles Street
Commercial Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
7%
7%
3%
4%
1.5%
2%
6%
41%
33%
Somerville
Cambridge
Charlesto
Bost
Alewife Brook Pkwy
Massachusetts Ave
Somerville Ave
Beacon St
Broadway
Hampshire St
Memorial Dr
Cambridge St
Western Ave
Soldiers Field Rd
McGrath Hwy
Rutherford Ave
Monsignor O'Brien Hwy
Edwin H Land Blvd
Charles River
MIDDLESEX
Fresh Pond
Fresh Pond Mall
Danehy Park
Fresh Pond Reservation
Acorn Park
Alewife Brook Reservation
Linear Park
Tufts Park
Winter Hill
Spring Hill
Prospect Hill
Lincoln Park
Harvard University
The Quad
Mount Auburn Hospital
Mt. Auburn Cemetery
Mt Auburn Cemetery
Mount Auburn
Cambridge Cemetery
Harvard University
Hoyt Field
Massachusetts Institute of Tech
MIT Field
Briggs Field, MIT
Bunker Hill
Bunker Hill Community College
North Point
TD Garden
Boston Common
Public Garden
City Hall Plaza
Revere St
Beacon St
Main St
Broadway
Harvard St
Mass Pike
MBTA
CSX-Boston
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


East Cambridge
Commercial Trip Distribu on
Legend
Study area intersec on
X%
Propor on of trips out of 100% of total trips entering the subarea
X%
Propor on of total trips passing through a study intersec on outside of the selected subarea
The Trip Distribu on map graphically illustrates the es mated percentage, direc on, and most likely travel corridors of trips going to/coming from the subarea
6%
22%
42.5%
6.5%
26.5%
9%
5%
5%
Somerville
Cambridge
Charleston
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

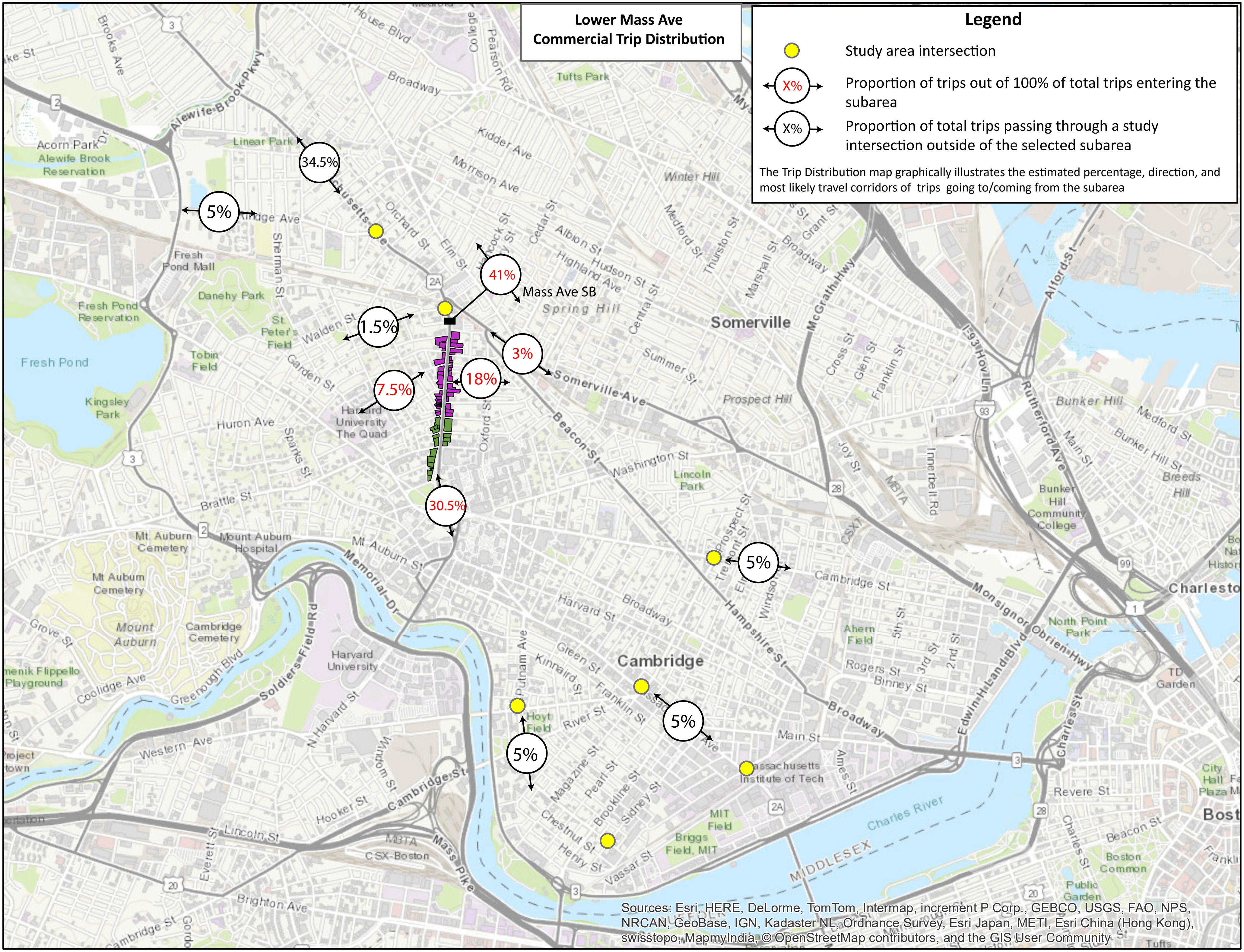

Harvard Square
Commercial Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
10%
15%
12%
20%
10%
7%
4%
1%
39%
1%
10%
5%
2.5%
3%
1%
Somerville
Cambridge
Harvard University
Mount Auburn Cemetery
Fresh Pond
Fresh Pond Reservation
Alewife Brook Reservation
Tufts Park
Lincoln Park
Bunker Hill Community College
Charles River
MIDDLESEX
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

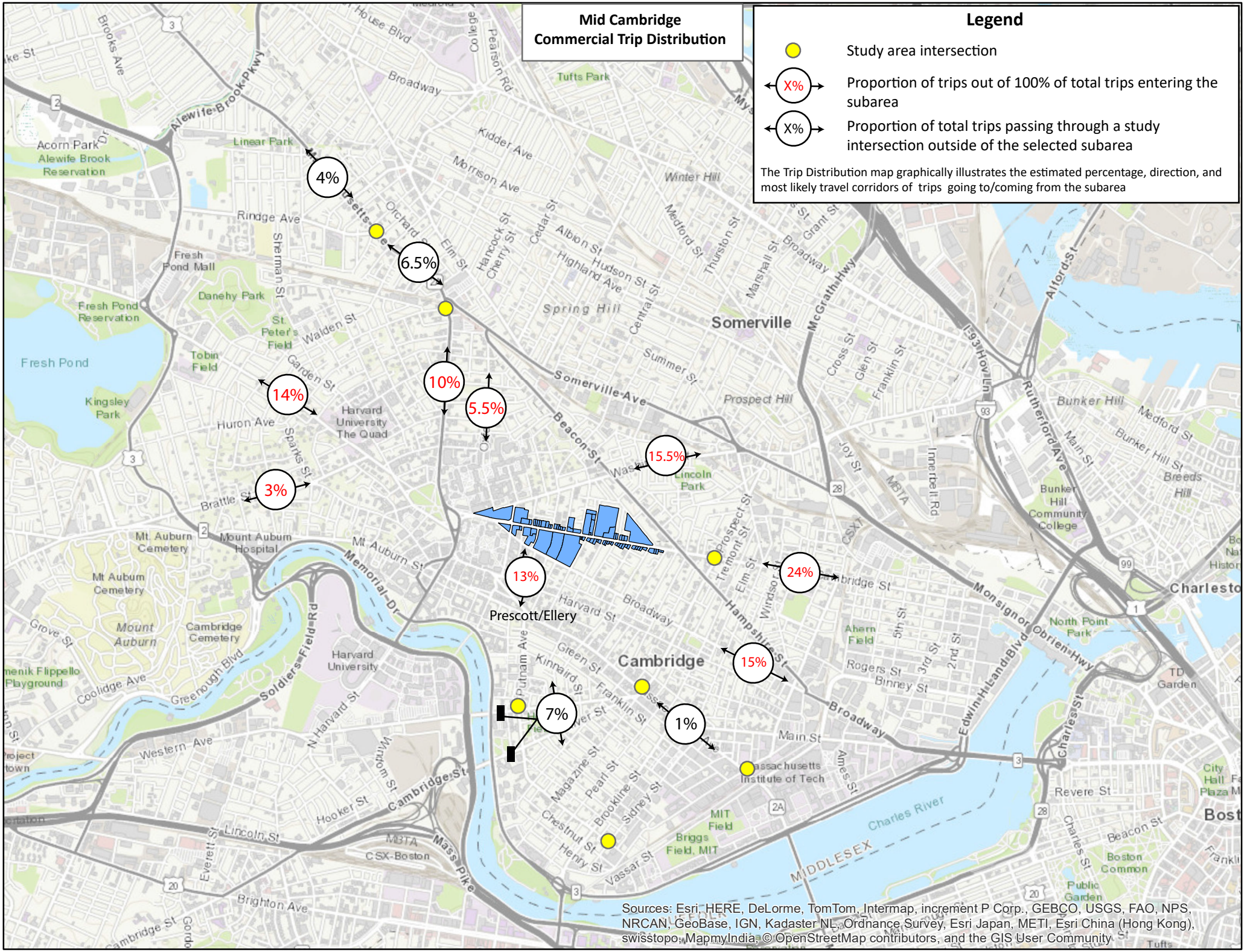

Inman Square
Commercial Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
2.5%
3.5%
18%
17.5%
12.5%
24%
21%
7%
16%
Somerville
Cambridge
Charlesto
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

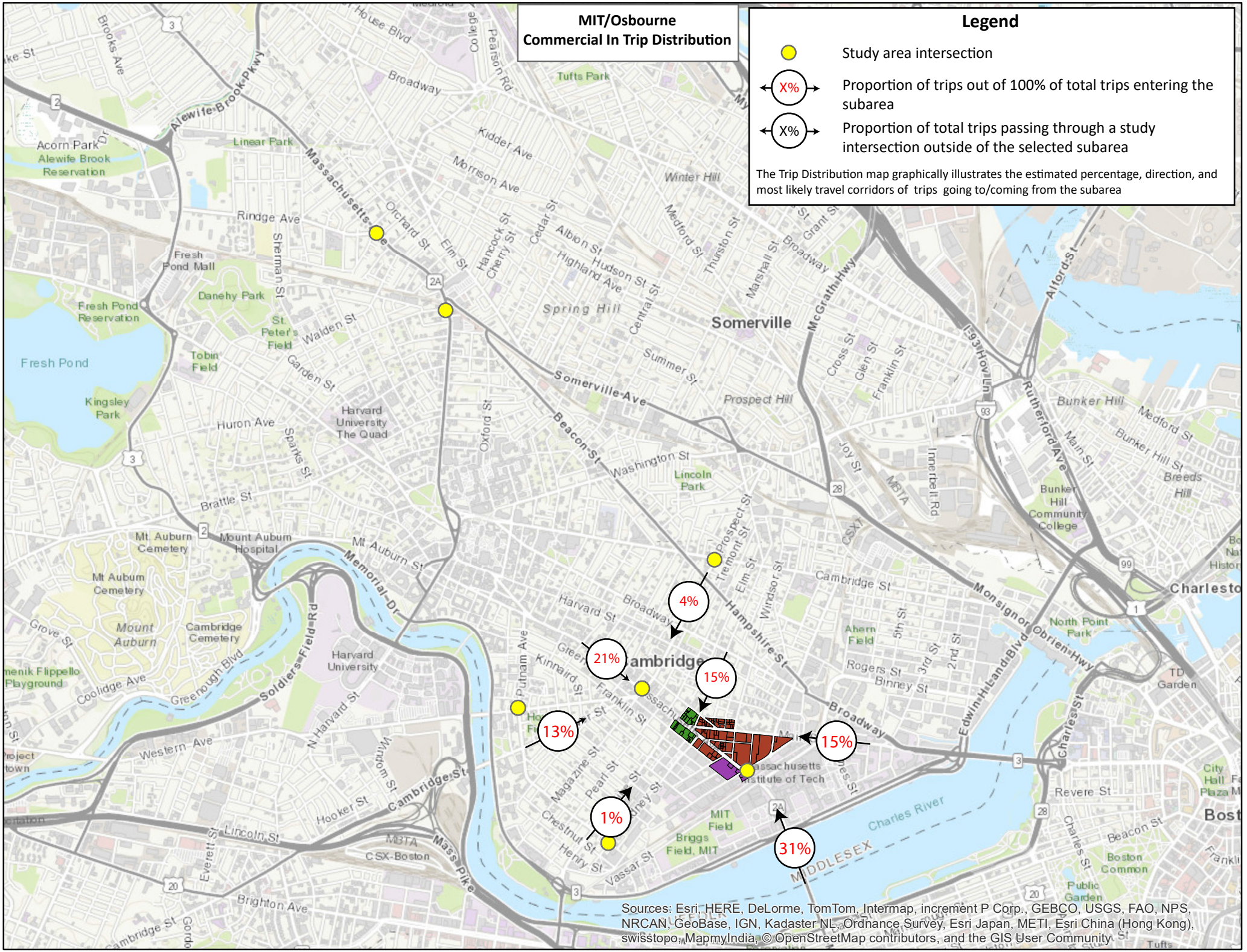


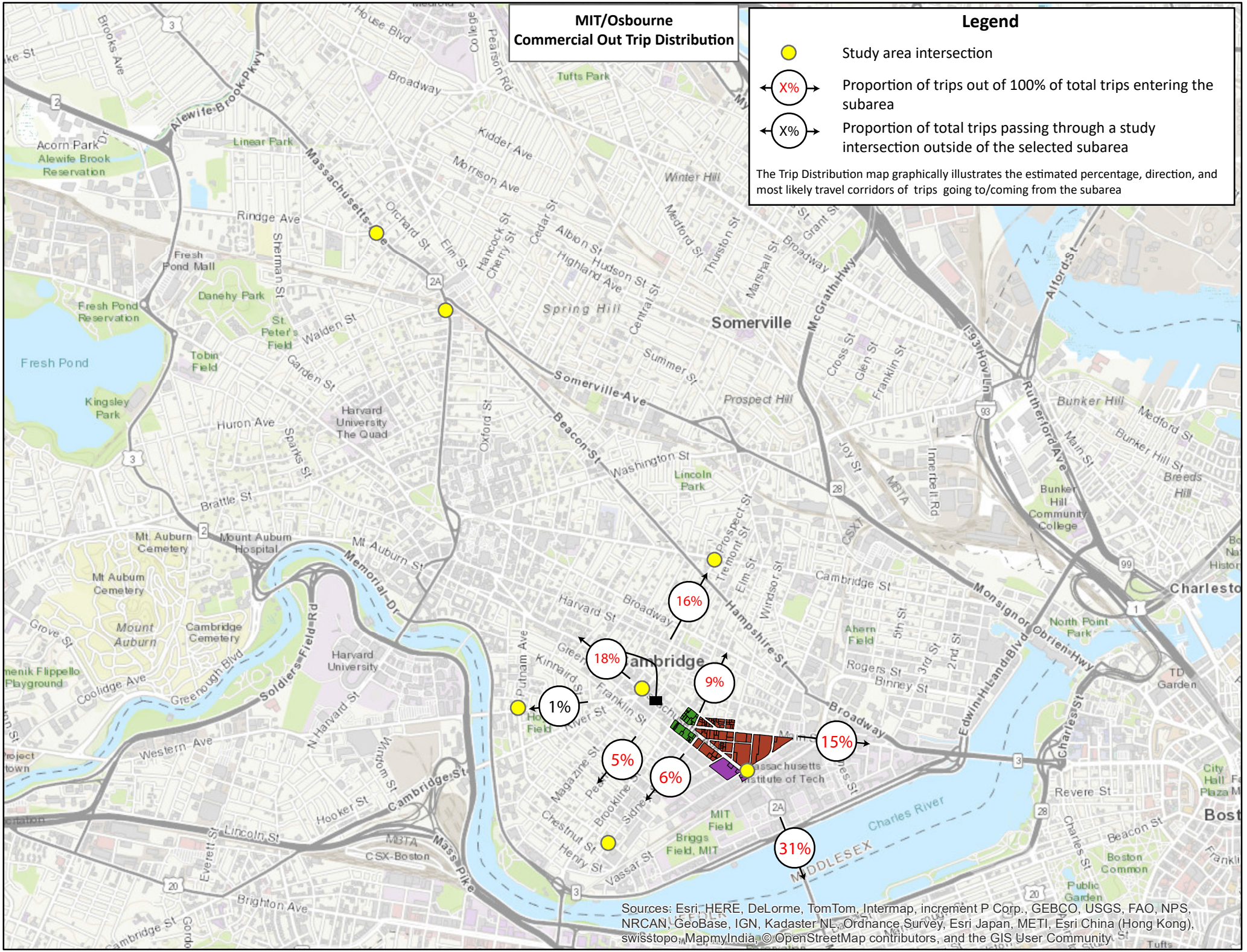
Trip distribution for Kendall/Volpe subarea compiled based on subarea trip distributions for subareas 2, 3, and 4 from K2C2 Critical Sums analysis, June 2012. This is before the Third Street Connector was constructed, but the connector does not change the distributions as it is internal to the Kendall/Volpe subarea.

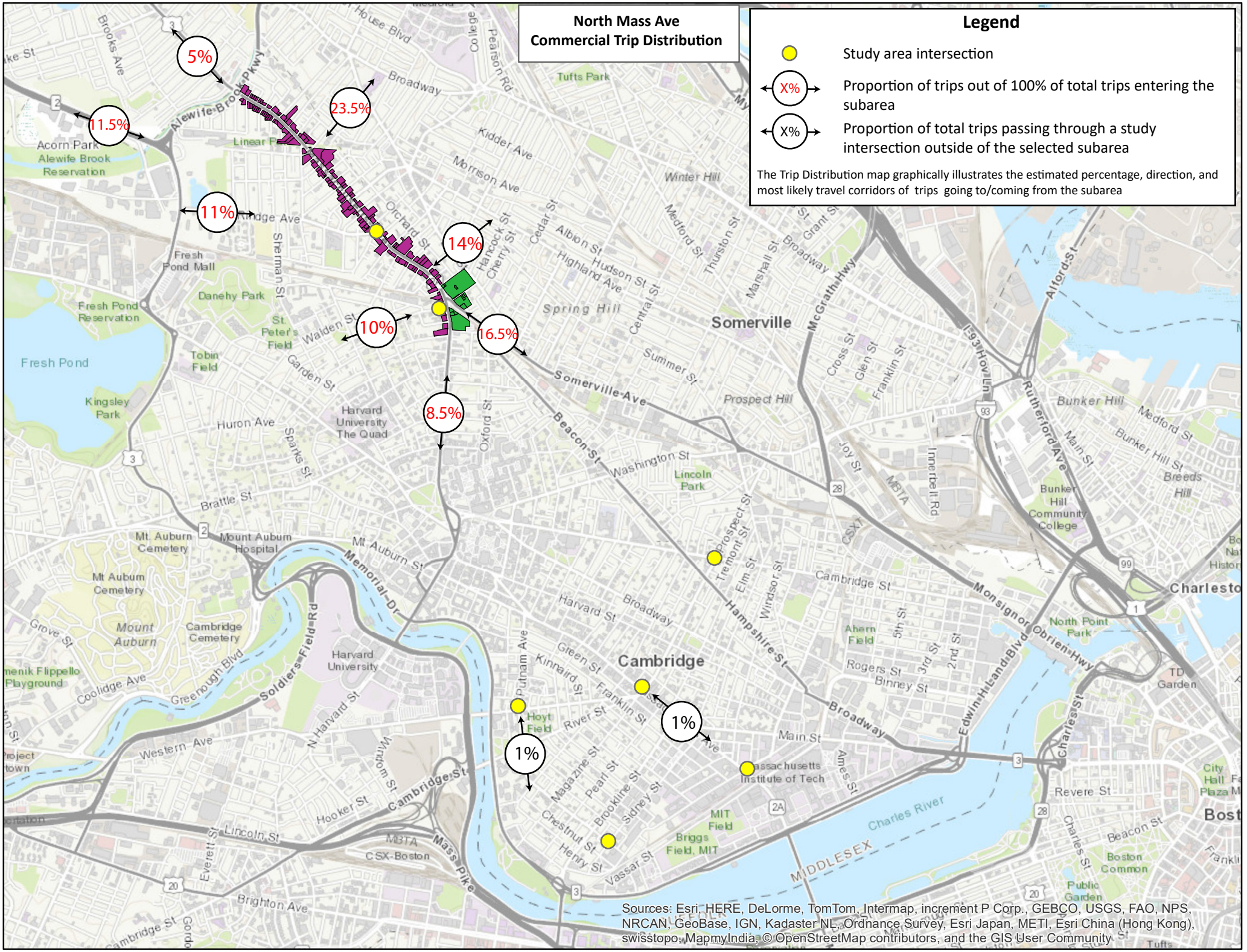
Attachment D



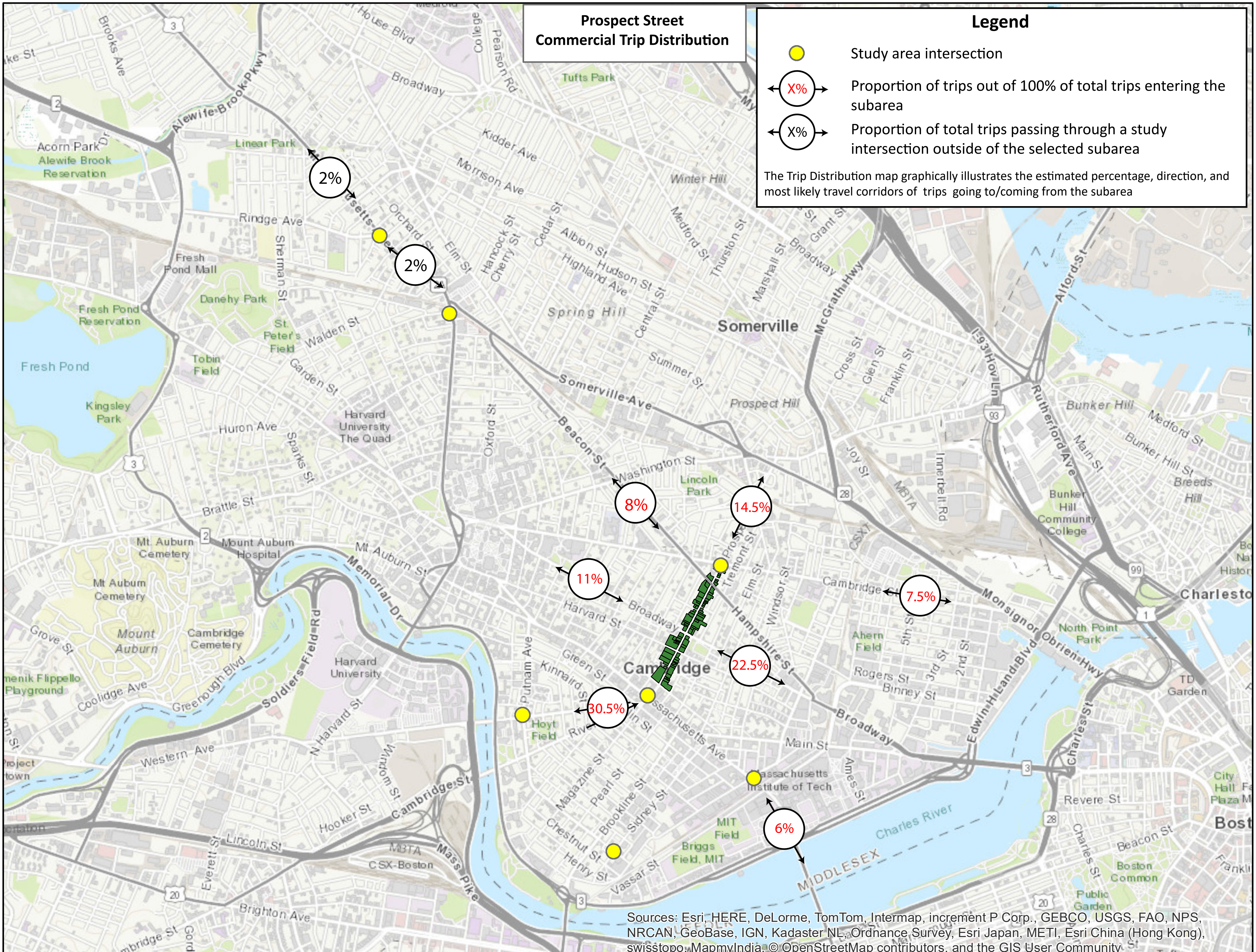

Mid Cambridge
Commercial Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
4%
6.5%
10%
5.5%
14%
3%
15.5%
13%
Prescott/Ellery
24%
15%
7%
1%
Somerville
Cambridge
Tufts Park
Winter Hill
Spring Hill
Prospect Hill
Lincoln Park
Harvard University
Mount Auburn Hospital
Mt. Auburn Cemetery
Cambridge Cemetery
Fresh Pond
Fresh Pond Reservation
Kingsley Park
Danehy Park
Fresh Pond Mall
Acorn Park
Alewife Brook Reservation
Linear Park
St Peter's Field
Tobin Field
Ahern Field
MIT Field
Briggs Field, MIT
Massachusetts Institute of Tech
Bunker Hill Community College
North Point Park
TD Garden
Boston Common
Public Garden
Charles River
MIDDLESEX
Alewife Brook Pkwy
Somerville Ave
Broadway
Beacon St
Hampshire St
Memorial Dr
Soldiers Field Rd
Cambridge St
Mass Pike
Western Ave
Harvard St
Main St
Massachusetts Ave
Charles St
Revere St
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

