4. SCENARIO ANALYSIS

INTRODUCTION

The purpose of this chapter is to describe the results of an analysis of future development scenarios conducted jointly by the ITCTC and the Tompkins County Planning Department (TCPD). The TCPD developed the Tompkins County Comprehensive Plan (Comprehensive Plan) at the same time that the LRTP was being updated. This provided the opportunity for both agencies to coordinate their efforts to ensure the creation of mutually supportive planning documents.

The principles and policies of the Comprehensive Plan recommend future development that emphasizes nodal development patterns, where development, increased densities and mixed uses are encouraged in existing urban areas, villages and other currently developed areas. This approach is supported by the goals and objectives found in the LRTP. A shift to nodal, mixed use development patterns is expected to result in, improved conditions for the provision of transit and for shifting a greater number of trips to walking and bicycling.

The TCPD developed a series of scenarios to help illustrate the potential impacts of future growth based on different land use development patterns. The ITCTC used its travel demand model (TransCAD) to help determine the impacts on the county's road network. The scenarios and analysis results are described below.

The Comprehensive Plan and the LRTP recognize that responsibility for regulating land development lies at the local municipal level, within the towns, villages and the City of Ithaca. Thus the land use scenarios were not meant to prescribe a specific future land use pattern. Rather, the scenarios were intended to show the relative impacts of future development on various systems in the county: transportation, natural areas, water resources, etc. The LRTP analysis explored the impacts on the transportation system. The Comprehensive Plan includes expanded analysis of other systems impacted by land use.

SCENARIOS

Two future land use scenarios, Trend-Based and Plan-Based, were developed for this analysis. A current conditions scenario was also developed to provide a point of comparison. The Trend-Based scenario was based on a development pattern that continues recent land development trends. The Plan-Based scenario included a nodal development pattern as supported by policies in the Comprehensive Plan. The scenarios were built by applying different geographic distributions of future housing units and future jobs. Each scenario assumed relatively little change in the existing land uses in Tompkins County and was based on future population projections reflecting an increase in population of 5,650 persons and 7,000 to 8,000 new jobs over a 25-30 year period, based on data from the New York Statistical Information System.

Trend-Based Scenario

Under the Trend-Based scenario future housing was distributed around the county based on patterns of development between 1990 and 2000. In that decade, housing growth occurred primarily in rural and suburban areas. The rest of housing growth took place in existing urban areas and other historical center of development (also called nodes or nodal areas in the Comprehensive Plan) – the county's villages, hamlets, and the City of Ithaca. Future housing in the Trend-Based scenario was projected to continue this pattern.

Job growth was designed to roughly follow housing growth pattern, with most of the growth happening in rural and suburban areas and the remaining in nodal areas. It was also assumed that job growth would most likely locate along or near major transportation corridors.

Plan-Based Scenario

The Plan-Based scenario was based on a change in the distribution of housing growth among rural, suburban and nodal areas. This scenario placed most housing growth in existing, expanded and new nodal areas. The remaining residential growth was distributed in the rural and suburban areas. Job growth was distributed roughly proportional to the residential growth. This scenario also assigned suburban and rural growth away from Natural Features Focus Areas and Agricultural Resource Areas as identified in the Comprehensive Plan.

The principal difference in the geographic distribution of housing and job growth assumed in this scenario compared to the Trend-Based scenario is the expansion of the existing villages, City of Ithaca, and hamlet areas; and nodal development of South Lansing, Danby, Jacksonville and the area around the Cayuga Medical Center following the historical village pattern found in Tompkins County.

There would still be growth in the suburban and rural areas of the county, together accounting for roughly one-third of new residential development. However, there would be very little creation of new suburban areas. Rather, there would be infill development within existing suburban areas where there exists or is planned water and sewer service.

ANALYSIS

The maps in **FIGURES 18, 19 and 20** depict the distribution of land uses for the existing conditions, Trend-Based and Plan-Based scenarios (Source: Tompkins County Comprehensive Plan). As can be observed the proposed scenarios are only marginally different, a result of efforts to portray future conditions that are realistically achievable.

The TransCAD travel demand model used population and employment data to generate and distribute trips along the model's road network. The network included all state roads and county roads and other roadways of major regional significance. For this analysis the basic model network was modified to include recent roadways changes and others that were expected to occur with a high degree of certainty.

