

TRANSPORTATION

Inventory

Analysis

Plan



Nassau-Suffolk Regional Planning Board



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Gentlemen:

We have the pleasure of submitting this major segment of the Nassau-Suffolk Regional Comprehensive Plan, entitled Transportation.

This report contains the major findings of an intensive fouryear inventory, analysis, and plan development for all modes of transportation in the two-county area. We feel it is a significant contribution in that it relates transportation needs to an overall land use development program including the interrelationship between highway, rail, air, and water modes and facilities.

June 1, 1970

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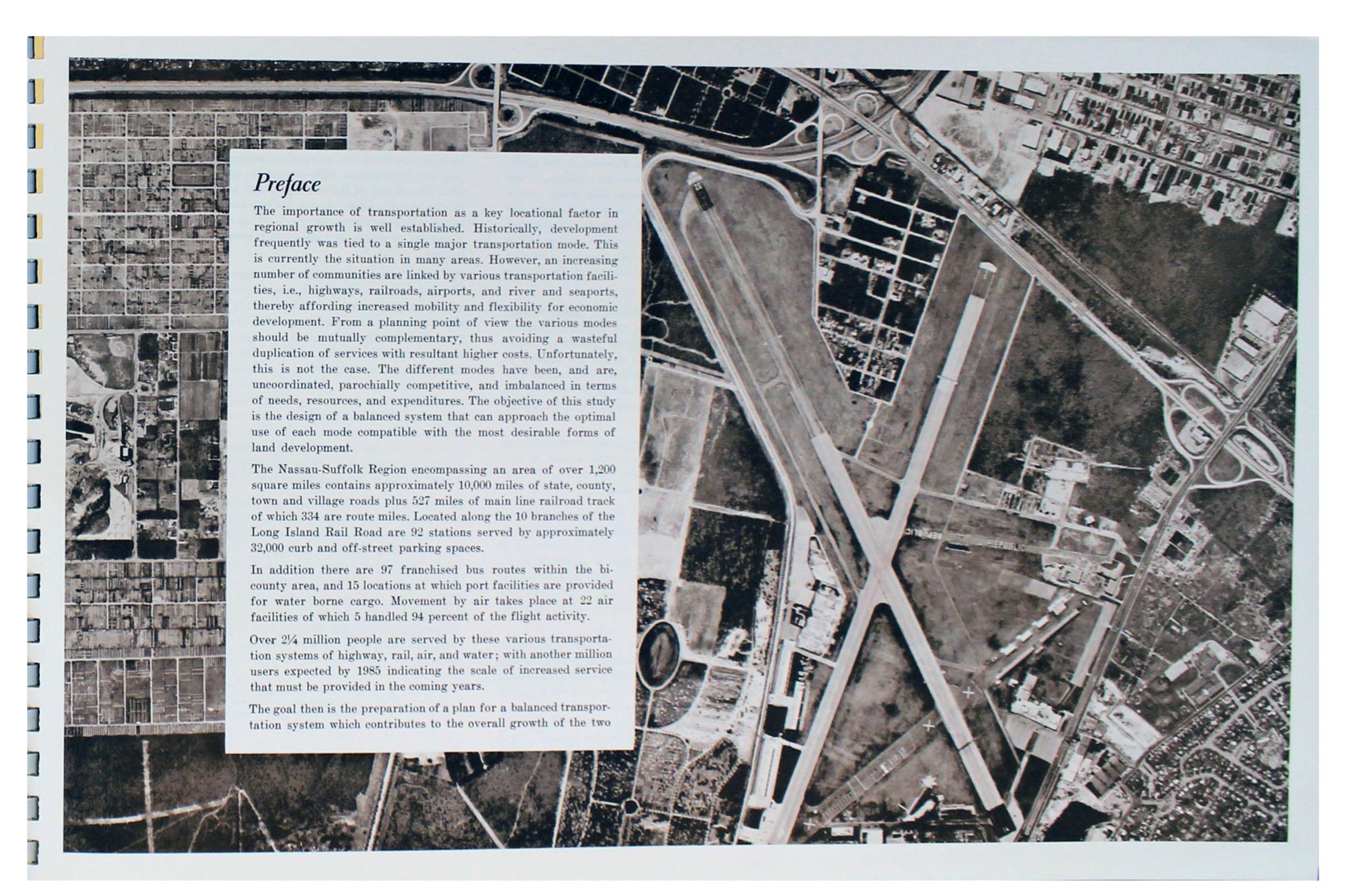
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counties. This requires balance between modes and balance between the transportation system and patterns of land use. The foundation of such a plan requires a thorough knowledge of the existing system—quantity and variety of facilities, levels of services, surplus or deficient capacities to meet existing and projected demands, and the relationships to land uses. This information constitutes Part I of the report.

The major segment of the overall transportation network in Nassau and Suffolk counties—in terms of number of users, vehicles, movements, facilities, and capital investment—is the road system. It has afforded the mobility and locational advantage most responsible for the rapid population and commercial expansion since World War II. What this system is, how it works, and what are its deficiencies are essential pieces of information in the quest for a future, rational, and comprehensive transportation plan.

The Highway section defines and identifies: the nature of the system; the capacity of the existing system based on size, condition and usage as determined by the measurement of traffic volumes, speed and delay studies, central business district parking analyses, intersection capacities, and accident profiles on major highways. Additional information on the three vehicular components that use the system, i.e., automobiles, trucks, and buses are discussed under individual headings for those aspects where discrete qualities exist.

The other modes—rail, air, and water transportation—were similarly inventoried and analyzed in terms of facilities, movements, and cargo handled. Since time-cost relationships are major determinants in the choice of transportation modes, cost-data was examined for the various facilities. These inputs have been utilized in the section dealing with modal split analysis and in traffic assignments of future trips to the transportation network. Available data including prior studies were updated by the staff through the use of field studies, interviews with bus operators, parking studies in selected areas, and travel time runs on the major highway systems. In addition to the field studies, office computation and analysis were performed by the staff where such

data was not available from other sources. However, in the desire to produce a readable document for the broadest audience, it was necessary to omit a great deal of statistical data which contributed to the analytical conclusions. The complete findings are available for examination at the offices of the Board, Hauppauge, New York. For study and presentation purposes, the inventory and initial analysis was prepared on a modal basis, i.e., highway, rail, air, and water transportation. The format of this report follows this pattern.

The inventory and analysis of the transportation system of Nassau and Suffolk counties clearly reveals the need for improvements within each mode and the reordering of priorities in order to achieve a balanced system. If present trends are allowed to continue, the reliance on the use of automobiles will require substantial new highway construction, add additional loads on the existing system, and create conflicts in community compatibility and environmental protection.

Clearly, the necessity for providing improved and expanded mass transportation facilities must be an important aspect in any rational plan for this region. This includes bus, truck, rail, air, and sea modes for passenger and freight usage.

Part II examines the options available to the Region within the time span of the study, 1970-1985. Although the format follows that of Part I, with two exceptions for literary consistency, it must be borne in mind that each modal plan is conceived of as part of the total system. And so, highways, bus transportation, rail, air, and water transportation proposals are presented individually and not aggregated until the end of the report in the composite Transportation Plan—1985.

The two exceptions to the format are the first and last sections of Part II. The first contains a brief discussion of the models and methodology used in developing the projections and assignments for the various plan alternatives. This is included for the technical reader. The last section contains a capsule discussion of innovations in transportation equipment that may prove feasible in the near future. They are meant to alert the reader to some of the creative work in this field. Although most of these more exotic

tools are not within the more direct recommendations of the plan, they are, nevertheless, fully compatible with the objectives of the plan. Should any of the techniques still in the development stage become operational and economically feasible, their usage on Long Island would reinforce the goals of more safe and expeditious movement of people and goods with greater environmental protection.

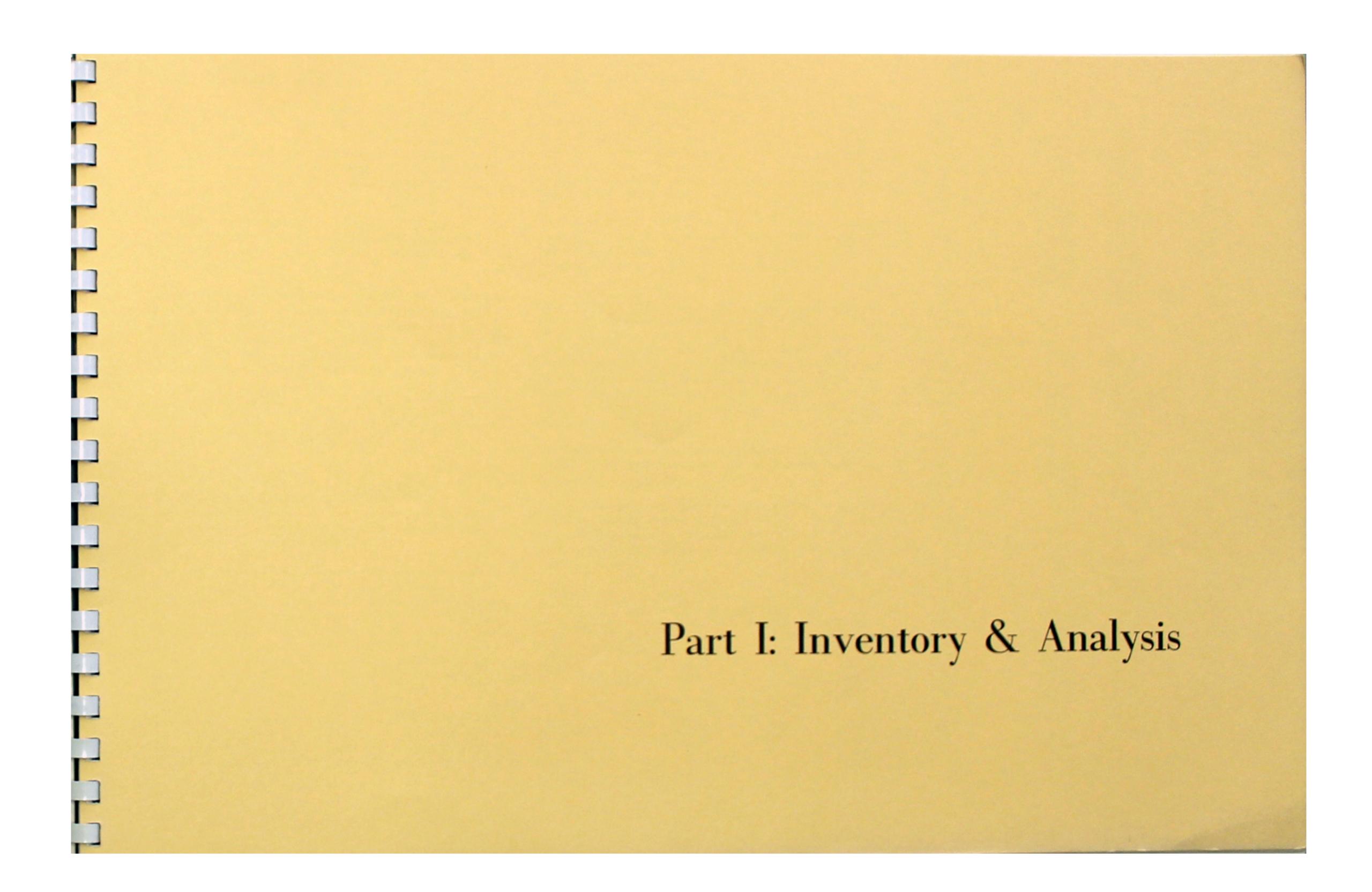
This study received the interested support from many sources. We wish to acknowledge the perseverance of the staff members who worked diligently on a daily basis to carry out the field and office tasks for the past four years. Our Chief Transportation Planner—John Sheridan—deserves commendation for his service as the project director. In addition, the generous cooperation of state, regional, and county agencies must be noted. To avoid the risk of unintentionally omitting recognition of any of the deserving individuals from the New York State Department of Transportation, Office of Planning Coordination, and Metropolitan Transportation Authority, the Tri-State Transportation Commission, and the Regional Plan Association of New York, and the County Departments of Police, Franchises, and Public Works—we say thanks to our anonymous friends for aiding the study.

In particular, we acknowledge our debt to Mr. Ned Whitlock and Mr. Bruno Wildermuth of Wilbur Smith Associates for their valuable consulting services, and to Mr. Ronald Siegel, Assistant Executive Vice President of the New York State University at Stony Brook for making possible the services of Mr. William Graves and Mr. Walter F. Dunne of the Technical Assistance Office. They made available the computer facilities of the University and worked in conjunction with our staff and consultants in the development and testing of the transportation models. The first section of Part II on models and methodology is a brief summary of their valued contribution to the Transportation Plan.

June 26, 1970

L. E. K.

It is projected by 1985 that over 2 million cars will be registered in the two counties, and that rider density per car will decrease from 2.5 persons per car in 1966 to 2.0 persons, and auto trips per person per day will increase from 1.79 to 1.83 over the same period.



The Highway System

Automobile Ownership Trends - The automobile, by far the primary mode of transportation for most of the Region's population, is the principal mode of travel for about two-thirds of the Region's journey-to-work trips and is the secondary mode for about 70 percent of those who use the railroad for journey to and from work. For inter and intra-county work trips the percentage of automobile use ranges from 91 percent to 98 percent.

The dependence upon the automobile is further evidenced by the fact that only about 8 percent of the Region's households are without automobiles and 30 percent of the Region's families have two or more autos.1

As of January 1, 1966 the Region's population of about 2,350,000 persons had registered approximately 944,000 passenger vehicles for a ratio of about 2.5 persons per auto as compared with the 1951 ratio of slightly more than 3.0 persons per auto. During this period of 1951 to 1966 the Region's population grew by 127 percent while automobile registration increased 177 percent.

Table I shows the number of automobiles available per housing unit based on the 1960 census and lists the number of one, two and three or more car households numerically and by percentage for each county and for the Region as a whole.

Table II lists the population, number of passenger vehicles and population per passenger vehicle for Nassau and Suffolk and for the Nassau-Suffolk Region from 1951 through 1966. Trend lines were fitted to the data and used to project population and passenger automobiles from 1970-1985 (Table III) and total motor vehicle registrations 1970-1985 (Table IV).

It should be noted here that these are projections based on current trends which could be affected by changes in income, land use, availability of public transit and other factors, and are intended to show the possible results of a continuation of present trends. Transportation Plan proposals take into account the effect of such trends as well as alternative solutions based on a directed effort toward the increased use of mass transit facilities. However, the Region is faced with a continued increase in automobile usage on the already overburdened highway system.

Elements of the Highway Network — The State Highway System, e.g., Long Island Expressway and major arterial roads, is intended to serve the through movement of traffic. The original State concept of providing service to abutting land use is outmoded and is in conflict with the main purpose of the State Highway Network. This premise, while simple to expound, is difficult to enforce. Except for limited access highways where abutting land use does not interfere with traffic movement, the state does not control land use along its highways. Such control is exercised by the cities, towns, and villages through which the highways pass. As a result many of the major highways in the two counties no longer are able to serve as arterial routes because of the intense commercial development which has occurred along them.

The County Highway Network is intended to provide access to the primary system of highways and to connect smaller communities and areas of traffic generation. Service to abutting properties, except in the case of limited access roads, is also a County function.

Town Highway Networks are primarily intended to provide access to abutting properties. These networks comprise two-thirds of the total highway mileage in the two counties. Discussion of town roads has been excluded from this study except in those instances in which the particular road is performing a major street function or where additional routes are needed to provide continuity to the highway network. This applies mainly to Suffolk County. In Nassau County many major roads are under the jurisdiction of the state or county.

The Highway Classification Map which shows the major highways included in this study. The legend indicates the roads by jurisdition; state, county or town.

In the Bi-County area there are approximately 583 miles of state highways, 756 miles of county highways and 8,220 miles of town, city and village roads. The town roads comprise about 66 percent of the total miles of road. The state and county systems account for about 15 percent.

TABLE I AUTOMOBILES AVAILABLE (Per Occupied Housing Unit - 1960)

Autos Available	Nassau	Suffolk	Region
One	214,349	112,663	327,012
Two	98,114	41,713	139,827
Three or More	9,446	4,386	13,832
None	26,811	14,650	41,461
Total Units	348,720	172,412	522,132

AUTOMOBILES AVAILABLE

	(Percentage Break	down)	
Autos Available	Nassau	Suffolk	Regio
One	61.5%	65.0%	62.65
Two	28.1	24.1	26.8
Three	2.7	2.5	2.7
None	7.7	8.4	7.9
SOURCE: U. S. Census	1960		

TABLE II PASSENGER AUTOMOBILE REGISTRATIONS and POPULATION A. NASSAU COUNTY

Year (as of Jan. 1)	Population	Passenger Vehicles	Population
1951	740,240		Passenger Veh.
1952	830,640	238,987	3.10
1953	889,000	274,613	3.02
1954	966,850	297,432	2.99
1955	1,032,460	332,593 367,354	2.91
1956	1,037,120	401,556	2.81
1957	1,162,556	432,508	2.71
1958	1,225,227	444,978	2.69
1959	1,261,834	465,778	2.75 2.71
1960	1,292,415	489,312	2.64
1961	1,323,705	497,215	2.66
1962	1,346,398	511,468	2.63
1963	1,372,630	544,086	2.52
1964	1,391,544	551,531	2.52
1965	1,392,967	581,423	2.40
1966	1,410,429	583,149	2.42
% change			
1951-1966;	+90.5%	+144.0%	
	K COUNTY		
1951	295,950	101,605	2.91
1952	322,230	112,594	2.86
1953	351,550	123,571	2.84
1954	379,580	140,344	2.70
1955	412,090	155,898	2.64
1956	452,090	178,381	2.53
1957	516,132	198,086	2.60
1958	558,376	205,016	2.72
1959	586,687	219,714	2.67
1960	653,662	239,648	2.73
1961	697,462	251,713	2.77
1962	738,506	271,071	2.72
1963	769,460	295,779	2.60
1964	829,278	315,948	2.62
1965	892,932	339,946	2.63
1966	938,846	360,736	2.60
% change 1951-1966:	217.2%	+ 255.0%	
1951	J-SUFFOLK REGION 1,036,190	340,592	3.04
1952	1,152,870	387,207	2.98
1953	1,240,550	421,003	2.95
1954	1,346,432	472,937	2.85
1955	1,444,550	523,252	2.76
1956	1,539,210	579,937	2.65
1957	1,678,688	630,594	2.66
1958	1,783,603	649,994	2.74
1959	1,848,521	685,492	2.70
1960	1,946,077	728,960	2.67
1961	2,021,167	748,928	2.70
1962	2,084,904	782,539	2.66
1963	2,142,090	839,845	2.55
1964	2,220,822	867,479	2.56
1965	2,285,899	921,369	2.48
1966	2,349,275	943,885	2.49
% change			
1951-1966	+126.7%	+177.1%	
1967	2,405,000		
	WI NEED .	M. W.L.L	1

Source: Passenger vehicles: N.Y.S. Dept. of Motor Vehicle registration. Population: LILCO and U.S. Census. Census figures are adjusted to Jan 1 basis to be compatiable with LILCO (see Appendix, Part B)

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¹ Source, U.S. Census - 1960.

PROJECTED POPULATION and AUTOMOBILES—1970-1985

	Nas	sau-Suffolk Re	gion (000's)		
	Ratio	Projected High	Population Low	Projected High	Automobiles Low
1970	2.34	2,605	2,592	1,113	1,108
1975	2.18	2,969	2,893	1,362	1,327
1980	2.01	3,391	3,221	1,687	1,602
1985	1.85	3,825	3,548	2,068	1,918
% change		+46.8	+36.9	+85.8	+73.1

PROJECTED TOTAL MOTOR VEHICLES (000's) 1970-1985

	Nassau-Suffolk	Region		
	Passenge	r Vehicles	Total Motor	
Year	High	Low	High	Low
1970	1,113	1,108	1,248	1,242
1975	1,362	1,327	1,527	1,488
1980	1,687	1,602	1,891	1,796
1985	2,068	1,918	2,318	2,150
% change	+85.8	+73.1	+84.9	+73.1

Traffic Volumes — Within any given period of time, there is a limited number of automobiles which can pass over a highway section. The ratio of the number of vehicles using that section compared with the total possible capacity provides a measure of the road's adequacy.

Traffic volume counts are usually related to an average day of the year and expressed as an A.A.D.T. which means, simply, annual average daily traffic. For any given day, traffic volumes may vary considerably from the average. Long term counts at permanent counting stations provide a record of hourly, daily, and monthly variations in traffic which can be applied to shorter counts at other locations in order to estimate the annual average daily traffic.

Traffic volume counts used herein were obtained from the New York State Department of Transportation, the Nassau County Traffic Department, the Suffolk County Police Department and several other sources.

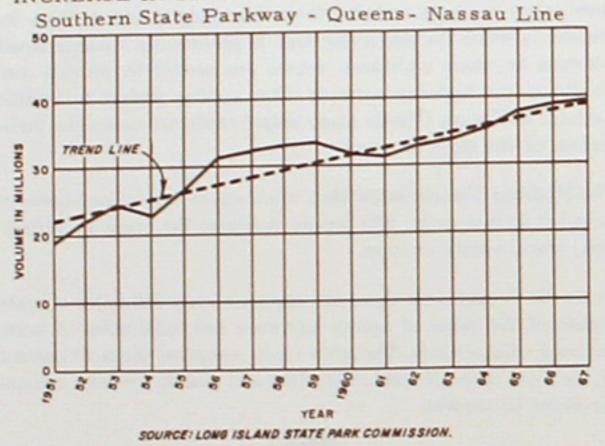
Traffic volume data were generally complete for Nassau County. In Suffolk County, however, no regular counting program exists on the county or town levels. The New York State Department of Transportation conducted a number of volume counts on county roads but some gaps exist. These omissions were filled, in part, with Suffolk County Police Department data and with local counts by the towns or their consultants. In general, the estimates of traffic volume used in this analysis are conservative, so that the capacity-volume relationships developed later in this report will also present a conservative estimate of existing conditions.

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In the Nassau-Suffolk Region east-west traffic crossing the Queens-Nassau line on eight selected major routes increased 11 percent from 1963 to 1967. As illustrated on the Corridor Volume Map following page 6, over 560,000 vehicles crossed the Queens-Nassau line daily during 1967 in three east-west corridors. The bulk of this traffic, approximately 57 percent, was carried on three limited access highways, the Long Island Expressway, the Northern State Parkway and the Southern State Parkway. Each of these facilities has far exceeded its design capacity and all are now operating at low peak-hour levels of service at their westerly ends.

Figure 1 shows the traffic increase on Southern State Parkway for the years 1951 through 1967 at the Queens-Nassau line and graphically illustrates the continuing growth in traffic at the west-erly end of the Region.

INCREASE IN TRAFFIC VOLUME 1951-1965



At the Nassau-Suffolk line approximately 340,000 vehicles crossed daily during 1967. Here again, the greater proportion of this volume, about 57 percent was carried on the Long Island Expressway and on Northern and Southern State Parkways. The Long Island Expressway has reached its design capacity at the Nassau-Suffolk line, having more than doubled its 1963 volume. Total east-west traffic crossing the Nassau-Suffolk line on nine major routes increased by 33 percent since 1963.

FIG. 1

Thus far volume counts have been expressed as average daily conditions. Actually, traffic volumes vary considerably by the hour of

the day, by the day of the week, and by the month of the year. It is these variations which generally create the problems of congestion on the highways. Very few roads are continuously overloaded. Traffic during the week usually exhibits morning and evening peaks reflecting the concentration of journey-to-work trips. Figure 2 is a graph of average hourly variations in traffic at 30 locations in the Nassau-Suffolk Region. Peak traffic volumes occur from 7:00 A.M. to 9:00 A.M. in the morning and from 4:00 P.M. to 6:00 P.M. in the evening. The highest average peak hour of 8 percent occurred between 5:00 P.M. and 6:00 P.M. in the evening. Roads which are highly commuter oriented have peak hour volumes reaching 10 percent. Roads which are service, business or shopper oriented have peak volumes less than 8 percent but have relatively sustained flows throughout the business day. Figure 3 is a graph of hourly variations in weekday traffic on the Long Island Expressway at the Queens-Nassau line. Morning and evening peaks are quite pronounced with the 5:00 P.M. to 6:00 P.M. peak hour carrying about 7.2 percent of the daily volume. Traffic flow is fairly continuous throughout the day on Saturday.

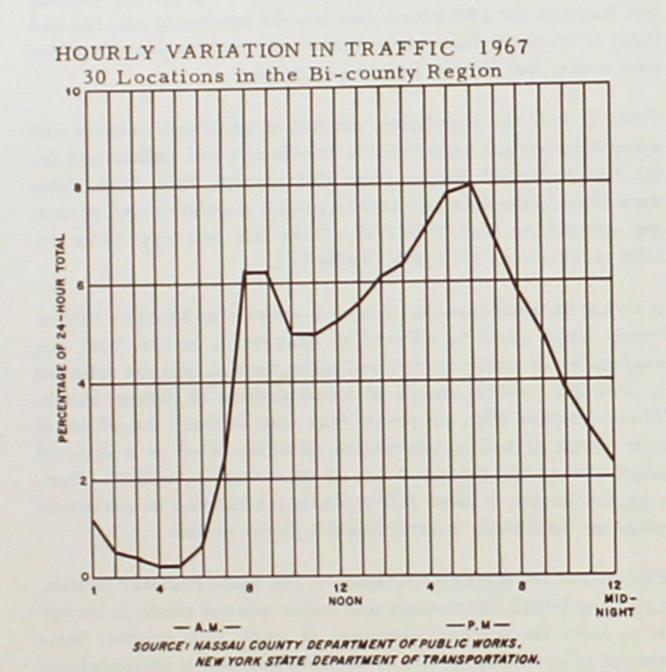
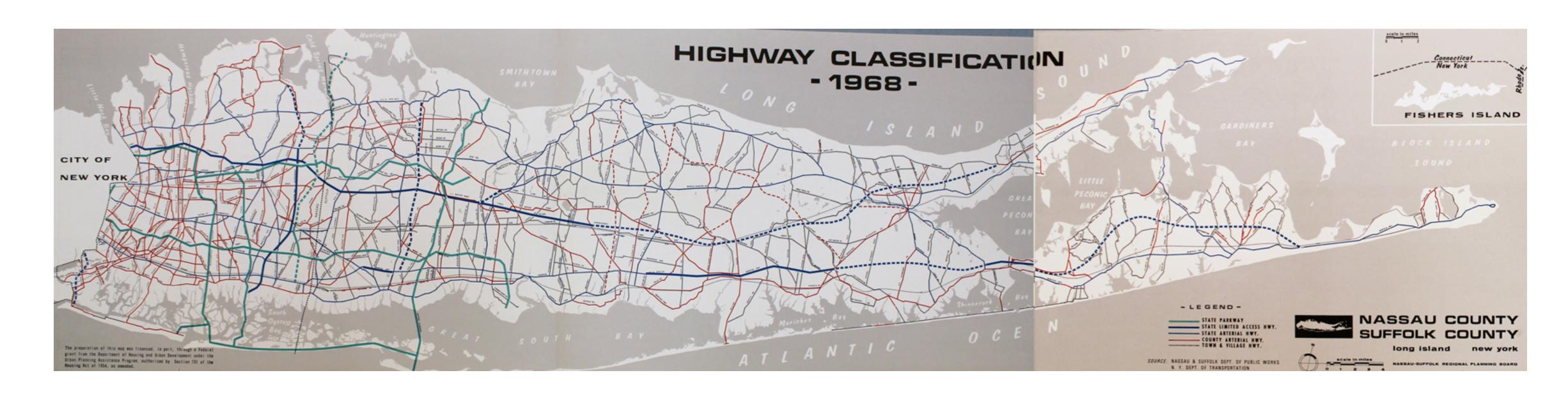
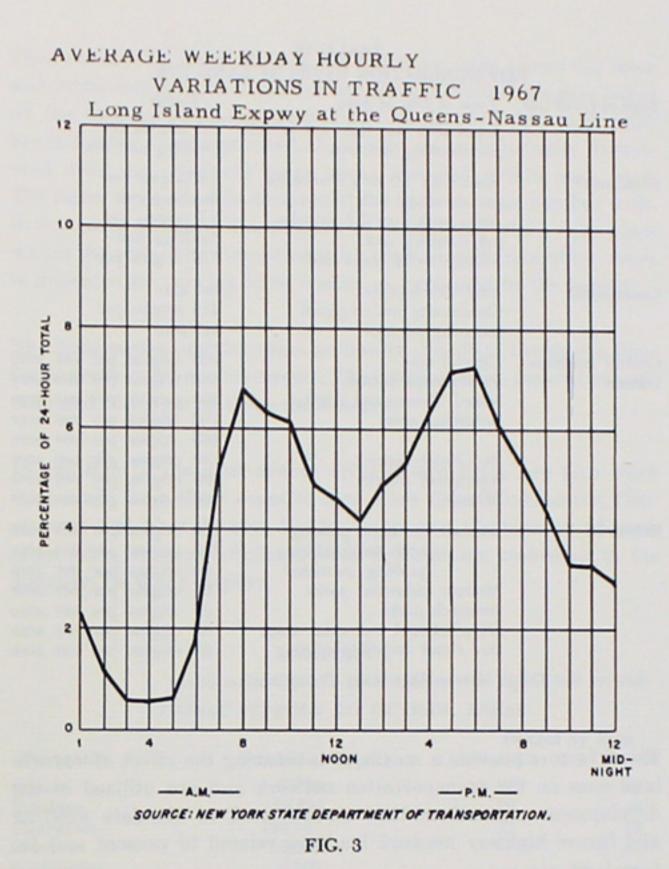


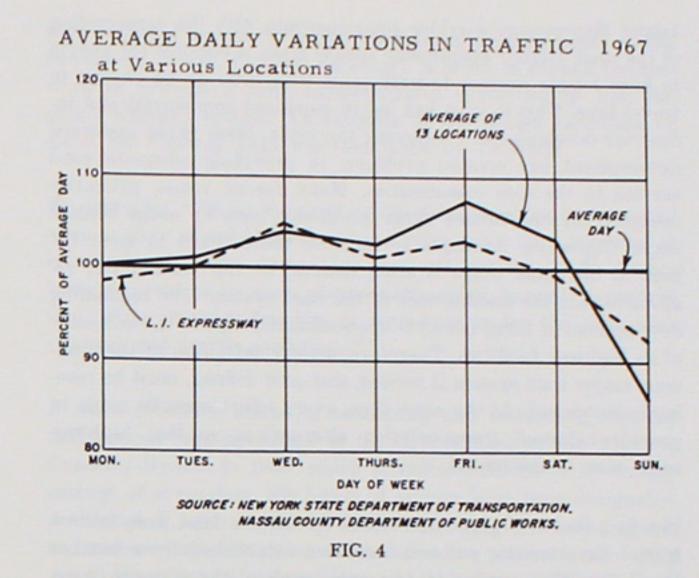
FIG. 2



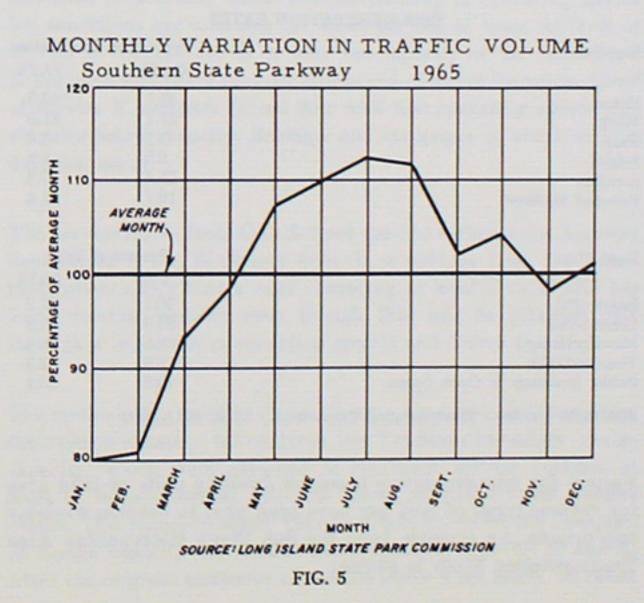


The analysis of average daily variations in traffic at 13 locations on major highways in the Region indicated that Friday volumes were the highest for the week. Figure 4 shows the average daily variations in traffic at these locations by percentage of the average day of the week. In addition, the average daily variations at two locations on the Long Island Expressway are shown, indicating peaking is less pronounced than at the other locations, demonstrating a fairly even flow throughout the week with the greatest deviation from the average occurring on Sunday.

