Measuring Travel Characteristics for Transportation Impact Fees

BY WILLIAM E. OLIVER

Many government agencies in Florida have adopted transportation impact fees as a means of assessing the additional demands for road capacity imposed by new developments. The magnitude of these fees is related to the amount of new travel added to the road system as a result of the development. For example, a development that adds 10 vehicle-miles of new travel would be expected to pay more in impact fees than a development that adds only 5 vehicle-miles of new travel.

The general equation used to compute the transportation impact fee for a given land use is

$$\text{Demand} \times \text{Cost} - \text{Credits} = \text{Fees}$$

The travel demand placed on the transportation system is usually expressed in units of new lane-miles of roadway consumed or new vehicle-miles of travel generated. The cost is usually expressed in units of dollars per lane-mile of roadway or dollars per vehicle-mile of travel. The credits are based on an estimate of the revenues generated by the development that will be allocated to roadway construction or transportation system capacity expansion.

A primary consideration in establishing impact fee rates is that the fees be appropriate and equitable. This means that the fee for a given land use should not be higher than the cost to replace the road system capacity it consumes and that developments consuming similar amounts of the road system should be charged similar fees. For these reasons, it is important to develop standardized and conservative procedures for measuring travel characteristics of land uses.

The amount of new travel is estimated by multiplying three variables: the trip-end generation, the assessable trip length, and the percentage of new trips added to the road system by the development. Although there are standard procedures[1] to estimate the trip-end generation for a site, no standard terminology or procedure has been established for measuring the assessable trip length or the percentage of new trips to a site. The purpose of this article is to suggest standard procedures for measuring these travel characteristics for use in the demand and credit components of an impact-fee equation. In addition, this article introduces important concepts regarding the definition of "captured" trips in an impact fee context, which differs from the definition typically encountered in a traffic-impact-analysis context, and considerations for allocating responsibility for diverted trips.

Assessable Trip Length

The trip length used to compute an impact fee (the assessable trip length) is the amount of new travel that a development adds to the arterial and collector road system, for which payment should be made. Typically, the portion of the trip on local streets is excluded from the assessable trip length because governments in Florida usually do not build local streets using their transportation funds. This job is usually left to the developer of a subdivision. Thus, the procedures to measure assessable trip lengths should exclude travel on local streets. In addition, the portion of trips using the interstate or toll-road system is frequently excluded because local agencies typically do not use their impact-fee revenues to expand the interstate highway or toll-road systems. The proportion of interstate and toll-road travel is highly dependent on the proximity of a site to these facilities and the presence of such facilities in the community. Interstate and toll-road mileage is usually discounted from the assessable trip length by applying a community-wide estimated interstate and toll-road mileage-reduction factor prior to computing the fee.

Motorist interviews are conducted to collect data on trip length. An example of a typical interview form is shown in Figure 1. The purpose of the questions is to ascertain the type of trip, as well as the trip length. The form includes optional questions regarding length of stay and nature of the visit. For some land uses, these questions can be helpful in establishing normal and unusual site-visit patterns and in categorizing trips. From each interview, information relative to two trip-ends is obtained—the inbound trip-end and the outbound trip-end. Using the survey information, trips