The ITCTC travel demand model used for this analysis was calibrated to model the PM peak hour of traffic from 5:00 to 6:00pm. As such it was designed to reflect the worst traffic conditions on the roadway network.

The travel demand model served as a useful tool to generate a general view of the distribution of trips along the road network, highlighting major trends and patterns in traffic movements. To illustrate the impacts of the Trend-Based and Plan-Based scenarios we used the measures of vehicle-hours-travelled (VHT) and vehicle-miles-traveled (VMT). These factors provided systemwide measures of the efficiency of the road network for comparison between scenarios (see **TABLE 25**). VMT reflects the cumulative miles traveled for all trips, and VHT, the total hours of travel on the road for all trips. Both measures were derived from the model's road network for the PM peak hour.

TABLE 25

Scenario Comparison
(percent change is shown in parenthesis)

Scenario	VHT	VMT
Current	317,561	220,194
Trend Based	391,960 *(23%)*	263,714 *(20%)*
Plan Based	382,712 *(21%)*	258,942 *(18%)*
%Change Plan Scenario from Trend Based	-154 (-2%)	-4,772 (-2%)

The table shows two basic tendencies. First, both future scenarios had higher VHT and VMT than current conditions. Second, the Plan-Based scenario had lower VHT and VMT than the Trend-Based. The overall increase from current conditions was expected since the scenarios needed to accommodate an increase in population and employment, which would generate traffic activity. The comparison between the Plan-Based and the Trend-Based scenarios showed that the allocation and distribution of growth could have an effect on traffic.

Although a 2% reduction in VMT and VHT may not seem like much, it is important to remember that it is only reflective of the one-hour afternoon peak hour of traffic. If future land use development patterns apply the vision of the Comprehensive Plan and the LRTP reductions in traffic can be expected to extend through the 24-hour period. The cumulative differential between the Trend-Based and the Plan-Based scenarios then becomes significant when measured over a period of time. For example, looking at the peak-hour VMTs over a one year period would result in 1.1 million less vehicle miles traveled in the Plan-Based than in the Trend-Based scenario. The benefits of this difference translate directly into reduced congestion and all its secondary positive effects, in addition to lower emissions of smog inducing gases and greenhouse gases and reduced energy consumption.

FIGURE 21 shows another comparison of the Plan-Based and Trend-Based scenarios by highlighting the roads with significant increases in traffic compared to current conditions. Based on the distribution of volumes on the network 180 additional cars per afternoon peak traffic hour (3 cars per minute) or more was considered significant in this map. The Trend-Based scenario showed more road miles being significantly affected, with expanded impacts outside the county's urbanized areas.

Model results also showed that the nodal development pattern in the Plan-Based scenario resulted in a small reduction in traffic volumes (1% to 10% less) among many rural roadways, particularly in the northern half of the County – Towns of Ulysses, Enfield, Lansing and Groton. This effect was less pronounced in the southern half of the County – Towns of Newfield, Danby and Caroline.

1. Energy and Air Quality

The State of New York Energy Plan requires that long range transportation plans quantify their energy and air quality impacts. For purposes of the ITCTC LRTP the Plan-Based and Trend-Based scenarios were analyzed to determine how they would affect these environmental parameters. NYSDOT guidance for complying with recommendations of the State Energy Plan provided the formulas, emission factors and conversion factors needed to make the required calculations.

TABLES 26 and **27** show the result of the comparison between scenarios. In summary, energy consumption and greenhouse gas (CO2) emissions increase between the current and future scenarios (**TABLE 26**). However, the Plan-Based scenario shows lower energy use and greenhouse gas emissions levels than the Trend Based scenario.