In the five eastern towns of Suffolk County the average of 13 count locations indicates that summer weekday traffic is about 140 percent of the average annual daily traffic; summer Saturday traffic is over 200 percent and summer Sunday traffic is about 150 percent of the annual average daily traffic. The result is that many roads which are entirely adequate in capacity for 75 percent of the year may be seriously overloaded for the remaining 25 percent. In Nas-



sau and western Suffolk County, however, the seasonal variations are not nearly as severe as they are in the eastern towns with the exception of the parkway system. To illustrate this, Figure 5 shows the monthly variation in traffic on Southern State Parkway at the toll booth for 1965. Note that the January volume is about 80 per-



cent of the average while the July volume is about 113 percent of the average, a variation of 33 percent from January to July. In contrast, Figure 6 shows the average monthly variation at 20 locations on major roads in the Bi-County Region. The January volume is about 90 percent of the average and the June volume is 110 percent, a variation of 20 percent between the high and low months. The graphs indicate average conditions during the year. During the summer months higher weekend volumes occur especially on those routes serving recreational facilities. Traffic volumes on parkway sections servicing the state parks and beaches are many times the average for the year.

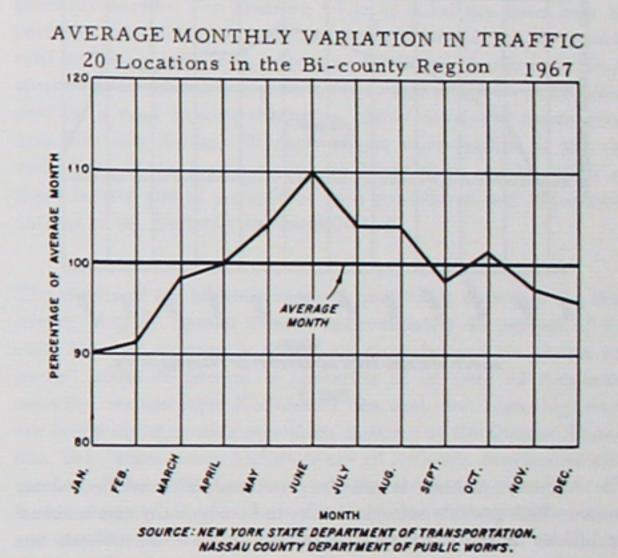


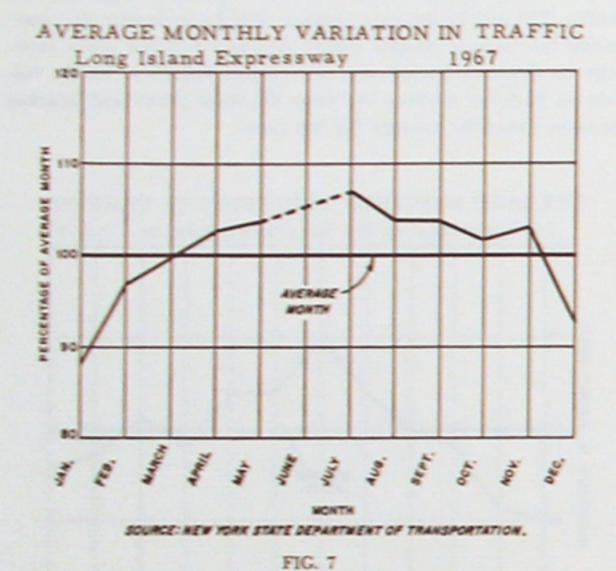
FIG. 6

The Long Island Expressway, too, exhibits less extreme monthly variations at the Queens-Nassau line than the Southern State Parkway, as shown on Figure 7. Here the difference between the low volume month of January and the high volume month of July is 19 percent.

Faced with the problem of hourly, daily, and monthly variations, the highway planner must select a design volume that can be economically justified. Experience has indicated that the volume which occurs at about the 30th highest hour of the year is the one which provides the greatest economy of construction in relation to traffic service. This is the design hour used by the New York

Page T—Three

State Department of Transportation. This should not be a hard and fast design criteria. In urban areas highway facilities may be designed to accommodate the 10th highest hour while the most economical design hour for a recreational route might approach the 50th or 100th hour.



The highway planner is vitally concerned with traffic volume counts which provide information as to hourly, daily and seasonal variations on the highway system and, in addition, indicate the relative use of each facility. For these reasons, regular traffic counting programs, such as are conducted by the New York State Department of Transportation and by the Nassau County Traffic Department should be extended to all important routes in the Bi-County Region. Ultimately, a systematic counting program for Suffolk County as part of an overall traffic engineering and highway planning function should be instituted.

Traffic Generation — Traffic volumes occur in response to a desire for movement of people and goods between points of origins and ultimate destinations and so on. The patterns of land use development create and generate travel demands. Conversely, the pattern of land use development is influenced by the adequacy of the transportation facilities serving the area. An example of this is the continuing easterly development which has occurred along the Long

Island Expressway corridor commensurate with the construction of the road. Higher expressway speeds make it possible for people to have longer journey-to-work trips with little or no change in travel time. This in turn has led to increased commercial and industrial development, continuing the cycle. Such rapid eastward development has created problems in providing adequate road service to the new communities. Many feeder roads, primarily designed for low volume rural conditions, have by usage become major highways. Attempts to improve these roads to meet the need of increased usage is often resisted by the communities responsible for the obsolescence of the road system. The continuing development of Long Island is unquestionably tied to the adequacy of its highway facilities. Therefore, a clear definition of the minimum major road system is needed, and once defined, must be resolutely developed. At the same time, every effort must be made to provide balanced transportation alternatives so that highway needs may be minimized.

The fact that trip generation rates by various land uses follows fairly characteristic patterns has been established by a number of studies. The results of two such studies, the Chicago Area Transportation Survey (CATS) and the Pittsburgh Area Survey (PATS) indicating the percentage of trip by land use and purpose are listed as follows:

TABLE V
TRIP GENERATION RATES

Purpose

Percent of Destinations

. arpor	CATS	PATS
		Inio
Home	45.1	43.3
Work	21.1	21.0
Shop	5.7	8.5
School	2.0	5.8
Soc-Rec-	15.4	9.2
Personal Business	10.7	12.2
Land Use	Percent	of Trips
	CATS	PATS
Residential	56.1	52.2
Commercial	23.9	26.9
Manufacturing	7.6	5.4
Transportation	2.3	2.3
Public Buildings & Open Space	10.2	13.2

SOURCE: Tri-State Transportation Commission, I.T.R. 4011-1320

Factors for trip generation based on dwelling units or land area for various types of land use have been used to develop weekday trip origins. An example from the San Diego Metropolitan Area Transportation Study is shown:

TABLE VI TRIP GENERATION RATES BY LAND USE

Type of Land Use	Type of Use or Area	Factor
	Areas with less than 1.0 vehicle per dwelling unit No.	2.7 origins per dwelling unit No.
Residential	Area with 1.0 to 1.5 vehicles per dwelling unit Areas with over 1.5 vehicles per dwelling unit Mature trend areas and	3.2 origins per dwelling unit 3.7 origins per dwelling unit 215 origins per
Commercial	strip development Community and regional shopping centers	net acre 275 origins per net acre
Central Business District	Central core Professional district Mixed commercial district Industrial areas	700 origins per net acre 550 origins per net acre 250 origins per net acre 180 origins per net acre
	Bay Front district Apartment district Schools	105 origins per net acre 150 origins per net acre 200 origins per net acre 60 origins per net acre
Industrial	Aircraft: without parking with some parking parking provided Modern industrial parks Research parks	180 origins per net acre 110 origins per net acre 60 origins per net acre 65 origins per net acre 35 origins per net acre
	Distributional industrial areas Bay Front and Shipbuilding	85 origins per net acre 25 origins per net acre

Source: San Diego Metropolitan Area Transportation Study

These factors provide a means of estimating the effect of various land uses on the transportation network and are utilized in the development of mathematical models used to simulate existing and future highway network loadings related to present and future land use.

Journey to and from work trips make the most serious impact on the highway network. These trips are generally concentrated over a short period of time. For example, the Long Island Journey to Work Report² stated that 45% of the Nassau-Suffolk workers arrive at work during the 8:00 a.m. to 9:00 a.m. period and 85% arrive during the three hour period of 7:00 a.m. to 10:00 a.m. For those who work in Manhattan, 59% arrive at work during the 8:00 am. to 9:00 a.m. period and 92% arrive during the three hour period of 7:00 a.m. to 10:00 a.m. In the evening about 45% of Nassau-Suffolk workers leave work between 4:30 p.m. and 5:30 p.m. Approximately 68% leave between 4:00 p.m. and 6:00 p.m. Therefore transportation facilities all experience peak loading over relatively short periods of time.

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² Long Island Journey-To-Work Report, 1963 N.Y. State Office of Transportation.

The Journey-To-Work Map on the following page shows the inter and intra-county work trips for the Nassau-Suffolk Region based on the findings of the Journey-To-Work Report. Although trips are indicated as concentrated at a point, they are actually distributed over the relatively large areas included within each zone. The letter in each circle designated the zone and the number within the circle indicates the number of work trips which take place within the zone. The volume of work trips to and from other zones is indicated by varying band widths as explained in the legend.

The lines connecting the zones generally illustrate the desire lines for journey-to-work movements. They indicate the general magnitude and direction of these movements.

In addition to the inter-county trips shown there are also work trips made from these zones to New York City, Westchester, Connecticut and New Jersey. Listed below are the number of such trips from Nassau-Suffolk to these destinations according to the Journey-To-Work Report.

JOURNEY-TO-WORK
NASSAU-SUFFOLK TO OUTSIDE AREAS

		Percent by Auto		
Destination	Number of Trips	Nassau	Suffolk	
Queens	46,739	85	84	
Brooklyn	29,625	72	49	
Manhattan	123,757	20	12	
Bronx	4,609	_	_	
Westchester	2,369	-	=	
Connecticut	675	-	-	
New Jersey	2,490	_		
Other Places	6,498	80	82	
Not Specified	12,597	this was -	-	

Source: L. I. Journey-To-Work Report, 1963, N. Y. S. Office of Transportation

The total number of work trips originating in the Bi-County area was 510,456, 56 percent of which were made within the two counties. The automobile was by far the principal mode of travel except for Manhattan trips made from Nassau and Manhattan and Brooklyn trips from Suffolk.

Capacity Analysis — In 1963 the Tri-State Transportation Commission conducted a field study of a large number of streets and highways for the purpose of estimating capacities and operating levels. This study included collection of data on road width, posted speed limits, average speeds, signals per mile, volume, general land use character and other necessary data. In 1966 similar data

were collected by the Bi-County staff for additional roads in the two-county region. This was necessary in order to expand the network to provide a more comprehensive evaluation of this Region's highway system. An estimate of the design capacities of all of the highway links was then made by Tri-State.

By definition, "design capacity or practical capacity, is the maximum number of vehicles that pass a given point on a roadway or in a designated lane during one hour without the traffic density being so great as to cause unreasonable delay, hazard, or restriction to the driver's freedom to maneuver under the prevailing roadway and traffic conditions".

A more definitive means of measuring and estimating highway performance was developed in the later edition of the Highway Capacity Manual in 1965' which introduced the 'level of service' concept of evaluation. Six levels of service have been designated. A through F, each of which includes a range of operating speeds and volume/capacity ratios which define the service level. Levels A and B are generally descriptive of stable flow conditions. Level C is still in the zone of stable flow but most drivers are restricted in their freedom to select their own speed, to change lanes or to pass. This level is generally equivalent to urban design capacity in terms of service volumes. At level D operating conditions approach unstable flow. Fluctuations in volume and temporary restrictions to flow may cause substantial drop in operating speeds but conditions are tolerable for short periods of time. At level of service E volumes are at or near the capacity of the road. Flow is unstable and there may be stoppages of short duration. Level of service F indicates forced flow with low operating speeds and volumes below capacity. Backups and stoppages of short or long duration occur.

The service levels from C to E were used to estimate the highway deficiencies in the Bi-County area. It is obvious from the definitions given above that a road operating at level C or D still has some reserve capacity even though this will be attained only through a reduction in operating speeds and driver freedom.

The methodology used in the evaluation consisted of determining the volume-capacity ratios from the Tri-State inventory design capacity, which were assumed to represent service volumes at level C, in conjunction with the latest available traffic volume counts. The degree to which volume counts exceeded the designated design capacity determined the evaluation of levels D and E. After the original estimates of service levels were made, all roads

operating at or beyond design capacity were remeasured in the field to determine if widenings had occurred since the 1963 inventory. Where roads had been widened, a new estimate of design capacity was made and service levels re-evaluated.

The strict definition as to what operating speeds and conditions are tolerable or intolerable is, of course, subject to subjective determination. Assuming, however, that the point at which most people would consider these conditions as intolerable can be reasonably estimated there remains the fact that for various highway types and conditions of traffic flow different standards are generally applied. For example, while 30 miles per hour may be perfectly satisfactory for certain roads it would not be considered so for an expressway designed for 60 or 70 miles per hour speed. On the other hand, even lower speeds might be quite tolerable for a road passing through a highly developed commercial area. For this reason, different criteria were applied to the various links in the highway network based upon consideration of these factors and in accordance with procedures and recommendations of the Highway Research Board.

The results of the highway capacity analysis is shown on the Deficiency Map. In Nassau County approximately 60 percent of the state highway mileage is operating at or beyond its design capacity. About 37 percent is operating at or near its maximum capacity, service level E. Most of the east-west state highways are operating at or near maximum capacity at the Queens-Nassau line. The limited access highways are all seriously overloaded with the Long Island Expressway carrying about 180 percent of its design capacity, the Southern State Parkway about 130 percent and the Northern State Parkway about 125 percent. Similarly, Northern Boulevard, Hempstead Turnpike and Sunrise Highway are also operating at level of service E at their westerly ends. Other roads in Nassau County operating at level E include portions of Bayview Avenue, Middle Neck Road, Glen Cove Road, South Oyster Bay Road, Woodbury Road, Old Country Road, Stewart Avenue, Central Avenue, Tulip Avenue, Peninsula Boulevard, Newbridge Road, Hicksville Road, Front Street, Broadway, Rockaway Turnpike, East Rockaway Road, Long Beach Road, Bellmore Avenue and Merrick Road as indicated on the deficiency

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³ Highway Capacity Manual, U. S. Dept. of Commerce, Bureau of Public Roads, 1950.

⁴ Highway Capacity Manual, 1965—Highway Research Board, Special Report 87 National Academy of Sciences, National Research Council, Publication 1328.

map. The Nassau County road network has approximately 33 percent of its system operating beyond design capacity of which 16 percent are operating at level of service E.

In Suffolk County about 43 percent of the state highway system is operating at or beyond its design capacity. Approximately 25 percent is operating at or near its maximum capacity service level E. A substantial portion of this percentage includes Sunrise Highway which will be improved to limited access standards from Route 109 to Phyllis Drive. Other state highways in the level E category are portions of Route 110, Montauk Highway, Route 111 and Nesconset Highway.

Approximately 16 percent of the road mileage in the Suffolk County highway network is operating at or beyond design capacity of which 12 percent is at level of service E. Included in the latter group are portions of Pulaski Road, Elwood Road, Commack Road, Wellwood Avenue, Straight Path and Woodbury-Pulaski Road. The greatest restriction to traffic flow occurs in both counties on the east-west routes, all of which have large segments operating either at level D or E.

Conditions of deteriorated flow noted occur now on the limited access facilities but there is still some advantage in terms of average travel time in using the Long Island Expressway and Northern State Parkway in western Nassau County as determined by peak hour speed and delay runs. Southern State Parkway, however, appears to offer little or no travel time advantage in the western part of Nassau County during peak hours. In fact, travel time along the four major east-west highways in the southern corridor, Hempstead Turnpike, Southern State Parkway, Merrick Road, and Sunrise Highway, is about equal.

Similar conditions such as exist at the Queens-Nassau line could be expected at the Nassau-Suffolk line within the next 15 years if current trends continue.

Increased congestion will be reflected in higher travel costs for the motorist. For the purpose of estimating such costs, the Tri-State Transportation Commission uses a time cost of 2.5 cents per minute and fixed costs, representing accident and operating costs, of 3.5 cents per mile. Using these figures the average travel cost per mile for the Long Island Expressway in 1963 was 6 cents per mile from western Nassau to Route 110 in Suffolk as compared with 9 cents per mile for Jericho Turnpike. In 1967 the average peak hour travel time cost for the Long Island Expressway was 7 cents per mile and Jericho Turnpike was still 9 cents per mile. Obviously as travel times on limited access facilities such as the Long Island Expressway increase, the difference between travel time costs for these facilities compared with non-limited access highways, such as Jericho Turnpike, will continue to decrease.

Intersection Capacities - In more densely developed areas the capacity of a street or highway is controlled to a large extent by the number of intersections and the relative volumes of the cross street traffic. The highway capacity analysis made a general assessment of the physical capacity of each highway link, but quite frequently, a greater restraint to traffic flow was due to major intersections than by the factors considered in the analysis. To illustrate this, the Highway Deficiency Map indicates sections of Sunrise Highway, Merrick Road and Jericho Turnpike in Nassau County as operating at satisfactory levels of service. Actually, however, traffic flow is substantially constrained by a number of intersections which reduce the capacity of the road at the intersection approaches and therefore is the controlling factor of capacity for the road section. In these cases the solution to the problem may lie in intersection improvements such as approach widenings, separate turning lanes, signal coordination, removal of parking grade separation and so on rather than a total widening of the highway.

In order to estimate the number of intersections which were operating at capacity, the staff obtained field measurements of over 400 major intersections in the Bi-County region. Data was collected indicating approach widths, area type, separate turning lanes and turning signals, and whether or not parking in the approaches was permitted. The capacities of these intersection approaches were then calculated in accordance with the procedures outlined in the 1965 Highway Capacity Manual and using the latest available traffic volume counts.

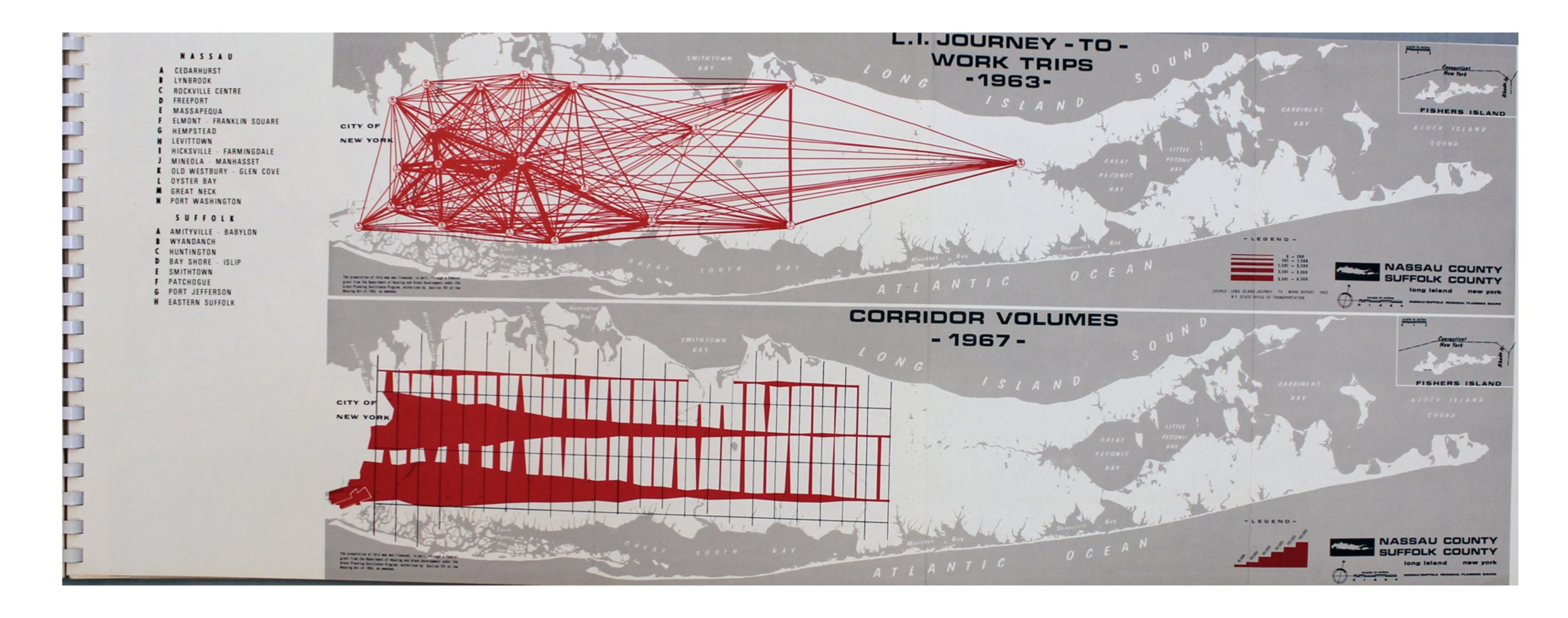
In computing one hour approach volumes it was assumed that peak hour volume was 10 percent of the average daily volume and that 60 percent of the peak hour volume occurred in the direction of heavier flow. The G/C ratio, that is the ratio of green signal indication to total cycle time, was estimated.

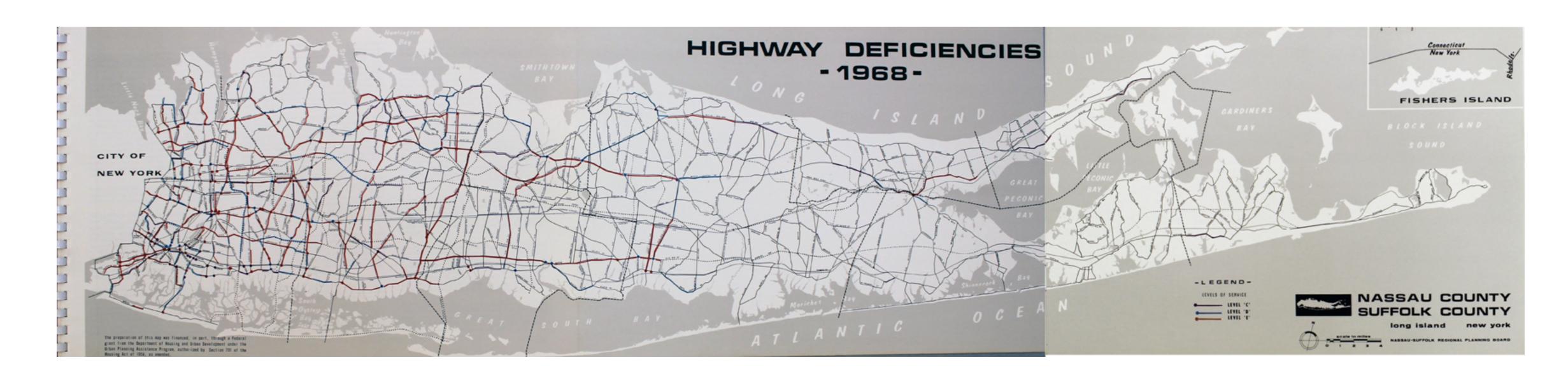
For each intersection the individual approaches were analyzed separately. Since each approach may be subjected to various conditions of loading and have differing physical restrictions, it was found that one or more approaches within an intersection often was operating at different levels of service. Consequently, those intersections indicated on the Highway Deficiency Map as operating at service level E may have one or more approaches operating at a higher level of service. The designation of service level E in relation to the intersections, therefore, means that one or more approaches are operating at or near maximum capacity. Approximately 22 percent of the intersections in the Bi-County region which were included in the analysis were found to be in this category. In Nassau County, approximately 38 percent were operating at level E during peak hours. The significance of an intersection operating at this level is that excessive backups occur and delays may be great. At service level D there may be substantial delays for short peaks but enough cycles with lower demand occur to permit periodic clearance of developing queues, thereby preventing excessive backups. Level C represents stable operation with occasional waits for more than one signal and possible backups behind turning vehicles.

The results of a number of speed and delay runs made in selected Suffolk County business districts, which included nine intersections classified as operating at service level E, yielded an average delay of 33 seconds at these nine intersections. Six runs were made through each intersection. The highest delay on any run encountered was 240 seconds at Jericho (for Jericho Turnpike traffic), Turnpike and Harned Road. This intersection also had the highest average delay of those included in the runs. The problem arises from a lack of separate turning lanes for storing the substantial number of turning vehicles and is further complicated by the northbound off-ramp from Sunken Meadow Parkway to eastbound Jericho Turnpike which exits in the intersection area. The replacement of this ramp with a slip ramp to Harned Road, would help to relieve the load on the intersection, such as was done south of Veterans Memorial Highway. The planned widening of Jericho Turnpike with the inclusion of left turn lanes will provide the required capacity for the Jericho Turnpike approaches. In western Nassau County, similar average delays of 30 seconds on the major east-west routes were encountered at level E intersections.

In addition to those intersections operating at service level E it is estimated that 9 percent of those intersections included in the analysis are operating at level D and 9 percent are operating at level C. In Nassau County 13 percent are operating at level D and 17 percent are operating at level C. The total percentage of intersections operating beyond design capacity, levels C through E is 40 percent for the Bi-County region and 68 percent for Nassau County.

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Parking was permitted in the intersection approaches at approximately 44 percent of the intersections operating at level E in the Bi-County area. In Nassau County about 41 percent of the level E intersections allow parking in one or more of the approaches. Removal of curb parking at these intersections would substantially improve the level of service. In general, the curb parking problem exists in those areas where there is a concentration of commercial and business uses such as, Valley Stream, Lynbrook, Rockville Centre, Freeport, Merrick, Wantagh, Huntington, Huntington Station and East Northport. In all central business districts where curb parking is permitted the capacity of the road is reduced. In those areas where the intersection restraint is reducing capacity to undesirable levels the removal of parking in the approaches will result in improved traffic flow. In others, where the capacity deficiency exists for the entire roadway section curb parking for the entire length rather than in just the intersection approaches, should be eliminated. Jericho Turnpike in the Smithtown central business district is one of many such areas. Without going into great detail, any business or commercial area for which a highway deficiency or an intersection deficiency is indicated on the Deficiency Map should not permit curb parking.

To the average motorist, the question as to whether delay he encountered on the highway system are the result of intersection restraint or inadequate highway capacity is probably academic.

In attempting to evaluate the system, however, it is necessary to know whether relatively minor intersection improvements can produce desirable service levels or whether a complete widening of a facility is needed. For this reason deficiencies have been estimated for both. In either case it is an estimate based on average conditions which can be affected by local influences. Since the levels of service concept by definition suggest operating conditions to anticipated for each service level, however, a reasonable check on the theoretical values is possible through actual speed and delay runs conducted by the staff and described in the following section.

Speed and Delay Studies — Assuming that the levels of service estimated for streets and highways and major intersections in the Bi-County region and discussed in the previous sections are reasonable, then the conditions associated with these levels should be encountered during average daily peak operations. In order to verify the theoretical evaluations, the staff conducted a number of speed and delay runs during average weekday peak traffic periods. The mileage and length of time required to travel the

various routes were recorded as well as the location, duration and causes of delays along the routes Initially about 340 miles of major routes in Nassau and 450 miles in western Suffolk County were run once. The results were compared with previous evaluations made by the Tri-State Transportation Commission in 1963. Those roads carrying substantially the same volumes as in 1963 and for which travel time values were found to be essentially the same as were obtained by Tri-State were not rerun. The major east-west routes were run a minimum of three times and separate speed and delay runs were made in selected central business districts for which the average of 6 runs was obtained.

In general, the conditions of flow, that is low average speeds and intersections delays, which would be anticipated based upon the estimated service levels shown on the Highway Deficiency Map were encountered on these runs. For example, in Nassau County on Route 25A, travel speeds of 9, 15, 18 and 19 miles per hour were encountered in the section from the Queens-Nassau line to Glen Cove Road during evening peak traffic periods. Major intersection delays were encountered at Community Drive, Searingtown Road and Glen Cove Road.

The three limited access facilities all exhibited low operating speeds consistent with the level of service E designation at their westerly ends. On Northern State Parkway from the Queens-Nassau line to Jericho Turnpike (Glen Cove Road) speeds ranged from 16 to 38 miles per hour with an average of about 30 miles per hour. East of Glen Cove Road an average speed of 40 miles per hour was recorded for the remaining section in Nassau County.

On the Long Island Expressway travel speeds of 16 to 18 miles per hour were encountered in western Nassau increasing to about 40 miles per hour. Traffic flow was found to be unstable with substantial variations in operating speeds. East of Route 106 higher operating speeds averaging about 42 miles per hour were experienced with some intermittent slowdowns occurring as far east as Bagatelle Road in Suffolk County.

The most severe breakdowns in flow on the limited access roads were experienced on Southern State Parkway in western Nassau where operating speeds ranged from 3 to 16 miles per hour at the most westerly end.

From the Queens-Nassau line to Meadowbrook Parkway, the average operating speed for three eastbound evening peak hour runs was 23 miles per hour. From Meadowbrook Parkway to

Route 110 in Suffolk County the average was 37 miles per hour. In both cases operating speeds were consistent with the levels of service indicated on the Highway Deficiency Map.

Operating speeds on Jericho Turnpike during evening peak hours averaged 22 miles per hour from the Queens-Nassau line to Meadowbrook Parkway and 23.5 miles per hour from Meadowbrook Parkway to Route 107. Average speeds over shorter sections as low as 16 miles per hour were recorded at the westerly end. Operating conditions were generally representative of service levels C through E with capacity restrained by a number of major intersections at which substantial delays occurred.

On Hempstead Turnpike, peak hour operating speeds were generally typical of service levels D and E from the Queens-Nassau line to the Seaford-Oyster Bay Expressway. From the Queens-Nassau line to Nassau Boulevard the average operating speed was 17 miles per hour with speeds ranging between 15 and 22 miles per hour. From Nassau Boulevard to the Meadowbrook Parkway the average speed was about 22 miles per hour. Operating speeds were quite variable over shorter sections ranging from about 12 miles per hour through the Hempstead Central Business District to about 26 miles per hour from Nassau Boulevard to Westminster Road.

East of the Meadowbrook Parkway to the Seaford-Oyster Bay Expressway the average operating speed was about 20 miles per hour, ranging between 14 and 26 miles per hour for shorter sections. From the Seaford-Oyster Bay Expressway to Route 110 in Suffolk County an average speed of 26 miles per hour was recorded.

Similar runs on Merrick Road and Sunrise Highway and on north-south routes in Nassau County indicated that the estimated levels of service were generally consistent with the average speeds encountered. On some roads, such as South Oyster Bay, and Route 110 and Commack Road just north of Deer Park Avenue in Suffolk County which are subject to heavy short term loading from the industrial plants served by them, operating conditions were worse than would be indicated by the estimated service levels.

In both Counties average speeds on those sections of major roads passing through the central business districts invariably ranged between 12 and 18 miles per hour. The effect on overall speeds on such east-west routes as Merrick Road, Hempstead Turnpike, Jericho Turnpike and Route 25A is obvious. The

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major factors contributing to delays are traffic signals at intersections, vehicles making left turns, and vehicles maneuvering in or out of curb spaces. In addition, curb parking seriously reduces the road capacity further complicating the problem.

Similar results were obtained in Suffolk County. Typically average speeds through central business districts ranged between 12 and 23 miles per hour with an average speed of about 18 miles per hour. The average length of the courses through the business districts was about 1 mile. Within these one mile sections, speeds as low as 9 miles per hour were encountered in the core areas. This occurred over a one or two block section in the most densely developed part of the business district. In these areas, curb parking was generally permitted further restricting flow in the through lanes.

It should be reiterated here that all speed and delay runs were made during these months which would normally represent fairly average conditions. In general, greater congestion than observed in these studies would occur from May through September, therefore, the estimates are conservative and represent average conditions. With that in mind, the following maps indicate west to east travel times from the Queens-Nassau line. The upper map indicates travel times on limited access highway. The lower map indicates travel times on the non-limited access roads. The advantages in travel times on the limited access system are evident except for Southern State Parkway in western Nassau County.

C. B. D. Parking Studies—Parking studies were conducted by the staff during the months of July, August and September, 1967, in ten selected business districts in the Bi-County area. Four were made in Nassau County in the Hicksville, Mineola, Freeport and Rockville Centre business districts and six in Suffolk County, in the Babylon, Huntington, Patchogue, Bay Shore, Smithtown and Riverhead business districts.

Essentially the purpose of these studies was to determine the effect of curb parking on the highway system and to investigate the possibility of the removal of curb parking on the major roads serving these business districts.

