tages that the turnpike towns realized. Even the three cities that grew very little in population experienced significant increases in retail sales.

Grand lists, building-lot values, and average house values are also generally higher in towns with greater accessibility. In all three categories, the turnpike towns show greater percentage increases than control towns, and I-95 towns show the greatest increases within this group. Data on the grand lists indicate that the short-term impacts of the turnpike on property values were much greater for turnpike than control towns. In the long run, however, the turnpike has increased property values throughout the region. Between 1968 and 1974 the grand lists in control towns rose almost as fast as those in the turnpike towns, demonstrating the ripple effect major highways can have on towns located some distance away.

CONCLUSION

Some 13 years after the 1965 Ribbon-of-Hope study, the socioeconomic effects of the Connecticut Turnpike continue to be significant. Except for retail sales, the short-term impacts examined in the 1965 study were concentrated in the towns along the turnpike. In the long run, some of the impacts have spread throughout the region. Manufacturing employment has remained concentrated in the turnpike towns, reflecting the interregional accessibility afforded by the turnpike. Impacts on nonmanufacturing employment, population, retail sales, and property values appear to have spread over time to the control towns within the region, reflecting the improved intraregional accessibility that allows persons to live in one town but to work or shop in another. The benefits of the turnpike remain greater in the turnpike towns, but not all turnpike towns have shared equally in these benefits. Generally, those towns along I-95 have benefited more than those along CT-52. The I-95 towns were growing faster than towns along CT-52, even before the turnpike was constructed. In addition, the improved accessibility provided by the turnpike reinforced their economic and locational advantages.

Thus, it appears that the economic impacts of highways are dynamic and continue to influence the level and distribution of economic activity over a long period of time. The impacts of highways on towns within a corridor are not uniform, however, and depend to a large extent on past trends, future potential, and the present actions that the town takes to exploit the development potential offered by a new highway.

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Abridgment

Rural Road-Closure Planning Program to Preserve Agricultural Land

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A dominant feature of counties in rural Michigan is the grid of roads. Except if interrupted or diverted to accommodate natural features, the road pattern generally runs north to south and east to west. The regularity and intensity of the pattern are significant. The grid usually conforms to 1.6-km (1-mile) spacing. An occasional major route will appear as a diagonal, but even these tend to be part of the 1.6-km (1-mile) grid.

The regularity and density of the road network evolved after much debate in the U.S. Congress, which enacted the Ordinance of 1785 (1, p. 161). This act established townships and the 1.6-km (1-mile) survey grid. From this evolved the 1.6-km grid of section line roads. The act's objective was to open up the land for settlement and various other uses.

The United States had vast tracts of undeveloped land suitable for farming. Early accessibility was provided by waterways; however, vast areas were unreachable without very difficult travel. Roads were needed to open up the area. The issue that confronts the country today, 200 years later, is whether or not the objective of opening up the countryside is still valid. Today the U.S. road network may be a double-edged sword for the farmer; i.e., it provides good accessibility but also facilitates the spread of urbanization.

Some impacts of the 1.6-km (1-mile) grid on the farmer, the county road commission, and providers of public services are discussed here. One impact of urbanization is illustrated by the change in the number of farms by size category. From 1969 to 1974, farms under 19.6 hm^2 (49 acres) have increased by 9 percent; farms of more than 200 hm^2 (500 acres) have increased by 31 percent. However, farms in the 20- to 199-hm^2 (50- to 499-acre) category have decreased by 20 percent (2, p. 148). Thus, some midsized farms are being split into smaller units, while others are being accumulated into units of more than 200 hm^2 (500 acres).

Putting together large contiguous agricultural production areas is inhibited by a dense road network. Therefore, crossing or traveling a road to go from one field

to another is common. Today's farmer is working many scattered fields, transporting equipment, and traveling long distances to these locations.

County road commissions are also impacted by the 1.6-km grid. For example, Clinton County, which covers an area of 1492 km^2 (576 miles^2) has approximately 1760 km (1100 miles) of county roads. However, very few of the county roads are more than 16 km (10 miles) long. The mean is about 12.8 km (8 miles); the mode is 1.6 km (1 mile). This represents a widely disparate road distribution.

Trying to service many short and discontinuous roads is inefficient. Route maintenance is expensive and time consuming. Limited maintenance funds must be expended to maintain many low-volume roads. What has resulted is a network of poorly maintained roads.

Studies have shown that low-volume rural roads have a disproportionately high volume of accidents, partly due to the low level of maintenance (3). Also, poor maintenance contributes to increased vehicle operating costs by increasing fuel consumption and wear and tear.