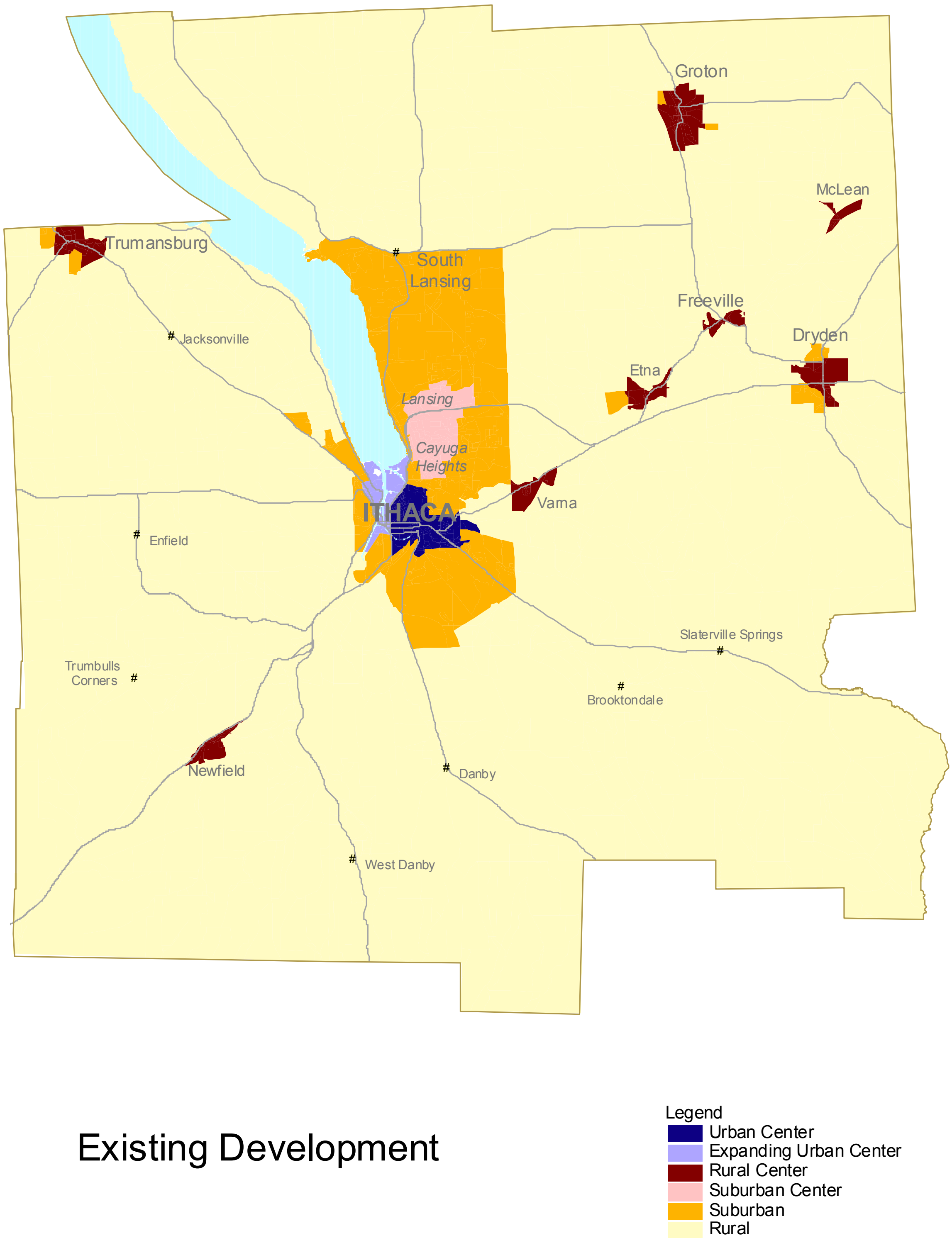


FIGURE 18