Based on an analysis of monthly department store sales in Nassau County for 1966 and 1967 and a similar record of monthly sales volume in one of the Suffolk County central business districts, the months of July and August are representative of average to perhaps fifteen percent above average monthly sales volume, as shown on Fig. 8. Sales volume and parking demand are substantially greater in the latter part of November and the two or three weeks preceeding Christmas.

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MONTHLY VARIATIONS IN SALES VOLUME Suffolk C. B. D. & Retail Department Stores

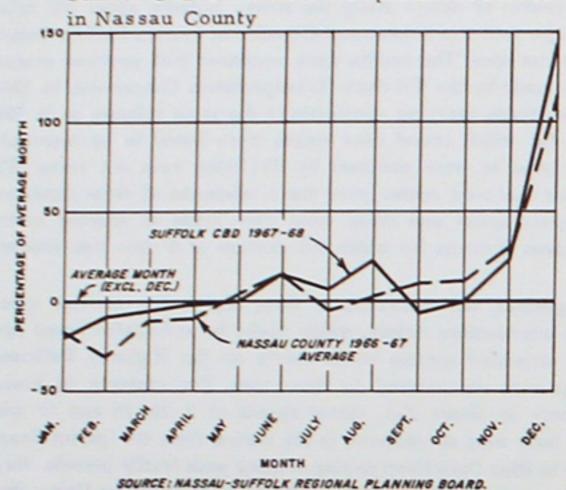


FIG. 8

UNITED STATES DEPARTMENT OF COMMERCE.

Each of the central business districts included in the study has several characteristics which are common to the others. For instance, all are a mixture of retail and non-retail, professional, industrial and general office uses. In addition, some of these areas also serve as transportation hubs, providing feeder bus service and parking facilities for rail commuters.

One effect of the non-retail and transportation hub functions is to lessen the demand for parking facilities on Friday evening and Saturday, resulting in a greater supply of parking spaces at these times to accommodate the higher shopper parking demand. In the areas studied, week-day occupancy was generally higher than on Saturday.

Another characteristic shared by these business districts is that the major generators are concentrated within a relatively small core area and within these areas both curb and off-street parking demand is high; although total parking demand for the overall business districts varied between 50 and 60 percent. Subsequent, more detailed studies of two of these C.B.D.'s conducted in 1968, indicated that a high percentage of core area parking was utilized by employees. An obvious improvement in shopper parking space availability could be realized by limiting parking in the core area to two or three hours and permitting all day parking for employees in less heavily utilized fields.

In terms of total parking space demand, a sufficient surplus of off-street parking spaces appeared to exist in all of the C.B.D.'s to permit the removal of curb parking. These surpluses usually existed in the outlying fields and not in the core areas, however. It should be realized that a single parking space utilized by an all day parker could conceivably serve, over an eight-hour period, sixteen one-half hour parkers, eight one-hour parkers, or four two-hour parkers. Since more than eighty percent of the parkers in the C.B.D. park for less than two hours, it is obvious that very substantial gains in shopper parking facilities can be made simply by restricting all day parkers to less convenient areas.

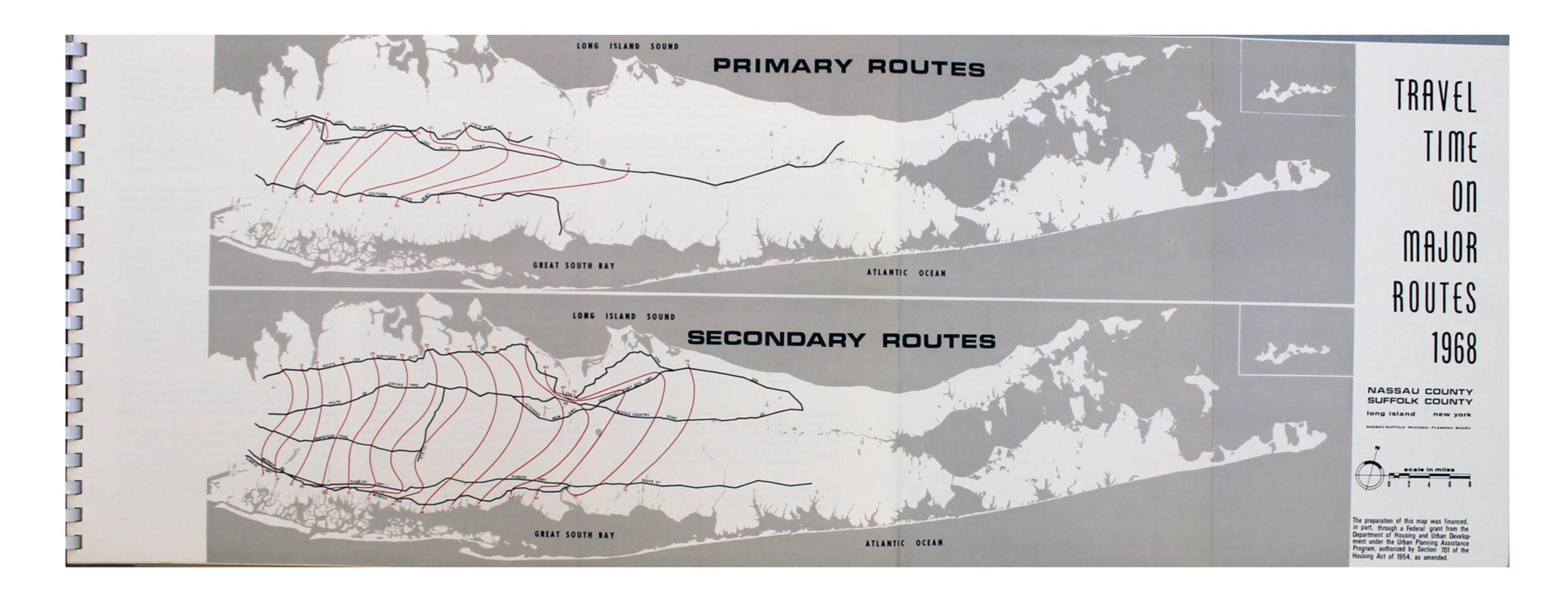
A brief outline of the data obtained in each of the C. B. D.'s studies follows:

Mineola—The area included within the Mineola C. B. D. study contains 1665 parking spaces of which 447 are curb spaces and 1218 are in the parking fields. Of these, 89 percent are in private fields and 11 percent are in municipal fields.

On Wednesday, July 5, 1967, a mid-day count was made of vehicles parked in all facilities. Sixty-one percent of the available spaces were occupied. The highest percentage of utilization occurred in the block bounded by Mineola Boulevard and Main Street on the west and east, and by 1st Street and 2nd Street on the north and south and amounted to 83 percent.

On Tuesday, September 5, 1967, an all day count was taken at one-hour intervals between 9 a.m. and 5 p.m. The peak utilization of 56.5 percent occurred between 2 and 3 p.m. Parking facilities were most heavily utilized in the two blocks bounded by Mineola Boulevard and Main Street on the west and east and by 2nd Street and Front Street on the north and south. For these two blocks the maximum utilization of 84 percent occurred between 2 and 3 p.m. Curb parking is permitted on Mineola Boulevard and on Old Country Road. The latter road is operating at level of service D and E and the removal of curb parking could provide additional capacity. The number of spaces which would be lost is relatively small.

Hicksville—There are 3053 parking spaces within the area covered by the parking study. Of these, 813 are curb spaces and 2240 are in off-street parking fields. Municipal parking fields provide 92 percent of the off-street spaces, private fields account for the remainder.



On Thursday, July 6, 1967, occupancy counts were made in the morning and afternoon. The occupancy rate for both counts was 68 percent. Heavy utilization, 85 to 100 percent, was noted in the area bounded by Newbridge Road on the west, the Long Island Railroad on the north and east and Nicholai Street on the south.

Morning and afternoon counts were again conducted on Saturday, July 8, 1967. The morning accumulation was 16 percent and the afternoon accumulation was 14 percent. The highest accumulation, 33 percent, occurred in the area bounded by Newbridge Road, Jerusalem Avenue, the Long Island Railroad, and Duffys Avenue.

On Wednesday, September 6, 1967, hourly counts were taken between the hours of 9 a.m. and 5 p.m. The peak accumulation, 61 percent, occurred between 1 and 2 p.m. The highest occupancy rates again occurred in the same area as in the Thursday count, ranging from 85 to 100 percent as before.

At the time of the study curb parking was permitted on Old Country Road and Newbridge Road, both of which were operating at levels of service D and E and would benefit by the removal of curb parking.

Hicksville is an important transportation center and will become even more important in this respect as Metropolitan Transportation Authority plans for improvements to the Long Island Railroad and further development of Hicksville as a transportation hub becomes a reality. The provision of adequate access and improved circulation in and around the area, beyond that which now exists, must be included in the development of the area.

Freeport—There are 1985 parking spaces in the Freeport C.B.D. study area, of which 1470 are in off-street parking fields and 515 are at the curb. About 54 percent of the off-street spaces are in municipal parking fields and 46 percent are in private parking.

Hourly counts of parked vehicles were made on Tuesday, August 22, 1967, from 10 a.m. to 5 p.m. The peak accumulation of 63 percent occurred between 2 and 3 p.m. The highest accumulation, 90 to 100 percent was in the blocks bounded by Railroad Avenue, Henry Street, Newton Boulevard, and Main Street. High parking rates were also observed in the remaining two blocks abutting Main Street between Sunrise Highway and Merrick Road. Curb parking is permitted on most of the streets in the C. B. D. including Sunrise Highway and Merrick Road but can probably be tolerated at this time.

Rockville Centre—The Rockville Centre C. B. D. area included in the study includes 2610 parking spaces of which 524 are curb spaces and 2086 are in off-street parking fields. About 80 percent of the off-street spaces are in private fields and 20 percent in municipal fields.

An occupancy count taken on Friday, July 7, 1967, about mid-day indicated a 66 percent utilization of parking spaces. Utilization rates in excess of 90 percent were found in the area bounded by Sunrise Highway, North Centre, Merrick Road, and North Village Avenue and the area bounded by Sunrise Highway, the Long Island Railroad, North Village Avenue, and Park Avenue.

An all day count taken at one-hour intervals from 9 a.m. to 5 p.m. on Saturday, August 12, 1967, indicated a peak utilization of 52 percent for the period between 9 a.m. to 11 a.m. The block bounded by Sunrise Highway, North Village Avenue, Park Avenue, and Merrick Road had the highest percentage of utilization, 96 percent between 1 and 2 p.m.

Curb parking is permitted on a number of streets including Merrick Road and Sunrise Highway. Merrick Road is operating at service levels C and D in this area and additional capacity for this road could be realized if curb parking were removed. Generally speaking, occupancy rates of off-street facilities in those blocks abutting Merrick Road were relatively high and did not indicate sufficient vacancies to absorb the curb parkers. Further studies are required to determine whether parking restrictions in the fields serving this area could free a sufficient number of off-street spaces for shopper parking or if additional facilities are needed.

Babylon—The area covered by the parking survey in Babylon did not include those blocks in the vicinity of the Long Island Railroad which primarily serve commuter parkers. Within the survey area there were a total of 1466 parking spaces of which 327 were curb spaces and 1139 were in off-street parking fields. About 54 percent of the off-street parking facilities are in municipal fields and 46 are in privately owned fields.

A mid-day count taken on Friday, June 30, 1967, indicated that about 50 percent of the available spaces were occupied. The maximum accumulation of 78 to 85 percent was in the two block area bounded by Main Street, Deer Park Avenue, Grove Street, and Mansfield Road.

On Saturday, August 26, 1967, an all-day count was made at onehour intervals between the hours of 9 a.m. and 5 p.m. The peak occupancy of 25 percent occurred between 11 a.m. and noon. The highest demand was in the block on the west side of Deer Park Avenue between Main Street and Grove Street and amounted to 56 percent of the available spaces.

Curb parking is permitted on both Deer Park Avenue and Main Street. Both of these roads are operating at level of service E and could benefit substantially by the removal of curb parking. There is an apparent surplus of off-street parking facilities which could absorb the curb parkers. However, a number of these off-street fields require improvement in surfacing, delineation, lighting, and drainage to make them more acceptable and encourage their use.

This must be done if an improvement in traffic flow on the major streets in the Village is to be realized. The removal of curb parking on Deer Park Avenue and Main Street is an absolute necessity.

Huntington—There were 2022 parking spaces in the Huntington C. B. D. area covered by the study. Of these, 521 were curb spaces and 1501 were in off-street parking fields. About 72 percent of the off-street spaces were in municipal fields and 25 percent in private fields.

On Tuesday, July 18, 1967, morning and afternoon counts were made of vehicles parked. In the morning 71 percent of the available spaces were occupied and 77 percent were occupied in the afternoon. The highest accumulation of vehicles, 88 to 92 percent, occurred in the block east of New York Avenue between Elm Street and Carver Street.

Morning and afternoon counts were again made on Saturday, July 22, 1967. The morning accumulation of parkers was 54 percent and in the afternoon 52 percent. On this day the highest utilization of spaces was in the block on the north side of Main Street between Clinton Street and Wall Street where the percentages of occupancy were 78 and 88 percent respectively.

An all-day count at one-hour intervals was conducted on Wednesday, August 30, 1967. The peak accumulation of 69 percent occurred between 11 a.m. and 2 p.m. Maximum utilization was in the area bounded by Main Street, Woodbury Road, Carver Street and New York Avenue and was in the order of 80 or 90 percent.

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Curb parking is permitted on New York Avenue and on Main Street. High parking demand in most of the off-street fields indicates little or no surplus to accommodate the additional demand which would result from the loss of more than 200 spaces if curb parking were removed. More detailed study is needed to determine if additional land can be acquired for off-street parking or, as an alternative, double-decking of existing fields might be more desirable.

Smithtown—There were 2405 parking spaces in the Smithtown C. B. D. at the time of the survey. Of these, 308 were curb spaces and 2097 were in off-street fields. The vast majority, 90 percent, of the off-street spaces are in privately owned fields.

Morning counts were made of vehicles parked on Tuesday, June 27, 1967, and Saturday, July 22, 1967. The percentages of occupied spaces were 42 percent and 30 percent respectively. An afternoon count was made on Tuesday, July 11, 1967, and 44 percent of the available spaces were occupied. On Wednesday, August 30, 1967, counts were taken at one-hour intervals between the hours of 9 a.m. and 5 p.m. The peak utilization of 40 percent of the spaces occurred between 11 a.m. and noon and again between 2 and 3 p.m.

For all of the counts, the highest occupancy occurred in the block between Elm Street and Lawrence Avenue and ranged from 66 to 98 percent occupancy of available spaces.

The low occupancy rates in Smithtown are misleading. As noted before, 90 percent of the off-street spaces are in private fields and reserved for patrons or employees. More than 50 percent of the total parking spaces are in the block containing The Branch Plaza Shopping Center and the contiguous shopping center. The commercial establishments on the north side of Main Street are quite dependent upon curb parking since off-street facilities are inadequate. A program to provide municipal fields to serve this area should be initiated so that curb parking can be completely removed from Main Street.

Bay Shore—There were 1570 parking spaces in the Bay Shore C. B. D. study area. Of these 447 were curb spaces and 1123 were in off-street parking fields. Municipal parking facilities accounted for 80 percent of the off-street parking and private facilities, 20 percent.

A mid-day count of vehicles parked in the C. B. D. on Wednesday, July 12, 1967, indicated that 56 percent of the available spaces were occupied. Higher occupancy, 65 to 81 percent, was noted in the area on the north side of Main Street from 5th Avenue to 2nd Avenue and on the south side of Main Street from South Park Avenue to Homan Avenue.

An afternoon count was taken on Saturday, July 29, 1967, at which time 43 percent of the available spaces were occupied. The higher accumulation of parkers, 66 to 81 percent occupancy on this day was in those blocks on both sides of Main Street between Park Avenue and Bay Shore Avenue

On Monday, August 28, 1967, hourly counts were taken from 9 a.m. to 5 p.m. Peak occupancy of 58 percent occurred between 11 a.m. and noon.

Curb parking is permitted on both sides of Montauk Highway. Restricting parking in some of the more desirable core off-street parking fields could produce a sufficient increase in space hour availability to accommodate these short term curb parkers.

Patchogue—There were 2723 parking spaces in the Patchogue C. B. D. study area at the time of the survey. Of these, 432 were curb spaces and 2291 were in off-street parking fields. About 78 percent of the off-street spaces were in municipal fields.

On Thursday, June 29, 1967 A.M. and P.M. counts were made of vehicles parked, about 52 percent of the available spaces were occupied. The two blocks in the northwest and southwest quadrants of the Ocean Avenue-Main Street intersection were the most heavily utilized with a range of 78 to 86 percent of all available spaces occupied.

An A.M. and P.M. count made on Saturday, August 5, 1967, showed 40 to 43 percent of the spaces occupied with the block in the northwest quadrant of the Main Street-Ocean Avenue again most heavily utilized with a 69 to 75 percent occupancy.

An all day count at one hour intervals made on Thursday, August 31, 1967, indicated a peak occupancy of 57 percent between 11 a.m. and 12 noon and again between 1 and 2 p.m. As before, those blocks on the north and south sides of Main Street and the west side of Ocean Avenue received the highest utilization.

In general, there was a substantial surplus of parking in the Patchogue C. B. D. Indications were that those blocks most heavily utilized were being used to a large extent by all-day or long term parkers. Restricting parking in these fields to 2 or 3 hours could induce a more even distribution of parking and, perhaps, enable the elimination of curb parking on Main Street and Ocean Avenue where additional traffic capacity is needed.

Riverhead—There were 1312 parking spaces in the Riverhead C. B. D. area. Of these 229 were curb spaces and 1083 were in

off-street fields. Approximately 60 percent of the off-street spaces are in municipal fields. A.M. and P.M. counts of vehicles parked in the C. B. D. were made on Monday, July 17, 1967. At both times about 58 percent of the available spaces were occupied. The highest utilization occurred in the block bounded by Griffing Avenue, Roanoke Avenue and Main Street and amounted to 81 percent occupancy in the morning and 86 percent in the afternoon.

A Saturday afternoon count made on July 22, 1967 indicated 39 percent of the available spaces occupied with maximum utilization of 65 percent occurring in the same block as before.

Curb parking is permitted on both sides of Main Street. At the time of the study it appeared that sufficient off-street spaces were available in most blocks to accommodate all parkers in the C. B. D. although certain fields might require some time restrictions.

Conclusions—The foregoing is a summary of a substantial quantity of data obtained relative to parking in some of the central business districts in the Bi-County area. Individually each study represents observations over a relatively short period of time. Collectively the studies present a fairly typical pattern. In general these business districts straddle at least one major highway. There is, in each of them, a central core in which parking demand is high although surplus parking facilities appear to exist at the extremities of the business districts. By restricting parking to relatively short term use, better utilization of the less conveniently located fields could be obtained and elimination of curb parking on the major highways would be possible in many

The central business district is in competition with the increasingly numerous shopping centers which offer expansive parking areas and a high degree of accessibility. It behooves those vitally concerned merchants, businessmen, and officials to minimize those deficiencies inherent in the strip development which typifies the central business districts by providing adequate off-street parking and eliminating curb parking, a major deterrent to efficient and orderly traffic flow.

Accidents on Major Highways—A survey of accidents in both Nassau and Suffolk Counties was conducted during 1966 and 1967. The purpose of the study was to develop average accident costs as part of the economic analysis of the highway system and to determine those locations where high accident frequencies suggest a need for remedial action.

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It is as much a function of our highways to provide for the safe movement of people and goods as it is to provide for efficient movement. The cost of accidents cannot be accurately determined since the effect of injuries or death from highway accidents is staggering in terms of social as well as economic impact. Nevertheless, an estimate of accident costs from a purely economic standpoint can serve a useful purpose by providing a basis for comparison of the costs of highway safety programs, proposed construction, and corrective traffic engineering measures with savings in accident costs.

For this purpose the National Safety Council* suggests the following unit costs for accidents:

Death	\$34,400
Non-fatal Injury	1,800
Property Damage	310

Using the above figures, an estimate of the costs of accidents in the Nassau-Suffolk Region for 1966 can be made. During that year there was a total of 39,171 accidents in Nassau County of which 143 were fatal, 20,712 were personal injury accidents and 18,316 involved property damage only—resulting in a total estimated accident cost of about \$48,000,000.

In Suffolk County for the same year there were 21,700 accidents of which 210 were fatal, 11,485 were personal injury, and 10,005 were property damage. The total estimated cost for Suffolk County was \$31,000,000 and the combined accident cost for the Region was \$79,000,000.

Accident Locations—A high percentage of the traffic accidents in 1966 in Nassau County and the five western towns of Suffolk County occurred at intersections. The Accident Location Map on the following page depicts those intersections at which 20 or more accidents occurred in 1966 in the Nassau-Suffolk Region. The indicated number of accidents are not directly comparable between Nassau and Suffolk Counties due to the difference in accident recording procedures. In Nassau County, traffic accidents are recorded for an intersection if they occur within 30 feet of the intersection while in Suffolk County they are recorded within 100 feet.

In Nassau County there were 44 intersections at which 20 or more accidents occurred in 1966. Nine of these intersections had over 30 accidents. These are indicated by red circles on the Accident Map. The black circles show the locations where 20 to 29 intersection accidents occurred. The highest number of accidents occurred at the intersection of Green Acres Road with Sunrise Highway with 63 accidents, and at the intersection of Ocean Avenue with Sunrise Highway, where 47 accidents occurred. The latter intersection has been a consistently high accident location for several years.

The remaining seven locations with 30 or more intersection accidents included two intersections with 40 or more accidents. Hempstead Turnpike and Hicksville Road with 40 accidents and Hempstead Turnpike and Merrick Avenue with 43 accidents.

A breakdown of the accidents which occurred at these 9 Nassau intersections showing the total number of accidents involving personal injury and the number involving fatal injuries follows:

HIGH ACCIDENT LOCATIONS
NASSAU COUNTY
1966

Intersection	Total Accidents	Pers. Injury Accidents	
Hempstead Tpke. & Merrick Ave.	43	20	0
Hempstead Tpke. & Wantagh Ave.	35	11	0
Hempstead Tpke. & Hicksville Rd.	40	19	0
Sunrise Hwy. & Green Acres West	63	34	0
Sunrise Hwy. & Ocean Ave.	47	15	0
Sunrise Hwy. & Mill Rd.	37	14	0
Sunrise Hwy. & Atlantic Ave.	32	7	0
Sunrise Hwy. & Merrick Ave.	37	18	0
Merrick Ave. & Stewart Ave.	34	14	0

Source: Nassau County Police Department

In western Suffolk County there were 81 intersections at which 20 or more accidents occurred in 1966, 24 of which had over 30, 4 had between 40 and 50, and 4 had 50 or more accidents. The highest number, 65, occurred at the intersection of Montauk Highway and Sunrise Highway in Oakdale. This intersection is to be reconstructed as a directional interchange, eliminating the crossing conflicts and thereby providing for greater traffic safety.

The three remaining intersections with 50 or more accidents were Jericho Turnpike and Port Jefferson-Nesconset Highway with 63 accidents, Sunrise Highway and Waverly Avenue with 52, and Route 110 and the Long Island Expressway with 50 accidents. Ultimately, when the Port Jefferson-Nesconset Highway is developed as a controlled access highway, the intersection with Jericho Turnpike will be replaced with a directional interchange. This, however, will not occur for several years and it is, therefore, sug-

gested that the interchange be built under separate contract at an earlier date. The possible savings in accident costs more than justifies such action. When Sunrise Highway is reconstructed as a limited access highway, the Waverly Avenue intersection will be replaced with an interchange.

A breakdown of the accidents which occurred at intersections having a total of 30 or more accidents including property damage accidents, personal injury accidents and fatal accidents is contained in the following table.

TABLE IX
HIGH ACCIDENT LOCATIONS
SUFFOLK COUNTY
1966

1000			
Intersection	Total Accidents	Personal Injuries	Fatalities
Route 110 & L. I. Expressway	50	16	0
Route 110 & Route 25	40	6	1
Route 25 & Deer Park Ave.	43	15	1
Route 25 & Elwood Road	33	5	0
Route 25 & Larkfield Road	39	7	0
Sunrise Highway & Connetquot Ave.	34	9	0
Sunrise Highway & Montauk Hwy.	65	20	0
Old Willets Path & Veterans Hwy.	31	7	0
Old Willets Path & Route 25	30	6	0
Route 25 & Route 25A (West)	31	5	0
Rte. 111 & Nesconset-Pt. Jefferson Hwy.	38	5	0
Route 25 & Nesconset Hwy.	63	14	0
Old Town Rd. & Nesconset Hwy.	36	7	1
Nichols Bd. & Nesconset Hwy.	38	16	1
Sunrise Hwy. & Veterans Highway	32	15	0
N. Ocean Ave. & Sunrise Highway	45	13	1
Smithtown Ave. & Veterans Hwy.	34	10	1
Suffolk Ave. & Veterans Hwy.	41	8	0
Sunrise Hwy. & Waverly Ave.	52	21	0
Nesconset Hwy. & Terryville Bd.	35	8	0
Edgewood Ave. & Route 25	39	5	0
Harned Road & Route 25	37	6	0
Lake Avenue & Nesconset Hwy.	34	12	0
Route 110 & Schwab Road	30	6	0

Source: Suffolk County Police Department

In the five eastern towns of Suffolk County, approximately 82 percent of accidents were non-intersectional, a typical characteristic of rural area traffic accident experience. In 1966 there were no intersections in the eastern towns at which 10 or more accidents occurred. Experience indicates that in rural areas excessive speed is the greatest single cause of accidents. A detailed study of accidents in East Hampton for 1964 and 1965 included in the Town's Comprehensive Plan indicated a high percentage of acci-

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Estimating the Cost of Accidents, Traffic Safety Memo 113, National Safety Council, Chicago, July 1965.

dents resulting from vehicles out-of-control colliding with fixed objects or other vehicles which would seem to indicate excessive speeds for prevailing conditions. A precise means of determining high accident locations so that hazards can be identified and corrected is absolutely essential. In addition, copies of accident records throughout the eastern towns should be provided for use by a countywide central records bureau for ultimate traffic engineering analysis. A proposed computerized traffic accident records keeping system is discussed later in the text.

Comparative Accident Rates and Costs—Accident records for selected major highways in Nassau and Suffolk County were analyzed in order to draw comparisons as to relative safety, especially in respect to access controlled highways versus non-access controlled highways and to develop average accident costs on a vehicle—mile basis. This latter figure enables comparisons to be made of accident experience to roads within or without the immediate area.

Table No. X lists the major roads in both counties which were included in the analysis; the total number of accidents including the number of property damage accidents, personal injury, and fatal accidents; the length of the highway; the average daily traffic; the annual vehicle miles of travel for each route in hundred millions; and the accident rate including the personal injury rate and the fatality rate for each road analyzed.

In Nassau County five east-west highways, including the Long Island Expressway, were analyzed and the accident rates were computed from the average of a number of traffic volume counts over the entire length of each road from the Queens-Nassau line to the Nassau-Suffolk line. Total accident costs were computed using the previously referred to unit costs and then reduced to an accident cost per vehicle mile. The average accident cost per vehicle for the non-access controlled highways was 0.84 cents per mile; for the Long Island Expressway the accident cost was 0.24 cents per mile.

In Suffolk County the sections of highway analyzed were taken from the Nassau-Suffolk line to Deer Park Avenue. The average accident cost per vehicle mile for the non-access controlled highways was 0.86 cents per mile; for the Long Island Expressway it was 0.23 cents per mile.

The estimated vehicle-mile accident costs agree with the 1960 average accident costs in the United States of 0.9 cents per vehicle mile. The actual cost is now, in all probability, somewhat higher since the unit costs used in the estimate were for 1964 and these costs have increased since then.

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TABLE NO. X
ACCIDENT RATES FOR MAJOR HIGHWAYS
in the

NASSAU-SUFFOLK REGION

		Personal Injury	1966 Fatality	100 Million Vehicle Miles	Accident Rates Per 100 Million Vehicle Miles		illion
Major Road	Property Damage				Property	Personal	Fatality
Nassau County							
Sunrise Highway	779	520	11	1.755	444	296	6.3
Jericho Turnpike	510	357	6	1.175	434	304	5.1
L. I. Expressway	589	527	6	5.72	103	92	1.1
Route 24	761	624	5	1.614	471	387	3.1
Route 25A	329	240	4	1.168	282	205	3.4
Avg. (Less Expressway)				1.428	417	305	4.6
Avg. Cost per 100 Million Vehicle Miles Cost Per Vehicle Mile = 0.0	084	\$836,510					
Expressway Cost 100 Million Vehi Cost Per Vehicle Mile = 0.0	icle Miles 024	\$235,370					
Suffolk County							
Sunrise Highway	239	83	2	0.515	464	161	3.9
Jericho Turnpike	481	116	4	0.431	1116	269	9.3
L. I. Expressway	116	71	4	1.418	135	50	2.8
Route 27A	289	108	1	0.418	691	258	2.4
Avg. (Less Expressway)	360	100	3	0.473	790	215	6.6
Avg. Cost Per 100 Million Vehicle Miles Cost Per Vehicle Miles = .00		\$858,940					
Expressway Cost 100 Million Veh Cost Per Vehicle Miles = .0	icle Miles	\$228,170					

The relatively low accident per vehicle mile cost for limited access facilities is also in general agreement with National experience and amply demonstrates the advantages to be gained in terms of safety as well as capacity in the construction of these facilities.

Source: Nassau County Police Dept.

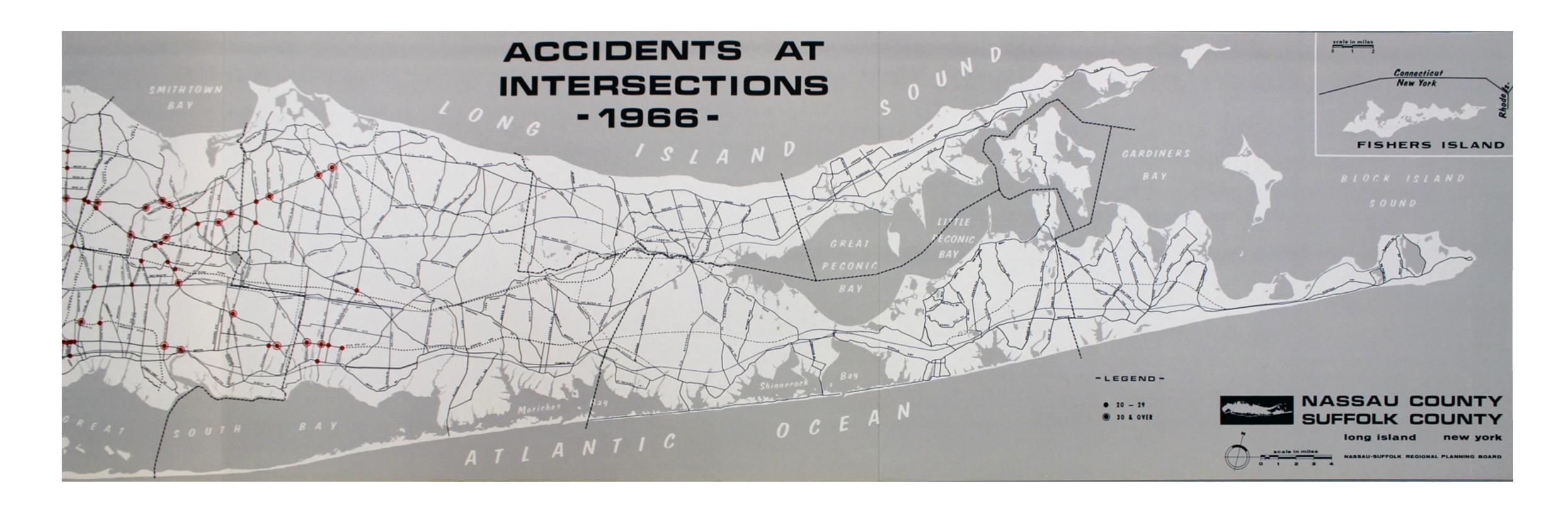
Suffolk County Police Dept.

The comparisons of Bi-County accident rates with National statistics leave no room for complacency. There can be no acceptable accident rate. Continuing efforts must be made to reduce traffic accidents on our highways. Although the total number of motor vehicle deaths increased from 1943 to 1963, the motor vehicle death rate decreased from 11.5 deaths per 100 million vehicle miles to 5.5 deaths per 100 million vehicle miles. Increased population, travel and motor vehicle ownership have resulted in more than a doubling in vehicle miles of travel while the number of traffic deaths has increased at a much lower rate. Considering the fact that even the reduced death rate will result in 50,000 to 60,000 traffic deaths in the nation this year, it is obvious that greatly accelerated research and traffic safety programs are needed to identify the causes and develop greater safety on our highways.

