to encourage short-term, carpool, and vanpool parking; construction of fringe and park-and-ride lots; stricter enforcement; and the use of RPPPs. Communities that have implemented such comprehensive programs include Boston, Portland, San Francisco, Seattle, and Washington, D.C. Other communities around the nation have implemented selected new and innovative tactics to meet local objectives and problems.

Based on the detailed assessment of the 20 communities cited earlier in this paper, the most widely used innovative parking management tactic is the RPPP. Extensive use has also been made of park-and-ride lots; preferential parking spaces and rates for carpools and vanpools; zoning changes to reduce the growth of parking supply; supply, pricing, and marketing incentives to encourage short-term (e.g., shopper) parking; and aggressive enforcement tactics, such as ticketing, towing, and booting.

Many factors have contributed to the growing interest in parking management tactics. In some areas, including Boston, Portland, San Francisco, Seattle, and Los Angeles, EPA requirements in the early 1970s to develop parking management plans led to the development and application of new parking policies and tactics. Many communities have shown great interest in implementing actions to discourage work-trip commuting by automobile, particularly by single-occupant automobile. The joint FHWA/Urban Mass Transportation Administration TSM regulations have also encouraged local jurisdictions and regional agencies to develop coordinated TSM plans and programs to achieve transportation and related objectives.

The ruling of the U.S. Supreme Court upholding the legality of the Arlington, Virginia, RPPP has given a major impetus to the implementation of such tactics throughout the nation. Other factors that are generating interest in parking management tactics and programs include the nation's efforts to conserve energy and improve air quality in urban areas.

Local governments are primarily responsible for initiating, planning, implementing, and operating tactics of interest. The types of agencies actively involved in parking management activities include local parking authorities, traffic engineering departments, city planning departments, zoning and planning commissions, carpool agencies, and, in selected instances, transit agencies. Although many metropolitan planning organizations are interested in parking management, most acknowledge that the power to plan and implement such tactics rests primarily with local governments. The highly localized impacts of many parking management tactics also suggest that local governments must take an active role in initiating and implementing such tactics.

Although many jurisdictions are attempting to slow the growth of downtown parking facilities, many of these same jurisdictions are endeavoring to increase the supply and attractiveness (e.g., the location and rates) of short-term parking. Such parking is considered to be highly important to maintaining and encouraging the economic development of CBDs and other older commercial areas. In some jurisdictions, such as Los Angeles, there is strong feeling within the city government and the business community that an attractive parking system must be available to promote CBD development that might otherwise occur in suburban areas.

The implementation of transit and HOV incentives in conjunction with parking management disincentives is a growing practice that helps to encourage support by community members. Some communities contacted during the project were reluctant to implement "strong" parking management tactics unless alternative transportation modes and service were improved.

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Impact on Commuters of a Residential Parking-Permit Program in Alexandria, Virginia

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The results of the first empirical assessment of the impact of residential parking zones on commuter behavior are discussed. Residential parking zones, areas where on-street parking is short-term (usually 2-3 h) for all cars except those owned by people who live in the zones, have been adopted in at least 40 communities where there is competition between residents, commuters, and others for on-street parking spaces. Some policymakers appear to believe that such measures may induce commuters who used to park in curbside spaces to change to transit or to carpool. In a survey of drivers who commuted to the central business district of Alexandria, Virginia, it was found that, after residential parking zones were adopted in that area, only 12 percent of the sample changed commuting modes from single-occupant automobiles to either transit or carpools. Most commuters continued to drive alone but changed location to either off-street parking (frequently subsidized by their employer) or streets outside the districts.

A number of urbanized communities in the United States have, over the past few years, delineated residential parking districts to grant residents of certain neighborhoods special on-street parking privileges and to restrict on-street parking by all others. This has typically been done in neighborhoods that have suffered from parking shortages or other traffic-related problems because of their proximity to major trip attractors. Within districts that have implemented such parking policies, streets where parking previously had been unregulated are usually limited to short-term parking except for residents of the area, who may purchase

permits for a nominal fee to be displayed on their cars to show that they are exempt from the time limits. The stated purposes of these districts are usually to reduce congestion, improve air quality, encourage the use of transit, expand the parking supply for residents, and maintain a residential quality of life in the neighborhoods.

Even though such plans have been adopted in at least 40 communities in the United States and many others are considering such plans, it appears that the study described here is the first empirical assessment of the impacts of these regulations.