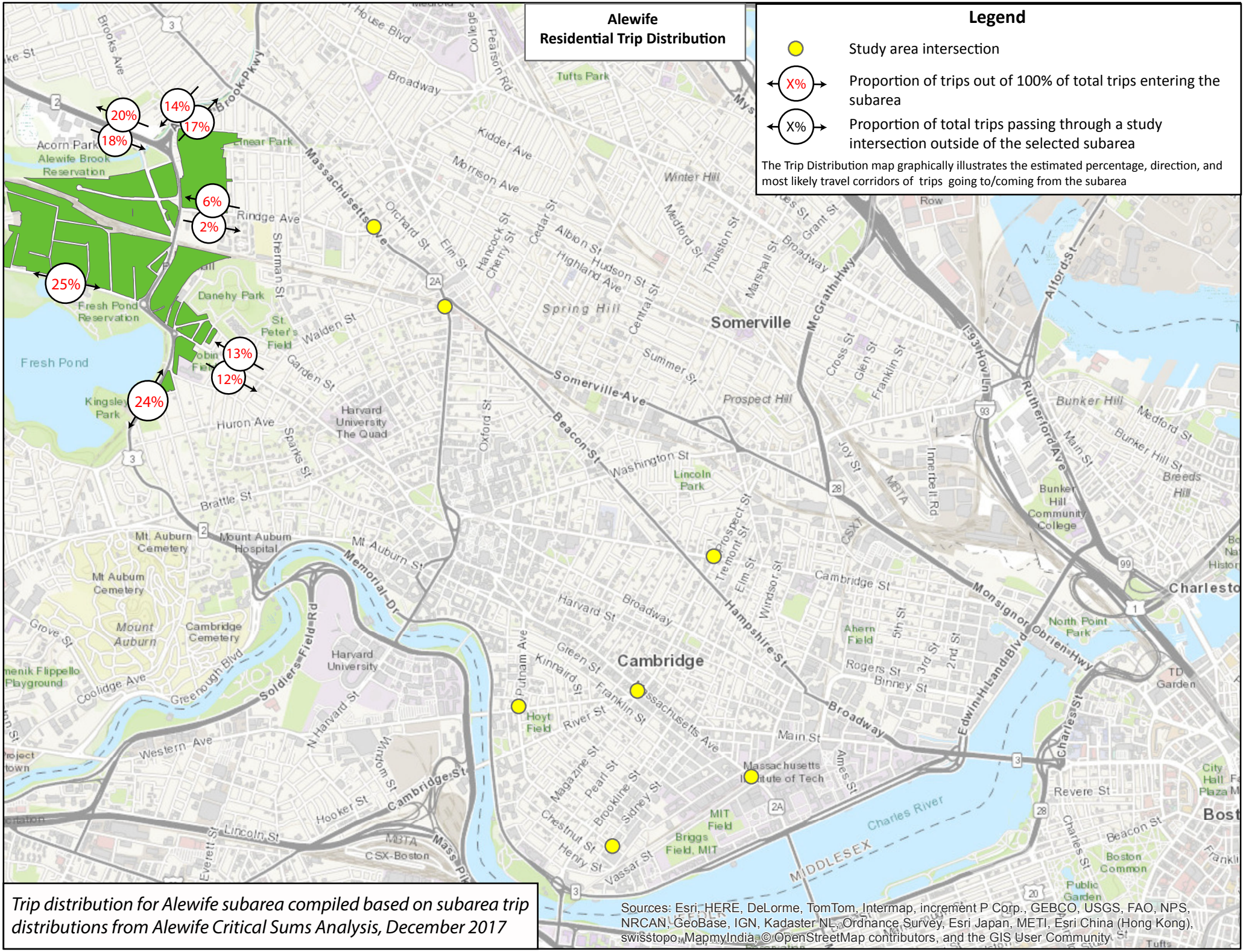

MIT/Osbourne
Commercial In Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
4%
21%
15%
13%
15%
1%
31%
Somerville
Cambridge
Massachusetts Institute of Tech
Harvard University
Charles River
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


MIT/Osbourne
Commercial Out Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
16%
18%
9%
1%
15%
5%
6%
31%
Somerville
Cambridge
Charlestown
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


North Mass Ave
Commercial Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
5%
11.5%
23.5%
11%
14%
10%
16.5%
8.5%
1%
1%
Somerville
Cambridge
Alewife Brook Pkwy
Somerville Ave
Beacon St
Broadway
Hampshire St
Memorial Dr
Soldiers Field Rd
Mass Pike
Charles River
MIDDLESEX
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Attachment D

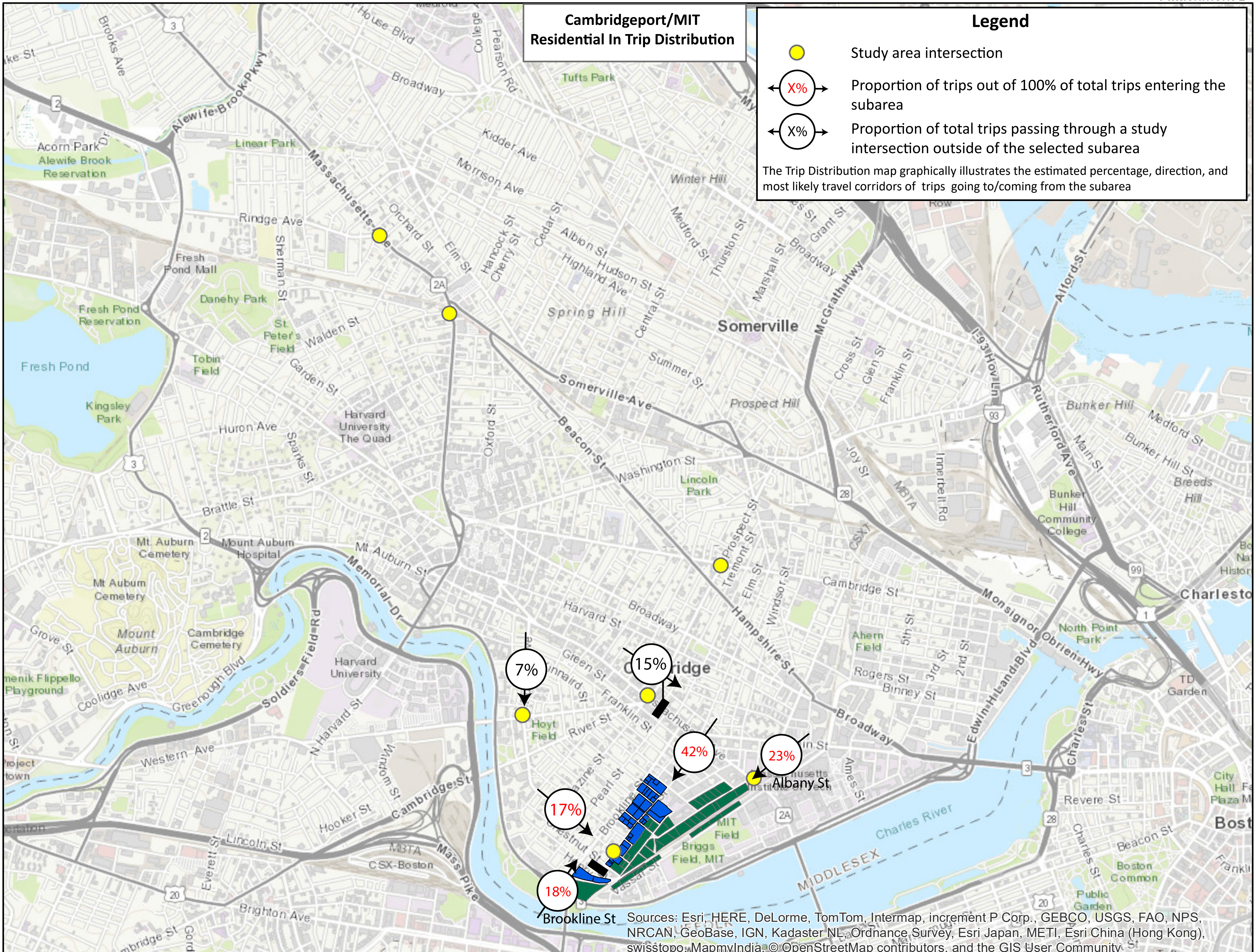




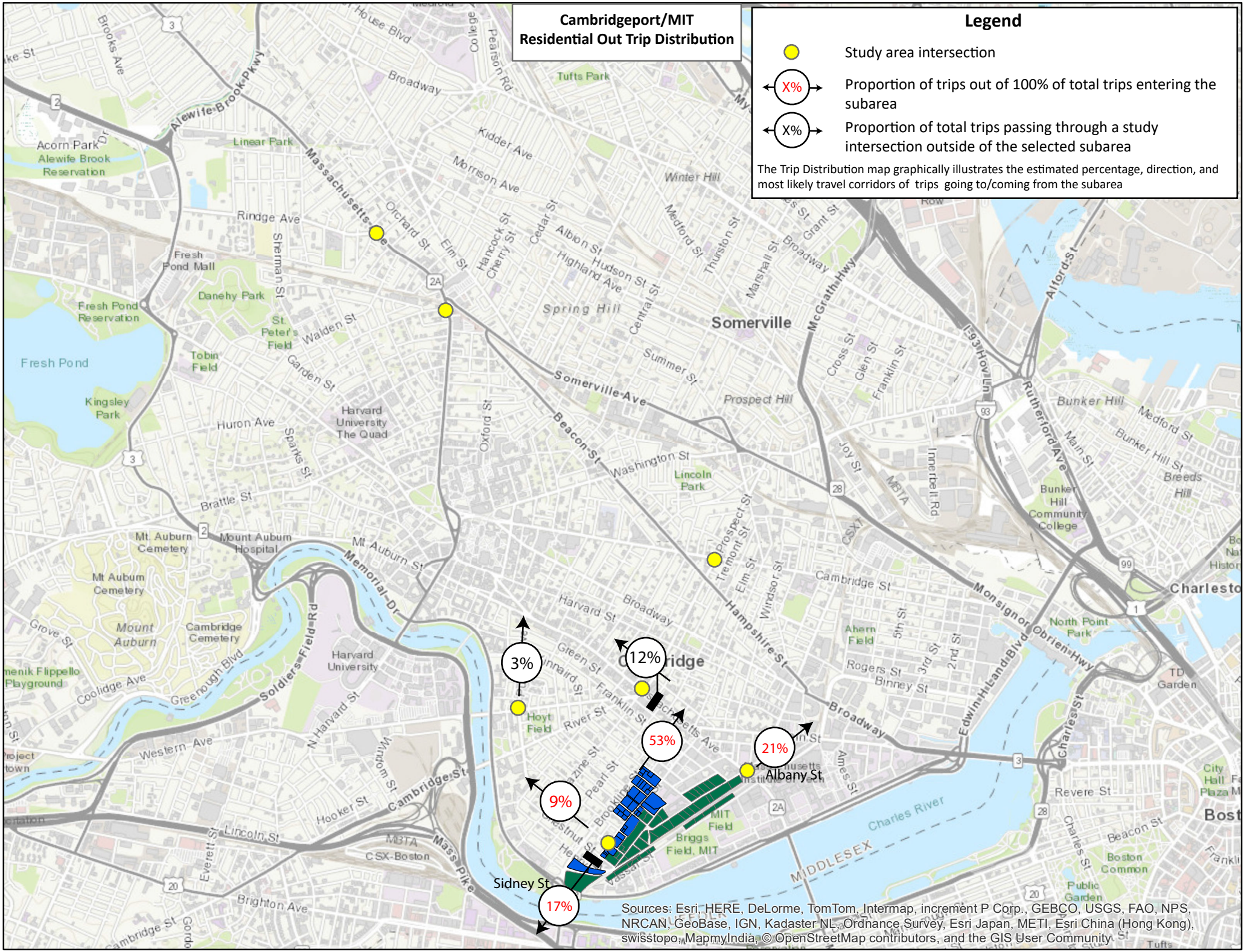
Trip distribution for Alewife subarea compiled based on subarea trip distributions from Alewife Critical Sums Analysis, December 2017

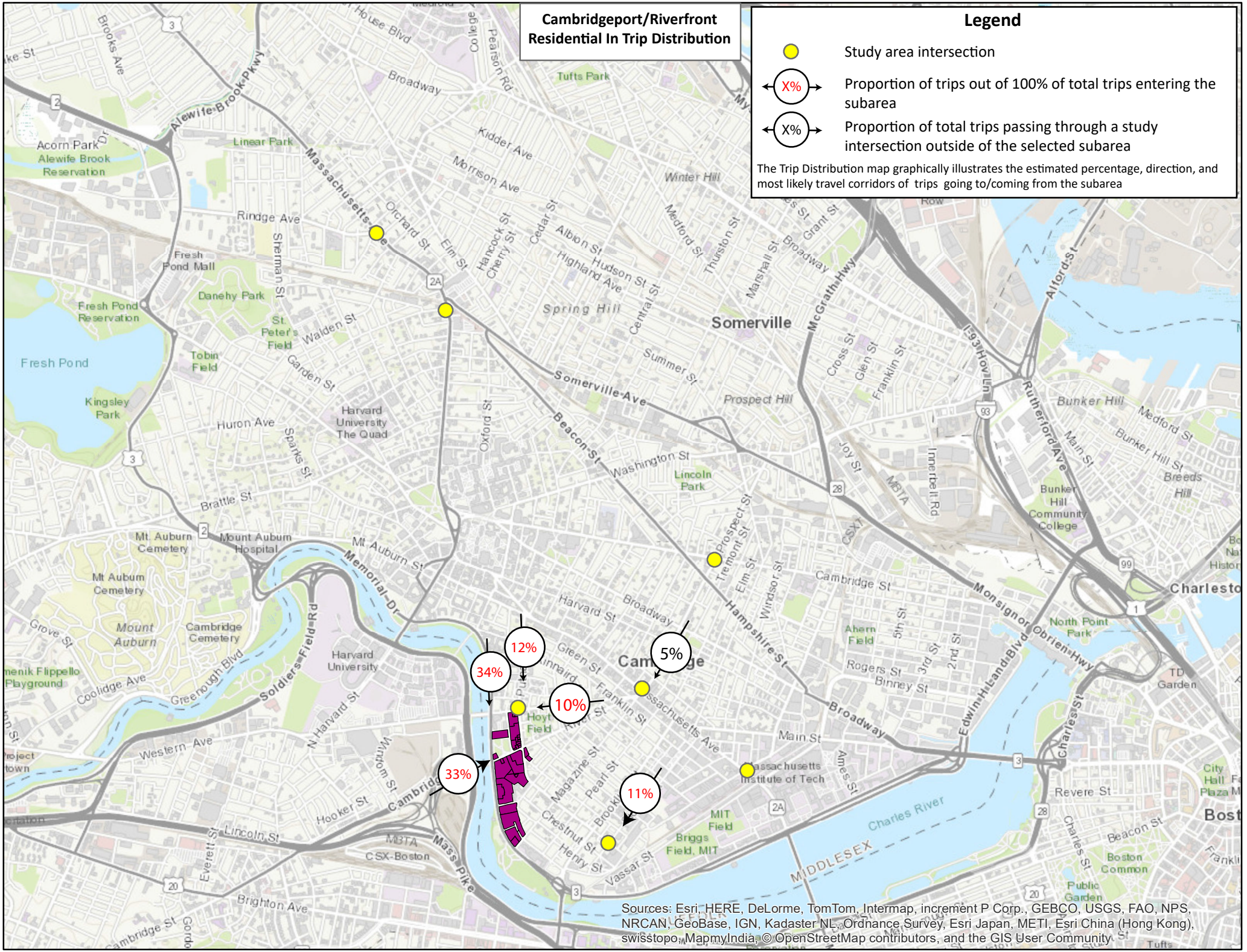
Attachment D

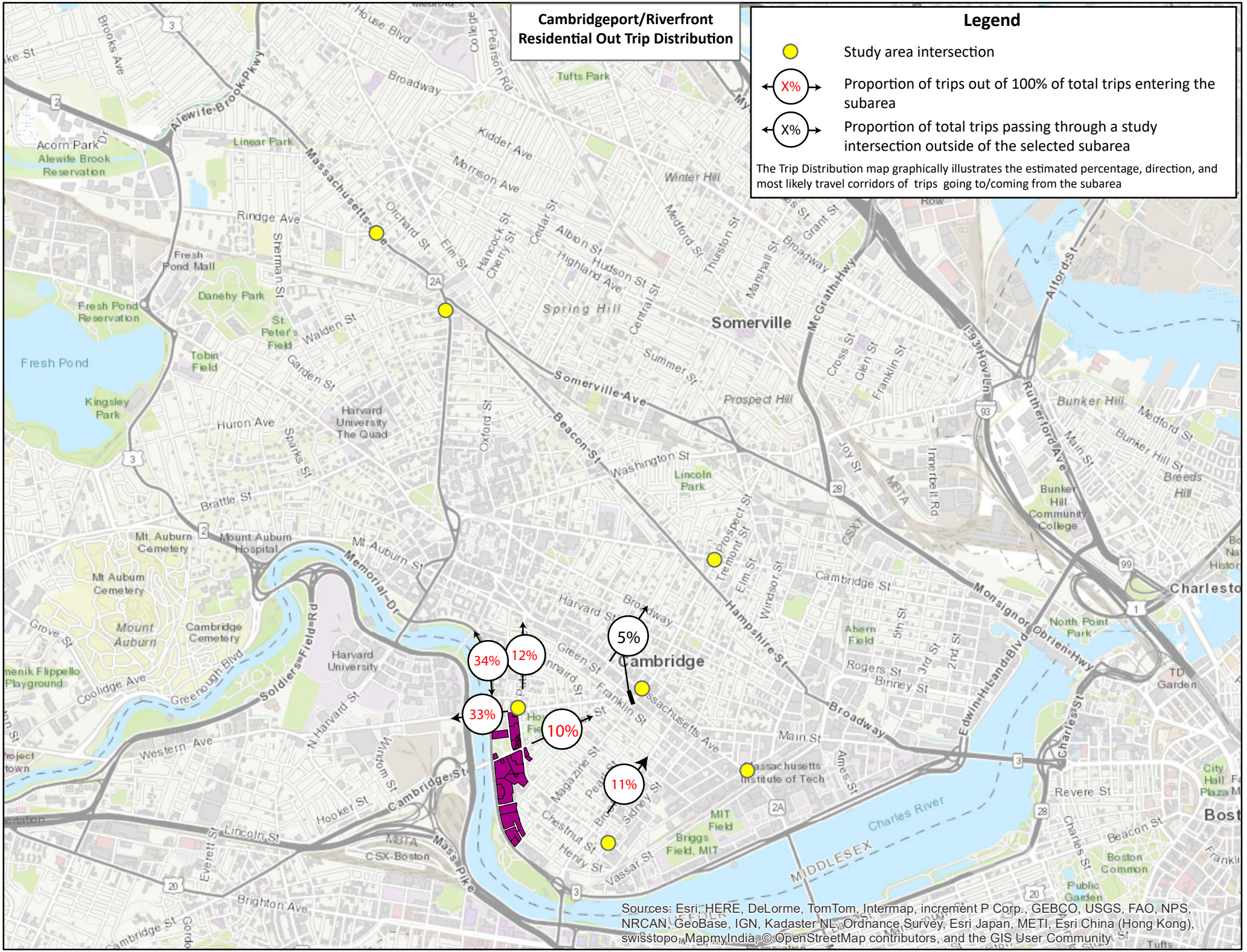
Cambridgeport/MIT Residential In Trip Distribution

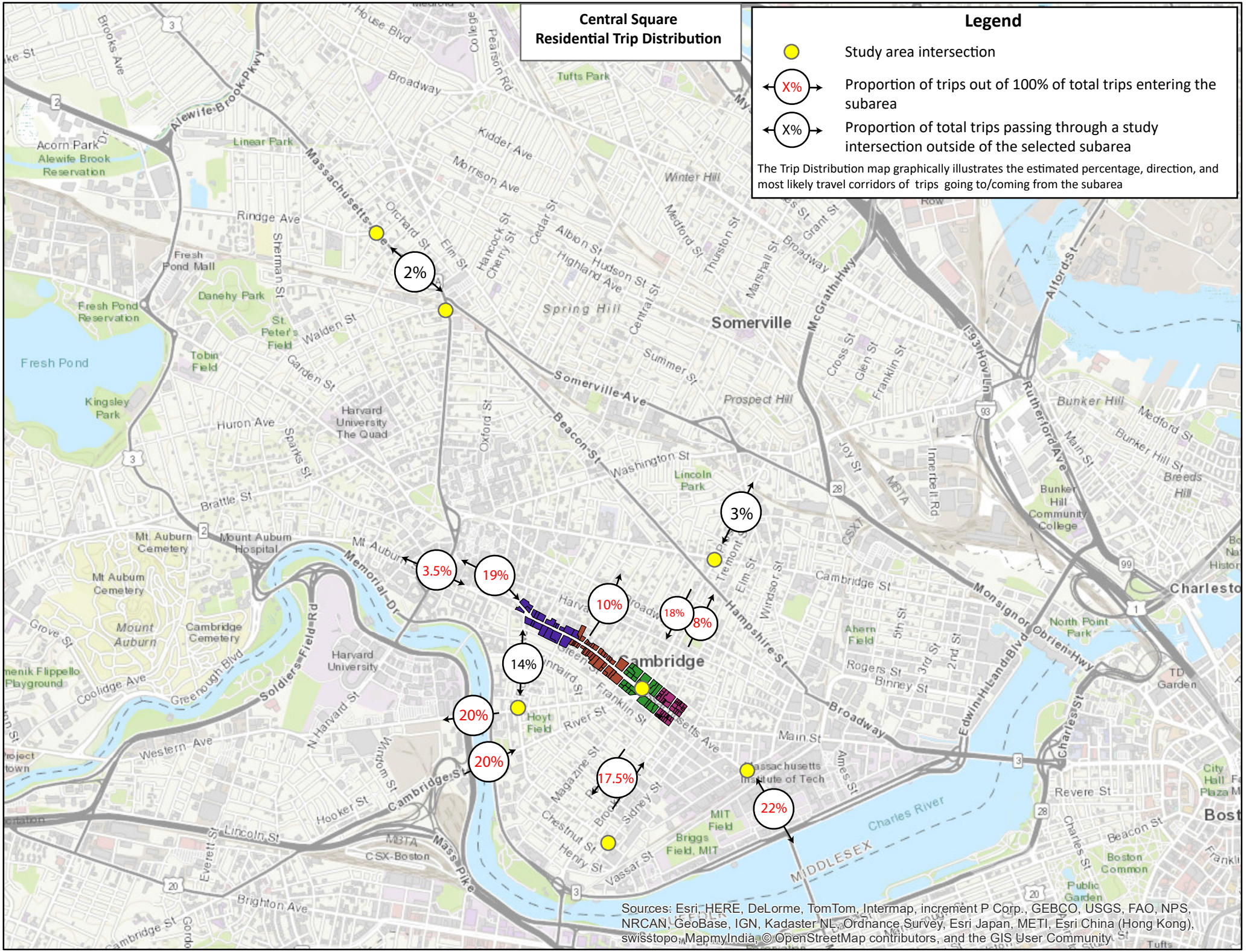

Legend
Study area intersection
X% Proportion of trips out of 100% of total trips entering the subarea
X% Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
7%
15%
42%
23%
17%
18%
Albany St
Brookline St
Somerville
Cambridge
Fresh Pond
Charles River
Massachusetts Ave
Somerville Ave
Beacon St
Hampshire St
Broadway
Cambridge St
Memorial Dr
Mass Pike
Monsignor O'Brien Hwy
Alewife Brook Pkwy
Brattle St
Mt Auburn St
Harvard University
Briggs Field, MIT
MIT Field
Boston Common
Public Garden
Bunker Hill
Prospect Hill
Spring Hill
Winter Hill
Charlestown

Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

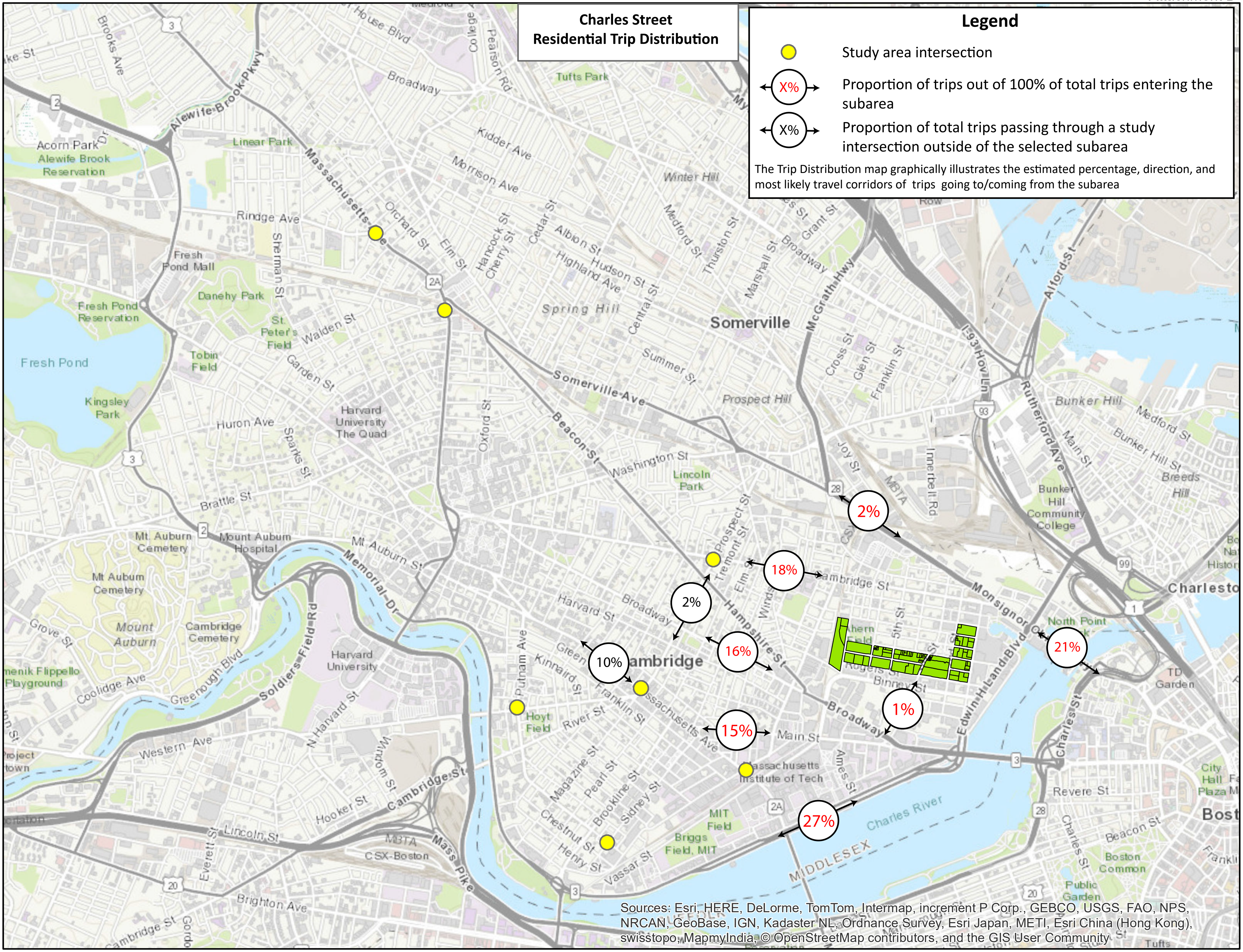

Cambridgeport/MIT
Residential Out Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
3%
12%
53%
21%
9%
17%
Albany St
Sidney St
Somerville
Cambridge
Charlestown
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

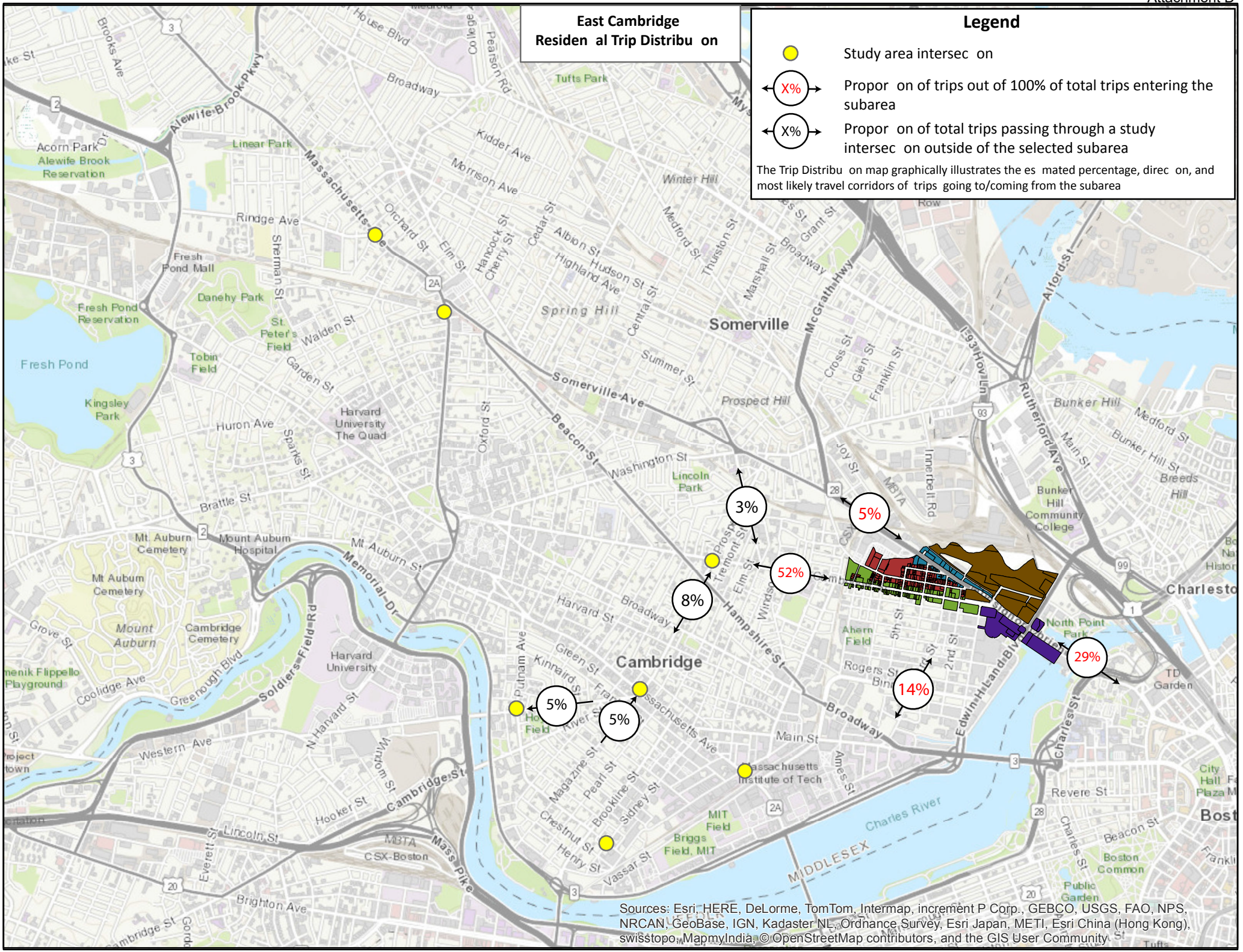

Cambridgeport/Riverfront Residential In Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
12%
34%
5%
10%
33%
11%
Somerville
Cambridge
Charlestown
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

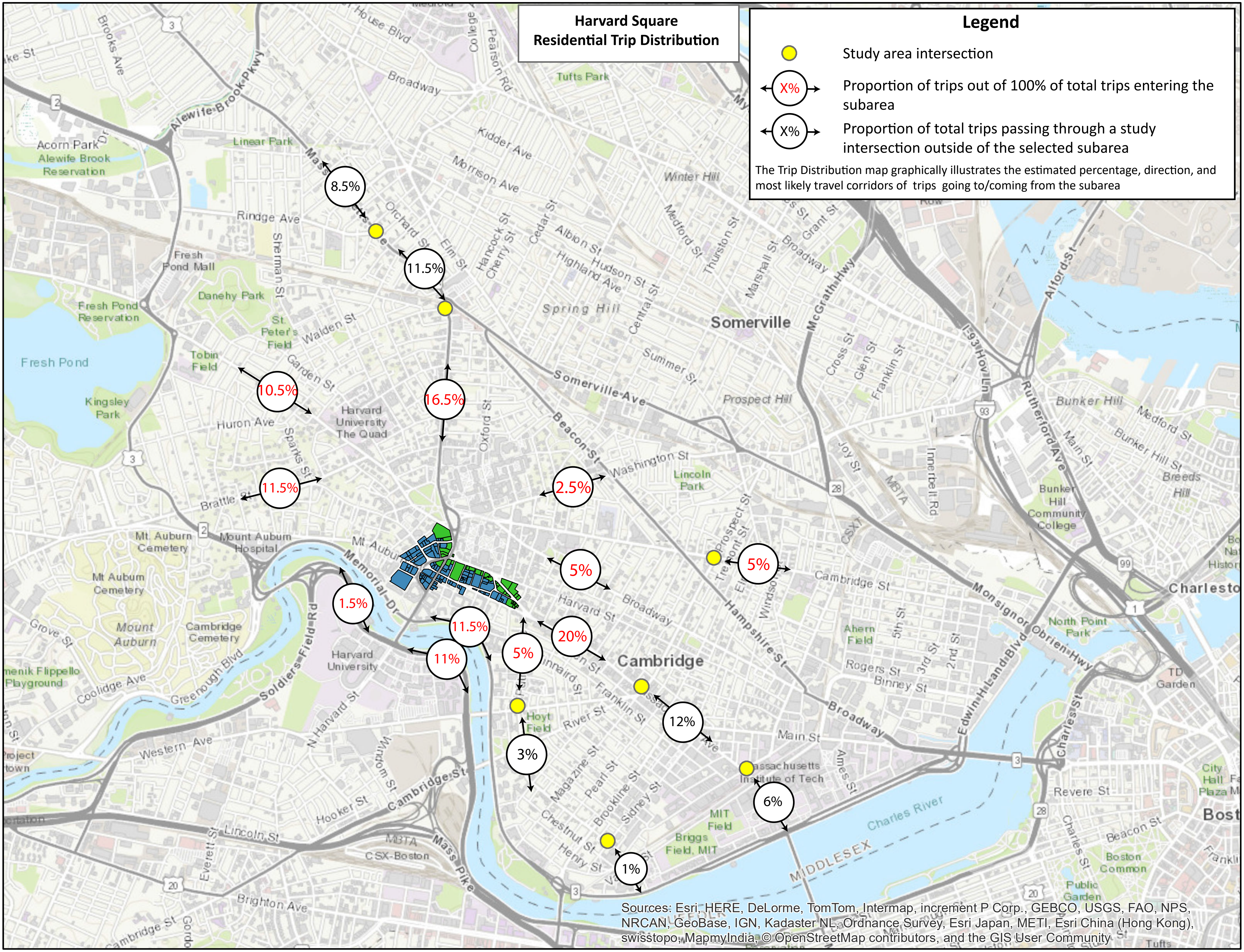

Cambridgeport/Riverfront
Residential Out Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
34%
12%
33%
10%
5%
11%
Cambridge
Somerville
Fresh Pond
Harvard University
Mt. Auburn Cemetery
Mount Auburn Hospital
Massachusetts Institute of Tech
Charles River
MIDDLESEX
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

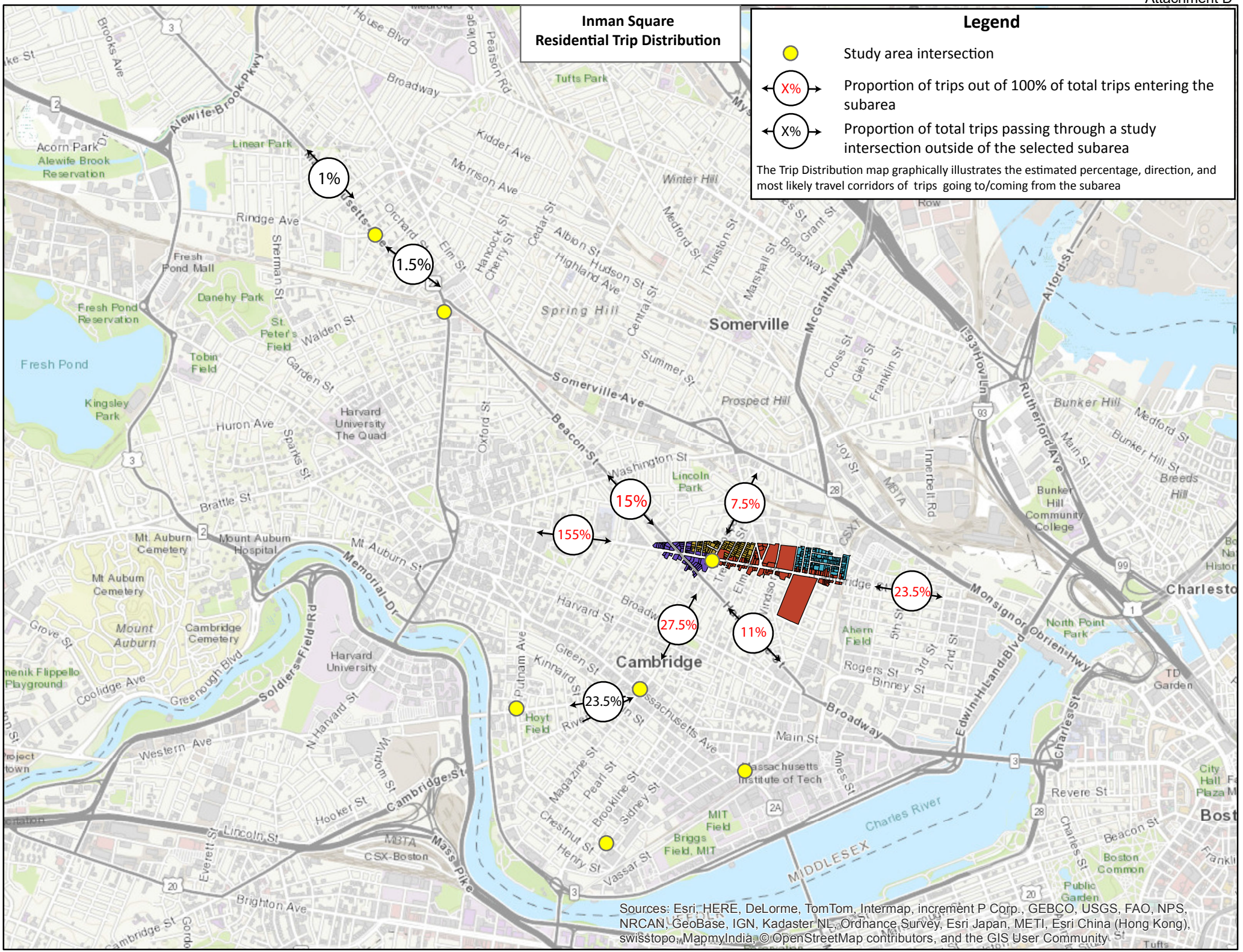

Central Square
Residential Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
2%
3%
3.5%
19%
10%
18%
8%
14%
20%
20%
17.5%
22%
Somerville
Cambridge
Charlestown
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

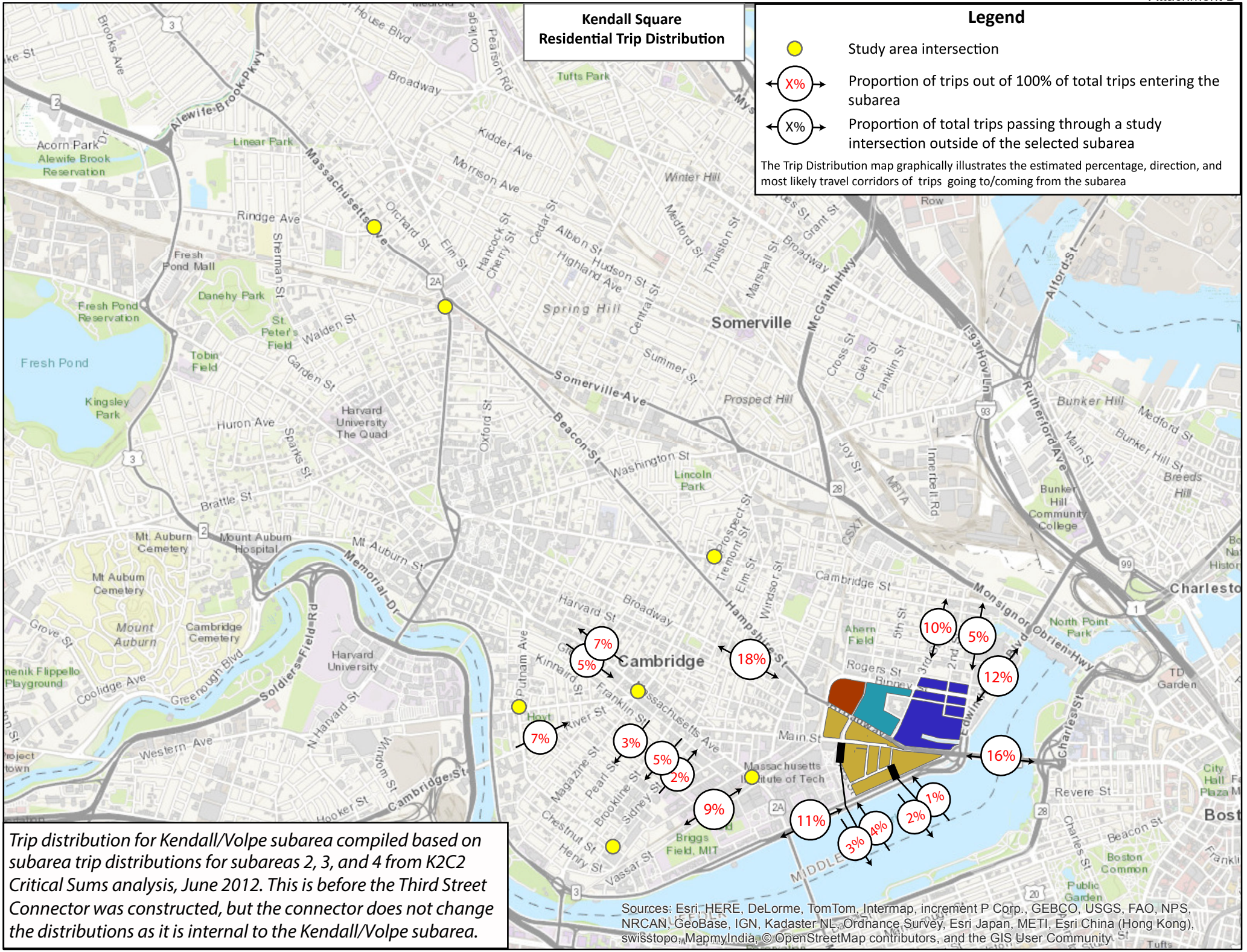
Attachment D



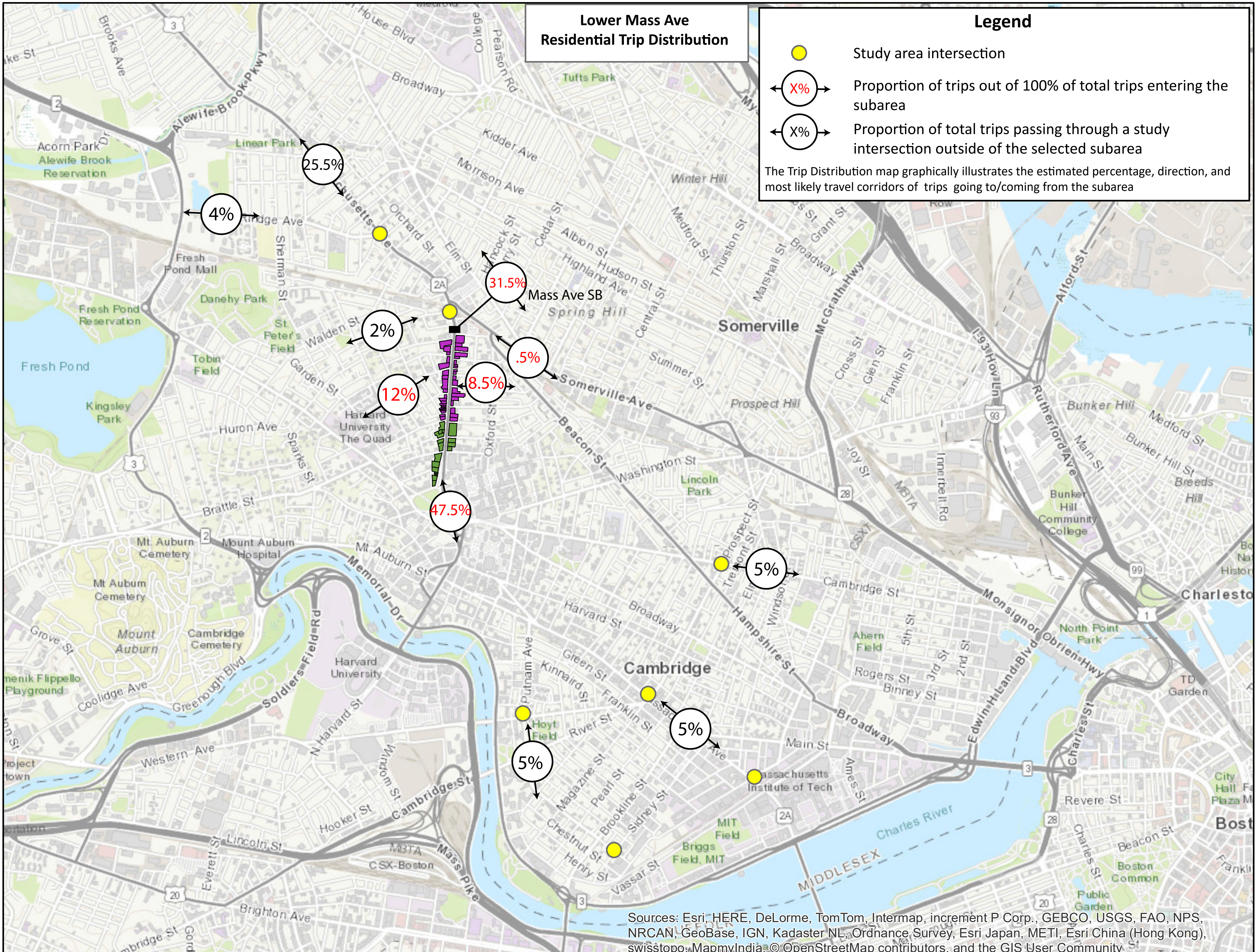

East Cambridge
Residen al Trip Distribu on
Legend
Study area intersec on
X%
Propor on of trips out of 100% of total trips entering the subarea
X%
Propor on of total trips passing through a study intersec on outside of the selected subarea
The Trip Distribu on map graphically illustrates the es mated percentage, direc on, and most likely travel corridors of trips going to/coming from the subarea
3%
5%
52%
8%
5%
5%
14%
29%
Somerville
Cambridge
Charlesto
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

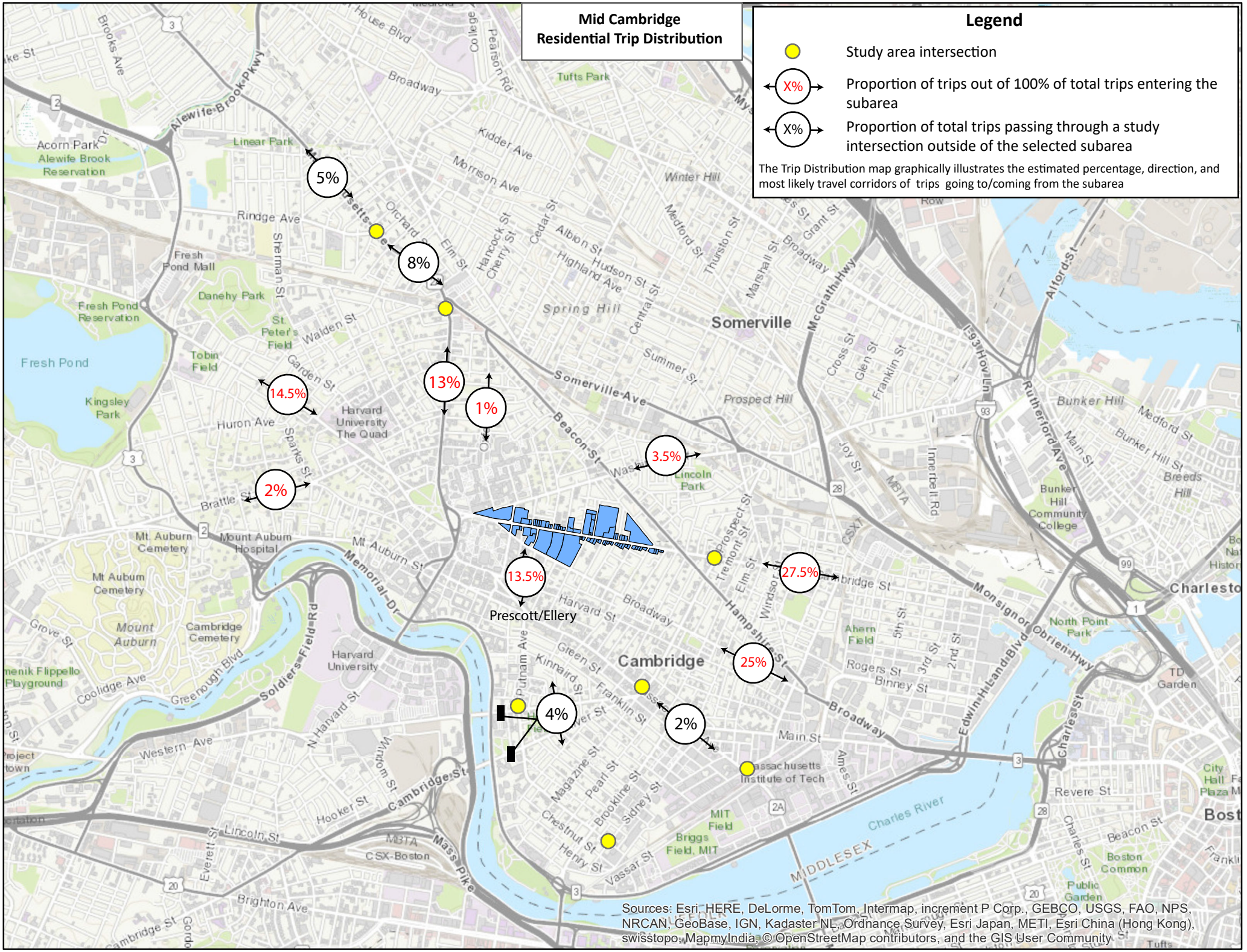

Harvard Square
Residential Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
8.5%
11.5%
10.5%
16.5%
11.5%
2.5%
5%
5%
1.5%
11.5%
11%
5%
20%
12%
3%
6%
1%
Somerville
Cambridge
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

