SMART GROWTH TRIP GENERATION DATA COLLECTION GUIDELINES

California Smart Growth Trip Generation Rates Study

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AUTHORS
Robert Schneider, Ph.D., University of California, Davis
Kevan Shafizadeh, Ph.D., California State University, Sacramento
Benjamin Sperry, Ph.D., Texas Transportation Institute
Susan Handy, Ph.D., University of California, Davis

1. INTRODUCTION

There is currently no commonly-accepted methodology in the U.S. to collect trip generation data and estimate trip-generation rates for land use projects in "smart growth" areas. Standard trip generation estimation methods established by the Institute of Transportation Engineers (ITE) are derived from data obtained mostly at suburban locations that lack good transit or pedestrian facilities (ITE Trip Generation Handbook 2004). The standard method is difficult, if not impossible, for practitioners to accurately estimate the actual transportation impacts of developments proposed in places where many different modes of travel are used. By following existing guidelines, transportation engineers often over-prescribe automobile infrastructure in smart-growth locations, resulting in wider roadways, more turning lanes, and more parking spaces than necessary. In addition, there is no established approach to recommend adequate pedestrian, bicycle, or public transit facilities that may improve conditions for traveling by these other modes.

The purpose of this report is to describe the data collection and analysis methodology used to document the number of pedestrian, bicycle, public transit, and automobile trips generated by developments in smart growth areas. This multimodal trip generation data collection and analysis approach was applied at 30 study locations in California. It is intended to be replicated and refined in other communities seeking to collect trip generation data in smart growth areas. This approach builds upon established methods so that it can be integrated easily into standard transportation engineering and planning practice. Ultimately, the results of this study and other smart-growth trip generation studies will benefit practitioners seeking to evaluate developments that support sustainable transportation and land use systems.

1.1. Definitions

There is no detailed, broadly-established definition of smart growth. However, in general, **smart-growth areas** are places where many common activities (e.g., workplaces, parks, coffee shops, stores, other homes) are located within a convenient walking distance of where many people live and work. Smart-growth areas are also typically served by pedestrian and bicycle facilities and frequent and reliable public transportation.

Places where activities take place are referred to here as **sites**, or developments. Sites may have a single type of land use activity (e.g., office building) or could include several different land use activities. Land use activities on a site are commonly called **uses**. Sites with more than one use are often referred to as **multi-use sites** (alternatively, "mixed-use developments"). These multi-use sites may be a single building with multiple uses (e.g., office building with restaurants on the ground floor) or several buildings with multiple uses on the same property (e.g., residential condominium building next to an office building).

Study locations for these guidelines should be located within a smart-growth area, and there are two types of possible smart-growth study locations. The first type of study location may have a single set of data collected for an entire, multi-use site. The second type of study

location may have a **targeted land use** (e.g., mid- to high-density residential, office, retail, or coffee/donut shop use) within a larger site. One or more targeted land uses could be studied separately at a given site.

A **person trip** is defined here as the movement of one person between two activity locations. Travel from a person's previous activity location to one of the study locations is an **access trip**. Travel from one of the study locations to the person's next activity location is an **egress trip**. The sum of access and egress trips is the total number of trips generated at the study location. The **person trip generation rate** is the total number of trips generated at the study location during a one-hour period per square foot (for office and retail land uses) or per dwelling unit (for residential land uses). These guidelines further define the **afternoon peak hour person trip generation rate** as the highest rate for a one-hour period between 4 p.m. and 7 p.m. The **automobile trip generation rate** is the total number of automobile trips generated at the targeted activity location during a one-hour period per square foot (for office and retail land uses) or per dwelling unit (for residential land uses). If two people are traveling in the same automobile to a targeted activity location, they are making two person trips by automobile but only one automobile trip.

People often use more than one type, or mode, of transportation on trips between two activity locations. Modes may include walking a few blocks and then taking the bus for several miles or driving an automobile for several miles and then walking a few blocks. Bus stops, parking lots, or other places where people simply change modes are not defined as activity locations. As a result, the **primary trip mode** is defined as the mode used by a person for the longest distance on his or her trip between two activity locations.

2. GENERAL DATA COLLECTION APPROACH

The data collection approach was structured to be straightforward, easily replicated, and adaptable to any potential land use and smart growth development type. It builds on established ITE site-based trip generation data collection guidelines. This section provides an overview of the data collection timeframe and process used to derive multimodal trip counts. Additional details are provided in subsequent sections.

2.1. Study Timeframe

The study timeframe was chosen so that the trip generation data collected at smart growth study locations could be compared easily to standard trip generation data. Overall trip generation rates and modal trip generation splits at smart growth study locations may vary by the time-of-day, day of the week, season of the year. However, the timeframe selected for these guidelines match the most common time periods evaluated in practice. Established trip generation practices typically focus on weekday morning and afternoon commute travel periods, which often have the highest amount of traffic across the transportation system as a whole. It is important to recognize that travel to and from some specific land use types (e.g.,

schools, churches, restaurants) may peak at different times or on different days than the transportation system as a whole. Transportation system impacts at times other than weekday commute periods (e.g., mid-day or weekend peaks) may be an important topic for some studies, but these guidelines focus on overall peak periods rather than peaks specific to individual land uses. It is generally recommended that data be collected during the following periods:

- *Time of day*. Data should be collected during the peak travel periods from 7 a.m. to 10 p.m. and 4 p.m. to 7 p.m. The focus is on identifying the weekday peak hour, defined as the one-hour period with the highest automobile trip generation rate within each peak period.[1]
- *Day of the week*. Data should be collected on typical weekdays, including Tuesday, Wednesday, and Thursday.
- *Seasonality*. Data should be collected in the spring or fall seasons in most areas. Data collection should not occur during holiday periods or in the summer when schools are not in session.
- *Weather*: Aside from seasonal variation, data collection should be avoided on days with particularly cold or rainy weather, which could ultimately affect typical mode choice.

In general, data should be collected on typical commute days – when schools are in session and offices and business are operating normally. The data collection time periods should not represent any seasonal highs or lows at study locations.

2.2. Data Collection and Analysis Process

The data collection and analysis process should include the following four main components, described in greater detail below, for each peak hour studied:

1) Select study locations in smart-growth areas where trip generation data can be collected.
2) Collect data to quantify the total number of person trips generated and percent of person trips by mode for each study location.
3) Combine multimodal person trip data with vehicle occupancy information to estimate actual automobile trip generation rates.
4) Compare actual automobile trip generation rates to ITE automobile trip generation rates.