The Ordinance of 1785 also established that a portion of one section of each township should be reserved for the school system. Slowly, over the years, the rural one-room school system was developed. Then, as education became more complex, the rural school consolidation movement began.

The yellow school bus became a standard fixture on the rural scene. Today, the school bus fleet is perhaps the largest mass transportation system in the world. For example, an unpublished report by the Michigan Department of State Highways and Transportation, noted that the state's primary and secondary school districts operated a fleet of some 12 000 vehicles in 1974. These buses traveled more than 800 000 km (500 000 miles) daily; most of the distance traveled was on the rural road system.

In counties that have a low population density, school buses must travel long distances between stops for pupils. In Michigan's southern counties, which have a higher density of pupils, buses are operated for less than 20 cents/pupil trip. In northern areas, which are less densely populated but have the same road-network density, the cost is more than 32 cents/pupil trip.

Public utilities, such as electric power and telephone companies, are also influenced by the 1.6-km (1-mile) grid. Local electric and telephone lines usually follow the road network. Because of the scattered distribution of rural dwelling units, utility lines must be constructed over long stretches of land and maintained to serve a rural area.

The Ordinance of 1785 established the 256-hm^2 (640-acre) section as the basic unit of land. Although other survey standards were contemplated, the 1.6-km (1-mile) grid met the needs of 200 years ago. The farmer's primary concern was feeding his family and providing some extra agricultural products to buy or barter for those few commodities he did not produce. The amount of land tilled was usually 16 or 32 hm^2 (40 or 80 acres).

In contrast, farm size and productivity have increased until today's farmer is producing enough to feed 50 nonfarm families. However, the road network is still predominantly based on the 1.6-km (1-mile) grid. Thus, the question is, Will the existing network serve tomorrow's needs? Current trends in farm and farm equipment size are briefly examined here in response to this concern.

Recently, a dramatic change has occurred in the size of Michigan farms. Farms in the range of 20 to 200 hm^2 (50 to 500 acres), which were adequate for full-time farming not too many years ago, have decreased between 18 and 20 percent in the last 6 years. What is happening is that many of these farms are being divided into very small, less than 4-hm^2 (10-acre) plots occupied by a nonfarm family. These small parcels have increased by 25 percent. At the opposite end of the spectrum, the full-time farmer has been trying to accumulate more land. This is demonstrated by the increase in the number of farms in excess of 200 hm^2 (500 acres). These larger farms have increased between 27 and 74 percent. As farm size has increased, so has equipment size.

The change in the size of farm equipment is highlighted by the sale of farm tractors from 1969 to 1975 (4, 5). Sales of all tractors under 74.6 kW (100 hp) have decreased, while those of tractors having more than 74.6 kW have dramatically increased. Sales of the larger tractors have increased more than 200 percent in the United States and more than 300 percent in Michigan.

There are indications that these trends in farm and equipment size will continue. If the productivity of the farmer is increased, the trends should be encouraged. One impediment to the continuation of this trend is the high degree of accessibility and division of the countryside by the 1.6-km (1-mile) grid of roads. The density of the road network that served the farmer of yesterday so well is an impediment today.

What alternatives to the 1.6-km (1-mile) road grid are available? Because most county road networks follow this pattern, the alternatives would be combinations of 1.6-km (1-mile) spacing. A 3.2×3.2-km (2×2-mile) grid would result in the closing of every other road, theoretically reducing by 50 percent the total distance covered by county roads. A road-free area of 1000 hm^2 (2500 acres) would be created compared to the 256 hm^2 (640 acres) in the 1.6×1.6-km (1×1-mile) grid. Also, some of the land now used for roads could be returned to agricultural use. For a county the size of Clinton County, this would total more than 1800 hm^2 (4500 acres).