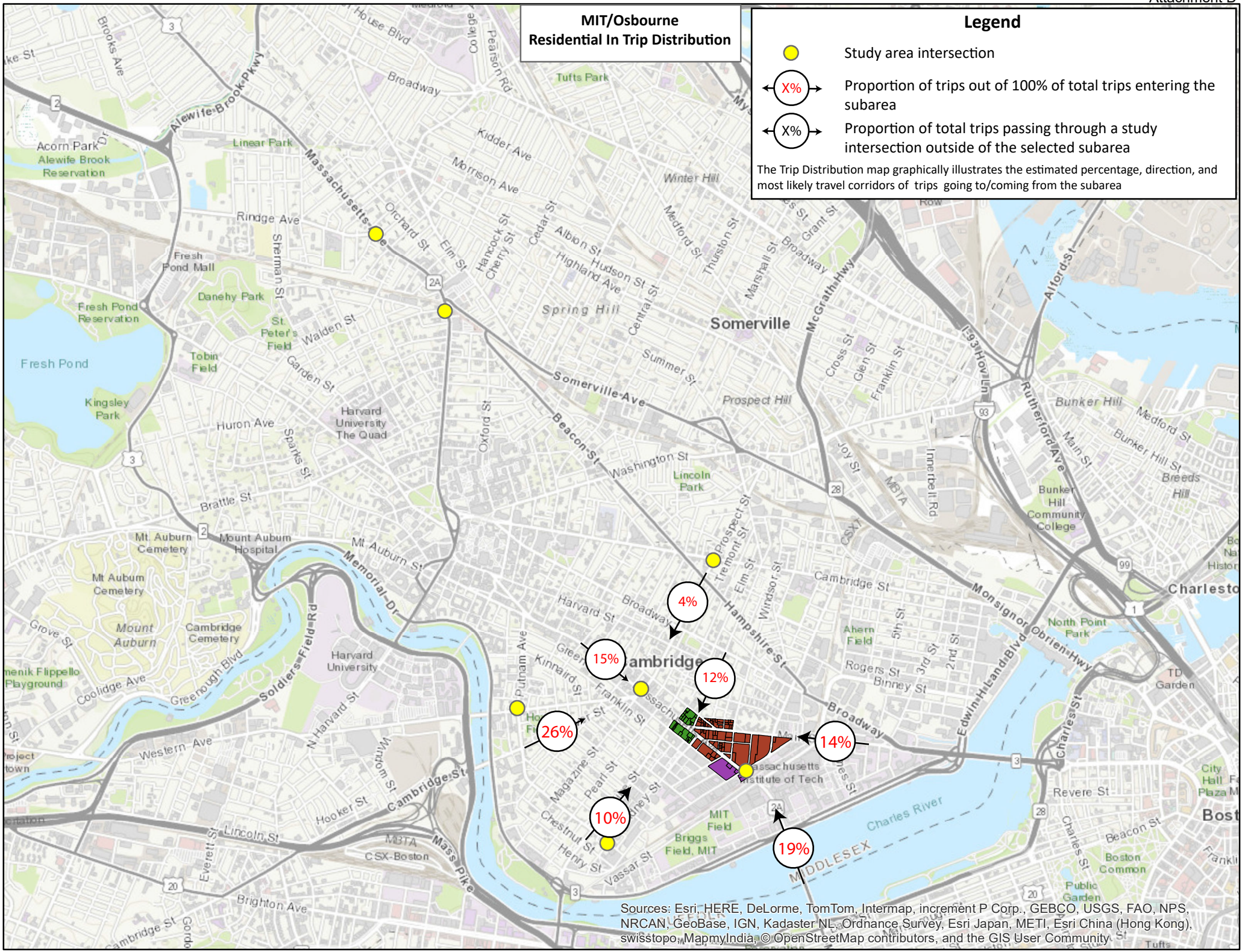

Inman Square
Residential Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
1%
1.5%
15%
155%
7.5%
23.5%
27.5%
11%
23.5%
Somerville
Cambridge
Charlestown
Alewife Brook Pkwy
Somerville Ave
Beacon St
Broadway
Washington St
Harvard St
Main St
Cambridge St
Memorial Dr
Soldiers Field Rd
McGrath Hwy
Monsignor O'Brien Hwy
Rutherford Ave
Charles River
MIDDLESEX
Fresh Pond
Fresh Pond Reservation
Danehy Park
Tufts Park
Linear Park
Acorn Park
Alewife Brook Reservation
Lincoln Park
Harvard University
Harvard University The Quad
Mount Auburn Hospital
Mt. Auburn Cemetery
Mt Auburn Cemetery
Cambridge Cemetery
Mount Auburn
Hoyt Field
Ahern Field
Briggs Field, MIT
MIT Field
TD Garden
North Point Park
Public Garden
Boston Common
Massachusetts Institute of Tech
Bunker Hill Community College
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



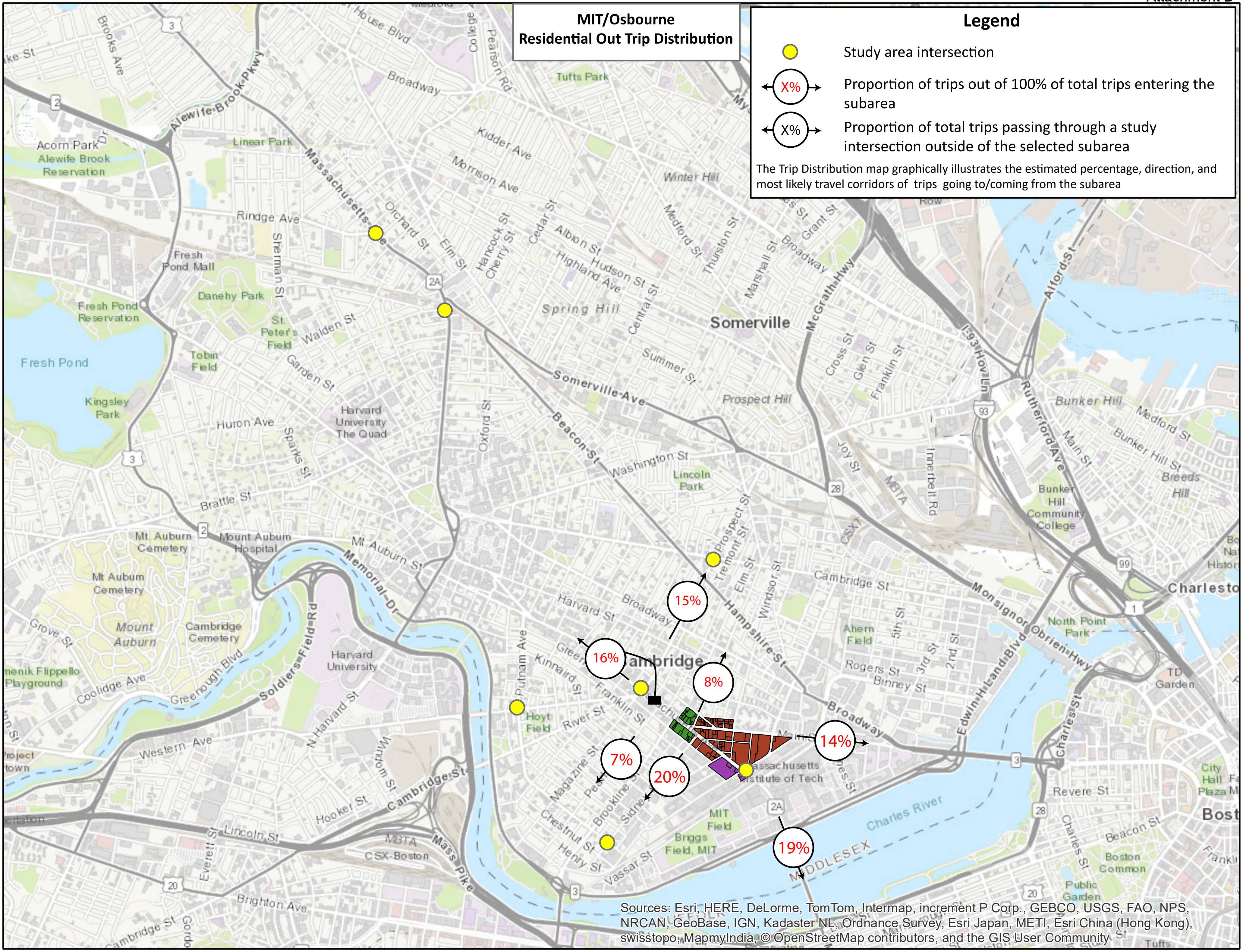
Trip distribution for Kendall/Volpe subarea compiled based on subarea trip distributions for subareas 2, 3, and 4 from K2C2 Critical Sums analysis, June 2012. This is before the Third Street Connector was constructed, but the connector does not change the distributions as it is internal to the Kendall/Volpe subarea.

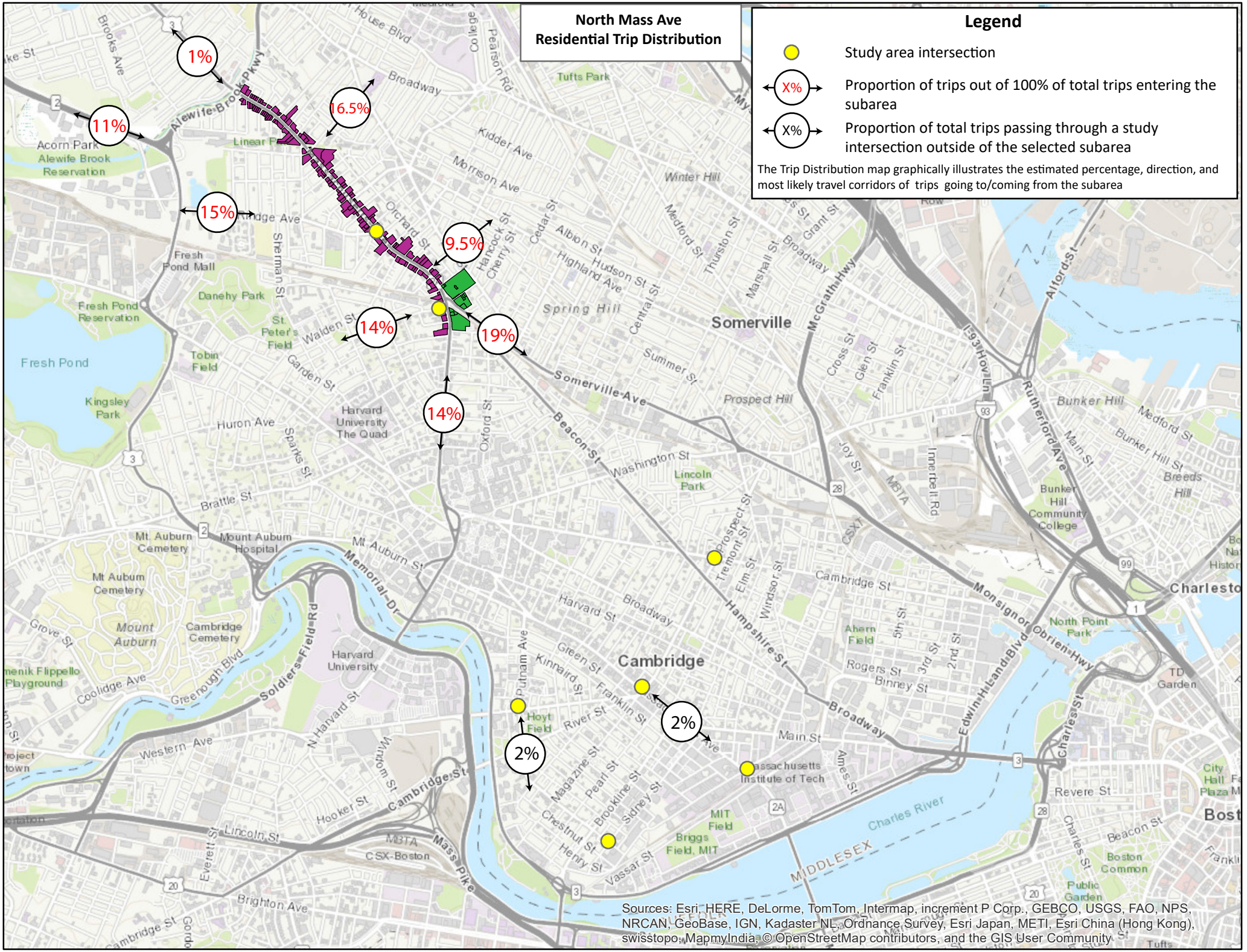

Lower Mass Ave
Residential Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
25.5%
4%
31.5%
Mass Ave SB
2%
.5%
8.5%
12%
47.5%
5%
5%
5%
Somerville
Cambridge
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

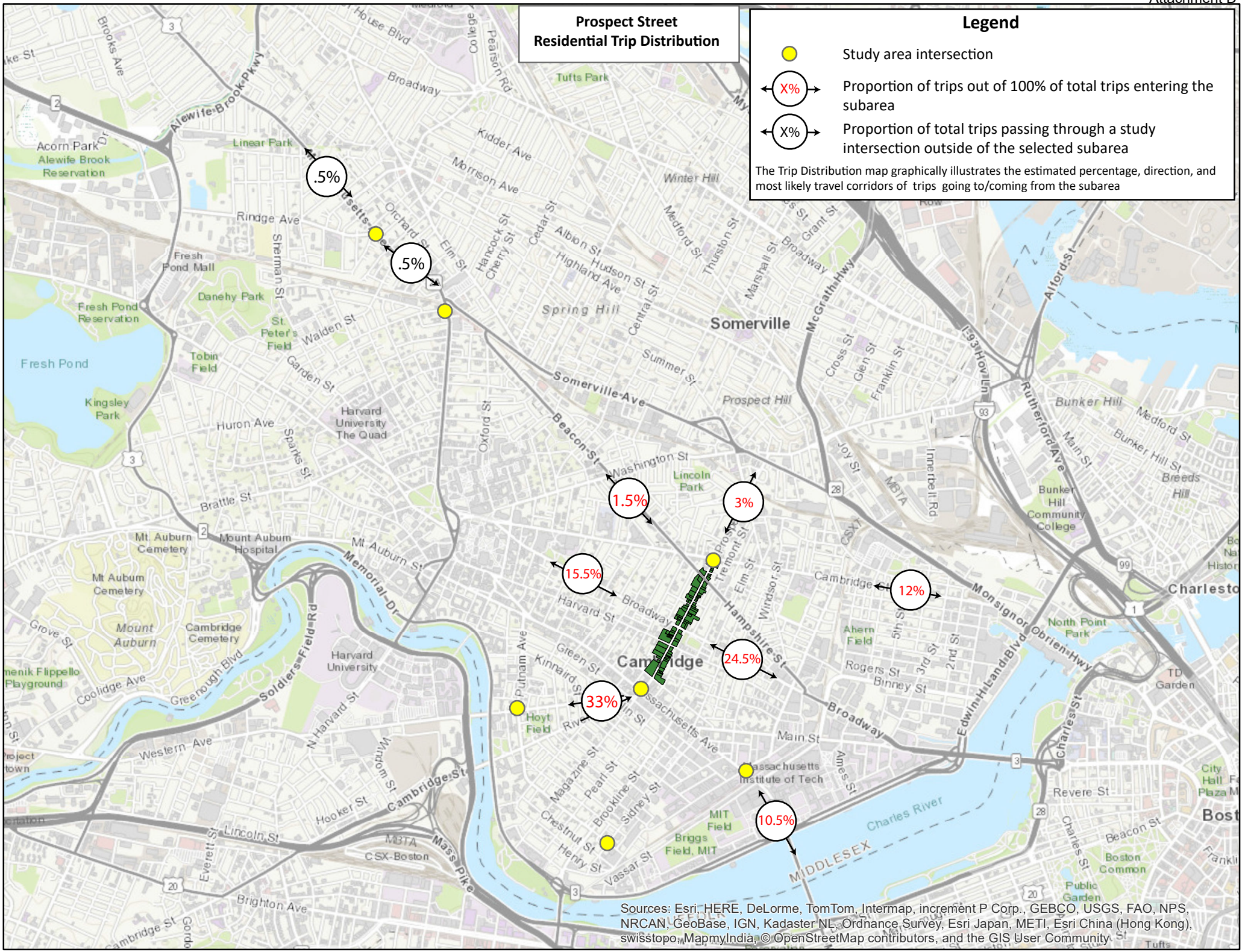

Mid Cambridge
Residential Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
5%
8%
13%
1%
14.5%
2%
3.5%
13.5%
Prescott/Ellery
27.5%
25%
4%
2%
Somerville
Cambridge
Alewife Brook Pkwy
Broadway
Somerville Ave
Beacon St
Harvard University
Massachusetts Institute of Technology
Charles River
MIDDLESEX
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


MIT/Osbourne
Residential In Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
4%
15%
12%
26%
14%
10%
19%
Somerville
Cambridge
Massachusetts Institute of Tech
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

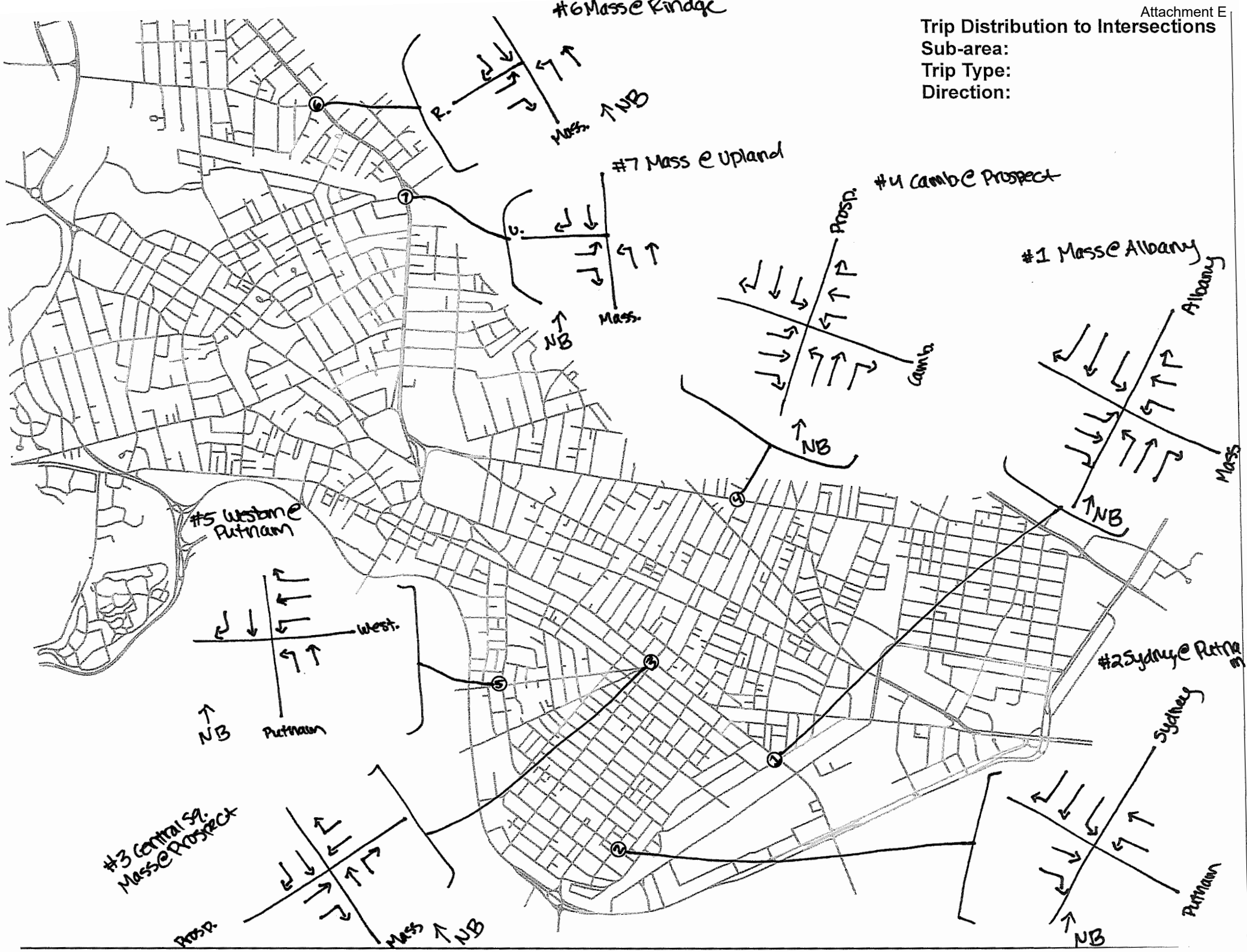
Attachment D



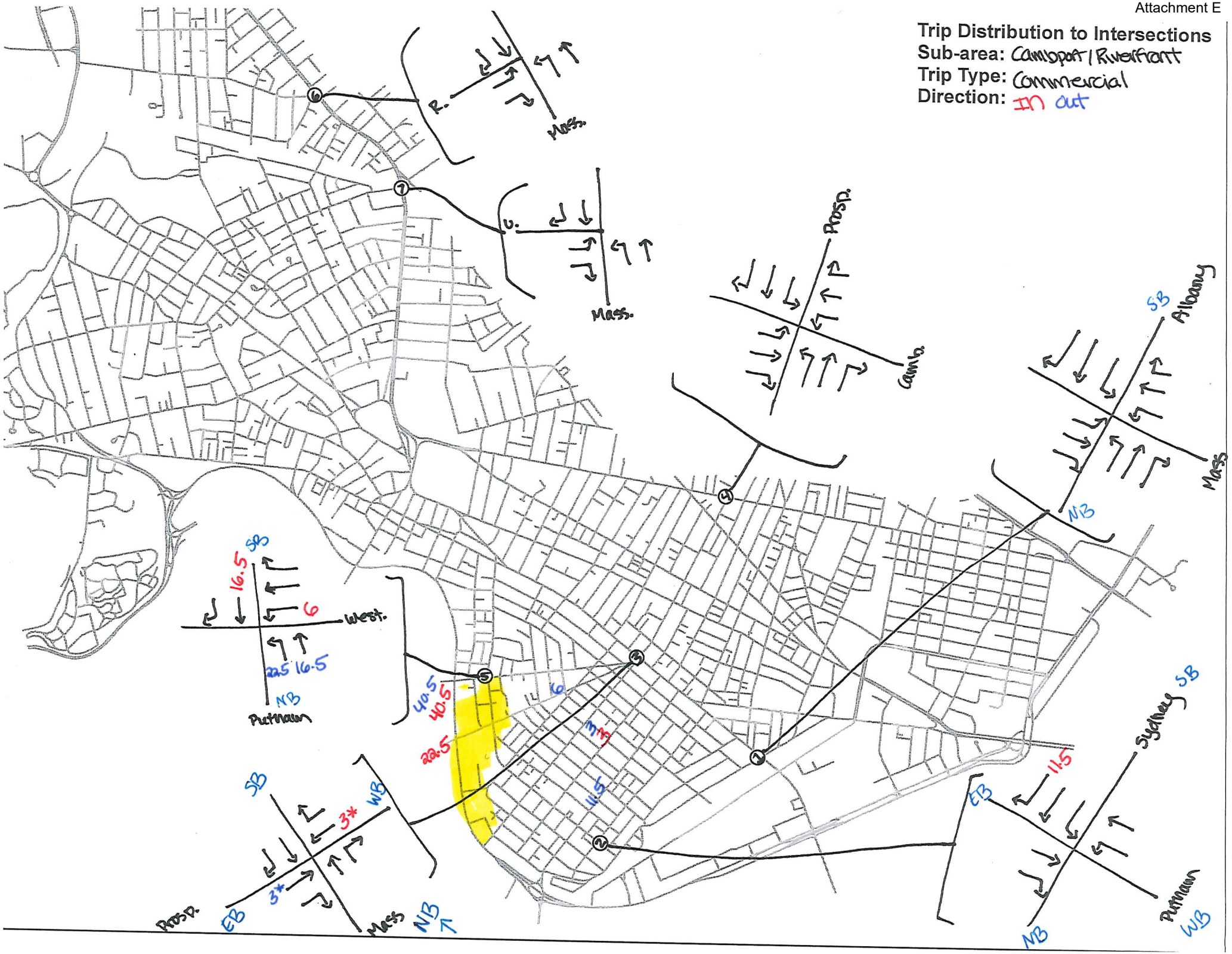

North Mass Ave
Residential Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
1%
11%
16.5%
15%
9.5%
14%
19%
14%
2%
2%
Somerville
Cambridge
Alewife Brook Pkwy
Somerville Ave
Broadway
Beacon St
Hampshire St
Memorial Dr
Soldiers Field Rd
Mass Pike
Charles River
MIDDLESEX
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