LIKELY IMPACTS OF RESIDENTIAL PARKING REGULATIONS

Many impacts on nonresidents and residents have been hypothesized for residential parking regulations. Commuters or others who can no longer park all day on streets in these districts may change their parking locations to off-street facilities or may park on unregulated streets just outside the districts. Those who change to parking in commercial facilities may form carpools in order to share the costs of parking. Others may switch to transit. Nonresidents may remain in the parking districts and move their cars from one space to another to conform to the time limits. If nonresidents are not given adequate transit or parking alternatives, one long-range impact may be a change of trip destination. Transit service to the area could be augmented if more commuters ride to avoid parking costs, and this could have a broad, long-term impact on travel to the area.

Residential parking districts probably have different impacts on nonresidents who normally park for short periods of time, such as shoppers, people conducting personal business, and employees whose offices are in the area but whose jobs require them to use their cars a great deal. If a permit plan is successful in opening up on-street spaces that were previously occupied by long-term parkers, short-duration trips to the area may increase. This may fulfill some urban policy objectives, such as encouraging shopping, but it may work against others, such as reducing automobile emissions and discouraging "outsiders" from parking on residential streets.

The group directly affected by residential parking districts is, of course, the residents. Since parking districts have usually been implemented where residents have had a hard time finding convenient on-street space, the new parking regulations will probably significantly increase the on-street parking supply for residents. The new districts could lead to increased automobile travel by residents and may in the long run lead to increased automobile ownership.

The degree to which residential parking districts will prompt any of these changes will vary from neighborhood to neighborhood. Impacts in any one neighborhood will depend on several factors, including existing parking supply and demand, the price of off-street parking, transit service to the area, and the stringency with which the regulations are enforced.

ALEXANDRIA, VIRGINIA, PARKING DISTRICTS

Although it is a close suburb of Washington, D.C., Alexandria, Virginia, has a unique and active central business district of its own, usually referred to as Old Town. Extensive restoration of colonial townhouses and construction of new townhouses, the presence of specialty shops and restaurants, the cobblestone streets and brick sidewalks, and the growing number of offices in the area have created a pleasant urban atmosphere in a relatively tranquil setting on the Potomac River.

Both the number of employees and the number of high-income residents in the area have continued to grow since the mid-1960s. About 7000 residents live in the Old Town area, and more than 20 000 people work there. A 1974 survey of Old Town workers indicated that about 70 percent drove an automobile, 10 percent were automobile passengers, 10 percent used buses, and 9 percent walked to work. About 45-50 percent of those who drove to work parked on the street.

The city leadership has become concerned about traffic and parking problems brought about by the increased development in Old Town. On January 1, 1979, the city implemented a residential parking-permit plan for approximately 105 block faces (about 1800 parking spaces) in the area. This created two districts, located on either side of a main retail street. The city ordinance that implemented the districts states that creation of the districts would help solve the following problems: (a) hazardous traffic conditions, (b) air pollution, (c) excessive noise, (d) the accumulation of trash and refuse, and (e) the inability of residents to "gain access to their homes".

Within the parking districts, the only vehicles that can be parked for more than 3 h in the same on-street space are residents' vehicles that have permits. These regulations are in effect during weekdays, from 8:00 a.m. to 5:00 p.m. Special temporary permits are available for vehicles that belong to guests of residents and to people doing business with residents. Enforcement by the city police is considered to be effective.

The districts were implemented on a three-month trial basis, after which the city council decided to continue the program, which is popular with residents. During the trial period, however, some changes were made in the boundaries of the parking districts: The southern district was almost doubled in size in response to petitions from residents, and some blocks in the northern district were eliminated.

STUDY METHODOLOGY

About six weeks before the Old Town parking districts were implemented, the Urban Institute conducted a brief study of parking use that covered about half of the streets to be included in the districts. The purpose of the study was twofold: (a) to assemble a sample of long-term parkers in the area for interviews to be conducted after the permit plan was implemented and (b) to measure certain characteristics of on-street parking, such as duration and trip purpose, before the parking regulations were put into effect. The survey was conducted on November 13 and 14, 1978.

The study focused on a sample of 60 block faces (about 630 parking spaces) where long-term parking was allowed. In addition to noting all unused spaces on each block, the study team recorded license-plate numbers so that ranges of parking duration could be developed. A postage-paid mail-back questionnaire was placed on the windshield of each parked car. The questionnaire asked for information on trip purpose, arrival time, departure time, and walking distance between parking location and destination. A total of 320 completed questionnaires were returned for a response rate of 30 percent.