Source: Tompkins County Planning Department

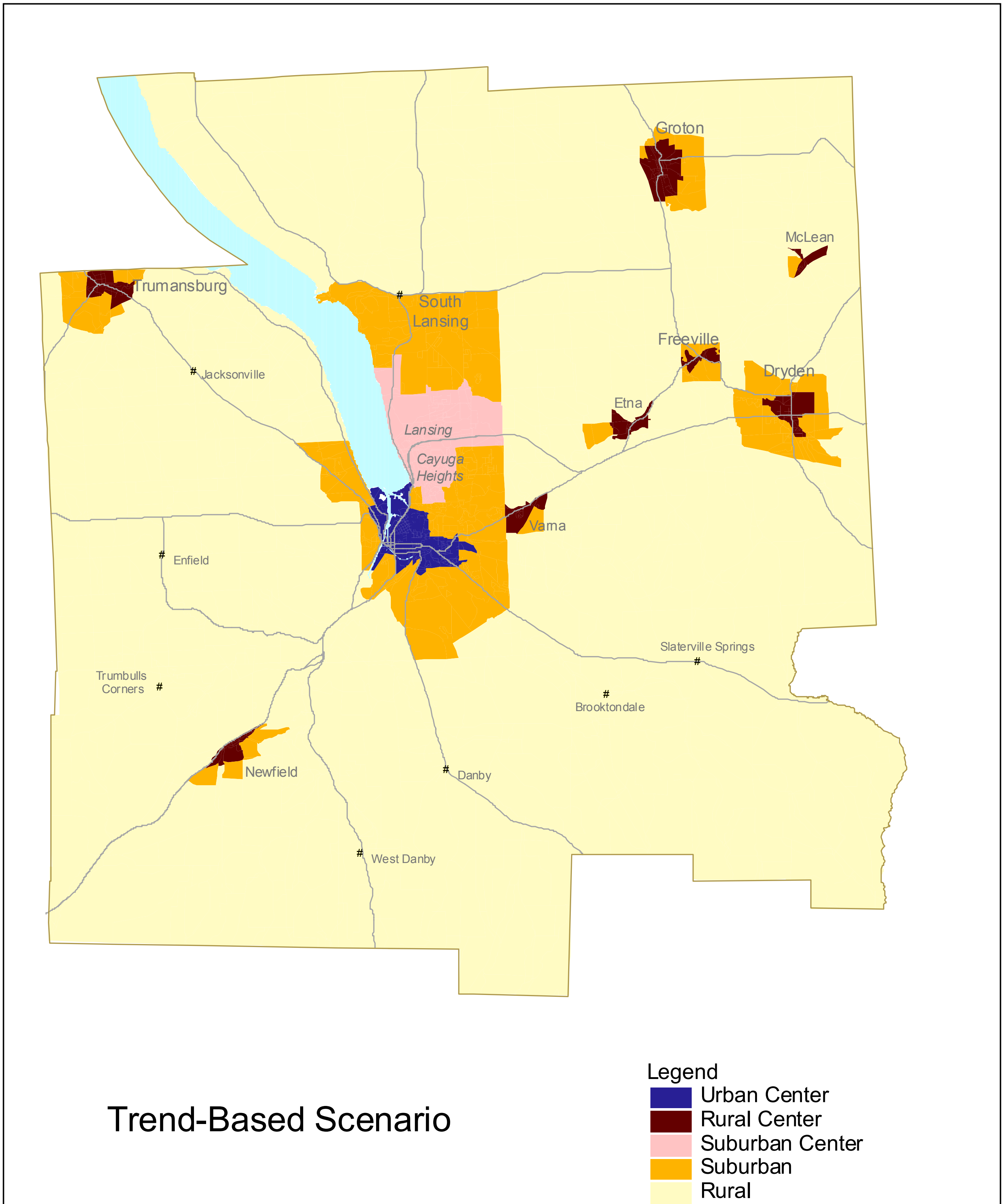