[1] Door counts are typically collected from 7 a.m. to 10 a.m. with the exception of commercial retail uses that do not open before 10 a.m. Intercept surveys are also collected from 7 a.m. to 10 a.m. at residential and coffee/donut shop study locations, and some trip information is gathered for the 7 a.m. to 10 a.m. period from 4 p.m. to 7 p.m. surveys at office study locations. The analysis may chose to avoid conducting intercept surveys in the morning period at an office study location because the intercept surveys are offered only as people exit doorways and because relatively few people exit offices in the morning. At some residential land uses, door counts can be collected from 6:30 a.m. to 10 a.m. to see if the morning peak hour is earlier than 7 a.m. to 8 a.m. Three-hour data collection periods are used rather than shorter periods to capture more intercept survey responses and create a better estimate of trip mode shares at targeted land uses.

Step 1. Select Study Locations in Smart Growth Areas
Identify appropriate land use category(ies) in the ITE *Trip Generation* report – Use of this method, the first step requires identifying the appropriate ITE-designated code for each land use on the site.

Step 2. Select Study Locations in Smart Growth Areas
In general, study locations with smart growth characteristics are found in urban areas with many activities located within walking distance and with good access to public transportation. Detailed guidelines for selecting the smart growth study locations are presented later in this report.

In general, there are two different approaches to data collection at study locations. Some study locations can be entire, multi-activity sites (i.e., trip generation is evaluated for the entire development of residential, retail, and office uses). Other study locations can be targeted land uses within a larger development (e.g., trip generation was evaluated for individual uses). The types of land uses targeted for the study are described later in the document.

Step 2. Collect Data to Quantify Total Person Trips Generated by Mode
A combination of door counts and intercept surveys are required to quantify the total number of person trips made to and from each study location by pedestrians, bicyclists, transit users, and automobile users during the peak hour. This information is combined with vehicle occupancy data to estimate an automobile trip generation rate in Step 3.

The combination of door counts and surveys is preferred over standard automobile tube counts for several reasons. Automobile tube counts at driveways and other site access points do not provide an accurate count of automobile trips, especially at smart growth study locations because 1) automobile users may park on the street or in an off-site parking lot and then walk to the study location and 2) people may park at a site but walk to a different location nearby without accessing a targeted land use, which is especially common at sites that have shared parking or general public parking. Automobile tube counts at driveways and other access points to a site do not capture trips made by other modes.

It is necessary to combine door counts and surveys to gather accurate multimodal trip generation data. The combination of data collection methods is preferred over using either method independently for several reasons:

- Simple door counts cannot determine whether each person's main mode of transportation is walking, bicycling, public transit, or automobile. Similarly, counting people at the boundary of a development cannot identify whether a pedestrian is walking as their primary mode, walking to or from a parked car, or walking to or from transit (Pike 2011). Intercept surveys gather detailed travel characteristics from respondents so that their primary trip modes can be determined accurately.
- It is difficult and impractical to survey all people exiting a building. Therefore, door counts are necessary to quantify the total number of person trips generated by each

targeted land use. These counts are then used to extrapolate the intercept survey data to represent the total number of person trips by mode at each targeted land use.

Step 3. Estimate Actual Automobile Trip Generation Rates

The multimodal person counts and intercept surveys are used to estimate automobile trip generation rates. Door counts provide the total number of person trips to and from the study location during the peak hour. The intercept survey shows the proportion of all trips that are made by automobile as well as automobile occupancy. The total number of person trips is multiplied by the proportion of trips by automobile to derive automobile person trips. These automobile person trips are then divided by the average automobile occupancy at each site to calculate the total number of motor vehicle trips generated at each study location during the peak hour.

Step 4. Compare Actual Automobile Trip Generation Rates with ITE Rates

The previous step provided an estimate of the actual afternoon peak hour automobile trip generation rates at each study location. ITE peak hour automobile trip generation rates are derived from study location characteristics (e.g., number of residential units, number of gross square feet of office space) using the ITE Trip Generation Manual (2008). The difference between the actual automobile trip generation rates and ITE rates will be the focus of further analysis.

These guidelines are based on ITE data collection guidelines for trip generation studies[2]. Basic ITE requirements should be followed, though some aspects can be modified to capture data efficiently and accurately at study locations with smart-growth characteristics. The only ITE site selection guideline that is not considered in the criteria for selecting study locations in these guidelines is the recommendation to count at isolated sites and discourage counting at study locations where pedestrian and transit access are common. Since the purpose of this effort is to gather data at smart growth sites and collect data on different modes, the count and intercept survey guidelines have been designed to capture these modes accurately[3].

3. SMART GROWTH SELECTION CRITERIA AND STUDY LOCATION CHARACTERISTICS

The analysis focuses on trip generation data at study locations in smart growth areas. Three principles guide study location selection process.

1) Study locations should meet objectively-defined smart growth criteria and include at least one specific land use targeted by this study.
2) Study locations should have similar characteristics to other locations where trip generation analyses are applied.

[2] Institute of Transportation Engineers. *Trip Generation Handbook: An ITE Recommended Practice*, Second Edition, Principal Editor: Hooper, K.G., June 2004.

[3] Site selection guidelines are on pp. 17-18 of the ITE *Trip Generation Handbook: An ITE Recommended Practice* (2004).

3) Study locations must be practical for conducting intercept surveys and cordon counts.

The guidelines in the following sections helped identify study locations.

3.1. Smart Growth Characteristics

The smart-growth guidelines in this subsection provide more specific information related to the four smart-growth principles described in "Evaluation of the Operation and Accuracy of Five Available Smart Growth Trip Generation Methodologies"[4] and include characteristics commonly used as smart-growth measures by the State of California[5] and other organizations[6,7]. Since there are no detailed, broadly-established smart-growth standards, the smart-growth guidelines used for this project were established collaboratively by the project Research Team and a Practitioners Panel. The following criteria were used to selected study locations in California:

- Location: The area within 0.5 miles of the study location should be mostly developed[8]. The study location should not be on the periphery of an urban area.
- Land Use Mix: There should be a mix of land uses in the area within 0.25 miles of the study location. In general, single-use zoning is not consistent with smart growth principles.
- Jobs/Housing Density: There should be at least 6,000 residents living within 0.5 miles of the study location (7,639 residents/mi^2) or at least 1,000 jobs within 0.5 miles of the study location (1,273 jobs/mi^2)[9]. These values provide a rough measure to ensure that the study location is close to a sufficient number of people and activities.
- Transit Accessibility: The study location should be served by frequent transit service. This includes bus stops for at least two routes within one block of the study location that have 15 minute or shorter bus peak period headways or a rail station within 0.5 miles that has 20 minute or shorter peak period rail transit headways[10]. Ferry terminals should not be considered.
- Bicycle Accessibility: The study location should have bicycle lanes, multi-use pathways,

