Fiscal Costs and Public Safety Risks of Low−Density Residential Development on Farmland: Findings from Three Diverse Locations on the Urban Fringe of the Chicago Metro Area

revised, January 1999

by

J. Dixon Esseks

Division of Public Administration

Northern Illinois University

Harvey E. Schmidt

Department of Political Science

Northern Illinois University

Kimberly L. Sullivan

Department of Political Science

Northern Illinois University

with assistance from

Vicki B. Clarke, Edward J. Furlong, David D. Oldfield and Patrick Stewart

Department of Political Science

Northern Illinois University

 CAE/WP 98−1

Table of Contents

Acknowledgments

The report's authors are very grateful to:

- The Joyce Foundation and the Gaylord and Dorothy Donnelley Foundation for funding the research for this report,
- Dr. A. Ann Sorensen, director, Center for Agriculture in the Environment, for her indispensable intellectual and other forms of assistance in developing and carrying out the research,

- Denyse Sturges and Teresa Bullock of CAE for producing the report both in its hard copy and internet versions,
- Vicki B. Clarke, Edward J. Furlong, David D. Oldfield and Patrick Stewart of Northern Illinois University's Department of Political Science for assisting with the project's field work and data analysis,
- Dr. Charles Trott, director of NIU's Center for Governmental Studies, and his colleagues − Thelma Hiland, Pat Barger and Sandy Petit, for their multifaceted support of the project and
- the many officers of governmental bodies (municipal, township, county, school district and fire protection district) in the three study communities who shared their records and insights with us.

Chapter 1

Focus and Purpose of Study

Focus of the Study

This report presents findings from three diverse geographic areas of low−density residential development on agricultural land in Northeastern Illinois. By low−density housing built on farmland, we mean either one or a combination of two development patterns: (1) homes built on large lots − such as on one or more acres per dwelling unit − or (2) houses with smaller lots but located in developments that are scattered so that a half−mile or more of farmland separates one development from the other. Either way, the densities of dwelling units per square mile are low; and from an airplane or the vantage point of a hill, the new housing presents a scatter pattern. With residential scatter it is likely that large distances separate the homes from schools, fire stations, rescue squads, grocery stores, pharmacies and other providers of essential services. In these three study sites, we looked for whether the distances generate fiscal costs and public safety risks that could be avoided or reduced in more compact development. Specifically, we hypothesized that the residents and businesses of nearby municipalities have been subsidizing *school busing, road maintenance and sewer and water services* provided to the homes located in developing low−density areas The public safety risks we tested for were *long waits before paramedics, fire fighters and police respond to calls for assistance and long bus rides for school children to and from school.*

Low−density development is by no means unique to Northeastern Illinois. As David Rusk observed, "Since World War II, all urban growth has been low−density, suburban style."[(1)] Our findings from three locations in one region cannot, of course, claim to be representative of the entire phenomenon of low−density housing. However, coordinated cases studies like ours may provide initial or additional support for hypotheses about fiscal costs and safety risks that other researchers will test on a larger scale.[(2)] Moreover, readers residing or working in communities similar to the ones we describe may be persuaded to look in their contexts for the same relationships that we found. Additionally, our case studies may help readers with measurement issues. Much of this report is devoted to discussing, step by step, how we measured fiscal costs and public safety risks associated with scatter−type residential development.

Purpose of the Study and its Intended Audience

This study's sponsor, the American Farmland Trust, has since its founding in 1980 been concerned about the loss of productive farmland to subdivisions, shopping malls, highways, airports and other public and private developments.[(3)] Residential housing built in rural areas may be particularly disruptive of farming. In addition to consuming productive land for home sites and streets, such developments may create problems for agricultural operations on the land still being farmed adjacent to them. Nonfarm residents frequently constrain when and how farmers farm because of the formers' complaints about livestock and fertilizer smells, about dust from tractors, pesticide sprays and late−night or early−morning sounds (tractors, grain dryers), among other by−products of farming that they regard as nuisances.[(4)] Also, crop and livestock yields may be reduced because of trespassing on farmland by adult and child residents (on foot, horseback, motorbikes, or all−terrain vehicles), by dogs who scare livestock, or by stormwater run−off from subdivision streets, roofs and yards that flood portions of farmers' fields.[(5)]

Given these two kinds of costs to agriculture, AFT has sponsored a variety of studies designed to persuade local governments, landowners and other actors in the development process to protect prime and unique farmland.[(6)] One type of study has argued that, unlike residential development, agricultural uses of the land pay for themselves by generating enough land taxes and other revenues to cover the cost of road maintenance and other public services that they consume.[(7)]

Our study has a similar purpose in testing for fiscal subsidies and public safety risks, but the target audience is broader. In the first place, we sought to inform prospective home buyers. If they regard as excessive the waiting times we measured for how long families in the scatter sites waited before paramedics arrived to help the injured and sick or before police responded to calls about prowlers or other perceived threats to personal safety, buyers may be dissuaded from selecting rural home sites. Another set of findings that should be pertinent to their locational decisions concern how long their children would ride school buses each day. We measured round−trip times for elementary and high school students. A second group of readers whom we intended to inform are the taxpayers residing in adjacent municipalities who share school districts, township road districts and public safety jurisdiction with the residential scattered households. We hypothesized that the in−town taxpayers were subsidizing the distance−related costs of the services being provided to the residents of new homes constructed in the scatter sites.

The main policy recommendation coming from our findings is not a naive call for banning residential development on farmland. The diverse society in which we live requires a variety of housing opportunities. Some families, particularly the well−off, want large−lot home sites, can afford them and may move outside the Chicago Metro Region if they fail to find the life style they desire here. With them may go the businesses which they own or manage, as well as their disposable incomes, much of which they would spend in our region if they continued to live here. However, as we found in parts of one of our study sites, they may be persuaded to live on comparatively modest−sized rural home sites. And given their lot sizes, those homes may be built in sufficient densities to justify locating schools and fire stations close to them so that school bus rides and emergency service response times are not excessive.

A second study site provided a positive model for another dimension of residential development: affordability. The middle−class is often priced out of new developments on the urban fringe because the host communities insist on large minimum lot sizes and other standards that increase sale prices.[(8)] Many local governments deliberately use their zoning, subdivision ordinances and other regulations to attract the well−off and to discourage moderate− and even middle−income families. When middle class buyers look for less expensive housing, they frequently must go to communities that have much longer−commuting distances (like De Kalb, Illinois, 48 miles from the region's main beltway − I−294 − or Belvidere, 50 miles out). Therefore, as demand for new homes in those more remote locations increases, there occurs new nodules of residential scatter on rich farmland. By contrast, one of our three study sites is much closer to job opportunities, its city government has welcomed housing developments marketed to the middle class, and the density of those developments (among other factors) resulted in sales prices that median−income families could afford.

Our study sites provide both negative and positive models if this report's readers, like us, assume that new housing units will continue to be built in the region, but who favor an efficient pattern of development. Our case studies found significant fiscal costs and public safety risks from low−density scatter, as well as examples of less costly and less risky residential development closer to sources of public services. Chapters 3 to 6 break down our findings about costs and risks into the four service areas of public schooling, emergency services (medical, fire and police), maintenance of public roads and provision of public sewer and water services. Then Chapter 7 presents a summary of policy recommendations.

We shall be arguing for increased densities for developments of *single−family (SF) detached homes*; the prevailing low densities produce excessive costs and risks − we believe. Whatever our preferences about other styles of housing like attached single−family units or multi−family units, our data in this study and hence our analysis are limited to SF detached homes.

Prior to the chapters on costs and recommendations, we use the immediately following chapter (2) to describe the study sites, the criteria used in selecting them, the levels of density we measured, the distances to service providers and the quantity of farmland consumed.

Chapter 2

Study Sites: *Selection, Density of Development,*

Distances to Service Providers and Consumption of Farmland

Selection Criteria

Three criteria guided the selection of study sites. Firstly, when conducting case studies, researchers must choose between homogenous and heterogeneous study areas. Because time and other resources limited the number of sites to three, we opted for *diversity.* Although homogeneous sites (e.g., three cases of scattered residential development due to municipal annexations) might have yielded consistent findings, three cases are too few on which to base generalizations about any one type of low−density scatter. Moreover, heterogeneity promised to broaden the readership and therefore the utility of our research. Since low−density development is our central focus, we sought diversity in that type of development.

The three selected sites exhibit four kinds of diversity − in (1) the number of resident persons per square mile in the studied areas, (2) the distances from the study sites to service providers, (3) the size of the incorporated areas that are adjacent to the study sites and that provide schools and other services for the sites' residents and (4) the level of government that hosted the new development − county versus municipal. One of the three sites is an example of residential scatter resulting from municipal annexations, while in the other two cases, county boards have authorized subdivisions and individual non−farm homes to be developed on unincorporated land.

A second condition for inclusion in the study was *the existence of shared local government services* between the scatter area and a nearby municipality. To test the hypothesis that locating new development next to or within a municipality was less costly fiscally and less risky from a public safety point of view, we sought areas that had recent examples of both types of development sites: low−density scatter and city−density development. Rather than comparing the actual costs and response times of serving the former with hypothetical data on the latter type of setting, we found study sites with both types side by side that had shared services. Therefore, we could isolate differences in costs and response times attributable to distance and density rather than to differences in service providers. The shared services are schools, fire suppression, emergency medical and in one study case − police.

Our last selection criterion was *interest in our study from local government.* Both of the funding foundations (Joyce and Donnelley) and a long−standing tradition in policy research[(9)] encouraged us to find study communities where one or more relevant agencies − planning department, mayor's or city manager's office − pledged both to help with gathering facts and to give serious consideration to our findings. Those pledges became generous realities over the 15−month period of the study. We cannot name the several agencies and many individuals who helped us because of our pledge to protect the confidentiality of their situations. The pledge derived from our conviction that, because they permitted us to see deeply into their fiscal records and administrative operations, it is their exclusive right to decide if and when any of our findings are publically identified with a particular agency of city, township, or county government. Therefore, this report refers to the three sites by their types of low−density residential development: (1) *early scatter* on unincorporated land, (2) *maturing scatter* on unincorporated land and (3) *transitional scatter* on newly annexed municipal land.

Diversity of Research Sites: Density of Population and Home Sites

According to U.S. Department of Commerce 1990 census data, the number of residents per square mile in our three study sites of residential scatter ranged from 45.8 in the case that we label "early scatter" to 333.1 in the "maturing scatter" site and then to 492.9 in the "transitional scatter" study area (see Table 1). By comparison, the municipality adjoining the "early" site averaged 1,402.4 persons per mile, the city next to the second site had 2,207.1 and in the third site − 2,754 residents.

The name "*early scatter*" was suggested both by the small number of residents per square mile and by the county planning department's identification of the site as being at risk for substantial scatter−type development. The 1990 Census classified only 12.3 percent of the population of 6,401 as "farm residents." Parts of this area attract non−farm housing because of their proximity to a tollway. In all three study sites, another attraction for many home buyers may have been the racial homogeneity of the areas − 96.6 percent or more white (Table 1).

The name "*maturing scatter"* came from the comparison with the first site and the knowledge from earlier censuses that this second study area had been housing large numbers of non−farm families for many years. For example, in 1981 the two townships comprising that site had 174 separate rural subdivisions with a total of 9,215 platted lots.[(10)] The 1990 Census found 18,772 residents in the unincorporated parts of those townships, compared to only 6,439 in the four townships that include our "early scatter" site. Townships are ordinarily 36 square miles in area. In 1990 the early site contained a small city of about 3.4 square miles in size, while the maturing site included a municipality of around 10.2 square miles. Since this second scatter site in early 1998 still has considerable buildable open space, we call it "maturing" rather than "matured." If this second site became fully built out − with homes or other structures on virtually all feasible building lots − it might no longer have the large spaces between subdivisions, that is, the discontinuous pattern of growth that occurs in the early scatter sites. However, from an airplane, we would still see scatter in the sense of homes looking like rocks spread out on a field. The "stones" might be rather evenly spaced, but there would be considerable open space around them. The one−acre or larger lot sizes would continue to cause fiscal inefficiencies, such as long distances from school campuses over which children must be bused and relatively few homes per mile of publically maintained roads that pay taxes for that maintenance.

We label the third site "*transitional scatter*" because the average lot size points towards a relatively high overall population density once the area is fully developed. For our sample of 280 detached single−family homes newly occupied between 1990 and the end of 1995, that average was not quite a quarter of an acre (Table 1). One of the most widely cited scholars on the fiscal impacts of land use, Robert Burchell, places the threshold of scatter−type densities at one−third of an acre.(11) In this third site lots can be small and homes compactly placed along public roads because the developments are served by city sewer and water lines. The

Table 1

The Population Density, Racial Composition, Average Lot Sizes and Average Road Frontages of the Three Scatter Sites and Their Adjoining Comparison Sites

Trait	***Early Scatter Site***	Small City Surrounded by Early Scatter	***Maturing Scatter Site***	Medium−sized City Adjacent to Maturing Scatter	***Scatter Site Produced by Municipal Annexation***	*All of Annexing City*
Persons per square mile (entire area in 1990)	***45.8***	1,402.4	***333.1***	2,207.1	492.9	2,754.0
Whites as % of total population	***99.3%***	96.1%	***96.6%***	98.1%	***97.6%***	about 70%
Average lot size in acres (1990−95 new homes)*	***5.8*** (5.0)#	0.27 (0.24)#	***2.1*** (1.3)#	0.47 (0.35)#	***0.24*** (0.22)#	no data
Average street frontage of lots in lineal feet (1990−95 new homes)	295.7 (216.0)#	83.5 (76.5)#	268.2 (191.0)#	126.6 (103.0)#	***74.9*** (75.0)#	no data

Sources: U.S. Department of Commerce. *1990 Census of Population and Housing: Summary Tape File 3A.* Washington, D.C.: Bureau of Census, Data User Services Division; and building permit files of the particular cities, counties, or townships.

*For detached single−family homes; townhouses have been excluded.

= median value.

---

smaller the lots' frontage on those roads, normally the less expensive it is per home to build and maintain the lines, because they usually run along or down the roads. Road maintenance functions like snow clearance and sweeping are also cheaper per dwelling unit. The transitional scatter site is clearly the most efficient in this respect with its average lot frontage of 74.9 feet compared to 295.7 feet and 268.2 feet found for the other two scatter sites. In those two sites lots normally must be close to an acre in size in order to accommodate on them both a private water well and a septic field for disposing of waste water.

Despite the comparatively small lot sizes prevailing in our third site, the area's overall density may remain low for some time. The city has continued to annex large acreages and new developments have continued to be scattered over them. By scatter in this kind of site, we mean sizable expanses of open−space between one development and the next. For example, along one two−mile road serving new subdivisions before it reached the city's limits, we measured a gap of 1.2 miles on the south side and a half−mile gap on the north. The gaps consisted of farmed parcels, some of which would probably be developed in the next year or so but others that could remain vacant indefinitely, as developers skipped over them in favor of cheaper land farther to the west and due to be annexed. However, at least as of 1994 the home−building in the study area had brought about a substantial increase in density. While from the 1990 census we estimated 493 residents per square mile, data from a special local census in 1994 yielded an estimate of 879 persons. But new annexations after 1994 raise doubts about whether overall densities will continue to increase.

In−fill was problematic also in the early scatter and maturing sites. Moreover, the large lot sizes precluded approaching urban densities. For all three sites we obtained measures of lot size and the related trait of road frontage by examining Sidwell platbooks.[12] In the maturing scatter site and the transitional site, we drew random samples since the numbers of new homes were too large to analyze all cases, while in the first site we could avoid sampling. These records showed large average lot sizes − 5.8 and 2.1 acres − and (as discussed above) long average road frontages − 295.7 and 268.2 feet − in both the early and maturing unincorporated sites (Table 1). In other words, the home sites averaged almost a football length of land along roads and totaled more than two times the minimum space required by state law for private wells and septic fields on the same home site (about an acre).

We conducted a parallel analysis of lot sizes and frontages of homes newly occupied during the same six years in the adjoining municipalities. If in fact there were trivial differences in home sites and the number of dwellings per mile of public road, it would be useless to argue that locating homes within those cities would mean less farmland consumed and more efficient provision of distance−sensitive public services (school busing, emergency medical responses, street maintenance). Some municipalities in the Chicago Metro area use large−lot zoning requirements to restrict new housing to upper−class or upper−middle households. The best known case is Barrington Hills, which for some years has had a five−acre minimum to obtain a building permit. The nearby cities for our early and maturing scatter sites, were much less restrictive. The average lot size of newly occupied homes, 1990 to 1995, in the comparison municipality for the early site was just over one−quarter of an acre, while the city near the maturing site recorded an average of a little less than half an acre (Table 1). The average road frontages were also much smaller relative to the comparison rural sites : 83.5 linear feet for the city adjacent to the first site, and 126.6 feet in the maturing site (Table 1).

Since averages may be biased upwards by relatively few extreme cases, we calculated also the median values for these two measures of home sites. The medians are given in parentheses in Table l. In all cases medians are less than averages, but substantial differences remain across the scatter sites and between them and the adjoining municipalities. The median lot size in the early scatter site is almost 21 times the median for new homes built during the same six years in the adjacent city, and the median frontages is 2.8 times larger. In the maturing scatter study area, the corresponding differences are a factor of 3.7 for lot size, while the median frontage of homes in the unincorporated area is about 1.9 the median for new city homes. The transitional scatter site's median lot size − .22 acres − is far below those of the two unincorporated sites and significantly less than one of the municipal study area's. Its median frontage measure − 75 feet − was virtually the same as the first municipal site's, indicating efficiency both in the cost of road maintenance per dwelling unit and in tax yields per mile of road. That is, as the snow plow goes up and down the street, relatively many more homes are being served per mile than when the frontage is 191 feet or 216 feet; and more homes are paying taxes to support the service.

Hypotheses about Shared Local Government Services

In all three study areas the same units of local government provided services to the scatter site as well as to the comparison municipal sites. In the early and maturing areas, there were four shared services on which we focused: public schooling, emergency medical, fire suppression and road maintenance. With these services, we tested the hypothesis that the per−dwelling−unit costs were significantly higher for the rural home sites compared to the city locations because of the greater distances to the former. The distance−related cost differences might be offset either by lower frequency of demand for the service or by higher tax contributions. The second major hypothesis was that new residents in the unincorporated areas had significantly higher waits for emergency services and longer school bus rides. Invalidating this hypothesis might have been the reality of satellite fire stations and rural school campuses that reduced travel times to levels experienced by municipal consumers of the same services. Alternatively, the cities may have annexed land in such a scatter pattern that distances from their newly developed residential areas to service providers might be little or no less than what we measure for the new homes in the rural areas.

It was plausible also to test in the transitional scatter site for excessive response times by police, fire department and emergency medical services. Two other distance−sensitive services that we studied in this location were sewer and water provision. All new homes in this study area hooked into city sanitary sewers and water mains. The city charged modest enough connection fees for there to be the possibility that residents, merchants and other taxpayers in the rest of the city were subsidizing the extensions of sewer and water lines to scattered new developments in the study area. We, therefore, set out to determine whether subsidies were in fact being paid. Specifically, we looked to see if the buildout rates for the new developments were fast enough to yield sufficient total collections from the modest per−lot fees. If lines were extended but relatively few homes were built, the study city could suffer significant fiscal deficits and, thus, regret that it lacked the bargaining power or political will to require developers to cover all off−site capital costs.

Since distance plays potentially such an important role in our research hypotheses, we present in Table 2 the "as−the−crow−flies" mileage from the 1990 to 1995 new homes we studied to the source of one major public service. For the early and maturing scatter sites, that service is public schooling. The high school district demarcated the boundaries of those two study sites. All the new homes we surveyed − whether in the unincorporated or incorporated part of the site − fall within the high school district. Almost all those homes shared also the same fire department and emergency medical services; and in each site there was one township where our pools of studied rural and city homes paid taxes to the same township road district. In the transitional scatter site, the boundaries were defined by the relatively recent history of annexation. We examined a random sample of new homes in land annexed in that quadrant of the city since 1987. The shared services included fire, police, EMS, road maintenance, sewer and water. Table 2 measures straight−line distances from the studied homes in this site to the nearest fire station with emergency medical service.

Across the study sites, the modal (or most common) distances to the high school or fire/EMS station vary considerably, according to the location of the referent service and the kind of scatter. In the early site, the high school building is old and therefore located in an older, almost completely built−out part of the city. Therefore, very few (2.7 percent) of the 1990 to 1995 new homes constructed in the city were located within less than a mile of that campus (Table 2). By contrast, in the maturing scatter site, because of substantial residential growth both within the city and in the unincorporated part of the school district, the old high school had become inadequate; and a new campus was built on the edge of the city near to developing residential areas. Consequently, 65.3 percent of our sample of new city homes were found to be within less than a mile of that campus.