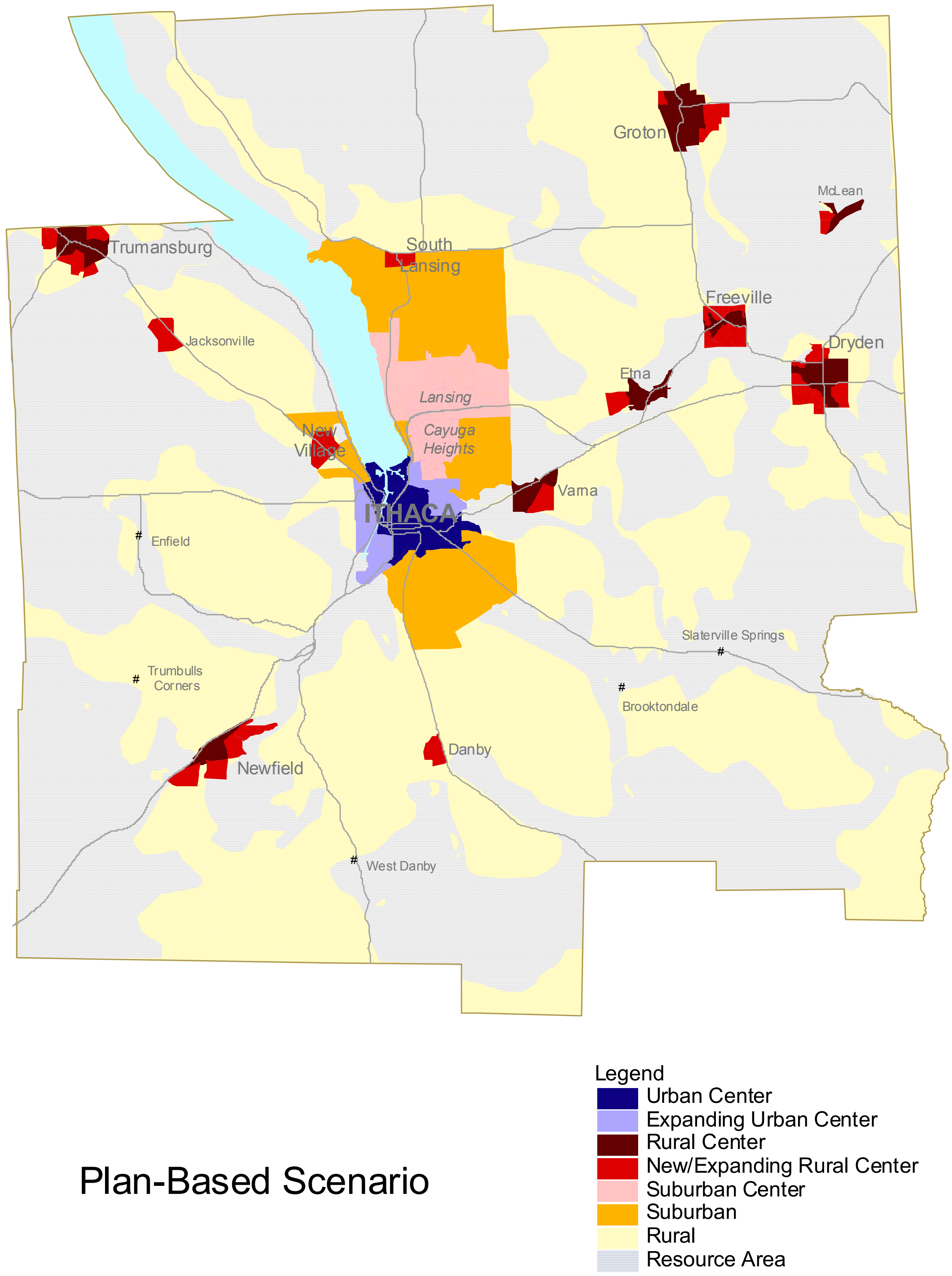