[4] Lee, R., J. Miller, R. Maiss, M.M. Campbell, K.R. Shafizadeh, D.A. Niemeier, S.L. Handy, and T. Parker. *Evaluation of the Operation and Accuracy of Five Available Smart Growth Trip Generation Methodologies*. Appendix B, Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-11-12, 2011.
[5] California Senate Bill 375, 2008. Section 13 defines "infill site," and Section 14 defines "transit priority project."
[6] US Green Building Council. *A Citizen's Guide to LEED for Neighborhood Development: How to Tell if Development is Smart and Green*, Available online: http://www.nrdc.org/cities/smartgrowth/files/citizens_guide_LEED-ND.pdf, 2011.
[7] Washington Smart Growth Alliance. *Smart and Sustainable Growth Recognition Criteria*, Available online: http://www.sgalliance.org/documents/SGRPCriteriaOnly.9-1-2010.pdf, 2010.
[8] Smart growth criteria that use area measurements can be calculated from simple buffers at specified distances from the center of the study location.
[9] 7,639 residents/mi^2 is equivalent to 4.59 dwelling units per gross acre, assuming the national average of 2.6 residents per household.
[10] Smart growth criteria that use proximity to specific transportation facilities (measured in numbers of blocks) can be measured from the boundary of a multi-use site or from the doors of a targeted land use.

or other designated bicycle facilities within two blocks[11].

- Pedestrian Accessibility: There should be more than 50% sidewalk coverage on streets within 0.25 miles of the study location (100% sidewalk coverage is sidewalks on both sides of all streets; 50% sidewalk coverage is a sidewalk on one side of all streets or sidewalks on both sides of half of streets).

Note that some study locations chosen for study may not meet every single guideline. The guidelines were treated with enough flexibility to identify a sufficient sample of study locations for analysis, and these guidelines should not be viewed as rigid constraints that preclude a study location that meets nearly all of the criteria but does not quite meet the minimum or maximum threshold for a few characteristics.

3.2. Study Location Characteristics for Transferrable Results

Study locations should be comparable to other similar developments throughout California and the United States, which would make it easier to integrate the results of the project with existing trip generation analysis practices. The following guidelines have been established to make the results more transferrable to other locations:

- The study location should contain at least one of the following land uses:
  - Mid-to-high density residential, including high-rise apartment (ITE land use code 222), mid-rise apartment (223), or high-rise residential condominium/townhouse (232) (developments that contain more than 50% subsidized, low-income residential units should be excluded).
  - Office, including general office building (710).
  - Retail, including specialty retail (814), pharmacy/drugstore without drive-through window (880), or shopping center (820).
  - Coffee/donut shop without drive-through window (936).[12]
- The land use mix within and surrounding the study location should be similar to other developments (i.e., it is not so unique that the trip generation data would not apply to other sites). For example, the following study locations should probably be avoided:
  - Specific land uses with higher-than-normal overall customer bases, such as the only grocery store in an entire downtown district.
  - Study locations in university areas. This includes study locations within 1.0 miles of a university with 5,000 or more students and study locations within 0.5 miles of census tracts with more than 15% of the population between ages 18 and 21.
  - Study locations that include or are located within 0.5 miles of stadiums, military bases, commercial airports, major tourist attractions, “specialty” shopping areas (e.g., Union Square in San Francisco), subsidized housing projects, or other special attractors that are not typically included in trip generation studies.
- There should be no construction or other activity at or near a study location that

[11] To be counted as “designated bicycle facilities,” the facilities should include more than standard bicycle route signs or pavement markings that direct drivers and bicyclists to share existing travel lanes.

[12] The targeted land uses can be limited to these specific land use codes in order to have a manageable number of land use codes to study.

restricts access and activity volume.

- The site or targeted land use should be at least 80% occupied and at least two years old. As a rule of thumb, retail and residential developers generally look to achieve 90% occupancy. Below 75% occupancy is considered a failed retail development. Office developers look for 85% occupancy.

3.3. Study Location Features for Efficient Data Collection

It is important for study locations to be practical for conducting door counts and intercept surveys. The following guidelines help to identify study locations for efficient data collection:

- Permission should be obtained from the property owner/manager to collect data at each site or targeted use[13]. Even if a study location has ideal smart growth characteristics and land use types, it may not be possible to collect data because the property owner will not grant permission. In most cases, the property owner or manager communicates with internal businesses, residents, and other tenants about permission for the study. In some cases, the survey supervisor may need to make direct contact with individual owners to gain full permission. Therefore, study locations under ownership or management of one entity are preferred over locations with multiple owners or managers due to the complexity of obtaining permission to collect data.
- The study location should have a definable external boundary that can be used for cordon counts, which may include a site (property) boundary, a building perimeter, the set of doorways used to enter and exit a targeted land use, or an arbitrary cordon line that will be readily comprehensible and easily remembered by survey personnel.
- Multi-use buildings should have definable internal boundaries (e.g., doors where counts can be taken) between different targeted land uses. For example, in a mixed-use office building with a restaurant on the ground floor, data should be collected at internal doors that connect the restaurant to the office space (as well as other external doors to both uses). If ground-floor retail or restaurant units have no internal connection to other uses within the building, they can be evaluated independently.
- To conserve data collection resources, the study location should have a limited number of doorways. In general, one door counter and one intercept surveyor is needed at each door. Yet, it is possible to increase the coverage of each data collector at certain types of study locations.
    - At some study locations, a single door counter can observe two or three different

[13] Obtaining permission to collect data at specific sites or targeted uses is essential to implementing the door count and intercept survey methodology. The survey supervisor should contact property management by phone and e-mail, and then meet as necessary to discuss the purpose and procedures of the data collection effort. During each contact, the survey supervisor should emphasize that the data collection team 1) will be professional, 2) will not impede or hassle tenants or customers (any person who refuses to participate in the intercept survey will be left alone), and 3) will not divulge proprietary or sensitive information. An incentive for property management to cooperate may be to offer the opportunity to receive the survey results or a copy of the study report. In some cases, when permission is first requested, the initial contact person may not allow data collection. However, follow-up calls or visits with the initial contact or someone at a higher management level (e.g., corporate headquarters) may help ease concerns and secure permission. In other cases, the first contact person may initially provide permission, but their boss or corporate management may later rescind permission. It is can a challenge to obtain permission.