Table 2

Dispersal of New Homes Built from 1990 through 1995:

Percent of Homes by Miles from Point of Service, by Study Site

Distances from point of service	***Early Scatter Site****	Small City Surrounded by Early Scatter*	***Maturing Scatter Site****	Medium−sized City Adjacent to Maturing Scatter*	***Scatter Site Produced by Municipal Annexation****
Less than a half mile	0.0	2.7	0.0	10.2	0.3
from 0.5 to less than 1 mile	1.1	0.7	0.5	55.1	0.0
from 1 mile to fewer than 2 miles	8.6	93.2	0.0	17.0	4.4
from 2 miles to fewer than 3 miles	20.6	0.0	2.6	17.6	50.5
from 3 miles to fewer than five miles	43.4	0.0	17.5	0.0	38.6
Five miles and over	25.1	0.0	79.5	0.0	6.2
Unclassified	1.2	3.4	0.0	0.0	0.0
Total cases	175	146	189	176	322

*Point of service = high school campus

**Point of service = nearest fire/emergency medical service station.

___

There was an important difference also in the spatial distribution of new homes in the unincorporated areas. In the early scatter area, there were still enough buildable and attractive land relatively close to the city that 9.7 percent of the new homes built in the unincorporated area found themselves within fewer than two miles of the high school. A total of 30.3 percent were within fewer than three miles. By contrast, in the maturing scatter site almost all the suitable space that close to the city had been used by 1990, so that 97 percent of the new homes built from 1990 through 1995 were found from three to over five miles from the high school. The modal distance category (79.5 percent) for that site was five miles and over, while for the early scatter study area it was three to fewer than five miles (43.4 percent).

In the transitional site, the most frequent distance class was one more category down the scale − two to fewer than three miles. However, the referent service provider was a fire station with one ambulance and one fire−fighting "engine"; and it is obviously easier to distribute that ensemble of facilities closer to units of residential scatter than it would be to construct a high school. We did not measure distances to a school campus for this third site because time constraints prevented us from estimating school costs and measuring busing distances.

For this third study site, a modal distance of two to three miles was large relative to the cost of two services that had to be extended across that space**.** In early 1998 building a mile of 16−inch water main might average $60 per lineal foot, and a mile of 18−inch sewer line was $60 to $70 per foot.[13]

Type of Home Site and Consumption of Farmland

The three study sites varied also in the type of parcel on which new homes were constructed. The differences were in the percent of studied new homes built in subdivisions and the percent located in areas with trees as opposed to open land. In northeastern Illinois, undeveloped land without trees is usually farmed, both because it tends to be very productive for row crops and because state law provides preferential (i.e., low) assessments for farmed land.[14] Although building sites with trees tend to be more attractive to buyers and therefore cost more, they do not take land out of cropping, at least not directly. As Table 3 shows, we classified 31.4% of the studied home sites in the early scatter site and 17.5 percent in the maturing site as "mostly in trees" (that is, at least 50 percent of the parcel showed tree cover). Periodically, the assessment offices for these counties commission aerial photographs on which are superimposed the boundaries and legal identification number of each parcel. For our classification analysis, we worked with photos that were taken within a year before or after the end of our study period, December 1995.

This observed difference in the relative importance of home sites situated in forested areas suggests a distinction between early and maturing scatter sites. We suspect that, as development of nonfarm homes progresses in an area, more and more of the lots with trees are built upon; and the remaining undeveloped parcels become scarcer and more expensive. Therefore, in the absence of a slackening of demand for home sites, more of the new homes will be built on open land that was probably farmed in the very recent past.

While some buyers shun the relatively plain home sites created out of farm fields, our maturing site in two townships attracted buyers for almost 900 homes; and our random sample of 189 such homes found that 82 percent were built in open land rather than in the forested areas that are common in that area but increasingly already built upon. Since virtually all of the study site that we labeled as "transitional scatter" consisted of subdivisions built on recently farmed land, we did not bother classifying them on the basis of aerial photo−maps.

A related difference between the early and maturing scatter sites is the percentage of new homes built on subdivision lots versus free−standing parcels. The latter were relatively common in the early scatter site, comprising 41.7 percent of the total (Table 3). Averaging 10.1 acres (Table 3) and with a median value of 6.3 acres, they may provide extensive recreational space for their families, such as for horseback riding and trail−biking. By contrast, the homes built on subdivision lots averaged 2.6 acres, and their median size was 1.5 acres. It is not easy to predict which type of home site eats up more farmland per lot. Because non−subdivision home sites tend to be larger in acres, they may have portions that are still farmed, such as through lease arrangements with an area farmers. Forty−one percent of the 73 non−subdivision parcels in our early scatter area included land being farmed. Those parcels tended to be the larger ones among the free−standing home sites that we studied; their farmed acres averaged 14.5 in the 1996 tax year.[15]

The maturing scatter site provides a clear contrast with the early site. Only four or 2.1 percent of the former's sample of 189 rural home sites were *not* in a platted subdivision. They averaged 30.4 acres while the subdivision parcels were only 1.5 acres on average. The assessments records for the two study sites suggested a major reason for this difference in the prevalence of free−standing (or non−subdivision) home sites. Land cost

Table 3

Comparisons between the "Early Scatter" and "Maturing Scatter" Study Sites		
	Early Scatter	***Maturing Scatter***
Average Frontage	295.7 ft.	268.2 ft.
Average Lot Size	5.8 acre	2.1 acre
Median Lot Size	5.0 acre	1.3 acre
Percent of lots mostly in trees*	31.4 %	17.5 %
Percent mostly on open land	66.3 %	82.0 %
Percent difficult to classify	2.3 %	0.5 %
Percent in subdivisions (Their average size)	56.0 % (2.6 acres)	97.4 % (1.5 acres)
Percent free−standing	41.7 %	2.1 %

(Their average size*)*	(10.1 acres)	(30.5 acres)
Percent difficult to classify	2.3 %	0.5 %
Number of studied homes	175	189

***Classified as at least 50 percent in trees according to aerial photographs at county assessor's office.

---

too much in the maturing scatter site to permit many buyers to indulge in estates of five acres or larger. Also, few residential developers may be attracted to subdivision projects where their costs, such as for roads, utility lines and grading for stormwater, must be spread over one home per five or more acres.

Summary

Our study sites offer contrasts that suggest four dimensions for a typology of residential developments in a scatter pattern: *frontage, lot size, subdivision versus non−subdivision status, and lots mostly in trees versus lots mostly on open land*. In comparison to what we label an "early scatter site," the "maturing site" had shorter average road frontages and smaller lot sizes. In addition, proportionally very few of its studied home sites were free−standing as opposed to being in subdivision developments; and relatively few were built on mostly forested sites. Assessment data suggested that the law of supply and demand accounted for the higher prevalence in the early scatter site of lots that were free−standing, larger and mostly in trees.

Chapter 3

Public Education and Low−Density Residential Development

Public Education − Fiscally the Most Important Local Government Service

For the payers of local property taxes, the single most costly local government service is education. In the 1996 tax year, the public school districts in the two residential scatter sites that we analyze for this chapter accounted for 64.3 percent and 71.5 percent, respectively, of the total property tax levy (Table 4). That year the owners of the new homes in the early scatter site were billed an average of $2,568 for the two school districts serving them (i.e., separate elementary and high school districts), while the studied new homes in our maturing scatter site paid an average of $4,749, to the consolidated district of their community (that is, all schools came under a common board of education and administrative staff). As Table 4 indicates, the differences in these dollar amounts derived from higher levels in the second site for both the tax rate per $100 of assessed valuations and for the assessed valuations, themselves. Education's dominant share of the tax bill results basically from the large ratio of service providers to citizens served. For example, state−wide in the school year 1994−95 Illinois had a ratio of one teacher for 17 students.[(16)] The corresponding percentage for the nation as a whole in 1995−96 was one to 19.[(17)] By contrast, the Illinois municipality next to our maturing scatter site employed one sworn police officer for every 526 residents.[(18)]

For many owners of the new homes in these study communities, the perceived quality of public education may have been a major attraction for settling there.[(19)] If they were seeking to escape the real or perceived racial problems of schools in Chicago or in suburbs closer to the city, they found school districts in our two sites that were racially homogeneous − over 95 percent white (Table 5).

Table 4

School Finance Characteristics of Two Unincorporated Areas of Residential Scatter:

1996 Tax Year

School Finance Characteristics	***Early Scatter Site***	***Maturing Scatter Site***
K−12 public schools' share of total 1996 property tax bill	64.3%	71.5%
Average taxes due to school districts from the studied new homes (i.e., homes newly occupied in the calendar years 1990 to 1995)	$2,568	$4,749
Average tax levy per $100 of assessed valuation	3.64	4.233
Average assessed valuation of studied new homes	$72,680	$112,190

Number of studied homes	175	189

Table 5

White Students as Percentage of Total Pre−School, Elementary and Secondary Students: 1990 Census	
In early scatter site	In maturing scatter site
95.9%	95.4%

The Importance of School Busing Costs to the Study

As introduced in Chapter 1, this study's main purposes are to evaluate arguments as to why local governments should discourage the building of single family homes far from school campuses and other public services and, also, for why prospective buyers should avoid remote home sites. For fiscal arguments, the cost of busing is important because the in−school cost of educating a child is virtually the same whether he/she lives close or far from the schools. And our concern is not with whether to build new homes but rather with their locations. Therefore, in this chapter we examine the hypothesis:

The average new home in the unincorporated areas does not generate sufficient revenues for the school district to cover the cost of busing its children to and from school campuses.

Whether there exists this kind of deficit attributable to new rural homes depends on the number of public school children they house, the real estate and other revenues they generate for the school districts, their distance from school campuses and the costs of busing and other aspects of educating their children. The new homes might have sufficiently high assessed valuations or low enough coefficients of students per house that they cover both in−school expenditures and the extra costs of busing their children. Alternatively, they cannot pay all their schooling bills; but the subsidies they enjoy are less than the level of help experienced by new homes built in incorporated parts of the same school district. In other words, from a fiscal point of view, the rural homes might or might not be a better bargain. The structure of our study makes possible this kind of comparison. We analyze the costs and revenues from newly occupied homes, 1990 to 1995, in both municipal and unincorporated portions of the same school districts.

School busing is also the exclusive focus of the second main hypothesis that we examine in this chapter:

On average children from the studied new homes in unincorporated parts of the school districts have substantially longer bus rides to and from school than do students from new homes built during the same period in incorporated parts of the same district.

For many families that settle in rural parts of our study areas, school busing may not be a new experience. The children or their parents may have ridden buses in the cities or suburbs from which they moved. School campuses, especially for middle and high school students, were likely to have been far enough from their homes to require busing. What may be new, however, is the length of the ride. Also inexperienced and unexpected may be the weather−related risks of being bused through Illinois corn and soybean fields. Snow blowing off the farm fields may accumulate to dangerous thickness on the adjoining roads. Typically there are few trees or fences to shield the roadways. Fog is usually thicker in the country than in built−up areas; yet, buses on rural routes usually must stop on active lanes rather than on the too−narrow or soft shoulders when picking up and discharging students.

Since our study focuses on public schooling in only two sites, it cannot properly "test" these hypotheses. Rather we have two other goals. First, we seek to measure key fiscal and risk variables. Measurements that may be credibly applied to these two sites will hopefully assist analysts who wish to measure the fiscal costs and public safety risks of scatter in other sites. This chapter and the three following offer step−by−step discussions of how the measurements were developed. Second, our case studies permit us to identify causes of variation in those costs and risks that may help analysts in other settings who wish to predict outcomes and influence the location of new residential housing.

Examining the Extent to Which New Homes in Rural Scatter Sites Cover the In−School and Busing Costs Attributable to Them: *Steps in Measuring Costs and Revenues Attributable to Individual New Homes:*

I. Enumerating New Detached Single−Family Homes and Obtaining Enrollment Data

We began the measuring task by asking the relevant school districts for the addresses and grade levels of their currently enrolled students. After pledging in writing not to share or sell that information, we obtained the lists and compared the addresses to those of the study homes that we had enumerated from occupancy permits and/or assessment files for 1990 through 1995. Our census of new homes in the early scatter site identified a total of 175 dwelling units built there during the six years of the study period. All these units were detached single−family homes (DSFHs). A comparable census of the maturing scatter site yielded 897 new dwellings, also all DSFHs. In the same time period the adjacent municipality for the first site had 146 new DSFHs and a handful of townhouses (attached SFHs). The incorporated part of the second site had 861 DSFHs and about 100 townhouses. Given the lack of attached dwelling units in the unincorporated parts of both sites, we decided to limit our analysis to the detached SFHs. And given the large numbers of homes enumerated in the second site, we had to sample. Finding and analyzing building permits files, school enrollment data, emergency service records, etc. for over 1,700 separate homes was beyond our time resources. Separate samples were drawn from the second site's municipal and rural areas, with stratification by the two townships or by five sections of the city (Table 6). The city's planning department demarcated the sections for us. Each township's share of the rural sample was proportionate to its share of total new SFHs occupied 1990 through 1995, and each of the city's five sections had a percentage share equal to its proportion of the corresponding total of new dwellings built in that municipality.

Table 6

Enumerating Newly Occupied Detached Single−Family Homes, 1990 to 1995, in the High School Districts of the Early and Maturing Scatter Sites and Sampling in the Latter Site

	Early Scatter Site with Adjacent Municipality		*Maturing Scatter Site with Adjacent Municipality*	
	Early Scatter	Municipality	Maturing Scatter	Municipality
Full enumeration	175	146	897	861
Sample	not needed	not needed	189	176

Maps of the school districts identified which new homes were likely to be in each district. Border−line cases were classified after we obtained the property identification number for every address from county or township assessors' offices. When we entered a PIN into the county assessor's or treasurer's computerized data base, the information presented for that home site indicated whether tax was levied on it by the school district of interest to us, as well as by the relevant fire protection district, emergency medical service district and township highway district.

This data−gathering stage at county offices proved useful also for determining whether a home was occupied as of the 1996 tax year (the terminal point for our study). Homes listed in occupancy permits for 1995 should have been fully assessed for the 1996 tax year (whose bills were sent out to owners in 1997). Those homes without full assessments were excluded from our data set, on the assumption that either the occupancy permits were in error or the assessor (an elected township official) failed to update the assessment. Either way, the home could not participate in our cost−revenue comparisons. Our finding of 11 potentially under−assessed home sites greatly interested the superintendents of school districts whom we briefed about the study's findings. The extent of their potential losses was not difficult to calculate. If a vacant rural subdivision lot paid on average only $388 in property taxes to the school, but it owed $2,500 if the assessor bothered to re−assess the property, the schools were losing about $2,100 per mistake. The superintendents then talked about ways to improve the assessors' performance.

II. Calculating Average Numbers of Public School Students per New Home by Level of Schooling − Elementary and High School

Since the enrollment lists provided the students' grade levels as well as their addresses, we could develop separate totals for grades K through 8 and high school and then divide those sums by the number of new homes enumerated or sampled for the six years 1990 to 1995. The result was an average number of public school children per dwelling unit. Table 7 indicates that our early scatter and maturing scatter sites do not differ much in their K through 8 coefficients either between themselves − 0.49 versus 0.55 − or by comparison to the incorporated areas adjacent to them − 0.49 versus 0.58 in the early site and 0.55 in both components of the maturing site. However, the second site has a three times larger coefficient for high school enrollments: 0.43 as opposed to 0.14. This difference gives the maturing scatter site a statistically significantly larger combined coefficient of public school students per new home − 0.98 versus 0.63 for the early scatter site.[20] Other things (like local teacher salaries) being equal, a higher overall coefficient should mean greater average costs per new home in the second study area, especially since its combined value includes a larger component of high school students. The latter tend to be more expensive to educate.

Table 7

Average Number of Students Living in Newly Occupied (1990 to 1995) Detached Single−Family Homes and Attending Public Schools in the Early and Maturing Scatter Sites, with Comparisons to State−Wide Estimates for Same Time Period					
	Early Scatter Site with Adjacent Municipality, 1995−96		***Maturing Scatter Site with Adjacent Municipality, 1996−97***		***State−Wide Estimate***
	Scatter Site	Municipality	Scatter Site	Municipality	***for New Homes****
Kindergarten through 8^{th} grade	0.49	0.58	0.55	0.55	0.69
High School	0.14	0.21	0.43	0.30	0.27
Both levels combined	0.63	0.79	0.98	.85	0.96
Number of homes	175	146	189	176	not available

*Average per−pupil estimates for both three− and four−bedroom detached single−family homes, by Illinois Consulting Services/Associated Municipal Consultants, Inc., 1996.

Table 7 provides also a comparison to state−wide coefficients. Our early scatter site is below the state mean for both K−8 and high school, 0.69 and 0.27, respectively, while the maturing site is slightly above the state−wide estimate for high school and below that for the elementary grades. We hypothesized that the larger average number of children going to public schools from the maturing scatter site resulted in part from the higher proportion of new four−bedroom homes in that study area compared to the early scatter site**.** Burchell and Listokin, among others, have noted the importance of bedroom numbers in determining school−age children.[21] The surveys of the Illinois School Consulting Services have found higher per−pupil coefficients as the bedrooms of DSFHs increase from two to four (but not above four).

Our findings are similar (Table 8). In the early scatter site, homes with four bedrooms averaged 0.84 students going to public school (K−12) compared to 0.55 from three−bedroom homes. The difference was more marked in the adjoining municipality − 1.47 versus 0.71 pupils. The maturing scatter site showed largely the same pattern, with 4 bedroom homes yielding on average of 1.14 students compared to 0.71 from three−bedroom homes. However, among the total number of new homes for which we had bedroom numbers in that community, there were proportionately many more houses with four bedrooms − three−quarters − compared to about a third in the early scatter site. Therefore, the overall average number of public school children per new home was significantly larger in the maturing scatter site.

Though broadly similar to the state−wide estimates, our findings varied enough across the different school districts to justify the effort we went to calculating coefficients for each district. Look, for example, at the difference between the average number of high school students per new home in the early scatter site (0.14) and the corresponding coefficient for the maturing site (0.43 − see Table 7). This disparity supports arguments made by Fisher (1981) and Dekel (1994) that coefficients derived from regional or even district averages may be seriously misleading.[22] Therefore, we base our analysis only on recently built homes in two particular types of subdistrict settings: incorporated and unincorporated.

Table 8

Average Number of Students Enrolled in Public School from New Homes, by Number of Bedrooms, Two Northeastern Illinois Scatter Sites								
Number of bedrooms	***Early Scatter Site with Adjacent Municipality, 1995−96***				***Maturing Scatter Site with Adjacent Municipality, 1996−97***			
	Scatter Site		Municipality		***Scatter Site***		Municipality	
	Average K − 12	***% of total homes***	Average K − 12	% of total homes	***Average K − 12***	***% of total homes***	Average K − 12	% of total homes
Two	***0.09***	***6.4***	TF	TF	***TF***	***TF***	TF	TF
Three	***0.55***	***57.2***	0.71	86.1	***0.71***	***12.2***	0.47	11.0
Four	***0.84***	***35.8***	1.47	13.9	***1.14***	***75.4***	0.92	77.4
Five	***TF***	***0.6***	TF	TF	***1.57***	***12.3***	0.75	11.6

Total Homes	−	***173***	−	137	−	***57****	−	173

TF = too few cases (zero to six)

*We were unable to obtain data on number of bedrooms for one of the two townships.

____

III. Relating Per−Dwelling−Unit Enrollment Coefficients to School Districts' Costs

After calculating per−dwelling−unit enrollment coefficients, our next step in measuring costs attributable to new detached single−family homes was to estimate the average cost of educating the children who enroll from those homes. We divide those costs into two broad categories: (1) expenditures for instructing them in school and (2) costs of busing them to school campuses and back to their homes. Since the cost data are kept by school district, and since we promised to report our findings in a format easily usable by those districts, the analysis presented here is by district. Also separated out are the estimated costs and revenues per new home for the unincorporated and municipal components of each school district.

a. In−School Costs

The best estimate that we could find for average in−school costs was "operating expense per pupil." This value comes from the "Annual Financial Report" submitted by each school district to the Illinois State Board of Education after the close of the school year (August to June). It is calculated by dividing the district's figure for average daily attendance into "operating expense: regular programs." This latter value consists of salaries, employee benefits, purchased services, supplies, materials and interest on bonds, excluding such expenditures on non−"regular programs" as summer school and early childhood education and excluding also payment of principal or other capital outlays.

For purposes of comparing costs and revenues, we focus on the most recent school year with available data: 1996 to 1997. Across the four school districts we studied for that year, average operating costs per pupil varied considerably. As expected, the one exclusively high school district reported a higher value − $5,624 − compared to the two elementary districts located within its boundaries, whose averages were, themselves, substantially different − $3,905 versus $4,785 (see line 2 of Table 9). The greater average cost in the second district may derive in large part from its small enrollment; its average daily attendance in 1996 to 1997 was just 278 students, while the first district enrolled an average of 951. These differences for in−school costs are important to determining whether the new homes were paying for themselves, that is, generating enough revenues to cover both the district's in−school costs and its expenditures on busing students. As discussed later in the chapter, we found that, while the new homes in the rural parts of both elementary districts failed on average to cover their 1996 to 1997 costs, the deficit was much greater in the lower−enrollment district. There the deficit derived from both higher in−school costs and greater per−student expenditures on busing. By comparison, the rural homes in the larger district were able to cover all their in−school costs and most of the busing expenditures.