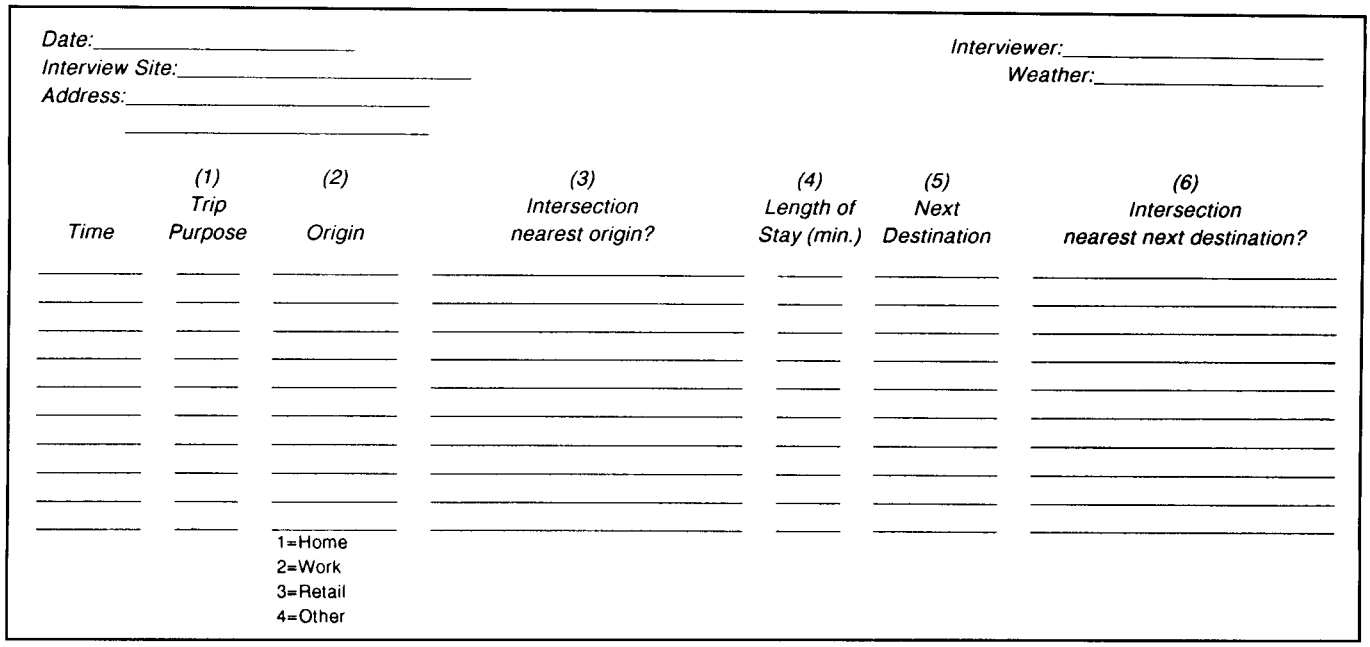


Figure 1. Example of a typical survey form.

were classified into one of four groups: primary, captured, diverted, or secondary.

Primary trips are trips made from the origin (home, place of work, etc.) to the survey site and then back to the origin. The length of a primary trip is measured along the shortest reasonable route between the trip origin and the survey site, as illustrated in Figure 2. The length of the trip is recorded twice, once for the trip to the site and again for the return trip. An important feature of the trip-length measurement technique is that in an ideal grid street network, regardless of the route chosen within a rectangle defined by the trip origin and the destination, the trip length is the same. This feature is important because it relates to the definitions of captured, diverted, and secondary trips that follow.

Captured trips in an impact-fee context are different from those encountered in a traffic-impact-analysis context. In an impact-fee context, a captured trip is a trip that adds no travel to the road network. A captured trip occurs if the survey site is an intermediate stop located within the ideal grid street rectangle defined by the primary trip origin and destination (see Figure 3). The intermediate stop at the survey site may cause the route selected for travel to be different than if no intermediate stop were planned, but no additional travel is introduced as a result. The captured trip is identified by locating the trip origin and next destination and determining if the site is within the rectangle. No travel distance is allocated to the site for a captured trip. The percentage of new trips used in the demand component of the impact-fee equation is simply one minus the percentage of captured trips.

In a traffic-impact-analysis context, a trip whose route has been altered, but that adds no additional travel to the road network, is still a new trip on the road to which the trip was attracted. Although in theory a difference in concept exists, our experience in analyzing travel characteristics survey data indicates that little or no practical difference in measurement of captured trips exists, because there are usually no reasonable alternative routes to travel between the trip origin and the next destination.