doors simultaneously from a carefully-selected vantage point. This approach works best at locations with relatively low levels of activity.
    - It may be possible for a single intercept surveyor to cover more than one doorway at the same time. This approach is possible when doors are no more than 20 to 30 feet apart.
    - It may be possible for a single intercept surveyor to rotate among several doors, spending specific time intervals at each door so that the probability of intercepting an individual from each door over the entire data collection period is roughly equal.
    - In undesirable cases where certain doors are counted but not surveyed, it is possible to extrapolate survey responses from a carefully-chosen sample of other similar doors at these sites. However, as the percentage of surveyed doors becomes smaller, extrapolation estimates become less accurate.
- The study location should not have significant through traffic. If there are people who pass through the building doors without accessing a targeted land use on the site (e.g., people who use public parking in a building before walking to another building or people who access a different use in the building that is not being studied), these trips should be identified through intercept surveys. These trips should be excluded from the analysis.
- A study location should have enough activity to provide a sufficient number of intercept survey interviews during a single day of data collection. A goal should be to record at least 50 trips (absolute minimum of 30 trips) during each afternoon peak period at each study location. Sample sizes of less than 30 are typically avoided to ensure the sample results benefit from the central limit theorem that says the sampling distribution of the means will approach that of a normal distribution even if the population being sampled is not normally distributed.[14] As a rule of thumb, residential sites with fewer than 150 units and offices with less than 100,000 gross square feet may not to have enough activity.

3.4. Field Visits to Finalize Study Locations

Field visits should be made to the study locations before the day of data collection. Field visits should be conducted to:

- Select specific buildings and uses within buildings to be targeted for data collection.
- Observe activity patterns within and around the study location and anticipate how activity patterns may change between morning and evening peak periods (based on observed movements and land use types).
- Observe how people travel to and from transit stops, parking lots, and parking garages to access the study location.
- Note whether parking lots and garages allow public parking, which may suggest that people use an on-site parking lot but do not go to any of the targeted land uses on the site.
- Estimate the total number of data collectors needed to do door counts and intercept

[14] *Fundamental Research Statistics for the Behavioral Sciences*, John T. Roscoe, Holt, Rinehart and Winston, Inc., 1969.

surveys at each study location (e.g., identify any locations where a single counter or surveyor could cover more than one door or any low-activity doors where surveyors may not be needed).
- Identify where data collectors should stand outside of all doors at each study location during morning and evening periods.
- Anticipate potential challenges to data collection.
- Record data on explanatory variables that can only be collected in person.

Google Street View can be used to review site characteristics at study locations before data are collected. This approach works but is not ideal, because on-line image sources like Google Street View may not always have up-to-date pictures, may not always indicate whether parking garages allow public parking, may not show internal building doorways between uses, and may not provide a good sense of specific activity patterns or overall levels of activity at study locations.

3.5. Characteristics of Study Locations

Some targeted land use study locations shared the same building, site, and surrounding area characteristics. Summary statistics describing the characteristics of the entire set of study locations should be interpreted with this in mind.

The study locations represented smart-growth areas in the urban areas. A variety of development types can be represented, including:

- Central business districts
- High-density residential developments within urban areas
- Office developments within urban areas
- Commercial retail developments within urban areas
- Mixed-use developments within urban areas
- Transit-oriented developments

3.6. Site Layouts

Development sites in smart growth areas often have multi-use buildings with internal doorways, multi-story parking garages, parking lots shared among several nearby land uses, and a mix of public and private parking. These site layout characteristics are critical to understand in order to obtain an accurate count of the trips generated by each mode at each study location. Different layouts required different approaches to data collection. Common site layouts observed at the study locations are described below.

Type 1. Multi-Building Site

Multi-building sites have one trip generation rate calculated for a single property with several different buildings. Data collection at these sites involves counts and surveys at each access point on the boundary of the site. These access points includes driveways, external building doorways, and parking garage entrances and exits.

Type 2. Targeted Use with No Parking Lot

Some targeted land uses do not have a direct connection to a parking lot. These targeted uses are typically in urban core areas with high-density residential or commercial development. Data collection at these study locations involves doing counts and surveys at the doors to the targeted use. Unless there is a transit stop within the site containing the targeted use, all people who travel to this type of study location should be recorded as walking for at least part of their access or egress trip (although walking should only be considered the primary trip mode if the person walked for the entire trip distance).

Type 3. Targeted Use with Private Parking Lot

Other targeted uses may be served by their own private parking lot, which could be a surface parking lot or a parking garage. Where possible, data should collected at all doorway access points to the targeted use (including access points from different levels of a multi-story parking garage). However, if the property manager does not provide permission to survey inside the parking garage or at other locations on private property, data collectors may stand at direct public access points to the targeted use and public access points to the parking lot. Respondents who park in the private parking lot should be considered to be using an automobile to access the targeted use. They should not be recorded as walking for the part of their trip between their parked car and the doorway.

Type 4. Targeted Use within Site with Shared Parking

A few targeted uses may be part of larger sites that share parking between uses or provide public parking, which could be a surface parking lot or a parking garage. Where possible, data should be collected at doorway access points to the targeted use. However, if the property manager does not provide permission to survey inside the parking garage or at other locations on private property, data collectors can stand at direct public access points to the targeted use and public access points to the parking lot. In most cases, respondents who park in the parking lot at this type of study location should considered to be using an automobile to access the targeted use, regardless of where they park on the site. However, if a respondent parks in the parking lot and visited a different use on the site before he or she went to the targeted use, he or she can be recorded as walking to the targeted use. The same rule can be applied in reverse for the egress trip from the targeted use. People who accessed the parking lot or a different use on the site but did not access the targeted use should not be counted in the analysis phase of the study.

Type 5. Targeted Use in Multi-Use Building with Internal Connections

In some cases, the targeted use can be connected to other uses in the same building through internal doorways. Data collection at these study locations involved doing counts and surveys at the doors to the targeted use. This included internal building doorways connecting from other uses to the targeted use. If a respondent traveled between the targeted use and another use in the building through an internal doorway, he or she should be recorded as walking for this trip. It is possible for multi-use buildings to have no parking, private parking, or shared parking.

4. FIELD DATA COLLECTION

Field data collection requires a combination of door counts and intercept surveys. These two aspects of the trip generation data collection process are described in detail below. The final parts of this section describes the data collector training process, field work, and data entry.

4.1. Door Counts

The core field data collection component at each study location is a count of all people entering and exiting the site or targeted land use. This count provides the total number of person trips generated at each study location during the afternoon peak period.

Door counters should tally all people passing through the doorways (except people who take out garbage, take a smoke break near the building, or other people who obviously enter and exit without going to another activity location). People entering each door are counted separately from people exiting. Gender can also be recorded to help identify if either gender is underrepresented in the intercept survey. Gender bias can be corrected later by weighting the survey results based on observed door counts. Finally, the door counts are tallied in five-minute increments, which makes it possible to identify trip generation peak patterns within shorter time intervals (e.g., the afternoon peak hour can be identified as being 4:25 p.m. to 5:24 p.m. rather than 4:30 p.m. to 5:29 p.m.). The door count form is provided in Appendix A.