FIGURE 19

Source: Tompkins County Planning Department



Plan-Based Scenario

FIGURE 20

Source: Tompkins County Planning Department

Roads with Significant Increase in Traffic

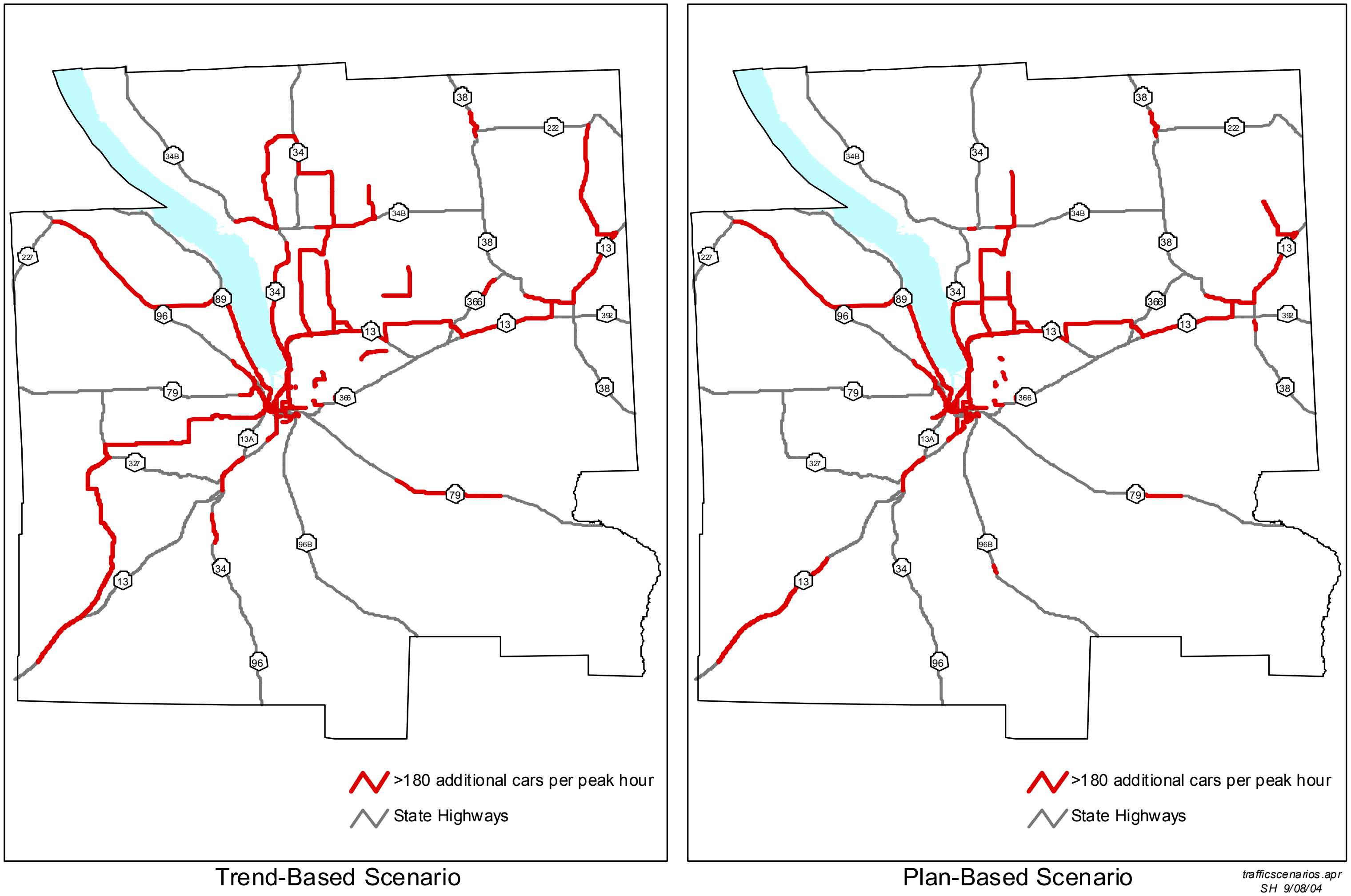


FIGURE 21

Source: Tompkins County Planning Department

TABLE 26

Scenario Analysis
Energy Use and Greenhouse Gas Emmissions

Scenario	Fuel Use			CO2 - Metric Tons Emitted		
	Total Gallons Gas	Total Gallons Diesel	Gallons Total	CO2 from Gas	CO2 from Diesel	CO2 Total
Current	11,122	1,801	12,924	99	16	115
Trend Based	12,959	1,992	14,951	115	18	133
Plan Based	12,725	1,995	14,680	113	18	131

TABLE 27

Scenario Analysis
Air Quality Criteria Emissions
(5:00-6:00 Peak Hour Analysis)