Diverted trips are similar to captured trips in that they are intermediate stops between trip origins and primary destinations; however, in diverted trips the survey site is located outside the boundaries of the rectangle defined by the trip origin and primary destination. This situation is illustrated in Figure 4. These trips add travel to the street network to the extent that the site is located outside the rectangle. The length assigned to these trips is the distance of travel from the boundary of the rectangle to the site. As was done for the primary trip length, the distance is recorded twice—once for the trip to the site and once for the trip from the site. A unique feature of the diverted trip is that there is no "other end" of the trip with which to share the responsibility for generating travel. When combining diverted trips with trips of other purposes, they are weighted by a factor of two to offset division of the average trip length by two in subsequent steps of impact-fee calculation.

Secondary trips are a type of diverted trip; they are identified when the distance from the boundary of the primary-trip rectangle to the site is greater than one-half the travel distance from the trip origin to the next destination (Figure 5). The rationale for this definition is that once the round trip from the rectangle to the site and back exceeds the distance from the origin to the next destination identified by the interview, then the diverted-trip measurement procedures overestimate the allocation of travel to the site. In this case, the length of the trip from the origin to the survey site is logged, and the length of the trip from the survey site to the next destination is logged.

The assessable trip length for secondary trips is finally calculated as shown in Equation 1.

This systematic approach to categorizing and measuring trip lengths was developed as a result of our experience with surveys. Drivers were asked how far

had they traveled out of their way to stop at a survey site or, had they not stopped, would they have passed the survey site; their responses were compared with the reported locations of trip origin and next destination (considered to be more fac-

$$\frac{\Sigma \text{ (lengths of primary and secondary trip-ends)} + 2\,\Sigma \text{ (diverted trip-ends)}}{\text{number of primary, secondary, and diverted trip-ends surveyed}}$$

Equation 1. The assessable trip length for secondary trips.

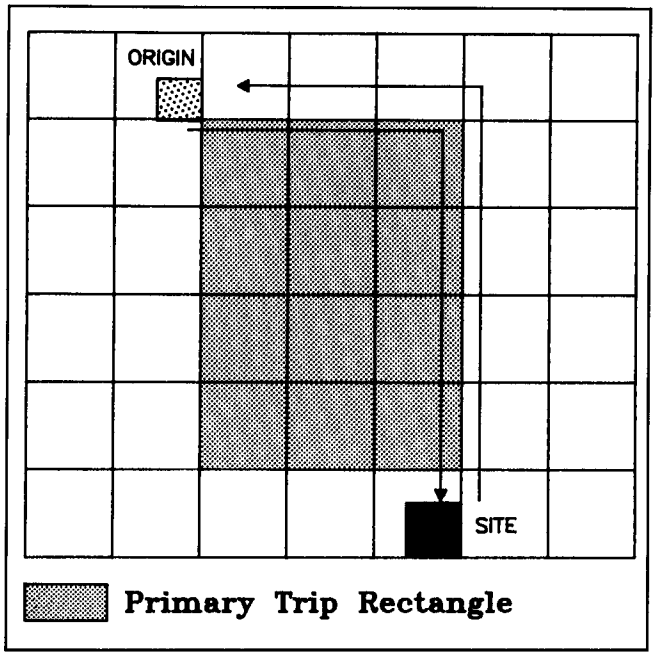


Figure 2. An example of how the length of a primary trip is measured.