Among the four districts being compared, the consolidated district serving the maturing scatter site reported the highest operating expenditures per pupil, $6,296. As will be discussed a little later in this chapter, the average new home in the incorporated part of that district did not generate sufficient revenues to pay the costs of public schooling for its children. Deficits are not necessarily bad. Many or most readers may accept the normative argument that commercial developments − automobile dealers, a shopping mall, upscale speciality shops − found in a school district like this particular one should contribute to educating the young people who must become capable of either working in their stores or earning sufficient income elsewhere to make purchases at those stores (or do both). However, our analysis will show that the deficit for new homes in the district's unincorporated part is due to a significant extent to the higher busing costs compared to the city part of that district.

b. State's Share of In−School Costs

Under state−aid formulae operative for the 1996 to 1997 school year, the level of assistance per pupil provided to the four school districts we studied was very modest. It ranged from $289 in the small−enrollment, completely rural district to $483 for the high school district, both in the early scatter study area (line 3 of Table 9). In none of the four cases did state aid reach 10 percent of average operating costs; it varied from 5.8 percent to 9.5 percent (line 4). The level of support was low because the districts had high revenue resources (i.e., real estate assessed valuation) relative to enrollments.[23] Therefore, the districts were

Table 9

Annual Costs Per New Detached Single Family Home: In−School and Busing Costs by District and Location within Districts, 1996−97 School Year							
	High School District with an Early Scatter Site		Elementary District Covering part of the Same Early Scatter Site		***Rural District Covering Rest of that Site***	Consolidated District with a Maturing Scatter Site	
Cost Coefficients	***Scatter Part***	Municipal Part	***Scatter Part***	Municipal Part	***Scatter Area***	***Scatter Part***	Municipal Part
(1) Students per dwelling unit (DU)*	.144	.205	.380	.592	.608	.984	.847
(2) Av. opera− ting costs	$5,624	$5,624	$3,905	$3,905	$4,785	$6,296	$6,296
(3) ***Less*** general state aid per pupil	$483	$483	$371	$371	$289	$367	$367
(4) State aid as % of total −school costs	8.6%	8.6%	9.5%	9.5%	6.0%	5.8%	5.8%
(5) Estimated busing costs per pupil**	$405	$72	$215	$49	$385	$278	$155
(6) ***Less*** state reimbursement	***$107***	$19	***$93***	$21	***$154***	***$121***	$68
(7) Total av. net cost per new DU*	$783	$1065	$1,389	$2,109	$2,874	$5,989	$5,096
Number of new homes	***167***	146	***92***	142	***79***	***188***	176

*DU = dwelling units in our study=those detached single−family homes that we had enumerated or sampled from all homes newly occupied between 1990 and 1995.

**For the particular new homes in our study sites; see line 6 of Table 10.

***Total average net cost per new dwelling unit = (sum of [line 2's value minus line 3's value] + [line 5's value minus line 6's value]) multiplied by line 1's coefficient for students per new DU.

---

obliged to fund over 90 percent of their operating costs for regular programs.[24]

c. Average Busing Costs for Students from New Homes

Busing costs were more challenging to calculate because, unlike in−school costs, no useful average could be calculated from district−wide data. Any average derived from all students whom the district bused would not account for differences in distances from homes to school campuses. Consequently, for our estimated average we needed to determine (1) which bus routes served the students from the homes in our study, (2) the costs to the district of operating those routes and (3) the share of those costs attributable to one student.

(1) Determining Which Homes Are Eligible for Busing and the Bus Routes Serving Them

Sources: The new homes located within distances from school campuses that some authority specifies as "walkable" may nevertheless be served by school buses. In Illinois that specified distance is normally 1.5 miles, but students within that radius may also be bused if they face hazards to safe walking to school, like a busy highway that must be crossed or roads leading to their schools that lack sidewalks. The best way to determine which of our studied homes had bus services was to obtain the school districts' official rosters per route. Two of the four districts provided them, and it was a simple matter of comparing addresses on the bus rosters to the addresses on the enrollment lists that we had previously received. The other two districts supplied the instructions given to bus drivers as to the streets served, leaving it to us to determine which studied homes were on or close enough to those streets for their children to be picked up on the buses' ways to school campuses and dropped off after school.

Findings: From these sources we found that the first three districts provided busing to 100 percent of the studied homes in their "scatter" or unincorporated parts. This finding is reported in Table 10 (line 1) as "Ratio of busable students" being 1.0. We were not surprised. The completely rural elementary district's one school campus sits at the intersection of two rural roads with only a handful of homes within easy walking distance, while the two main school campuses serving the other two districts were located in the adjacent municipality, and virtually all the studied scatter−site homes were at least a mile from those campuses as "the crow flies" (see Table 2 in Chapter 1).[25]

The fourth district − the one with a maturing scatter site − provides an instructive contrast. From the busing route information made available to us, we estimated that 8 percent of the sampled homes in the rural areas were not served by bus routes because they were within "walkable" distances of school campuses. In unincorporated parts of that district there were four primary schools, and a middle school stood right at one edge of the city. While two of these rural campuses were built years earlier when their particular small communities areas had their own school districts, three were rather new construction. How could they be justified? Being a maturing scatter area, the populations served were large. Moreover, the densities were not too low. It is easier to justify building rural school campuses where, as in this district, the median rural lot size was 1.3 acres rather than five acres (as in the three districts that serve our early scatter site − see Table 1).

The estimated busable ratios for the studied homes in the incorporated areas were *not* that much lower. They ranged from .81 in the municipal part of consolidated district with a maturing scatter site to .93 in the corresponding portion of one of the districts with an early scatter site. The somewhat lower busable ratio in the former site means relatively more students being able to walk to school. And that situation probably results from that city being larger and having multiple school campuses dispersed closer to the locations of new residential development. As previously mentioned, the city with the early scatter site has just a single elementary campus (K−8) and one high school campus within its boundaries. On the other hand, in that small city why did not proportionally more students walk? Our case study site suggests two reasons: there may be physical barriers to safe walking, such as city streets with no sidewalks. Secondly, new multi−lot subdivisions tended to be located at the edge of the city where large enough parcels of land were available. The edge of even a small city may be far enough from school campuses to justify busing.

Table 10

Estimates of Busing Costs Per Enrolled Student from New Detached Single Family Homes: By District and Location within District, 1996 to 1997 School Year

	High School District with an Early Scatter Site		Elementary District Covering part of the Same Early Scatter Site		***Rural District Covering Rest of that Site***	Consolidated District with a Maturing Scatter Site	
Cost Coefficients	***Scatter Part***	Municipal Part	***Scatter Part***	Municipal Part	***Scatter Area***	***Scatter Part***	Municipal Part
(1) Ratio of busable students*	1.00	.93	1.00	.85	1.00	.92	.81
(2) Av. per− mile cost of busing them	$3.08	$3.08	$2.18	$2.18	$2.54	$2.51	$2.51
(3) Weighted daily av. miles							

their buses travel**	53.3	13.0	46.6	12.4	41.0	38.0	29.0
(4) Av. share of per−mile cost attribut− able to one student***	.014	.011	.012	0.011	.021	.018	.015
(5)Av. daily cost = (1) X (2) X (3) X (4)	$2.30	$0.41	$1.22	$0.28	$2.19	$1.58	$0.88
(6) Av. annual cost = (5) X total school days (176)	$404.50	$72.09	$214.72	$48.67	$385.44	$278.08	$154.88
(7) Less state's share of busing costs (percent)	26.5%	26.5%	43.4%	43.4%	40%	43.6%	43.6%
(8) Net av. annual cost	***$297.31***	$52.99	***$121.53***	$27.55	***$231.26***	***$156.84***	$87.35

*Busable ratio=proportion of total students from new homes who are outside the 1.5 walk zone or who are authorized to be bused because they face hazards when walking to school (such as a busy highway or railroad line to cross).

**Each route's mileage is weighted by the ratio of students from our study homes to the total number of students on the roster for that route. That is, the larger the proportion of total seats occupied by students from the new homes, the greater the weight. Included in the route's mileage is the distance from place of parking to students' homes back to school, twice daily.

***This average = the average of one (i.e, one student) divided by the number of total students on the roster for each bus .

(2) Estimating the Costs to School Districts of Operating Bus Routes

a. Operating cost per mile − Sources: In order to be eligible for state reimbursements, each district keeps records of the different purposes that students are bused and the miles associated with that purpose. The category of interest to us is the mileage for "regular pupil transportation," that is, the distances covered when taking children from their homes to school and back. Although pupils from our studied homes may have been bused for special programs like sports or vocational education, we sought to estimate the costs attributable to the location of their homes, not with the pupils' special interests or needs. Also, for the sake of reimbursement from the state, districts calculate the costs of busing students for "regular" transportation. Those total costs divided by the miles traveled yield an average operating cost per mile for this category of busing. Line 2 of Table 10 has that per−mile average derived from the 1996 to 1997 cost figures and total mileage reported by each of the four districts to the state. These averages varied rather considerably − from $2.18 to $3.08. The highest value in that range is 41.3 percent above the lowest. District records did not permit us to differentiate between average costs for the routes serving the rural sections of the district and those covering mostly the incorporated components. However, the per−mile costs were lowest, $2.18, in the one district among the four with the smallest number of rural routes; and the incorporated portion of the district that it served was very compact − only about 3.4 square miles according to the 1990 census.

b. Weighted Average Daily Miles the Buses Travel − Sources and Assumptions: Three of the four districts estimated for us the total miles per bus route for transporting students to and from school. They and we agreed to operationalize this total as consisting of two components: the morning miles from the "barn" or other place of vehicle storage back to that place after the students had been dropped at the school campuses; and then the afternoon's total distance for the process in reverse − from "barn" to schools, to homes and back to "barn."

Lacking the requisite records, the fourth district went to the trouble of measuring their buses' odometers across four mornings and reporting to us the average of the differences between the first and second mornings' readings, between the second and the third, and finally between the third and fourth. These three−day averages of distances covered served to reduce the effect of any special trips (such as for sports). In addition, with the help of the district's transportation director, we netted out the miles for special shuttles between campuses and the stops at parochial schools. The remaining mileage totals per bus were allocated to the transportation of students from their homes to school and back, according to the time schedules provided to us for elementary, middle and high school students. This school district was large enough for separate runs per school campus, whereas the other three districts mixed students with different destinations. The schedules per bus specified the times for all stops from the first pickup to the arrival at the school in the morning and, also, from the departure from school to the last drop off in the afternoon, for each level of school served.

Here is an example of how we allocated total mileage for one bus in the largest district. According to the four odometer readings, that bus averaged 61 miles per day. The elementary school runs − both morning and afternoon − summed to 34 minutes out of a total of 99 minutes of home−to−school and school−to−home transportation. The middle school run also totaled 34 minutes, while the high school run was 31 minutes. Therefore, we assigned a little more than third of the 61 miles to the run for elementary students, the same percentage to the middle school run and 31 percent to the high school component of the total.

Before proceeding with this discussion of cost allocation, we must explain four assumptions that were made. If estimating the miles that family cars traveled from home to school campuses and back, we would measure the one−way distances by the shortest route and multiply times two. If taxi cabs were used, the actual mileage might be from the cab's point of dispatch to the home, then from the pick−up to the school, and finally from that campus back to wherever the cab waits for new calls. Whether a family or a commercial taxi, the total costs would be attributed to the one household, unless some neighbor children shared the ride. However, school bus routes normally have multiple stops; and different numbers of students may be riding any one day or at any one point during a run. In consultation with officials from the four districts, we made the following four assumptions.

(1) If a student from one of our studied homes is on a bus route's roster, he/she is responsible for some part of the route's daily costs whether he/she rides or not. If that student were not on the roster, the bus might be able to follow a more direct route to school; the driver would not need to stop outside the house to see if the child was riding that day; or perhaps in other ways time and money could be saved.

(2) Each student rostered is responsible for an equal share of the route's total costs. We were told that in three of the four districts, students ride approximately the same amount of total minutes per day. This equality in ride time results from a policy of "first on in the morning, first off in the afternoon." That is, the buses tend to follow the same routing morning and afternoon, so that students who ride the longest in the morning because they are picked up at the start of the route going to school will ride the shortest period of time in the afternoon because they are dropped off first. For example, if the whole route took 45 minutes, and one student got on in the morning with 30 minutes left, he/she would get off 15 minutes into the run after school.

The fourth district followed largely the same policy except that its population was dense enough for sizable groups of students to be located along routes taken by the bus from the school campus back to the position where the morning pickups begin. In the after−school runs, rather than having those groups of students ride past their own stops, the driver was authorized (and often very relieved) to drop off the groups. A rhetorical question we received from one interviewed driver in that district was, "Who wouldn't be glad to be rid of five or so middle school students as soon as possible?"

(3) The higher the proportion of total rostered seats on a route that is attributable to our studied new homes, the higher the portion of total costs of that route that is assignable to those homes.

(4) When deriving an average daily cost across bus routes, we weighted each route both by (a) its mileage and by (b) the proportion of total seats on it that was attributed to students from the studied homes. As Table 11 indicates, the district−wide unweighted averages varied greatly across the four districts. One pattern was that the average for routes in the "scatter" or unincorporated part of the district was greater than the average for the municipal portion. For the first two districts, this difference was 87 percent and 134 percent,[26] respectively. For the consolidated district, however, the rural routes' mean was only 27.6 percent larger than the city routes'.

Table 11

Unweighted and Weighted Average Daily Lengths of School Bus Routes (in Miles) that Served Newly Occupied Homes in Four School Districts, 1996 to 1997 School Year							
Average	High School District with an Early Scatter Site		Elementary District Covering part of the Same Early Scatter Site		***Rural District Covering Rest of that Site***	***Consolidated District with a Maturing Scatter Site***	
Length of School Bus Routes	***Scatter Part***	Municipal Part	***Scatter Part***	Municipal Part	***Scatter Area***	***Scatter Part***	Municipal Part
District−wide unweighted average (miles)	50.9	27.2	49.3	21.1	43.7	37.4	29.3

District−wide weighted average (miles)*	53.3	13.0	46.6	12.4	41.0	38.0	29.0

*The mileage for each route was multiplied by the proportion of total students slated for that route who came from our studied homes. Then we added the discounted mileage values for a site (e.g., the municipal component of the elementary school district with an early scatter site) and divided it by the sum of the proportions of total students slated for the different routes who came from studied homes.

___

Table 12

Average Daily Lengths of School Routes (Weighted and Unweighted) for Students from New Homes in a Consolidated School District with a Maturing Scatter Site, by Elementary, Middle and High School Levels, 1996 to 1997 School Year

	Elementary School Runs		Middle School Runs		High School Runs	
	Scatter Part	Municipal Part	***Scatter Part***	Municipal Part	***Scatter Part***	Municipal Part
Unweighted average distance (miles)	***38.3***	30.3	***29.9***	26.8	***44.7***	30.1
Weighted average distance (miles)*	***41.2***	27.9	***29.2***	28.3	***43.7***	32.2
Number of separate runs	***21***	11	***16***	7	***14***	10

*The mileage for each route was multiplied by the proportion of total students slated for that route who came from our studied homes. Then we added all the discounted mileage values for a site (e.g., the municipal component of the elementary school district with an early scatter site) and divided it by the sum of the proportions of total students slated for the different routes who came from studied homes.

To help explain this smaller disparity and other differences between the fourth district and the other three, we broke the former's busing data down by elementary, middle and high school (Table 12). As mentioned above, it was a large enough district to have separate bus runs for each of those three levels of schooling. Table 13, row one, indicates that the lesser overall disparity between the averages for rural and city routes in the fourth district resulted largely from the smaller differences between the elementary and middle−school components of those means. As discussed earlier, there were four elementary school campuses and one middle school located in or at the edge of the unincorporated areas; and those locations reduced the distances buses had to travel from rural homes to school.

We should note an important qualification to the apparent advantage of building new homes in a scatter−type rural community with sufficient population and financial resources to place schools within the rural area rather than exclusively within the neighboring town. The length of bus rides will be reduced only if the rurally located schools have the space to accommodate the children from nearby new homes. As of the 1997 to 1998 school year, there were nine rural areas within this district where residential development was proceeding faster than the nearby elementary schools could cope with, so that the children living in those sections were bused to school campuses in the town rather than to the nearer rural schools. Therefore, before families congratulate themselves for buying home sites near rural schools, they must be sure that their children will actually be attending those schools. In another one of our districts, a cluster of new homes was built close to a rural elementary school. But since the district decided to limit enrollments there to first through third grade, any families with kindergartners and children in fourth through eighth grades saw their children bused four miles to town.

When analyzing the bus runs for the largest of our four districts, we had expected to find the elementary distances to be smaller than the middle school routes within that district since there were 3.3 times as many school campuses at that level compared to the middle school level. However, the middle school routes had the smaller unweighted average (Table 12). The explanation was that the elementary school average was lengthened by the need for separate midday bus trips for the kindergarten students. Those in the morning session rode to school with other primary school students but were returned home in special runs at noon, while the children scheduled for afternoon kindergarten were bused to school after lunch.

Findings: Tables 11 and 12 permit comparisons between the unweighted and weighted average daily lengths of the school bus routes that served our studied homes. The latter values were calculated by multiplying the round trip unweighted distance for each run by the proportion of total students rostered for that run coming from our studied new homes. We summed those discounted mileage values and then divided them by the sum of those proportions. The resulting weighted averages do not greatly differ from the unweighted means except in two similar cases. The weighted values for the municipal components of the first two school districts are smaller by 52.2 percent and 41.2 percent, respectively, compared to the unweighted. These differences mean that proportionately few of our studied homes within the city were served by the comparatively long bus routes. When we inserted those weighted average mileage figures for the sites' municipal parts into data line 3 of Table 10, we find that they contribute importantly to the relatively lower costs of busing children from the new homes located in towns.

In neither the high school district with an "early scatter" area nor the consolidated district with a "maturing scatter" component did this weighting procedure significantly change the findings for high school bus runs. In both cases, the runs for new homes in the rural sections had by far the longest weighted average distances − 53.3 miles and 43.7 miles, respectively (tables 11 and 12). As discussed earlier, the basic reason for the long distances traveled by high school students from the rural areas is that there was only one high school campus.

In the early scatter area, the weighted average distance might decrease over time because there is room for considerable in−fill in the rural part of the district. However, in the site with maturing scatter, 79.5 percent of the new homes built between 1990 and 1995 were located five or more miles from the high school "as the crow flies" (Table 2), at least in part because builders were running out of feasible parcels closer to the city that has the one high school campus. This means that the distances from new homes to the high school in the consolidated district will probably not decrease; they may increase unless the funds for a new campus can be found.

c. Average daily costs per student from new homes − Calculations: If we multiply the average operating cost per mile by the average weighted miles traveled per day, the result is the average daily cost of operating the buses serving the new homes. To transform that result into an average cost *per student* from those homes, we need the average number of students rostered for those buses, because for any one student the share of daily costs would be that overall cost per bus multiplied by one over the total students on the roster. For example, if 70 students were rostered, the share of costs attributable to any one pupil would be 1/70 or .014. The average ratios reported in Table 10 (data line 4) came from the roster totals given to us by the school districts. Those ratios varied from .011 to .021, with the higher values found in the rural sections of the districts. For example, the average number of students slated for the rural buses serving the consolidated district was 56.3 while the corresponding value for that district's city homes in our sample was 65.6 In the high school district with the early scatter site, the difference was 70.6 versus 89.6.[27] On average not as many students could be rostered for the rural runs because the homes with students were more dispersed. As one administrator told us, his buses needed to arrive at school at approximately the same number of minutes before classes start; therefore, if he aimed to fill the buses on all runs, he would have to start the rural routes so early that the total riding time would become excessive.

Findings: Our estimates of average daily cost varied from just 28 cents per student from the studied homes in the municipal part of the elementary district with an early scatter site to $2.30 for the high school district in the same area (line 5 of Table 10). In the three districts with both rural and urban components, the estimated averages for the rural sites exceeded the figures for the corresponding municipal sites by considerable margins − from 79.5 percent in the consolidated district to over 336 percent in the other two districts. The estimated average cost figures of 28 cents, 41 cents and 88 cents per day for the urban students may seem low, especially to readers who pay $1 or more one−way fares when riding public transit system. However, since our estimates are based on allocating costs across all rostered students, we assumed full buses.

Table 10 indicates three cost advantages that the urban homes had compared to the rural. First, some of the home sites in towns were close enough to school campuses that the students could walk (see line 1 of that table). Second, the weighted average distances to and from school were smaller for urban homes (line 3). Even in the district with school campuses located in the rural areas, the difference in these average distances traveled was not trivial (i.e., 31 percent; see line 3 of Table 10; and see also Table 12). Third, as discussed earlier, since the rostered number of students for the in−town bus routes tended to be larger, the average share of per−mile cost attributable to city students was lower, other things being equal (line 4 of Table 10). Therefore, for these three reasons, the new homes within city boundaries were less costly to serve with school busing.

d. *Average annual costs per student from new homes − Calculations and Findings:* Converting from daily cost estimates to annual requires only the information about the average number of days the buses run. For these four districts, the reported average was 176 days; and multiplying that figure by the estimated daily cost per student yielded annual estimates for the unincorporated areas ranging from $278.08 in the consolidated district to $404.50 in the high school district serving the early scatter site (line 6 of Table 10). As expected, the annual cost figures for the municipal locations were much lower − ranging from $49 for one of the early scatter site's elementary districts to $154.88 in the municipal part of the consolidated district.

e. *Significance of findings:* Although these particular dollar figures may be useful to the four districts that we studied, the more broadly applicable findings concern (1) the relative level of costs, (2) the relative difference (if any) between the fiscal burden of serving new rural versus new urban homes and (3), as discussed in this chapter's next section, who pays for any such difference. As discussed at the beginning of this chapter, the rural homes may offset their greater busing costs by generating higher revenues.