Prospect Street
Residential Trip Distribution
Legend
Study area intersection
X%
Proportion of trips out of 100% of total trips entering the subarea
X%
Proportion of total trips passing through a study intersection outside of the selected subarea
The Trip Distribution map graphically illustrates the estimated percentage, direction, and most likely travel corridors of trips going to/coming from the subarea
.5%
.5%
1.5%
3%
15.5%
12%
24.5%
33%
10.5%
Somerville
Cambridge
Alewife Brook Pkwy
Somerville Ave
Beacon St
Broadway
Hampshire St
Memorial Dr
Soldiers Field Rd
Cambridge St
Massachusetts Ave
Main St
Charles River
MIDDLESEX
Harvard University
Mount Auburn Cemetery
Fresh Pond
Fresh Pond Reservation
Tufts Park
Lincoln Park
Bunker Hill Community College
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

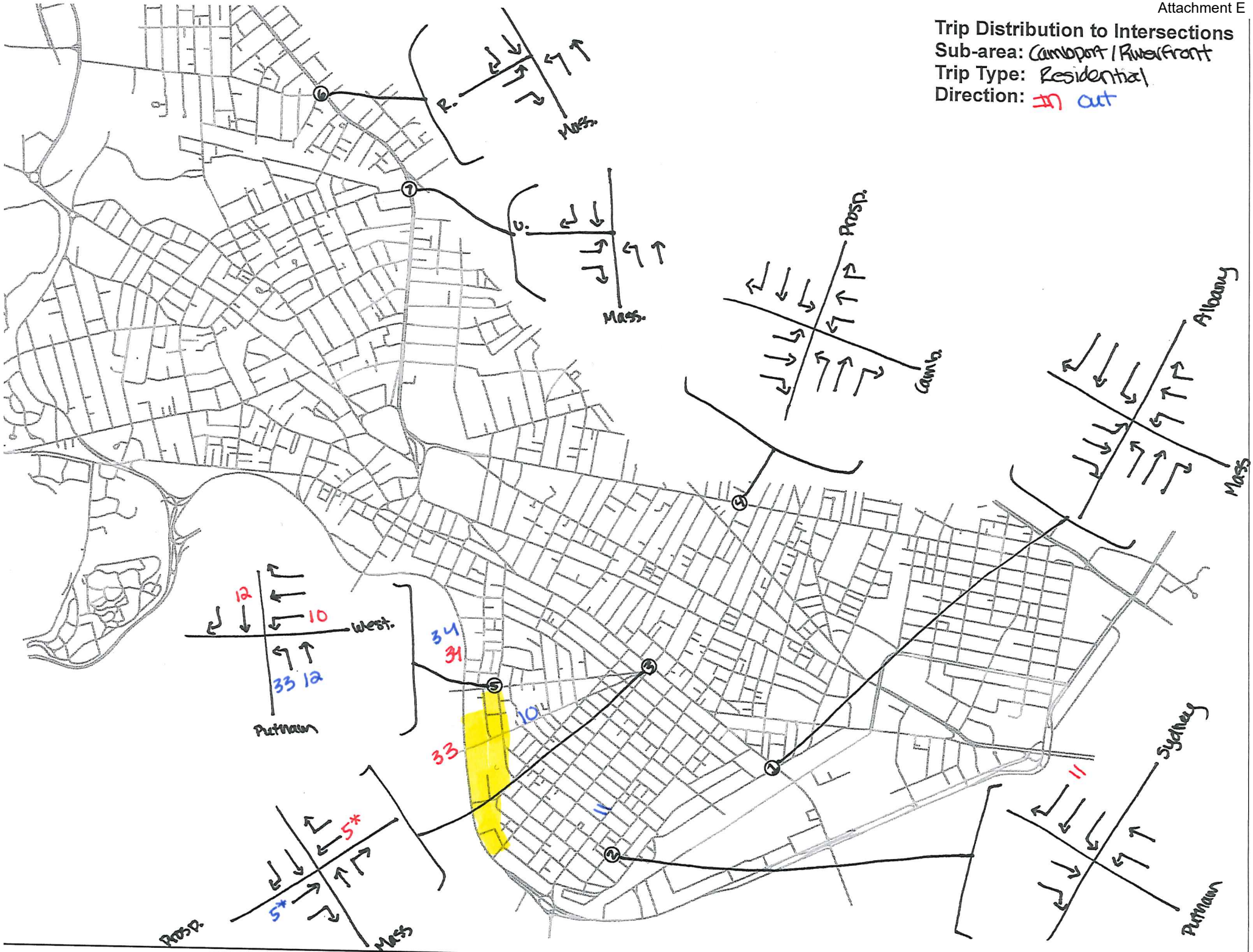
Trip Distribution to Intersections
Sub-area:
Trip Type:
Direction:



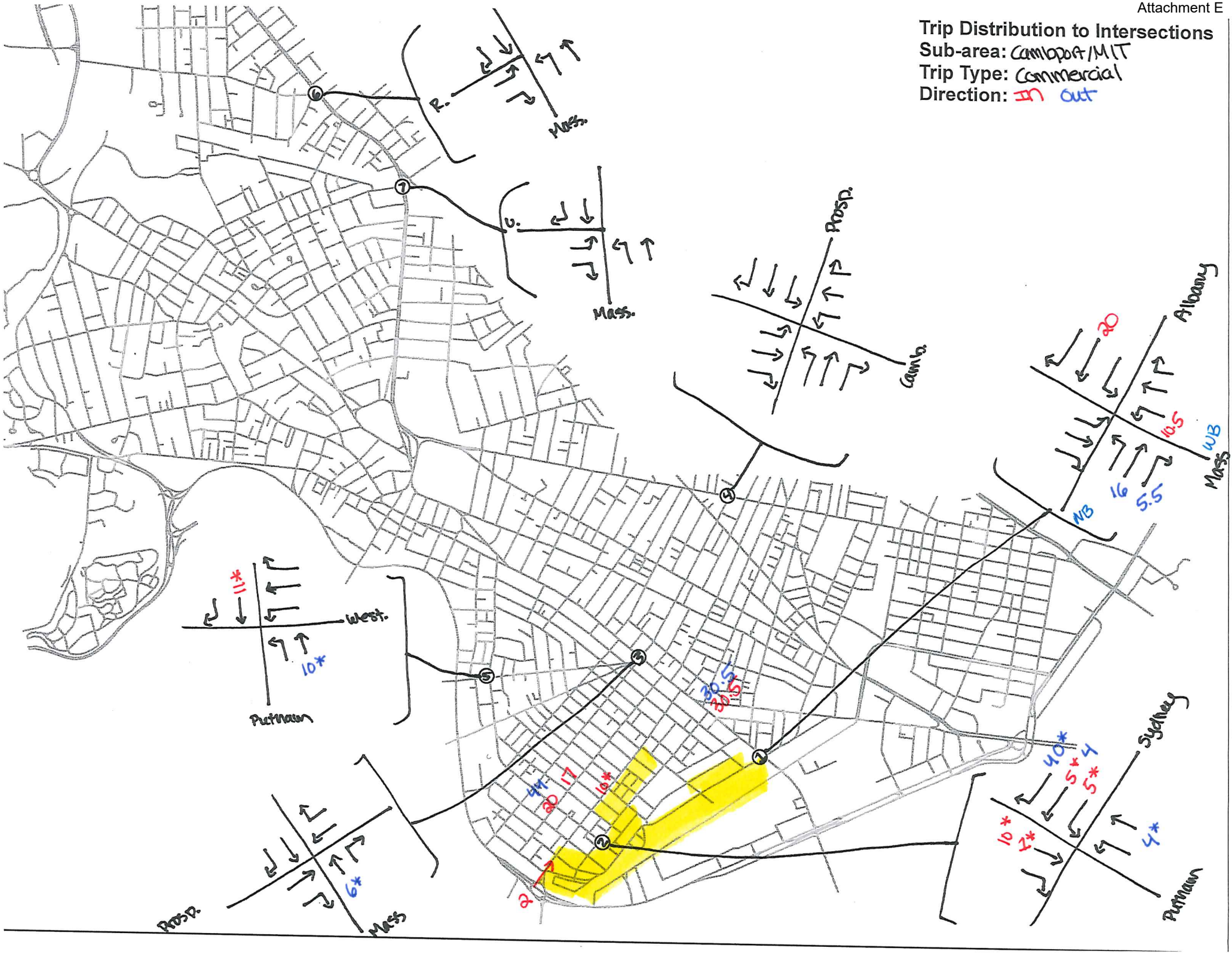
Trip Distribution to Intersections
Sub-area: Camsport / Riverfront
Trip Type: Commercial
Direction: IN out



Trip Distribution to Intersections
Sub-area: Camboport / Riverfront
Trip Type: Residential
Direction: in out

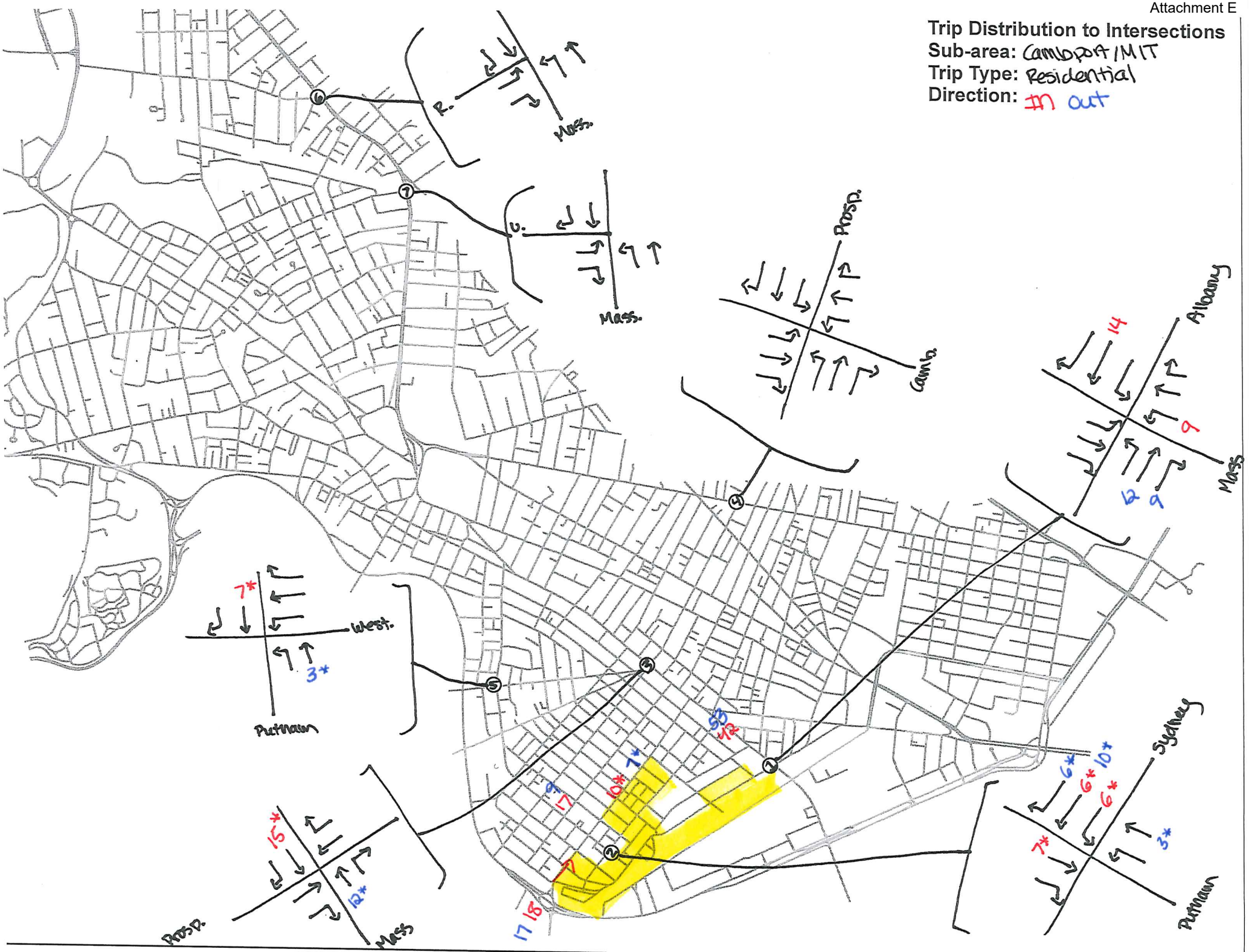


Trip Distribution to Intersections
Sub-area: Cambpdge/MIT
Trip Type: Commercial
Direction: IN Out

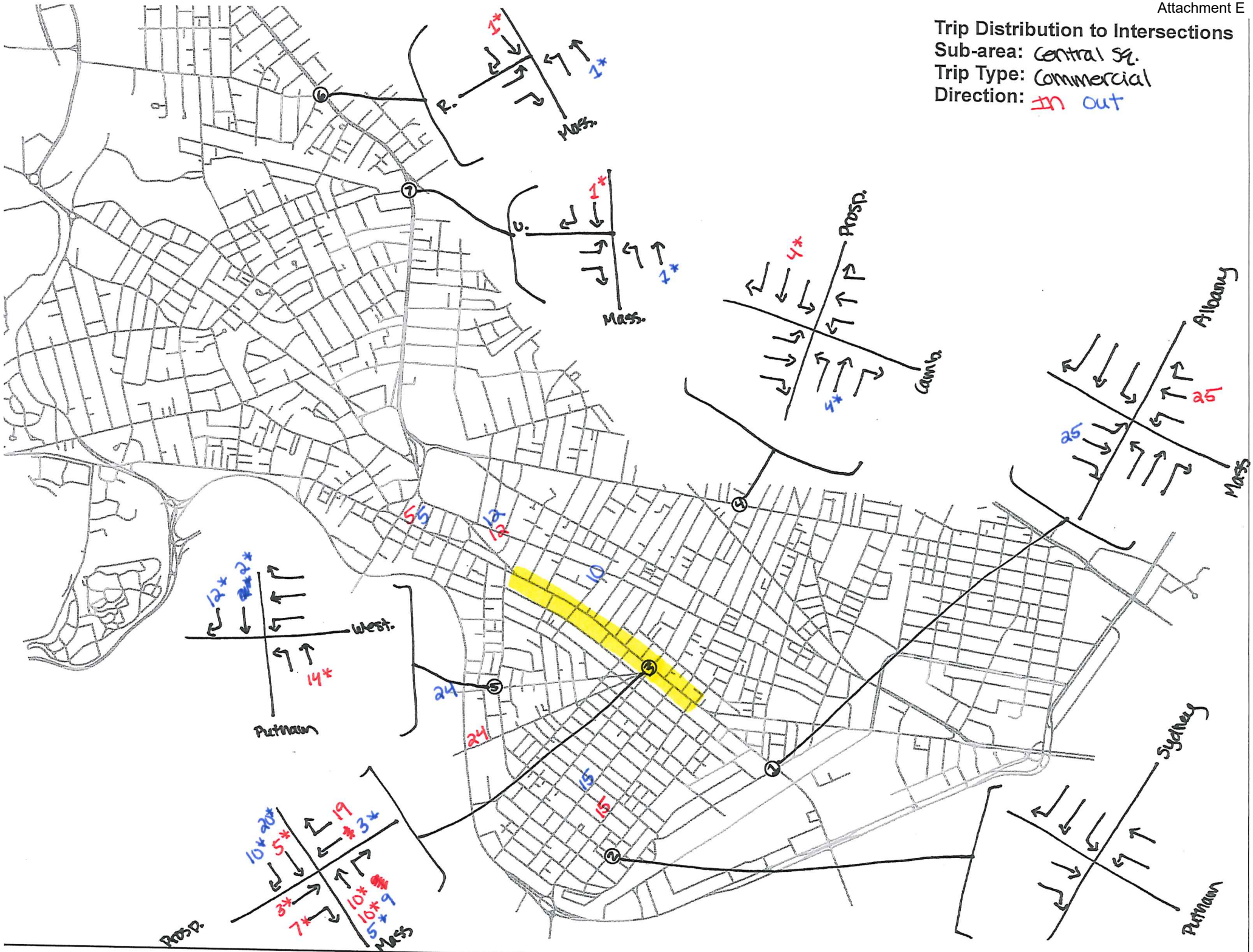


Attachment E

Trip Distribution to Intersections
Sub-area: Cambpdt/MIT
Trip Type: Residential
Direction: In Out

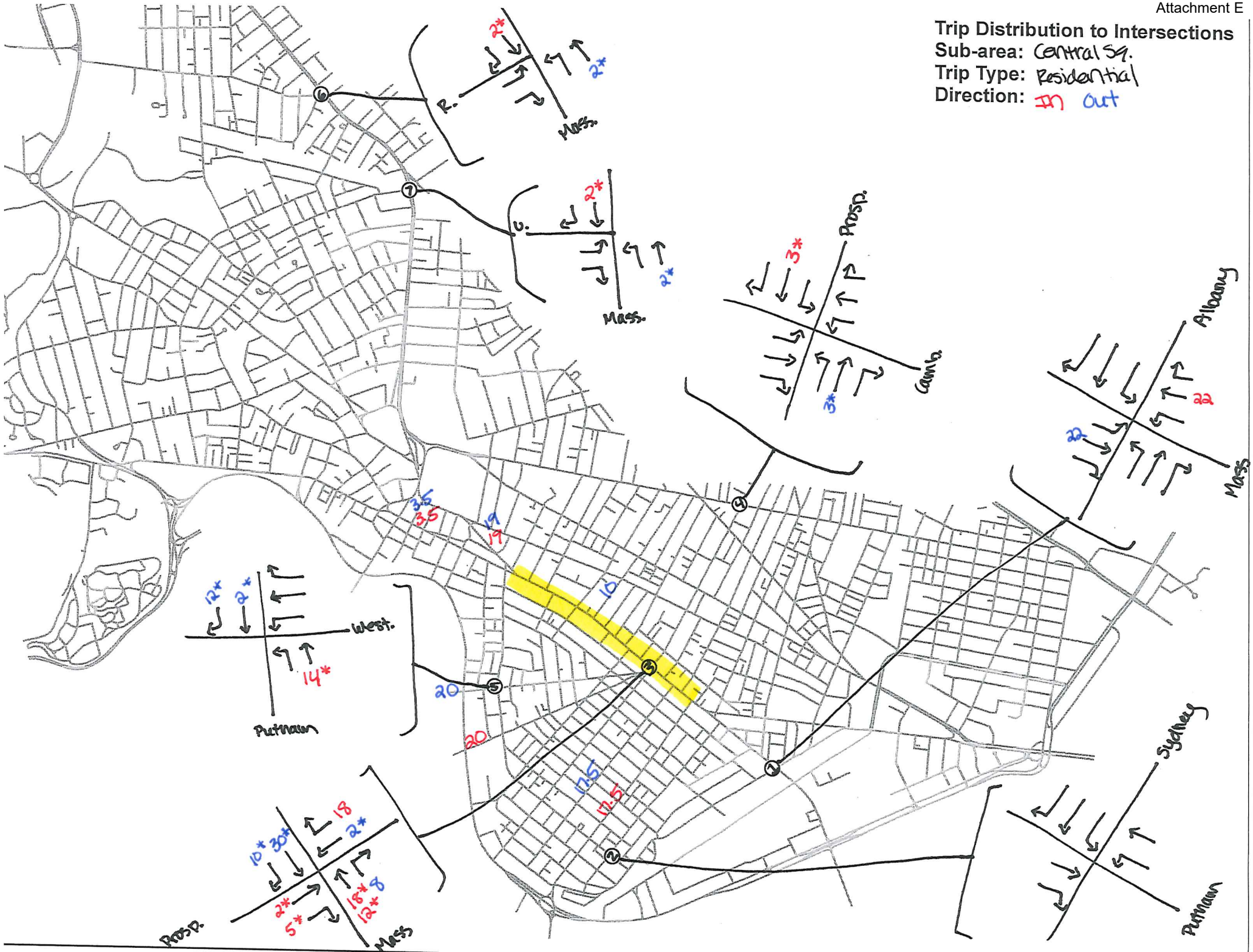


Trip Distribution to Intersections
Sub-area: Central Sq.
Trip Type: Commercial
Direction: In Out



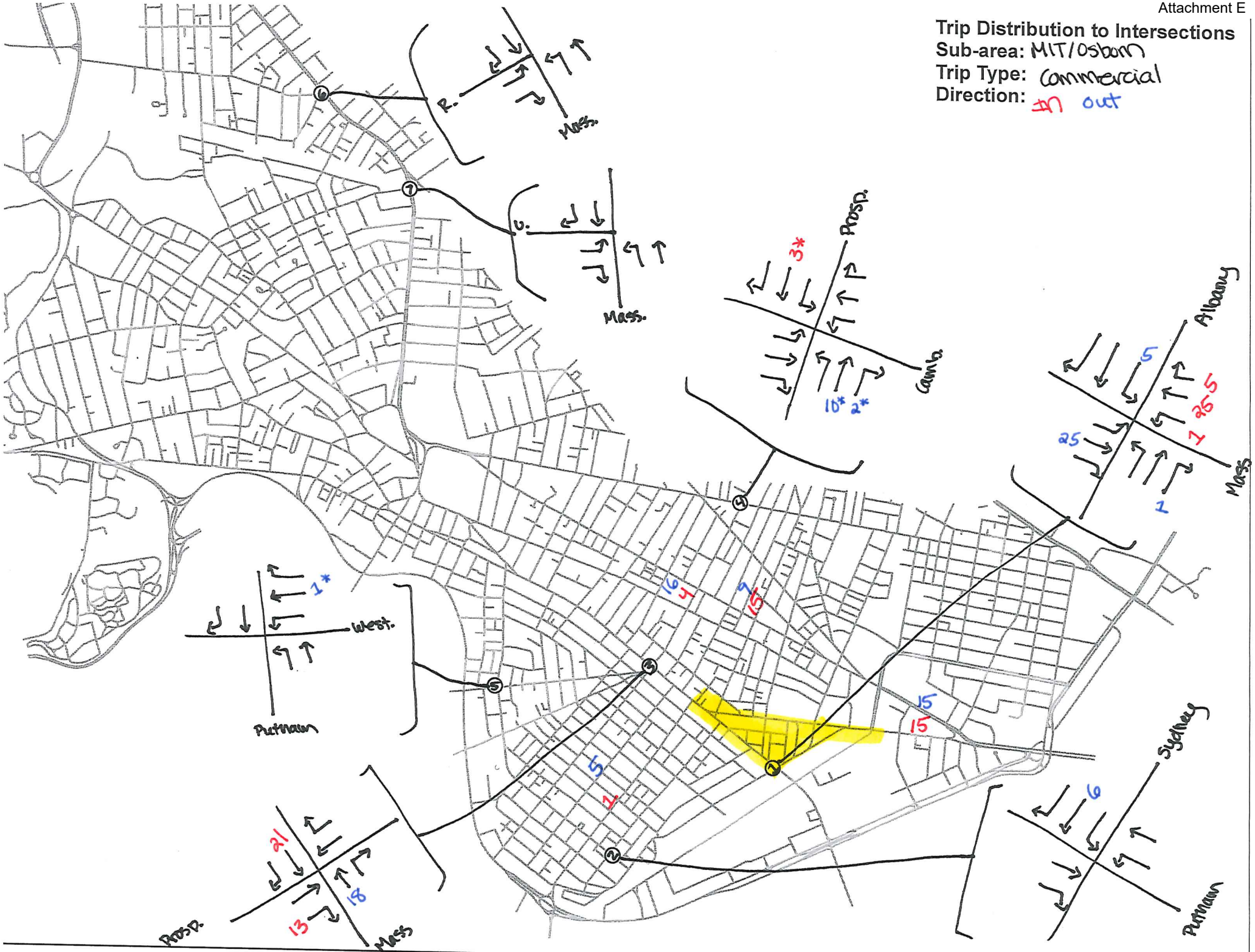
Attachment E

Trip Distribution to Intersections
Sub-area: Central Sq.
Trip Type: Residential
Direction: In Out