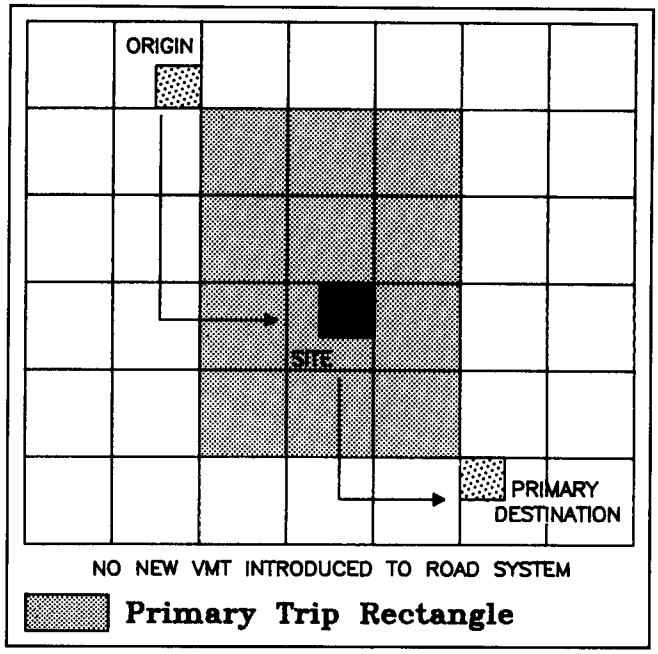


Figure 3. An example of how the length of a captured trip is measured.

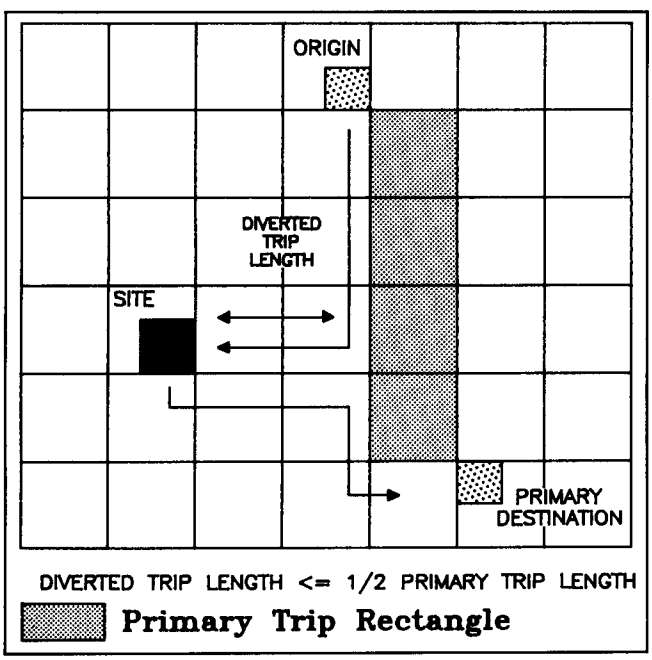


Figure 4. An example of how the length of a diverted trip is measured.

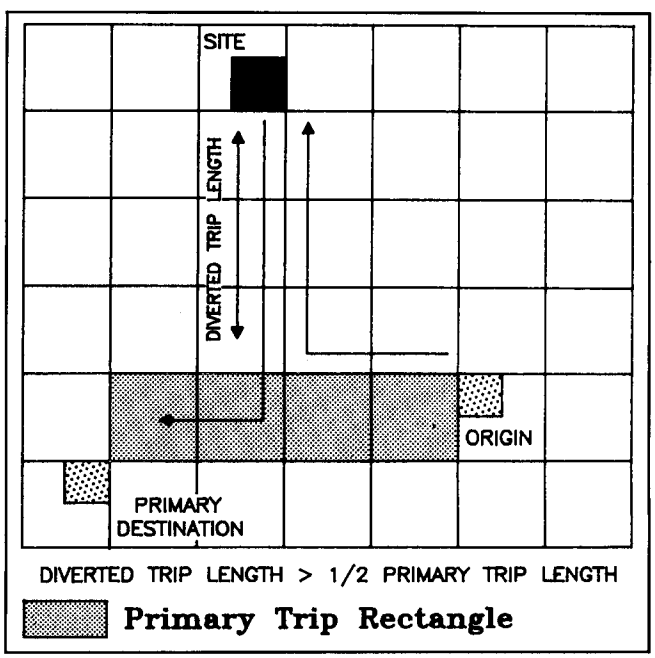


Figure 5. An example of how the length of a secondary trip is measured.

