

Planning Commission Research Topic No. 2 (1996)

Research Question: How do various types of development differ in traffic generation?

Introduction

Staff was directed to research this question by the Planning Commission because concern about increased traffic is a recurring theme raised by neighborhood residents at rezoning public hearings for land uses other than single-family residential. Typically, staff comments regarding a proposed rezoning address the potential traffic impacts of that specific proposed development and ways to mitigate those impacts.

Purpose

Staff felt that it would be useful to look at the variation in the traffic impacts of different types of development at the same location. The Planning Commission and City Council can use this information to examine how various types of development differ in traffic generation and how they might impact an adjacent residential neighborhood.

Methodology

For the purpose of this analysis, staff selected a hypothetical site of 20 acres. Based on a single-family residential density of 3 dwelling units per acre, a medium-density residential density of 12.5 dwelling units per acre and a land use intensity rating of 5, the 20-acre site would have the following intensities of development under 6 different scenarios:

Single-Family	60 units
Multifamily	250 units
Office	220,000 square feet
Shopping Center	188,000 square feet

Industrial	220,000 square feet
Business Park	220,000 square feet

The information regarding the number of average daily trips generated by the above types of development on a 20-acre site, as shown in Table 2-1, comes from *Trip Generation, An Informational Report*, 5th Edition, Institute of Transportation Engineers, 1991. The number of vehicle trips likely to be generated by a particular land use included in the tables in this book is based on more than 3,000 trip generation studies/surveys conducted by public agencies, developers, and consulting firms and reported to the Institute of Transportation Engineers. The number of average daily trips shown on this table represents the average 24-hour total of all vehicle trips counted to and from a study site from Monday through Friday. The A.M. Peak Hour traffic volume represents the highest volume of traffic entering and exiting a site over the course of one hour between 7 and 9 a.m. Usually, the A.M. Peak Hour is 7:30 to 8:30 a.m. Similarly, the P.M. Peak Hour traffic volume represents the highest volume of traffic over the course of one hour between 4 and 6 p.m. The P.M. Peak Hour might be 4:30 to 5:30 p.m. or 5:00 to 6:00 p.m.

The typical single-family site surveyed for the studies included in *Trip Generation* is a suburban subdivision. Multifamily information comes from surveys of quadrplexes and all types of apartment buildings, including both low-rise and high-rise multifamily dwellings. *Trip Generation* defines office as a general office building or building housing a mixture of tenants. Because of differences in trip generating characteristics, the report distinguishes between corporate headquarters, single tenant office buildings and medical offices. The report defines a shopping center as an integrated group of commercial establishments, planned, developed, owned and managed as a unit, with on-site parking facilities. The industrial trip generation information is based on a general light industrial use, defined as light industrial facilities usually employing fewer than 500 persons, with an emphasis on activities other than manufacturing. Typically, a business park consists of a group of one- or two-story buildings served by a common roadway system. The business park sites surveyed for trip generation information have an average mix of 20 to 30 percent office/commercial and 70 to 80 percent industrial/warehousing.

Comparison of Results

As seen in the examples on pages 2-8 through 2-12, the results of this comparison of typical trip generation characteristics are very interesting.

Example 2-1 shows that for residential uses, apartment complexes generate less average daily trips per unit than do single-family developments. The single-family rate per unit is 10.7 average daily trips compared to a multifamily rate of 6.3. Nevertheless, a multifamily development on a 20-acre site will generate almost 2.5 times the amount of traffic as a single-family development on that same site. The difference in traffic generation characteristics is about the same for the two uses whether the time period under examination is a 24-hour period or peak hours (Table 2-1 on page 2-7). Obviously, the difference is due to the increased density of multifamily developments. Neither development, however, generates a significant amount of traffic.