	Avg. Speed (mph)	Total VMT (miles)	Total Emissions (kg) VOC	CO	NOx
2004 Current Conditions					
Urban Arterials	33.12	81,404.49	99.320	2,431.246	116.207
Urban Collectors	33.39	12,463.72	15.028	374.877	16.283
Rural Arterials	47.75	74,921.63	82.264	2,376.626	126.505
Rural Collectors and Local Roads	46.27	45,126.83	49.632	1,426.289	71.086
Total Road Network	160.53	218,413.62	246.24	6,609.038	330.08
2025 Trend-Based Development Pattern					
Urban Arterials	32.32	97,976.13	24.565	1,005.165	18.615
Urban Collectors	33.83	16,871.12	4.089	175.639	3.037
Rural Arterials	47.22	87,530.91	18.868	939.585	19.645
Rural Collectors and Local Roads	46.38	53,775.25	11.682	576.862	11.441
Total Road Network	159.75	262,699.87	59.20	2,697.251	52.74
20205 Planned-Based Development Pattern					
Urban Arterials	32.61	98,338.22	24.541	1,008.993	18.684
Urban Collectors	33.74	16,190.71	3.927	168.544	2.914
Rural Arterials	47.37	85,646.26	18.436	920.074	19.248
Rural Collectors and Local Roads	46.37	51,680.26	11.228	554.360	10.994
Total Road Network	160.09	258,089.17	58.13	2,651.971	51.84
2025 % Difference: Trend VS Planned					
Urban Arterials	0.9%	0.4%	-0.1%	0.4%	0.4%
Urban Collectors	-0.3%	-4.0%	-4.0%	-4.0%	-4.1%
Rural Arterials	0.3%	-2.2%	-2.3%	-2.1%	-2.0%
Rural Collectors and Local Roads	0.0%	-3.9%	-3.9%	-3.9%	-3.9%
Total Road Network	0.2%	-1.8%	-1.8%	-1.7%	-1.7%

TABLE 27 shows the PM peak hour calculations for the criteria emissions: Volatile Organic Compounds (VOC), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO). In summary, all emissions were reduced in the future scenarios when compared to the current. This happened principally due to anticipated technological improvements that were incorporated into the air quality coefficients provided by NYSDOT for LRTP calculations. Once again in this table the Plan-Based scenario compared well with the Trend-Based scenario showing 1.7 % to 1.8% lower emissions.

2. Impacts From Other Initiatives

It is difficult to predict what will be the status and impacts of transportation projects when looking 20 years into the future. However, a review of future project and transportation related activities in Tompkins County identified three specific initiatives that can be expected to help reduce energy consumption and emissions:

- City of Ithaca traffic signal upgrades
- TCAT bus fleet upgrade
- TCAT increased ridership

Each of these initiatives is described below. ITCTC staff, with assistance from NYSDOT, performed an energy and greenhouse gas (CO2) analysis to estimate the impacts of implementation of these initiatives. When possible, figures were calculated for the one-day 5:00pm to 6:00pm Peak Hour to permit comparisons with the scenario analysis presented earlier in this chapter. Annual figures for all initiatives except the bus upgrade refer only to the PM peak hour. Although the data to develop estimates for other time periods is not available, it is expected that benefits above and beyond those indicated in the table would be significant. **TABLE 28** shows the statistics derived from the analysis.

City of Ithaca Traffic Signals Upgrade

The City of Ithaca has begun a project to upgrade 27 traffic signals in the central business district and adjacent areas of the downtown. An additional three to five signals may be added to the system in the future. Automated traffic signals are key components of an effective traffic management system. Automated traffic signals synchronize changing lights to reduce congestion and bottlenecks. In combination with other intelligent transportation system technologies, automated traffic signals can be used to change traffic patterns in response to accidents and other disruptions.

Analysis performed by the City indicates there will be substantial benefits from completion of this project. The City of Ithaca's Final Report to the NY State Energy Office for the Signal Timing Optimization Program (June 1989) reports the results of a series of model runs based on optimizing the signal timing for the existing system, with no hardware upgrades. Travel time, vehicle wear-and-tear and fuel consumption factors were used to develop a cost/benefit analysis. Fuel savings were determined to be 18.81 gallons per hour, a 9.79% reduction from existing conditions at the time. This results in savings of 300 gallons per day based on a 16-hour activity period. The combined morning and afternoon peak hours showed reductions of 59 gallons per day. Multiplying this latter figure time 250 workdays per year results in a savings of 14,750 gallons in fuel consumption.

A follow-up analysis (June 1990) assuming an upgrade in signal hardware showed along with signal timing optimization even more impressive results. Fuel savings of 69.29 gallons per hour were 23% lower than existing conditions at the time. Fuel savings were reported at 69 gallons per hour, or 1,104 gallons in a 16-hour activity period. These savings would total 276,000 gallons per year based on a 250 workdays annually. The peak hour analysis indicated savings of 669 gallons per day from the morning and evening peaks, or 167,250 gallons per year (250 workdays per year).