- *Relative level of costs:* The annual busing costs that we estimated for the three rural sectors are not trivial. Even if the average is at the low end of our range, $215, 100 such homes with public school children would translate into an annual cost of $21,500.
- *Relative Difference in Fiscal Burdens:* Comparing the annual busing cost estimates for the three districts with both rural and urban components, we find differences of about $332 for the high school district serving the early scatter site (that is, $404.50 minus $72.09) , $166 for the elementary district receiving students from the same site and $123 for the consolidated district that includes the maturing scatter site (compare values in line 6 of Table 10). A policy inference is that locating the same homes within the boundaries of the nearby city would save significant money. The actual average savings would probably not be as high as these estimated differences, since the cities would need to expand to accommodate the additional families and consequently the greater average busing distances would likely increase somewhat the average costs per city student.

d. Who Pays the Difference in Busing Costs: Rural versus Municipal Home Sites

The State of Illinois, that is, the general taxpayers, covers a portion of the cost difference in busing rural versus city students. The four districts we studied were reimbursed for 26.5 percent to 43.6 percent of the costs of their total, regular home−to−school−and−back−to−home busing (line 7 of Table 10). This assistance reduced our estimates of the district's net annual busing costs per student from scatter sites to a range of $121.53 to $297.31 (line 8).

Another portion of the difference between busing rural and urban students may be covered by higher average revenues generated by the rurally located homes, provided that their in−school costs are not greater because of higher average enrollments per−dwelling unit. The in−school costs, state aid per student and in−school general fees should be the same regardless of where the student lives within a district. Among the four districts studied, we found no consistent pattern for this set of measures. In the high school and elementary school districts serving both rural and urban homes in the community with the early scatter site, the rural homes' enrollment coefficients were lower compared to the new city homes that we studied (line 1 of Table 13). Moreover, because the rural homes' assessed values averaged higher (line 2 of Table 13), they generated more revenue on average. However, in the consolidated district with a maturing scatter site, the measures were just the reverse; the sampled rural homes averaged higher enrollments but lower assessed valuations. Further evidence of inconsistency was that the second, completely rural elementary district that covered part of the early scatter site had lower mean assessments and appreciably higher average enrollments compared to the new homes in the rural component of the other elementary district in that community (lines 1 and 2).

Table 13

Annual School District Revenues Attributable to New Detached Single Family Homes, Compared to Average Costs Per New Home, by District and Location within Districts,

1996−97 School Year

Cost and Revenue Coefficients	High School District with an Early Scatter Site		Elementary District Covering part of the Same Early Scatter Site		***Rural District Covering Rest of that Site***	Consolidated District with a Maturing Scatter Site	
	Scatter Part	Municipal Part	***Scatter Part***	Municipal Part	***Scatter Area***	***Scatter Part***	Municipal Part
(1) Students per dwelling unit (DU)*	.144	.205	.380	.592	.608	.984	.847
(2)Average assessed value**	***$70,403***	$40,869	***$71,462***	$40,702	***$67,974***	***$112,190***	$121,137

(3) 1996 tax rate per $100 assessed valuation	1.6882	1.6882	1.8217	1.8217	2.0954	4.233	4.233
(4) Av. real estate tax yield per new DU	***$1,189***	$690	***$1,302***	$741	***$1,424***	***$4,749***	$5,128
(5) General fees per new DU*	***$8***	$12	***$15***	$24	***$28***	***$50***	$43
(6) Total revenues per new DU	$1,197	$702	$1,317	$765	$1,450	$4,799	$5,171
(7) Total av. net cost per new DU**	$783	$1,065	$1,389	$2,109	$2,874	$5,989	$5,096
(8) Difference (line 6 minus line 7)	***+ $414***	***− $363***	***− $72***	***− $1,344***	***− $1,424***	***−$1,190***	***+$75***
(9) Number of new homes	*167*	146	*92*	142	*79*	*188*	176

*Taken from line 1 of Table 9 above.

**Assessed valuations are supposed to be one−third of fair market value. To be conservative, we deducted from these averages the $3,500 reduction in assessment that the state mandates if the home is occupied by its owner.

***General fees=fees paid by all students (such as text book fees) multiplied by the number of students per new dwelling unit going to that kind of school (line 1 of this table).

****Taken from line 7 of Table 9 above.

From this variability of measures, we conclude that districts cannot count on the rural homes covering their extra busing costs from higher assessed valuations and/or lower enrollment coefficients. Our initial driving around the study sites had led us to expect a consistent pattern of the rural homes − with their usually larger lots and frequent stables or other outbuildings − being more expensive and, since they cost more, of their families being older with relatively fewer children of public school age. We assumed that buying more costly homes would be associated with being further along in the families' capacity to earn money, i.e., the parents and their children being older. We were wrong about two of the four districts.

Table 13's comparisons of overall cost and revenue estimates show that in only two of the seven districts or subdistricts being compared did the studied new homes generate enough revenues to cover in−school and busing costs. According to our estimates, the new homes in the urban part of the consolidated district produced a $75 surplus on average, while the new homes in the rural component of the high school district (the first district listed in that table) generated on average $414 more in 1996 to 1997 than they cost the district. By contrast, the 1990 to1995 homes built in the urban setting of that district were net fiscal drains of $363 per home. The losses estimated for the other three districts varied from only $72 per home to $1,424.

What if the extra busing costs attributable to rural settings were eliminated? What impact would there be on these overall gain and loss estimates? In Table 14, we estimate the net dollar gain per home if these extra busing costs were eliminated, that is, if the rural homes had been built in the adjacent municipality rather than in their rural locations.

Findings: Since there was such a small average number of students per new home in the rural component of the early scatter site's high school district (just .144 per dwelling unit), the substantial difference in busing costs ($244) had only a modest estimated impact on the district's net surplus per new home, $35.14 (or $244 X .144 − see Table 14's line 3). For the same reason, the estimated contribution to the second district's deficit was small in absolute terms, though large in relative terms (line 3). In the third and fourth district, the net dollar effects are larger because the average enrollments per home were greater. For example, with an enrollment coefficient of about six−tenths of an elementary school child per new home, a $204 estimated difference in busing costs *per student* translates into a savings of about $124 *per home*. In the fourth district, the estimated savings per home is about $68. Since there were 897 single family homes built in the rural component of that district during our study period, the estimated total savings would be about 897 X $68 or $60,996 annually, if it were possible to place those households at the same distances from schools as were measured for our sample's municipally located homes.

Table 14

Estimated Impact on Net Gain or Fiscal Loss Per New Home if Extra Busing Costs Attributable to Rural Setting Were Eliminated				
	(1) ***High School District with an Early Scatter Site***	***(2)*** ***Elementary District Covering part of the Same Early Scatter Site***	***(3)*** ***Rural District Covering Rest of that Site***	***(4)*** ***Consolidated District with a Maturing Scatter Site***
(1) Estimated av. surplus or deficit per new DU*	+ $414	− $72	− $1,424	− $1,190
(2) Difference in av. annual busing costs for rural and city students**	$244	$94	$204	$69
(3) Difference in busing costs per DU**	$244 X .144 = $35.14	$94 X .380 = $35.72	$204 X .608 = $124.03	$69 X .984 = $67.90
(4) Difference as a percentage of the deficit or surplus	8.5%	49.6%	8.7%	5.7%

*From line 8 of Table 13.

**The difference in average costs estimated for new homes in the rural setting is compared to the corresponding cost for new homes in the municipal setting in the same district, except that in the case of the completely rural district, the comparison is made to the urban homes in the adjacent elementary district that sent children to that district. See the entries in line 8 of Table 10. Then that difference is multiplied by the coefficient for the average number of enrolled children per new home − see line 1 of Table 13.

Policy recommendation: An obvious alternative is to impose a modest busing fee on the new homes built in rural areas whose children are bused. The fee could be flat or graduated according to distance from school campuses. Both city and rural homes could be charged. In line 2 of Table 14, we report the average difference in the cost of busing children from new homes in unincorporated locations versus city home sites. Such a fee might help to mollify current taxpayers in the district who oppose further development because they believe they are subsidizing it. They may be right if they own commercial properties, or if they are not sending children to the schools, or if their homes are located close to school campuses.

The town dwellers among such opponents would be even more unhappy if they learn that the homes being subsidized tend to have higher assessed valuations than those built in the same time period in the towns. That pattern was found in three of our districts. For example, the assessments for the studied new city homes in the elementary district with an early scatter site averaged $40,702 (line 2 of Table 13), while the homes sited in the rural parts of that district averaged $71,462 (assessed value is supposed to be one third of market value). The higher average assessment and lower average enrollment coefficient for the rural homes translated into a smaller overall deficit compared to the new homes in the city (line 8 of Table 13). According to our estimates, the new rural homes in that elementary district covered on average their children's in−school costs plus about 40 percent of the busing costs not shouldered by the state (Table 10), leaving about a $72 deficit per home (Table 13). However, the town dwellers could still argue that they should not be expected to subsidize even this much of a deficit due to rural locations. A related question is whether taxpayers statewide should be providing a subsidy for rural life styles through the state's reimbursement for busing costs, which in our four districts ranged from 26.5 percent to 43.6 percent of the districts' total expenditures for regular transportation of students (line 7 of Table 10).

Limitations and Conclusions: As Table 14 indicates, the busing cost disadvantage for rural homes was the smallest in the fourth district. And as discussed earlier in this chapter, that district's advantage, compared to the other three, derives from having the student numbers and financial resources to build schools in the unincorporated areas so that rural bus route mileages were the lowest among the studied districts (tables 11 and 12). The costs of building and staffing those additional campuses comprise another major kind of fiscal impact. This chapter, however, is limited to operating costs associated with residential growth. Capital expenditures may be covered through development impact fees, which are paid at some point in the development review process (such as when builders apply for building permits) and which the U.S. Supreme Court has found to be constitutional, provided that the fees are reasonably related to the service burden the new homes actually impose on the school district.[(28)]

Another limitation of the forgoing analysis is that its findings derived from only detached single−family homes in four school districts of one region of one state. However, the estimation methods we used may be helpful in other contexts. Rather than relying on state−wide or even school−district−wide coefficients, we (1) conducted a census of the homes built over a recent six−year period, (2) drew a random sample in the one district where total numbers were too large for a census analysis, (3) developed enrollment coefficients per new dwelling unit by matching school roster addresses to the addresses in our census or sample, (4) obtained school bus rosters for the studied areas, (5) weighted each route's round−trip mileage proportionate to the fraction of total rostered students who come from the studied homes served by that route, (6) added the average per−student busing costs to the in−school average costs and (7) discounted that overall sum by the relevant enrollment coefficient, so as to yield an average cost per new home.

Also useful in guiding analysis in other school districts might be the kinds of findings that emerged from our comparisons of net costs for new rural homes to the net for residences built in the same years in towns served by the same school district. Other analysts may decide to test for the same types of findings: (1) The busing costs for rural residences tended to be appreciably higher than those for homes in the municipal part of the same district; (2) the greatest part of that difference derived from the high school bus routes; (3) the rural homes tended to have the three cost disadvantages of relatively fewer of them being within walking distances to schools, their children traveling more round−trip miles and their buses having lower numbers of students on the rosters; (4) the rural residences may not be able to offset their busing cost disadvantage with sufficiently higher assessed valuations and/or lower average enrollment coefficients; (5) the state's subsidy of busing did not cover all the cost difference for rural versus town riders; and (6) therefore most of the burden was carried by local taxpayers.

Estimating Travel Times on School Buses

A focus of other case studies should be the length of school bus travel times for children from new homes built in areas of residential scatter. As Table 15 presents, we calculated some rather lengthy times when morning and afternoon runs are combined.

Sources: One of the districts provided us with lists of the stops and both the morning and afternoon times the buses were scheduled to reach each stop. Another supplied the same information only for the morning runs, but the afternoon runs were supposed to replicate the morning trips. The other two districts gave us the route maps, the total one−way run times (e.g., 45 minutes), and the assurance that morning and afternoon times are largely the same. For the first−mentioned district, knowing the different morning and afternoon times at each stop was important because, unlike the other three districts, this one did not return all students in the same order as they were picked up in the morning. As discussed earlier in the chapter, although the district tried to follow the fairness principle of "first on in the morning, first off in the afternoon," its residences were densely enough located that, along the roads to the first morning pickup, were the homes of students who boarded the buses towards the end of their morning runs. Therefore, the drivers were instructed to drop off those students in the afternoons as the bus went past their stops. The other three districts reported few cases of "late−on, early−off" students. Virtually all their students rode the whole route when both the morning and after−school runs are combined. For example, if someone boarded two−thirds of the way through the morning run, he would sit on the bus in the afternoon until it reached that two−thirds point; therefore, his total ride per day would be one−third of the route in the morning plus two−thirds in the afternoon.

Findings: Interestingly, the times for rural routes do not simply correlate with the size of the school districts. While the total square miles for the first−listed district in Table 15 is about twice the size of the fourth−listed district, the average travel times for rural high school runs are almost identical. The unweighted average lengths of their routes in miles did not differ by much (compare tables 11 and 12), perhaps because more of the fourth districts' runs followed curving subdivision roads rather than the straight section−line roads more common on the routes of the first.

The finding of long−in−time high school bus routes − averaging 51.5 and 53.9 minutes round trip (Table 15) − may not impress those readers who recall how infrequently that they, themselves, rode school buses at that age. However, even though many or most high school juniors and seniors drive themselves or ride in friends' cars, the buses must still pick up the underclassmen. Also, if upperclassmen take the bus now and then, the drivers are obliged to stop at their homes in the mornings on the chance that day they want to ride. Only the chronic non−riders may be routinely passed over. Prospective home buyers who inquire about the lengths of bus trips from potential home sites may conclude that round trips approaching an hour each day provide their newly licensed young drivers with arguments for permitting them to go with friends or to obtain a car of their own. Short bus trips or walkable distances should help parents to resist teenager pressures of these types.

Another major finding is that long bus runs were not limited to the high school campuses. The rural routes serving the second district, for K−8th grades, averaged 42.4 minutes round trip, while the average for the third district, also K−8, was 46 minutes. To avoid presenting averages that are biased by a few extreme cases, we include in Table 15 also the median (or middle) value in the array of round trip route times, the 25th percentile (the value showing the end of the lowest 25 percent of route times) and the 75th percentile (the value marking the beginning of the top 25 percent of times). All of the medians are within 4.2 minutes of the averages. For

six of the 11 locations covered in the table, there is some appreciable variation − nine minutes to 18 minutes − between where the lowest 25 percent of route times ends and the top 25 percent begins.[29]

Table 15

Scheduled Round−trip Times (in minutes) that Students from New Homes Rode on School Buses, by District and Location within Districts, 1996 to 1997 School Year											
	(1) High School District with an Early Scatter Site		***(2) Elementary District Covering part of the Same Early Scatter Site***		***(3) Rural District Cover−ing Rest of that Site***	***(4) Consolidated District with a Maturing Scatter Site***					
						Elementary School		Middle School		***High School***	
	Scatter Part	Munici−pal Part	*Scatter Part*	Muni−cipal Part	*Scatter Area*	*Scatter Part*	City Part	*Scatter Part*	City Part	*Scatter Part*	City Part
(1) Av. time on bus	*51.5*	33.0	*42.4*	31.0	*46.0*	*29.1*	27.4	*32.8*	33.0	*53.9*	31.8
(2) Med− ian time	*48.0*	33.0	*45.0*	33.0	*45.0*	*27.0*	25.0	*37.0*	31.0	*52.0*	32.0
(3) Low− est 25% of times ends at:	48.0	NA	33.0	33.0*	43.0	21.5	23.5	24.0	24.0	51.0	25.0
(4) High −est 25% of times begins at:	57.0	NA	48.0	33.0*	47.0	32.0	27.0	37.0	42.0	58.0	34.0
(5) Number of students	29	32	33	84	47	97	63	45	23	39	44

NA = since all the routes were estimated to have the same round trip times, there technically were no 25th and 75th percentiles.

*Almost all routes were estimated to have the same round trip times.

With one exception, both the averages and medians are longer for the rural locations compared to the routes serving residences in towns. The average for the consolidated district's middle−school runs from rural homes is a little below the mean for city homes.

We do not mean to imply that total daily bus−riding that averages 51.5 minutes or 53.9 minutes are necessarily too long for high school students or that 42 minutes and 46 are definitely excessive for grade school children. It is up to parents and the riders, themselves, to judge how best to spend their waking hours. Our point is that prospective home buyers should inquire before buying. We draw their attention also to our finding that, among the first three districts listed in Table 15, bused children living in the town tended to be on the buses significantly shorter time periods compared to their peers in the rural areas. The differences in elementary students' average rides were 11.4 and 15 minutes (compare the rural and city values in line 1 of Table 15). For high school students, it was 18.5 minutes. But in the larger, consolidated district, there was not a clear advantage except for the high school students resident in the city, whose ride time we estimate to have averaged about 22.1 fewer minutes compared to the rural students. Also, some of the studied homes were close enough for walking to school.

While prospective buyers might not value daily savings of 11 to 22 minutes when they recall the busing experiences they had as children in cities or suburbs, they should note some important differences in these scatter areas. Much of the bus traveling is still adjacent to farm fields that are prone to drifting snow in the winter. The schools close early when drifting is threatened. And from time to time buses with children do get stuck. These incidents are reported to be relatively rare. One bus manager told us that, out of 14 routes, approximately two buses a year must be pulled out of ditches because of snow. The manager of a district with fewer miles of roads next to farms reported that, among his 53 routes, there had been only three such incidents in the previous five years.

Another serious hazard in open areas may be fog. They are often thicker in the country because, as explained to us by Allen Staver, Emeritus Professor of Meteorology at our university, fog develops if warm moist air comes into contact with a cold surface. If that surface cools below its dew point, fog appears. Farm fields and other country surfaces tend to be cooler than urban surfaces like roofs, driveways, parking lots, or streets. One bus manager whom we interviewed cautions her drivers against picking up students in a fog if they must cross the road to board the bus. Although state law requires all other vehicles to stop behind or in front of a loading or unloading school buses, the fog may obscure their vision. Therefore, the bus drivers are directed to find a safe turn−around place and pick up students on the side of the road where they live.

Given these weather hazards, prospective home buyers may prefer sites either in town or, as in the consolidated district, where rural school campuses reduce the average times that their children ride buses. They should ask the school administrators for information on actual ride times for specific routes. As indicated in Table 15's listings of 25th and 75th percentile values, averages may obscure large differences across individual routes.

When school bus ride times from rural home sites are comparable to those from in−town subdivisions, the absence of differences may be due to the construction of rural school campuses that some development impact fee and/or higher real estate tax levy pays for. Since the rural homes with school children tend to be much more dispersed than those in towns, bus rides to rural campuses should be longer except if the school district builds relatively more, smaller campuses. For example, according to data for our second studied district (all elementary), the campus situated in the city that served 731 children in the fall of 1997 could provide walking access to some of its students from new homes and round−trip bus rides of no more than 31 minutes to the rest. To have achieved for rural students daily rides averaging 31 minutes (rather than the 42 minutes we estimated), the district would have been required to build one or more rural campuses. The consolidated school district that we studied had four rural campuses with enrollments ranging from about 400 to 556. A representative of that district told us that, since administrators regarded bus riding times for students in the western part of the district as excessive, a new, fifth campus was being planned for that area.

Chapter 4

The Public Safety Risks of Residential Scatter:

Frequency and Response Times of Calls for

Emergency Medical Services, Fire−Fighting and Police

A. Introduction

When residents call for emergency services − medical, fire suppression and police − the response should be quick enough to be helpful. Rapid responses are needed for various reasons, including to help seriously injured or ill persons like heart attack or stroke victims, to fight fires before affected structures are beyond saving and to prevent criminal behavior or to keep it or domestic disputes from escalating. Obviously, a key variable in determining response times is the distance service providers must travel. U.S. Department of Transportation data for vehicle accidents in 1992 found that "the average response times for rural areas, 11.47 [minutes], was almost twice that of urban areas."[30] We assume that prospective buyers looking to build or buy new homes in rural areas will desire adequate response times for these services. If out of cluelessness or bravado, they are not concerned, at least the county officials who approve zoning for rural home sites should insist o n minimum service standards for emergency services.

B. Emergency Medical Services

In our maturing and transitional scatter sites, emergency medical services were provided by the fire departments serving those communities. Fire fighters were trained to also be paramedics or emergency medical technicians. In the early scatter site, a rescue squad separate from the local fire department responded to calls for medical help. All three agencies were licensed to supply "advanced life support" services, that is, to use injections, liquids administered intravenously, and other sophisticated procedures to sustain life. Their ambulances were equipped with oxygen, medicines, radios to communicate with hospital emergency rooms and other resources needed to fulfill their missions. However, if they were unable to reach the sick or injured person in a timely manner, their training, equipment, etc. would be of no use.

A potentially critical delay factor may be the failure of the person calling for help to give an adequate address. This problem was eliminated or minimized in all three communities by the adoption of a "911" system that automatically provides a full address to the EMS dispatcher. For all the new homes in our study, those addresses specified streets and numbers like 10513 Ridge Lane, rather than some geographically vague address like Rural Route 1, Box 783, that is still common in many rural areas.

Another cause of delay may be the placement of the stations where ambulances and EMS personnel wait for calls. A study of EMS services in Washington, D.C. found an unacceptably high average response time, 10.1 minutes ("among the highest in the country"), and attributed it in part to poor location of ambulances relative to the actual demand for service.[31] In our study, both the maturing scatter site and the transitional site had stations located at city edges where residential development was already occurring and more was likely.

Responsibilities and Resources: A third and fourth possible delay factors are the total square miles for which the EMS agency is responsible and its resources of staff and ambulances. The early scatter site had a single rescue squad station, located near the edge of the small municipality around which the rural development was occurring. That station served a district totaling about 110 square miles (all of two 36−square mile townships, plus about half of both a third and a fourth), with a 1990 population of approximately 10,000 people.[32] Its resources included advanced−life−support (ALS) ambulances and two paid staff on duty from 5 AM to 5 PM each day, with additional persons available on call (Table 16). However, only volunteers were present from 5 to 8 PM; and during the night, everyone was on call. That is, no response was possible until EMS personnel arrived at the station from their homes or night jobs.