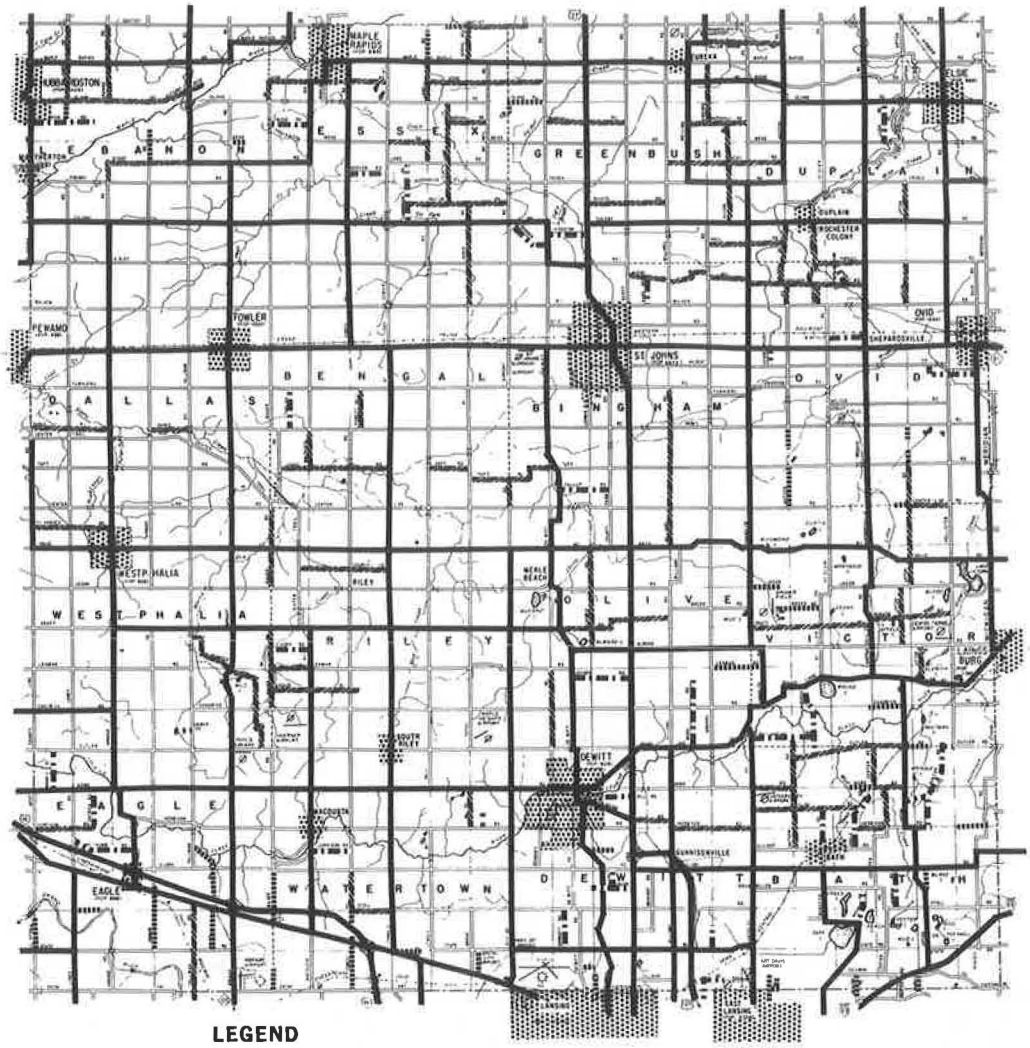
Another alternative would be the 4.8×4.8-km (3×3-mile) grid. This would result in the closing of two out of every three roads and in reducing the total county roadway figure by 66 percent. It would result in a road-free area of over 2000 hm^2 (5000 acres)—a ninefold increase over the 256-hm^2 (640-acre) section used today. Thus, more than 2400 hm^2 (6000 acres) of land used for road rights-of-way could now be used for other purposes.

Conversion to one of these alternatives would, of course, have many serious repercussions. But, before dismissing the idea entirely, some of its benefits and advantages should be considered as they affect the farmer, the nonfarm resident, the county road commission, and providers of public services.

For the farmer, a reduction in the amount of roadway could reduce the potential for nonfarm land uses. For example, the 4.8×4.8-km (3×3-mile) grid would have only 18.2 km (12 miles) of road frontage for development compared to 54.6 km (36 miles) in the 1.6-km (1-mile) grid. If nonfarm development is reduced, land value should stabilize. This, in turn, will help stabilize the assessed valuation. A stabilization of the assessed valuation would slow down the current upward spiral of property tax increases. Also, right-of-way areas used for roads could be returned to agricultural production. With a larger road-free area, larger contiguous fields could be assembled without being crossed by a road. This would mean that the farmer would not have to transport equipment over long stretches of poorly maintained county roads.

On the other hand, some disadvantages to this approach exist. Some farm homesteads would have to be relocated. Because accessibility is decreased, some trip lengths would be increased. Any increase in distance traveled between farm and market would affect the farmer's profitability. The greater the travel that is re-

Figure 1. Roads in Clinton County, Michigan, selected for possible closure.



quired, the lower are the farmer's profits. Closing many kilometers of roads would also disrupt the social interface of the farm community.

The rural nonfarm resident could realize some benefits. If the roads that remained were improved and paved, travel for work and other trip purposes would be easier. If fewer kilometers are driven, vehicle operating costs are lowered. The cost of public services may also be lower. However, the rural nonfarm resident may have to relocate his home. Depending on where he lived, he may have to travel farther to get to work. The residential density of an area would increase. Because many rural nonfarm families locate in a rural area to enjoy a low residential density, they would find this undesirable.