The most dramatic differences in traffic generation characteristics can be seen between nonresidential land uses and even within a single nonresidential land use category. As shown by Example 2-1, a 220,000 square foot multi-tenant office development on 20 acres will typically generate 3,572 daily trips with one-quarter of those trips occurring during the a.m. and p.m. peak hours. In contrast, a 188,000 square foot commercial development on the same 20 acres would generate almost three times the number of trips over the course of the day (10,485), with less than 12 percent of those trips (1,217) occurring during the peak hours (Table 2-1). This is not surprising considering most retail establishments are not open to the public between the hours of 7 and 9 a.m. On average, a 220,000 square foot Industrial development of the same 20-acre site would only generate 1,541 daily trips with approximately one-fifth of those trips (323) during the peak hours as shown by Example 2-4 and Table 2-1. The trip generation characteristics for business parks differ from those of industrial developments because of the greater mix of uses allowed in business parks. A typical 220,000-square-foot business park development on 20 acres could be expected to generate 3,098 daily trips with almost 22 percent of those trips (676) occurring during the a.m. and p.m. peaks. Thus, a Business Park development will have traffic generation characteristics more like those of multi-tenant offices than industrial developments.

Example 2-2 shows typical average daily trip generation by number of trips for three types of commercial developments. These are examined separately from the general commercial category and other land uses on a 20-acre site as they are size specific types of development. For instance, a 100,000-square foot neighborhood shopping center, similar to Shannon Valley, could be located on a 10 to 11 acre site. A community shopping center, similar to Regency Park, with 200,000 square feet, could locate on a 21 to 22 acre site. A regional

shopping center of 1,000,000 square feet, similar to Oak Park Mall, would require more than 100 acres.

In comparing the three types of shopping centers, it is interesting to note that the traffic volume from one type of center to the next does not increase incrementally as might be expected. For example, a neighborhood shopping center of 100,000 square feet generates, on average, 7,067 daily trips. A community shopping center at 200,000 square feet, twice the size of a neighborhood center, generates less than half again as much traffic. Similarly, a regional center of 1,000,000 square feet, five times the size of a community center, generates less than three times as much traffic. The neighborhood center generates, by far, the most traffic on a per square feet of development basis with a rate of 70.67 per 1,000 square feet of development as compared to a regional center's rate of 32.09.

Traffic generation characteristics for other specific land uses are included in Table 2-1 and Example 2-5 for information purposes. These uses should not be compared to each other or to the more general land uses shown in the other examples. They are unique types of land uses with trip generation characteristics that do not relate to the amount of development, as do general office and commercial trip rates, nor to number of units, as do residential trip generation rates. One conclusion that can be drawn from these examples, however, is that size does not necessarily correspond to amount of traffic generated. A drive-thru fast food restaurant of only 3,000 square feet can be expected to generate almost 1,900 average daily trips. A 6,000 square foot drive-in bank could also be considered a high traffic generator with 1,323 average daily trips. The information on hospitals is of limited use because of the changing nature of modern hospital complexes but when combined with traffic generation characteristics of other uses on the site such as medical offices, a true picture could be developed of a hospital's impact on surrounding uses. A theater complex is such a unique use that its peak hour of impact on surrounding land uses will most likely occur much later than the traditional P.M. Peak identified in traffic studies and there will be no impact at the A.M. Peak.

Summary

The findings of this report are that significant differences in the amount of traffic generated by different types of land uses do exist as shown by Graphs 2-1 and 2-2. Of the typical 20-acre development scenarios, by far the highest

traffic generator is the neighborhood shopping center. Some of the special types of land uses that were also examined, such as fast food restaurants with drive-thru and drive-in banks generate trips at a much higher rate even than a neighborhood center. Other special uses such as hospitals or movie theaters have impacts that are not easily comparable to more common land uses. As seen in Table 2-1, a 200-bed hospital will generate less average daily trips than most office developments. The changing nature of medical care, however, may invalidate this conclusion in the future. As hospital complexes include more outpatient clinics, day surgeries and medical offices, the amount of traffic generated could be expected to rise and be more similar to medical offices. Though movie theaters generate no measurable traffic during the A.M. Peak and would add little to the traffic congestion on neighboring streets during the P.M. Peak, the amount of traffic generated during the late evening hours could create a second peak in traffic at a time when traffic volumes are normally expected to decline.