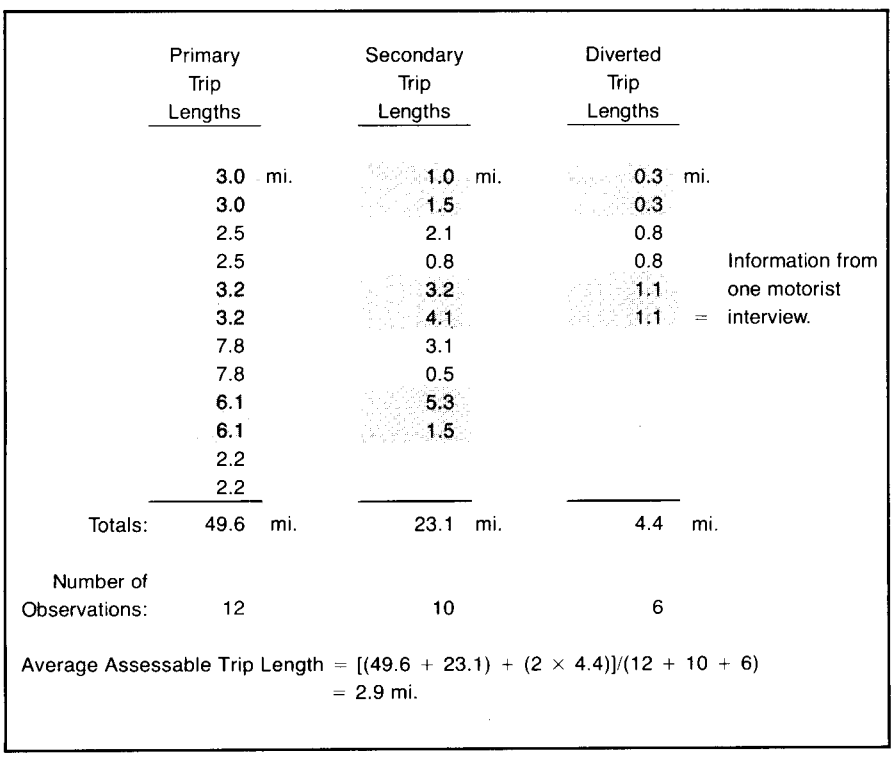
tual information). We found that the motorists' subjective judgments of distance traveled were frequently in great error. Furthermore, their unfamiliarity with the concepts of trip capture and trip diversion led to very inconsistent results. As a result, we developed the quantitative approach described in the preceding paragraphs.

To analyze the survey data, each survey form is reviewed, and the two trip-ends surveyed are identified as primary, captured, diverted, or secondary based on the locations of the origin of the inbound trip and the destination of the outbound trip. The length of each trip is logged onto a data summary form (illustrated in Figure 6). Each survey form provides information regarding two trip-ends. The lengths for each trip type are then added and combined in accordance with the equation provided earlier. Because impact fees allocate the assessment for a trip evenly to the origin-end development and the destination-end development, the demand equation usually includes a denominator of two. If not, then one-half the average trip length as calculated in Figure 6 should be used in the fee equation.

This procedure has a systematic flaw that fails to account for 100 percent of the travel on the road network. In the captured trip example in Figure 3, if the survey and analysis procedures were applied at the "primary destination" location, the trips from the site to the primary destination and from the primary destination back to the origin would be identified as secondary trips, and one-half their lengths would be allocated to the primary destination. Since none of the captured-trip length is allocated to the site, the first half of the trip from the site to the primary destination is unassessed. Similar "gaps" in the allocation of travel can occur in the case of diverted trips as well. There is no easy way of accounting for all the travel through survey or analysis technique modifications.

The travel unaccounted for by the survey and analysis methods could be accounted for if all trips were treated as primary or secondary. However, not accounting for all of the travel is preferable to the alternative of not recognizing trip capture and diversion of the land uses that exhibit these characteristics. Furthermore, if the approach is consistently applied to all land uses, the land uses will be treated objectively and a lower trip length will be provided, thereby improving the chances of successful defense of a fee if it is challenged as being excessive.