The county road commission would also be affected by a change in the road network. There would be fewer kilometers of roads to maintain and many substandard roads could be eliminated. In 1975, more than 46 400 km (29 000 miles), or almost 48 percent, of the county local roads in Michigan were inadequate (6). A decrease in the amount of roadway would enable the county road commission to increase maintenance on the remaining roads and to bring them up to a higher standard. In Michigan, over $7.7 million is spent annually on snow and ice control. Some of this money could be saved if the county road network were reduced. Road closures would result in a more efficient use of roadway capacity. Because providing road capacity is a discrete function, the density of today's rural roads provides more capacity than traffic volumes warrant.

Benefits would be realized by the providers of public services. Some utility lines could be eliminated, and the savings in maintaining those lines could be passed to the customers. Also, as the residential density along the remaining roads increased, there would be an increase in revenue per line kilometer. The potential for line breaks, due to an ice or wind storm, would be reduced because there are fewer kilometers of exposed lines. Reinstitution of service after a storm could be quicker and at a reduced cost because fewer lines would have to be repaired. The per pupil cost of school bus service would be reduced, as would the time students spend riding the bus. Fewer kilometers would be trav-

eled by school buses and these would be on better-maintained roads, thus reducing school bus costs.

There would, of course, be some disadvantages to the public service providers. As future urbanization is reduced, there would be fewer future customers. It also would be very difficult for an area to diversify its tax base as less land would be available for nonfarm uses.

If the benefits of an alternative road grid outweighed the disadvantages, then a planning program to implement the selected alternative is needed. Planning is preparing for change. However, most physical planning focuses on change that requires more streets, buildings, and physical facilities. What is suggested here is a planning program that requires fewer roads. A program of converting to an alternative road grid would be politically and financially impossible to accomplish in a short time frame. Therefore, a two-phased program is envisioned: a short-range program to identify which roads, if closed, would cause a minimum of disruption and a long-range program, which would perhaps establish the desired road network over a 20-, 30-, or 40-year period.

The long-range planning program should be viewed as a policy plan. The objective is to determine the long-range direction that development should take. It should deal with generalized areas and alternative land development patterns. Once a development pattern is selected, then a road network that complements the pattern should be selected. If the long-range goal is to preserve and enhance an area for agricultural production, then an alternative to the 1.6-km (1-mile) road grid should be considered and selected for implementation.

Once a long-range goal is developed, then a short-range program is needed. The short-range program should develop a step-by-step implementation of the long-range goal. During the short-range process, procedures for closing roads should be established. Issues that have to be addressed are funding of relocation expenses, notification of public hearings, and a specific timetable for closing the roads. The short-range program should also identify those roads that have the most potential for closure.

Using Clinton County as an example, a four-step procedure was developed for identifying roads having closure potential. The first step identified all of the densely developed areas, state trunk lines, and county primary roads. These roads would not be considered for closure and would form the network for statewide and countywide travel.

The next step located the stub or discontinuous roads. These roads do not form any system. Included were roads with the lowest surface types, such as soil surface, graded and drained, or unimproved. In general, these roads are less than 1.6 km (1 mile) long. About 41.6 km (26 miles) of roads were in this category.

The next step located all roads less than 3.2 km (2 miles) long. These roads are not vital to the system for countywide travel. Of the 144 county roads, 40 were in this category. Essentially these roads provide a high degree of accessibility and encourage rural nonfarm development.

The next step identified longer road segments that are discontinuous. The service they provide is duplicated by nearby parallel roads. Many of these roads are just 3.2 km (2 miles) long. There were 208 km (130 miles) of roads in this category.

These last three steps identified almost 320 km (200 miles) of county roads with closure potential. Very few of these roads were longer than 3.2 km (2 miles). They obviously are not being used for any significant trip making (Figure 1).

These roads exist because at one time there was a policy to construct all section line roads. It is time to reconsider that policy. Should we continue to develop those section line roads or are changing conditions in the rural area demanding a different direction and a different policy? For example, in Clinton County almost 50 percent of the local roads are inadequate. The nearly 320 km (200 miles) of roads identified would reduce the amount of roadway by 25 percent.

A recent editorial in the Des Moines (Iowa) Register stated: "County roads that served dozens of farms 40 years ago may be serving two or three farms today. Many roads that were once vital to a county's well-being have become in effect private roads, although the county is responsible for their upkeep. Such roads no longer belong in a county road system." The concept of closing little-used, poorly maintained rural roads has enough merit to warrant more detailed examination. Perhaps it is time to evaluate the 200-year-old objective of opening up the country and to develop an objective that serves the needs of the future.

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