The maturing scatter site was served by 24−hour paid staff who stayed at the stations unless in their ambulances providing services. One station, located at the western boundary of the city, provided the primary response to the rural areas of the district, which with the adjacent city totaled around 50 square miles and about 40,000 people in 1994. A second ALS ambulance operated from the headquarters station in the center of the city.

The third agency, serving the transitional scatter area, consisted of seven stations, four with ALS ambulances. The "primary response" station for the scatter area had jurisdiction for about 22 square miles and 15,000 people (1994 count). While the second and third agencies had one or more stations that could back up the primary response station, the first (and smallest) agency had to rely on agreements with rather distant neighboring rescue squads. Although the first agency functioned only as a rescue squad, the second and third provided both fire−fighting and EMS. Most of their staff were trained in both disciplines. For example, in the larger department, 63 percent of the firefighter/apparatus operators were certified paramedics.

Table 16

Comparison of Responsibilities and Selected Resources of Emergency Medical Service (EMS) Agencies Serving Three Communities with Residential Scatter Sites

Responsibilities and Resources	EMS Agency Serving Early Scatter Site and Adjacent Small City	***EMS Agency Serving Maturing Scatter Site and Adjacent Medium−Sized City***	***EMS Agency Serving Transitional Scatter Site Annexed to a Sizable City***
Square miles for which agency is responsible	about 110 sq. miles	about 50 sq. miles	22 sq. miles (the nearest station's assigned response area, including the newly annexed land)
Population	about 10,000 (1990)	about 40,000 (1990)	about 15,000 (1994)

24−hour paid staff?	12−hour	24−hour	24−hour
Advanced Life Support Ambulances	four	two	four
Back−up Station in Same Agency?	No	Yes	Yes

Response Times: Sources and Findings: Given the differences in the square miles for which the EMS agencies were responsible, we expected to find significant variation in response times. All three agencies provided access to their data on EMS calls, which included for each call for assistance, the date, address, time call was logged in and time EMS personnel reported that they had arrived at that address. "Response times" were measured as the minutes elapsed between initial receipt of the call and the reported time of arrival on scene.

As expected, the average response times for calls to homes in the early scatter and maturing scatter areas were higher than for calls received from the municipalities that adjoined those areas and in which the ambulances were stationed. Also anticipated was that the differences in both average and median response times were greater in the early scatter site, where the new rural homes were spread over more square miles and the urban homes were found in a small, compact municipality. In that site, the 19 rural calls for the three years on which we had data (1994−1996) averaged 9.6 minutes while the 18 calls in the same time period to city addresses averaged 6.4 minutes (Table 17). The corresponding median values were nine and six minutes.

These differences of three to 3.2 minutes could be medically significant, especially since the rural calls' average and median times exceeded six minutes. According to the American Heart Association, after a person has suffered a heart attack, every minute that goes by without restoring the normal heart beat decreases the chance of survival by about 10 percent.[(33)] The chief of one of the fire department/EMS agencies we studied said, "Ideally, we get there in the four to six minutes, because it has to do with cardiac arrest. If the brain does not receive oxygen within that time, the brain cells begin to die; and the person may suffer irreversible damage."[(34)] Victims of severe cuts and other trauma also need quick attention from skilled medical personnel.

The findings for the maturing scatter site are mixed and, because of the small number of cases, far from conclusive. In the six years studied, only six calls went to sampled homes with rural addresses and six to urban homes (Table 17). Although the averages derived from these small numbers exhibit the expected ranking − rural being higher, at 7.0 minutes, and urban being lower, 6.2 − the medians were in reverse order (6.0 versus 6.5). These relatively few cases may provide a misleading picture. However, the absence of significant differences may be explained by the placement of a satellite station on the city's western edge. Five of the six rural calls were on that side of the city. That is, for the welfare of the residents of the new rural homes we studied, fire and EMS administrators chose the right location for this station.

The data for the third EMS agency suggest that there *was* a response time cost for homes being located in the newly annexed land at one edge of the city. The nearest fire station with a regularly responding ambulance (rather than a "reserve ambulance") averaged 3.1 miles as "the crow flies" from the studied homes. The responses times on record for EMS calls to the studied homes averaged 7.5 minutes, as opposed to the only city−wide comparative figure we could find − a mean of 4.6 minutes for all EMS runs in calendar 1996. Again, this difference of almost three minutes could be very significant in cardiac cases. While the city−wide average was below the six−minute ceiling for cardiac emergencies, the average for calls within the transitional site was higher (the median response time was higher yet, 8 minutes − Table 17).

Table 17

Comparison of Response Times for Emergency Medical Service (EMS) Calls Generated by New Homes Built 1990 to 1995 in Three Communities with Residential Scatter Sites					
	First EMS Agency		***Second EMS Agency***		***Third EMS Agency***
Response Times	Early Scatter Site	Small City adjacent to early scatter site	Maturing Scatter Site	Medium−Size City Adjacent to Maturing Scatter Site	***Transitional Scatter: Newly Annexed Areas of a Sizable City***

Total emergency medical calls to the studied new homes*	19	18	6	6	21
Average response time for those calls (minutes)	9.6	6.4	7.0	6.2	7.5
Median response time for those calls (minutes)	9.0	6.0	6.0	6.5	8.0
Those calls' ***range*** of response times (minutes)	2 to 15	3 to 12	1 to 14	4 to 7	3 to 12
Total number of new, occupied homes in emergency medical service's jurisdiction	161	142	137	175	318

*These were the calls during time periods for which we had data on both the date and the response time for calls. For the early scatter study area, this period was from January 1994 through December 1996. For the maturing scatter site, it extended from January 1990 through December 1995, while for the transitional site the study period comprised calendar years 1990 through March 1997.

In future years the higher mean response time compared to the city−wide average should be reduced, if not eliminated, because in 1997 the fire department added an ambulance and associated staff at another station that averages about a mile closer to the studied new homes (2.2 miles rather than 3.1 miles). As implied in the phrase "transitional scatter, "in the early phases of development there may be too few lots with occupied homes on them for EMS agencies to justify building and staffing close−by stations. Prospective home buyers may wish to inquire about the schedule of opening such facilities and what exactly will be stationed there. For example, the transitional site had a fairly close fire station from 1990 (i.e., the one that averaged 2.2 miles from the homes in this study), but it was not scheduled to have ambulances located there until mid−1997.

The ambulances and staff are not cheap. We received the following cost estimates for the ambulance and personnel who were added in 1997 to a fire station serving a major part of the transitional site area: Ambulance = $60,000; and cost of six men to staff that ambulance (two men per 12−hours shift) = $258,552.(35)

As the city continued to annex land in that area, the fire department planned to open an entirely new station five miles from the station where the ambulance was added in 1997. Its expected cost for land, building, furnishings and equipment (though no ambulance yet) was $1.2 million. Since the city's revenue situation was strong, no special development impact fee was imposed for this type of development−related expenditure. However, city money spent there was money that could not be allocated elsewhere. As of September 1996, the city had either approved or was reviewing developments with a total of 1,450 lots for the area to be served by the new station. More were in the planning stage. With a total of 2,000 lots, each home's share of the capital costs for the new station serving them would be about $600. That amount of money wrapped into a 30−year conventional mortgage at 8 percent translates into only $5.87 in monthly payments.

Policy Recommendation: Although this chapter emphasizes public health risks of scatter−pattern residential development, we cannot neglect an obvious fiscal issue. When a new fire station is built to serve almost exclusively an easily identifiable set of new subdivisions, and the per home cost of impact fees to cover the station's capital cost is likely to be very modest, public officials should give serious consideration to imposing the fee.

Relative Frequency of EMS calls: Our findings about long response times may not impress prospective home buyers if the relative frequency of calls for help is trivial. We have in mind the calls per year relative to the number of the studied homes that were occupied and capable of asking for help. It would be misleading to report frequencies as if all homes built over a six− year period were occupied the entire period when in reality 20 percent were built in the first year, let's say another 25 percent in the second and the remaining 55 percent over the following four years.

Since we knew when almost all the studied homes received occupancy permits, we counted the number of months each was occupied through the end of the relevant period of analysis (that is, we had separate periods for EMS, fire and police). Then we summed the number of those months across all homes in the study, divided that sum by 12 to yield an average number of years of occupancy. That average was divided into the fraction, total number of calls divided by total number of new occupied homes, to obtain the average number of calls per home per year. Multiplying that average by 100 gave us the "Annual average number of calls per 100 new homes" (see data line 4 of Table 18). That number tells public officials in the early scatter site, for example, that on average 4.4 out of 100 new homes would call for emergency medical service in a year (Table 18). To prospective homeowners, the same figure suggests that (risk factors specific to their families not taken into account) they would have a 4.4 percent chance per year of calling for emergency service if they lived in that rural area. We can add from Table 17 that on average they would wait 9.6 minutes for the ambulance to arrive.

For the kinds of families who settle in rural home sites in the maturing scatter area, our figures suggest a lower chance of calling for EMS − a 1.3 percent probability per year − and waiting an average of 7 minutes for help. Our data on the transitional site indicate an average probability of 3.2 percent, and the estimated average waiting time for help is 7.5 minutes. Are these values high enough to deter home buyers or to

Table 18

Comparison of Demand for Emergency Medical Service (EMS) Generated by New Homes Built 1990 to 1995 in Three Communities with Residential Scatter Sites

	First EMS Agency		***Second EMS Agency***		***Third EMS Agency***
Measures of demand for service	***Early Scatter Site***	***Small City adjacent to early scatter site***	***Maturing Scatter Site***	Medium−Size City Adjacent to Maturing Scatter Site	***Newly Annexed Areas of a Sizable City***
1. Total number of new, occupied homes in emergency medical service's district*	161	142	137	175	318
2. Total emergency medical calls to those new homes during the study period**	19	18	6	6	31
3. Average number of years during study period when those new homes were occupied	2.7	2.7	3.3	3.2	3.0
4. *Average annual number of calls per 100 homes****	*4.4*	4.7	*1.3*	1.1	*3.2*

*For which we had data on the month in which the home received an occupancy permit.

**For the early scatter site, we had service call data for January 1994 through December 1996; for the maturing site, that period extended from January 1990 through December 1995; and for the transitional site it covered calendar years 1990, 1991 and 1993 through March 1997.

***The row 4 value = (the row 2 value divided by the row 1 value) divided by the row 3 value, with the result multiplied by 100.

---

impress zoning authorities? Maybe they should, since all three averages exceed the recommended six−minute maximum for EMS response times. When the possible outcome is death or permanent injury, even a 1.3 percent chance may be high enough to influence behavior.

The low relative frequency in the second study site − only 1.3 calls per 100 homes annually − is intriguing. The new homes in that site's city and rural components tend to be much more expensive and, presumably, their families are more wealthy than their counterparts in the other two scatter sites. An officer of the fire department/EMS serving the wealthier site suggested two reasons for the lower incidence of calls: the homes are vacant much of the day since almost all adults are at work and the children are at school; and secondly, the professionals and other wealthy people living in that area tend to be very health conscious − as exhibited by their attendance at area health clubs. Perhaps this attention to personal health pays off in relatively lower need for emergency medical assistance. The marked difference in EMS demand begged this kind of speculation.

C. Fire−Fighting Services

Our findings as to the service capabilities and response times for fire fighting are largely the same as those for EMS. One resource difference is that in the early scatter site the fire department was separate from the rescue squad district.

The former's geographic boundaries were close to those of the latter (a little over 100 square miles). But it had only a single employee on site at regular hours − the chief. All others were paid, but on call. As already mentioned about the other two study sites, single agencies with full−time personnel provided both emergency medical and fire−fighting services.

Sources and Findings: As with the analysis of EMS response times, the fire departments provided us with data on the addresses, times of call and times of arrival on scene. Either their staff or ours searched for calls with addresses that matched those of the studied homes. As we found with EMS calls, the early scatter site experienced the longest response times: 15.0 minutes for the average and 14 for the median (Table 19). Contributing to these lengthy times were the distances covered in a fire protection district that exceeded 100 square miles in total size, and also the fact that all staff except the chief were on call rather than being in the station when the alarms sounded. The chief told us, "We aim to be out of the building in four minutes." Prospective home buyers should be aware that, if they settle in rural areas served by on−call fire fighting staff, the response time will be lengthened, not just by their distance from the station, but also by the minutes required for fire−fighters first to travel to that station from their homes or jobs. Although some staff may drive in their own vehicles to the site of the fire, a minimum number is needed to move the equipment to the scene.

The department responsible for the maturing site had much shorter times for the studied calls: 6.9 on average and 7.5 minutes for the median (Table 19). Also like our findings for the emergency medical services, calls to city homes had shorter average and median response times than did calls to rural sites served by the same department (Table 19). Although those differences were limited to about two minutes, they could be significant for fire−fighting, especially if the advantage for urban sites meant times below six minutes. That appears to be the case for the maturing scatter site; its average and median are 6.9 and 7.5 minutes, whereas the corresponding values to calls to homes in town were 5.2 and 5 (Table 19). The National Fire Protection Association has been quoted as recommending a ceiling of six minutes, because "If a fire has been burning for six minutes, flashover is more likely to occur. Flashover is an explosion caused by the spontaneous ignition of all materials in a room. During flashover, temperatures reach such extreme levels that a person is unlikely to survive."[(36)]

The transitional scatter site fared much better. Both its average (5.4 minutes) and median response times (4 minutes) were within this six−minute standard, although that average was more than a minute higher than the city−wide average for all 1996 fire calls.[(37)] When we interviewed the department's chief, he acknowledged that response times were longer for our study site on the edge of the city. The new fire station scheduled for that area should reduce or eliminate that disparity. However, (as discussed earlier) under the current financing plans for that station, it would be an expense borne by the whole city while the benefit would be largely limited to a groups of subdivision homes that could most probably afford to share the capital costs.

Table 19

Comparison of Response Times for Fire Calls Generated by New Homes Built 1990 to 1995 in Three Communities with Residential Scatter Sites

	First Fire Dept.		***Second Fire Dept.***		***Third Fire Dept.***
Response Times	Early Scatter Site	***Small City adjacent to early scatter site***	Maturing Scatter Site	Medium−Size City Adjacent to Maturing Scatter Site	***Newly Annexed Areas of a Sizable City***
Total fire calls to the studied new homes*	*6*	5	*10*	6	9
Average response time for those calls (minutes)	15.0	12.2	6.9	5.2	5.4
Median response time for those calls (minutes)	14.0	12.0	7.5	5.0	4.0
Those calls' ***range*** of response times (minutes)	10 to 20	8 to 19	1 to 11	4 to 6	2 to 12
Total number of new, occupied homes in fire dept.'s jurisdiction					

	146	142	137	175	318

*These were the calls during time periods for which we had data on both the date and the response time for calls. Response times were missing in some cases, as all we had was total time from receipt of call until personnel left the scene. For the early scatter study area, this period was from January 1994 through December 1996. For the maturing scatter site, it extended from January 1990 through December 1995, while for the transitional site the study period comprised calendar years 1990 through March 1997.

Table 20 deals with the issue of whether the number of fire calls to new homes is large enough for prospective buyers and zoning officials to care about our response−time analysis. Using the same types of measurements discussed for EMS, we estimated that on average (i.e., knowing nothing about fire risks specific to their particular houses and families), occupants of the studied new homes in the early scatter site had a 1.2 percent chance per year of calling their fire department for help (Table 20). The percent probability was about the same for new homes in the adjacent town, in the transitional scatter site and in the maturing scatter site's nearby city, while in the maturing site proper it was higher − 2.2 percent.

Summary: While we are dealing with a small numbers of cases, and none of these figures are large, none are trivial (such as a 0.01 percent chance). The 1 percent to 2.2 percent probabilities we found suggest that long response times may be valid subjects of concern to prospective home buyers and zoning authorities. Also worrisome may be our probability findings (1.1 percent to 4.4 percent) for EMS incidents in the three scatter sites and the corresponding average and median waiting times for help to arrive. The solution is either to locate new residential development closer to existing rescue and fire stations or to build new facilities**.** However, when the expenditures on a new station (or new school) is compelled by the development of new homes that can afford a $600 share of the facility's capital costs, it seems to us that they should bear those costs. Of course, if the same homes are taxed for other capital costs like sewer, water, schools, library buildings and park land, the cumulative cost may be high. However, even a total bill for impact fees of $2,000 would cost only $14.67 per month if included in a 30−year conventional mortgage at 8 percent interest.

Table 20

Comparison of Demand for Fire−Fighting Services Generated by New Homes Built 1990 to 1995 in Three Communities with Residential Scatter Sites

	First Fire Dept.		***Second Fire Dept.***		***Third Fire Dept.***
Measures of demand for service	***Early Scatter Site***	***Small City adjacent to early scatter site***	***Maturing Scatter Site***	Medium−Size City Adjacent to Maturing Scatter Site	***Newly Annexed Areas of a Sizable City***
1. Total number of new, occupied homes in fire dept.'s jurisdiction*	152	142	137	175	318
2. Total fire calls to the studied new homes**	6	5	10	6	10
3. Average number of years during study period when those new homes were occupied	3.3	3.6	3.3	3.2	3.0
4. *Average annual number of calls per 100 homes****	1.2	1.0	2.2	1.1	1.0

*For which we had data on the month in which the home received an occupancy permit.

**For the early scatter site, we had service call data for January 1994 through December 1996; or the maturing site, that period extended from January 1990 through December 1995; and for the transitional site it covered calendar years 1990, 1991 and 1993 through March 1997.

***The row 4 value = (the row 2 value divided by the row 1 value) divided by the row 3 value, with the result multiplied by 100

C. Police Services

The typical county or municipal police department in Northern Illinois does not build satellite stations in order to reduce response times. For timely responses, it normally relies on patrolling cars being reasonably near the origin of the call. The police administrators interviewed for this study emphasized to us that most of the calls for assistance they receive are not for emergency situations. Their statements were largely confirmed by Table 21's classification of the service calls made by two county and three municipal departments to new homes in our study.

Only in the records of the municipal department serving the small city adjacent to the early scatter site (the second−listed department in Table 21) did we find that as many as half of the total calls dealt with such possible emergencies as burglary alarms and crimes committed or in progress (lines 1 and 2 in Table 21). Another classification, "suspicious person, car, or telephone call" (line 3), might also indicate an emergency. Adding its percentages to the first two classes brings the total percentages for *possibly* emergency calls to 50 percent to 61 percent across the five departments. However, the records did not permit us to differentiate between (a) crimes in progress and (b) crimes already committed or between (c) suspicious incidents occurring at the time of the call and (d) situations being reported after they happened. The only category that unambiguously merited a quick response was "burglary alarms."

Even though departmental administrators told us that almost all these cases proved to be false alarms**,** there was the small chance of a real burglary. Moreover, what a former Chief of Police of Kansas City called "response−related arrests" for burglaries are more likely if both the reporting and traveling times are short.[38] The alarms' electronic sensors make reporting automatic, and a compact population to serve should help to minimize travel time.

Sources and Findings: Each of the five department searched its records for calls for service originating from the new homes (1990 to1995) in our study. We were able to differentiate between calls for information versus calls for assistance.[39] Response times were calculated as the time elapsed from receipt of call until the responding officers reported their arrival at the address. Across the five departments, the smallest average overall response time (across all categories of calls) was recorded by the municipal department serving new homes in the small city next to the early scatter site (see the third−to−last−row in Table 22). Its average, 4.1 minutes, was one−sixth the value of the mean for the sheriff's department that answered calls from new homes built in the adjacent scatter site. The difference in median times was even greater (Table 22). The corresponding disparity between the averages for the maturing scatter site and its nearby city was not as dramatic but still substantial − 17.9 minutes versus 7.6 minutes.

For all four departments that responded to burglary alarms calls, which we assume were treated as possible emergencies, the response times averaged below the means for all calls, but still seemed long in the three scatter development sites: 16.2 minutes in the early site, 13.2 in the maturing and 9.4 in the transitional (Table 22).

The small city department's average responses times were the shortest − 1.8 to 7.7 minutes, across the different categories of cases − probably because of the small, compact size of the city it patrolled (only 3.4 square miles in 1990), and because the city could afford to have two cars on patrol at all times, with a third

Table 21

Types of Calls for Police Service Received from Studied Homes,*

by Department and Location

	(1) ***Sheriff's Police Serving Early Scatter Site***	***(2)*** ***Municipal Dept. Serving the Adjoining Small City***	***(3)*** ***Sheriff's Policy Serving the Maturing Scatter Site***	***(4)*** ***Municipal Dept. Serving the Adjoining Medium−Sized City***	***(5)*** ***Municipal Dept. Serving the Transitional Scatter Site***
	%	%	%	%	%

Type of Call					
1. Burglary alarm	18.5	0.0	25.6	39.6	15.0
2. Crimes committed or in progress**	24.6	50.9	12.8	9.1	27.5
3. Suspicious person, car, or telephone call	13.7	11.3	11.6	12.5	20.0
4. Nuisances***	9.6	5.7	5.8	10.8	10.0
5. Domestic problems****	15.1	22.6	11.6	6.0	8.8
6. Check home for open door or windows	2.1	0.0	0.0	5.4	0.0
7. Other	16.4	9.4	32.6	16.5	18.8
8. Total Calls	146	53	86	351	78

*The study time varied by department according to available records and staff time for digging records out for us. For the first listed department, the period was 63 months; for the second, 29 months; third, 72 months, fourth, 83 months; and fifth, 43 months.

**Battery or assault, theft, burglary committed, civil disorder, disorderly conduct, criminal damage to property, or sexual abuse.