Though traffic generation is an important consideration when examining the compatibility between proposed development and existing uses in the neighborhood, it should not be the only or even the most important consideration. The raw volume of traffic alone is not the sole determinant of the traffic impact of a proposed development. Other factors such as adequacy of access, the level of improvement of abutting streets, and existing and projected traffic volumes on the streets also must be considered. On traffic generation alone, a 220,000-square foot industrial development would be the most compatible use adjacent to a single-family residential area. An equally important consideration in this instance, however, would be the type of traffic and its impact on adjacent areas. For example, heavy truck traffic will have more of an impact on the adjacent street system and adjacent land uses than will a higher volume of automobile traffic. As mentioned above, sometimes the timing of traffic is also an important consideration. The screening and buffering techniques included in the Comprehensive Plan's land use goals will be most valuable in dealing with type and timing of traffic issues. Finally, the directional distribution of the traffic being generated should also be considered. For example, at the P.M. Peak, office traffic is predominately exiting traffic while commercial traffic is split 50/50 between exiting and entering traffic. This is one of the reasons why the commercial P.M. Peak rate is so much higher than the office P.M. Peak rate as shown on Table 2-1.

Planning Commission Action

The Planning Commission approved Planning Commission Research Topic No. 2 for use as a reference tool on Monday, February 12, 1996.

Table 2-1
Typical Trip Generation
by
Rate and Number of Trips

Land Use	Average Daily Trips		A.M. Peak Hour		P.M. Peak Hour	
	Rate per Unit or 1,000 sq. ft.**	Volume	Rate per Unit or 1,000 sq. ft.**	Volume	Rate Per Unit or 1,000 sq. ft.**	Volume
* Single-Family (60 units)	10.75	645	0.86	52	1.13	68
* Multifamily (250 units)	6.31	1,578	0.50	126	0.60	149
Office (220,000 sq.ft.)						
* Single Tenant	11.58	2,547	1.60	352	1.51	332
* Multi Tenant	16.24	3,572	2.18	480	2.18	479
* Medical	32.80	7,215	2.49	543	3.90	859
* Commercial (188,000 sq. ft.)	55.77	10,485	1.25	236	5.22	981
Neighborhood Center (100,000 sq. ft.)	70.67	7,067	1.88	132	7.47	523
Community Shopping Center (200,000 sq. ft.)	54.50	10,899	1.22	244	5.10	1,020
Regional Shopping Center (1,000,000 sq. ft.)	32.09	32,089	0.63	631	2.97	2,966
* Industrial (220,000 sq. ft.)	7.01	1,541	0.78	171	0.69	152
* Business Park (220,000 sq. ft.)	14.08	3,098	1.54	339	1.53	337
Drive-Thru Fast Food Restaurant	632.10	1,896	55.56	167	36.53	110
Drive-In Bank	220.10	1,323	8.41	50	43.63	262
** 200-Bed Hospital	14.71/bed	2,943	0.61/bed	121	0.83/bed	166
** 18-Screen Theater***	200/screen	3,960	---	---	24.11/screen	434

* Indicates development permitted on a typical 20-acre site

** Rates are not based on a per unit or per square foot basis

*** The peak hour for theaters is different from the peak hour for other land uses as noted in the text

Source: **Trip Generation, An Informational Report**

5th Edition, Institute of Transportation Engineers, 1991

Information on theater traffic comes from the AMC Theater Traffic Study

Example 2-1
20-Acre Site
Typical Average Daily Trip Generation
by
Number of Trips

60-Lot Single-Family Development

- 20 acres X 3 units per acre = 60 homes
- 10.75 trips/unit = 645 Average Daily Trips