Accident Causes

Many factors are involved in traffic accidents. Among these are the geometric design of the roadway, surface condition, weather, visibility, the number of intersections, roadside interference, mechanical condition of the vehicles and human behavior. The latter is probably the most difficult contributory factor to deal with since human reaction to the various factors which produce accidents is, at least within our present realm of knowledge, largely unpredictable. The other factors, however, can be more easily identified and are more amenable to correction. Improved roadway design standards, the applications of sound traffic engineering principles in problem areas, extensive driver-education, and the mandatory inspection of motor vehicles to minimize the probability of mechanical failure, can all serve to further reduce the accident rate on our highways. Improved accident record keeping systems and the use of the latest techniques, will aid in the quick identification of high accident locations so that prompt

Accident Facts, National Safety Council, Chicago 1964



remedial action can be taken. A regional computerized system of accident record keeping which will permit the rapid retrieval of stored accident data should be established. Based upon a grid system of coordinates it could enable the analyst to quickly and accurately identify accident locations and provide information as to weather conditions, time of day, types of accidents, enforcement, property damage, injuries and fatalities, on a county-wide or regional basis.

When Accidents Occur—The occurrence of traffic accidents in the Nassau-Suffolk Region follows a fairly typical pattern in respect to National experience when analyzed by time of day, day of week and month of year. Although the number of accidents on a highway generally increases with volume, accident rates are higher during the lower traffic volume months and on a daily basis, during the lower volume hours. Fig. 9 is a graph of monthly variations in traffic accidents versus traffic volume on Southern State Parkway for 1965. Note that the percentage of accidents exceed the

MONTHLY VARIATION --TRAFFIC ACCIDENTS vs VOLUME 1965

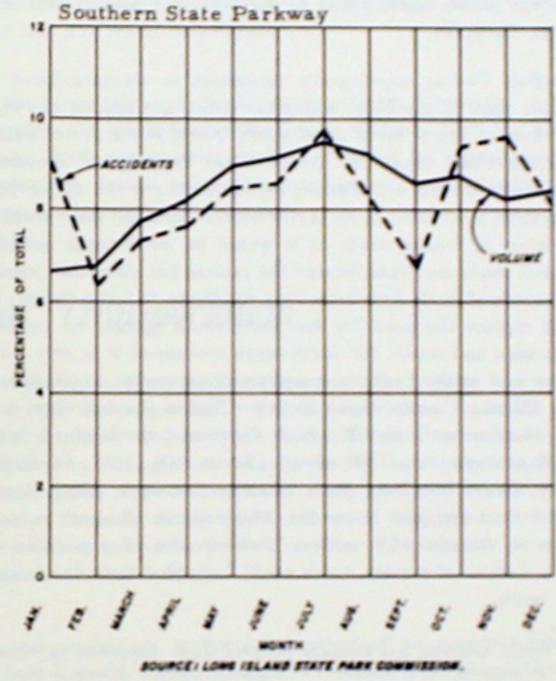


FIG. 9

January with the highest percentage of accidents occurring during November. Although the October through January period accounted for about 32 percent of the total annual volume it experienced approximately 36.5 percent of the total annual accidents.

The situation is similar on Fig. 10 which shows average monthly variation in traffic volumes at some 20 locations in the Bi-County area in relation to the average of four annual accident counts in Nassau-Suffolk. For the same period, October through January, 32 percent of the traffic volume accounted for about 36.7 percent of the total accidents. In contrast, during the four month period from May to August, inclusive, 35.2 percent of the annual volume accounted for 32.9 percent of the total accidents. Probably the longer hours of daylight account in part for the reduction in accident rates. Weather conditions also are a factor in the difference between the two periods, although it is interesting to note that

MONTHLY VARIATION --TRAFFIC ACCIDENTS VS VOLUME



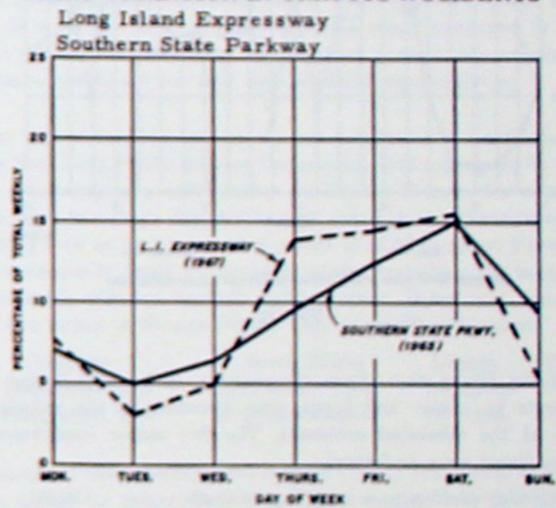
SOURCE: MASSAU COUNTY POLICE DEPARTMENT, SUFFOLK COUNTY POLICE DEPARTMENT, MEN FORK STATE DEPARTMENT OF TRANSPORTATION, MASSAU COUNTY DEPARTMENT OF PUBLIC WORKS.

FIG. 10

during the months of February and March when weather conditions are generally severe, the percentage of accidents is substantially less than the percentage of annual volume.

Traffic accidents vary by day of week also, as indicated on Fig. 11, the graph of daily variations in accidents on the Long Island Expressway (1967) and Southern State Parkway (1965). Saturday is the day on which the highest percentage of accidents occurred on both highways although high rates were experienced from Thursday through Saturday. Again a greater amount of travel during the hours of darkness occurs on these days due to evening shopping and recreation trips normally made during this period. On the Long Island Expressway, 58.5 percent of the weekly accidents occurred during the period when 44.0 per cent of the weekly traffic was on the road.

DAILY VARIATION IN TRAFFIC ACCIDENTS



The hourly variation in traffic accidents compared with traffic volume on the Long Island Expressway is indicated on Fig. 12. As before, a high rate of accident occurrence during the periods of low traffic volume is evident. During the period from 6:00 p.m. to 6:00 a.m. when approximately 32 percent of the daily traffic volume was counted, about 52 percent of the accidents occurred with the highest rates occurring between 2:00 a.m. and 6:00 a.m.

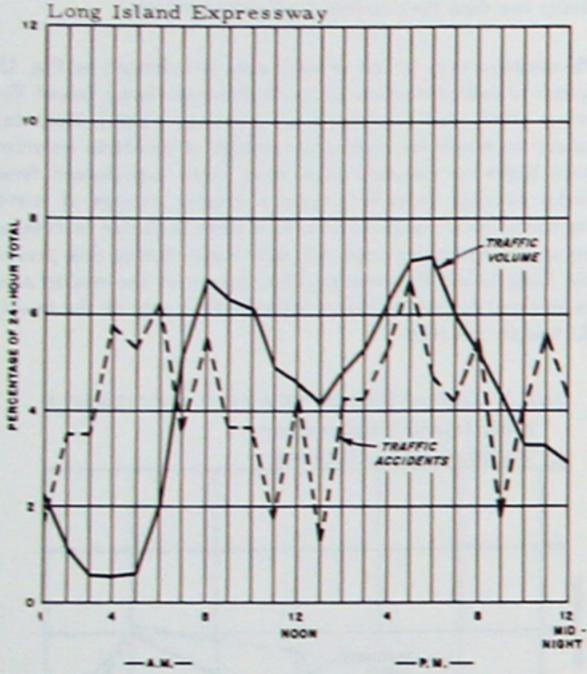
SOURCE: NEW YORK STATE DEPARTMENT OF TRANSPORTATION, LONG ISLAND STATE PARK COMMISSION.

FIG. 11

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HOURLY VARIATIONS

TRAFFIC ACCIDENTS vs VOLUME 1967



SOURCE: NEW YORK STATE DEPARTMENT OF TRANSPORTATION

FIG. 12

The Long Island State Park Commission, in its 1965 listing of accidents by causes and types, cites speeding as the principal cause of the tabulated accidents. The five major contributory factors listed were as follows:

Slowing suddenly or stopping in traffic	28.6%
Cutting in and out of lane	15.3%
Skidding - wet pavement	13.2%
Losing control	7.6%
Skidding - ice and snow	7.5%

The parkways are limited access highways and are not subject to intersection conflicts or the influence of roadside development which affect accident rates on highways not having restricted access. As mentioned earlier, 73 percent of the Bi-County Region's accidents occurred at intersections. Studies have indicated that accident rates increase as the number of roadside features in-

creases. One such study' found the following relationships for a rural and suburban highway:

No roadside features 3.74 accidents per M.V.M.*

0.1 to 3.99 features per 1000 ft. 9.06 accidents per M.V.M.

4.00 and over features per 1000 ft. 13.48 accidents per M.V.M.

*Million vehicle miles.

While these rates may not specifically apply to highways in the Nassau-Suffolk Region, the Accident Map on the preceding page shows that a clear relationship does exist between intensity of roadside development and traffic accidents. It is a factor worthy of further exploration so that the consequences of future land development may be carefully weighed, and possibly, through diligent site plan review and improved design, a reduction in accident potential realized.

Immediate Needs — A highway plan is but one element in the total transportation system and, must be related to the overall development plans for the region. At the present and within the planning scope of this study it is apparent that no new systems of transportation will replace the automobile in importance. Projections of population growth and automobile registration, coupled with a continued inclination toward low density development, indicate the necessity for continued efforts in the development of an efficient highway system. This does not negate however, the desire and commitment to minimize this influence in the future by shaping the development to encourage mass transit.

Much of our existing system of highways is inadequate to accommodate todays demands. The situation is especially critical on the State system of highways where, at the Queens-Nassau line, eastwest movement during peak periods reaches the point of strangulation. The bulk of the traffic on the system is carried by the three limited access facilities, i.e., the Northern and Southern State Parkways and the Long Island Expressway. Trips made on these highways are generally of the intermediate and long-haul type. Limited access roads are ideally suited for this kind of traffic. Unfortunately, the demand has far exceeded the supply. Further complicating the situation is the fact that two of the three highways are specialized in that they serve passenger cars only. The result is that external commercial trips going to or from Long Island's north and south shore areas must use the Long Island Expressway or the non-limited access arterials. Appreciable relief could be obtained by the provision of an additional limited access facility, particularly in the Sunrise Highway corridor.

Although an efficient system of highways is of vital importance to the growth and development of Long Island, much controversy and public opposition has been directed at State proposals for improvements to the system, due in part to the fact that few individuals are aware of the manner in which the apparently fragmented improvements fit into an overall highway plan. To alleviate this problem and perhaps pave the way for greater public acceptance of future proposals, a comprehensive plan for state highways in the region should be developed, in cooperation with local agencies, and reflecting as far as possible, the local planning objectives.

Ideally, the State highway network should be limited access. In some of the highly developed areas however, conversion of existing facilities to limited access routes would pose overwhelming problems of acquisition and relocation of homes and businesses. Hence, some lesser improvement might be more practical.

The County highway network should complement the State network. In both counties effort must be made to provide for improved north-south movement. In western Nassau such a movement is accomplished by a continuing process of changing direction. In central Nassau, three major roads, Newbridge, Jerusalem Avenue and Hicksville Road converge radially in Hicksville into Broadway which again splits to the northeast and northwest at Jericho Turnpike.

In Suffolk County north-south movement is accommodated for the most part by the State highways which are spaced anywhere from three to ten or more miles apart. North-south movements in the intermediate areas are accomplished by diagonal movement or on discontinuous north-south segments. Since the major highway system is oriented in an east-west direction the most economical system of feeder roads to it would be north-south oriented. Diagonal roads may complement the system but since they contain components of both directions they duplicate to some extent, but do not replace the need for the north-south routes. As evidence of this need and desire for north-south movement it is only necessary to look at the traffic volumes on those routes which provide it. In Nassau County these include Clinton Avenue-Glen Cove Road, Meadowbrook and Wantagh Parkways, the Seaford Oyster Bay Expressway and Broadway (Route 106, 107); in Suffolk County, Route 110, Deer Park Avenue, Commack Road, Sunken Meadow Parkway, and Route 111. These routes all serve as major feeders to the east-west system. Development of a parallel secondary system of county roads could help to reduce the load on these routes.

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⁷ Traffic Accidents and Roadside Features, Land Acquisition and Control of Adjacent Area, Bulletin 55. Highway Research Board, J. Carl Mc-Monagle.

In order to properly evaluate the highway networks, the performance standards as set forth by the Highway Research Board should be used in the region. Since ultimately this evaluation will be made in respect to the freedom and speed of movement desirable for a particular trip length and purpose, it is evident that the State highways should serve to carry intermediate and long haul traffic. Within this system a high level of performance is required and service to abutting land uses is of secondary importance. Limited access highways are not affected by friction from abutting land use development. Non-limited access highways, such as the Sunrise Highway and Jericho Turnpike, are hampered by the abutting land uses. These roads nevertheless are an important part of the State highway network. Therefore, traffic service should take priority over land use considerations on these roads. If the National Standards were applied, average speeds in the order of 25 miles per hour or more should be the goal.

Route 25A in Suffolk and Merrick Road-Montauk Highway which serve predominantly local movement and abutting land uses to a high degree should not be expected to provide the same high level of service as the major routes. Actually, these roads more reasonably belong on the County system of highways where service to land use is of equal importance.

In the development of the highway network a primary objective should be the attainment of maximum efficiency from the existing roads. Much can be done in this direction by improvements in intersection design, signs and signalization, parking regulations, curve realignment and drainage.

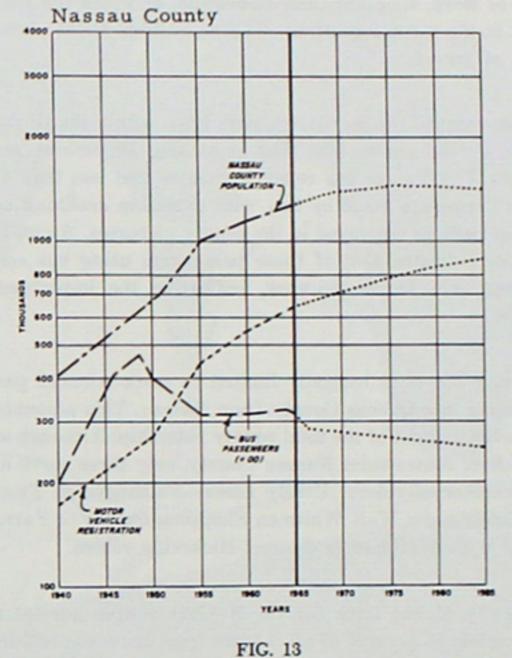
Bus Transportation

Introduction — Over the past three years the Agency has conducted several investigations in bus transportation, including a detailed inventory and analysis of the Suffolk County bus system, prepared by the Agencies consultants. This particular report used in conjunction with a companion study prepared by the Nassau County Planning Commission, offers a complete inventory of existing bus service in the two counties. This chapter contains a summary of these efforts.

Several constraints to the development of an adequate bus network are readily apparent. These include the low population densities throughout most of the Region and the uncoordinated pattern of locating routes, issuance of franchises, and lack of systematized transfer opportunities between carriers on differing routes.

The relationship of population growth to bus ridership between 1940 and 1965 as shown on Figure 13, indicates a close parallel between population growth and automobile registration increase in contrast to the decline in bus ridership.

A COMPARISON OF MOTOR VEHICLE REGISTRATION --POPULATION -- BUS PASSENGER TRENDS



Inventory — Locations of the bus routes are shown on the following map according to A.M. peak service levels, indicating generally poor service, in Suffolk County and the eastern portion of Nassau County.

Routes on the location map having the shortest headways are shown in blue, and indicate waiting periods of 15 minutes or less; those shown in purple have the poorest service. Overall service levels in the Bi-County area are generally low. Twenty-one of the forty-seven routes in Nassau County have headways of 30 minutes or less, only nine routes provide headways of 15 minutes or less. Four of the forty-nine routes in Suffolk County have a 30 minute headway.

Both counties lack schedule coordination and transfer opportunities. The problem in Nassau County extends to the railroad stations where train arrivals and departures are unrelated to bus scheduling. Coordination of bus and rail schedules is found in limited areas of Suffolk County.

Travel times vary due to schedule considerations and the amount of congestion encountered along the route. The more concentrated areas, particularly the downtown business areas, have lower operating speeds. Therefore, in Suffolk County, speeds vary from 10 miles per hour on some routes to a high of 37 miles per hour for the Long Island Railroad bus route. The weighted average speed of 20 miles per hour is quite favorable when compared to Nassau's 10-12 miles per hour. In terms of present day travel, the Nassau speeds are too slow and generally uncompetitive.

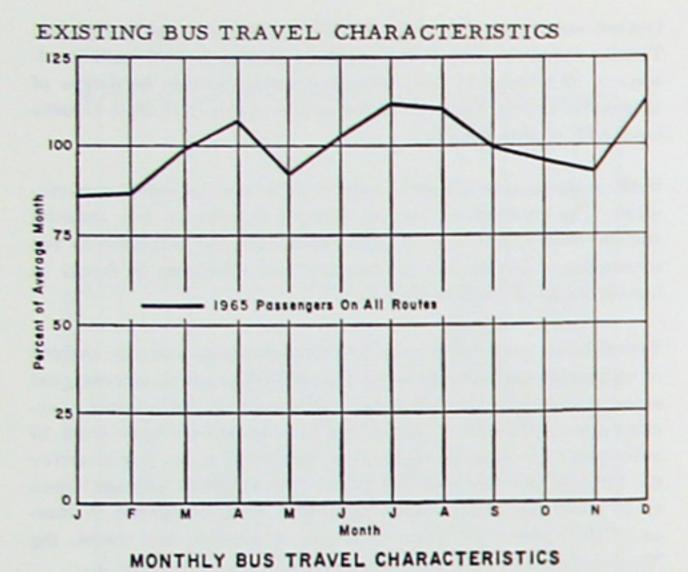
The rate of fare charged by the bus companies is established by the New York Public Service Commission without regard to fares on connecting or parallel routes. In Nassau County, for example, the fares to a single destination may entail two or three transfers taking over an hour's travel at a cost of \$1.50 or more. Fares are also unequally rated for separate routes travelling the same approximate distance through similar areas. Below are examples of two routes in Nassau County that exemplify this point:

Company	Route Name	Length	Fare
Hempstead Bus	Hempstead Loop	6.8 miles	70c
Hempstead Bus	Mineola-Freeport	7.3 miles	30e

Bus travel characteristics for Suffolk County are shown in Figure 14, except for minor variations. Both counties have low demand on weekends, possibly due to the low level of service provided, with a high demand around Wednesday and Thursday.

Monthly passenger volumes during April and December of 1965 were 7.2 and 12.7 percent higher than the average for Suffolk County. In Nassau, the corresponding months of April and December were 2 percent above average and 2 percent below average. This seems to reflect the more consistent use of bus transit in Nassau for all types of bus trips other than for peak holiday shopping. July and August are above average ridership months for both Nassau and Suffolk.

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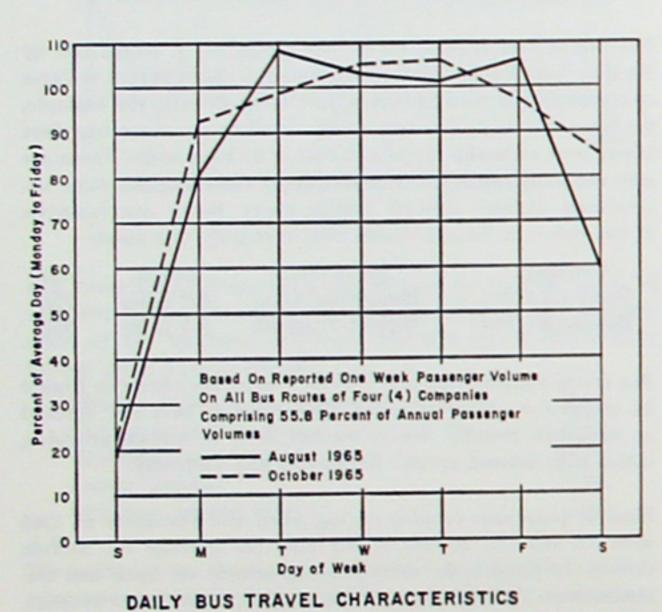


FIG. 14

SOURCE: SUFFOLK COUNTY FRANCHISED BUS SYSTEM REPORT - 1967

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Economic Evaluation — The most financially viable routes are in western Nassau and those crossing into Queens County — the result of higher population densities and strong journey-to-work patterns. Over eighty percent of all Nassau County bus riders are carried on those bus lines serving the western part of the County. Most Nassau and Suffolk routes provide only fair or poor service reflecting a financially marginal operation. For example, in Suffolk County, twenty-three of the fifty routes do not earn enough to meet operating and fixed costs. Another five companies must offset route losses with revenues from school and charter work.

Travel Patterns — Patterns of travel in Nassau and Suffolk are determined by the necessity to travel to various destinations for reasons of work, shopping, and recreation, of which the journey-to-work is the most important. The work trip is the dominant purpose of travel.

Yet, 90 per cent of the journey-to-work trips within the Bl-County area are by the automobile. The remaining 10 percent are by rail or bus. The Nassau bus report estimates that less than 4 percent of all trips are made by bus, with ridership declining as the number of persons employed in the county increases. An on-board bus survey indicated that of those passengers using bus service, 77 percent were journey-to-work, indicating the importance of this mode.

Inter-county travel is basically limited to work-oriented passengers crossing into Queens County from Nassau. This accounts for twenty-seven percent of the total county ridership. Although seven of the Suffolk routes enter Nassau County, only three serve a significant number of riders: Utility Lines—Patchogue to Freeport route; Mid-Island's Walt Whitman Shopping Center to Farming-dale; and Walt Whitman to Syosset-Hicksville routes.

The majority of bus trips for the Bi-County area are internal. Approximately 73 percent of all Nassau trips are made within the County itself, and in Suffolk almost all trips, other than the routes mentioned above, are local.

Conclusions and Recommendations — Deficiencies in the Nassau bus structure have not changed appreciably from those found in studies performed in 1950 and 1963. The Suffolk routes were studied for the first time in 1967 and appear to have characteristics and problems similar to those found in Nassau. Both counties have a total lack of coordination among the various operators, each company operating within its own sphere.

In Nassau County less than four percent of all trips are by bus, and in Suffolk it is less than one percent with total ridership declining in the face of a rising population."

A spiral of increasing fares and declining patronage resulting from the increasing labor costs, has brought about a decline in total level of service, e.g., headways, hours of operation and Sunday service.

Feeder service oriented to the needs of the rail commuters is lacking in Nassau County, in contrast to Suffolk County which has fairly good rail-bus schedule coordination.

Those with the greatest need for bus service, the old, the young, and the poor are essentially "captive" riders; that is, persons without alternate means of transportation.

Using a quarter mile as the maximum reasonable walking distance, substantial population areas that could be served are without bus service.

Terminal facilities are wholly inadequate. The public uninformed about bus service. Efforts to market but transportation are wholly lacking; bus stop signs are few and far between and schedules are not posted for public information.

Great inequities exist in the fare structure. In Nassau County, for example, trips of comparable distances to similar destinations can vary as much as one-hundred-twenty percent.

For most intra-county destinations, the traveler is faced with an inordinate amount of inconvenience, cost, and time. Lack of transfers and through routing leads to lengthy and often comparatively expensive trips.

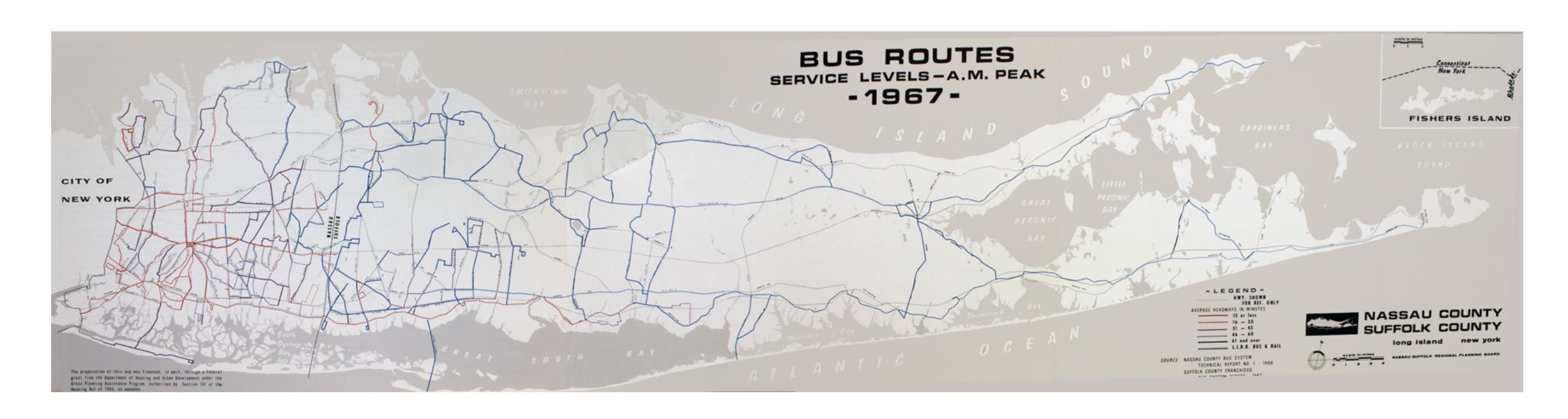
Elimination of these deficiencies will require substantial financial investment. Objectives as enumerated by the Nassau County Bus Study, will need to be more vigorously pursued:

Provisions of through routes providing as much service as possible to eliminate bus transfers.10

^{*} Long Island Journey-To-Work Report, 1963, Department of Transportation

Nassau County Bus System, An Analysis of Present Service, Technical Report No. 1, Nassau County Planning Commission

Nassau County Bus System, An Analysis of Present Service, Technical Report No. 1, Nassau County Planning Commission.



Routes should be revised so as to provide convenient access to railroad stations.

Coordination of service at particular interchange points to facilitate transfers with a minimum of inconvenience and delay.

Operation of service during similar periods each day to facilitate coordination.

Provisions of transfers between routes within a system, even though different companies may be involved, and for not more than a one fare zone increment charge.

A uniform information service is to be maintained in each system under which each company would provide detailed service information on all of the other companies.

Revision of zone fares to eliminate inequities and provide for charges on a reasonably uniform basis.

Future travel activities, because of increasing highway and parking congestion and operating costs, will need to rely less on the automobile and more on mass transit. The most realistic program will be one that efficiently develops a balanced system that will serve existing and future land uses. The Nassau consultant's report has worked out the following recommendations:

A system which provides about eighty-one percent more annual active bus miles than the existing system would realize an estimated fifty-three percent increase in patronage over that of the existing structure. This system, which is labeled the "ideal" system, would require annual subsidy if operated under present financial conditions. However, the consultant estimates that it would break even if operated by a single organization (private or public), which was exempt from capital costs and all taxes, as is the case with the New York City Transit Authority.

Many of the benefits of this proposed system, such as increased patronage and enhanced operating effectiveness, would result from a simplified route system (22 routes as opposed to 47), improved coordination and increased efficiency which would be made possible by unified operation.

It is recognized that transition from the present multi-operator system to a high service level unified system cannot easily be accomplished in a short time. The ideal system is, therefore, offered as a desirable planning objective for the County, and one whose effective annual cost to the County would be reduced by savings in other areas of transportation as well as benefits to Nassau County residents.

For more immediate implementation, a less extensive bus system is proposed. This system, comprising twenty-six bus routes and three operating divisions, would provide twenty-seven percent more annual active bus-miles than does the existing system and would attract an estimated thirty-seven percent increase in patronage. The system as a whole would produce an estimated net annual profit of about eight percent of estimated annual revenue.

Thus, the recommended system would provide considerably better service than the existing system due to consolidation of routes, higher bus frequencies and greater coordination, while yielding an estimated net profit for its operators which equals that of the existing system taken as a whole.

The Suffolk County consultant's report has indicated the need for further study that would:

Investigate the benefits of a franchise or transit agency similar to Nassau County's. It would be the duty of the franchise and Public Service Commission to oversee the establishment of the franchises, route, continuity, fares, transfers, and levels of service. Determine the criteria to be used by the Franchise agency in handling the problems of bus service extensions and changes to meet better levels of service.

Prepare a program of upgraded public relations aimed at attracting patronage away from competitive modes, and dissemination of pertinent bus information. This would include knowledge of bus routes, schedules, transfer points and fares, and perhaps bus stop shelters and terminals to key loading and transfer points.

Truck Transportation

Introduction — Truck is the most frequently used mode of transportation to ship commodities in the Tri-State Region. Approximately fifty-eight percent of the domestic tonnage is carried by trucks. This represents almost 3 billion dollars, or 61 percent, of the domestic freight revenue or cost.¹²

Origin and Destinations of Truck Freight—In 1963, the Tri-State Transportation Commission conducted a "Truck Survey" to determine the volume and characteristics of truck transportation. The survey included all types of trucks carrying freight. This information is important in determining the effect of trucking upon

the existing highway system and to predict future highway needs. The origins and destinations of truck trips are useful in locating major trip generating areas and in planning highway improvements.

The following map shows the volume and general direction of trips between designated areas within the Bi-County region for those trips having both their origin and destination within Nassau and Suffolk Counties. The designated areas are those established by the Long Island Lighting Company for the purpose of making yearly, comparative population surveys. The predominant direction is generally east-west.

Approximately 227,000 trips originate and terminate within Nassau County. Nassau County also generates 6,300 trips which terminate in Suffolk County, and another 10,000 trips with destinations outside the Bi-County area. Suffolk County generates 127,000 trips that terminate within its borders and 6,000 trips that have destinations in Nassau County. Approximately 2,000 trips generated in Suffolk County have destinations outside of the two counties. Incoming trips to Nassau and Suffolk Counties amount to 10,000 trips with destinations in Nassau and 2,000 for Suffolk County.

There is considerable internal movement within most of the designated areas, as shown on the following map.

Estimated Volumes of Truck Freight — In the Tri-State Region an estimated 331 million tons of freight were moved by truck in 1963. This volume represents 68 million tons brought into the region, 68 million tons that were shipped out of the region, and 195 million tons that had an origin and destination within the region. Bi-County's share of the total volume was approximately 28 million tons, or eight percent.

Regionally, the Tri-State Region generates less tonnage of freight per person than the national average. This is attributed to the unique character of the region which generates less freight because it specializes in the finance, communication and transportation and service industries. Manufacturing industries located within the region are typically light industry which require little fuel and a minimum of raw materials. The output of these light manufacturing industries is comparatively high in value and light in weight.

In addition, the region is so large and complex it is capable of supplying much of its own needs.13 On the basis of volumes han-

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Bus Route Planning Study, Nassau County, New York, Traffic Research Corporation, 1963.

¹² Tri-State Transportation Commission "Freight Traffic," Regional Profile Vol. 1, No. 1 (June 1966).

¹³ Tri-State Transportation Commission. "Freight Traffic" Regional Profile, Vol. 1, No. 1 (June 1966).

dled, the Bi-County Region generates about 13 tons per person of freight moved by truck compared to 18 tons generated by the Tri-State Region.

This great reliance upon the truck in the Bi-County area is evident when comparing the amount of tonnage moved percentage wise by all modes. In 1963, an estimated 42 million tons of freight were moved into, out of, and within the Bi-County area. The amount transported by air was a fractional part of a million tons. Eleven million tons, or 26 percent was moved by ship or barge and by rail. Truck transport accounted for the remaining 28 million tons or 67 percent of the volume. The Tri-State Region trucking handles 58 percent of the tonnage. In highly developed areas, such as New York City, other modes of transportation are more highly developed. Nassau and Suffolk's development is predominantly highway oriented.

Local Findings - In 1966, an Industrial Development Study was made of the Town of Babylon as part of that Town's Master Plan.14 The manufacturers responded that 92 percent utilized trucks to transport goods with an estimated value of 192 million dollars. Seventy-five percent of the raw materials were brought in by trucks and 75 percent of the finished products were shipped out by trucks. Sales distribution, by value was 45.9 percent to governmental agencies; 31.9 percent to other industries and 18.7 percent to the wholesaler or consumer. The destination of the goods by value, was 16.3 percent within the Bi-County Region; 7.7 percent to N. Y. C., 74.2 percent nationwide and 1.6 percent to foreign markets. Babylon is not dependent upon a local market for the distribution of goods but it is dependent upon a good highway system. One hundred and one manufacturers out of 148 respondents felt that "proximity to good highways" was the most important factor in selecting a site for a plant. Only ten felt that the availability of rail service was an important factor. This tends to indicate industries' increasing reliance upon the truck instead of the railroad which at one time was the most important factor in plant location.