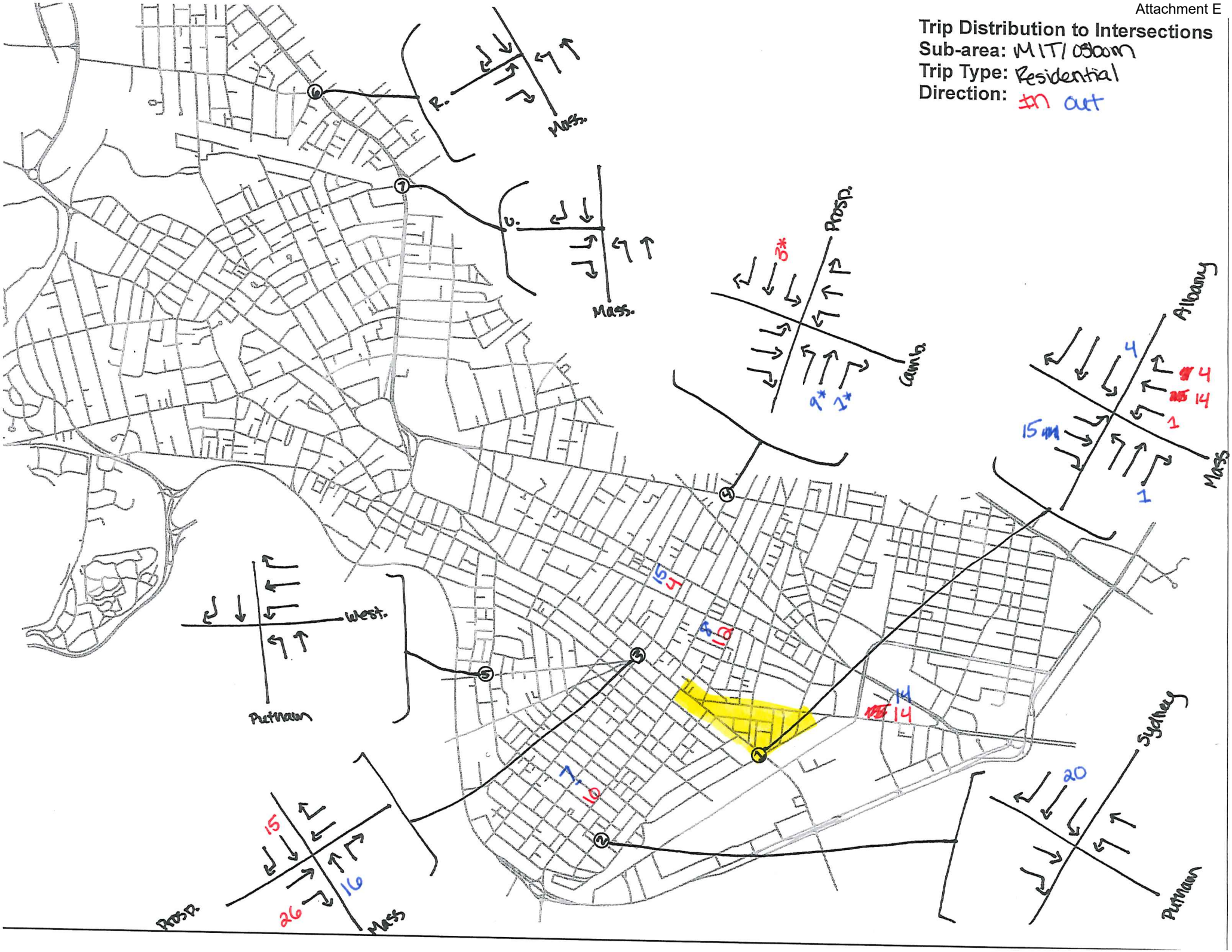
Attachment E

Trip Distribution to Intersections
Sub-area: MIT/Osborn
Trip Type: Commercial
Direction: In Out



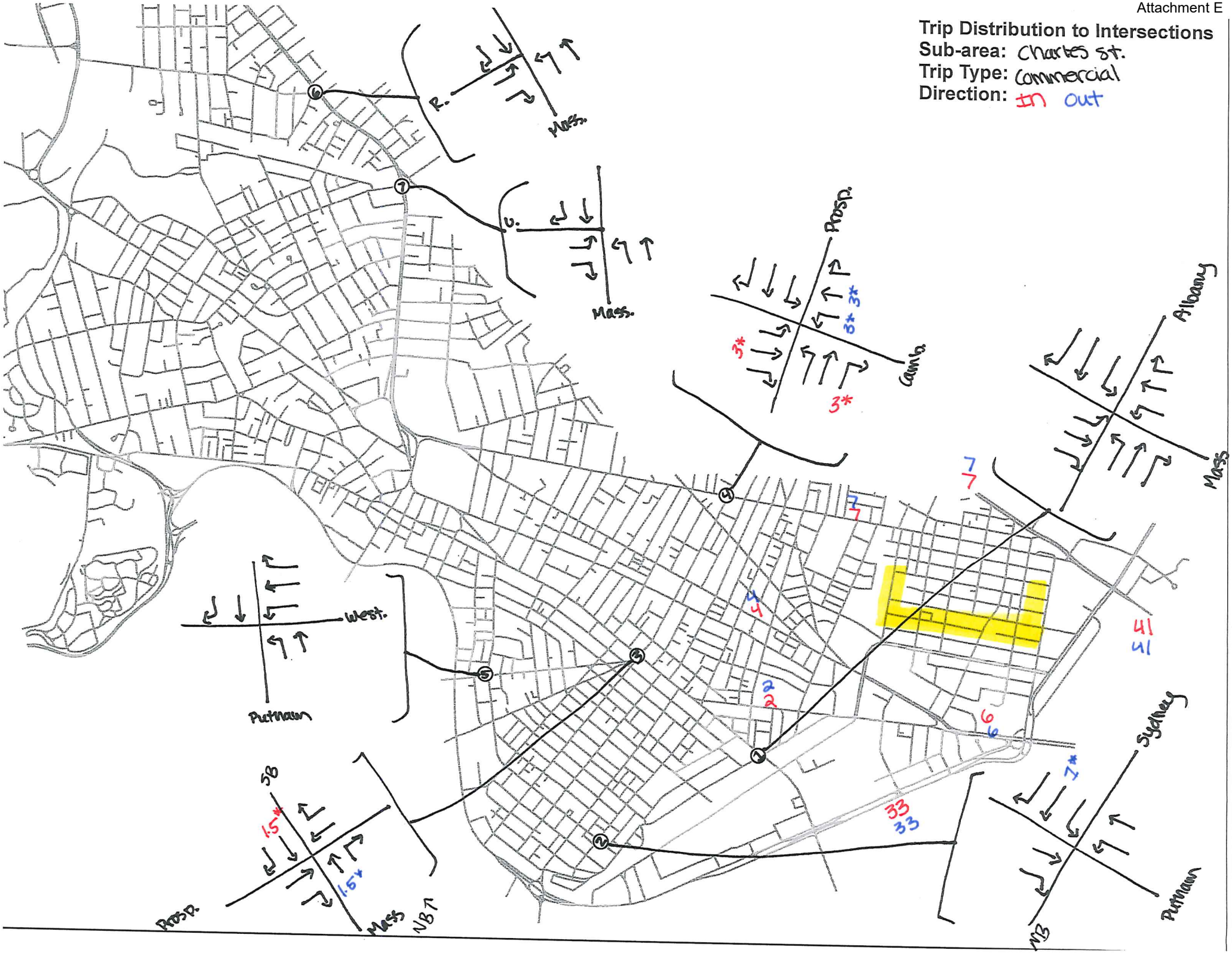
Attachment E

Trip Distribution to Intersections
Sub-area: MIT/Osborn
Trip Type: Residential
Direction: in out



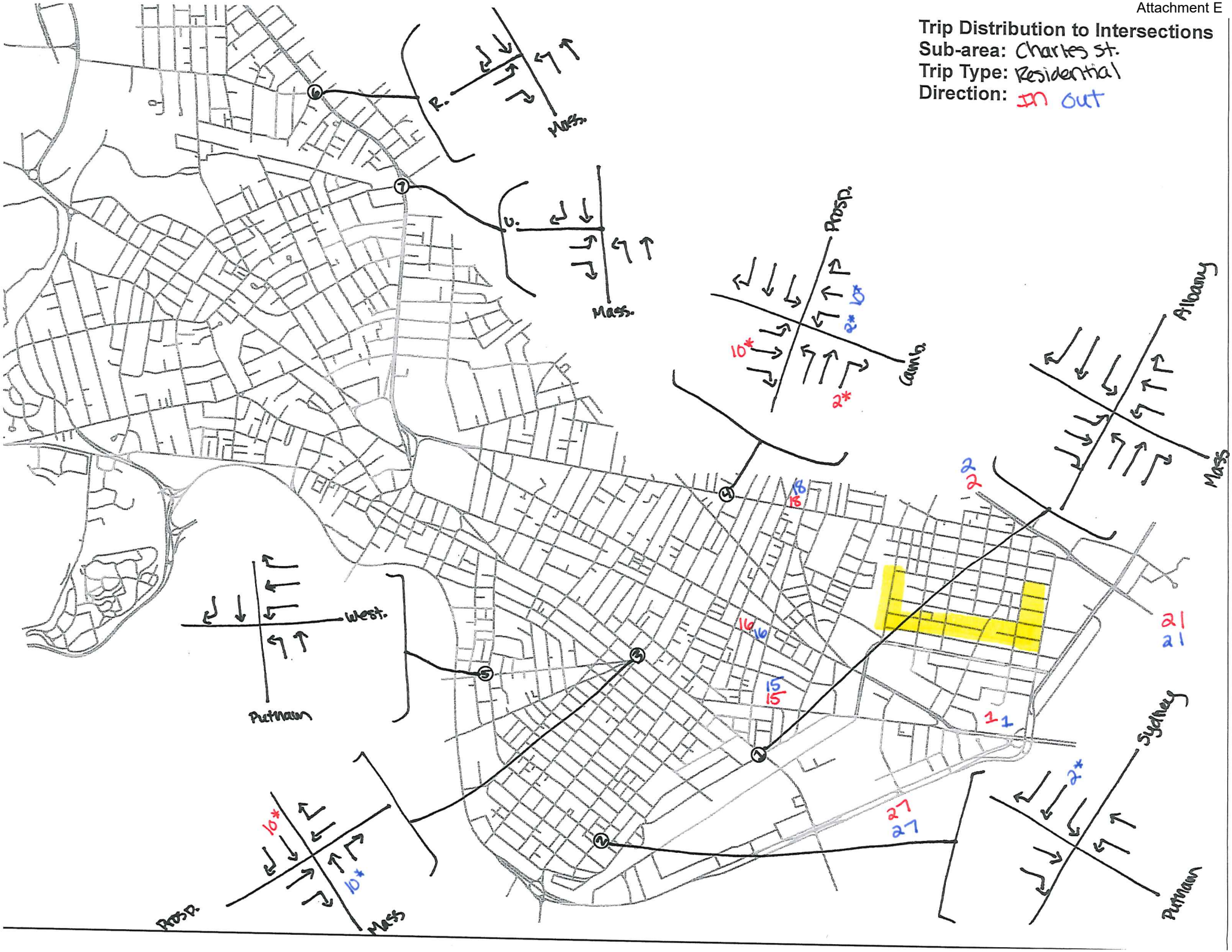
Attachment E

Trip Distribution to Intersections
Sub-area: Charles St.
Trip Type: Commercial
Direction: In Out

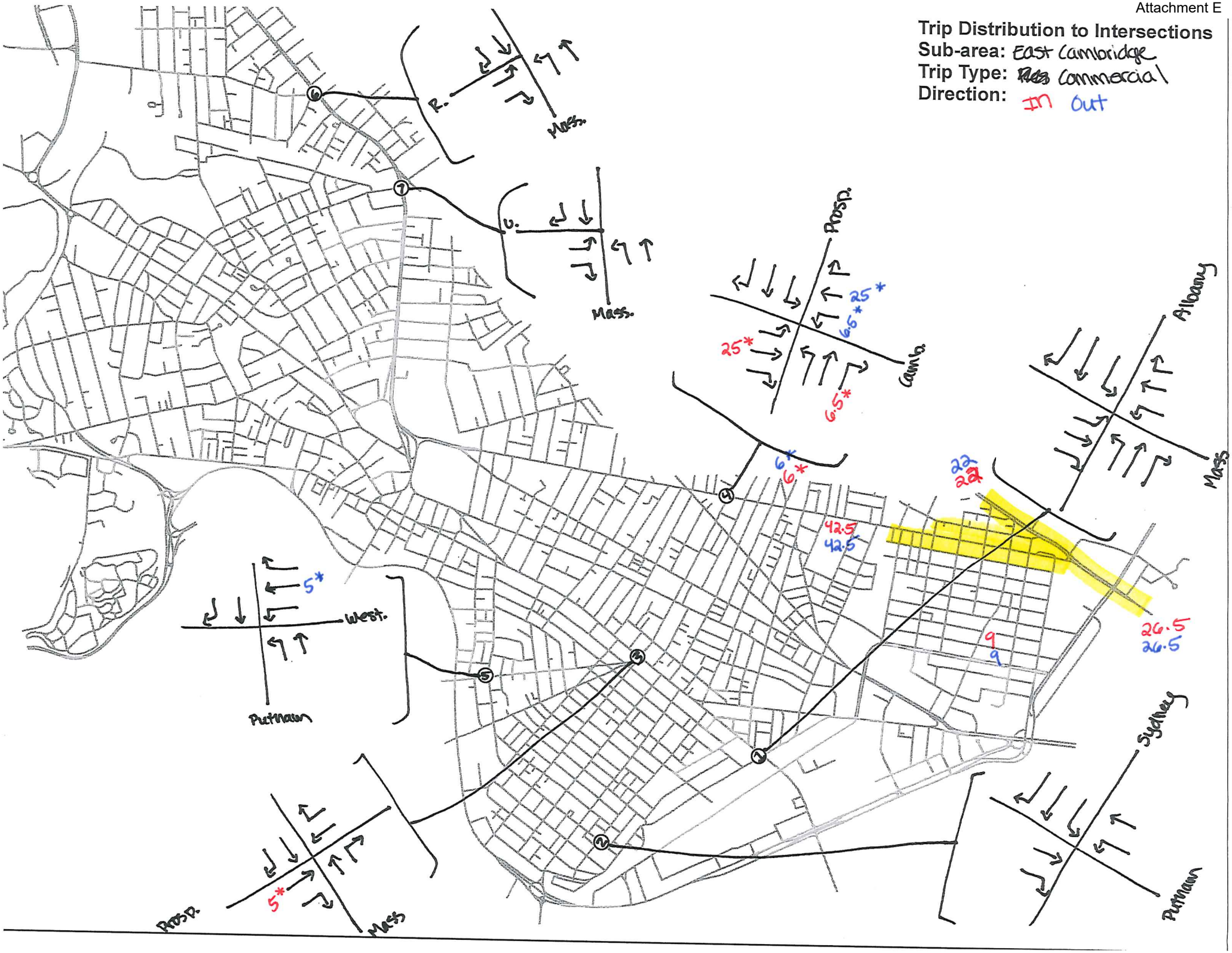


Attachment E

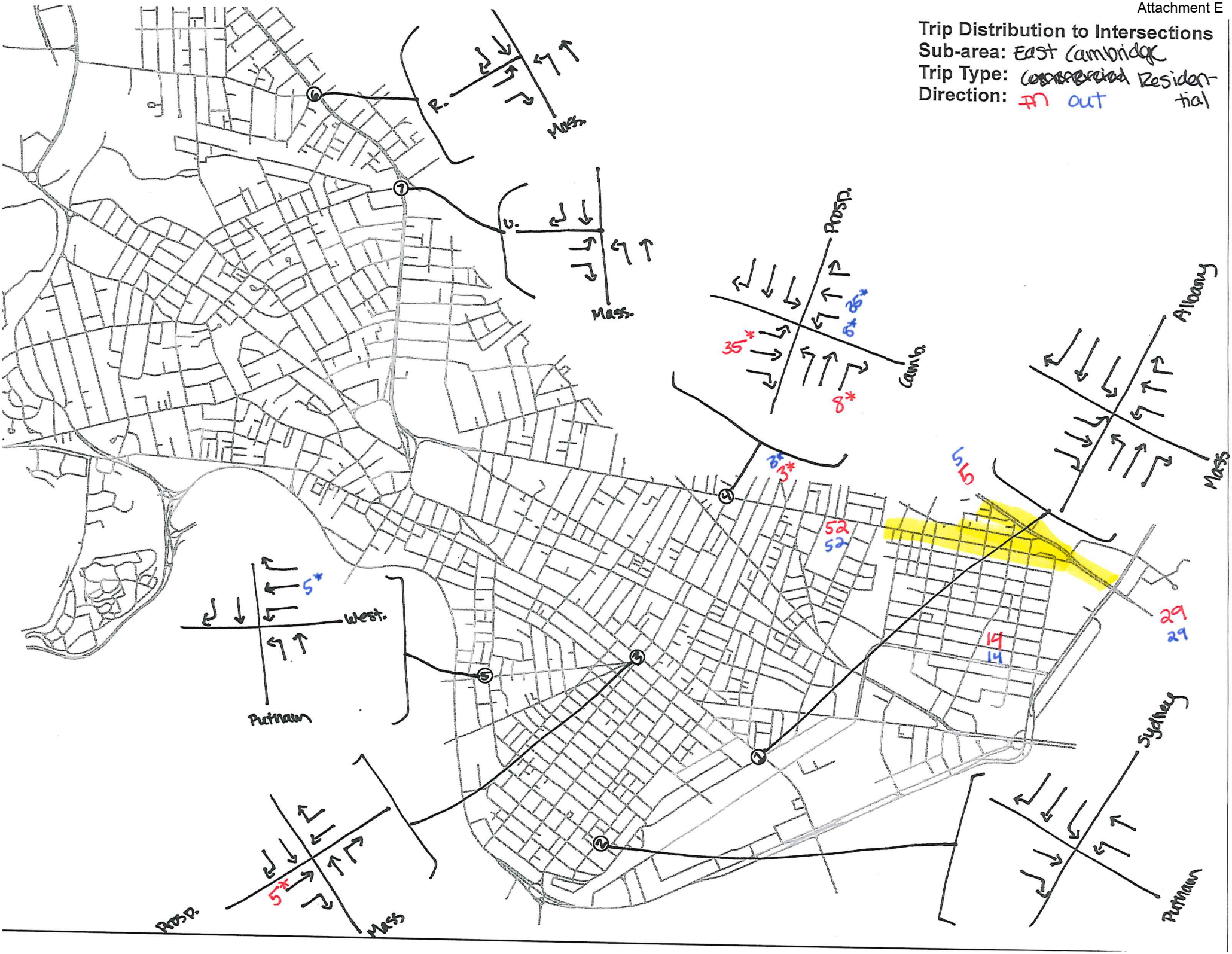
Trip Distribution to Intersections
Sub-area: Charles St.
Trip Type: Residential
Direction: In Out



Trip Distribution to Intersections
Sub-area: East Cambridge
Trip Type: ~~Res~~ Commercial
Direction: In Out

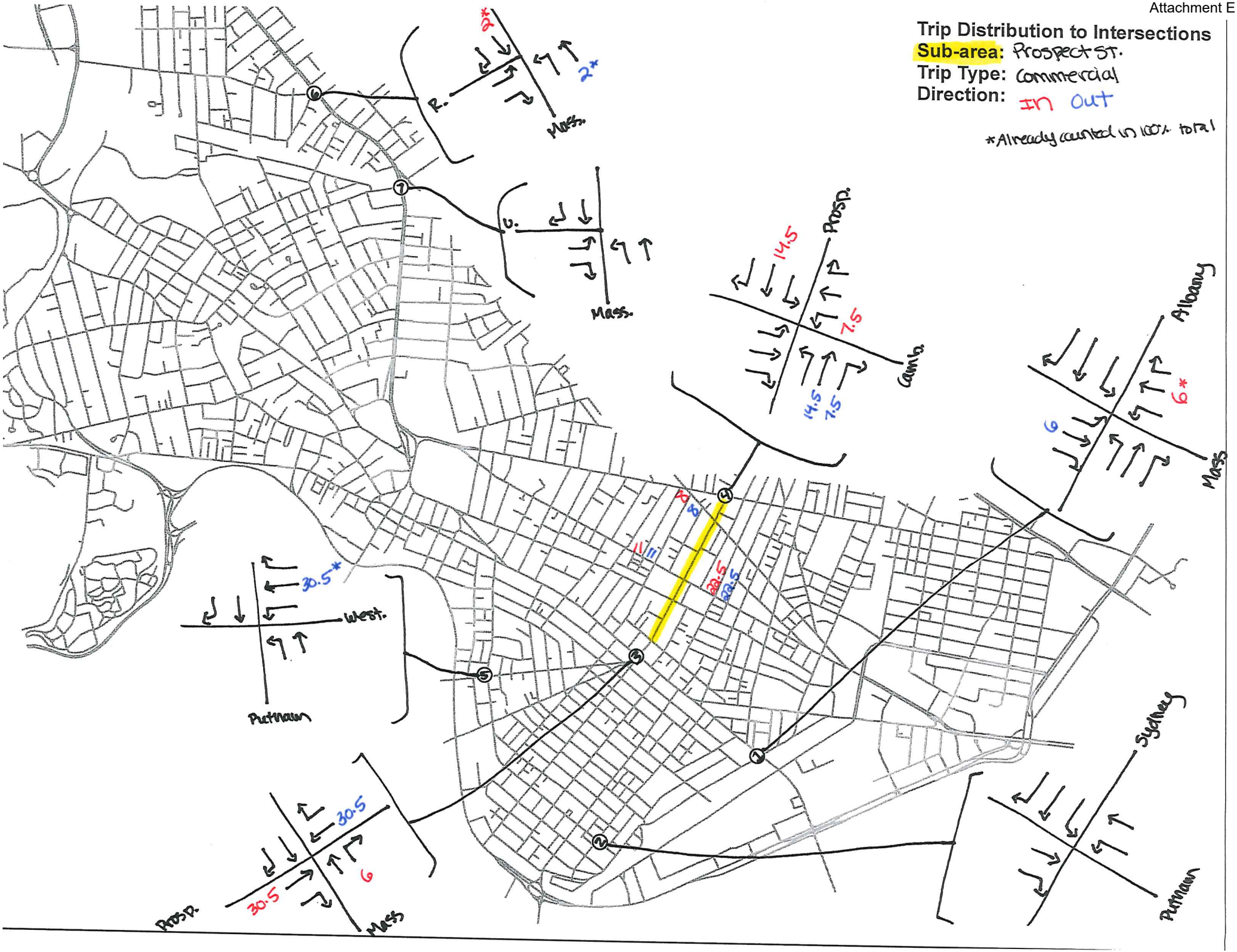


Trip Distribution to Intersections
Sub-area: East Cambridge
Trip Type: ~~Commercial~~ Residential
Direction: In Out



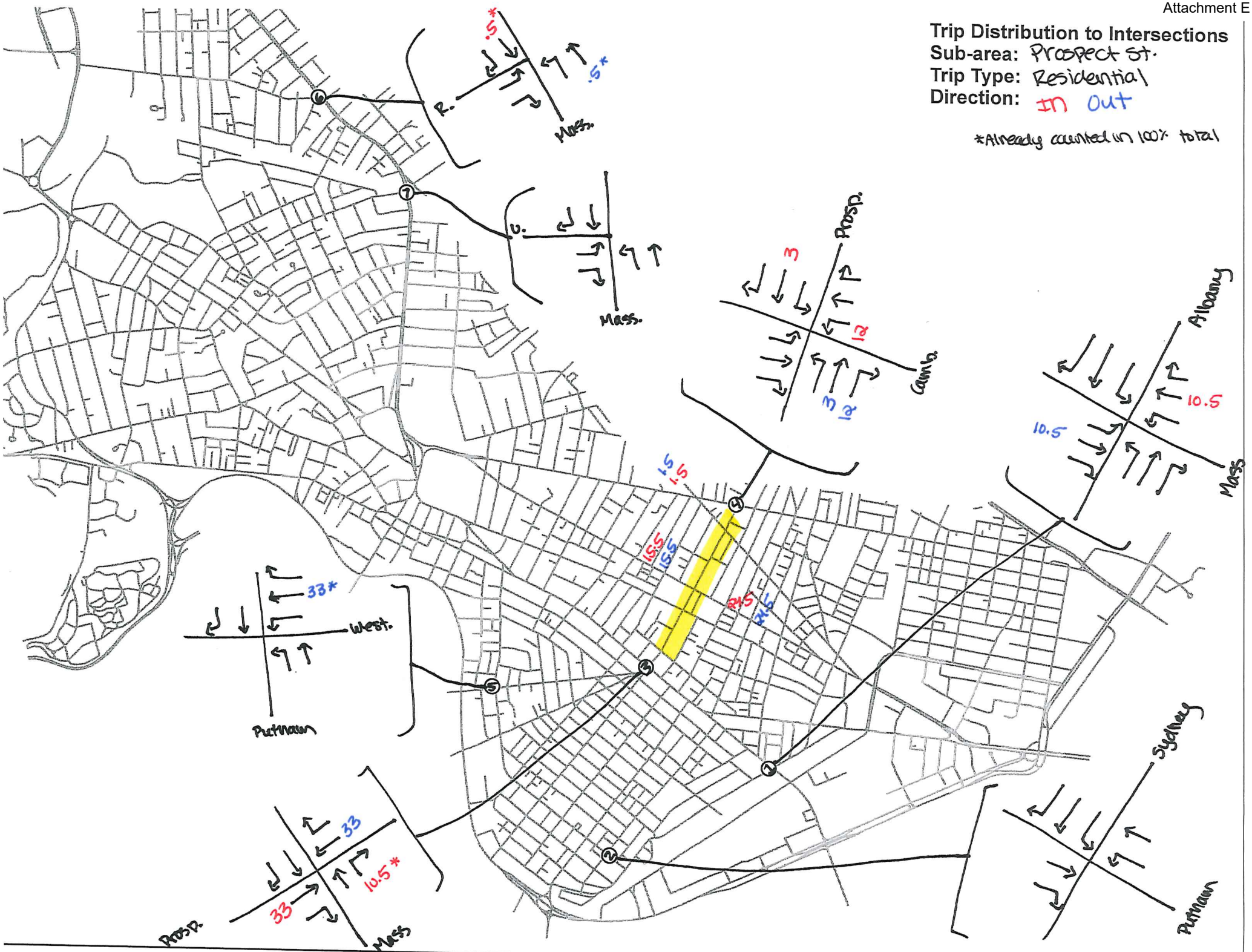
Trip Distribution to Intersections
Sub-area: Prospect ST.
Trip Type: Commercial
Direction: In Out

