AN INTEGRATED TRANSPORTATION LAND USE MODELING SYSTEM FOR INDIANA

Introduction

This research is proposed to develop an integrated model to represent the interrelationships between land use and transportation, subject to the requirements of the ISTEA of 1991 and the CAAA of 1990. The integrated model includes two major parts: a land-use allocation module and a travel demand module. An interface module has also been built to transform data between these two modules.

Land-use Allocation Module

It contains a residential location model, an employment location model, a land use potential model, and a land consumption model. The purpose of this module is to estimate the spatial pattern of households (or population), employment, and density of occupation and floorspace. It simultaneously estimates the passenger movement by work-to-home, home-to-shop and work-to-shop trips between zones before entering the travel demand module.

Travel Demand Module

This module contains trip generation and trip distribution stages for estimating home-based school, home-based other, non-home-based, external-internal trips. It splits the trip matrices into individual modes and then assigns the vehicle trips on the links of networks being analyzed. It includes capacity restraint on these links to represent congestion on the routes and considers the behavior of individual stochastic route choice. Because of a statewide license was acquired by the Indiana Department of Transportation. (INDOT), this study used TRANPLAN as the basis for the travel demand module.

Policy Test 1 – improvements of highway network for 2010

This policy assesses the effect of changes in the highway network in the Lafayette area for the year 2010. A realignment of US 231 will cross Wabash River from South River Road to County Road 350S, then connect to the current US 231 south of McCutcheon High School near County Road 500S. Furthermore, County Road 350S will be expanded to a major two-lane highway connecting State Road 38 (at County Road 475E) west to the new US 231.

From the test result, the changes will improve the traffic conditions in Fairfield, Sheffield and Wabash Townships. These townships will be more accessible by 2010. Realignment of US 231 will improve the accessibility between West Lafayette area and southern Tippecanoe County. Furthermore, the congested condition on old US 231 will be improved due to large amount of traffic shifting to the new US 231.

Policy Test 2 – changes in land use pattern

This policy assesses the effect of changes in the land use pattern in the Lafayette area. The test policy indicates that the 1981 adopted Comprehensive Plan for Tippecanoe County called for little residential expansion in the mostly rural sector between I-65 on the west, Wildcat Creek on the north and east, and the Town of Dayton on the south.

Expansions of utilities along SR 26, and along Haggerty Lane, have changed the development equation.

The expansion of utilities to the shaded area (Fig 5.9) will create significant residential growth in this area after 2000. As a result of policy 2, a little residential expansion is expected to appear in the shaded area (southern Perry Township and northern Sheffield Township) for 2010. Also, it is found that traffic conditions on SR 26 will get worse by 2010. It is necessary to make an improvement on SR 26 between US 52 and County Road 700E by 2010, especially the section between I-65 and County Road 700E on SR 26.