250-Unit Apartment Complex

- 20 acres X 12.5 units per acre = 250 units
- 6.31 trips/unit = 1,578 Average Daily Trips

220,000 sq. ft. Office Development - multi tenant (4 buildings)

- 20 acres X L.U.I. of 5 = 220,000 sq. ft.
- 16.24 trips/1,000 sq. ft. = 3,572 Average Daily Trips

188,000 sq. ft. Commercial Development

- 20 acres X L.U.I. of 5 = 188,000 sq. ft.
- 55.77 trips/1,000 sq. ft. = 10,485 Average Daily Trips

Source: *Trip Generation, An Informational Report*, 5th Edition, Institute of Transportation Engineers, 1991

Example 2-2

Commercial Sites Typical Average Daily Trip Generation by Number of Trips

Neighborhood Shopping Center (similar to Shannon Valley)

- approximately 100,000 square feet
- 70.67 trips/1,000 sq. ft. = 7,067 Average Daily Trips

Community Shopping Center (similar to Regency Park)

- approximately 200,000 square feet
- 54.50 trips/1,000 sq. ft. = 10,899 Average Daily Trips

Regional Shopping Center (similar to Oak Park Mall)

- approximately 1,000,000 square feet
- 32.09 trips/1,000 sq. ft. = 32,088 Average Daily Trips

Source: *Trip Generation, An Informational Report*, 5th Edition, Institute of Transportation Engineers, 1991

Example 2-3

20-Acre Office Site Typical Average Daily Trip Generation by Number of Trips

Single Tenant Building(s)

- approximately 220,000 square feet
- 11.58 trips/1,000 sq. ft. = 2,547 Average Daily Trips

Multi Tenant Building(s)

- approximately 220,000 square feet
- 16.24 trips/1,000 sq. ft. = 3,572 Average Daily Trips

Medical Offices

- approximately 220,000 square feet
- 32.80 trips/1,000 sq. ft. = 7,215 Average Daily Trips

Source: *Trip Generation, An Informational Report*, 5th Edition, Institute of Transportation Engineers, 1991

Example 2-4

20-Acre Nonresidential Site Typical Average Daily Trip Generation by Number of Trips

Multi Tenant Office Development

- approximately 220,000 square feet
- 16.24 trips/1,000 sq. ft. = 3,572 Average Daily Trips

Industrial Development

- approximately 220,000 square feet
- 7.01 trips/1,000 sq. ft. = 1,541 Average Daily Trips

Business Park Development

- approximately 220,000 square feet
- 14.08 trips/1,000 sq. ft. = 3,098 Average Daily Trips

Source: *Trip Generation, An Informational Report*, 5th Edition, Institute of Transportation Engineers

Example 2-5

Typical Average Daily Trip Generation by Number of Trips for Select Nonresidential Land Uses

Drive-Thru Fast Food Restaurant

- approximately 3,000 square feet
- 632.10 trips/1,000 sq. ft. = 1,896 Average Daily Trips

Drive-In Bank

- approximately 6,000 square feet
- 220.10 trips/1,000 sq. ft. = 1,323 Average Daily Trips