Commodities Shipped — There are a considerable number of different products, goods, and materials moved daily. These commodities are listed under 22 uncoded, general categories listed in Table XI.

The following figures indicate the commodity flows affecting Nassau and Suffolk Counties. Figure 15 shows the origin and destination of major categories within the two counties. Mineral products (sand and gravel) and petroleum products account for seventy percent of the total tonnage.

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COMMODITY ORIGIN AND DESTINATION ON A TYPICAL DAY

Within the Bi-County Region

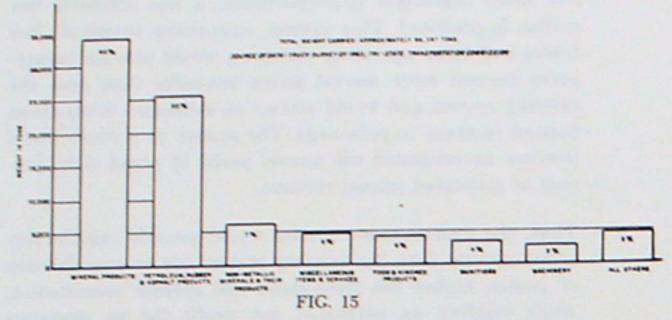


Figure 16 shows the importance of mineral products as the major export item from the two counties, accounting for thirty-seven percent of the total tonnage.

COMMODITY DESTINATION ON A TYPICAL DAY

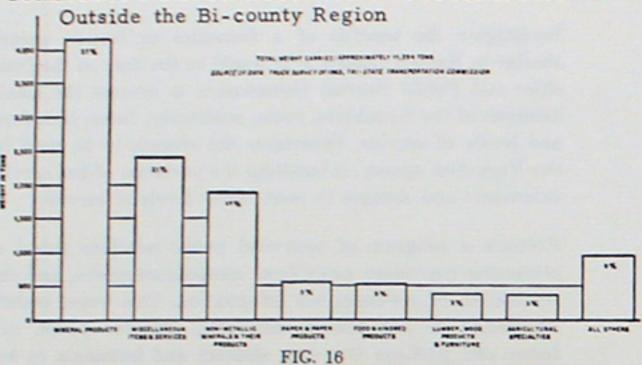


Figure 17 shows the imports into the two counties with lumber and food products accounting for fifty percent of the total tonnage.

COMMODITY ORIGIN ON A TYPICAL DAY

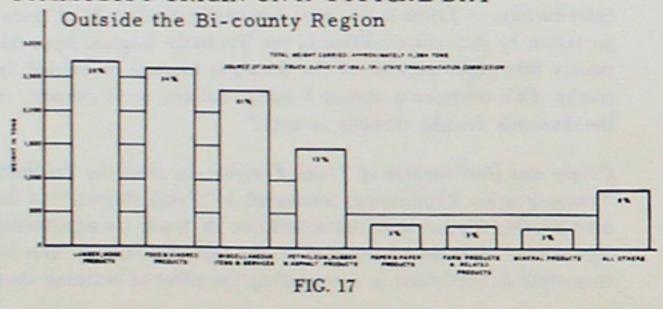


TABLE XI

STANDARD TRANSPORTATION COMMODITY CODE GENERAL CATEGORIES

- 1. Farm Products & Related Products
- 2. Horticultural Specialties
- 3. Mineral Products
- 4. Munitions
- Food and Kindred Products
- 6. Tobacco and Related Products
- 7. Textiles and Related Products
- 8. Lumber, Wood Products and Furniture
- 9. Paper and Paper Products
- 10. Industrial Chemicals
- 11. Petroleum, Rubber and Asphalt Products
- 2. Leather and Leather Products
- 3. Glass and Glass Products
- 14. Non-Metallic Minerals and their Products
- 15. Metal and Metal Products
- 16. Machinery
- 17. Household Appliances
- 18. Electric and Electronic Equipment
- 19. Transportation Equipment
- 20. Scientific and Control Apparatus
- 21. Miscellaneous Items and Services
- 22. People

Source: Tri-State Transportation Commission

Freight Rates — Because of its insular character the Bi-County area is placed at a freight rate disadvantage. This is specifically noticeable when the freight rate structure is compared to other areas in the Tri-State Region. Examples of this can be seen in Table XII.

Part of the reason lies in the archaic rate structure; which in some cases followed the patterns established by the railroads. Basically, the problem is related to the dead-end condition which prevents through movement of shipping. Trucks loaded in the south and destined for New England must transfer their Long Island cargo in New York City. This results in extra handling, thus increasing the transportation cost. Due to the nature of our industries, the trucks that bring shipments out on Long Island often return unloaded or with an uneconomical load. The size of the shipment is also a factor in the rate structure.

¹⁴ Master Plan Industrial Development Survey, Report No. 9 Research and Analysis Phase 3, April 1967 Edwin S. Voorhis & Son Inc. Consulting Engineers & Planners

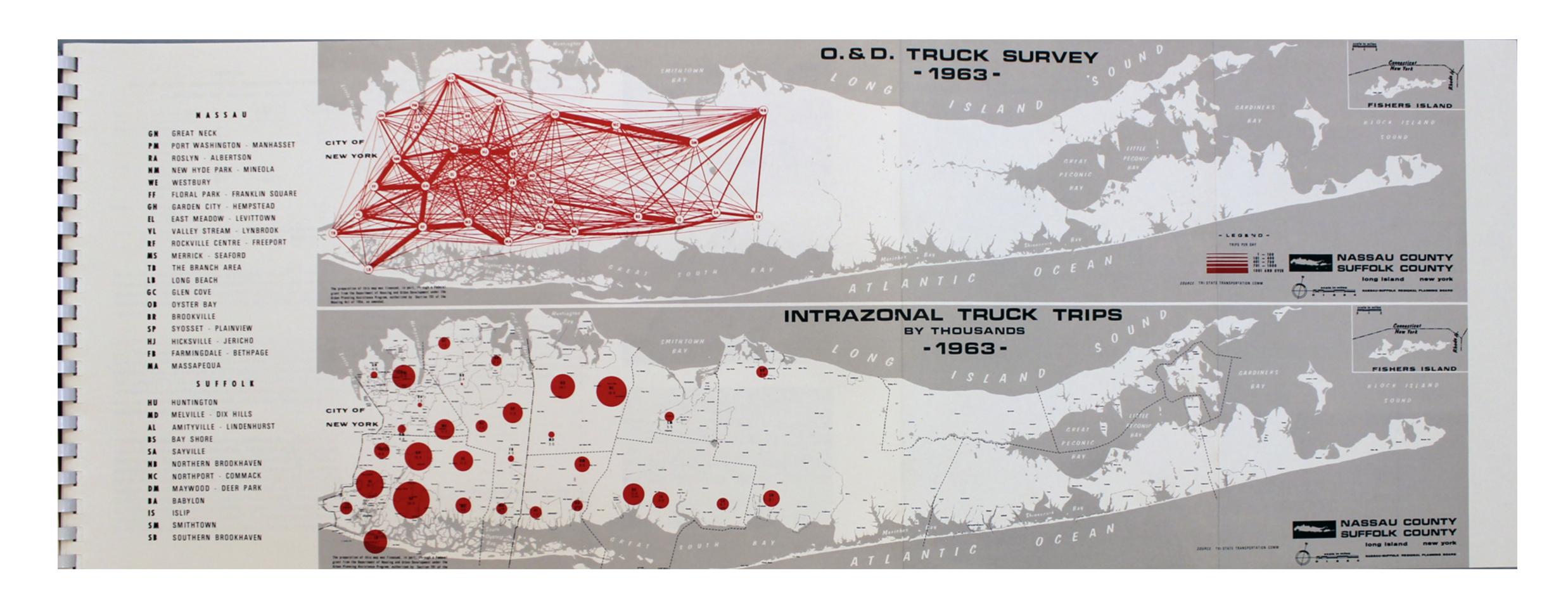


TABLE XII
COST OF TRUCK SHIPMENT OF ELECTRICAL EQUIPMENT
IN DOLLARS PER HUNDRED POUNDS

To:	New York City	Miles	Trailer Load 16,000 Lbs.	Trailer Load 24,000 Lbs.
From:	Bridgeport	50	esaministant an	.81
	Huntington	35		1.00
	New Brunswick	35		87
To:	Boston			
From:	Bridgeport	160	1.10	
	Huntington	240	1.47	
-	New Brunswick	250	1.43	
To:	Philadelphia			
From:	Bridgeport	140		1.39
r Tolli.	Huntington	125		1.64
	New Brunswick	55		.91

Source: An Industrial Development Study of Suffolk County, Published "Motor Carrier Freight Tariffs," by Arthur D. Little, Inc., September 1965, pg. 35.

When the truck does not carry a full load the LTL (Less Than Truck Load) rate applies. This results in higher costs due to additional handling. Suffolk County shipping rates may average 20 percent above those of other competing areas in the metropolitan region.¹⁵

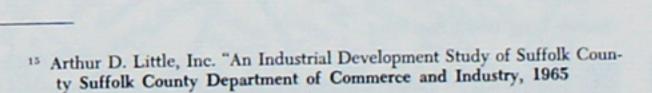
Motor freight transport is broken down into several types of carriers. The common carriers of general freight utilize motor freight terminals as the base of all activity for handling, control, storage and maintenance of equipment. The private carrier, usually owned and operated by the manufacturer, moves between the factory, or warehouse, and the consignee. The contract carrier has little need for terminal facilities of their own as they operate from the shippers to the consignees platform.

Terminal Facilities — There are no central motor freight terminals in Nassau and Suffolk Counties. All of the major motor carriers operate from private terminal facilities which are individually owned or leased primarily for storage purposes. To a certain extent these terminals act as distribution points for interstate, and intrastate freight. The terminals, through working arrangements, are made available to carriers from outside the region as connecting points in the distribution system. Consolidated shipping terminals in the region, especially in Suffolk, may be helpful as the size and number of shippers increase in the future.¹⁶

In 1964, of the 580,000 trucks registered in the State, 10 percent were used by "for-hire carriers". In the Bi-County Region there was about 90,000 commercial vehicles of all types registered. Approximately 65,000 persons were employed by the trucking industry with the annual payroll reaching 450 million. The "for-hire" trucks were operated by approximately 2,000 companies with gross revenues exceeding one billion dollars. By 1967, this revenue had grown to an estimated 1.5 billion dollars. Generally the growth during this period has averaged about 5 percent per year. There is no doubt that trucking is an important part of the state's economy.

In the Tri-State Region the number of tons of freight carried by trucks increased, in the 20 year period from 1945 to 1965, by 170 percent while the corresponding increase in freight revenue or cost jumped 345 percent. During the same period population increased by 31 percent. It is estimated that in the period 1965 to 1985 the tonnage carried by trucks will increase by 60 percent and the revenue or freight cost by 70 percent while the population growth will only increase by roughly 26 percent. The length of haul characteristics will undoubtedly remain the same with trips in and out of the region of 115 miles while trips within the region will be about 14 miles in length.¹⁸

Conclusions — As the Bi-County Region continues to develop, it is expected that industrial and commercial development will keep pace. These trends will create a demand for increased motor transport facilities to handle the needs of the additional plants. Through the development of additional industrial facilities, and the construction of one or more bridges to New England, the pattern of truck shipping will be balanced and a more equitable freight rate structure should result.



¹⁶ Annual Report of the Office of Transportation 1964



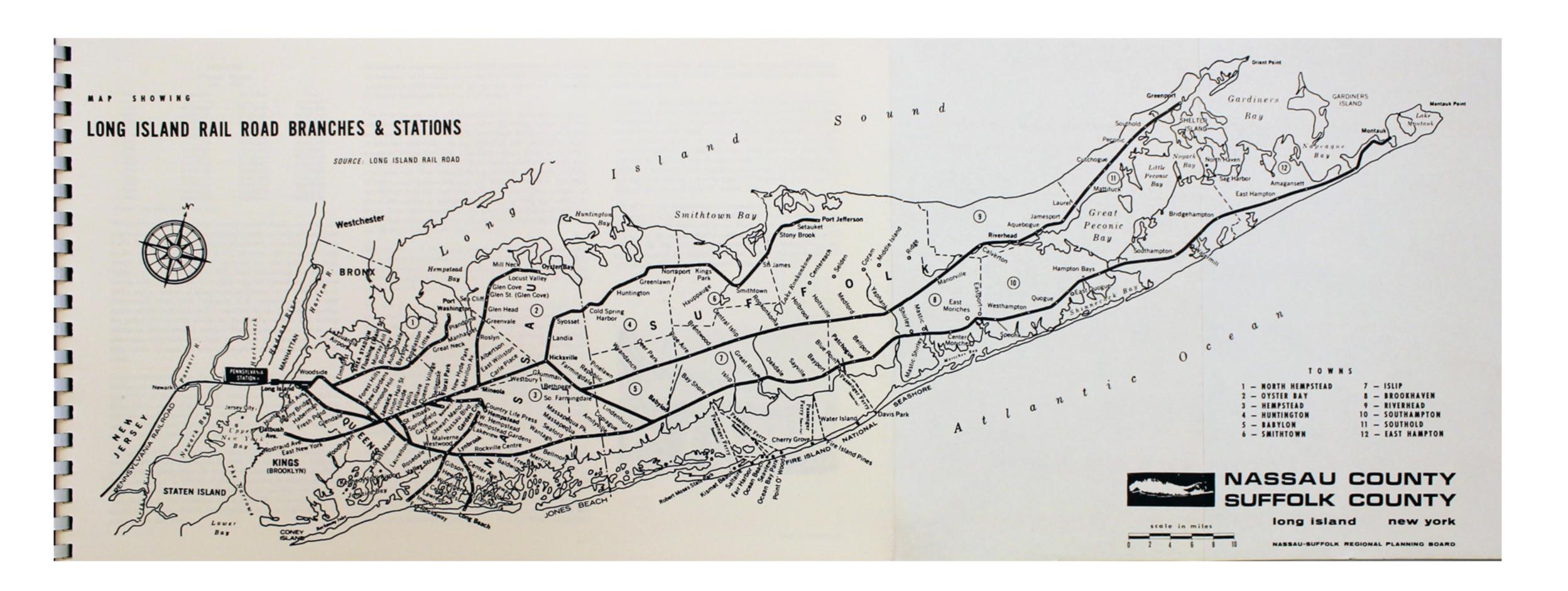




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¹⁷ Annual Report of the Office of Transportation 1967

¹⁸ Annual Report of the Office of Transportation 1964



Rail Transportation

Introduction — The Long Island Railroad is the largest suburban railroad in terms of volume of passengers carried in the nation. The map on the following page depicts the various lines and stations.

The primary function of the railroad now as in the past, is that of providing commuter transportation. Present plans of the Metropolitan Transportation Agency would indicate that its passenger service will become even more important. At the present time approximately 10 percent, or 93,000 persons in the Bi-County labor force, use the railroad as their principal mode of transportation. A relatively small number of people use the rail for purposes other than journey-to-work. This is evidenced by the fact that 88 percent of rail commuters are carried within the 7-10 a.m. and the 4-7 p.m. peaks, according to the Tri-State Transportation Commission.

Long Islanders use several modes of transportation for their journey-to-work. The automobile handles most of the daily travel. The complete breakdown of the various modes is indicated as follows:

TABLE XIII
COMMUTATION BY MODE

19	63
Mode of Transportation	Nassau-Suffolk Percentage
Automobile	70
Rail	9
Bus	3
Subway	3
Other*	15

Source: Long Island Journey-to-Work Report 1963

* Walk, Work at Home, Taxi, Motorcycle, etc.

It is significant that while the population of Bi-County has increased about 79 percent from 1954-1967, rail passenger traffic has actually declined almost 5 percent. The explanation can be traced to increasing competition from the automobile and in part to the level of rail service offered.

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As a freight carrier, the importance of the L.I.R.R. declined over the same period, 1954-1967. The number of revenue freight tons hauled fell 12 percent. Proportionately, as with passengers carried, only 10 percent of Bi-County's total freight movement is shipped by rail.

Inventory — The railroad operates 334 route miles of main line track and 270 miles of company sidings, most of which are located in the Nassau-Suffolk region. This total includes 103 miles of electrified rail using 660 volts DC with overrunning third rail shoes extending from Penn Station and Flatbush Avenue eastward to Port Washington, East Williston, Babylon, Hempstead, Long Beach, West Hempstead, and Far Rockaway.

As of July 1, 1965, the L.I.R.R. owned 56 locomotives, 1192 passenger cars and 89 freight and miscellaneous cars and leased 22 locomotives and 30 passenger cars. The total 1222 cars include 857 multiple unit (electric) cars, 363 standard coaches and 2 RDC coaches (self-propelled diesel cars). Of these only 300 are needed for non-peak hour service.

Updated figures given as of February 1, 1968, indicate that the L.I.R.R. owned 56 locomotives, 1193 passenger cars and 80 freight and miscellaneous cars while leasing 25 locomotives. Of the 1193 passenger cars, 808 are multiple unit cars and 385 are standard coaches.

Current Revenue and Traffic — As shown on Table XIV and XV despite a 5 percent drop in passenger traffic, revenues rose because of higher fares and the longer average distances commuters traveled in 1967 as compared to 1954.

TABLE XIV

1967

Commuter Traffic Characteristics

County of Origin (%)

Year	N. Y. C.	Nassau	Suffolk	Average Distance*
1954	10.8	75.2	14.0	25.3 miles
1965	2.5	74.5	23.0	28.8
1966	2.1	74.1	23.8	29.1
1967	1.8	73.4	24.8	29.5

Source: Long Island Rail Road

The percentage of passengers in the zones up to and including 25 miles has been steadily declining. Those zones beyond the twenty-five mile limit have been showing a proportionate increase as shown on Table XV.

TABLE XV

PERCENTAGE OF L. I. R. R. TERMINAL COMMUTERS
TRAVELING VARIOUS DISTANCES FROM NEW YORK

		MILES FROM NEW YORK							
ERS	YEAR	0-10	10,1 - 15	15.1-20	20.1-25	25.1- 30	30.1-35	35.1-50	SO.1
COMMUTERS	1954	0.2%	5.4%	26.0%	32.0%	16.4%	8.3%	9.7%	2.0%
0 40	1958	0.1	3,3	22.2	29.3	19.3	10.7	12.9	2.2
PERCENT	1964	0.3	1.7	18.5	27.7	20.7	12.1	16.4	2,6
	1967	0.1	1.0	16,4	26.1	21.6	12.8	18.8	3.2

Source: L. I. R. R. Summary of Terminal Commuters, 1967

The price of a commuter ticket on the L.I.R.R. rose 184% from 1947 to 1965, while the consumer price index (CPI) rose only 42% and the price of transportation items in the family budget rose only 73%. In other words, during the past 18 years the L.I.R.R. has raised its prices over four times higher than the increase in the general price level and yet has been unable to produce a profitable operation due to rising operating costs and declining sales.

The loss of patronage by the commuter can be traced largely to the growing competitiveness of the automobile as an alternate mode of transport to work. For instance, the extension of the Long Island Expressway was probably the principle cause of a drop in passengers carried by the L.I.R.R. in the early 1960's. As shown on Table XVI.

¹⁹ Long Island Journey-To-Work Report, 1963

²⁰ CPI and Transportation Index: U. S. Dept. of Commerce—L.I.R.R. commuter price index computed by the Bi-County Planning Board staff.

TABLE XVI Passenger Volumes 1954 - 1967

Year	Commuters	All Others	Total
1054	70.040.000	25 252 224	70 001 000
1954	50,648,908	27,373,084	78,021,992
1955	50,542,723	25,884,421	76,427,144
1956	50,087,389	25,189,601	75,276,990
1957	49,934,088	23,995,687	73,929,775
1958	53,828,700	19,779,920	73,608,620
1959	53,980,708	19,953,922	73,934,636
1960	47,800,938	16,577,653	64,378,591
1961	50,563,617	18,538,516	69,102,133
1962	53,107,352	18,175,461	71,282,813
1963	53,622,003	17,890,823	71,512,826
1964	55,037,984	22,511,055	77,549,039
1965	53,763,639	20,231,343	73,994,982
1966	54,950,234	18,858,713	73,808,947
1967	55,694,104	18,589,281	74,283,385

Source: The Long Island Rail Road

The growing impact of motor vehicle transportation over railroad transportation had its effect on freight traffic as well as passenger traffic. Despite a 79% increase in population, revenue freight tons hauled by the L.I.R.R. fell 12.3% between 1955 and 1967, and freight revenues fell 28.0%. Revenue per ton mile fell from 14.306c in 1955, to 10.638c in 1965. This decline was the result of both a shift in the types of freight handled toward less lucrative items, and a downward adjustment of freight rates in the face of competition from truck transport. It is interesting to note that motor vehicle competition has resulted in the L.I.R.R. pursuing the policy of lowering prices on its freight service, and raising prices on its passenger service. Hence, passenger revenue per passenger-train mile rose from 7 cents to 11 cents from 1955 to 1965, while revenue ton-mile of freight fell from 14 cents to 10 cents.

Despite rising revenues, the L.I.R.R. continued to operate on the borderline of bankruptcy due to rising costs. During the 12 years from 1954 to 1965, the L.I.R.R. showed a net loss of \$1,874,675. Even during years of profits, the rate of return on invested capital has only rarely exceeded 1%. This can be compared to the prosperous 1920's when the annual rate of return averaged 4.9%, and even as late as 1933 when it was a comfortable 3.0%.

Findings and Conclusions — In spite of a \$65 million capital improvement program launched in 1954, the Long Island Railroad steadily lost influence in the commuter and freight traffic markets due in some part to the use of the automobiles by commuters and trucks for freight shipments. However, the greatest shortcoming contributing to this situation was a generally poor service level, as evidenced by schedule inadequacies and obsolete equipment and station facilities.

An extensive program of improvements has been formulated since the takeover of the L.I.R.R. by the Metropolitan Transportation Authority in 1965 and aided by the approval of the state-wide 2.5 billion transportation bond referendum.

The program that will affect the New York State portion of the metropolitan region will cost a total of 2.9 billion dollars and will be conducted in two phases. The first phase would cost 1.6 billion dollars and would be fully committed in five years and totally completed within ten years. The second phase would be an extension of the first and cost 1.34 billion dollars. Regionally, this area is divided into four transportation corridors; Nassau, Suffolk, Brooklyn, and Queens make up the Eastern Corridor. The Nassau-Suffolk corridor has been allocated 1.34 billion dollars of which 806 million is assigned to Phase One and 533 million to Phase Two. Improvements to the Long Island Railroad will cost 216 million during the first phase and 271 million during the second phase; a total of 487 million dollars.

Improvements to the Long Island Railroad encompass three areas: one is the extension of electrification and the construction of high level platforms; two, the purchase of new high-speed, air-conditioned cars; and three, general improvements to the system so that the new equipment can be fully utilized.

The first phase of the extension of electrification includes that portion of the Main Line between Mineola and Hicksville (6.3 miles), the area between Hicksville and Huntington on the Port Jefferson Branch (9.8 miles), Huntington to Northport (5 miles), and the Main Line extended from Hicksville to Pinelawn (7.6 miles). The second phase will complete the program; the Port Jefferson branch will be completely electrified; the Main Line to Ronkonkoma; and from Bethpage to Patchogue. At the completion of both phases, a total of 86.7 miles of line will have been electrified. During each phase of this work high-level platforms will be constructed at all stations along the newly electrified lines to allow use of the new cars. In addition, monies from an urban mass transportation grant will be used to upgrade the existing electrified portion of the railroad.

In August 1967, the M.T.A. announced the awarding of a contract for 57.3 million dollars to the Budd Company of Philadelphia for construction of 270 high-speed, air-conditioned cars which will be used on the Long Island Railroad. During Phase One, a total of 350 eighty-five foot electric cars will be purchased from car manufacturers at an estimated cost of 84 million dollars. During Phase Two, 178 million dollars will be expended upon an additional 650 cars. Two-hundred-fifty cars will be used for lower Manhattan

service, 150 gas-turbine electric cars for non-electrified territory, and the remaining 250 eighty-five foot electric cars for future traffic requirements.

In order to accommodate this new rolling stock, extensive improvements are needed in the system. Included in the first phase of construction is the expansion of the yard and shop facilities, improvement of the signal system to permit the operation of more trains at faster speeds and with greater safety, improvement of track and roadbed so that the high-speed potential of the new cars can be utilized, and modernization of the Jamaica Station facility to minimize train changing and delay. Additional expansion and improvements will be made in the yards, shops, signals, stations and track during the second phase.

The M.T.A. has included in its proposed program the concept of transportation centers as developed in the Suffolk County Planning Commission Study, Park and Ride, to provide for the creation of several transportation centers. These centers will coordinate air, rail, bus, and auto transportation. The first of these centers is proposed for Republic Airport. Later, transportation centers will be developed at Hicksville and MacArthur.



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Air Transportation

Introduction — Air traffic is assuming an ever greater importance in the overall movement of people and goods. According to the Federal Aviation Administration, the national rate of growth for expenditures in air transportation has been approximately three times the rate of growth of the gross national product.

Air transportation includes the movement of passengers and cargo via the scheduled public airliners and all other civil non-scheduled flying; e.g., business, personal, pleasure, instructional, and air taxi, are referred to as general aviation. General aviation has shown the largest increase in terms of movements, registered aircraft and hours flown. Industry is increasingly utilizing aircraft to provide urgently needed mobility and flexibility for its sales, engineering and scientific staffs as well as for the shipment of critical materials. In 1960, 76,000 registered aircraft were used for general aviation purposes; triple the number of domestic commercial planes. Many factors are responsible for the increased use of air transportation including mounting highway congestion, increasing costs of surface transportation, the loss of many rail and marine passenger services, and faster travel times with resultant cost savings.

Bi-County General Aviation — Air traffic movements in 1967 at the busiest Bi-County airfields were approximately 44 percent greater in Suffolk County than the total movement at Kennedy and LaGuardia fields, as shown in the following Table XVII.

TABLE XVII

COMPARISON OF LOCAL & REGIONAL AIR TRAFFIC

1967

••
Number of Movements
420,000
290,000
710,000
Number of Movements
318,000
300,000
180,000
145,000
28,000
(approx.) 50,000
1,021,000

Source: Port of New York Authority, Federal Aviation Agency

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The demand for general aviation is measured by the actual number of aircraft registered, and the number of movements they generate. Nationally, movements have increased 16 percent compared to a registration increase of 5 percent. Table XVIII shows the comparison between the New York Region and the nation.

TABLE XVIII
ANNUAL GROWTH RATE OF MOVEMENTS AND REGISTRATIONS
1957-1967

Movements	Annual % Increase	Registrations	Annual % Increase
N. Y. Region*	5	N. Y. Region*	5
Nation	16	Nation	5
		Bi-County	6

Source: F.A.A. and MacArthur Airport

*At the three New York Authority Airports

In the Bi-County Region, the number of registrations have been increasing at an annual rate of a little over 6 percent, slightly more than the national and New York regional averages. The total registrations for Nassau-Suffolk residents grew from 337 to 551, as shown on Fig. 18, and is projected to increase to about 760 by 1975.

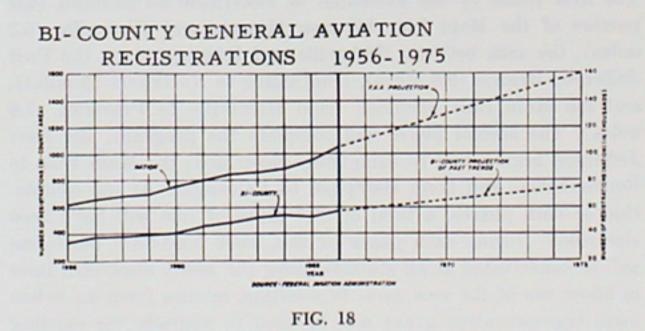
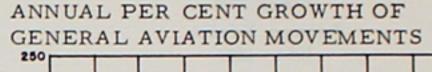
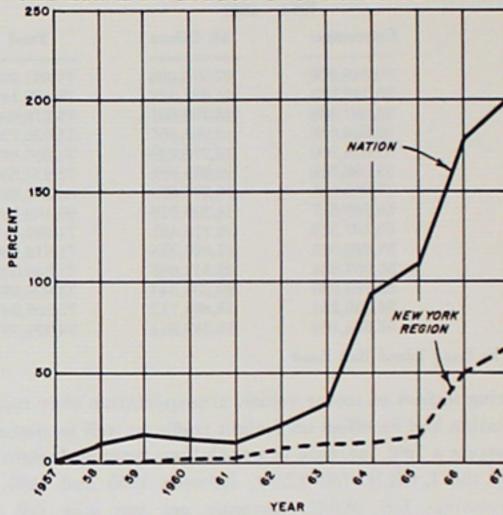


Fig. 19 shows the actual percent growth of movements over the base year 1957. The New York Region grew 60 percent as compared to 200 percent for the nation.

Bi-County Market for Scheduled Passenger Service — The Nassau and Suffolk region is a prime market for air travel. General aviation is currently the most important facet of air transportation on Long Island.





SOURCE: FEDERAL AVIATION ADMINISTRATION, PORT OF NEW YORK AUTHORITY

FIG. 19

Table XIX shows the steady growth of domestic air service within the Nassau-Suffolk area. From 1956 to 1963, it increased 58 percent. Suffolk County's domestic air passengers increased 135 percent and Nassau County's increased 46 percent during the same period.

TABLE XIX DOMESTIC AIR PASSENGERS ORIGINATING FROM THEIR COUNTY OF RESIDENCE

	1956	1963		rease
Nassau	296,000	433,000	+	46
Suffolk	47,000	111,000	+	135
Bi-County	343,000	544,000	+	58
Queens 16 County N. Y.	263,000	435,000	+	54
Metropolitan Total Source: Port of New York	3,603,000 Authority	6,000,000	+	66

The demand for foreign air travel, while increasing at much higher percentages than for domestic flights, is numerically a much smaller share of the total as shown on Table XX. For example, in 1963 there were 36,000 foreign air passengers whose county of residence was Nassau and Suffolk, compared with 544,000 domestic air passengers.

TABLE XX FOREIGN AIR PASSENGERS ORIGINATING FROM THEIR COUNTY OF RESIDENCE

	1956	1963	% Change
Bi-County	10,300	36,000	260
Queens	12,000	47,000	290
N. Y. Metropolitan Total	292,000	907,000	210

Source: New York Port Authority

DOMESTIC AIR PASSENGERS TRIPS BY COUNTY OF RESIDENCE 1963

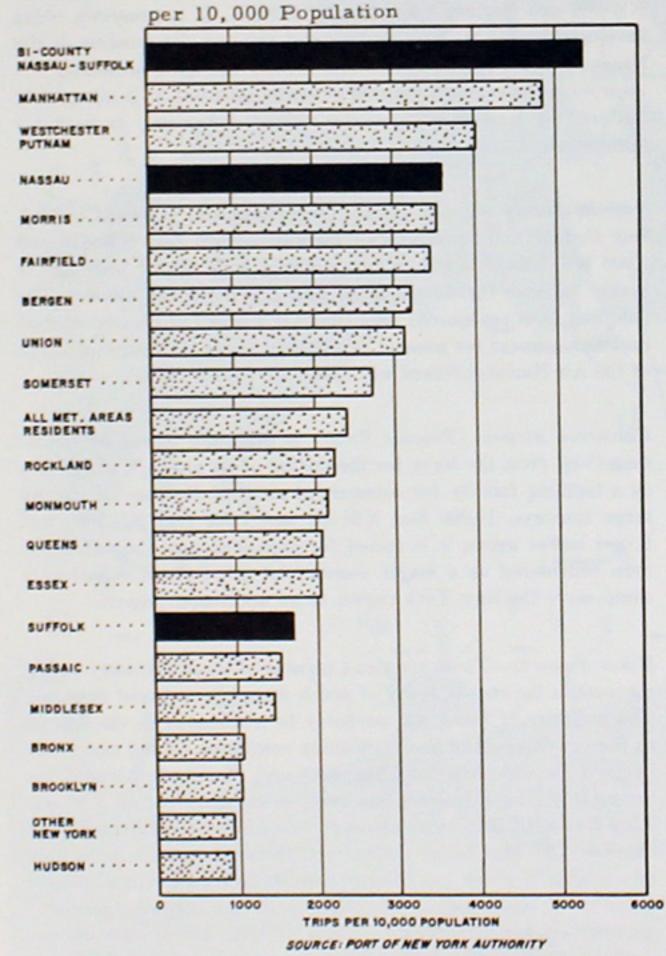


FIG. 20

Figure 20 indicates the number of trips made by passengers originating from their county of residence. Of the 21 location groupings in the region, Nassau is third in the number of trips per 10,000 population and Suffolk County is fourteenth; but together they generate more air passenger trips per 10,000 persons than even Manhattan.