***Litter dumped, intoxicated subject, juvenile nuisance, mischief complaint, neighborhood trouble, noise complaint, fire works, parking or driving complaint, complaints about animals.

****Child custody dispute, neglect of child, juvenile runaway or missing, adult missing, domestic trouble, suicide, overdose, locked out of house, motorist assist, 911 hang up, public accident.

---

officer at a centrally located headquarters who could be dispatched to arrive at any part of town in two to three minutes. By contrast, the sheriff's department typically had only one or two cars patrolling an entire quarter of the county. The next best−performing department in response times served the medium−sized city adjacent to the maturing scatter site. It patrolled three times the square miles of territory as did the small city's department (10.2 square miles compared to 3.4),but not always with three times the number of cars on patrol. Four to six cars were normally deployed, depending on the time of day and the day of the week. Moreover, the new homes we studied were located mostly on the periphery of the city (as is usually the case with sizable new residential developments), rather than being near the centrally located single police station or being near the center of patrol beats. That department's averages across the seven categories ranged from 6.3 minutes to 9.8 (Table 22).

Table 22's fifth−listed police department served the transitional scatter site with patrol cars whose only station averaged 6.1 miles from the studied homes.[40] Its average times per class of calls − 9.4 minutes to 37.8 minutes − were the longest by far among the municipal departments (Table 22). Although a large majority of the calls responsible for those relatively high response times were not emergencies,[41] we note that even the burglary alarms recorded an average of 9.4 minutes for responses. Moreover, in most cases when citizens place calls for service − whether about suspicious persons, nuisances or domestic problems − they probably want prompt, in−person responses. A study of citizen assessment of police performance found that satisfaction depended greatly on the person's expectations as to response times.[42] If they expected a 15− minute wait, and the officers arrived in about a quarter of an hour, they were satisfied. However, new residents who have moved from cities or suburbs with good response records may be severely dissatisfied if the response is longer than they were accustomed to. In our study, only the first and fourth−listed departments, both municipal, appear to have provided rather prompt responses − fewer than 10 minutes on average − across all categories of calls. In this arena of public service performance where physical or at least emotional costs of long response times might be high, none of the three scatter sites competed well.

Could the scatter sites' longer overall average times(25.3 minutes, 17.9 and 16.2) be attributable to relatively more of their calls, compared to the other two departments', consisting of non−emergency situations? Such differences might account for the longer response times. However, Table 21 indicates that the percentage breakdowns of types of call are too similar for them to be major causes of the large disparities in average times. When we add together the first three classes in Table 21 (the ones that probably had the largest number of genuine emergencies), the difference between the total for the early scatter site and the sum for the adjacent urban site was 5.4 percentage points, while the same comparison for the maturing site yielded a difference of 11.2 points. Therefore, the main cause for the disparities in response times is likely to be the greater dispersal of homes that is characteristic of low−density, discontinuous residential development.

Before leaving this discussion of police response times, we must address the question of whether police calls to new homes are frequent enough for the response times to be a significant concern to their occupants or to public officials. Perhaps the middle− and upper−scale families occupying these new homes make little use of the police. They, their neighbors and guests could be such law−abiding citizens or so remote from the itineraries of criminals that police services are rarely requested. Earlier in the chapter, we addressed the same

Table 22

Average Response Time for Seven Types of Calls for Service Received from Studied Homes,* by Department and Location					
Type of Call	***(1)*** ***Sheriff's Police Serving Early Scatter Site***	***(2)*** ***Municipal Dept. Serving the Adjoining Small City***	***(3)*** ***Sheriff's Policy Serving the Maturing Scatter Site***	***(4)*** ***Municipal Dept. Serving the Adjoining Medium−Sized City***	***(5)*** ***Municipal Dept. Serving the Transitional Scatter Site***
	Minutes	Minutes	Minutes	Minutes	Minutes
Burglary alarm	*16.2*	NSC	*13.2*	6.7	*9.4*
Possible crime committed or in progress**	*30.1*	3.1	*27.6*	8.8	*20.1*
Suspicious person, car, or telephone call	*25.8*	1.8	*28.9*	8.1	*11.7*
Nuisances***	*31.9*	2.3	*36.8*	7.9	*37.8*
Domestic problems****	*19.5*	7.7	*8.3*	9.8	*11.7*
Check home for open door or windows	*14.0*	NSC	*NSC*	6.3	*NSC*
Other	*31.1*	5.2	*13.8*	8.1	*10.8*
Average: All Calls	**25.3 mins.**	**4.1 mins.**	**17.9 mins**	**7.6 mins.**	**16.2 mins.**
Median: All Calls	**20.0**	**2.0**	**14.0**	**6.0**	**9.0**
Total # of calls	*146*	53	*86*	351	*78*

*The study time varied by department according to available records and staff time for digging records out for us. For the early scatter site (#1 in the table above), it was January 1992 through March 1997; site #2 =January 1995 through May 1997; sites 3−4, calendar years 1990−1995; and site 5, May 1992 through December 1995.

**Battery or assault, theft, burglary committed, civil disorder, disorderly conduct, criminal damage to property, or sexual abuse.

NSC= no such calls recorded for the homes in our sample during the study period.

***Litter dumped, intoxicated subject, juvenile nuisance, mischief complaint, neighborhood trouble, noise complaint, fire works, parking or driving complaint, complaints about animals.

****Child custody dispute, neglect of child, juvenile runaway or missing, adult missing, domestic trouble, suicide, overdose, locked out of house, motorist assist, 911 hang up, public accident.

____

Table 23

Comparison of Demand for Police Services Generated by New Homes Built 1990 to 1995 in Five Jurisdictions, with Comparisons also to Demand for EMS and Fire−Fighting Services					
	(1) ***Sheriff's Police Serving Early***	***(2)*** ***Municipal Dept. Serving the***	***(3)*** ***Sheriff's Policy Serving the***	***(4)*** ***Municipal Dept. Serving the Adjoining***	***(5)*** ***Municipal Dept. Serving the***

Type of Call	***Scatter Site***	***Adjoining Small City***	***Maturing Scatter Site***	***Medium−Sized City***	***Transitional Scatter Site***
1. Total studied new dwelling units (DUs) with adequate data*	175	142	184	175	302
2. Total police calls to those new DUs	146	53	86	395	78
3. Average number of years during study period* when those DUs were occupied	3.42	2.2	3.30	4.13	1.9
4. *Average annual number of police calls per 100 new DUs***	24.4	17.0	14.2	54.7	13.6
5. Aver. Annual number of EMS calls per 100 new DUs	4.4	4.7	1.3	1.1	3.2
6. Aver. Annual number of fire calls per 100 new DUs	1.2	1.0	2.2	1.1	1.0

*Adequate data = we needed the month of initial occupancy in order to develop an average number of years between when the homes were capable of calling for service (i.e., the month of occupancy) and the end of the period for which we had data on police calls. That latter period varied by site: for the early scatter site (#1 in the table above)), it was January 1992 through March 1997; site #2 =January 1995 through May 1997; sites 3−5, calendar years 1990−1995.

**The row 4 value = (the row 2 value divided by the row 1 value) divided by the row 3 value, with the result multiplied

by 100.

---

kind of question regarding emergency medical and fire−fighting services; and here again we found non−trivial levels ofdemand for service.

In the early scatter site where a county sheriff's department answered calls, the frequency averaged 24.4 calls annually per 100 new homes (Table 23). In the maturing site, also served by a sheriff's department, that coefficient was 14.2, while in the transitional scatter site (with a municipal department) it was 13.6 calls per new dwelling unit. Based on these figures, a new home would be expected to have a 13.6 percent to 24.4 percent chance of calling the police for assistance during a 12−month period. The municipal department next to the early scatter site recorded about the same level of calls − an average of 17 per 100 new dwelling units annually. However, the city adjacent to the maturing site had a much higher level of calls for assistance − 54.7 calls − largely because of the frequency of burglary alarms (Table 21). An administrator of that department explained that almost all the alarm calls were false in the sense that residents of the homes set off the alarms accidentally or mischievously.[(43)]

Summary of Findings

Table 23's last three lines of data (numbers 4 through 6) indicate that the new homes in our three scatter sites had non−trivial chances each year of needing emergency medical, fire−fighting and police services. Then, the tables on response times (numbers 17, 19 and 22) report that the waits for help to arrive tended to be long both on a common−sense basis and in comparison to the experiences of adjoining municipalities (in the case of the transitional site, the average experience of that city as a whole). We suggest that both prospective home buyers and the governmental authorities responsible for siting new residential developments be aware of the safety risks of relatively remote home sites. Both types of stakeholders in this kind of policy analysis have at least two options: either find/authorize places to build that are closer to emergency services or tax new homes sufficiently so that providers of those services can be located closer to the geographically dispersed new homes.

Chapter 5

The Costs of Maintaining Public Roads in

Early Scatter and Maturing Scatter Areas

Introduction

The emergency medical, fire−fighting and police services consumed by residents in the studied scatter sites depend on roads that are adequately free of snow and ice in the winter and drivable in other respects. Moreover, adult residents of new rural homes commute to jobs each week day just as their school−age children either ride buses or are driven to school by parents, friends, or themselves. As Davis and colleagues observed, "exurban households derive their incomes from urban jobs";[(44)] and the 1990 Census found for our three scatter sites that 35.9 percent to 47.5 percent of workers over 16 commuted at least 30 minutes to their jobs and 15.7 percent to 29.5 percent were traveling one−way at least 45 minutes (Table 24). The highest values in both time categories came from the early scatter site, presumably because its location was farthest from the urbanized edge of the metropolitan area.

Table 24

Percentage of Workers over 16 Commuting One−Way at least 30 Minutes and at least 45 Minutes, as Found by the 1990 Census			
Time Categories	Early Scatter Site	Maturing Scatter Site	Transitional Scatter Site
at least 30 minutes	47.5	35.9	37.8
at least 45 minutes	29.5	19.9	15.7

Township agencies have borne the primary responsibility for road maintenance in the early scatter and maturing scatter sites that we studied, while a city department handled the new subdivision roads in the transitional site. Although rural residents typically use also state and county roads, most of the new homes we studied were located on township roads. The latter are of two kinds: roads built by developers within subdivisions and pre−existing roads that were typically situated along the section lines laid out by surveyors in the 19th century. In Illinois, the township's voters select a single highway commissioner who, as head of the township highway district, is in charge of maintaining the township roads.

Table 25 (Parts I and II) presents an inventory of the responsibilities reported to us by six current or recently retired township highway commissioners. While all six townships' borders encompassed about 36 square miles, the total number of road miles under the commissioners' jurisdictions varied from 36 for the township in the early scatter area that included a municipality within its borders to 92 miles for the township in the maturing area that was largely rural. The difference was the greater degree of subdivision development in the latter township. In between the extremes were three mostly rural townships in the early scatter site, with 41

Table 25*: *Part I

Township Highway Districts: Their Size, Tax Rate, Per−Mile Expenditure, and Services Provided to Rural Residences, 1997 Fiscal Year						
	In Early Scatter Study Site				*In Maturing Site*	
District's Traits	(1) Township with a municipality within its borders	(2) An almost entirely rural township	(3) A second almost entirely rural township	(4) A third almost entirely rural township	(5) Township with a munici− pality within its borders	(6) A largely rural township
Total miles maintained	36.0	45.0	49.8	41.0	79.0	92.0

Tax rate per $100 assessed valuation	.2675	.2798	.2118	.2522	.0744	.2461
Fiscal Year 1998 average expenditure per mile	$11,354	$2,400	$3,158	$4,895	$13,544	$9,640

Table 25: Part II

Township Highway Districts: Services Provided to Rural Residents						
	Early Scatter Site				***Maturing Scatter Site***	
	(1) Township with a municipality within its borders	(2) An almost entirely rural township	(3) A second almost entirely rural township	(4) A third almost entirely rural township	(5) Township with a munici− pality within its borders	(6) An largely rural township
% asphalt surface	100.0%	93.3%	58.1%	64.0%	100.0%	99.2%
Extent of salting or sanding roads	All miles covered	Subdivision and other busy roads	All miles covered	Hilly roads and intersections	All miles covered	Hilly roads and intersections
Percent of the anti−ice and snow spread that is salt	33%	20%	25%	16.7%	50%	25%
Resurface or repair (e.g., potholes) and shoulders	Resurface with 1.5 inches of asphalt	Resurface with 1 to 3 inches of asphalt	Resurface with 1.5 inches of asphalt	Resurface with 1.5 to 2 inches of asphalt	Resurface with 2 inches of asphalt	Resurface with 2 inches of asphalt
Sweep roads	Intersections and subdivision roads in spring	Intersections in spring	Intersections in spring	Intersection & subdivision roads in spring	All roads every spring and once in summer	All roads every spring
Pick up brush from homes	Only after big storm	No	No	No	Every three weeks	No
Pick up trash from roads and ditches	Weekly	No	Weekly	In spring	In spring	In spring
Street lights provided	43 total	2 total	28 to 29 total	none	215 total	14

to 49.8 square miles, and the township in the maturing scatter site that included a city and that had 79 miles of road still in its jurisdiction.

The service responsibilities of the highway district include repairing road surfaces, such as filling potholes or patching larger areas of pavement and rebuilding shoulders damaged by frost heaves and traffic. When patching does not suffice, stretches of road may be completely resurfaced with asphalt. Snow clearance is a conspicuous assignment. For the maturing scatter site, there was recorded an average of 27 storms in the winters of 1991−92 through 1993−94, with an average of 39 inches of snow per winter.[45] With the building of new homes in more parts of their district, the highway commissioners must clear roads early for both the school buses and commuters. One commissioner told us he aims to have all intersections open by 5 AM. A second said that his four regular plows start between 2 and 3 AM and must open up the roads by 6 to 7 AM. Two others gave 6:30 to 7 as their target times for finishing one round of plowing over all their roads.

Other services provided to rural residents include sweeping their roads, clearing trash from right−of−ways, picking up brush in two districts, and providing street lights at intersections and within some subdivisions. Right−of−ways are mowed along roads bordering on farm fields but typically not in front of home sites. Another general service is the maintenance of traffic signs.

Differences in Maintenance Expenditures per Mile and Quality of Service

Sources and Findings: For this analysis about expenditures, we had access to the highway commissioners' budgets (obtained from township government offices); and the commissioners graciously allocated two hours or more for personal interviews.

The financial resources available to them for meeting their service responsibilities varied greatly. When we divided the total expenditures reported by each commissioner for the 1997 fiscal year by the number of miles for which he was responsible, the cost per mile for maintaining roads ranged from $2,400 to $13,544 (Table 25, Part I). In the lowest case, the highway commissioner worked by himself except when coping with snow or ice or when major surface repairs were done. By contrast, the commissioner with over $13,000 per mile of expenditures had one foreman and five other full−time workers. In between these extremes were one commissioner with a single part−timer working year−round, one with a single 40−hour−per−week assistant, another with two full−timers and a third with five.

We noted some differences in quality of services that correlate at least roughly with differences in level of resources. Critical to many commuters and school buses is the extent to which the commissioner can clean the surface of snow and ice, and important to that objective is the extent to which he can use salt rather than a salt−sand mix. As Table 25 (parts I and II) reports, the best (i.e., highest) mixes of salt to sand were reported for the districts with the highest resource levels − $11,354 and $13,544. Moreover, these districts were the only two with asphalt surfaces on all their roads, and they were among only three that treated 100 percent of their roads with a salt−sand mix as opposed to limiting the spread to intersections, bridges, hilly areas, or other high−risk stretches of roadway. The highest−expenditure district is also the only one to sweep all roads in the spring and after that "as needed," rather than cleaning just high−priority mileage or only once a year. It alone picked up brush (tree limbs, bushes) on a regular basis (every three weeks between April and October) and delivered wood chips on request.

Although these differences in quality are important, they might not provide sufficient explanations for the differences in per−mile maintenance expenditures. In the city adjacent to the maturing scatter site, the same kinds of services − pavement repair, snow and ice−removal, street cleaning, removal of storm−damaged limbs from trees, maintenance of street lights − were being provided , as well as curb and sidewalk maintenance and replacement, at a lower cost than reported for three of the six rural townships. The city cost per mile averaged about $4,800 for the three fiscal years ending in 1995[(46)] compared to the $9,640 to $13,544 averages calculated for those three township highway districts. The city public works department serving our transitional scatter site reported a 1996 per−mile maintenance cost of $3,600.

Policy Recommendation: The marked disparities in average maintenance expenditures that we found (across the six rural townships and between three of those townships and two of the studied municipalities) suggest the need for cost−effectiveness analysis. Perhaps the lowest−spending townships have too few resources to do good work, or the highest−spending have more revenues than they can effectively spend.

Who Paid for the Higher−Quality Maintenance in the Highest−Cost Two Districts?

We were surprised to find that some of the cost of maintaining subdivision roads in the scatter sites was borne by residents of the adjacent *municipalities*. Two of the townships include in their taxing borders, but not in their maintenance jurisdictions, the residential and commercial properties of municipalities. We estimated that in both districts the average new detached single−family home built in the municipality paid $83 to $84 a year to the township that the Highway District kept rather than rebate back to the city or origin (Table 26). State law requires the township highway districts to rebate to the municipalities 50 percent of what they collect there from their "General Road Fund" levy. The proceeds of other levies such as the "Permanent Road and Bridge Fund" need not be shared with the city of origin; and state statute does not regulate whether the tax rate for the General Road Fund is greater, equal, or less than the other levies. As Table 26 indicates, the two partially urban township districts we studied set their General Road Fund levy below the other levies, thereby sharing relatively less with the municipalities.[(47)]

While $83 to $84 per home may seem to be a modest fee per home, the estimated total annual tax flows from new homes in the study sites to the township highway districts were rather large: $12,405 and $71,652, respectively (Table 26). Moreover, there was no reverse flow from new homes in the township. That is, no property tax or other regular levy was paid by rural residents to help maintain the roads they may use in the nearby city, such as when driving their children to schools or to park district programs. Rural residents may contribute to road maintenance in cities when they purchase taxable goods and services there. However, in the early scatter case, the nearby city offered very limited shopping opportunities (e.g., no supermarket); and in the maturing scatter case there was competing shopping in cities to the north and southeast.

We are not suggesting that city homes pay nothing towards township road maintenance − only that the tax rates be reviewed and probably reduced, perhaps by the money currently being used to help maintain rural subdivision roads.

According to our estimates for the two townships with significant municipal components, the new homes built along rural subdivision roads were not generating enough revenue to cover maintenance expenditures (Table 27). Residential streets in the cities may have deficits, but they are supported by other properties in that city. Although city taxpayers are likely to use township roads sometime during the tax year, it is probably a rare trip that takes them to rural subdivision roads. They are more likely to travel on the through roads that follow section lines, if not the county and state roads that lead from both cities.

Table 26

Annual Real Estate Tax Flow to Township Highway Districts from the Average−Assessed New Home (Built 1990−1995) in the Municipalities Adjoining Two Scatter−Type Sites of Residential Development, Per Dwelling Unit and Overall, 1996 Tax Year		
	Early Scatter Site	***Maturing Scatter Site***
1. Average assessed valuation less home−owner's exemption	$40,869	$121,137
2. General Road Fund levy: tax rate per $100 equalized assessed valuation	.1194	.0114
3. Other township highway district levies − no rebate*	.1482	.063
4. Per new home average tax payment to highway district = row 1 X (row 2's value/2 + row 3's value)/100**	$84.97	***$83.22***
5. Number of new city homes studied	146	176
6. Total number of new detached single family homes built in city during 1990 to 1995	146 (in this study site all new homes were studied)	861 (In this site a sample of homes was studied.)***
7. Total tax payment from new homes to Township Highway Distr. = row 4 X row 6	***$12,405.62***	$71,652.42

*Permanent Road and Bridge Fund and Equipment Fund.

**Row 2's tax rate is divided by 2 because half of that levy is rebated to the city.

***Since the sample was random, and the "response rate" was 100 percent, row 4's value of $83.22 should be a good estimate for all new homes built in the years 1990−1995.

____

Sources and Findings: The township highway districts' principal sources of revenue for road maintenance are their local real estate tax levies. As discussed earlier, the roads maintained by the townships we studied may be classified into two groups: (1) roads built within platted subdivisions and added to the highway district's jurisdiction if they meet county specifications and (2) nonsubdivision roads, most of which are situated along sections lines and some of which adjoin railroads, follow former Indian paths, or otherwise cross sections at other than right angles. For every studied new home located on a subdivision road in the early scatter site, we enumerated all the properties adjacent to that road (developed and undeveloped). From the county treasurer's office we obtained data on their annual tax payment to the township highway district; and from the county highway department we received computer printouts that provided official measurements of the mileage per subdivision road. In the maturing scatter site, we conducted the same analysis for a sample of studied homes.

It was a simple matter of totaling the tax payments and dividing the sums by the number of miles per road (or group of related roads, such as a residential street that began and ended on section−line roads and had a cul−de−sac or two that intersected it within the subdivision). The resulting figure was the tax yield per mile of road. Comparing that yield to the estimated expenditure per mile of maintenance that we obtained from the township highway commissioner (Table 25, Part I) indicated which roads, if any, paid for themselves. The commissioners agreed to this methodology, both for subdivision roads and section−line roads. With the latter, we enumerated all the properties along mile segments of the roads if one of our studied homes had frontage on that road. This enumeration was easy when using the large aerial photographs available at the county Supervisor of Assessments office. Parcel boundaries and their identification numbers have been superimposed on the photos. Also found on those pictures are section lines spaced a mile apart. Since most of the non−subdivision roads went along section lines, there was no problem in finding the properties that bordered on a mile stretch of public road on which was built one of the new homes in our study. In a few cases, we measured half−mile segments because the road curved after a half mile or we encountered a municipal boundary before the end of the mile stretch.