The second phase of the study involved the identification of a sample of commuters to be interviewed after the regulations were implemented. Telephone interviews were completed with 107 people who commute to the Old Town area by automobile. This sample was drawn from respondents to the postcard

survey who identified themselves as workers and from observing others who parked. Individuals were identified by tracing license-plate numbers back to the registered owners of the vehicles.

CHARACTERISTICS OF ON-STREET PARKING BEFORE CREATION OF THE DISTRICTS

The study confirmed the difficulty of finding parking spaces in the Old Town area. In the late morning and early afternoon, 93-97 percent of all parking spaces surveyed were occupied. Spaces appeared to be somewhat easier to find in the early mornings and early evenings, when occupancy rates ranged from 82 to 90 percent.

Half of the on-street parkers who responded to the mail-back survey were residents of Old Town. There were almost as many workers (42 percent) as there were residents, and relatively few (7 percent) were there for other purposes, such as shopping or personal business. However, the small proportion reporting "other" trip purposes may underrepresent the actual number, since people who were making this type of trip probably had less motivation to mail back the questionnaire.

The almost equal ratio of workers to residents did not hold throughout the day. According to the mail-back survey, by midmorning there were about twice as many workers' cars as residents' cars parked on the surveyed streets. In addition, many residents' cars were not moved at all during the day.

Study observations showed that the turnover rate in parking was also low for people in the "other" trip category. Given the high-occupancy parking rates during much of the day, the large proportion of parkers who were not residents of Old Town, and the large proportion of those who parked for longer than the 3-h limit specified in the new parking regulations, it appeared that the parking districts would have a significant impact on on-street parking in the area.

IMPACT OF PARKING DISTRICTS ON COMMUTERS

Two and one-half months after the Old Town parking districts were implemented, the Urban Institute conducted a telephone survey of commuters to the Old Town area in an attempt to gauge the short-term impact of the districts on commuting patterns. Telephone interviews were completed with 107 people who commuted to the Old Town area. This constituted approximately 15 percent of the estimated 750 commuters who parked on the streets within the parking districts.

The responses indicate that the parking restrictions have had a significant impact on commuters to the area. Seventy-six percent of the respondents reported that they had changed their parking location. Twelve percent of the sample reported that they had changed their travel mode (those who changed locations and joined a carpool are included in this group). Of the 13 respondents who changed from driving alone, 3 changed to bus transportation and 10 formed carpools. The new carpools average 2.4 members. Six of the new carpoolers parked off the street, two parked in the parking districts, one parked outside the area, and one was dropped off by the carpool.

The specific changes in parking patterns among respondents who formerly parked in on-street spaces are given below:

New Parking Location	Respondents (%)
Off street	29
On street	
In districts	20
Out of districts	20
Metered space in districts	1
Dropped off	1
No regular parking pattern	5
Total	76

Commuters who changed parking patterns are fairly evenly split between parking on the street but moving to spaces outside of the districts, parking in off-street facilities, and parking in curbside spaces within the districts.

All of the commuters who still parked in curbside spaces within the districts said that they never stay in the same space longer than the 3 h that they are legally allowed. Apparently the districts have improved the situation for some of these commuters: Three volunteered the information that they used their cars on the job, rarely parking for more than 3 h, and that they now have a much easier time finding spaces. Two others claimed that the ease with which they now can find spaces close to their jobs more than makes up for the inconvenience of moving their cars every 3 h. However, for the most part, those who still park in the districts consider the current regulations a great inconvenience. Many of these people said that they often try to find on-street spaces outside of the districts but, in order to find one within an acceptable walking distance of their offices, they must arrive very early in the morning. Another reason given for parking within the districts was fear of one of the neighborhoods that lies just outside one district boundary. One of the more unique arrangements for parking within the districts was reported by a teacher at an elementary school, where the school custodian moves some of the teachers' cars from space to space every 3 h.

Almost all of the respondents who parked outside the districts also considered the regulations an inconvenience. Many corroborated the difficulty, reported by those parking in the restricted areas, of finding spaces outside the districts. Many said that they left home half an hour early in the mornings in order to find an out-of-district space within what they considered reasonable walking distance of their offices.

The largest group in the sample has continued to drive to work and park in curbside spaces, either within or outside the parking districts. The second largest group drives to work but has changed parking locations to off-street facilities. A large proportion (around 40 percent) of the respondents who changed to off-street facilities have made arrangements where they can park for free. The price of parking for those who do pay ranges from around $0.70 to $3.00/day and averages $1.90/day. A number of employers in the Old Town area appear to have begun to provide parking subsidies of one form or another when the new regulations were implemented.