The market for Bi-County air travel to upstate New York and New England increased sharply from 1956 to 1963. As indicated in Table XXI, Nassau passengers traveling upstate during this period increased by 120 percent and to New England by 67 percent. Suffolk County passengers to upstate areas increased 550 percent and those going to New England by 60 percent.

AIR TRAVEL TO UPSTATE NEW YORK AND NEW ENGLAND
FROM NASSAU, SUFFOLK, AND QUEENS COUNTIES

		Upstate New York	k*
			Percent
	1956	1963	Increase
	-		
Nassau	16,000	35,000	120%
Suffolk	2,000	13,000	550
Bi-County	18,000	48,000	166
Queens	20,000	30,000	50
		New England	Percent
	1956	1963	Increase
			070
Nassau	28,000	47,000	67%
Suffolk	5,000	8,000	60
Bi-County	33,000	55,000	66
Queens	20,000	55,000	170

Source: Port of New York Authority

The MacArthur Airport is the only scheduled air facility within the Nassau-Suffolk area. In 1965 MacArthur handled 39,000 passengers, increasing by 25 percent one year later and 40 percent, or 70,000 passengers, in 1967.

Air Freight — The importance of air transportation includes the movement of goods. Nationally and regionally the tonnage moved by air is steadily increasing. Although the volume is proportionately small compared to the total amount moved by surface modes, the freight is mainly high value cargo. The actual rates or cost of shipping per ton-mile by various modes for the Tri-State region is listed on Table XXII.

TABLE XXII
REVENUE OR COST PER TON-MILE

		(cents)		
Water	Pipeline	Rail	Truck	Air
0.46	0.39	1.66	7.40	26.00

Source: Tri-State Transportation Committee, "Regional Profile-Freight Traffic," 1966.

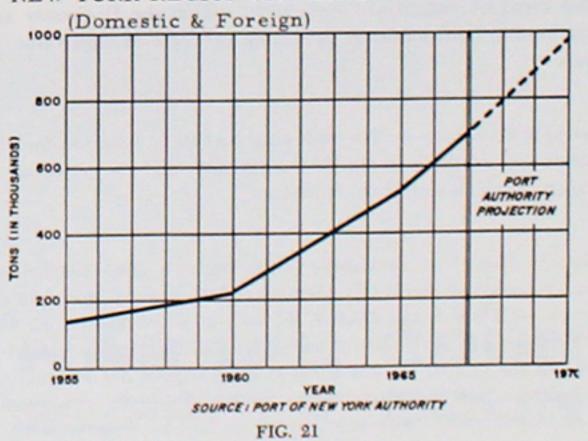
The table indicates that it is almost four times as expensive to ship by air than by truck and fifteen times more than by rail.

As super-cargo jets take their place in the air freight industry and larger volumes of commodities are handled, a subsequent decrease in rates is possible.

Nationally and regionally, as of 1962 less than one percent of the total freight (ton-miles) was handled by air freight. Trucks handled 73 percent of the total freight carried, water-borne freight accounts for 26 percent, rail 1.5 percent, and pipeline less than one percent.

Air freight has shown a steady increase. As shown in Figure 21, 518,000 tons of air freight were flown in 1965; a 136 percent increase over 1960. The New York Port Authority estimates one million tons of cargo to be shipped via air freight by 1970, or an increase of 88 percent over 1965.

NEW YORK REGION AIR CARGO



²¹ Tri-State Transportation Committee, "Regional Profile-Freight Traffic," 1966.

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^{*}Note: Albany, Utica, Buffalo, Rochester, Syracuse

In 1963 44,000,000 tons of cargo entered and left the Bi-County area via the various carriers. Air freight's share of this total was approximately 25,000 tons. The majority of this Bi-County freight was processed at the major New York commercial airports. A steadily increasing amount of freight tonnage is flown directly from Long Island MacArthur Airport.

The value of the product being shipped is an important element of air freight. Information obtained from a local transportation study shows that air freight has a proportionately higher dollar value than that of other freight carriers as shown on Table XXIII.

TABLE XXIII

ESTIMATED DOLLAR VALUE OF FINISHED PRODUCTS SHIPPED BY TYPE OF TRANSPORTATION WITHIN THE TOWN OF BABYLON—1966

Transportation Type	Value of Finished Product Shipped (millions of dollars)	Percent of Total		
Air Freight	29.0	3.6		
Truck	736.1	92.0		
Rail	9.4	1.2		
Other	25.3	3.2		

Source: "Industrial Development Survey Report No. 9 Research and Analysis, Phase I," Town of Babylon (1966), Edwin S. Voorhis & Son, Inc.

Thus air freight with less than one percent of the total volume, constitutes 3.6 percent of the total value.

The trend of industrial development within the Bi-County area has been in light industry, producing products of high value/low bulk.

Airport Inventory — The following inventory lists the facilities which are available in the Bi-County area and the potential for future expansion of these facilities.

Zahn's Airport — Amityville is the region's most heavily used general aviation facility. It operates at full capacity from two runways— 4,200 N-S and 3,000 E-W, both of which are paved. Over 350 planes are permanently based here, and there are hangar facilities for 175. Of the 130 acres at Zahn's, none are available for expansion, and the surrounding lands are heavily developed in residential uses. There are only small buffer zones between the runways and the adjacent residential lands. The site has good access via Southern State Parkway and Sunrise Highway. Its future

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is limited due to the conversion of Republic Airfield for general aviation by the Metropolitan Transportation Authority.

Deer Park Airport at Deer Park is operating at full capacity, and is the permanent base for 125 general aviation aircraft. It has one NW-SE paved runway of 2,400 feet and hangar facilities for 35 aircraft. A second smaller runway has been closed, because of directly abutting residential development. Industrial development and roads limit any further expansion to the north or west, while residential areas in the southeast prohibit expansion in that direction.

MacArthur (Long Island Airport), Bohemia is owned by the Town of Islip. It operates at full capacity from three 5,000 foot runways. The airport is the base for about 190 aircraft with hangar facilities for about 20 planes. Access to MacArthur is excellent with frontage on Veterans Memorial Highway, between the Long Island Expressway and the Sunrise Highway. The site has good buffer zones and at the present time the surrounding land is only lightly developed in residential and industrial uses. Current plans call for the extension of the main runway and additional ancillary facilities. In addition to providing general aviation facilities, MacArthur offers scheduled airline service via Allegheny and Mohawk to a number of cities including Boston, Bridgeport, Philadelphia, and Washington, D.C. Extension of this service to other locations is foreseen in the near future. Air taxi service is available to the New York airports on a regular basis.

Brookhaven Airport (Shirley) is owned by the Town of Brookhaven and operates at capacity. It contains two runways—4,200 NE-SW and 4,375 feet NW—SE and facilities for basing approximately 65 aircraft. Recommendations of the National Airport Plan call for various improvements aimed at better utilization of the existing runways. It has good access, located close to William Floyd Parkway and the Sunrise Highway. Although the surrounding land is lightly developed, there are inadequate buffer zones along the sides of the runways. Vacant land to the northeast represents the best possible area for future expansion.

East Hampton Airport (East Hampton) is owned by East Hampton Town and operates at approximately 80 percent of its full capacity from three runways: 4,232 feet E-W, 2,491 feet NW-SE, and 2,501 feet NE-SW. Approximately 36 aircraft are based at the field with plans for a new terminal and a six plane hangar. This site is completely surrounded by vacant land and for the time being is well buffered from surrounding uses. Expansion is somewhat limited by the Long Island Railroad on the south and the

LILCO right-of-way to the north but it is feasible to provide additional expansion.

Grumman Airport (Bethpage) contains two runways; one 6,600 feet NNW-SSE and another 3,200 feet E-W. The lack of buffer zones and the highly intensive residential development surrounding this facility probably will preclude its development for general aviation. It is presently being utilized to test-fly production aircraft.

Republic Airport (Farmingdale) has two runways; one 7,500 feet NW-SE and another 6,596 feet NNE-SSW. It is presently being developed by the M. T. A. for general aviation. Its position at the Nassau-Suffolk border makes this facility the most promising for improving the region's general aviation potential. It is adequately buffered by land which is either vacant, industrial, or used for cemeteries.

Suffolk County Air Force Base (Westhampton) is owned by Suffolk County and contains two runways—9,000 feet NE-SW and 5,000 NW-SE. It is adequately buffered with vacant land and is highly suitable for development into a general use airport. The field has been reacquired from the Air Force for County control and management for general aviation purposes. In addition, a unit of the Air National Guard will operate from the field.

Calverton Airport (Peconic River) is presently leased by Grumman Corp. from the Navy for the testing of jet aircraft, and serves as a training facility for commercial airlines. Because of its two large runways, 10,000 feet NW-SE and 7,000 feet NE-SW, and larger buffer areas, it is suited for expanded use. Calverton has been considered as a major commercial jetport and conceivably could serve the New York region as an additional jetport.

Minor Airports—There are also a number of small privately owned airports in the region, many of which do not have paved runways. The majority of these will probably be abandoned in the future, as the development of Suffolk County continues. Of the minor airports, Edward's Airport (Bayport) and Mattituck Airport are the most active. Edward's has two runways, 2,840 feet N-S and 2,500 feet NNE-SSW with about 20 based aircraft. Mattituck with one N-S 2,260 foot paved runway and 14 based aircraft is the only minor airport which has hangar storage facilities with a present capacity of eight planes. In addition to the airports surveyed above, there are four major private airports which have the potential for conversion into substantial general aviation facilities.



Findings and Conclusions - The Bi-county area will experience a substantial growth in general aviation activity. Fig. 22 depicts the projected increase in general aviation movements at an annual rate of five percent. This is a conservative estimate in view of the Port of New York Authority projection of an eight percent increase through 1985. Should airport capacities remain at their present level, a critical shortage of runway space will develop in the near future. The F.A.A., in its 1968 National Airport Plan, indicates that if all of its suggestions for the New York region were implemented, the demand would be satisfied only until 1973.22 The Bi-County area will grow by an additional one million movements by 1985. The Airport Facilities Map depicts 17 general aviation facilities serving the Bi-County Region. Five of these airports: MacArthur, Zahns, Deer Park, Brookhaven and East Hampton, handle 94 percent of all Bi-County movements. Four of these fields are located in the western half of Suffolk, one in the eastern half.

GENERAL AVIATION MOVEMENTS



FIG. 22



SUFFOLK COUNTY AIRPORT

²² F.A.A. National Airport Plan 1969-1973.

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Water Transportation

Location of Seaports — On the north shore of Nassau and Suffolk Counties there are 7 major, 2 minor, and 3 unclassified seaports. On the south shore there are 1 major, 4 minor, and 7 unclassified seaports. The following map depicts the location of these facilities. Table XXIV lists the terminals, by type of waterborne commerce. Table XXV depicts the volume in tons for the period between 1956 and 1966 for the following seaports and waterways.

Hempstead Harbor — This six-foot channel extends about two miles from Bar Beach to Old Town Wharf. There are several facilities for handling sand and gravel, cement and petroleum.

Glen Cove Creek — This eight-foot channel runs about one mile from deep water in Hempstead Harbor to the City of Glen Cove. There are several industrial and pleasure boat facilities.

Oyster-Northport Bay Area — This area includes Oyster Bay, Cold Spring Harbor, Huntington Bay, and Huntington and Northport Bay harbors. Huntington Harbor, serviced by the Old Town

TABLE XXIV

Terminals on Waterways by Type of Waterborne Commerce

(as reported to CE U.S.A. N.Y. District Office

September, 1967

County	Waterway	Oil Term	Sand & Gravel	Asphalt	Other	Fisheries	10
Nassau	Manhasset Bay	8	1	1	-	-	10
	Hempstead Harbor	6	5	1	-	-	12
	Glen Cove Creek	2	2.	1.	1	-	6
	Oyster Bay Harbor	1	1	_	-	1	3
	Cold Spr. Harbor	1	_	-	-	-	1
	Island Park	3	_	_	-	_	3
	Oceanside	6		-	_	-	6
	Total	27	9	2	1	1	40
Suffolk	Huntington Harbor	3	2	-	_	_	5
Julion	Northport Harbor	1	1		-	_	2
	Port Jefferson Har.	5***	2	_	-	_	7
	Northville, L. I.	1			-	_	1
	Mattituck Harbor	1		1	-	_	2
	Three Mile Harbor	_		_		1	1
	Greenport Harbor	1		_		3	4
	Sag Harbor	1		_	_	_	1
	Amagansett					1	1
	Fort Pond Bay		1		-	1	2
	Great South Bay	_		_	-	3	3
	Patchogue River	3		-	_	_	3
	Orowac Creek		-	-	_	3	3
	Shinnecock Inlet				-	2	2
	Total	16	6	1	-	14	37
Total P	ii-County	43	15	3	1	15	77

Sand and gravel and asphalt combined facility at Rosen Dock

*** Includes coal

Source: Corps of Engineers

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TABLE XXV Major and Minor Seaports

	High, Low and I	Percent Change In Volume 1956-1966	e For The Period		% change
	1956	Low Year	High Year	1966	1956/66
		-			
Nassau County-Major Ports Hempstead Harbor	6,850,160	3,527,604/1965 537,696/1959	6,850,160/1956 1,291,428/1956	4,293,470 956,820	—59.5 —35.0
Manhasset Bay Oyster Bay Harbor Glen Cove Creek	1,291,428 N.A. 1956-1959 233,312	271,543/1960 170,503/1964	1,225,704/1963 289,358/1960	517,178 280,651	N.A. +20.3
Suffolk County-Major Ports Port Jefferson Harbor Northport Bay & Harbor	821,442 N.A.	821,442/1956 10,362/1959	2,002,472/1966 2,939,576/1960	2,002,472 1,440,351	+143.8 N.A. +51.0
Huntington Bay & Harbor Patchogue River	366,943 209,896	366,943/1957 191,214/1957	1,466,857/1960 302,827/1965	553,967 290,075	+38.2
Minor Ports Greenport Harbor Mattituck Harbor	22,658 103,663	19,701/1961 38,594/1965	49,076/1966 113,872/1961 33,395/1965	49,076 40,414 30,223	+116.6 -156.5 $+11.8$
Sag Harbor Browns Creek Lake Montauk Harbor	27,038 N.A. 1956-1959 N.A. 1956-1959	21,852/1959	3,392/1965	3,443 2,615	*******
Orowoc Creek	N.A. 1956-1959	1,133/1966	9,183/1965	1,133	
Waterways East Rockaway Inlet Fire Island Inlet	1,094,649 214,147	1,066,925/1956 177,425/1966	2,028,915/1966 294,243/1965 321,219/1965	2,028,915 177,425 296,842	+85.3 -20.7 $+29.4$
Great South Bay	229,326	212,475/1957	021,210/1000	200,012	720.1

Note: A major seaport is any seaport which handled 100,000 or more tons in 1966.

All others are classified as minor seaports.

Dock, has an eight-foot channel which extends 2.4 miles from deep water in Huntington Bay to the dock. There is also a cross channel 0.4 miles long. This area is heavily used for recreational boating.

Port Jefferson — The channel runs through the entrance from Long Island Sound to Port Jefferson Harbor at the Village of Port Jefferson. The main channel provides a depth of 26 feet. The harbor accommodates scheduled ferry service to Bridgeport, Connecticut, large scale import of oil and commercial stone handling.

Northville — Northville receives its fuel in ocean tankers at a mooring berth 7,200 feet off shore in Long Island Sound through two 24 inch submarine pipe-lines. The depth of water and layout of the mooring area permit the largest tankers currently in use to deliver products to the terminal.

Great South Bay — The Great South Bay extends 19.1 miles from Fire Island Inlet to Patchogue Bay at a ten-foot depth. The channel then extends into the Central Basin at Patchogue to a depth of eight feet. Commercial oil shipments are handled at this port.

Manhasset Bay — Manhasset Bay has six feet of depth from deep water to the wharf at Great Neck. A current project is proposed to deepen the channel to eight feet.

Mattituck Harbor — This harbor has a channel depth of seven feet from Long Island Sound to Old Mill Road. It is 100 feet wide at

the entrance and 80 feet wide thereafter with a seven foot depth to the Village of Mattituck.

Greenport Harbor — This area has a 30 foot depth at dockside, almost two miles of dockage, and a rail terminal of the Long Island Railroad. The harbor is mainly used for commercial and recreational fishing boats and is suitable for industrial usage.

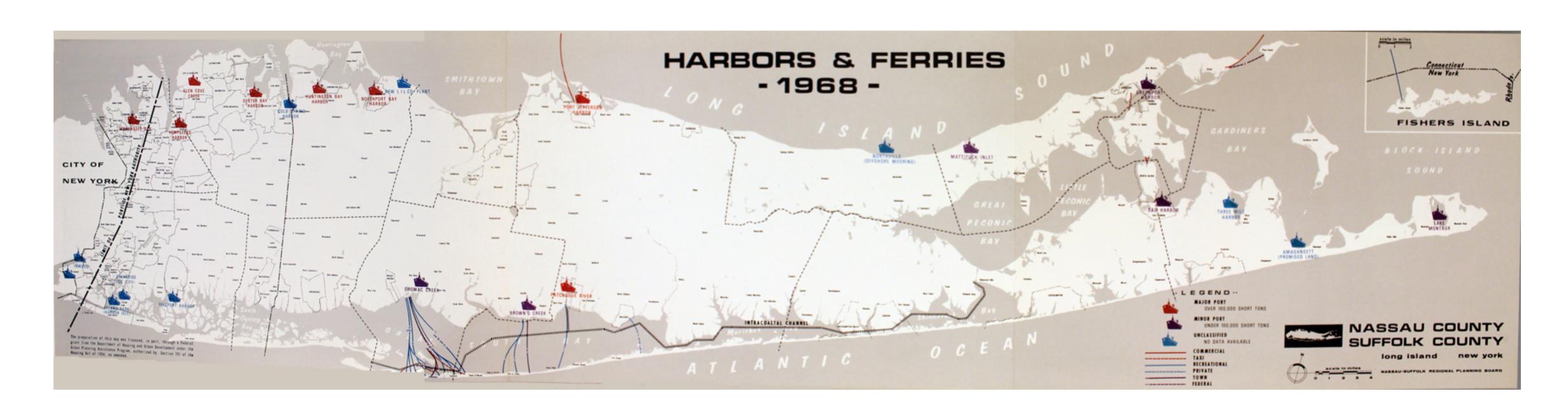
Orient Point — Orient Point has dockage for the operation of the Orient Point to New London ferry.

Commodities — Fresh fish, shellfish, crushed and broken stone, sand and gravel, lumber and petroleum products comprise the main waterborne commerce. Table XXVI lists the products handled in 1966 by percentage of total.

Shellfish and fresh fish which accounted for only 0.1 percent of the volume handled by the classified seaports, normally account for 20 to 40% of the volume handled by the minor seaports.

The value of these two commodities cannot be determined for each seaport as the statistical records of the catches are kept on the basis of large geographical areas, as shown on Figure 23. Although the landings of fresh fish, in pounds, have declined 12% over the period 1954 to 1965, the dollar worth has only declined 6%. Shell-fish catches during the same period have varied from a low of 9.7 million pounds in 1958 to a high of 13.6 million pounds with a 1965

^{**} Tungsten



value of \$8,853,500. Table XXVII, listing the landings in pounds and dollars shows an increasing value despite the decreased volume.

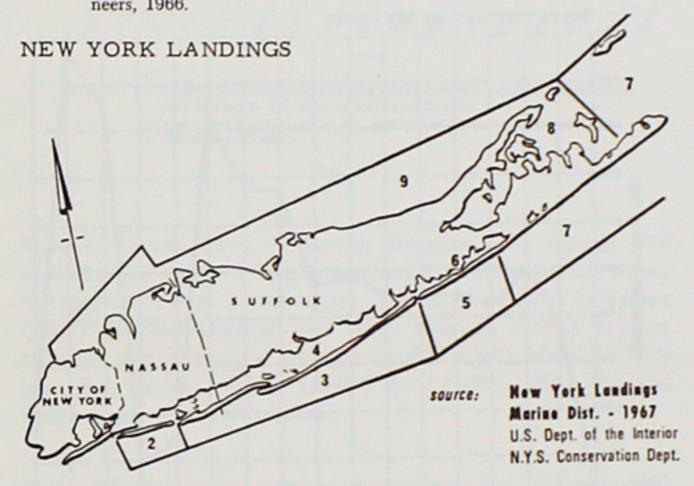
TABLE XXVI
Principal Commodities Handled by Seaports in Nassau and Suffolk Counties
1966

		1900			
	-Major S Nassau	Seaports Suffolk	Nassau & Suffolk	Minor Seaports	All Seaports
Fresh Fish	0.0	0.0	0.0	4.0	0.0
Shellfish	0.0	0.0	0.0	1.4	0.0
Crushed & broken stone	19.2	22.2	20.4	.0	20.2
Sand and Gravel	44.4	33.6	40.0	.0	39.5
Petroleum Products	33.6	41.0	36.7	72.2	37.1
Other	2.7	3.1	2.9	22.3	3.1
Figures may not add up t	o 100.0% d	lue to rour	nding		

Figures may not add up to 100.0% due to rounding (1) Normal range annually 10% to 20%

- (2) Normal range annually 10% to 20% (2) Normal range annually 60% to 80%
- (3) Normal range annually 0% to 5%

Source: Waterborne Commerce of the United States, "Part I—Waterways and Harbors—Atlantic Coast," Department of the Army, Corps of Engineers, 1966.



AREA DESCRIPTION

- 2 OCEAN, EAST ROCKAWAY INLET TO JONES INLET
- 3 OCEAN, JONES INLET TO MORICHES INLET
- 4 GREAT SOUTH BAY
- 5 OCEAN, MORICHES INLET TO SHINNECOCK INLET
- 6 MORICHES AND SHINNECOCK BAYS
- 7 OCEAN SHINNECOCK INLET TO MONTAUK, INCI. BLOCK ISLAND SOUND
- 8 GARDINER'S, PECONIC, AND ADJOURNING BAYS
- 9 LONG ISLAND SOUND

FIG. 23

TABLE XXVII

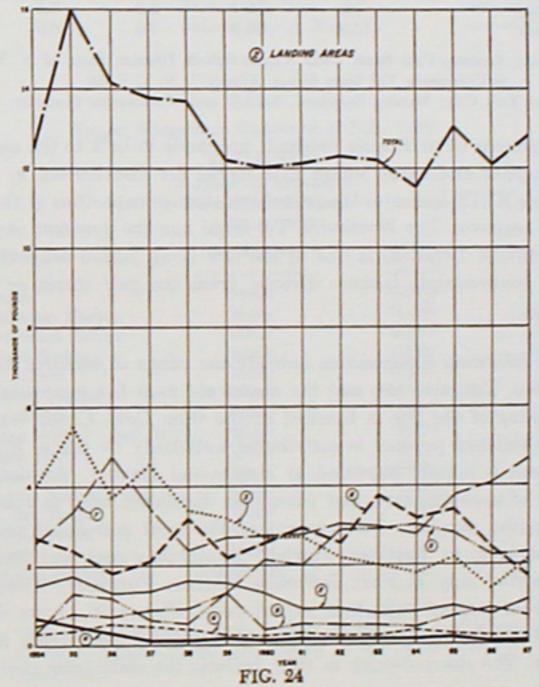
Commercial Fish and Shellfish Landings From
Long Island Waters, 1954 to 1965

			land Waters, 1954 to			
	— Fin		———Shellfish—		Total-All	Species -
Year	Thousand Pounds	Thousand Dollars	Thousand Pounds	Thousand Dollars	Thousand Pounds	Thousand Dollars
1954	125878.0	3430.3	10877.5	4121.4	136755.6	7551.7
1955	120208.5	3357.0	11994.6	5530.6	132203.1	8887.7
1956	141451.1	3633.9	11213.5	5161.4	152664.7	8795.4
1957	146751.0	3708.7	10242.0	4748.4	156993.0	8457.1
1958	87014.9	3315.4	9702.1	4522.5	95938.5	7837.9
1959	104628.8	3551.7	9810.7	5254.7	114439.5	8806.5
1960	115439.2	3407.1	10793.3	5332.6	126232.5	8739.7
1961	112125.3	3471.3	11490.4	5659.6	123615.8	9130.9
1962	165720.5	3645.3	12035.2	6184.7	177755.7	9830.0
1963	118285.6	3499.8	10362.4	5754.5	128648.0	9254.3
1964	67686.3	3017.0	11471.3	6866.9	79157.6	9884.0
1965	55421.4	3011.1	13627.1	8853.5	69048.5	11864.6

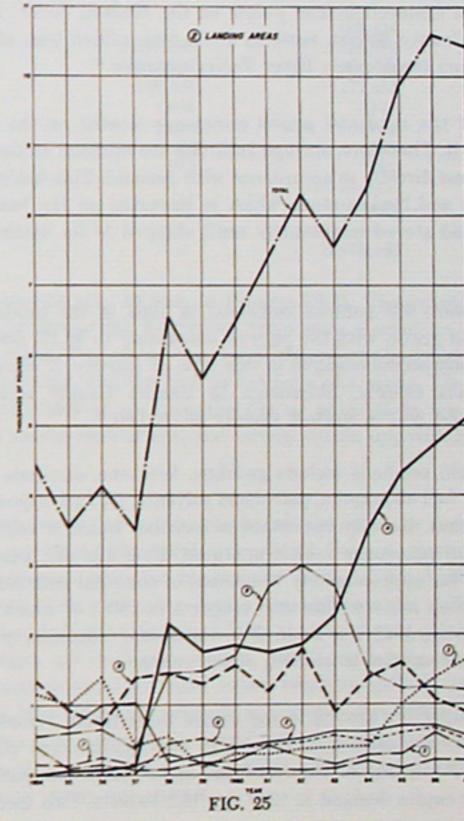
Source: New York State Conservation Department
Pg. A. 13 The Status and Potential of the Marine Environment
Report of the Oceonographic Committee to the Nassau-Suffolk Regional
Planning Board, 1966

The trend for shellfish landings during the period 1957 to 1967 has exhibited an almost steady increase in volume, being 197% greater in 1967 when compared to 1957. Figure 24 depicts the shell-fish landings between 1954 and 1967. Fresh fish, on the other hand, has been in a steady decline. Figure 25 depicts this situation.

SHELLFISH LANDINGS



FRESH FISH LANDINGS



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Fresh fish and shellfish are immediately processed and shipped to market due to their perishable nature. Many fisheries have limited storage facilities and, therefore, limit the catch to the capacity of the processing facilities. Most of the catch is shipped by truck to local and metropolitan markets although some products, such as oysters, are distributed nationwide. Fish oil and fish meal are distributed throughout the mid-Atlantic states and as far west as Ohio and a portion of the product is shipped by rail.

Next in importance is "Crushed and Broken Stone" which accounts for 20.2% of the area's waterborne commerce. This commodity is directly related to the construction industry where it is used primarily in the making of concrete. Sand and gravel is the largest commodity in terms of volume.

In 1962, eight million tons of sand and gravel were shipped from the north shore of Nassau and Suffolk Counties. Most of this tonnage was shipped to the Port of New York, with lesser amounts going to Connecticut and points on the Hudson River. In return the Bi-County Region receives about two million tons of crushed rock from the Hudson River Valley quarries.²³

Most of the sand and gravel mines are located on the water or near to it. Therefore, storage facilities are minimal as the product is shipped directly in accordance with demand. This holds true for crushed and broken stone which is imported on the basis of demand and stored temporarily until shipped to its destination by truck.

There were 698 persons employed in 1963 in the production of sand and gravel with the payroll amounting to \$5,177,000. Of the 35 establishments engaged in this type of activity 22 were located in Suffolk County. Shipments in Nassau County were worth \$12,909,000 and in Suffolk County \$6,765,000.24

Petroleum products include gasoline, kerosene, distillate fuel oil, residual fuel oil, naptha, petroleum solvents, jet fuel, asphalts, tars, and pitches. Equally important is gasoline which is required for truck and passenger vehicle operaton. Fuel oils and gasoline accounted for approximately 99 percent of the total petroleum products coming into the classified seaports in 1966; of which gasoline was one-third of the total. For the minor seaports, petroleum products comprise 60 to 80% of the volume.

The prospective growth in the future importation volume can be related to the estimated per capita consumption and population growth. According to Mineral Facts and Figures, the national annual per capita demand in 1949 was 14.2 barrels. This increased to

19.4 barrels in 1959 and is projected to increase to 26.4 barrels in 1975. The Corps of Engineers report, Port Jefferson Harbor Report, estimated the average per capita consumption in Suffolk County in the 1958-1964 period was 17 barrels. During 1970 this figure is expected to reach 19 barrels with a further increase to 24.5 barrels by the year 2020. Table XXVIII compares the various heating fuels by type and location of use. In 1960, 51.3% of the distillate fuel oils and 20.1 percent of the residual fuel oils were imported into the two counties at the classified seaports.

The per capita consumption of gasoline in New York State in 1967 was 242 gallons, an increase of 19.2% over the per capita consumption of 1958. Almost 90 percent was imported at the classified seaports. It is estimated that by 1975 this import will increase by 44 percent.

TABLE XXVIII

Heating Fuel Used

Percentage of Occupied Housing Units

	Utility Gas	Liquid Fuel	Coal or Coke	Elect.	Other
NYS	22.8	65.2	9.4	0.2	2.1
		77.4	9.0	0.1	1.5
		86.2	2.5	0.3	1.1
		89.1	2.2	0.2	0.5
Suffolk	13.3	80.6	3.2	0.5	2.3
N.Y.S. N. Y. Metro Area* Nassau-Suffolk Nassau Suffolk	22.8 11.6 9.7 7.9 13.3	86.2 89.1	9.0 2.5 2.2	0.1 0.3 0.2	

Source: Business Fact Book, 1963 Nassau-Suffolk District, State of N. Y. Dept. of Commerce 112 State Street, Albany 7, N. Y. P. 30

*New York City, Nassau, Rockland, Suffolk and Westchester Counties

Shipments of petroleum products are made in bulk to the seaports by tanker and barge where it is stored for distribution by truck. Table XXIX indicates the petroleum storage capacities at the various seaports. The Northville Terminal has the greatest capacity. Northville Terminal is one of the few Long Island seaports that can accommodate tankers directly from the gulf states or Venezuela.

The following commodities indicate the range of imports into the region. Tungsten ore and the chemicals used for processing and refining of the ore is handled at the Glen Cove Creek terminal. The finished product is distributed nationally by truck. Building cement is mainly imported at Hempstead Harbor. The importation of asphalts, tars, and petroleum distillates used in road construction comprise 18.6 percent of the total petroleum products brought in to Mattituck Harbor. Bituminous coal and lignite is imported only at Port Jefferson Harbor. Formally, Hempstead Harbor was an important import point. Figure 26, shows the importation of coal in tons at Port Jefferson Harbor from 1950 to 1966. The sharp decline in 1962, reflects the shift from coal to oil

TABLE XXIX

Approximate Gross Petroleum Storage Capacity of Nassau and Suffolk Seaports (in Millions of Gallons)

Nassau	Inwood	35,647,000
Ivassau	Oceanside-Island Park	34,787,000
		22,768,500
	Glenwood Landing (1)	11,438,000
	Port Washington (1)	8,729,000
	Cold Spring Harbor	7,181,000
	Great Neck (2)	7,000,000
	Roslyn (1)	4,000,000
	Oyster Bay	3,000,000
	Lawrence	120,000,000
Suffolk	Northville	
	Setauket (3)	20,640,000
	Patchogue	12,968,800
	Port Jefferson	7,826,000
	Halesite (4)	3,000,000
	Sag Harbor	1,462,000
	Greenport	1,274,000
	Mattituck	971,800

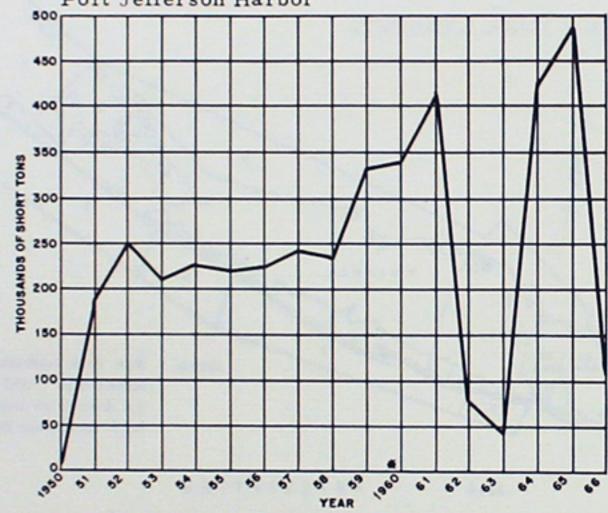
Source: Oil Heat Institute of L. I., Inc. NOTE:

- (1) Hempstead Harbor
- (2) Manhasset Bay
- (3) Inland terminal, products piped from Port Jefferson Harbor

(4) Huntington Harbor

COAL - COASTWISE RECEIPTS 1950-1966

Port Jefferson Harbor



1960 INCLUDES 1,648 TONS OF COASTWISE SHIPMENTS.

SOURCE: (1) WATERBORNE COMMERCE OF THE UNITED STATES - PART 1, WATERWAYS AND HARBORS, ATLANTIC COAST, 1966 EDITION. (2) PORT JEFFERSON HARBOR, M.Y., REVIEW OF REPORTS, AUG. 1964, REVISED JULY 1966.