Travel demand characteristics are usually incorporated into an impact-fee rate computation at two points: the computation of the demand for facilities, and the estimation of credits for transportation revenues generated.



	Primary Trip Lengths	Secondary Trip Lengths	Diverted Trip Lengths	
	3.0 mi.	1.0 mi.	0.3 mi.	
	3.0	1.5	0.3	
	2.5	2.1	0.8	
	2.5	0.8	0.8	Information from
	3.2	3.2	1.1	one motorist
	3.2	4.1	1.1	= interview.
	7.8	3.1		
	7.8	0.5		
	6.1	5.3		
	6.1	1.5		
	2.2			
	2.2			
Totals:	49.6 mi.	23.1 mi.	4.4 mi.	
Number of Observations:	12	10	6	

Average Assessable Trip Length = [(49.6 + 23.1) + (2 × 4.4)]/(12 + 10 + 6)
= 2.9 mi.

Figure 6. An example of assessable trip-length calculation.

Demand Component

For the demand component of the impact fee equation, the following equation and values are typically used:

$$\text{Demand (lane-miles)} = ADT \times \%NT \times ATL \times IRF/(2 \times CAP)$$

Where

ADT = Number of daily trips generated by the development,
$\%NT$ = Percentage of new trips,
ATL = Assessable trip length,
IRF = Interstate and toll-road reduction factor, which must be locally determined, and
CAP = Capacity per lane of road, from the local impact fee.

The resulting quantity is the assessable lane-miles of roadway consumed. When multiplied by the cost per lane-mile, the cost to replace the capacity consumed by the land-development activity is estimated.

Credit Component

The credit component of the impact fee equation will vary from community to community. Typically, it recognizes the revenues that will be collected from the land-development activity and applied to roadway system expansion. Examples of such revenues may be *ad valorem* taxes, utility taxes, or any special or benefit assessments, such as a municipal services tax. The most common credit is the gasoline tax, to which the travel characteristic should be applied. The gasoline tax credit is computed as follows:

$$\text{Gas tax credit} = \{[(\$ \text{ per gallon}) \times ADT \times TTL \times DPY]/(2 \times MPG)\} \times (P/A)_n^{i\%}$$

Where

$ per gallon = Amount of gasoline tax per gallon (federal, state, and local) that is

applied to road-system expansion,

ADT = Number of daily trips generated by the developments,

TTL = Total trip length, including local street, interstate, and toll-road mileage,

DPY = Number of operating days per year,

MPG = Fuel efficiency of vehicle fleet accessing the site,

P/A = The factor representing the present worth of an annually recurring uniform amount,

$i\%$ = Compounded interest rate to be applied to the annual gasoline taxes collected, and

n = Number of years of gasoline taxes to be credited, typically 25 to 50 years.

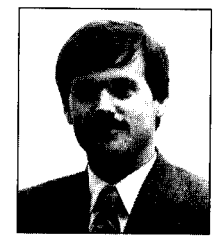
The rationale for including the local, interstate, and toll-road mileage in the credit component is that gasoline is consumed and gasoline taxes are generated for road construction regardless of the type of road.

Conclusion

A need exists to establish standard procedures so that assessable trip lengths are measured for use in transportation impact fees and so that these characteristics can be cataloged uniformly for various land uses. This article has provided a study methodology that is conservative and a solid, defendable base on which to determine a fee. The procedure is simple and lends itself easily to uniform application. Important considerations in identifying captured trips (or percentage of new trips) and the allocation of responsibility for diverted trips were introduced. Finally, the application of the assessable trip-length data has been discussed. These procedures have been applied to successful impact-fee studies in Florida.

Reference

1. Institute of Transportation Engineers. *Trip Generation*, 4th Edition. Washington, D.C.: ITE, 1987.



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