Staffing requirements and data collector positioning must be identified in advance of the data collection period at each study site. Slightly different strategies may be used to gather accurate counts at sites with different layouts:

- At multi-building sites, counts should be taken at all access points on the boundary of the site. These site boundary counts include all people entering and exiting the site. People traveling together in the same automobile should be counted individually.
- At most targeted land uses, counts should be taken at all doorways providing access to that use, including internal doorways connecting the targeted use to the parking garage or other uses within a building.
- At several targeted land uses, it may not be possible to count people at doorways leading directly to the targeted use, which may occur at multi-use buildings where permission is not provided to count at internal locations within the building, such as at doors leading from a parking garage directly to the targeted land use. In these study locations, counts can be taken at external doorways, such as parking garage entrances and exits. However, these counts should include people going to or coming from any use in the building (or other nearby locations if the garage is public), not just people who access the targeted use. Therefore, survey respondents intercepted at the external doorways should be asked to indicate whether or not they actually visited the targeted use, and this information should be used to adjust the count data to reflect the number of trips to and from the targeted use.
- At study locations where transit stops are located within the site or targeted use, it would be necessary to count all passengers as they boarded or exited the bus or train.

However, for comparison to standard automobile tube counts, buses would also need to be counted as single vehicles.

The total count of person trips at each door can be allocated by travel mode using intercept survey data collected at that door. It may not possible to obtain complete surveys from every person entering and exiting a study location, so the door counts are critical to providing the best-possible estimate of the correct trip generation rate.

4.2. Intercept Surveys

In-person intercept surveys should be offered to a sample of people as they exit doors at each study location. These surveys have been designed to determine: 1) the mode, time of day, origin, and length of access trips to the study location and 2) the mode, time of day, destination, and length of egress trips from the study location. The travel mode and time of day for each trip are the most important pieces of information on the survey because they are used to allocate the peak-hour door counts by travel mode. The intercept surveys also collect information about vehicle occupancy so that the person trip counts for automobile users can be compared to ITE vehicle-based trip rates.

Age, gender, and home zip code are included on the survey to identify socioeconomic characteristics of participants. Comparing the gender of survey respondents to the gender of people counted at doors makes it possible to account for any potential gender bias in the sampling procedure. Trip origins and destinations, trip length, respondent age, and respondent zip code are all optional and can all be used for additional travel behavior analysis. Finally, the survey form also includes space for data collectors to note the time of survey refusals as well as estimates of the gender and approximate age of individuals who refused to participate. The standard survey form is shown in Appendix B. There is space for up to five different respondents to provide access and egress trip information on a single page.

The full survey typically takes 30 to 60 seconds for respondents to complete. If a respondent makes multiple trips to and from the study location during peak hour travel periods that day, the survey can take slightly longer than 60 seconds.

Some potential respondents can be in a hurry as they exit study locations, so they may not want to stop to complete the full survey. Some of these people refuse to participate. However, some of them may be willing to share information quickly as they walk by. An abbreviated version of the survey can be used in this situation. This abbreviated version asks only two questions about the respondent's current trip: "How are you getting there?" and "Where are you going?" This option can be completed in around 10 to 15 seconds. The mode of transportation for the respondent's current trip remains the only absolutely essential information needed to constitute a usable survey for the purpose of this study. Therefore, partial survey responses still provide useful information, even though they may not include many details.

Exit surveys are used rather than entry surveys for several reasons. Survey participants can be selected randomly. Surveyors did not have an option to choose people who they thought would be more likely to participate in the survey; they should be trained to always invite the next person who exits the door. Furthermore, entry surveys have several disadvantages. It is more difficult to get permission for surveyors to stand inside the building and intercept people as they entered doorways. If the surveyors stand outside (typically on public property or in a common area), it can be difficult to determine which people are going to the targeted use and which people are just walking by. In addition, at locations where surveys are offered at parking garage access points, it can be onerous for drivers to stop while entering from the street. It is much easier to stop drivers at an exit as they approached the public sidewalk crossing.

During the survey, respondents are asked where they are going (egress trip) before they are asked where they came from (access trip) for three reasons:

1. Respondents are expected to be able to answer the question easily. They would be aware of where they are going at the time of the survey and would not need to try to recall a trip made earlier in the day.
2. The mode of the current trip is the only absolutely essential piece of information that is required from a respondent, so this survey design makes it possible to obtain that information in the first question. In many cases, hurried respondents may also able to respond with the name of the intersection closest to where they were going next before walking, bicycling, or driving away. These abbreviated surveys are still useful for the main purpose of the research project.
3. Asking about travel mode first helps to engage respondents. By quickly asking, “What type of transportation are you using now?” or using the modified wording, “Can you tell me about your commute home?” or “Can you tell me about your travel for 15 seconds for a Caltrans study?”, the surveyors are able to generate immediate interest in the survey.

In practice, when the full survey is used, the order of the survey questions can be somewhat confusing for the survey personnel and respondents. It may be easier to ask questions chronologically, starting with where the person came from immediately before accessing the study location and the mode they used to make that trip. Then the current trip mode and destination can be investigated. However, the abbreviated survey only asks about the current trip, so it makes sense to have this information listed first.

Surveyors will learn to adapt the language and order of the survey questions to obtain the information needed. Depending on the site layout, characteristics of the exit point, and the type of targeted land use where surveys are being offered, the survey can progress more smoothly when the surveyor put questions into his or her own words. Therefore, initial training and practice is critical to make sure surveyors understand the type of information that should be recorded and to let them know that they have the flexibility to modify and diverge from the survey script when necessary. The survey form can be adapted for respondents to provide

information about multiple trips to and from the study location (more than a single access and a single egress trip).

Surveyors and door counters should be stationed at parking garage access points at some study locations. This approach can be used at buildings where property management does not allow data collection in the parking garage or other locations inside the building. These parking garages often serve multiple uses (not just the targeted use). Therefore, the surveys are essential for determining the proportion of people exiting that actually accessed the targeted use.