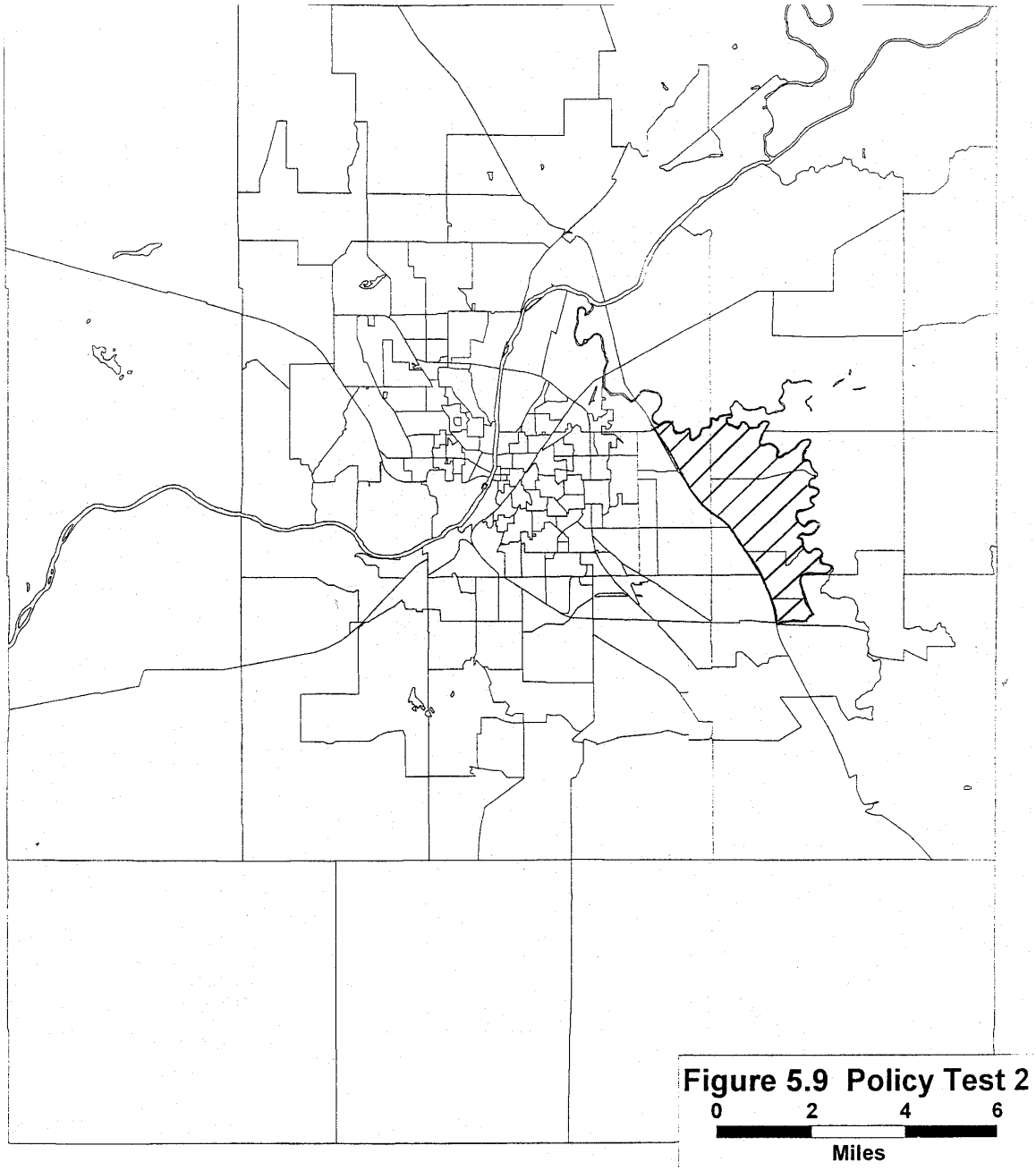

Figure 5.9 Policy Test 2

Test policy 3 – improvements of highway network for 2015
This policy assesses the effect of particular proposed changes in the highway network on the West Lafayette area for 2015. The realignment of US 231 in policy 1 is extended here to create a western bypass around the West Lafayette area. A new four-lane road will carry traffic from the US 231/South River Road intersection around the east and north sides of Purdue Airport, across State Road 26on up to McCormick Road, just before it crosses Lindberg Road. From there, McCormick Road will be widened to four lanes up to a new two-lane, southwest-to-northeast connector to Cumberland Avenue at US 52. The north end of McCormick will become a four-lane facility.

The above changes will improve traffic situations in Fairfield, Sheffield and Wea Townships, making them more accessible to/from other key trip end locations. Also, the realignment of US 231 will improve the accessibility to/from West Lafayette. Travel between West Lafayette and Tippecanoe County will be easier. Furthermore, the congestion on Northwestern Avenue on US 52 through West Lafayette will be alleviated by traffic shifting to the new northern alignment of US 231. Finally, results from Policy Test 3 shows retail employment increases will occur in southern Fairfield Township.

Interface Module
This module converts the generalized costs produced from the travel demand module into the accessibility between zones for use in the land-use allocation module. It operates in a reverse way, transforming output from the land-use allocation module such as the flows of activities between zones into the physical flows of person trips, e.g., the peak-hour trip matrices by purpose, used in the travel demand module.

Benefits from Lafayette Model

- It can reflect the effects of changes in the travel network on the level of activity – for example, more population and retail employment will be attracted to locations that have greater accessibility to workplaces, shopping etc. The model can also show impacts of changes in land use patterns on travel patterns – for example, more traffic will be generated because the current agricultural use of a region is converted into residential, commercial, or industrial use.

- The integrated model can be used to quantify positive or negative effects of long range transportation plans (e.g., the improvement of new construction of highway network) on land use (e.g., the spatial distribution of population and employment).
- The output from the travel demand model (speed, link, volume, V/C, travel time) can be easily input to an emission model. Thus, for example, MPOs in non-attainment areas can use the results generated from the emissions model to indicate whether new transport or land use projects will have positive or negative impacts on air quality. Furthermore, the information (e.g., the changes in traffic conditions) provided by the integrated model can help decision makers or planners devise strategies to avoid negative future effects.

- In land use potential study, the information generated can serve as a data base for a variety of planning activities, including the eventual land use plan itself.

- Because the land use potential study model is built based on a GIS database, this model can manipulate large amount of data more easily can an individual can. Furthermore, the point system approach and the Dempster-Shafer evidence theory ca be applied over a large study area, and the land use potentials generated can be counted on to sort out competing land uses rationally and consistently. The procedures proposed in the land use potential study have a technical basis and are systematically quantitative, rather than intuitive. Hence, such a study can be readily replicated or updated in the future.

- It is shown that the land use potential study can produce accurate breakdowns o current land area and rational estimates of future land area for residential, commercial, industrial, agricultural and open space uses. The areas for residential, commercial and industrial development are used as the input to the land use allocation module. Test runs for the Lafayette area has demonstrated that accurate calculations of residential and commercial area can improve the accuracy of parameter calibration in the residential model and in the employment location model, respectively.

Conclusion

A land use modeling system can be great to Indiana cities. It can determine the roadway network necessary to handle sharply increasing traffic due to residential, commercial, or industrial growth. The land use modeling system can predict whether it will benefit Indiana cities to expand or repair old roads, or to create new roads in order to accommodate an increase in traffic. As a result, more people will be willing to move to, or do business in Indiana cities because they are more accessible. The land use modeling system predict changes that need to be made in order to keep Indiana cities more accessible, therefore helps bringing people and business to these cities.