Table 27

Extent to Which Rural Homes Located Along a Mile of Public Roads Generated Enough Real Estate Tax Payments to Cover their Township's Average Per−Mile Cost of Maintenance						
	Townships in Early Scatter Site				***Townships in Maturing Scatter Site***	
	Township with Municipality in Its Boundaries		Three Other Largely Rural Townships		Township with Municipality in Its Boundaries	One Other Largely Rural Township
	Subdiv. Roads	Section−Line Roads	Subdiv. Roads	Section−Line Roads	Subdivision Roads*	Subdivision Roads*
1. Number of road segments studied	6	5	11	15	11	17
2. Percent of segments with adjacent properties that generated enough land tax to cover the township's average per−mile cost	0.0%	0.0%	63.6%	0.0%	0.0%	47.1%
3. Average loss/gain per mile = difference between total land tax revenues and total expenditures, divided by total miles of township roads in the studied segments	− $6,296	− $9,573	+ $1,499	− $2,685	− $10,088	+ $417

*Only a handful of studied new homes in the maturing scatter site were not located on subdivision roads.

As Table 27 indicates, in the early scatter site none of the mile or half−mile road stretches along section−line roads paid for itself by the measure we used. The basic problem was that there were too few properties along these roads that yielded more than trivial tax payments to the township highway district. Unlike the subdivision roads on which fronted one−to−two acre lots and few if any farm fields, the section−line roads typically had larger−lot home sites and farm parcels. The latter produce little tax because of preferential assessment laws for agriculture. For example, in the early scatter site there was a mile stretch of road on which fronted 14 separate farm parcels, ranging from 4 acres to 40 acres. The four−acre parcel paid $1.76 that tax year to the highway district, seven 10−acre parcels paid from $1.59 to $6.69 and the 40−acre field's tax bill listed $16.79 to the district.

What would have been the total payments if, instead, both sides of that mile stretch of road had been lined with non−subdivision homes, which in this study site averaged 412 feet of frontage? That average would translate into about 12 homes a side (allowing for right−of−ways at intersecting roads). Tax payments to the highway district from non−subdivision homes in that study area (the early scatter site) averaged $167; and multiplying 24 by that average would yield $4,008, not enough to cover per−mile expenditures in the first and fourth districts listed in Table 25, the districts with two−thirds of the non−subdivision homes built in that study site during the six year study period.

A solid mile of subdivision homes should do better fiscally if, as in our early scatter site, the average frontage is smaller (210 feet rather than the 412 feet for nonsubdivision homes built in the same study site). More homes per mile can be located along the roads, and therefore be contributing to their upkeep. Moreover, many of the studied subdivisions included cul−de−sacs whose configurations permitted more separate home sites for the same linear length of public road. However, in both the early scatter and maturing scatter sites, each township had subdivisions that failed to cover the average expenditure per mile. And in the rural parts of townships with significant municipal components, none of the studied subdivisions paid enough taxes in this respect (line 2 of Table 27).

Who covered the deficits? While state tax−payers paid part of them through motor fuel taxes distributed to the townships on a per−mile basis, local taxpayers shouldered most of the burden. The fuel tax rebates did not exceed $1,000, while the subdivision road deficits we found for these two townships averaged $6,296 and $10,088 per mile, respectively (Table 27's line 3).

As we argued above, the homeowners in the adjoining municipality also pay part of the subsidy. Commercial property owners may have a larger share. Whatever the distribution between these two kinds of owners, the new homeowners in the unincorporated parts of the township were clear beneficiaries. Table 28 shows that new rural homes in the first−listed highway district, the one with a sizable municipal component, enjoyed a much higher level of maintenance expenditures per mile compared to three other townships in the same study site, but they were taxed at almost the same rate as the average for the other three districts (that were completely or largely rural − see line 2 of that table). Even more advantaged were the new homeowners in the township of the maturing scatter site that contained a municipality. Their tax levy for the township highway district was only 30 percent of the rate charged to their counterparts in the neighboring, almost entirely rural township, .0744 per $100 equalized assessed valuation rather than .2461 (see line 2 of Table 28). The average tax bills were also much different − $93.10 compared to $261.88 (line 3).

Policy Recommendations: The zoning authorities should consider road maintenance costs when deciding whether to approve development projects for rural areas. As we found, even expensive new homes (assessed at over $200,000) may not generate enough taxes to cover these costs. The likelihood of doing so looks much lower if the homes are situated along section−line roads rather than in subdivisions.

Homes of the latter type may also be subsidized by other property owners, particularly if the new construction is situated in rural parts of townships with a sizable incorporated component. We found that property owners in the municipal areas were paying nontrivial sums for the maintenance of township roads although there was no reciprocal help for their own residential streets and other public roads. This one−way flow occurs even though the new homes in rural areas cost more or not much less than their counterparts in the cities. In the absence of a good reason for this redistribution of income, we recommend that the rural homes pay higher proportions of their own road maintenance costs.

Table 28

Real Estate Taxes Paid to Township Highway District by Average New Home Built in Unincorporated Area of Township, Early Scatter and Maturing Scatter Sites, 1997

	Townships in Early Scatter Site		***Townships in Maturing Scatter Site***	
	Township with Municipality in Its Boundaries	Three Other Largely Rural Townships	Township with Municipality in Its Boundaries	One Other Largely Rural Township
1. Average equalized assessed valuation (EAV) for new homes in unincorporated areas*	$75,679	$66,769	$125,140	$106,412
2. Gross tax levy per $100 EAV for township highway district	.2675	.2479**	.0744	.2461
3. Av. tax paid per new home to township highway district	$202.44	$165.52	$93.10	$261.88
4. Average annual expenditure on road maintenance, per mile	$11,354	$3,484***	$13,544	$9,640
Number of homes studied	46	129	58	131

*One third of fair market value less the homeowner's exemption of $3,500

**An average of three levies, which varied in the rather narrow range of .2118 to .2798.

***Average of three townships' average per mile expenditures (see Table 25).

Chapter 6

The Costs of Extending Sewer and Water Lines

to New Residential Development

Introduction

In the early and maturing scatter sites, the extension of public sewer and water lines to residential developments has not been a public finance issue because almost all new homes are served by private wells and waste water treatment facilities. Wells are dug on each lot, and waste water is processed through a septic tank and drain field installed on the same lot. In some cases there are facilities that serve groups of homes and that homeowners' associations manage. The low housing densities characteristic of early and maturing scatter sites do not justify public water and sewer investments.

Our third site, which we call a case of "transitional scatter," provides a contrast. The city officials who agreed to annex the land there believed that eventual densities would be high enough to justify expensive extensions of city sewer and water lines to the area. Moreover, those officials agreed to have the city bear most of the up−front costs of the extensions. Desiring to stimulate in these newly annexed areas residential growth that included new homes affordable to the middle class, the city council chose not to require developers to pay those costs. These savings appear to have helped to spur development, but at least through 1995 it followed a discontinuous pattern. While planned densities within individual developments were relatively high, there were sizable spaces between many of the projects. The dispersed patches of new homes meant that relatively more farmland was rendered impossible or difficult to farm than if the development had been compact. That is, as discussed in Chapter 1, proportionally more land had nearby nonfarm neighbors who might have complain about the sounds, odors and dust created by normal farming operations, or whose subdivision homes, driveways and roads might have created drainage problems for the adjacent farm fields. Moreover, the sewer and water lines had to be extended longer distances than if the growth had progressed incrementally from existing termini of those lines. This chapter is devoted to assessing the pattern of development that occurred, 1990 through 1995, the extent to which the city recouped its investment through its modest fees for connecting new homes to the sewer and water lines and whether the city achieved its purpose of providing housing opportunities affordable to the middle class.

The Pattern of Development and Costs of Extending Water and Sewer Lines

For the largest, most controversial component of that study area, the city's Public Works Department estimated the total cost to the city of providing water and sewer service as $6.3 million (Table 29). The controversy stemmed from the discontinuous pattern of residential developments there. The largest share of the $6.3 million, 83.1 percent, went for purchasing the materials for, and installing, the water and sewer mains (Table

Table 29

Total Water and Sewer Costs for the Major Section of the Transitional Scatter Site		
Cost Category	***Amount***	***Percentage of Total Cost***
Water main and sewers	$5,232,687	83.1%
Two lift stations	$701,912	11.1%
Land acquisitions and associated legal fees	$116,770	1.9%
Design costs	$246,262	3.9%
Total	***$6,297,631***	***100.0%***

29). In this cost breakdown, there is no provision for expanding the waste water treatment plant. None was needed since prior to the city's annexations into the study site, the plant was then operating significantly below capacity (at about 25 percent).[48] Obviously, if treatment capacity is nearing full utilization in cities that are contemplating annexations, the cost of increasing capacity must be estimated. Included in our study city's cost figures were, however, two lift stations to push the waste water over some obstacle or − in the very flat area where the development was occurring − to force the water through to a part of the system of sewer lines where gravity pulls the water down to the treatment plant.

By early September 1996, in the area where the $6.3 million had been spent, there were under construction 17 residential projects approved to build 4,325 single family (SF) lots and 486 multi−family lots.[(49)] Together these projects totaled 1,689 acres or about 3.2 square miles. The newly annexed areas adjacent to the $6.3 million worth of sewer and water lines 1995 was considerably larger − totaling about 5.6 square miles. Consequently, sizable gaps occurred between developments. For example, in 1995 one city road with new sewer and water lines in that area had a quarter−mile of few if any connections on its north side and an underutilized half−mile on the south. The most striking example of discontinuous growth was an east−west road served by new lines with a half−mile gap between homes on the north and a 1.2 mile gap on the south.

These gaps resulted in part from the city's pledge to annexing landowners that it would take water and sewer lines to the edge of their properties at the cost of modest connection fees. Until May 1992 the charge was only $750 per acre, at which time it changed to a combined sewer and water connection fee of $1,500 per lot. With no city requirement that new development proceed incrementally out from areas already served by water and sewer lines, builders were free to choose the parcels within the annexed area that were most cost−effective. In the case of the 1.2−mile gap, the developer found a half−square−mile parcel towards the western−most edge of the annexed area. Being almost the farthest out from stores and commuting roads, the land was relatively "cheap," so said its developer to us.

To justify the price he paid, the developer planned to build at a density of about 3.5 units per gross acre, which in turn required city sewer and water services. The nearest sewer and water lines were almost than two miles (10,000 feet) to the east. The city agreed to extend service to the edge of the developer's property; the work

was done in 1993 at a cost to the city of $392,000 for installing both kinds of lines as well as the project's design costs.[(50)] There were no land acquisition costs since the lines could be located in public rights−of−way.

Who Pays for the Extension of Sewer and Water Lines to "islands" of Residential Development?

Unlike many development situations where the builder pays an up−front annexation fee or other charge to cover the cost of taking sewer and water lines to his property, this city stood by its pledge that it would bear such "up−front costs." However, to reduce its financial burden in this particular case of extending lines, the city required the developer to pay for a lift station that would pump the waste water through the new main down to the existing terminus of the sewer line system. With the lift station, the city could install a relatively small pipe, eight inches in diameter, just deep enough to avoid damage from frost. Without pumps pushing the waste water, the project would have been more expensive to the city; a gravity feed line for the same−sized development normally is bigger and may be deeper.

Nevertheless, the city was responsible for almost $400,000 in cost to serve a single development at the far end of the newly annexed territory. Since the direct payback to the city consisted of connection fees collected only when homes are built, the risk was that the pace of development would be too slow. Indirect compensation would include property taxes, sales taxes and other revenues attributable to the new homes, provided there was money left over after those revenues sources financed current services like street maintenance, police and fire−fighting. If not, the direct source, connection fees, would have to cover the up−front cost plus compound interest until the principal is paid back. Even if the city financed the extensions out of cash reserves, an interest rate should be applied, since the money would have earned interest if it had remained in the bank. Table 30 presents projections of principal plus cumulative interest if the $392,000 were paid back in three, five, seven and 10 years, assuming a 5.9 percent rate of interest. We chose that rate because it was the highest interest rate in the previous five years for any of that particular city's general obligation bonds.

Also in Table 30 are the numbers of dwelling units required to meet the different amortization schedules, given different average values per new home for the combined sewer and water connections fees. In the particular site we studied, owners had the option of annexing to another city. Therefore, when reviewing the city's subdivision files and other documents on the area where the $6.3 million had been spent on sewer/water mains, we were not surprised to find that only three out of 14 residential projects then under construction were being charged the normal combined sewer and water connection fee of $1,500 per lot on any or all their lots.[(51)] Illinois law permits cities to offer incentives to landowners when negotiating for annexation, even if inducements are provided to some owners and withheld from others.[(52)] In several annexation agreements that we read or that were cited in subdivision review files, we found caps of $1,500 per *acre*. For example, if three dwelling units were planned, the fee would be $500 per lot; if four, $375, etc. From interviews we surmised that the properties assigned preferential connection fees had been the targets of "annexation wars" between the subject

city and two competing municipalities. To persuade owners to submit annexation petitions, the city offered the lower fees as incentives.

Table 30

Cost of Extending Sewer and Water Mains 10,000 feet to a New Residential Development in the Transitional Scatter Site, and Number of Lots Needed to Pay for the Extension (via Connection Fees), by Year and Level of Fees				
Year Since Extension of Mains	Cost* plus Interest if Fully Pay for Extension by That Year	Developed Lots Needed to Pay for Extension if Combined Sewer/Water Connection Fees Averaged:		
		$1,500 per Lot	$839 per Lot**	$409 per Lot***
3rd year	$428,675	285.8	510.9	1,048.1
5th year	$453,615	302.4	540.7	1,109.1
7th year	$479,454	319.6	571.4	1,172.3
10th year	$519,882	346.6	619.6	1,271.1

*Cost at time of extension estimated to be $392,000

**Weighted average of different fees for the farthest−out development, with each fee weighted by the ratio of the number of lots to which it applies to all 553 approved lots in that development, as specified in the annexation agreement.

***Weighted average of different fees for the only two other developments scheduled to tap into the same lines, with each fee weighted by the ratio of the number of lots to which it applies to all lots approved for those two developments.

The lower fees made the land easier to market but more difficult to pay for the extension of sewer and water mains. Table 30 shows that under the normal fee of $1,500 per lot, the extension costs could be paid back in three years if just 286 homes paid connection fees. If it required five years to cover principal and interest on the project, just another 17 homes would be required (for a total of 303). However, because of the annexation agreements, the weighted average fee in this particular development is $839 per lot.[(53)] Therefore, as many as 511 would be needed to pay off the project in three years; and 541 in five. In fact, by the end of the third year, assessment records showed that a total of 301 homes had been built,[(54)] or 55.6 percent of the number needed for full payback in five years. That percentage after three years was close to the level needed to meet a five−year amortization schedule, 60 percent. Moreover, the total approved lots in that one development were sufficient − 553 − and the sewer and water lines were large enough to serve an additional 459 dwelling units authorized for two other new residential projects to be located "downstream" along the pipes.

Therefore, it was likely that this extension of lines would pay for itself within five years providing the pace of development did not decline in the initial project with its weighted average fees of $839. The other two developments scheduled to tap in had a weighted average fee of only $409. In communities that are highly attractive for development like Naperville, Illinois, city government may require developers to bear the full risk of a downturn in real estate sales. Rather than being left with partially paid off−site improvements, such municipalities compel residential builders to pay the entire cost of sewer and water main extended to their properties, except if the lines have been oversized to accommodate future growth beyond the developer's land. Through "recapture agreements, the city may compel compensation payments to the initial developer from other users who tap into the lines anywhere between his property and the previous point of termination.

The "transitional scatter" site we studied lacked the attractiveness of a Naperville, but was eager to lure middle and upper−middle class families. Therefore, it took the risky development stance of annexing large amounts of farmland and permitting developers to locate along almost any public road in the newly incorporated area. According to three builders whom we interviewed, this freedom significantly reduced their land acquisition costs. They cited also that city's lower connection fees compared to those charged by a nearby competing community (no more than $1,500 compared to $3,500 per new home), the studied city's reasonable subdivision and building code standards, and the savings to them of working with a city government that desired development and, therefore, expedited the review process "without cheapening development standards." One developer said that, in this city, project approval was likely in 1.5 months rather than six months to two years in neighboring communities. Another builder praised the city's position of permitting him and his colleagues to determine the kind of new homes being built, rather than pre−emptively zoning for certain densities or styles of homes (i.e., single−family rather than multi−family).

The Pros and Cons of Annexing Large Areas of Open Land and Underwriting the Extension of Sewer and Water Lines

In summary, in the interest of stimulating residential development this city gave developers the great attraction of a relatively large choice of undeveloped parcels, almost all of which would be served by city sewer and water at the city's initial expense, except for the cost of distribution lines and other facilities within the subdivision (like a lift station). Therefore, the developers could bargain with landowners, none of whom had a monopoly or near−monopoly position as would prevail if the city insisted that development proceed incrementally out from existing areas served by water and sewer mains.

Developers pay the city back only as they sell lots, and the city helped additionally by keeping the connection fees at less than half the rate found in the nearby community that was the prime competitor for residential projects. These incentives led to considerable new construction of homes affordable to the middle class. In August 1996 we consulted the *Chicago Tribune*'s extensive Internet listing of residential developments in the section of the metro area to which our transitional scatter site belonged. Of the 410 developments listed, only 33 advertized single family homes priced from $120,000 or less; and nine of those 33 were in our transitional scatter site. The importance of $120,000 is that the six−county metro region's median household income in the 1990 census was $36,327. If it reached at least $40,000 by 1995, a home costing $120,000 would be about three times that annual household income, or close to the ceiling of affordability for that level of family income. Table 31 compares, by study site, estimates of the average and median market values of the new homes that we enumerated. The transitional site has the lowest values for both indicators of central tendency. Included in these comparisons are only detached single−family homes. Unlike the early and maturing scatter sites, the third study area contained some new townhouses.

Table 31

Comparison of Market Values of New Detached Single−Family Homes Built in Three Scatter Sites (1990−1995), as Indicated by Real Estate Tax Assessments

	Early Scatter Site	***Maturing Scatter Site***	***Transitional Scatter Site***
Average value*	$224,889	$347,070	$142,341
Median value**	$213,249	$315,650	$136,749
Total homes in study	164	188	287

*The average of assessed valuations multiplied by three since the published assessments are supposed to be one third the market value.

**The median assessed valuation multiplied by three since the published assessments are supposed to be one third the market value

---

Policy Recommendations: Another "pro" of the transitional site is the small average lot size compared to the other two sites (Table 1). Less farmland needs to be sacrificed per family settled there. As the transition to full development continues, and the undeveloped land becomes less abundant, housing prices should rise. The city can temper the price rise by maintaining its policy of recruiting enough staff for quick review of development proposals, as well as its reasonable building code and subdivision standards.

Less desirable to continue (and to be emulated by other cities) may be its policy of low negotiated connection fees. Unless the build−out rate is relatively fast, the city's general taxpayers bear the risk of fee collections not covering costs, including either the interest charged on borrowing or, if the sewer and water lines were paid out of reserves, the interest earned that would have been possible if reserves were invested. Cities might believe that deficits resulting from attractively low connection fees can be made up through other revenues generated by the new homes. However, sales tax receipts fluctuate with the economy's general health. A more reliable and fairer revenue source for paying off debt on sewer and water extension lines is the connection fee. It is fairer in the case of the transitional scatter site because the families settling in that site tended to have higher incomes than the average for the city as a whole. Moreover, the connection fees need not be onerous. Since a combined sewer and water connection fee of $1,500 is collected when the home is built, presumably the builder passes all or most of it to the home buyer. An extra $1,500 added to a conventional 30−year mortgage at 8 percent interest amounts to an additional $ 11 per month. Moreover, a $1,500 fee actually collected for all 4,325 lots approved as of September 1996 would have yielded more than $6.5 million, enough to cover the $6.3 million total costs for sewer and water line extensions to the entire area (Table 29).

Chapter 7

Recommendations

Opportunities and Problems Found in Three Different Types of

Low−Density Residential Development

As stated at the beginning of this report, we tested hypotheses about possible fiscal costs and public safety risks of low−density residential development. We hope that among the report's readers are both prospective home buyers and local government land−use regulators (like members of planning commissions, county boards and city councils). To both groups we recommend that they understand the type of low−density residential development being marketed, because opportunities and problems may significantly differ by type.

We studied three diverse types of low−density residential development that we labeled cases of "early scatter," "maturing scatter," and "transitional scatter." In our particular study site where scatter−type development was of fairly recent origin, the density of persons per square mile was low (averaging 45.8 according to the 1990 census); and land for rural home was plentiful enough for home buyers to enjoy a variety of opportunities. Relatively large lots were bought so that the overall average size was high, 5.8 acres. Buyers seeking privacy could find free−standing lots that were not parts of subdivisions; 42 percent of the studied new homes in this early scatter site sat on non−subdivision parcels. And almost a third were located in areas of substantial tree cover rather than the tree−less landscape of a recently farmed field. By comparison, densities in the maturing scatter site averaged 333 persons per square mile, the mean lot size was 2.1 acres, almost all parcels were in subdivisions and building lots with extensive tree cover were rare (enough for only 17 percent of the total new homes we studied). The transitional scatter site was a newly annexed portion of a city rather than, as in the previous two sites, being unincorporated areas under county government jurisdiction. Studied new homes in the third site averaged about four per acre; and when fully built out, this site should have a much higher density than the 493 persons per square mile measured in the 1990 census. By the time of a special census conducted in 1994, the site's overall density had increased to 879 per square mile.[55]

Although offering more opportunities in size and type of home sites, the early scatter site had the problems of potentially long distances from essential public services. Over two−thirds of the new homes built during our study period were at least three miles from school campuses and close to the same distances from the fire department and rescue squad. Twenty−five percent were five miles or more. Consequently, the high−school bus routes serving the studied homes averaged 51.5 minutes round trip per day, and the elementary routes, 44.5 minutes. Response times for emergency medical calls to the studied homes averaged 9.6 minutes, while more than six minutes tends to be highly dangerous for heart−attack victims. The mean response time for fire calls was 15 minutes compared to a recommended standard of six minutes, the time by which fires may become highly difficult to control. Responses to calls for police assistance averaged 25.3 minutes.