The City of Ithaca is in the process of upgrading the signal hardware in the downtown street grid as phase 1 of the traffic signal upgrade project. Phases 2 will involve upgrading the traffic signal controllers and Phase 3 will provide for signal interconnections. Once the traffic signal system is upgraded and linked the signal system will achieve its maximum benefits.

TCAT Bus Fleet Upgrade

TCAT has been aggressive in its bus replacement efforts. TCAT management estimates that over the next 10 to 20 years their current fleet of 48 buses will be replaced by more energy efficient hybrid electric models. Such a change would result in fuel savings of approximately 30% from present levels. Current TCAT fuel consumption is approximately 340,000 gallons of diesel per year. Fuel use reductions from the bus fleet upgrade would total approximately 102,000 gallons of diesel fuel per year, and result in estimated fuel consumption levels of 238,000 gallons of diesel per year.

TCAT Increased Ridership

TCAT data indicate that current ridership is 2.8 million passengers per year, approximately 11,000 per day. TCAT officials estimate that ridership will increase by 1 million passengers over the next 20 years to 3.8 million. For this analysis we looked at the impacts of this increase on commuter ridership. In particular the analysis looked at the 5:00pm to 6:00pm period to match the TransCAD travel demand scenario analysis described earlier in this chapter.

Currently, the afternoon peak hour ridership comprises 8.48% of total ridership. This figure was used to estimate future peak ridership based on the estimate of 3.8 million annual riders. Calculations showed future peak hour ridership increases totaled 84,811 riders per year. This resulted in approximately 339 additional peak hour riders per workday during the one-hour analysis period. Multiplying times the model derived average commuter trip length of 11.49 miles, results in a total daily mileage shifted to transit of 3,898 for the afternoon peak hour. Annually, this totals an additional 974,483 miles of travel that use transit during the 5:00pm to 6:00pm period compared to current conditions. It is expected that this shift to transit would easily top 1 million miles of travel if you were add the morning peak period and expanded the evening figures to cover the total 'commuter rush' period.

CONCLUSIONS

In order to meet energy and air quality reporting requirements for the State of New York Energy Plan ITCTC staff used its travel demand model and some off-model techniques to make future projections of energy use and emissions. The projections were made based on potential future development scenarios crafted in cooperation with the Tompkins County Planning Department.

The analysis in this chapter indicates that all criteria pollutant air emissions were reduced in the future scenarios when compared to the current conditions. Both the Plan Based and Trend Based scenarios show increases in vehicle miles traveled and energy used for transportation and greenhouse gas emissions. However, The scenario analysis indicates that the Plan Based scenario will generate less vehicle miles traveled, energy use, greenhouse gas emissions and criteria pollutant emissions than the Trend Based scenario. This will result in reduced stress to the transportation system, improvements in air quality and economic benefits through reduced energy expenditures and other secondary benefits. Additional energy, greenhouse gas and criteria pollutant emissions were identified through the off-model analysis of transportation initiatives that are expected to be implemented over the plan horizon.

Much of the analysis in this chapter relates to the 5:00pm-6:00pm peak hour of vehicle travel, which is a current analysis limitation of the transportation model used. In that sense the quantitative results showing fuel use and emission reductions are conservative. Accounting for the Plan Based scenario efficiencies in the morning peak and at other times of the day is expected would result in greater reduction in fuel use and emissions.

TABLE 28

Analysis of Selected Transportation Initiatives
Energy Use and Greenhouse Gas Emissions

	Fuel Use			CO2 Metric Tons		
	Total Gallons Gas	Total Gallons Diesel	Gallons Total	CO2 from Gas	CO2 from Diesel	CO2 Total
Bus Fleet Upgrade (annual)	0	102,000	102,000	0	934	934
Transit Ridership (one-day PM peak)	193	29	222	2	0.27	2
Transit Ridership (annual PM Peak)	47,885	7,359	55,244	425	67	492
Signal Upgrade (one-day PM Peak)	159,792	9,014	168,806	1,418	83	1,500
Signal Upgrade (annual PM-Peak)	263,691	14,876	278,567	2,340	136	2,476