Parking garage entrance surveys use a slightly modified approach. Intercept surveyors wearing orange and yellow vests stand on the driver's side of the garage exit point (at or just in advance of where the garage driveway crosses the public sidewalk). When a vehicle approaches, they can motion to drivers to roll down their window and take the abbreviated version of the survey. The mode question is straightforward (automobile), so the only other critical survey information is whether or not the respondent actually visited the targeted use. Many drivers may stop long enough to provide their trip destination and home zip code. The total number of people in the automobile can be observed. These parking garage surveys take less than 15 seconds. To prevent congestion and driver frustration, surveyors did not ask drivers to stop for the survey if there are other vehicles immediately behind approaching the garage exit. Future applications of the survey methodology can test different orders of questions and different types of survey forms. The ideal survey form should be adaptable to full-length or abbreviated surveys and be easy to understand in either case. Other suggestions for future multimodal trip generation intercept surveys include:

- Provide in-depth training to surveyors. Focus on understanding the definition of an access trip and an egress trip (some surveyors interpreted the "trip you took to get here" as the 10- to 20-foot movement from the door of the study location to the surveyor—rather than the trip they had taken to get to the study location).
- During training, clarify that surveyors should not try to guess the mode of transportation people are using if they refuse to participate in the survey. To be participant in the survey, a person must at least give a verbal answer to the type of transportation that he or she is using on his or her current trip. Otherwise, they should be marked as a refusal. Surveyors should not try to guess the mode being used, even if they are able to watch a person who refused the survey walk the whole way to his or her next activity or get on the bus at an adjacent bus stop. Even though the surveyor could record the mode used in the examples above "correctly," those trips would not be sampled in the same way as trips from other respondents which is a problem because there is no way to correctly guess the mode of a person who walks to parking or walks to a transit stop that is out of sight. If non-respondents whose mode could be observed "correctly" are included, the

modes that could be observed directly would be oversampled, which would introduce bias into the results.

- Add a short question to the survey to determine whether or not the person actually accessed the targeted use. This is needed at doorways that may be used by people from other uses in the building or surrounding area besides the targeted use.
- Surveyors should use the time in between surveys to make sure their handwriting is clear, spell out abbreviations, and clarify any markings or notes that could help make data entry easier. This is especially important because someone other than the data collector often enters the data.
- Data collection managers should review survey responses recorded over the first 30 minutes of a data collection period to correct any systematic errors being made by the surveyors. At sites with morning surveys and afternoon surveys, data collection managers should review the morning surveys to catch common errors and discuss them with the surveyors before they start afternoon data collection.
- Try to get permission to survey at doors that provide direct access to targeted land uses rather than at shared parking garage entrances. Surveying all people exiting parking garages just to obtain data from a certain proportion of people who accessed a particular use on a site is less efficient (surveyor time is spent collecting non-usable survey data) than surveying at direct access points. It also introduces another analysis step and its associated error into the final trip generation calculations. When the methodology is used in the future, data collection managers may want to make a rule that targeted uses should not be studied unless the property manager provides full permission to survey at all direct access points to the targeted use.

4.3. Recruitment and Training

This method requires reliable door counters and intercept surveyors. Professional data collection companies can be used to conduct intercept surveys, while temporary agency personnel can be hired to conduct counts at doorways. After recruiting professional data collection companies, the survey processes must be discussed and coordinated with managers at these companies. The intercept surveyors require an outgoing personality. The interviewers provided by the data collection companies should be friendly, assertive, willing to approach and talk to strangers, look professional, and understand the purpose and procedure for the interviews. Key points made to door counters and intercept surveyors during the data collection process are listed in Appendix C.

4.4. Data Collection at Study Locations

Several days in advance of field data collection at each study location, a map should be prepared of the study locations where door counts and intercept surveys are conducted. Maps also included the names of buildings, stores, and areas to which survey respondents could refer.

On data collection days, door counters and intercept surveyors should be oriented around the site at least 15 minutes prior to the beginning of the data collection period. Early arrival allows

data collectors to observe the site layout, familiarize themselves with their particular survey or count location, and use the restroom, if necessary. Prior to the start of a data collection period, the data collection manager can review the data collection procedure with each data collector and answer any questions. The data collection manager can also confirm that counters know which movements should be noted and where the counts should be recorded on the form. After data collection begins, the supervisor should circulate among the counters and surveyors in the field to ensure data are being collected correctly. (See Appendix D).

The data collection managers should monitor the real-time progress of the counts and intercept surveys and made adjustments as necessary to achieve a sufficient sample. Adjustments can include redeploying surveyors to different locations with more activity. If there are extra personnel, they can be rotated among the doorways where counts or surveys are being taken to give short breaks to other data collectors. If extra data collectors are not available, the data collection manager can step in to provide relief to the data collectors.

4.5. Data Entry and Quality Control

The paper door count and intercept forms are entered into electronic spreadsheets. Data entry is a time-consuming process, and quality control checks are important part of the process. Count forms and intercept forms should be systematically checked with the database for errors or mistakes.

5. DATA PROCESSING AND ANALYSIS

This section describes how the count and survey data are analyzed to estimate trips to and from each study location during the afternoon peak hour. This process involves several steps:

- Step 1. Quantify the total number of person trips made during the afternoon peak hour to and from each study location.
- Step 2. Determine the trip mode share at each door during the three-hour afternoon data collection period.
- Step 3. Allocate peak-hour person trips by mode at each door.
1. Step 4. Calculate peak-hour person trips by mode for the full study location.

5.1. Quantify Total Peak-Hour Person Trips at the Study Location

People should be counted entering and exiting doors over five-minute intervals throughout the three-hour study period at each study location. These door counts should be summed to quantify the total number of person trips generated by the targeted land use. At some sites, counts can be taken at doors to a garage that allowed public parking. In these locations, a portion of the people counted at the garage doors may not access the targeted land use (e.g., they may access another land use within the building, access another land use nearby, or just pass through the garage). Survey responses are used to identify and subtract the people who do not access the targeted use at each door. Next, the number of peak-hour person trips is quantified at each study location.

5.2. Determine Trip Mode Share at Each Door

To estimate the travel modes used for peak-hour person trips, the modes used by intercept survey respondents at each individual door at a study location should be determined. Surveys capture information about the mode of transportation used by a sample of people exiting doorways from each study location. The respondents report all modes that they used on each trip, including any walking done between an off-site parking space or transit stop and the study location. For all usable surveys, the primary trip mode can be assigned based on the following assumptions:

- If a respondent uses transit on any part of his or her trip, transit is likely the primary trip mode. People may drive, walk, or bicycle to or from transit, but if they use transit, they often take it for the longest distance on their trip.
- If a respondent did not use transit but used automobile on any part of his or her trip, automobile is likely the primary trip mode. People may walk to or from automobile parking, but if they use an automobile, they often use it for the longest distance on their trip.
- If a respondent did not use transit or automobile but used a bicycle on any part of his or her trip, bicycle is likely the primary trip mode. People may walk to or from bicycle parking, but if they use a bicycle, they often use it for the longest distance on their trip.
- If a respondent walked the whole way on his or her trip, walking is the primary mode.