The studied new homes in the maturing site were, on average, even farther from the community's one high school. But the higher densities of development and tax base permitted the building of elementary and middle−school campuses in unincorporated areas, as well as the location of a fire/emergency medical service station at the edge of the nearby city, relatively close to the new homes being built in unincorporated areas. Therefore, while high school students who rode school buses averaged 54 minutes per day, the mean times for elementary school riders was very close to the average for primary schoolers from new homes built within the adjacent city − 29.1 minutes versus 27.4 minutes. The corresponding comparison for middle−school pupils was 42.4 minutes as opposed to 31 minutes.

Emergency medical responses in the maturing scatter site were also closer to those recorded for new homes in the adjoining municipality. The average in the unincorporated area was seven minutes compared to 6. 2 for the city cases. The fire calls exhibit a similar pattern: an average of 6.9 minutes for the rural sites versus 5.2 for city homes. However, a seven−minute average exceeds the cardiac−emergency ceiling of six minutes; and 6.9 minutes is greater than the fire−suppression standard of six.

Response times by county sheriff's police were also better in the maturing scatter site, averaging 17.9 minutes rather than the 25.3 minutes in the early scatter site. The city police departments tended to provide much quicker responses, except in the third study site, which was the newly annexed portion of a city. There, an average of 16.2 minutes elapsed before officers arrived at the studied new houses that called for assistance. While most calls to the police do not involve crimes in progress or other genuine emergencies, even the burglary alarm calls that we studied had long average response times − 9.4 minutes in the transitional scatter site, 13.2 in the maturing site and 16.2 in the early scatter study area.

Recommendations regarding Time on Public School Buses and Response Times for Emergency Services

To prospective buyers of homes in *early scatter sites*, we recommend that they determine if the length of school bus rides and emergency service response times are at acceptable levels. The school district's director or coordinator of busing routinely provides the pick−up and drop−off times by stop, and the times for arrival at school and departure for the return trips should also be available. The families who find round trip times approaching an hour may change their minds about buying in relatively remote rural locations. Discovering that paramedics or fire−fighters will not likely arrive for at least seven minutes may also dissuade prospective buyers.

Rather than staffing its services with on−site personnel 24 hours per day, the fire department in our early scatter study area relied almost entirely upon on−call staff, as did the rescue squad during night−time hours. The chief of that fire department told us that he aims to "be out of the station in four minutes after receipt of call"; and then he figures on averaging 50 miles per hour to the scene, or a little more than a minute per mile. Therefore, if the person or building in trouble is two or more miles away, a response time of fewer than six minutes is unlikely to be achieved.

To buyers looking in a *maturing scatter site*, the school bus rides may be tolerable except to the high school campus. Elementary schools and even a middle−schools might be built in unincorporated areas, but a second high school campus may be too expensive. Emergency service response times may also be acceptable, except that in our maturing scatter site the averages and medians were just above or at the outer limit of the six−minute standards. The recorded police response times seem too long in the maturing site, averaging 17.9 minutes, although better than in the scatter site (25.3 minutes).

The *transitional scatter site* should provide good responses once the cumulative number of homes justifies additional fire/EMS stations. In our study site, there was a fire station near enough for the response times from

it to average 5.4 minutes, that is, below the six−minute standard. However, the paramedics came from a farther−away station and averaged 7.5 minutes.

If prospective home buyers are not persuaded to look elsewhere, perhaps land−use regulators for the scatter sites will think twice about authorizing developments when emergency services are likely to have excessive response times.

Recommendations about the Burden of Paying for Services

We found in all three sites evidence that residents in nearby geographic areas were paying for services enjoyed by new residents in the scatter areas. New homes built in unincorporated parts of two elementary districts and in one consolidated district failed to generate enough property taxes, state aid and general school fees to cover in−school services and busing. Requiring those homes to pay the extra costs of busing associated with their rural locations would help to close the gap. In the four school districts we studied, the cost differences for busing from new rural homes compared to new homes built in the adjacent cities averaged from only $69 to $244 per year.[(56)] Another likely benefit from imposing fees to cover those differences would be an improvement in the perceived fairness of allocating cost burdens. That is, families living on smaller lots in the city portions of a district would not see themselves as subsidizing the rural life styles of other families.

We recommend a similar, modest taxing change affecting residential scatter sites where township road maintenance districts include municipalities within their borders. There is an understandable temptation to use the real estate tax base provided by the city's commercial and residential properties to help pay for maintaining residential subdivision roads in the unincorporated areas. The rural residents who have bought expensive homes and who commute each work day expect high−quality snow clearance in the winter and clean, pot−hole free road surfaces year round. However, the average road frontages characteristic of large−lot rural subdivision homes mean relatively few housing units per mile of subdivision roads paying taxes to the township highway district. In our study, most subdivisions did not generate enough property taxes to pay for their road maintenance. Therefore, they relied on other revenues sources, including contributions from city properties. But the families who buy homes in the city most probably do not benefit from expenditures on rural subdivision roads; and they may rarely use the township's other roads that follow section lines, since most through traffic uses the state highways and county−maintained roads serving those two cities. Yet, we found that new homes in those municipalities were paying an estimated $83 or $84 dollars each year to the township highway district. If some major portion of those payments is rebated to the city, the collective fiscal benefit could be significant. Equally important may be the gain in the perceived fairness of local government. Residents of the city will no longer see themselves as paying to support large−lot homes in the country.

The extension of sewer and water lines to developments in newly annexed areas of a city, as well as the building of fire and EMS stations to serve homes there, will also excite grievances among residents in older parts of the same city once they realize that public funds for those services could otherwise be allocated to their parts of town or to reducing their tax bills. It may be difficult to convince such residents that fire stations or sewer lines built in an entirely new section of the city are in any way benefitting them.

Sewer and water connection fees and other development impact levies will be upheld in court if they are carefully designed to cover only the costs of services attributable to the new homes being taxed. And, when wrapped into mortgages, the monthly payments for these fees may be modest. For example, an extra $2,000 added to a conventional 30−year mortgage at 8 percent interest amounts to an additional $14.67 per month; and $3,000 would translate into $22.61 added on to the monthly payment.

The shifts in fiscal responsibility that we recommend could help achieve the locational decisions that we advocate. By transferring to home sites in scatter development areas more of the cost burden of school busing, road maintenance and infrastructure investments like fire stations, locating in municipalities becomes less costly, while settling in rural areas becomes more expensive.

Final Recommendation about Diversity in Housing Opportunities

Relatively high suburban densities like three to four units per acre are not desirable for *all* communities. Every large metro area has sizable numbers of executives, doctors, dentists, lawyers, musicians, professional sports stars and other high−income persons who expect to find housing opportunities commensurate with their wealth; otherwise, they and their wealth will go elsewhere in the country. While many upper−class households are content with apartments in the city, luxury condominiums, or even half−acre homes in the suburbs, many are not satisfied with small−lot home sites. Mini−estates of five acres likes those found in Barrington Hills, Illinois, eat up too much farmland. However, in our maturing scatter site, we found large quantities of upscale homes (worth on average $347,070) located on lots of 1acre to 2 acres, in sufficient densities that the school district could justify building campuses relatively close to them and the fire protection district could justify constructing a station not far from them. Therefore, school bus rides at least to elementary and middle schools were not too long, nor were response times for fires and medical emergencies. In other words, our maturing scatter site provides a positive model of how to house the metro area's wealthy families in ways that economize on farmland and reduce public safety risks.

Our transitional scatter site provides an example of how to house the middle class in affordable homes and in densities that − once build−out is achieved − will be highly efficient to service, while economizing on farmland. Development costs were reduced in part because of the large annexations that provided a relative abundance of buildable land. Also helping was the city's policies of low fees and permitting developers to respond to the demand for small−lot single−family homes, duplexes and multi−family units. The results included the smallest average lot sizes, shortest frontages on average and the least expensive homes on average that we found across the three scatter sites. However, for the transitional site to achieve its efficiency potential, there must be full build−out. The "transition" must be completed. For example, development of only half the total planned lots could translate into gross densities[57] little different from one−acre lots along rural roads.

We found too many problems in the early scatter type of residential development to recommend it to home buyers or to county boards. We hope that our analysis will contribute to reducing development there or at least to redirecting it to locations close to existing municipalities, so that less farmland is used up and so that emergency services and school busing may be provided efficiently.

Cited Sources

American Farmland Trust, 1992. *Does Farmland Protection Pay? The Cost of Community Services in Three Massachusetts Towns.* (Northampton, MA: American Farmland Trust).

Steven G. Brand and Frank Horvath, 1991. "Crime−Victim Evaluation of Police Investigative Performance," *Journal of Criminal Justice*, 19 (3): 293−305.

Robert W. Burchell, 1996. *Economic and Fiscal Impacts of Alternative Land−Use Patterns* (New Brunswick, N.J.: Center for Urban Policy Research, Rutgers − The State University).

Robert W. Burchell and David Listokin, 1985. *New Practitioner's Guide to Fiscal Impact Analysis* (New Brunswick, N.J.: Center for Urban Policy Research, Rutgers, The State University of New Jersey).

Norman A. Caron, 1980. *Response Time Analysis: Synopsis* (Washington, D.C.: U.S. Department of Justice, National Institute of Justice).

Mark Cordes, 1997. "Leapfrogging the Constitution: The Rise of State Takings Legislation," *Ecology Law Quarterly*, 24 (2): 187−242.

Judy S. Davis, Arthur C. Nelson and Kenneth J. Dueker, 1994. "The Exurbs and their Implications for Planning Policy," *APA Journal*, 45 (Winter): 45−59.

Gabriel P. Dekel, 1994. "Projecting School Enrollments: A Solution to a Methodological Problem*," School Business Affairs* (April): 32−34 .

Stewart H. Diamond, Ronald S. Cope and Gregory L. Dose, 1994. "Annexation and Annexation Agreements," a chapter in *Municipal Law and Practice in Illinois* (Springfield, IL: Illinois Institute of Continuing Legal Education).

Anthony Downs, 1994. *New Visions for Metropolitan America* (Washington, D.C.: The Bookings Institution).

J. Dixon Esseks and Robert B. McCallister, 1986. "Assessing the Need for Local Government Intervention in Farm−Subdivision Conflicts," in Jim Seroka, editor, *Rural Public Administration: Problems and Prospects* (New York: Greenwood Press).

Peter S. Fisher, 1981. *Assessing the Fiscal Impact of Residential Development, 1981: A Critique of Methods* (Iowa City, IA: Institute of Urban and Regional Research, The University of Iowa).

Illinois State Board of Education. 1996. *1995 Annual Statistical Report* (Springfield, Il.: Center for Policy, Planning and Research).

Illinois State Board of Education, 1997. *State, Local and Federal Financing for Illinois Public Schools, 1996−97* (Springfield, Il.: Illinois State Board of Education).

Illinois Department of Revenue, 1994. *Illinois Property Tax System* (Springfield, Il.: Local Government Service Bureau).

Patricia Kuhn and Raj Nagaraj, 1991. "Improving Ambulance Operations in the Nation's Capital," *Public Productivity & Management Review,* 15 (Fall): 95−102.

Neil Lacey and Max Cameron, 1995. "Mayday in the Rockies: Colorado's GPS−Based Emergency Vehicle Location System," *GPS World*, 6 (No. 10): 40−47.

David Rusk, 1995. *Cities Without Suburbs* (Washington, D.C.: Woodrow Wilson Center).

Jon Schmid, 1997. "6 minutes called 'magic number," *Chicago Sun−Times*, September 21, 1997, Metro Section, p. 17.

United States General Accounting Office, 1990. *Case Study Evaluations* (Washington, D.C.: U.S. General Accounting Office).

1. David Rusk, 1995. *Cities Without Suburbs* (Washington, D.C.: Woodrow Wilson Center), p. 7.

2. United States General Accounting Office, 1990. *Case Study Evaluations* (Washington, D.C.: U.S. General Accounting Office).

3. See, for example, American Farmland Trust, 1997. "Farming on the Edge: AFT's study warns of the loss of strategic and irreplaceable natural resource to development," *American Farmland*, 18 (1): 9−16.

4. Edward Thompson, Jr. 1980. *Farming in the Shadow of Suburbia*. Washington, D.C.: National Association of Counties Research Foundation, 1980; Charles W. Abdalla and Timothy W. Kelsey, "Breaking the impasse: helping

communities cope with change at the rural−urban interface," *Journal of Soil and Water Conservation*, 51 (Nov−Dec): 462−466.

5. J. Dixon Esseks and Robert B. McCallister, 1986. "Assessing the Need for Local Government Intervention in Farm−Subdivision Conflicts," in Jim Seroka, editor, *Rural Public Administration: Problems and Prospects.* New York: Greenwood Press, pp. 137−154.

6. An example of unique farmland is provided by the vegetable−producing areas in the Florida Everglades that are freeze−free nearly the entire year.

7. See, for example, American Farmland Trust, 1992, *Does Farmland Protection Pay? The Cost of Community Services in Three Massachusetts Towns.* (Northampton, MA: American Farmland Trust).

8. Anthony Downs, 1994. *New Visions for Metropolitan America* (Washington, D.C.: The Bookings Institution).

9. Julian L. Simon and Paul Burstein, 1985, *Basic Research Methods in Social Science, 3rd ed.* (New York: Random House); Emil J. Posavac and Raymond Carey, 1997, *Program Evaluation: Methods and Case Studies*, 5th ed. (Upper Saddle Creek, NJ: Prentice Hall).

10. Publication of the county's planning department.

11. Robert W. Burchell, 1996, *Economic and Fiscal Impacts of Alternative Land−Use Patterns* (New Brunswick, N.J.: Center for Urban Policy Research, Rutgers − The State University), 29 pp.

12. The Sidwell Company of Chicago prepares books that contains maps of subdivisions that include parcel dimensions. These books are available at the offices of the county Supervisor of Assessments.

13. January 1998 estimates from engineers of a public works department and a sanitary district in the region.

14. Illinois Department of Revenue, *Illinois Property Tax System* (Springfield, Il.: Local Government Service Bureau, 1994).

15. According to county assessment records for the 1996 tax year.

16. Illinois State Board of Education. 1996. *1995 Annual Statistical Report*. Springfield, Il.: Center for Policy, Planning and Research.

17. State of Georgia, Department of Education. November, 1997. World Wide Web site.

18. Office memo, government of that city. October 1997.

19. In responding to questions about the "three most important reasons for choosing a particular neighborhood" in which to settle, 27 percent of the sample of rural exurban residents in one study mentioned "good schools." Judy S. Davis, Arthur C. Nelson and Kenneth J. Dueker, 1994. "The Exurbs and their Implications for Planning Policy," *APA Journal*, 45 (Winter): 45−59.

20. Statistical significance at the .0005 level in a *t* test for the difference between two sample proportions .

21. Robert W. Burchell and David Listokin, 1985, *New Practitioner's Guide to Fiscal Impact Analysis* (New Brunswick, N.J.: Center for Urban Policy Research, Rutgers, The State University of New Jersey).

22. Peter S. Fisher, 1981. *Assessing the Fiscal Impact of Residential Development, 1981: A Critique of Methods* (Iowa City, Iowa: Institute of Urban and Regional Research, The University of Iowa),30 pp.; Gabriel P. Dekel, 1994, "Projecting School Enrollments: A Solution to a Methodological Problem," *School Business Affairs* (April): 32−34 .

23. Illinois State Board of Education, 1997. *State, Local and Federal Financing for Illinois Public Schools, 1996−97* (Springfield, Il.: Illinois State Board of Education). "Illinois' General State Aid formula is designed to provide higher levels of state financial aid to districts with comparatively low levels of wealth. Comparative wealth across school districts is based upon an annual measurement of the equalized assessed valuation of local property, standardized across school districts on a per−student basis. Per−student standardization considers a district's average attendance weighted for grade level and adjusted for a district's concentration of low−income students" (p. 96).

24. "Regular programs" do not include vocational education, special education, or summer school programs, for examples.

25. The elementary school campus is very close to the high school campus, and the distances reported in Table 2 are from the high school to the middle of the quarter sections in which the homes were built.

26. For example, if we subtract the unweighted average for the municipal part of the first district ("High School District with an Early Scatter Site") from the corresponding average for the scatter part, the difference, 23.2 miles (50.9 − 27.2) is 87% of 27.2 miles. See Table 11.

27. Although the buses were designed for 71 passengers, the district administrators expected enough chronic private−riders or periodic no−shows that more than 71 students could be slated per bus.

28. Mark Cordes, 1997. "Leapfrogging the Constitution: The Rise of State Takings Legislation," *Ecology Law Quarterly*, 24 (2): 187−242.

29. The technical terms for this range is the "inter−quartile range."

30. Neil Lacey and Max Cameron, 1995. "Mayday in the Rockies: Colorado's GPS−Based Emergency Vehicle Location System," *GPS World*, 6 (No. 10): 40−47.

31. Patricia Kuhn and Raj Nagaraj, 1991. "Improving Ambulance Operations in the Nation's Capital," *Public Productivity & Management Review,* 15 (Fall): 95−102.

32. To protect the identify of the agencies, only approximate values are given for square miles and population.

33. Telephone conversation with a representative of the American Heart Association, New York, N.Y., February 1998.

34. According to a 1993 publication of the American Red Cross, from four to six minutes after cardiac arrest, "Brain damage [is] possible"; from six to ten, it is "likely"; and "Over 10 minutes: Irreversible brain damage [is] certain." American Red Cross, *Community CPR* (St. Louis: Mosby Lifeline, 1993), p. 38.

35. 1996 internal memo of that city's fire department.

36. Jon Schmid, 1997. "6 minutes called 'magic number," *Chicago Sun−Times*, September 21, 1997, Metro Section, p. 17.

37. Since this city−wide average was published in a compendium of response times, we shall not provide it to protect the department's identity.

38. Norman A. Caron, 1980. *Response Time Analysis: Synopsis.* Washington, D.C.: U.S. Department of Justice, National Institute of Justice, 26 pp.

39. Calls for information typically had zero response times and no time on scene.

40. We measured from the city's only police station to the center of the quarter section in which the home was built.

41. That department's chief told us in an interview that city−wide 95 percent of the calls for assistance were non−emergency situations.

42. Steven G. Brand and Frank Horvath, 1991. "Crime−Victim Evaluation of Police Investigative Performance," *Journal of Criminal Justice*, 19 (3): 293−305.

43. Although the ratio of false to total alarms is high in virtually all cities, this particular city appears to have experienced an unusually large number of total alarms, perhaps because of the wealth of the new residents; they had the valuable possessions to protect and the funds to install alarm systems that communicate electronically with the police department.

44. Judy S. Davis, Arthur C. Nelson and Kenneth J. Dueker, 1994. "The Exurbs and their Implications for Planning Policy," *APA Journal*, 45 (Winter): 45−59.

45. Report of the Public Works Department of the municipality located adjacent to that scatter site.

46. Report of the Public Works Department of that municipality.

47. Compare the entries in rows 2 and 3 of Table 26.

48. Interviewer with member of the city's planning department, September 1996.

49. Memorandum from that city's planning department, dated September 3, 1996.

50. Interview with an office of that city's Public Works Department.

51. An August 1997 interoffice memo on "Sewer/Water Connection Fees for Subdivisions,"

52. According to Stewart H. Diamond, Ronald S. Cope and Gregory L. Dose in their 1994 publication, "Annexation and Annexation Agreements," a chapter in *Municipal Law and Practice in Illinois* (Springfield, IL: Illinois Institute for Continuing Legal Education), Illinois law permits annexation agreements to contain provisions affecting zoning, subdivision controls and "any other matter 'not inconsistent with the provisions of this Code, nor forbidden by law'" (p. 11.94). This latter provisions permits "the greatest degree of leeway for the municipality in terms of what the annexation agreement can cover" (ibid.). The agreement may even waive "a provision of [the city's] building code for a single developer . . . " (p. 11.95).

53. We had to calculate a weighted average fee because, according to an interoffice memorandum of this city, 12 different levels of combined sewer and water connection fees applied to this development.

54. Assessment maps prepared by the Sidwell Company identify all platted parcels by their PIN or property identification numbers. By accessing those parcels' PINs through the public computer terminals available at the office of the county supervisor of assessments, we could determine which of the parcels in any development had homes on them. The screens for each parcel indicate if buildings had been assessed rather than just vacant land.

55. Tables provided by that city's fire department.

56. These figures represent the differences that the local school districts had to cover. If we add the amounts paid by state taxpayers in the form of state aid to busing, the disparities in average annual busing costs for new rural compared to new urban homes in our study sites increase to a range of $123 to $332.

57. By "gross density," we mean the number of housing units per acre, including land set aside in subdivisions for roads, stormwater retention and other uses besides building lots.