CONCLUSIONS

If the initial impacts observed in this study are indicative of longer-term effects on commuters, then it is unclear whether the net effect on commuter automobile use is beneficial. If only 10-15 percent of automobile commuters switch to carpools or buses and 20-40 percent are forced to drive more to search for spaces or to move their cars around each day, there may not be a reduction in automobile vehicle miles of travel or pollutant emissions. More convenient parking for shoppers may increase automobile travel to the Old Town area. If residents begin to use their cars more because parking is available, this will also increase automobile travel.

The initial response in Alexandria suggests a

number of hypotheses that should be tested:

1. Residential parking restrictions alone will encourage few drivers of single-occupant automobiles to use transit or carpools,
2. Significant numbers of automobiles will be moved to off-street facilities,
3. Significant numbers of automobile drivers will continue to park in the area and move their cars from one space to another to conform to the time limits, and
4. Residents of the area will increase their use of automobiles.

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Land Use Zoning as Transportation Regulation

DON H. PICKRELL AND DONALD C. SHOUP

Land use zoning, which is frequently relied on to improve resource allocation in the land market itself, is also used to indirectly regulate the urban transportation market. The effects of one of the means by which it does so, the requirement for a minimum amount of off-street parking space in conjunction with new commercial development, are discussed. Evidence is demonstrated that this minimum amount of parking is well above what the land market would supply in the absence of such requirements. The result is to depress the market price of parking to a level below the cost of its supply. This indirect regulation of the price of parking has several consequences, principally an increase in the number of trips made by automobile. Aside from their effects on the urban transportation market, parking requirements may also cause distortions in the urban land market. In effect, they can impose a "tax" on new development, which not only slows the redevelopment of older areas but may also alter the spatial pattern of new development in undesirable ways. Unwisely used, land market controls can thus aggravate some of the transportation, and other, problems they are intended to solve. This illustrates the potential hazard of attempts to remedy urban transportation problems indirectly—for example, by intervention in the land market rather than direct intervention in the transportation market itself.

Land use zoning, which is frequently relied on to improve resource allocation in the land market itself, is also resorted to in attempts to improve the allocative outcomes of other markets. The catalog of goals for zoning listed in the Standard State Zoning Enabling Act suggests the variety of effects sought: to promote health, safety, morals, or the general welfare; to lessen congestion on the streets; and to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements (1). Clearly, this list includes many outcomes that are determined well outside the market for urban land, the traditional province of zoning. Despite an often tenuous causal link between the explicit form of intervention in the real estate market and its intended consequences in the market where a problem is perceived, attempts to regulate non-land-market outcomes through zoning do seem to be common.

A clear illustration is the surprising variety of ways zoning is used to regulate urban transportation activity. In new residential and commercial developments, detailed specifications typically govern the width and layout of street systems as well as the design of intersections and access ways. In the downtown areas of many cities, density controls, which take the form of floor-area ratios, minimum lot sizes, and limits on the number of dwelling units per parcel, are used in an attempt to reduce traffic congestion. Requirements for a minimum number of parking spaces in new buildings are intended to improve traffic circulation by getting cars off the street once they have arrived at their destination. All of these forms of regulation have the intent of increasing the quantity of land and other resources allocated to the provision of urban transportation services.

RATIONALE FOR RELIANCE ON ZONING

While land use zoning has as its legal basis the furtherance of the public welfare, it also has a long-recognized foundation in economic theory. Its potentially valuable role in mitigating the effect of negative externalities by regulating the location of offending land uses was first explicitly recognized by Bailey (2) and Davis (3).

More recently, zoning has increasingly been used to regulate the quantity of land used for various activities as well as simply to control the location of specific land uses. Like location controls, this rationing aspect of zoning has as its justification the improvement of resource allocation in a land market characterized by the presence of external diseconomies that arise from certain land uses. In fact, growing recognition of the pervasiveness of such diseconomies may have encouraged continued attempts to impose more detailed control on land use. The ease of implementing such controls has also caused them to be extended to a variety of urban problems that, while not specifically originating in the land market, often appear superficially to result from the manner in which urban land is used. Problems as diverse as slum housing, traffic congestion on city streets, and air pollution have all been the targets of local land use controls. Although confidence that zoning is a promising approach to such problems is certainly one rationale for local government's reliance on it, there are other understandable reasons why planners urge direct controls over land use to remedy what are not fundamentally land-market problems:

1. Political consensus in support of direct intervention in the various markets where problems originate is rare. For example, economists have long