*Already counted in 100% total

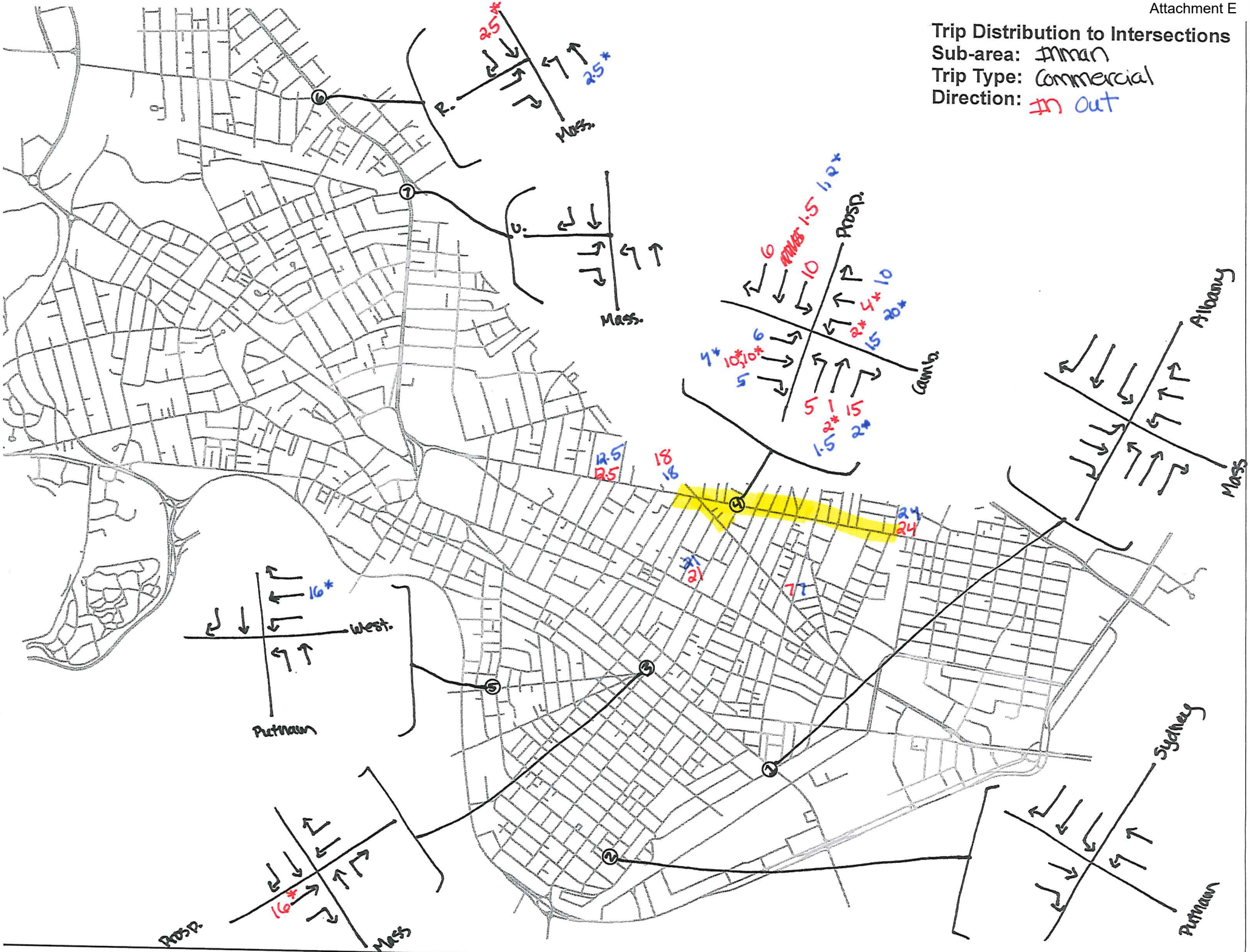


Trip Distribution to Intersections
Sub-area: Prospect St.
Trip Type: Residential
Direction: In Out

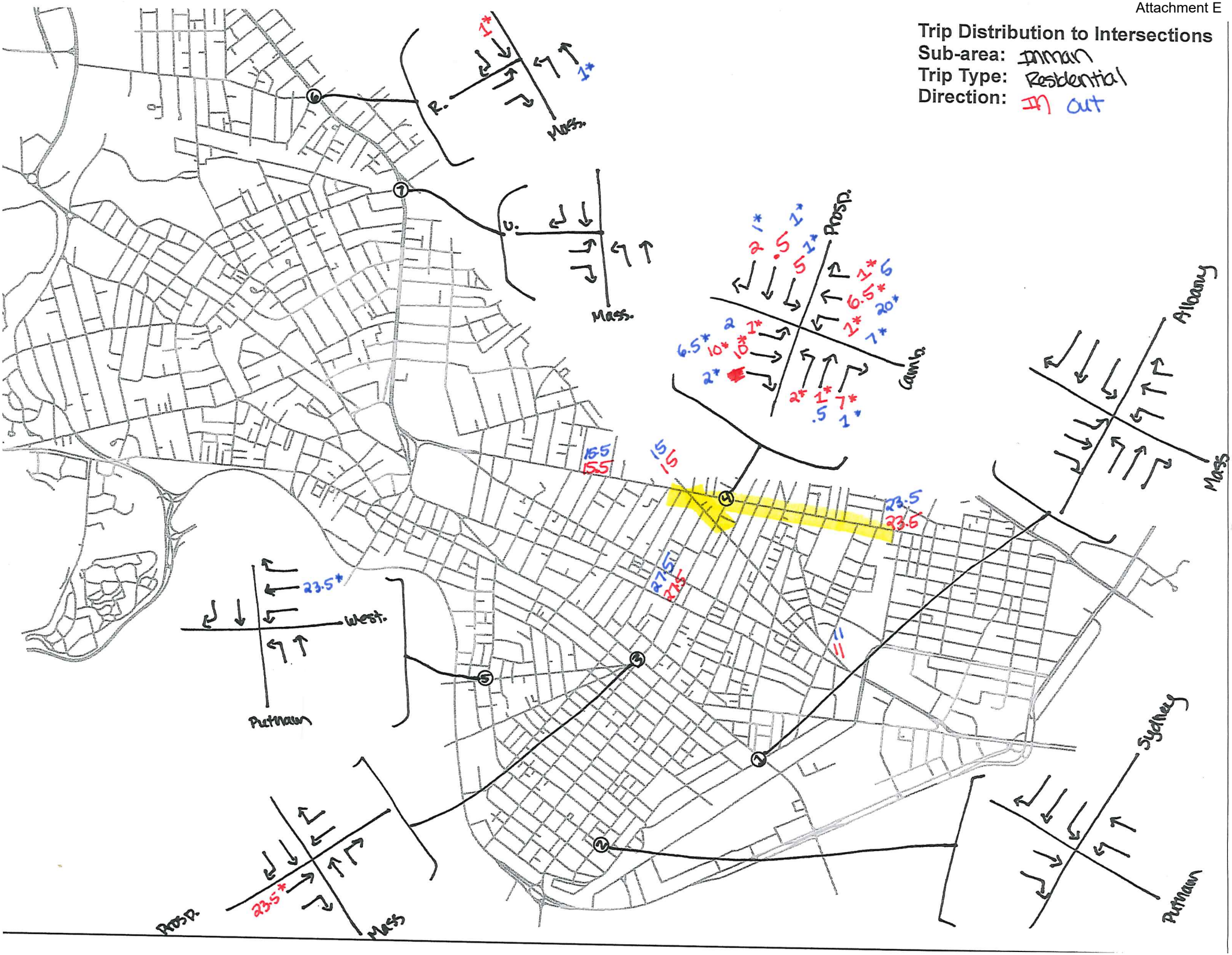
*Already counted in 100% total



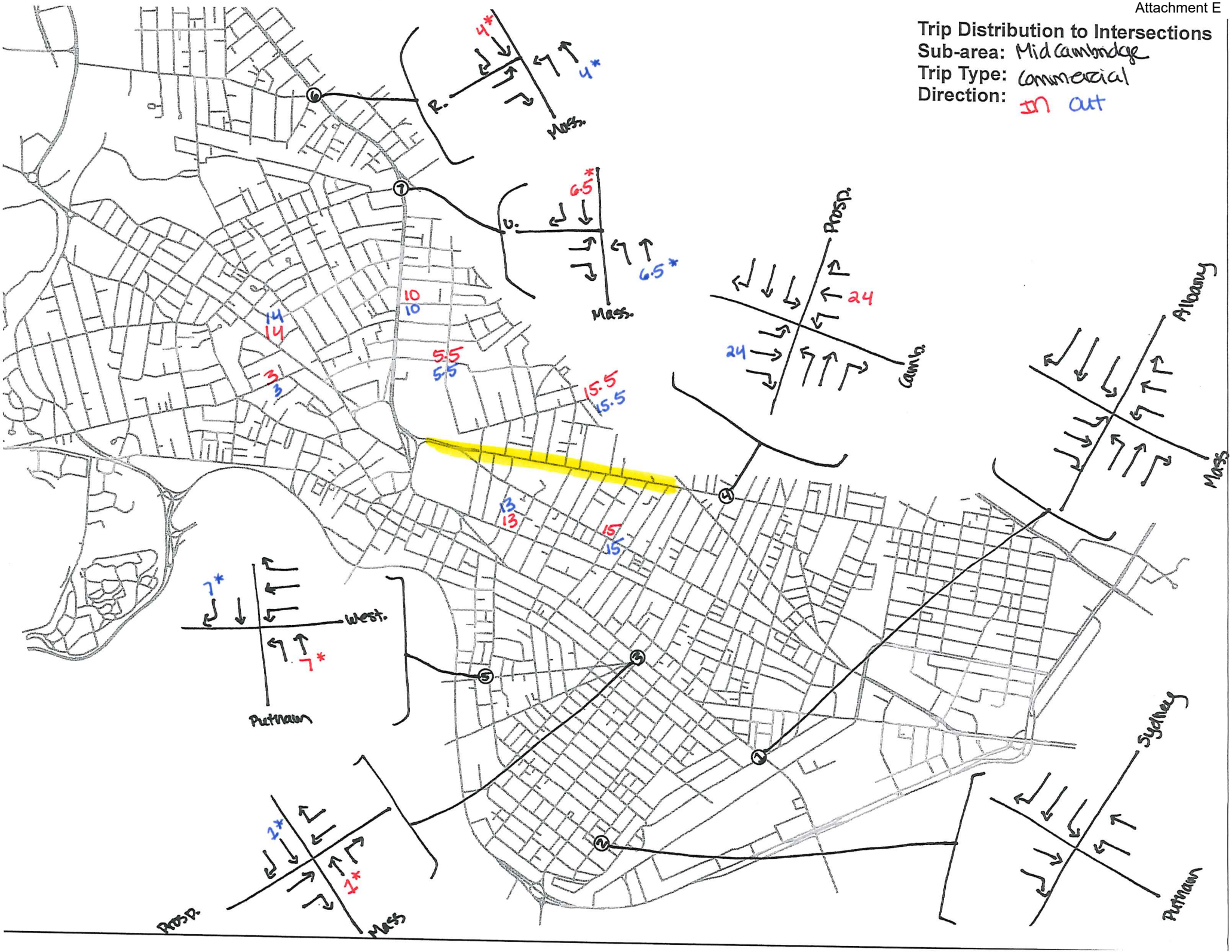
Trip Distribution to Intersections
Sub-area: Inman
Trip Type: Commercial
Direction: In Out



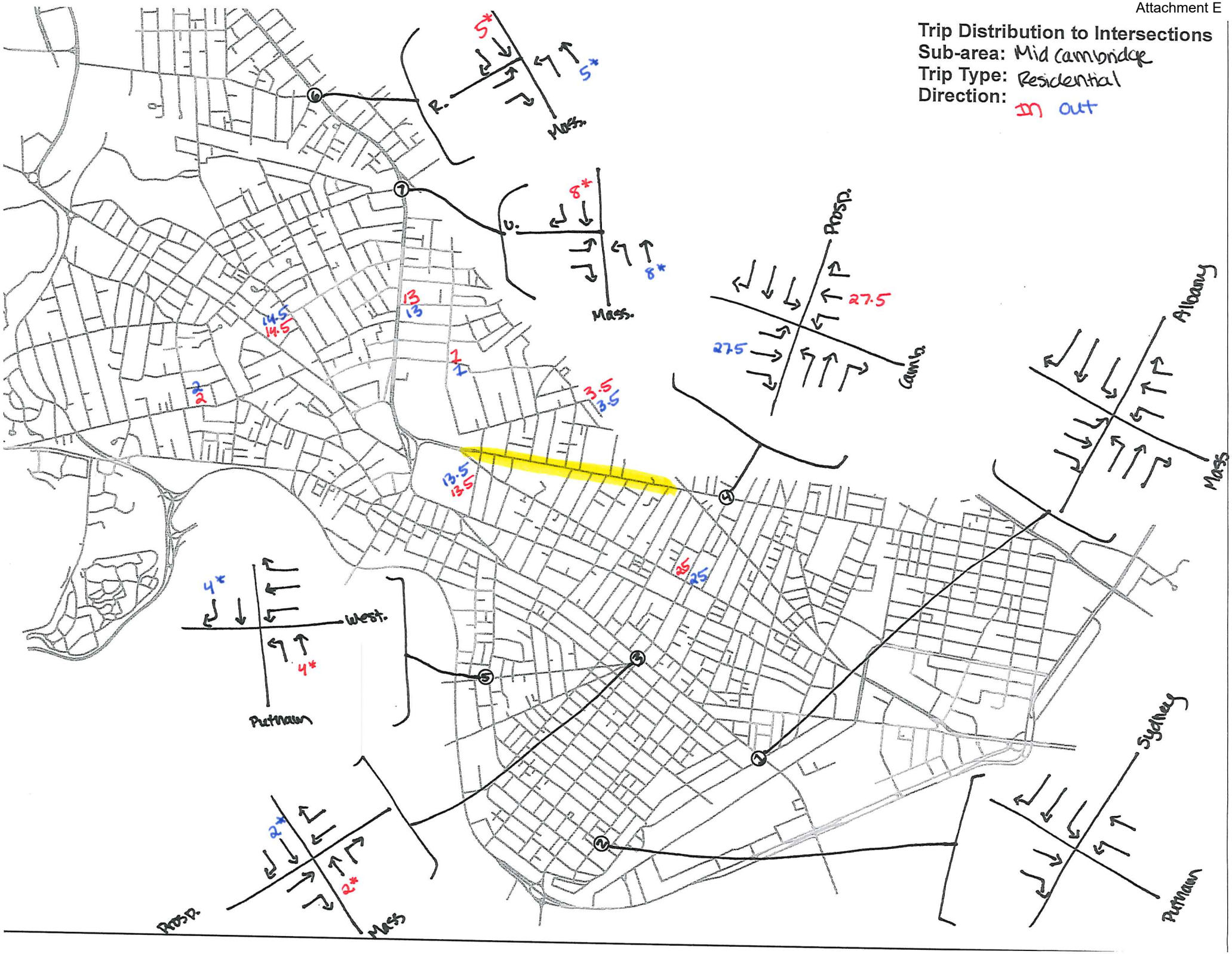
Trip Distribution to Intersections
Sub-area: Inman
Trip Type: Residential
Direction: In Out



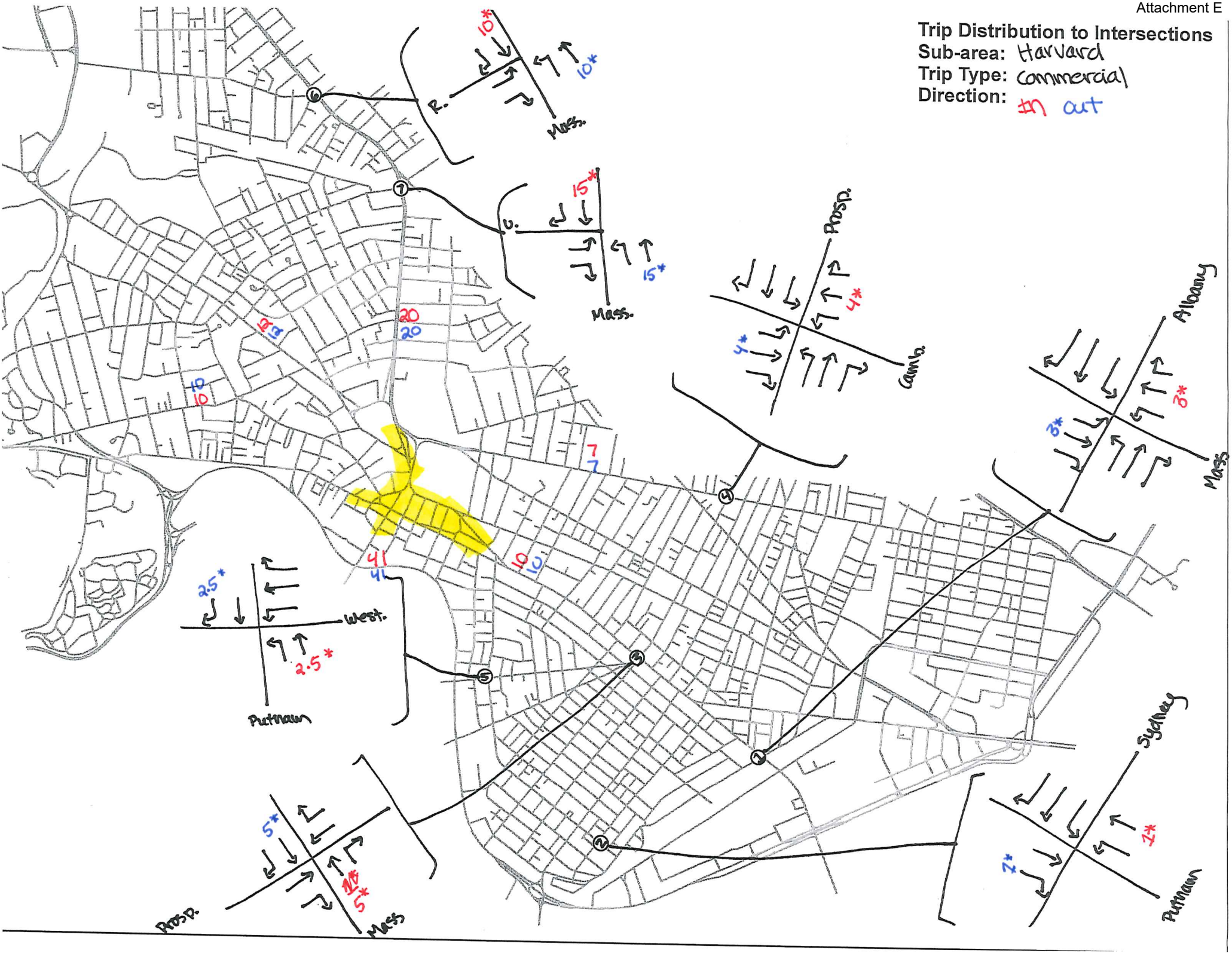
Trip Distribution to Intersections
Sub-area: Mid Cambridge
Trip Type: Commercial
Direction: In Out



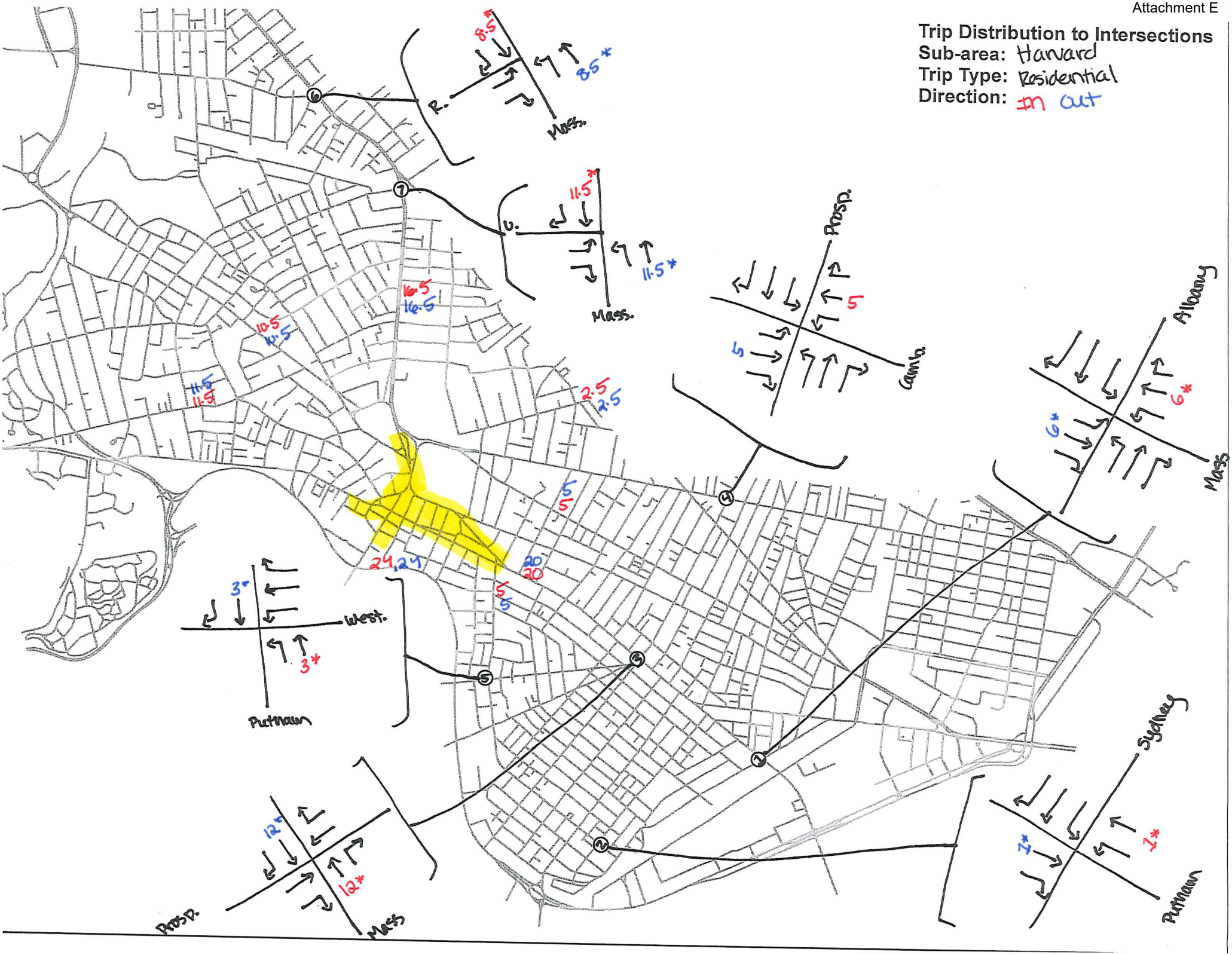
Trip Distribution to Intersections
Sub-area: Mid Cambridge
Trip Type: Residential
Direction: In Out