Individual doors should be analyzed because certain doorways may have different mode shares than the overall study location (e.g., a door leading to the parking lot may have more automobile users; a door leading to a bus stop may have more transit users). It is necessary to account for these differences to calculate the overall study location mode share correctly.

The mode share at each doorway is calculated from primary trip mode data collected over the full three-hour afternoon survey period, which is done to increase the number of sampled trips used to calculate mode share. It is possible that trip mode share at a particular door could change within the three-hour study period due to different activity patterns and transportation system characteristics (e.g., peak transit service frequency, traffic congestion, variable parking pricing), but it is assumed to be constant for the purposes of this type of study

Low-activity doorways at sites with multiple doorways should be counted but may not be surveyed. In these cases, person trips in and out of these doors are counted, but the modes used for these trips should be assigned based on other similar doorways at the study location. Mode shares from similar doors are used rather than an average of all doors because it is likely to provide a better estimate of the actual mode share at a particular door. For example, parking garage doors are likely to have a similar mode shares (a high proportion of automobile trips); doors leading to nearby transit stops are likely to have similar mode shares (a high proportion of transit trips).

During this step, survey respondent gender is compared with the count of females and males at each door. If the proportion of survey respondent trips from one gender is lower than the

other, the trips reported by respondents of that gender are given a higher weight in the final mode share calculation. This step should remove any gender bias from the surveys. Removing gender bias is important, because travel surveys have shown differences in mode share by gender, particularly for bicycling (Cervero and Duncan 2003; Schneider 2011).

5.3. Allocate Peak-Hour Person Trips by Mode at Each Door

The next step requires allocating the peak-hour door count trips by mode. The peak-hour trip numbers are calculated from the door counts in Step 1, and the mode shares are estimated from the survey data in Step 2.

5.4. Calculate Peak-Hour Person Trips by Mode at the Study Location

Finally, the trips made in and out of each door by each mode are summed to derive peak-hour person trips by mode for the overall study location. Note that this method of summing trips by door gives the appropriate weight to doors with different activity levels. Peak hour person trips can be estimated for pedestrian, bicycle, public transit, and automobile modes.

5.5. Compare Peak-Hour Vehicle Trips by Study Location with ITE Estimates

To compare trips generated at study sites with existing ITE trip generation methods, it is necessary to convert the afternoon peak hour automobile person trips to afternoon peak hour vehicle trips using automobile occupancy information from the surveys. The overall automobile occupancy at a site is simply the average occupancy for all reported automobile trips to and from the site. Afternoon peak hour vehicle trips are the peak hour automobile person trips divided by the overall automobile occupancy at the site. The observed trips can then be compared to the number of afternoon peak hour trips estimated by standard ITE trip generation methods (ITE 2008).

6. CONCLUSIONS

Many communities are encouraging development in urban areas so that they can grow more sustainably and provide more transportation options for residents and visitors. To better evaluate transportation impacts of these types of developments, there is a need to collect new, multimodal trip generation data in smart growth areas. The methodology described in this report can be used by other researchers and practitioners to modify existing suburban-based trip generation rates. This approach can be used to gather consistent data that can be compared across study sites in California and throughout the United States. Ultimately, a national multimodal trip generation database could provide the foundation for new, multimodal trip generation rates for a variety of land uses in smart growth areas.

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APPENDICES

A. Standard Door Count Form
B. Standard Intercept Survey Form
C. Instructions for Data Collectors
D. Field Data Quality Checks

APPENDIX A. STANDARD DOOR COUNT FORM

Door Count Form
(Use one sheet each hour. Write start time at top of each sheet.)

Site: _____ Name: _____ Date: _____

Time [Start ____:____ am/pm]	Direction	Location:_____		Location:_____		Location:_____	
		Male	Female	Male	Female	Male	Female
:00 to :04	In						
	Out						
:05 to :09	In						
	Out						
:10 to :14	In						
	Out						
:15 to :19	In						
	Out						
:20 to :24	In						
	Out						
:25 to :29	In						
	Out						
:30 to :34	In						
	Out						
:35 to :39	In						
	Out						
:40 to :44	In						
	Out						
:45 to :49	In						
	Out						
:50 to :54	In						
	Out						
:55 to :59	In						
	Out						

APPENDIX B. STANDARD INTERCEPT SURVEY FORM

Exit Intercept Survey: As persons DEPART, intercept as they leave a specific entrance.

Interviewer Name:__________________________ **Cell Phone: (____)**__________ **Building:** ____________________ **Date:** _____________ **Start Time:** ____:____ **am pm** **Page** _____ **of** _____

"Hello! Do you a have a minute to take a brief transportation survey?" (This survey is for a research project led by UC Davis for the California Department of Transportation. Feel free to decline to answer any questions you are not comfortable with.)