Hospital

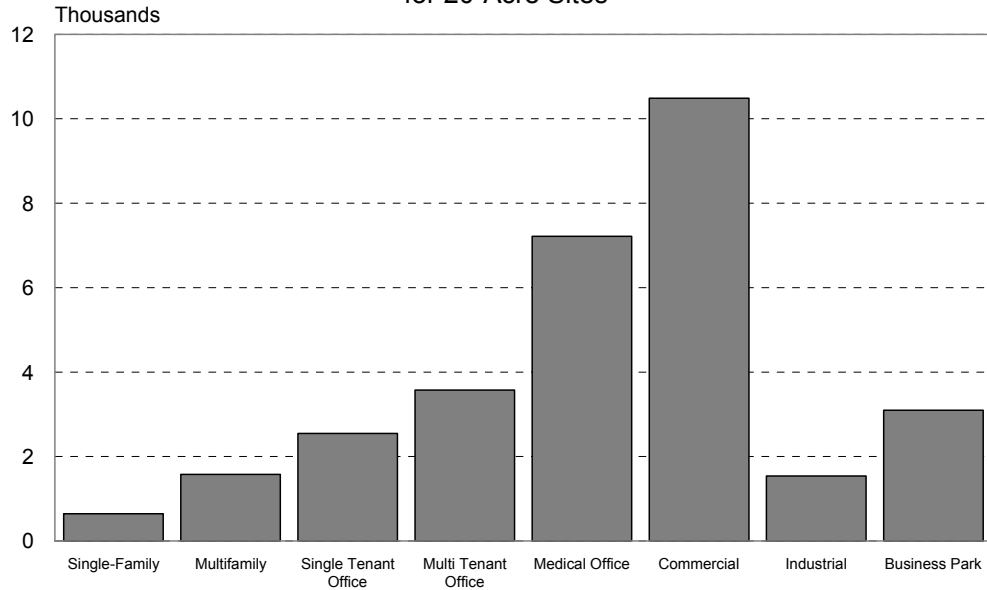
- 200 Beds
- 14.71 trips/bed = 2,943 Average Daily Trips

Theater

- 18 Screens
- 220 trips/screen = 3,960 Average Daily Trips

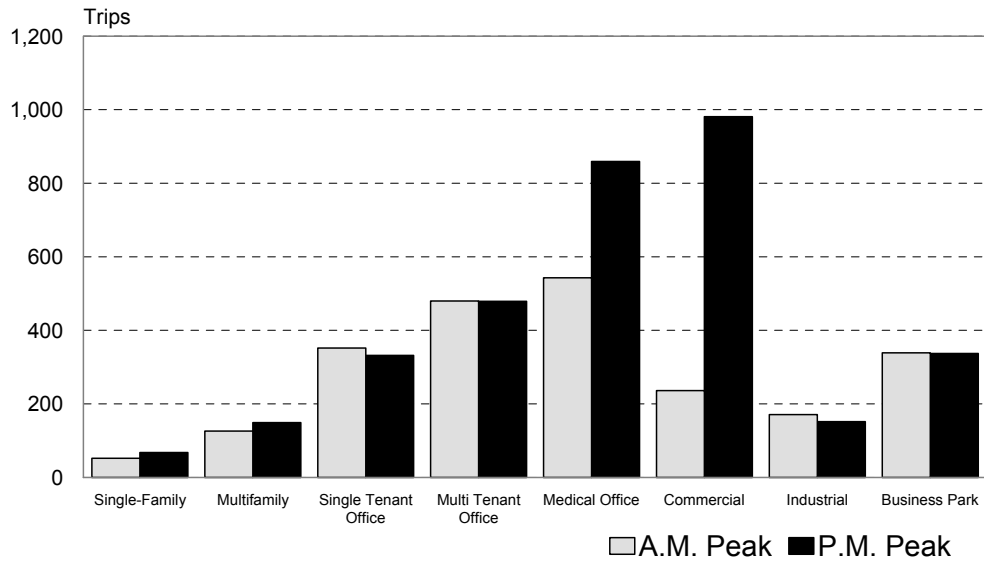
Source: *Trip Generation, An Informational Report*, 5th Edition, Institute of Transportation Engineers and AMC Theater Traffic Study

Graph 1
Trip Generation - Average Daily Trips
By Land Use
for 20-Acre Sites



Source: *Trip Generation, An Informational Report*,
5th Edition, Institute of Transportation Engineers, 1991

Graph 2
Trip Generation - A.M. and P.M. Peak Hour Trips
By Land Use
for 20-Acre Sites



Source: *Trip Generation, An Informational Report*,
5th Edition, Institute of Transportation Engineers, 1991