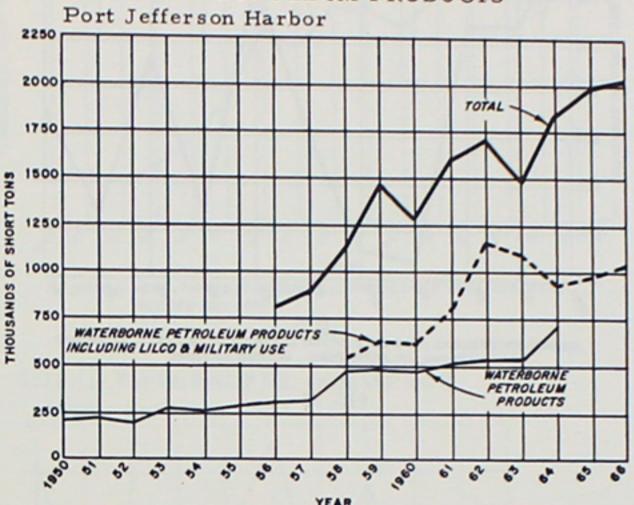
FIG. 26

- ²³ Waterborne Freight of the Tri-State Region, Vol. 1, March, 1967, pg. 27
- 24 New York State Business Fact Book, 1967 Supplement
- 25 N.Y.S. Statistical Year Book-1967

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at the Long Island Lighting generating plant and is reflected in Figure 27.

TOTAL WATERBORNE PRODUCTS & WATERBORNE PETROLEUM PRODUCTS



SOURCE: (1) WATERBORNE COMMERCE OF THE UNITED STATES - PART 1, WATERWAYS AND HARBORS, ATLANTIC COAST, 1966 EDITION. (2) PORT JEFFERSON HARBOR, N.Y., REVIEW OF REPORTS, AUG. 1964, REVISED JULY 1966.

FIG. 27

Volumes Handled and Number of Movements — During 1966 over 12,970,000 tons of freight were handled by the regions classified seaports and on its waterways. The major seaports in Nassau County handled 6,048,119 tons while those in Suffolk handled 4,286,861 tons. The minor seaports handled approximately 127,000 tons. The annual volumes handled during 1951, 1956, 1961 and 1966 are given in Table XXX.

Table XXXI lists the number of shipments for the years 1961 and 1966 at the various seaports. These figures include the total inbound and outbound movements of the following vessels: passenger and dry cargo ships, tankers, tow boats and tug boats, and self propelled and non-self propelled barges.

Most seaports have experienced an annual growth of 10 to 50% during the past ten years. Northville Oil Terminal has experienced a growth of 500% during the past ten years. The activity at some

TABLE XXX

Annual Volume of Seaports and Waterways
(In Short Tons)

		(III s	onort Ions)		
	Name	1951	1956	1961	1966
Major Port-	Hempstead Har.	4,054,532	6,850,160	40 114 700	_
Nassau	Manhasset Bay	875,875		48,114,780	4,293,470
	Oyster Bay Har.	510,010	1,291,428	800,607	956,820
	Glen Cove Creek	10,285	022.210	278,419	517,178
		10,200	233,312	289,302	280,651
Major Port-	Port Jeff. Har.	755,481	001 440		6,048,119
Suffolk		100,401	821,442	1,570,655	2,002,472
Dullok	Northport Bay and Harbor	1 179 700	411 707	1,959,844	1,440,351
	Huntington Har, and Bay	1,178,792	411,535	872,087	553,963
	Patchogue River		209,896	247,743	290,075
Man Posts	C				4,286,861
Minor Ports	Greenport Har.		22,658	19,701	49,076
	Mattituck Har.	33,995	103,663	113,872	40,414
	Sag Harbor		27,038	29,885	30,223
	Browns Creek			No. commerce rptd.	3,443
	Lake Montauk Har.			1,493	2,615
	Orowac Creek			2,189	1,133
					126,904
Waterways	East Rockaway Inlet	763,851	1,094,649	1,318,398	2,028,915
	Great South Bay	81,901	229,326	262,635	296,842
	Fire Island Inlet		214,147	249,490	177,425
	Jones Inlet			1,913	1,940
	L. I. Intra Coastal			2,562	1,692
	Shinnecock Inlet			1,225	998
	Peconic Bay & River			773	767
					2,508,579
	erhame Commerce of IIS 196				12,970,463

Source: Waterborne Commerce of U.S., 1966

Number of Shipments Nassau-Suffolk Ports 1961 & 1966

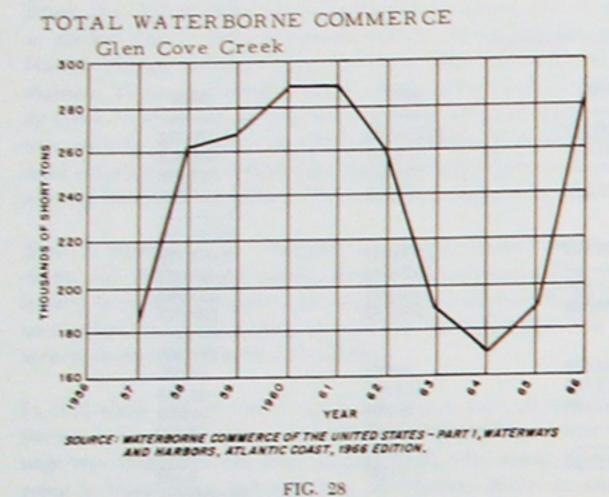
Seaport	Classification	1961	1966
Patchogue	Major	54078	4020
Port Jefferson Harbor	Major	51466	4438
Lake Montauk Harbor	Minor	42860	28066
Greenport Harbor	Minor	33199	28969
Orowoc Creek	Minor	13200	6800
Hempstead Harbor	Major	10775	22629
Browns Creek	Minor	8393	5212
Northport Harbor (incl. Bay)	Major	5883	20728
Mattituck Harbor	Minor	3127	2318
Manhasset Bay	Major	2948	2254
Huntington Harbor & Bay	Major	2840	16063
Oyster Bay Harbor	Major	1729	5223
Glen Cove Creek	Major	900	980
Sag Harbor	Minor	90	134
Cold Spring Harbor	Unclassified	N.A.	4222
		231666	171565

Source: Waterborne Commerce of the United States, "Part I-Waterways and Harbors-Atlantic Coast," Department of the Army-Corps of Engineers, 1966.

of the seaports may be seen in Figures 28-35. The growth of seaports is problematical. Forty-two firms were queried on their expansion plans. Two stated they have expansion plans, one is presently expanding, and the rest do not have any plans. The reasons given were: lack of room on the site or adjacent to the site, restrictive zoning regulations, and strong citizen opposition.

Petroleum product firms, in particular, do not have room to expand or are blocked by public opposition. Concern was expressed by the shippers with the inadequate depth of the harbors and waterways. This deficiency forces the shippers to utilize small tankers and half-laden barges, adding to the delivery costs. Weather problems are negligible except for heavy winds, which may cause inlets to shoal or make vessel handling difficult in narrow channels. Two terminal operators expressed concern with pleasure boats. One was restricted in vessel movements by the gradual encroachment of a marina and the other with pleasure boats interfering with vessel movements.

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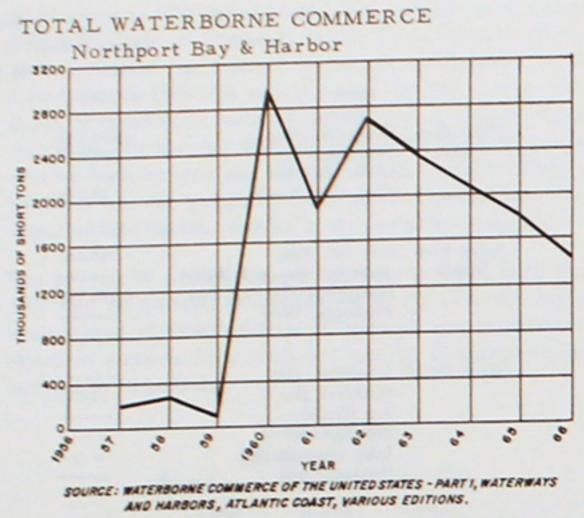
TOTAL WATERBORNE COMMERCE

SOURCE: WATERBORNE COMMERCE OF THE UNITED STATES -PART I, WATERWAYS

FIC. 29

AND HARBORS, ATLANTIC COAST, VARIOUS EDITIONS.

Hempstead Harbor



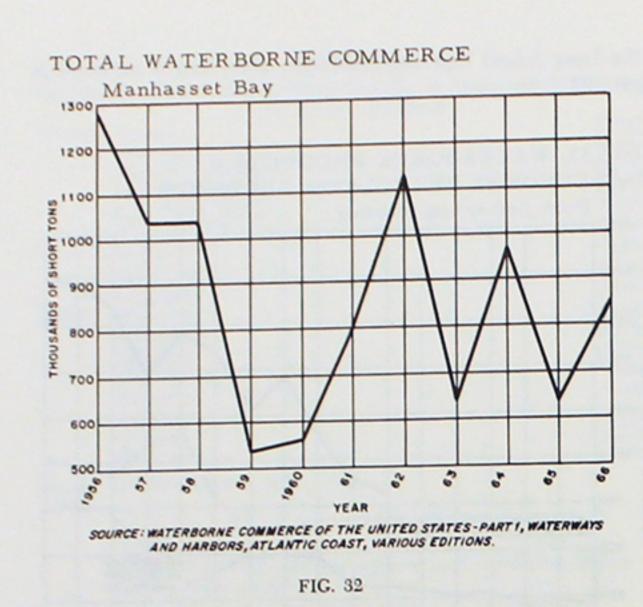
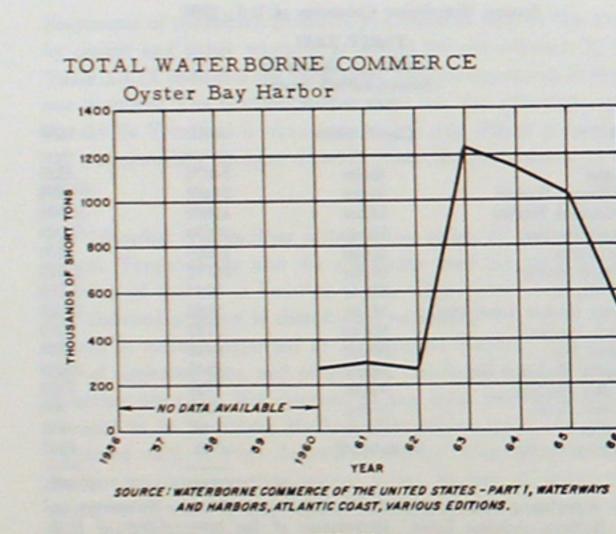
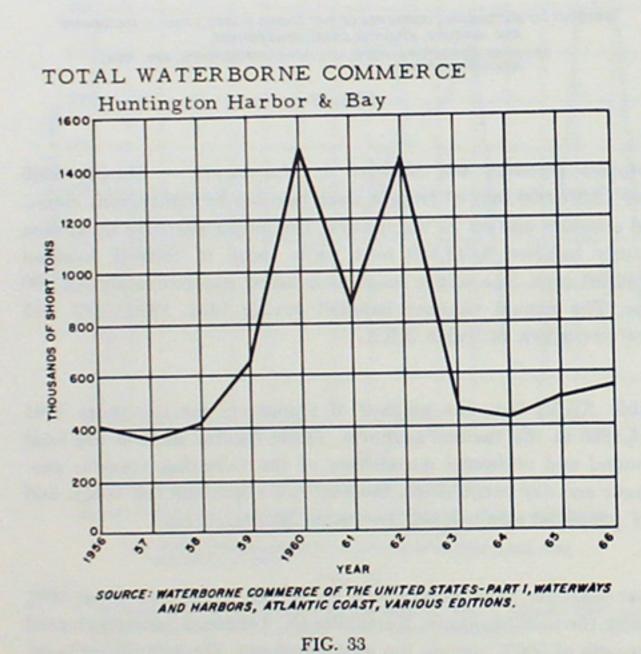


FIG. 30

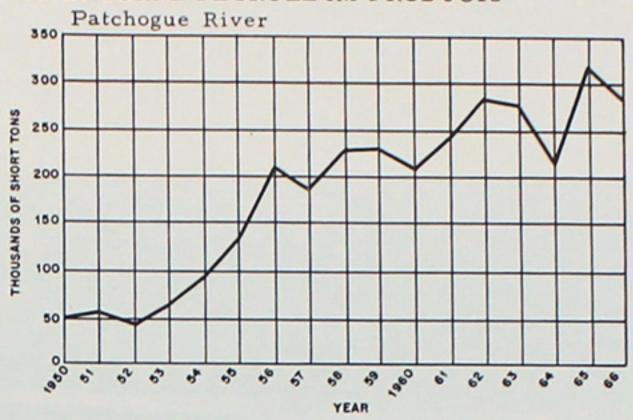




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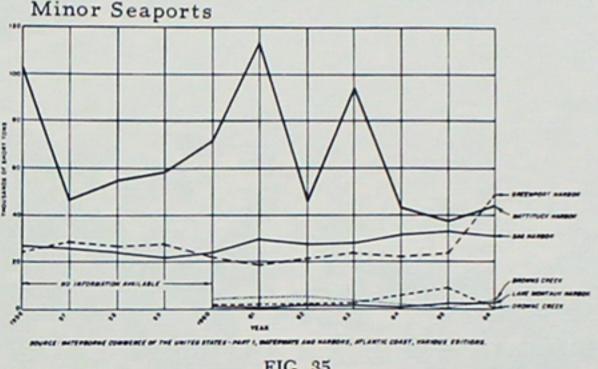
WATERBORNE PETROLEUM PRODUCTS



SOURCE: PORT JEFFERSON HARBOR, N.Y., REVIEW OF REPORTS, AUG. 1964, REVISED JULY 1966.

FIG. 34

TOTAL WATERBORNE COMMERCE



Ferries — Twenty-three ferries operate in the Bi-County area and all are located in Suffolk County. Most of the ferry lines are seasonal and/or recreational in orientation. Table XXXII lists the class and purposes of the ferries:

TABLE XXXII

Classification of Ferries in Accordance With Primary Use

Commercial carriers of passenger, passenger and automobile, freight, truck, and buses in intra-county or interstate move-

me

Recreation carriers of passengers to recreational area serving a private group or club

Town Recreational town ferries from mainland to town recreational areas on barrier beaches

Federal Government run

run for or by the federal government non-scheduled carriers

Source: Nassau-Suffolk Regional Planning Board

The location of each ferry terminal is depicted on the following map. Most of the ferries operate in the Great South Bay in southwest Suffolk County during the summer season carrying people to the recreational areas on Fire Island. The annual rate of growth for these lines has approximated 10 percent and the trend should continue as more people visit the island and the National Seashore. During the winter months almost all of the lines cease operation. The 300 year-round residents on the island then rely on a single ferry, private boats, or water taxi for access to the mainland.

Two of the four ferries, commercial classification, engage in interstate service and are seasonal. The Port Jefferson-Bridgeport Ferry, established in 1883, operates from late May to mid-September. Its principal activity is to carry passengers and automobiles. It also charters moonlight sails and excursions.

The other ferry engaged in interstate service is the Orient Point-New London Ferry. This line carries considerably more volume than the Port Jefferson-Bridgeport Ferry which may, in part, be attributed to a longer operating season from Mid-April to Mid-December. This line also provides excursions and tour service. These lines are Long Island's only relief from its dead-end condition but both are seasonal in operation and, therefore, are not a continuous part of the transportation pattern. Table XXXIII depicts the usage of both ferries. The ferry activity at Port Jefferson Harbor between 1956 and 1966 is shown on Figure 36.

TABLE XXXIII LONG ISLAND SOUND FERRY TRAFFIC—1964

Item	Bridgeport Port Jefferson Ferry	Orient Point New London Ferry
(3) Automobiles	11,084	30,641
Trucks and Trailers (4)		3,502
Passengers	43,760	116,191
General Cargo (1) Operates during period May	24 tons 26 through September 2	21 only.

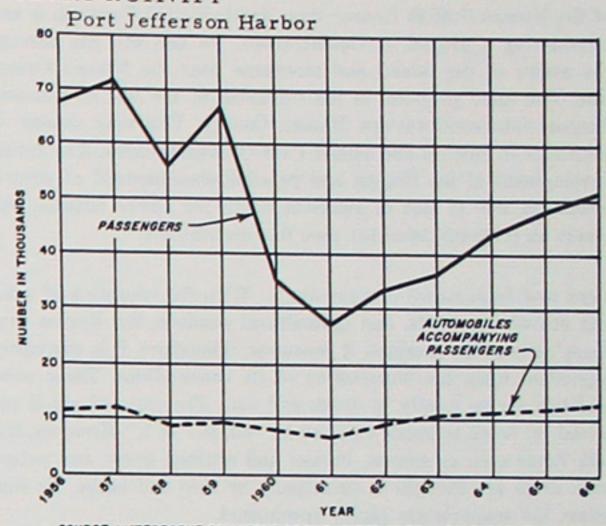
Operates during period May 26 through September 21 on
 Operates during period May 1 through October 26 only.

- (3) Toll rates based on passenger car toll of \$8.50 for one-way trip (includes driver).
- (4) Passenger toll rate for one-way trip is \$2.00.

SOURCE: Preliminary Report, Proposed Long Island - New England Bridge.
Traffic & Revenues, December, 1965. Prepared for New York State
Department of Public Works by Wilbur Smith & Associates, pg. 33.

The other two commercial lines operating between Shelter Island and the forks are a part of the continuous transportation pattern and are a vital connecting link between the north and south forks. If these lines did not exist an autoist would have to travel 39 additional miles to go from the Village of Greenport to the Village of

FERRY ACTIVITY



SOURCE | WATERBORNE COMMERCE OF THE UNITED STATES - CALENDAR YEAR 1966

FIG. 36

Sag Harbor. Each of these lines have been in operation since the late 1800's and are capable of carrying passengers, automobiles, trucks and buses.

Pipe Lines and Conveyor Belts — Many sections of the country utilize pipe lines and conveyor belts for the shipment of bulk commodities such as oil, gasoline, sand, gravel and coal. Pipe lines have been constructed to a limited extent on Long Island for petroleum products.

There are two facilities using pipe lines to transfer petroleum products from marine vessels to storage tanks. One of these facilities is operated by Consolidated Petroleum Terminal, Inc., which maintains a dock on the westerly side of Port Jefferson Harbor with storage tanks in South Setauket. The connecting pipe line runs approximately three miles along a Long Island Lighting Company transmission line right-of-way. The other facility is the Northville Oil Terminal in the Town of Riverhead. Its storage tanks are located behind the bluff overlooking Long Island Sound connected to an offshore mooring located approximately 7,000 feet off shore by a dual submarine pipe line.

The report on Port Jefferson Harbor offers three proposals for future construction of pipe lines for transporting petroleum products.²⁶ Consolidated Petroleum Terminal is considering the ex-

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²⁶ Port Jefferson Harbor, New York—Review of Reports U.S. Army Engineer District, N.Y. Corps of Engineers, August, 1964, Revised July, 1966

tension of its line to Holbrook and thence westerly to the vicinity of the Nassau-Suffolk County line. Northville Oil Terminal is also considering a project of similar scope. Its line will run through the center of the Island and terminate near the Nassau County line. The third proposal is the extension of the line at Kennedy Airport into southwestern Nassau County. This may connect to terminals in Inwood and Island Park-Oceanside areas. The future development of the Region and possible abandonment of several terminals, due to lack of sufficient depth for newer tankers, will create an economic need for pipe line distribution.

Need and Importance of Seaports — With the exception of sand and gravel, sea foods, and agricultural produce, the Region produces little of the products it consumes. Therefore, it is extremely dependent upon the importation of its commodities. These commodities arrive mostly by truck and rail. The ratio of goods received by truck to goods shipped by rail, is 7 to 1.27 However, the bulk items such as cement, broken and crushed stone, and petroleum items are brought in principally by ship and barge. To this extent the seaports are highly specialized.

A further indication of the dependency on waterborne commerce can be seen from the following figures for the Tri-State Region for 1962-1963. Freight traffic tonnage was moved²⁸ 25.1 percent by water; 73.5 percent by truck; 1.4 percent by rail and less than 0.05 percent by oil pipeline.²⁸ Table XXXIV shows the distribution of tonnage of New York State and Nassau-Suffolk ports.

TABLE XXXIV

Distribution of Waterborne Freight Tonnage New York State & Nassau-Suffolk (percent) 1964

	New York State	Nassau-Suffoll
Petroleum	54	30
Sand & Gravel	20	64
Food, Beverage	7	_
Coal	7	_
Other	12	6

Source: Annual Report of the N.Y.S. Office of Transportation, 1964
The total tonnage was 212 million tons, of which Nassau-Suffolk's share was 11 million tons.

The total tonnage was 212 million tons, of which Nassau-Suffolk's share was 11 million tons.

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PORT JEFFERSON HARBOR

²⁷ An Industrial Development Study of Suffolk County, September 1965, p. 29

²⁸ Interim Technical Report 4080-8081, Freight Traffic of the Tri-State Region, The Trend and the Projection, March 1968.



Transportation Models & Methodology

Transportation was given substantial emphasis as part of the comprehensive planning effort. Contrary to traditional practice, this effort attempts to closely relate all modes of travel based on proposed land use plans. In other words, transportation modes and facilities are designed to serve the goals of community development rather than to set the pattern around which land use decisions are constrained to follow. Fortunately, transportation planning has undergone rapid development over the last 10 years incorporating many of the new concepts of modern science and technology. This evaluation has been primarily the result of the heavy reliance upon the digital computer. Most of the methods and techniques used in today's transportation planning simulate real life processes through millions of mathematical operations which would not be possible without the speed and reliability of the computer.

One of the more complex tasks in developing models for a study area as large as Long Island is the detailed compilation and coding of the factors which influence travel desires. Movements or interactions in a transportation system, for the most part, result from the social and economic activities of the people living in the area and the spatial separation of the activities with which they have interactions. The set of transportation models described herein constitutes a series of mathematical procedures which simulate the main characteristics of the relationships between people and urban activities which generate these movements. Estimates of population characteristics and measures of land uses, therefore, are essential components of transportation models. Other information required for model development include origin-destination trip ends and interchanges, and a basic transportation network of major streets and highways.

Specifically, the methods used in developing the transportation models for Nassau and Suffolk Counties can be sub-classified as follows:

- An analysis of origin-destination data by purpose and mode;
- A category analysis of trip production characteristics of households related to levels of residential density and income;
- A study of trip attraction relationships utilizing trip rates of attraction for various purposes and land-use categories;
- 4. An analysis of car occupancy characteristics related to trip purpose and travel time;
- The calibration of a separate car-person trip distribution model for each purpose; and,
- 6. Projection of trips.

All analyses were based on data obtained in the 1963 Tri-State Transportation Study. This included household, taxi, truck and roadside surveys, and population and land use statistics. In addition, data on travel times were used as input to certain models.

Origin-Destination Data—A home interview survey conducted by the Tri-State Transportation Commission included all of Nassau and part of Suffolk County. A one per cent sample of the dwelling units in the study area was taken and the residents of each household were asked detailed questions regarding their average weekday travel habits. These data were compiled by analysis district and expanded to represent the universe of the study area. Trips were recorded by the purpose and mode of the trip maker. Tri-State established a square mile grid system in which origins and destinations of trips were coded. Origins and destinations were further subdivided into quarter-square mile grids or subdivisions.

The grid numbering system for Long Island was not sequential since two coordinates were required to define a point on the map. The basic square mile was retained as a traffic zone but an equivalence table of sequential numbers was substituted for the "X" and "Y" coordinates of the grid system. In some cases, especially in the eastern end of Suffolk County, large areas of underdeveloped or low activity grids were grouped to form traffic zones containing areas larger than one square mile. The final grouping of traffic analysis areas resulted in a total of 763 zones in Nassau and the portion of Suffolk County contained in the survey. Trip and socio-economic data were recorded to these areas.

Trip Linking—Because of the standard origin-destination survey definition of a trip, certain trips are obtained from the surveys which are not readily related to the primary purpose of the trip maker. These included those in which the driver uses his vehicle to serve a passenger while enroute to his primary destination, or to leave his vehicle and change his travel mode. If each of these trips were analyzed separately the relationship between the actual starting point and the ultimate destination and purpose or mode of the trip would be lost. It would also be difficult to relate land use with trip making at the destination end.

To retain the primary characteristics of the trip regarding mode, purpose, and final destination, it is desirable to combine or link the trips. As an example of "serve passenger" linking, consider the case where the driver takes a passenger to school and goes on to work. The unlinked data would indicate a trip from "home" to "serve passenger" and another trip from "serve passenger" to "work." Obviously, the primary purpose of the driver was to

get to work. Two trips were, in essence, created to replace the two trips each with one end having a "serve passenger" purpose. A new trip was made for the driver with an origin at home and a destination at work with "work" as the purpose of the trip. Another trip was created with the origin at the zone in which the passenger was served and the destination again being the zone of work. The purpose of this trip was "non-home based" since neither end was at the zone of residence. The same number of trips resulted from the linking procedure. It should be noted that the passenger trip was retained as a home based auto passenger trip with a purpose of "school."

In the case of the change travel mode trips, many people in the Long Island area drive their cars relatively short distances to meet a bus or train enroute to work. In this example, the primary mode and purpose are transit and work, respectively. The two trips are linked as a transit trip from home-to-work, while the auto driver trip is eliminated.

Production and Attractions—After linking the origins and destinations, trip ends are reclassified as "production" and "attraction" trip ends. Trips made by urban and suburban residents can be divided into two basic categories: home based and non-home based. Home based trips must have either the origin or destination at the residence of the person making the trip. Non-home based trips have neither the origin nor destination as a home end. For home based trips, the zone of the production trip end is considered to be the zone of residence, regardless of whether the home zone is the origin or destination. The other end of the trip is considered the attraction. For example, a "home-to-shopping" trip is considered to be produced by the zone of residence and attracted by the zone in which the shopping occurs. The return, or "shopping-to-home" trip is also considered as being produced at the home and attracted by the shopping zone.

The result of this recoding is two shopping productions at the zone of residence and two shopping attractions at the shopping zone. There are still two trips between the desired origin and destination, but the direction of one has been changed. The reason for this method of shopping trips is that trip generation factors (both productions and attractions) can be more easily related to land use and socio-economic data at the respective ends of the trip.

In transportation planning processes, it is conceptually difficult to describe a trip production by an urban resident as being generated or produced by places of commercial or business activity. It is far easier to relate attraction trip ends to these areas, and

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the production end to socio-economic characteristics of the trip maker at his place of dwelling. All non-home based trips and commercial vehicle trips are considered as being produced by the zone of origin and attracted by the zone of destination.

Preparing the Network Data—The basic data required to develop the study area network were furnished by the Tri-State Transportation Commission. After receiving the data, the study area network was reviewed by the staff and consultant. Several additional facilities were added to the network to reflect a street system which was considered detailed enough for adequate analysis of the Nassau-Suffolk area.

The data for the study area network were reformatted in order to insure usefulness as input to the Traffic Modeling System. This System, originally developed by the Consultant for the IBM 360 Model 30, was modified for use on the IBM Model 65 at the State University of New York at Stony Brook. The relatively large size of the Nassau-Suffolk area necessitated this change to the larger capacity machine. In addition, it was felt that by implementing the programs at Stony Brook, future studies would be greatly facilitated.

The significant step in reformatting the data was to develop a system of intersection, or node numbers, for each street intersection in the study area. At the same time, the additional data needed to describe each link, or street segment between intersections was retrieved from the Tri-State data and reformatted as dictated by the format specifications of the various computer programs.

Zoning of the Study Area—The Nassau-Suffolk areas were divided into zones of similar charcteristics with the minimum zone size being about one square mile. In the areas of lesser activity, the zones were increased in size, always in even square-mile increments. The square mile segments of the study area, as defined by the coordinate system, entirely covered by water (Atlantic Ocean, bays, or Long Island Sound) were not assigned zone numbers due to a lack of trip producing or attracting capabilities.

After zoning the study area, each zone was assigned a centroid number. These numbers began with 1 and were assigned consecutively to 783. These centroid numbers were then located within their respective zones at the center of zonal activity and connected to the street system through the use of centroid connectors.

Calibrating the Network—The first step in calibrating the network was to "Build the Network" using the BLDNET Program.

The program reads in all link data, performs various edit routines to check for errors, and prints out a listing of any

A network description is a table listing each zone and (A NODE) in numerical order and all nodes to which it may connect (B NODE), thus forming a link. For each link, the physical data (jurisdiction, distance, speed, calculated travel time, and capacity) were listed with the corresponding B node in the Table. One-way links were only listed in the direction over which the link may be negotiated. See Figure 37 for a sample printout of a network description.

The network description was then compared with the network maps and the resulting discrepancies, if any, were corrected. This portion of the calibrating procedure was repeated until the network description matched the maps as far as the links and their data were concerned. The second phase of the calibration process was the plotting of selected trees. A tree is defined as the minimum time path from one zone to all zones in the network. Using the network as input, selected trees were built by computer and listed for subsequent plotting on prints of the network maps. The tree tab listed every node in the network, the node to which it connects in the particular tree, and the time required to reach the home zone from the particular node. After plotting the trees, showing the paths from the home zone to all other zones, an analysis was made to determine if there existed some illogical routing in the minimum paths. The necessary speed adjustments were made, and selected trees were again built and plotted. At this point, the routings appeared to be legitimate and the network was considered to be calibrated. The network was then available as input to other stages of the system.