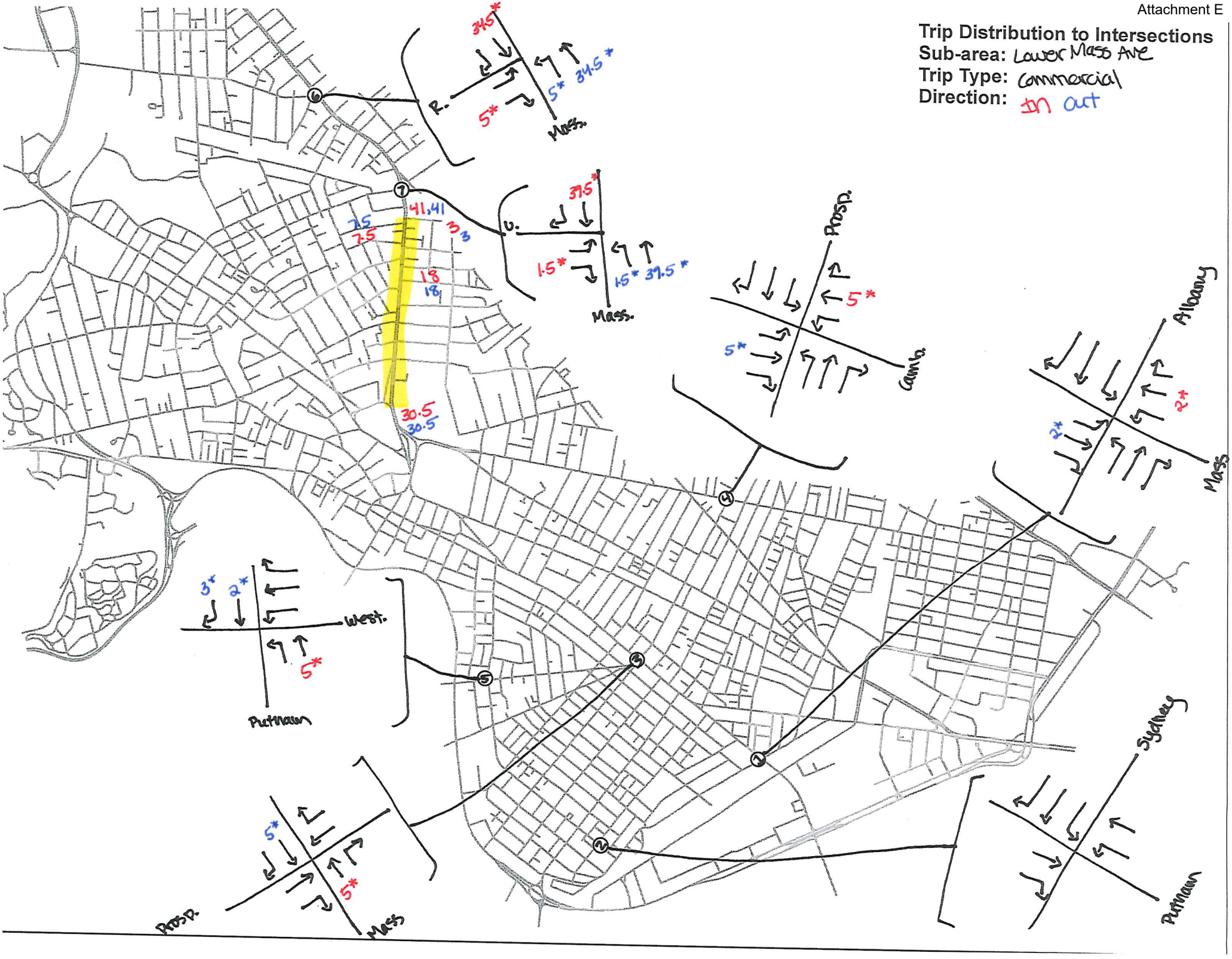
Trip Distribution to Intersections
Sub-area: Harvard
Trip Type: Commercial
Direction: In Out



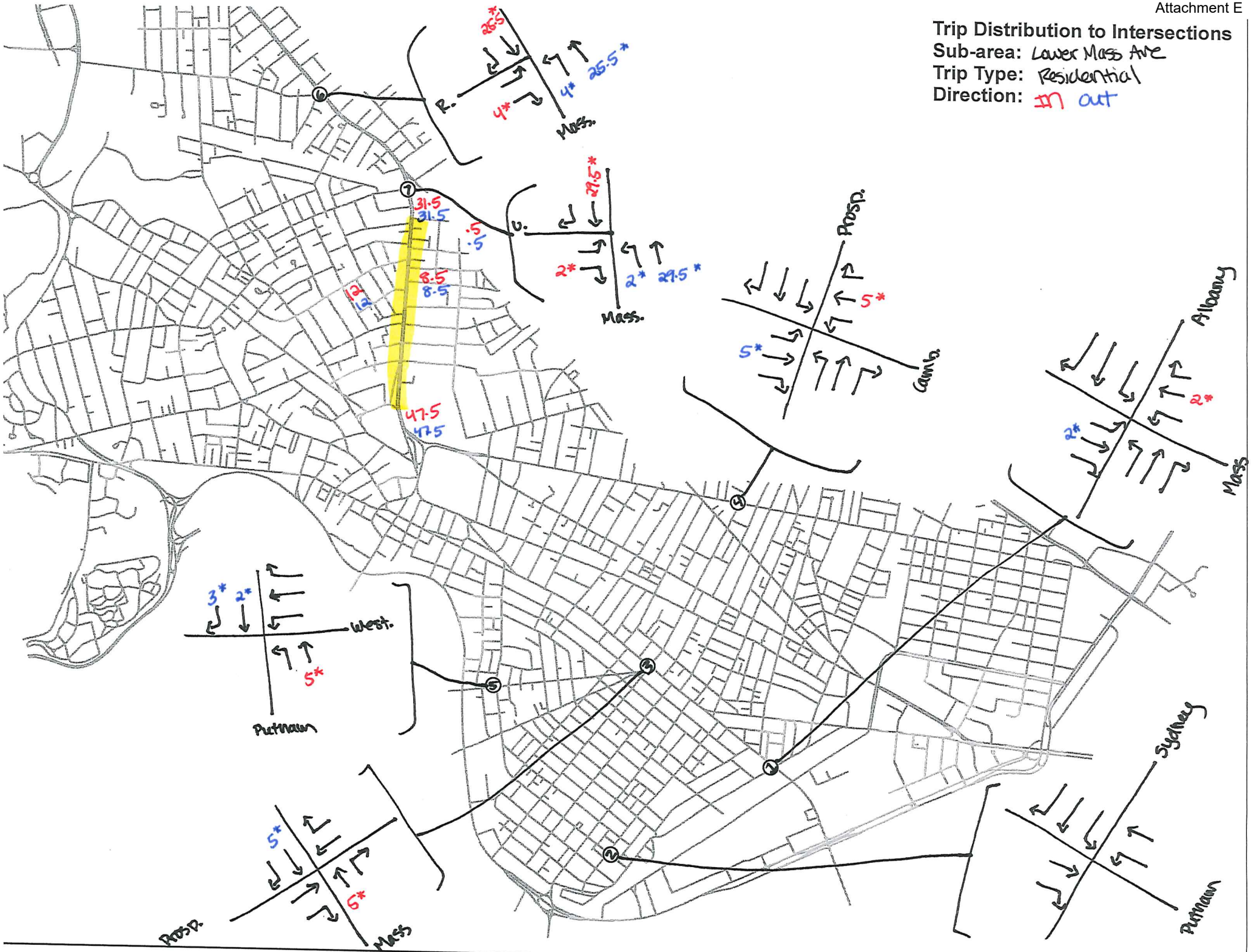
Trip Distribution to Intersections
Sub-area: Harvard
Trip Type: Residential
Direction: In Out



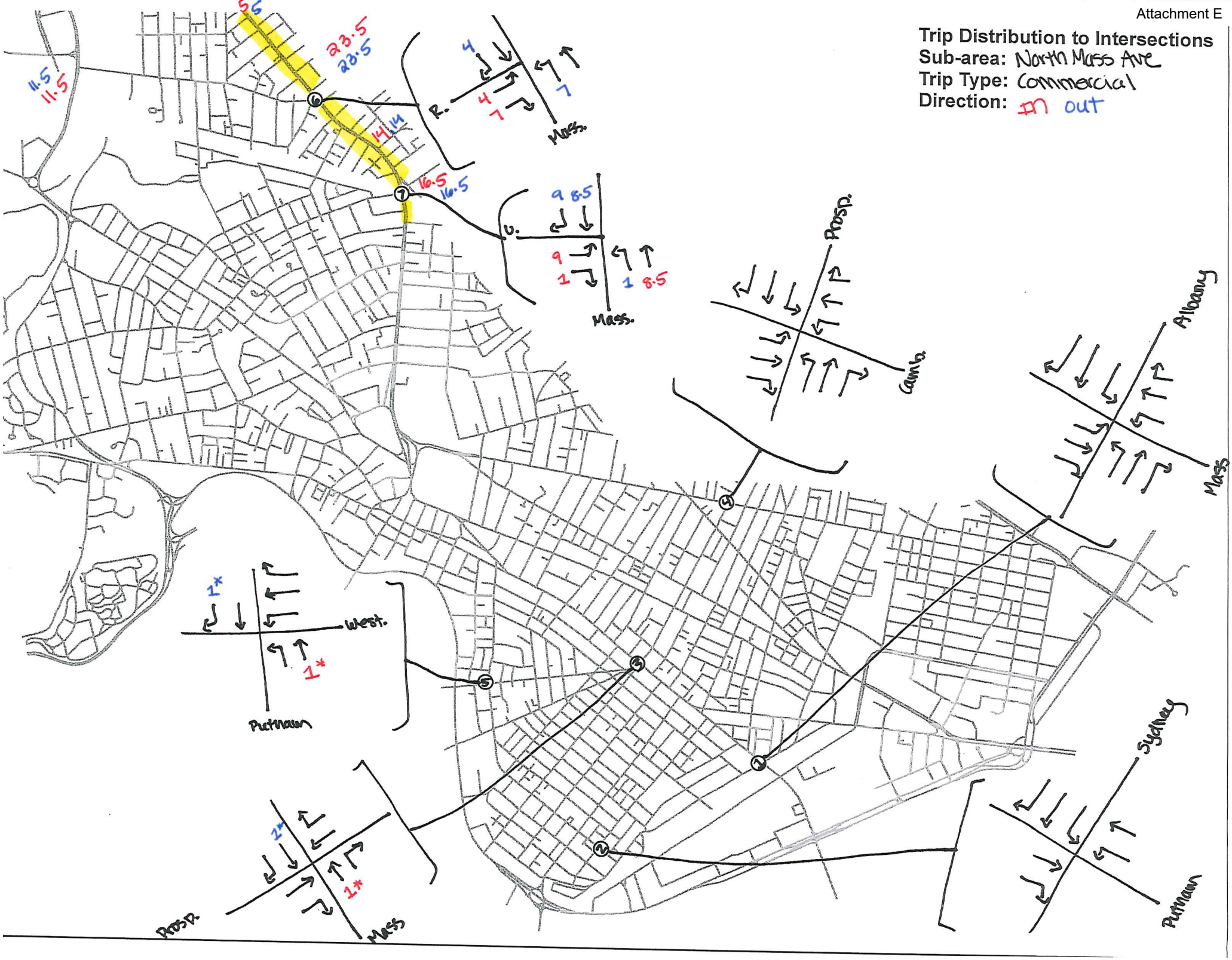
Trip Distribution to Intersections
Sub-area: Lower Mass Ave
Trip Type: Commercial
Direction: In Out



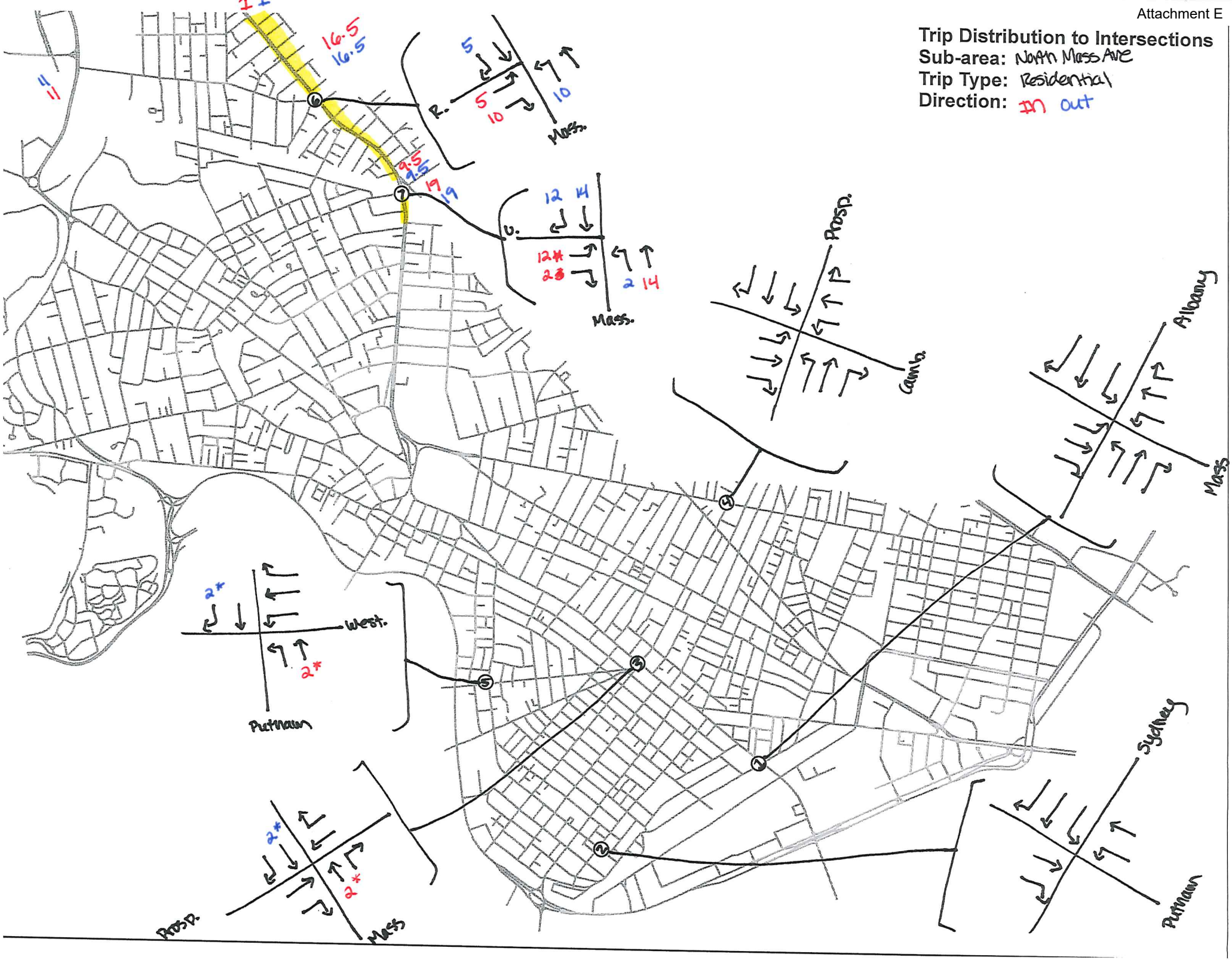
Trip Distribution to Intersections
Sub-area: Lower Mass Ave
Trip Type: Residential
Direction: In out



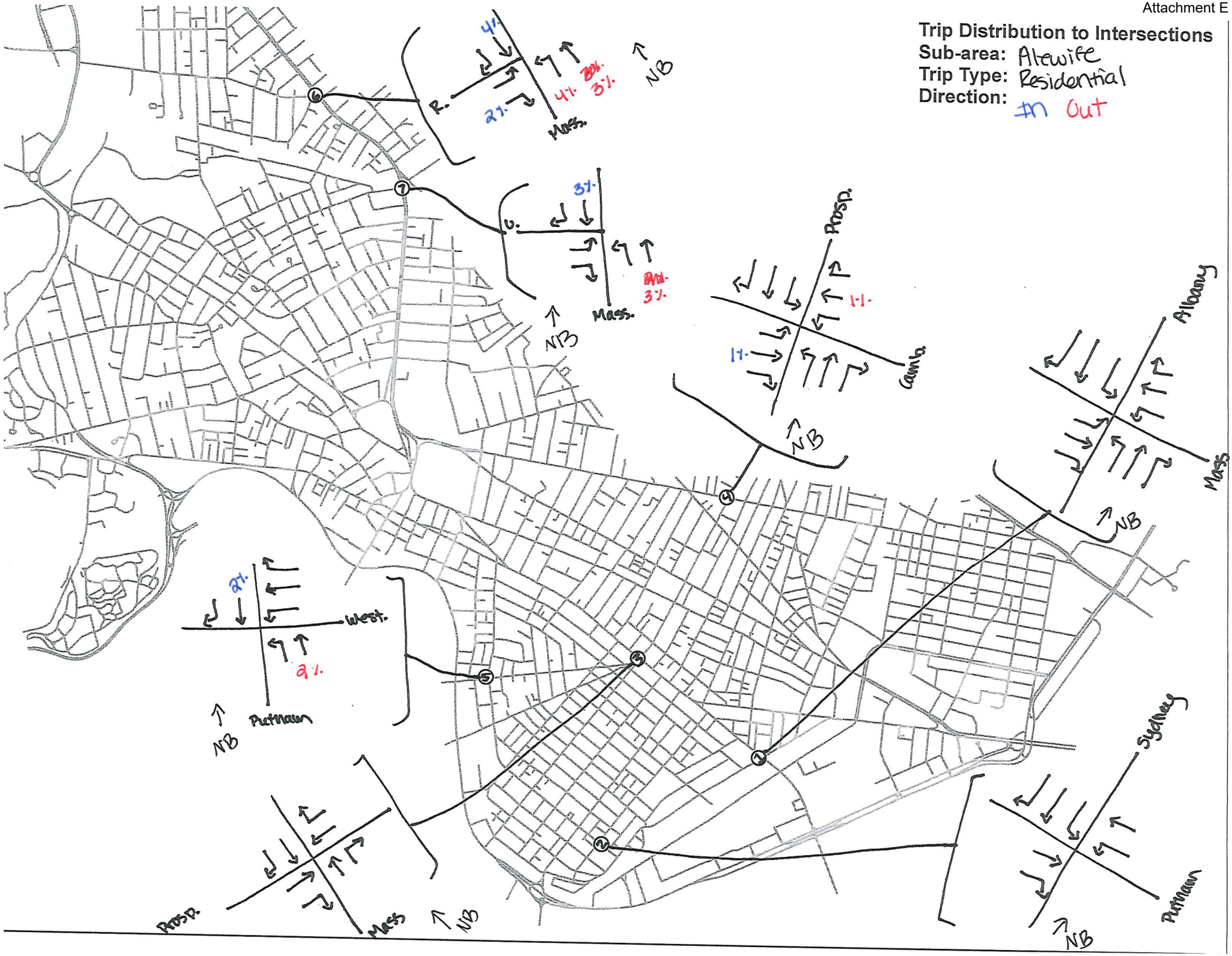
Trip Distribution to Intersections
Sub-area: North Mass Ave
Trip Type: Commercial
Direction: In Out



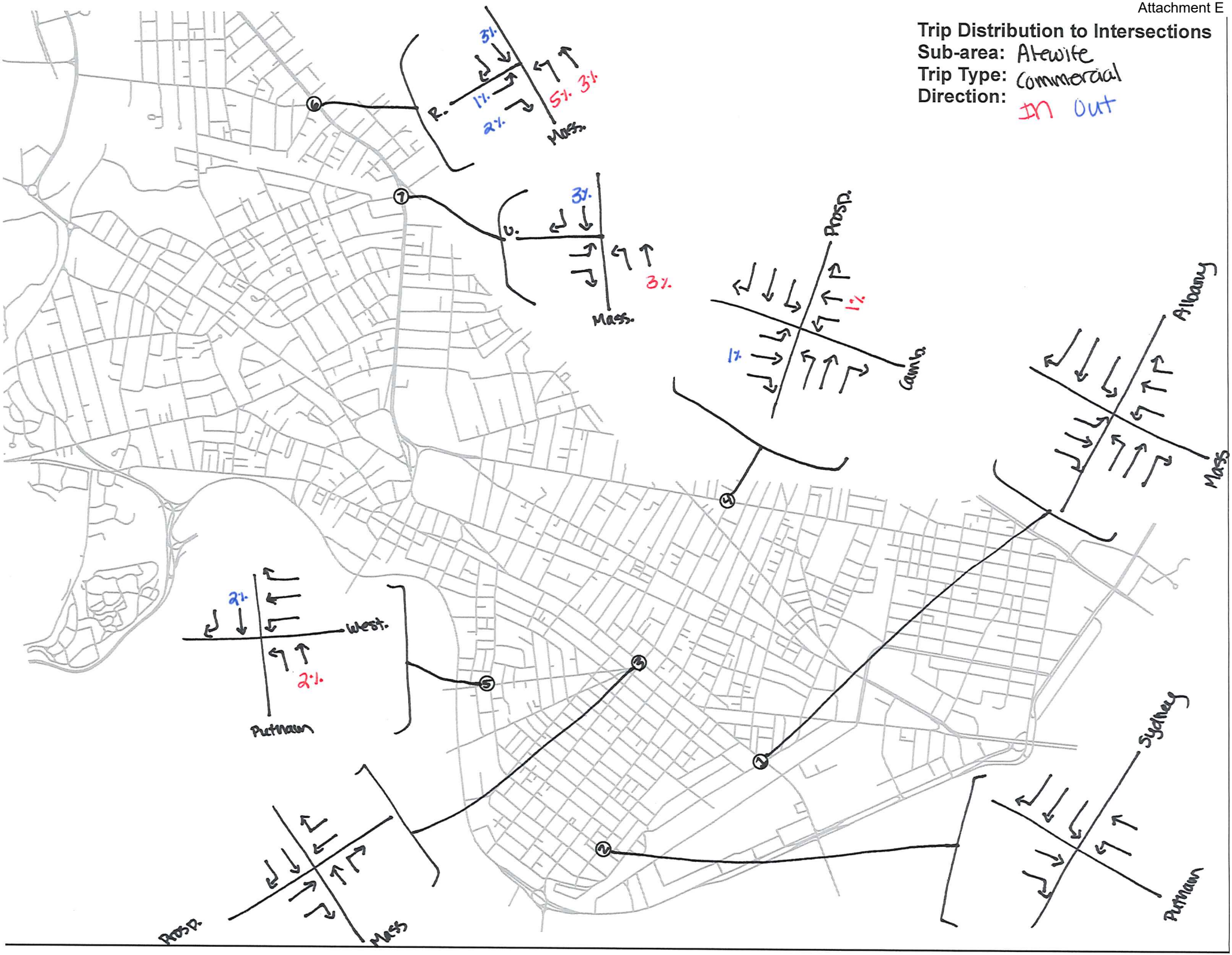
Trip Distribution to Intersections
Sub-area: North Mass Ave
Trip Type: Residential
Direction: In Out



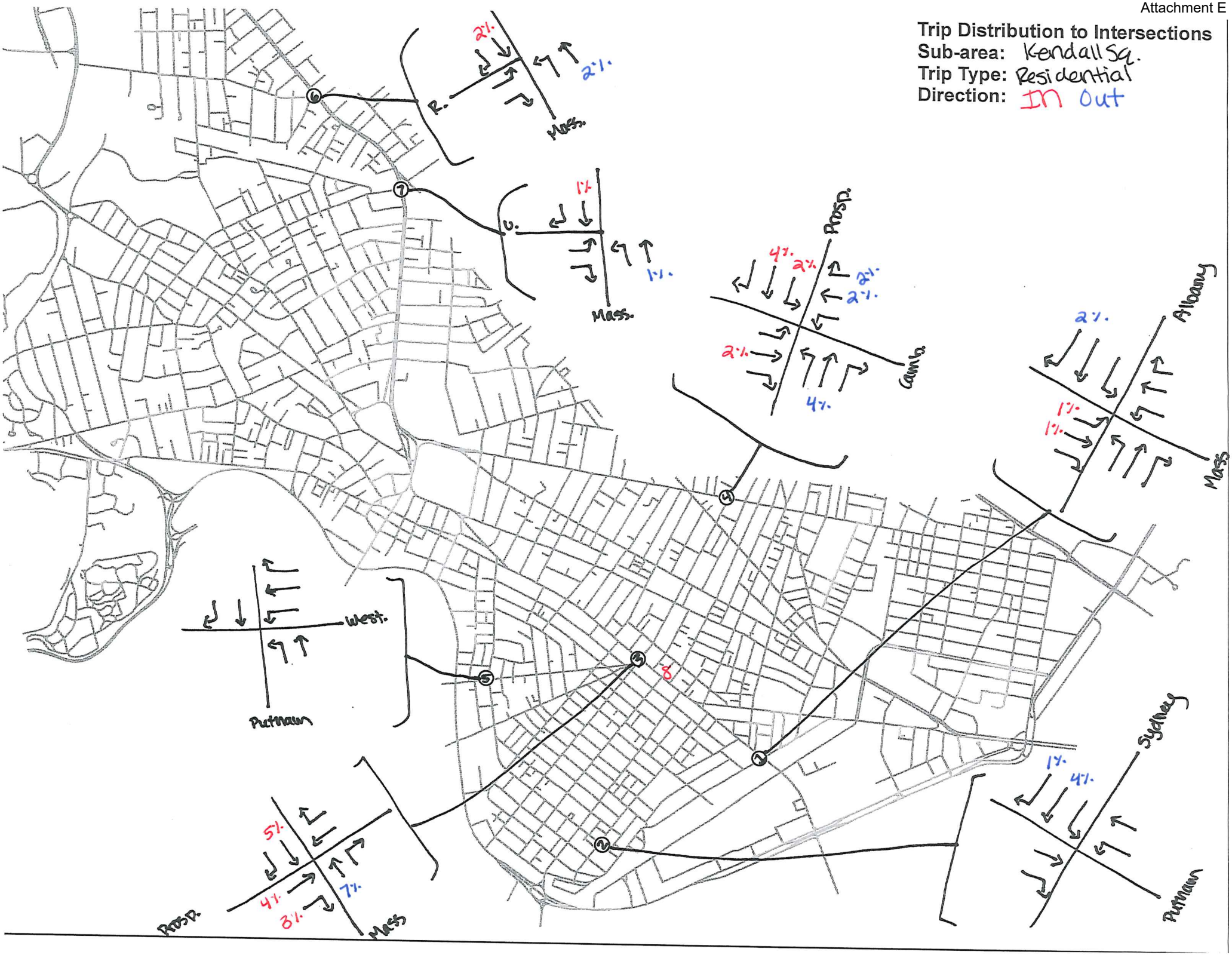
Trip Distribution to Intersections
Sub-area: Alewife
Trip Type: Residential
Direction: In Out



Trip Distribution to Intersections
Sub-area: Alewife
Trip Type: Commercial
Direction: In Out



Trip Distribution to Intersections
Sub-area: Kendall Sq.
Trip Type: Residential
Direction: IN Out



Trip Distribution to Intersections
Sub-area: Kendall Sq.
Trip Type: Commercial
Direction: In Out