Time of Survey	Where are you headed now? (Check **one** only.)	How will you travel to get there? (Check **each** that applies.)		Where did you come from **immediately before** you came here? (Check **one** only.)	How did you travel here? (Check **each** that applies.)			Other Info (Ask all.)	Refusal?
__:__ ☐ AM ☐ PM	☐ **On-Site**: Name of Business/Building __________ ☐ **Off-Site**: Address/Nearest Intersection __________ & City (if other) ________	☐ **Walk**: Will you walk all the way ? ☐ Y ☐ N ☐ **Auto**: ☐ Drive parked car ☐ Passenger in parked car ☐ Get picked up ☐ **Bus**: Catch on-site? ☐ Y ☐ N ☐ **Train**: Catch on-site? ☐ Y ☐ N ☐ **Bicycle**	How many **other** people are travelling w/ you? ______	☐ **On-Site**: Name of Business/Building __________ ☐ **Off-Site**: Address/Nearest Intersection __________ City (if other) ________	☐ **Walk**: Walked all the way ? ☐ Y ☐ N ☐ **Auto**: Did you park? ☐ Y -On-site ☐ Y - Off-site ☐ N Did you pay for parking? ☐ Y ☐ N Did you get dropped off? ☐ Y ☐ N ☐ **Bus**: Did you get off at a stop on-site? ☐ Y ☐ N ☐ **Train**: Did you get off at a stop on-site? ☐ Y ☐ N ☐ **Bicycle**	How many **other** people travelled w/ you)? ______	What time did you arrive here? ____:____ ☐ AM ☐ PM	Home Zip Code: ______ Age: ____ Sex: ☐ M ☐ F	~Age? _____ Sex: ☐ M ☐ F
__:__ ☐ AM ☐ PM	☐ **On-Site**: Name of Business/Building __________ ☐ **Off-Site**: Address/Nearest Intersection __________ & City (if other) ________	☐ **Walk**: Will you walk all the way ? ☐ Y ☐ N ☐ **Auto**: ☐ Drive parked car ☐ Passenger in parked car ☐ Get picked up ☐ **Bus**: Catch on-site? ☐ Y ☐ N ☐ **Train**: Catch on-site? ☐ Y ☐ N ☐ **Bicycle**	How many **other** people are travelling w/ you? ______	☐ **On-Site**: Name of Business/Building __________ ☐ **Off-Site**: Address/Nearest Intersection __________ City (if other) ________	☐ **Walk**: Walked all the way ? ☐ Y ☐ N ☐ **Auto**: Did you park? ☐ Y -On-site ☐ Y - Off-site ☐ N Did you pay for parking? ☐ Y ☐ N Did you get dropped off? ☐ Y ☐ N ☐ **Bus**: Did you get off at a stop on-site? ☐ Y ☐ N ☐ **Train**: Did you get off at a stop on-site? ☐ Y ☐ N ☐ **Bicycle**	How many **other** people travelled w/ you)? ______	What time did you arrive here? ____:____ ☐ AM ☐ PM	Home Zip Code: ______ Age: ____ Sex: ☐ M ☐ F	~Age? _____ Sex: ☐ M ☐ F
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__:__ ☐ AM ☐ PM	☐ **On-Site**: Name of Business/Building __________ ☐ **Off-Site**: Address/Nearest Intersection __________ & City (if other) ________	☐ **Walk**: Will you walk all the way ? ☐ Y ☐ N ☐ **Auto**: ☐ Drive parked car ☐ Passenger in parked car ☐ Get picked up ☐ **Bus**: Catch on-site? ☐ Y ☐ N ☐ **Train**: Catch on-site? ☐ Y ☐ N ☐ **Bicycle**	How many **other** people are travelling w/ you? ______	☐ **On-Site**: Name of Business/Building __________ ☐ **Off-Site**: Address/Nearest Intersection __________ City (if other) ________	☐ **Walk**: Walked all the way ? ☐ Y ☐ N ☐ **Auto**: Did you park? ☐ Y -On-site ☐ Y - Off-site ☐ N Did you pay for parking? ☐ Y ☐ N Did you get dropped off? ☐ Y ☐ N ☐ **Bus**: Did you get off at a stop on-site? ☐ Y ☐ N ☐ **Train**: Did you get off at a stop on-site? ☐ Y ☐ N ☐ **Bicycle**	How many **other** people travelled w/ you)? ______	What time did you arrive here? ____:____ ☐ AM ☐ PM	Home Zip Code: ______ Age: ____ Sex: ☐ M ☐ F	~Age? _____ Sex: ☐ M ☐ F

APPENDIX C. INSTRUCTIONS FOR DATA COLLECTORS

Data collector training is critical for obtaining reliable data at field study locations. The following points should be made whenever new data collectors arrive to a site. These points should be reiterated throughout the data collection process.

Key points should be made to door counters during training included:

- Understand the purpose of the study.
- Arrive at least 15 minutes before the start of the data collection period.
- Bring a watch or other device to keep track of five-minute periods.
- Bring a pencil and something to write on.
- Concentrate and count every single person accurately. Door counts are the most critical piece of information being used in the study.
- Count every person entering and exiting the doorway. However, do not count people who take out garbage, take a smoke break in front of the building, or other people who obviously enter and exit without going to another activity location.
- Do not talk to others. Also avoid other distractions during the data collection period, such as using mobile devices (e.g., phone calls, text messages, internet).
- Provide the one-page study information sheet to any person who asks them what they are doing; inform the data collection manager at the site if there are any problems with individuals.
- Show up on assigned data collection days. Even if the weather looks bad, assume that data will be collected until the data collection manager sends a cancellation notice. Data collection will be rescheduled on inclement weather days (i.e., ≥ 50% chance of rain predicted for the site at noon of the previous day on www.weather.com.)

Intercept surveyors should be trained to:

- Understand the purpose of the study and the specific information solicited by the surveys.
- Arrive at least 15 minutes before the start of the data collection period.
- Bring at least 50 survey forms per surveyor (space for 200 potential surveys or refusals).
- Be confident when approaching people to interview (assume that they will agree to participate), but be polite when people decline to participate. Do not bother people who do not want to participate.
- Obtain the necessary information from respondents. This may involve modifying the language of the survey questions so that they are understandable to each respondent at each location (i.e., do not read the survey questions as a script).
- Ask all questions on the full survey and just the essential questions on an abbreviated survey.
- Do not lead respondents by guessing answers for them.
- Obtain the all travel modes used on each trip, including walking to and from parking or transit stops.

- Record the time at the beginning of the survey.
- Record responses and information about non-respondents completely.
- Do not spend more time interviewing participants of the opposite gender.
- Avoid socializing with respondents who may want to discuss topics that are not on the survey.
- Keep the most direct pathway to and from the door clear when inviting people to participate and when administering surveys.
- Do not disrupt normal business activity at the study location.
- Provide the one-page study information sheet to any person who has questions about the study; inform the data collection manager at the site if there are any problems with individuals.
- Show up on assigned data collection days. Even if the weather looks bad, assume that data will be collected until the data collection manager sends a cancellation notice. Data collection will be rescheduled on inclement weather days (i.e., ≥ 50% chance of rain predicted for the site at noon of the previous day on www.weather.com.)

APPENDIX D. FIELD DATA QUALITY CHECKS

At the end of each data collection period, managers should review the door counts and data collection sheets for unclear responses, errors, or other discrepancies. It is important to do this check as soon as possible after data collection is complete while the data collector's memory is still fresh. This process will not catch every error, but it increases the accuracy of the counts and survey responses and helps the door count and survey personnel understand problems to avoid during any future collection period. The review of data collection sheets are completed most meticulously when data collectors first starting to learn the data collection process.

This check examined the following information on count sheets:

- Data collector's name and specific count location should be recorded on all sheets.
- The correct hour should be written at the top of each sheet.
- The count should cover the full data collection period.
- The balance of entry and exit counts should look reasonable for the time period observed.
- Variations by five-minute period should be logical.
- Total counts look should be reasonable.

The following aspects of the survey forms should be checked:

- Data collector's name and specific count location should be recorded on all sheets.
- Time, estimated age, and estimated gender should be recorded for survey refusals.
- Times of completed surveys should be recorded.
- Write-in responses should be complete and legible.
- All modes recorded for a specific trip should be logical.
- Destinations for egress trips recorded should be logical.
- Origins for access trips recorded should be logical.
- Times recorded for access trips should be logical (e.g., if the time of the access trip were after the egress trip, it would not make sense).
- Blank response items should be noted. Surveyors should be asked if they forgot to ask the question, if the participant didn't respond, or if they simply forgot to record the information on the sheet.