LONG	1	5	L	A	N	D	•	1966	NETWORK	FEBRUARY 13,1970	
------	---	---	---	---	---	---	---	------	---------	------------------	--

NETWORK	DESC	PIPTIC	IN																					
				TIME	50	PT	311	NODE	DIST	TIME	SP	RT	JU	NODE	DIST	TIME	SP	RT	JU	NODE	DIST	TIME	SP	RT
A-NODE	10	NODE	DIST	IIME	20	~.	30	HOUL	013.															
		7250	3.25	5.55	35	55													-	7201	1 30	2.60	30	38
****	6	940	1.10			0	9	941	0.65	2.60	15	0	9	942	1.30	5.20	15	0	2	7201	1.30	2.00	30	30
7225	-					38																		
	2	7226	0.90		15	0	2	7225	1.25	2.50	30	38	2			2.50		38						
7226	9	953				0	2	7226		2.50		38	2	7260	1.60	3.20	30	38				2	20	
7227	9	952	0.40		15	0	9	934		1.40		0	2	7196	3.15	6.30	30	51	2	7231	1.15	2.40	24	51
7230	9	933				0	2	7230		2.40		51	2	7232	1.40	2.90	29	51						
7231	q	945			15	0	9	946		2.40		0	9	954	0.55	2.20	15	0	2	7231	1.40	2.90	29	51
7232	9	944					,	740	0.00															
	2	7270		4.75		51	0	040	1 00	7.60	15	0	2	7236	2.30	4.30	32	42	2	7237				42
7235	ç	938		2.80		0	9			1.80		0	9			4.40		0	2	7235	2.30	4.30	32	42
7236	9	936		2.80		0	4	431	0.45	1.00														
	2	7250			32	42	-		2 05		22	42	2	7255	1.60	3.00	32	42						
7237	9	939			15	0	2			5.35				1233	1.00			-						
7240	9	943		1.20	15	0	2			6.50		38	2	7236	2.40	4.50	32	42	2	7270	2.13	4.25	30	48
7250	9	947	0.55	2.20	15	0	6	7220				55		7260		3.20		42	2	7275	1.95	3.90	30	38
7255	9	950	1.15	4. 60	15	0	2	7237	1.60		32	42	2		1.70	3.20		42		7265		2.70		42
7260	9	951	0.70	2.80	15	0	5	7227	1.60	3.20	30	38	2	7255				38	-	1205				
7265	2	7760	1.20	2.70	27	42	2	7266	1.60	3.20	30	42	2	7275	1.16	2.35			2	7290	1-40	2 - 80	30	42
7266	q	961	0.90		15	0	9	962	0.90		15	0	2	7265	1.60			42		7250				48
7270	9	955	0.60		15	0	9	956	0.65	2.60	15	0	2	7232	2.30	4.75	24	51	2	1250	2.13	4.62	30	70
	8	7271	2.90		29	48													-	050	0.05	3 90	15	0
7271	G	949	2.00		15	0	9	957	1.25	5.00	15	0	9	958	1.00	4.00	15	С	9	454	0.95	3.80	10	
	8	72 70		6.00	29	48	8	7285	1.80	3.70	29	48										2 00	20	4.2
7275	9	961			15	0	2	7255	1.95	3.90	30	38	2			2.35		38	2	7276	1.90	3.80	30	42
7276	o o	960			15	0	2	7275	1.90		30	42	2	7285		3.40		42						
7285	0	963			15	0	8	7271			29	48	2	7276	1.70	3.40	30	42		7300				42
7290	0	965			15	0	9	967	1.25	5.00	15	0	9	968	3.20	12.80	15	0	2	7266	1.40	2.80	30	42
1290	2	7291		4.10	30	42																		
7201	-			2.60	15	0	9	971	0.95	3.80	15	0	2	7290	2.05	4.10	30	42	2	7305	1.50	3.00	30	42
7291	9	970			15	0	9	965				0	2	7285	2.86	5.05	34	42	2	7301	1.80	3.40	32	42
7300	9	964				0	9	970	0.70			0	2	7300	1.80			42	2	7305	1.45	2.70	32	42
7301	4	969			15		2	7291		3.00		42	2	7301	1.45		32	42	2	7310	0.65	1.55	25	96
7305	9	572			15	0	9			10.40		0	9		0.90			0	9	977	1.25	5.00	15	0
7309	9	974		2.80			,	415	2.00	10.40				,										
	9			9.60		0	-	7205	0 45	1 66	25	96	9	7309	2-40	9.60	15	0	2	7311	2.05	4.25	29	42
7310	9	973		2.00		0	2							7320	2.35	4.85	29	42	_					
7311	9	978		1.40		0	2	7310				42		7311			29	42	2	7330	4.99	7-85	38	42
7320	5	979				0	9	980	1.30			0						30		7350				42
7330	9	991		2.40		0	2	7320	4.99			42		7340					-	,,,,,	****		-	
7340	9	982		1.80		0	2	7330	2.28			30		7350	1.71			30						
7345	9	984		2.80		0	2	7355				45			2.25			45						
7350	2	7330				42	2	7340				30		7355				55	-	7745	1 10	1 00	27	42
7355	9	983		2.80		0	2		2.90			45				1.10		55		7365				42
7365	9	985	1.30	5.20	15	0	2			4.00		45		7355	1.10	1.80	31	42	2	7370	4.10	7.50	38	38
7370	9	986	0.50	2.00	15	0	2	7365	4.76	7.50	38	38												

FIGURE 37

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TRIP PRODUCTION MODEL

Individual households generate the bulk of auto person trips made in any urban area so that the dwelling unit was selected as the basic analysis unit. Three main forces having the most dominant effect on trip making are first, the household's need for mobility which is determined largely by the household's location relative to the location of activities e.g., jobs, recreation centers, shops; second, the amount of disposable income available to the household; and third, the basic purpose for which the trip is made. Tables XXXV, XXXVI, XXXVII show the effect of these three factors on trip production.

TABLE XXXV

EFFECT OF RESIDENTIAL DENSITY ON TRIP PRODUCTION
Auto Person Trips

TRIP PER DWELLING UNIT
7.623
7.160
6.669
3.910

TABLE XXXVI EFFECT OF INCOME ON TRIP PRODUCTION Auto Person Trips

Auto I cis	on riips
ANNUAL FAMILY INCOME	TRIPS PER DWELLING UNIT
\$ 2,999 or less	1.904
3,000 to 3,999	2.943
4,000 to 4,999	4.223
5,000 to 5,999	5.104
6,000 to 7,499	6.459
7,500 to 9,999	6.969
10,000 to 14,999	8.015
15,000 to 24,999	9.145
\$25,000 and over	10.667
1	

TABLE XXXVII EFFECT OF TRIP PURPOSE ON TRIP PRODUCTION Auto Person Trips

Auto I ci	3011 22753
	TRIPS PER
TRIP PURPOSE	DWELLING UNI
Work	1.381
Shopping	1.305
School	0.305
Social-Recreation	0.689
Other Home Based	1.147
Non-Home Based	1.856

In addition to the effect of difference in trip production rates stratified by trip purpose, there are also distinct differences in the aggregate trip distribution characteristics of the various purposes. Trip Rate Models—The trip production models developed for Nassau and Suffolk Counties consist of a set of trip rate curves which relate trips per household to average household income for each trip purpose and one of four residential density groupings. It should be noted that the data for non-home based trips were tabulated at the zone of residence of each household regardless of the actual zone of origin or destination of the trip. The reason for this was to analyze the production rate of non-home based trips in relation to the socio-economic and land-use characteristics

of the household without regard to the spatial location of such trips. The trip rate model for non-home based trips was used to establish overall trip totals while the spatial location of nonhome based trip ends will be determined by the trip attraction model.

-

Figures 38 through 41 depict the series of trip rates in the three dimensional interrelationship of the previously discussed factors relating to trip production.

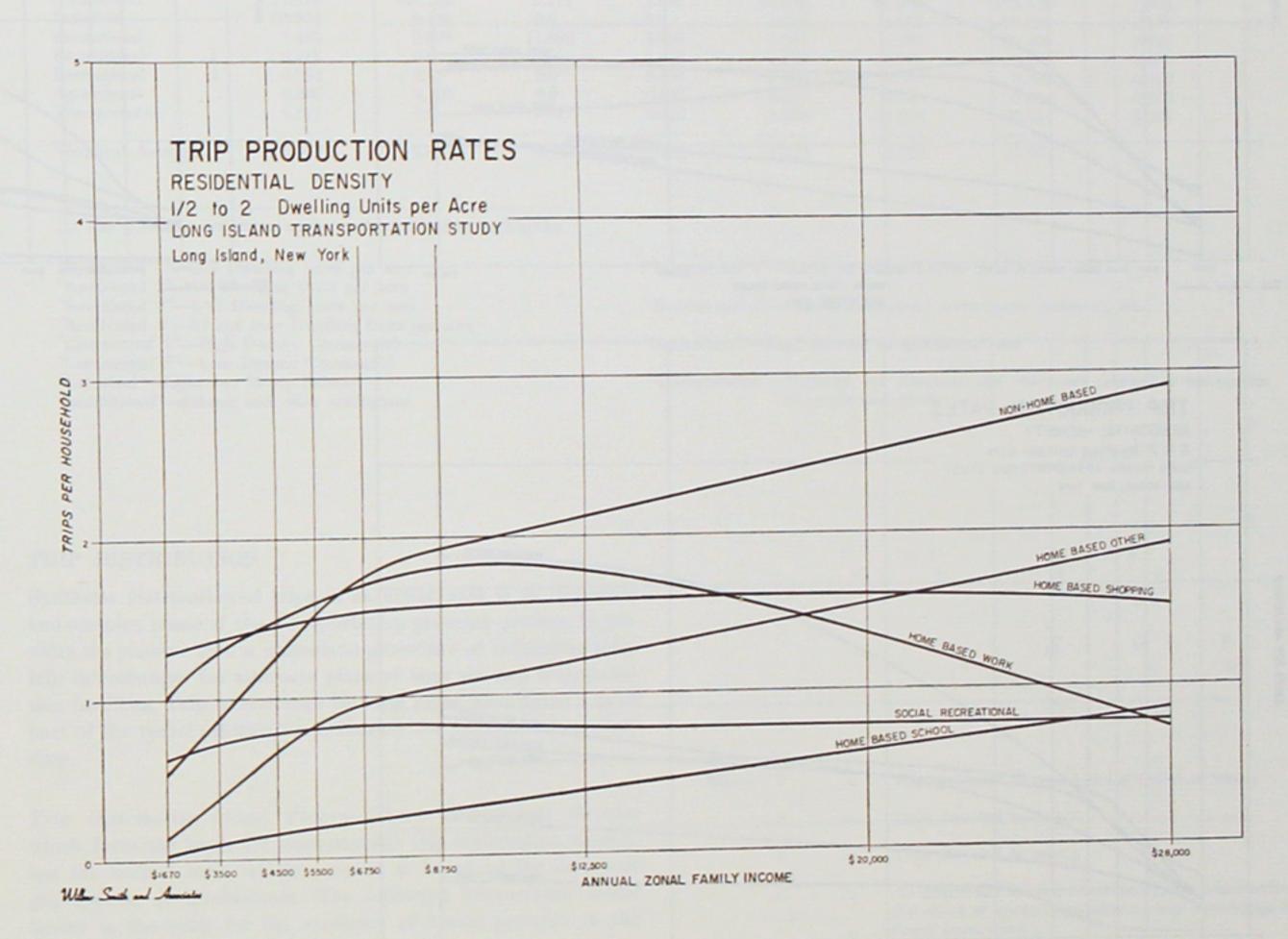
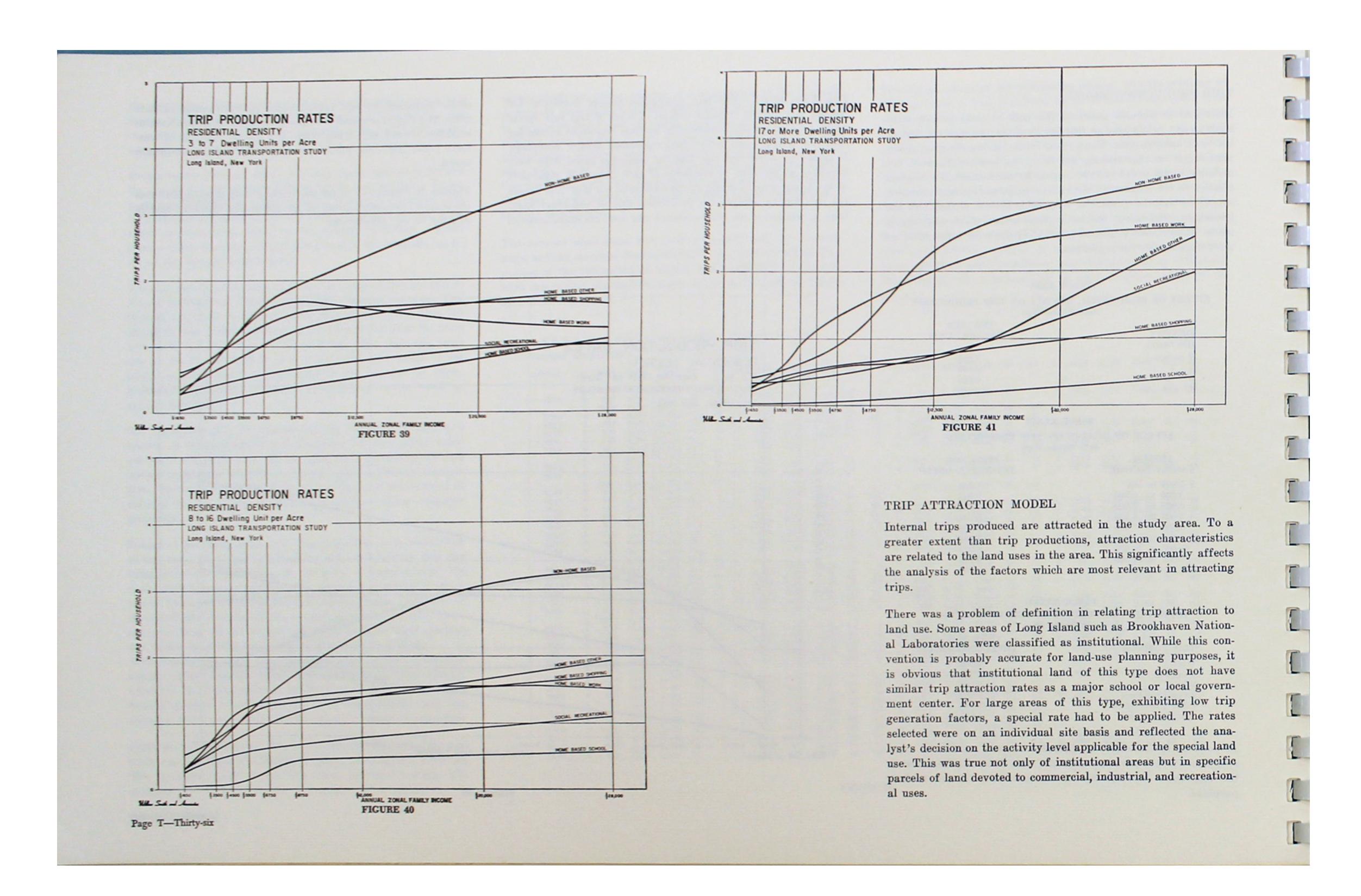


FIGURE 38

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The final average trip attraction rates are shown in Table XXXVIII for each land-use category and trip purpose, as well as cross totals for each group. Commercial trip end rates (truck and taxis) are also given in this table. These rates are used for both ends of the trip since the production and attraction criterion is not applicable. Whatever land use attracts a truck trip also produces it.

CAR OCCUPANCY MODEL

Major emphasis has been given to driver trips in model development for Long Island because of the dominance of the automobile for internal person trips. This technique allows the incorporation of the models in a modal split analysis, if at some future date transit trip making is to be analyzed.

Car occupancy is conveniently expressed as the percentage of car-driver trips to all person trips made by car. Factors which have been found to affect car occupancy are the purpose and length of the trip. Table XXXIX illustrates the significant effect of trip purpose upon car occupancy.

TABLE XXXIX

NUMBER AND PERCENTAGE OF CAR DRIVER TRIPS IN RELATION TO TOTAL PERSON TRIPS BY CARS AND PURPOSE OF TRIPS

Long Island Transportation Study

PURPOSE	PERSON TRIPS BY CAR	CAR DRIVER TRIPS	PER CENT CAR DRIVERS	AVERAGE OCCUPANCY
Home Based Work	700,042	582,884	83.3	1.20
Home Based Shopping	664,292	459,679	69.2	1.45
Home Based School	197,288	83,786	42.5	2.35
Home Based Social-	350,388	199,380	56.9	1.76
Recreation Home Based Other	584,464	379,086	64.9 73.0	1.54 1.37
Non-Home Based	942,688	687,786	10.0	
ALL PURPOSES	3,439,162	2,392,601	69.6	1.44

⁽¹⁾ Persons per vehicle.

The occupancy models developed for use in this study consist of a set of diversion curves which express the percentage or car-driver trips of all person trips made by car as a function of the trip purpose and length of the trip. Figure 42 illustrates the diversion curves used for the six trip purposes. Home based, social-recreation trips indicate a constant occupancy factor.

TABLE XXXVIII TRIP ATTRACTION RATES Long Island Transportation Study

		TRII	PURPOSE			TOTAL AUTO	COMMERCIAL			
(1)					SOCIAL		NON-HOME	PERSON	VEHICLE	
LAND USE		WORK	SHOPPING	SCHOOL	RECREATION	OTHER	BASED	TRIPS	TRIPS	
Residential	1	0.072	0.0	0.0	0.321	0.138	0.422	0.952	0.364	
Residential	2	0.181	0.004	0.002	0.909	0.315	1.409	2.820	1.000	
Residential	3	0.332	0.002	0.002	1.694	0.696	2.480	5.205	2.017	
Residential	4	0.341	0.0	0.0	3.284	1.051	4.031	8.709	3.456	
Commercial	1	25.026	62.211	0.037	2.394	30.192	38.290	157.969	10.060	
Commercial	2	41.878	139.198	0.172	2.895	28.589	65.960	289.542	1.600	
Industrial		26.976	0.128	0.0	0.0	1.216	3.835	32.154	1.378	
Institutional		7.410	0.005	11.686	2.550	7.507	4.153	30.890	0.587	
Recreational	1	0.418	0.0	0.0	3.015	1.019	0.745	5.206	0.037	
Recreational	2	0.058	0.0	0.0	0.333	0.209	0.145	0.722	0.010	
Agricultural		0.288	0.105	0.0	0.037	0.241	0.250	0.922	0.375	
Transportation		6.612	0.0	0.017	0.815	5.024	24.046	36.514	5.022	
Weighted Average		2.787	2.647	0.786	1.396	2.322	3.750	13.687		

⁽¹⁾ The following definitions apply to the 12 land-use categories:

TRIP DISTRIBUTION

Synthetic distribution of trips in an urban area is an important and complex phase of the transportation planning process. It provides the planner with a systematic procedure of estimating zonal trip interchanges for alternate plans of land use and transportation facilities. Trip interchange between zones constitutes a basic part of the travel information necessary for transportation planning.

Trip Distribution Model Theory-There are several theories which form the basis for mathematical trip distribution models, but the method most widely adopted is based on the theory of gravitation, or interactance. The following interactance model theory is the basis for the synthesis of travel patterns in the Long Island Transportation Study:

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[&]quot;Residential 1"-1/2-2 Dwelling Units per acre

[&]quot;Residential 2"-3-7 Dwelling Units per acre

[&]quot;Residential 3"-8-17 Dwelling Units per acre "Residential 4"-17 and over Dwelling Units per acre

[&]quot;Commercial 1"—High Density Commercial "Commercial 2"-Low Density Commercial

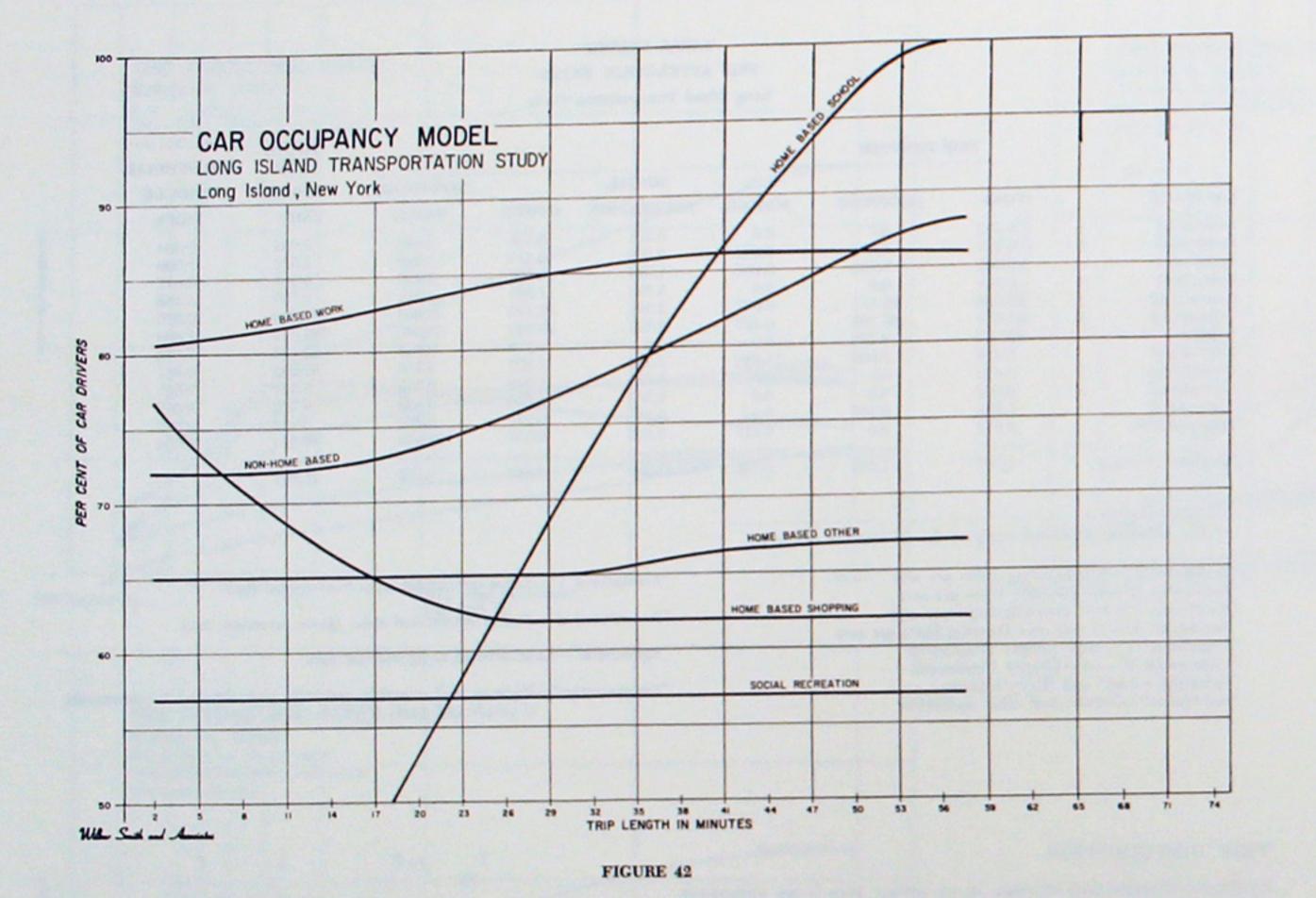
[&]quot;Industrial"-Light and Heavy Industry "Institutional"-Schools and other institutions

[&]quot;Recreational 1"-Active recreational areas (race tracks, etc.)

[&]quot;Recreational 2"-Passive recreational areas (game preserves, etc.)

[&]quot;Agricultural"-Land devoted to agricultural uses

[&]quot;Transportation"-Highway, rail terminals, and other uses devoted to movements of people and goods



Origin-destination and travel time surveys conducted by the Tri-State Transportation Commission were the source of the following:

- 1. Trip production in each zone (P);
- 2. Trip attraction to each zone (A);
- 3. Base-year trip table ends (T); and,
- Spatial separation (travel time) between each zone and all other zones in the study area.

The only unknowns were the relative distribution rates which were determined by successive runs of the interactance program. The inputs to the program were all parameters on the right side of the interactance model equation, including an initial approximation of the relative distribution rates.

Using the survey trip pattern as a base, these rates were adjusted after each calibration run of the program until the trip length distribution, total person trips, average trip lengths, and personhours of the synthetic trip patterns were within specified limits of the survey characteristics.

When these processes were complete, the interactance model was considered to be "calibrated". The relative distribution rates which yielded a satisfactory synthetic trip distribution for the base year were assumed to remain constant for use in distributing future year trip ends.

Calibrating the Model—There are basically four phases involved in calibrating a trip distribution model. For the Long Island Transportation Study, the initial phase involved organizing the survey data into a useful form for analysis purposes. The survey data, for which the models are to be calibrated, were edited, sorted, linked, and grouped into the selected categories. Then, minimum path travel times were developed between each zone and all other zones in the study area.

In the second phase, use was made of the previously processed trip survey records to obtain complete tables of intrazonal and interzonal movements for each trip purpose. From these tabulations, the number of trips produced in (Pi) and attracted to (Aj) each zone in the study area was obtained for each purpose category. In addition, the resulting zone-to-zone movements and the minimum-path travel time between zones were utilized to obtain the frequency distribution of trips, by lengths, in one-minute intervals for each trip purpose.

During the third phase, relative distribution rates were developed for each of the distribution models to be calibrated. Trip productions (P) and attractions (A) by zone, together with minimum-path travel time between zones and the initial approximation of the relative distribution rates were inserted into the distribution model formula and the resulting trip interchanges (i-j) calculated. This synthetic trip frequency distribution was then manually compared with the appropriate frequency distribution previously obtained in phase two, and the initial approximations of the relative distribution rates were adjusted accordingly.

A new set of trip interchanges was calculated and the process of trial and adjustment continued until the synthetic distributions agreed, within allowable limits, with the survey trip distributions.

Phase four provided for the testing of the calibrated models to assure simulation of present travel patterns.

Summary Trip Distribution—The result of various statistical tests and traffic assignment comparisons indicated that the trip distribution models for the Study were properly calibrated and will reliably distribute base-year trip ends. Charts and tables are available which serve to further illustrate these calibrations. A sample traffic assignment listing can be found in Figure 43.

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LONG ISLAND * 1966 ASSIGNMENT TO 1966 NETWORK FEBRUARY 10,1970

A-NODE	B-NODE	JUR.	VOLUME	B-NODE	JUR.	VOLUME	6-NODE	JUR.	VOLUME	B-NODE	JUR.	VOLUME
			£112									
7225	7250	6	5132 483	941	9	1079	942	9	85	7201	2	1885
7225	7226	2	1734	741	,		***				-	
7226	953	9	166	7225	2	1734	7227	2	1702			
7227	952	9	895	7226	2	1702	7260	2	1783			
7230	933	9	168	934	9	270	7196	2	1255	7231	2	1553
7231	945	9	1651	7230	2	1553	7232	2	1714			
7232	944	9	35	946	9	937	954	9	2166	7231	2	1714
1232	7270	2	1864		11							
7235	938	9	611	949	9	59	7236	2	1914	7237	2	1582
7236	936	9	479	937	9	27	948	9	1189	7235	2	1914
1230	7250	2	2453			Maria de la companya della companya						
7237	939	9	183	7235	2	1582	7255	2	1635			
7240	943	9	221	7215	2	221						
7250	947	9	1100	7220	6	5132	7236	2	2453	7270	2	3975
7255	950	9	350	7237	2	1635	7260	2	1362	7275	2	443
7260	951	9	731	7227	2	1763	7255	2	1382	7265	2	2354
7265	7260	2	2354	7266	2	1903	7275	2	1023			
7266	961	9	751	962	9	718	7265	2	1903	7290	2	2562
7270	955	9	3314	956	9	1892	7232	2	1864	7250	2	3975
1210	7271	8	4291									
7271	949	9	92	957	9	953	958	9	444	959	9	1457
12.1	7270	8	4291	7285	8	4549						
7275	961	9	1037	7255	2	443	7265	2	1023	7276	2	1381
7276	960	9	756	7275	2	1381	7285	2	1543			
7285	963	9	1084	7271	8	4549	7276	2	1543	7300	2	3210
7290	966	9	2249	967	9	81	966	9	345	7266	2	2562
	7291	2	1405									
7291	970	9	97	971	9	54	7290	2	1405	7305	2	1330
7300	964	9	628	965	9	646	7285	2	3210	7301	2	3238
	969	9	843	970	9	273	7300	2	3238	7305	2	3548
7301 7305	972	9	1807	7291	2	1330	7301	2	3548	7310	2	4765
7309	974	9	340	975	9	669	976	9	923	977	9	62
1304	7310	9	1222									2040
7310	973	9	1980	7305	2	4765	7309		1222	7311	2	2869
7310	978	9	899	7310	2	2869	7320		2522			1045
7311	979	9	1065	980		508	7311		2522	7330		1965
7320	981	9	752	7320		1965	7340		238	7350	-	1419
7330	982	9	334	7330		238	7350		56			
7340	702		622	7355	2	456	7365	2	66			

FIGURE 43

7355

7340

7345

7345

7365

522

1419

797

23

831

456

7355

7350

7355

External Trip Models-A significant portion of the trips in the study area, especially in Nassau County, cross the Nassau-Queens County line. Of the 3,288,410 vehicle trips made on an average 1963 day in Nassau and Suffolk Counties, 319,409, or approximately 10 per cent, crossed the external cordon line. Since socioeconomic and land-use data were not available for the end of the trip outside the study area, another less refined method of projecting these important trips had to be used for analysis purposes.

984

983

985

986

7330

7345

7350

7355

7365

7370

The method selected was a growth factor technique originally presented by Thomas J. Fratar to the Highway Research Board in 1954. This "Fratar" method expands existing trip patterns based on growth factors at each end of the trip.

The basic form of the Fratar expansion program can be expressed as follows:

7365

7370

780

831

1515

1515

780

The input to the program was a base year trip table of movements to be factored. Growth factors were applied to each interchange in the trip table supplied, and factoring was done in such a way that the proper number of original origins was always present. After any one application, however, actual destination totals did not always agree so that an iterative process was followed to refine the correspondence between actual and desired totals.

The trips produced inside the study area going outside were treated separately from those made by external residents who entered the study area. It was assumed that the best measure of future trips destined to Brooklyn, Queens, and Manhattan was the growth in employment in these areas. The growth in population in Nassau and Suffolk Counties was the basis of growth factors for trips coming into the area.

It is obvious that the trips made by external residents destined to Nassau and Suffolk Counties will increase at a faster rate than those leaving the area. The employment changes in New York City, especially in Brooklyn and Queens, are anticipated to significantly increase (Tri-State indicates an overall growth of 8 percent). However, there will be a substantial increase in the population of the two counties under study with a corresponding associated demand for external trip attractions.

Overview-The models were developed using 1963 trip data. The first test of their ability to perform adequately was made by applying them to 1966 socio-economic and land use data and confirming the results with actual vehicle ground counts on selected highways. In general, the models performed very well with accuracy levels within a range of approximately 10 percent.

While 1985 volumes in specific areas appear to be high, past experience has shown that they can be anticipated with the type and extent of urban growth projected for the Bi-County area.

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j=1

Projection—Three new 1985 highway networks were developed for testing as follows:

Network 1—Existing system and State proposed improvements and North Shore Corridor Expressway and the Sunrise Corridor Expressway;

Network 2-State proposed improvements only; and,

Network 3—Network 1 plus Nassau North-South Expressway.

New trip matrices were then generated, using projected 1985 population and income data. These matrices were assigned to each of the three variations of the 1985 network and outputs produced which depicted each link of the network and the daily volume it would be handling.

Common to all of these assignments was the fact that trip matrices were generated using an existing land use scheme. In addition two new models, each using a different land use scheme, have been tested. In the future, further variations of land use will be examined. Major land use variations necessitate a complete rebuilding of the trip matrices in contrast to network changes which are relatively simple to implement. The process of rebuilding the trip matrices involves some 15 different computer programs, some executed several times, ranging from a land use update, through a gravity based trip distribution to an add matrix routine which produces the final trip tape. Along the way, controls must be constantly observed to insure accuracy.

In addition to the three major models that have been constructed, many special sub-regional analyses were conducted. They include:

- 1. 1985 trip volumes to and from selected zones in the area
 of the proposed Nassau Sky Bus Loop. This information
 was helpful in assessing whether or not the majority of
 users of such a system would originate in the immediate
 area or would be entering from outlying zones.
- 1966 and 1985 trips to and from New York City. An analysis to determine the increase in volume as it would affect the various origin and destination zones both within the Bi-County area and the city of New York.
- 3. 1966 and 1985 Select Link Analysis* of that portion of the Long Island Expressway that crosses the City line. To determine future volumes.
- 4. 1966—1985 trips to and from all zones in the Town of Huntington. An attempt to more carefully pinpoint the effects of future growth in this area.

- 5. Town of Huntington—Route 110 and Jericho Turnpike. A Select Link Analysis for both 1966 and 1985. To determine what the make-up is and will be of the traffic at this major intersection for purposes of assessing the benefits, if any, of a proposed cloverleaf complex.
- 1966 and 1985 Babylon and Bay Shore—Select Link Analysis. To assist in determining whether or not a proposed limited access highway will alleviate the traffic problems in this area.
- A study of the affects that a proposed re-zoning of portions of the Melville industrial area might have on the existing and proposed roadways in that area.
- A link analysis examines a specific roadway by assigning appropriate trip matrices to the network and then listing the origin, destination, and volume for each zone that feeds traffic to or attracts traffic through the specified link. A zone analysis merely reflects the distribution of trips between selected zones without directly considering the specific routes.

The following figures, 44-45, graphically depict the flow patterns involved in the computer programming. Figure 44 indicates the process for preparing the input data. Figure 45 indicates the pattern for analyzing the distribution and assignment of trips.

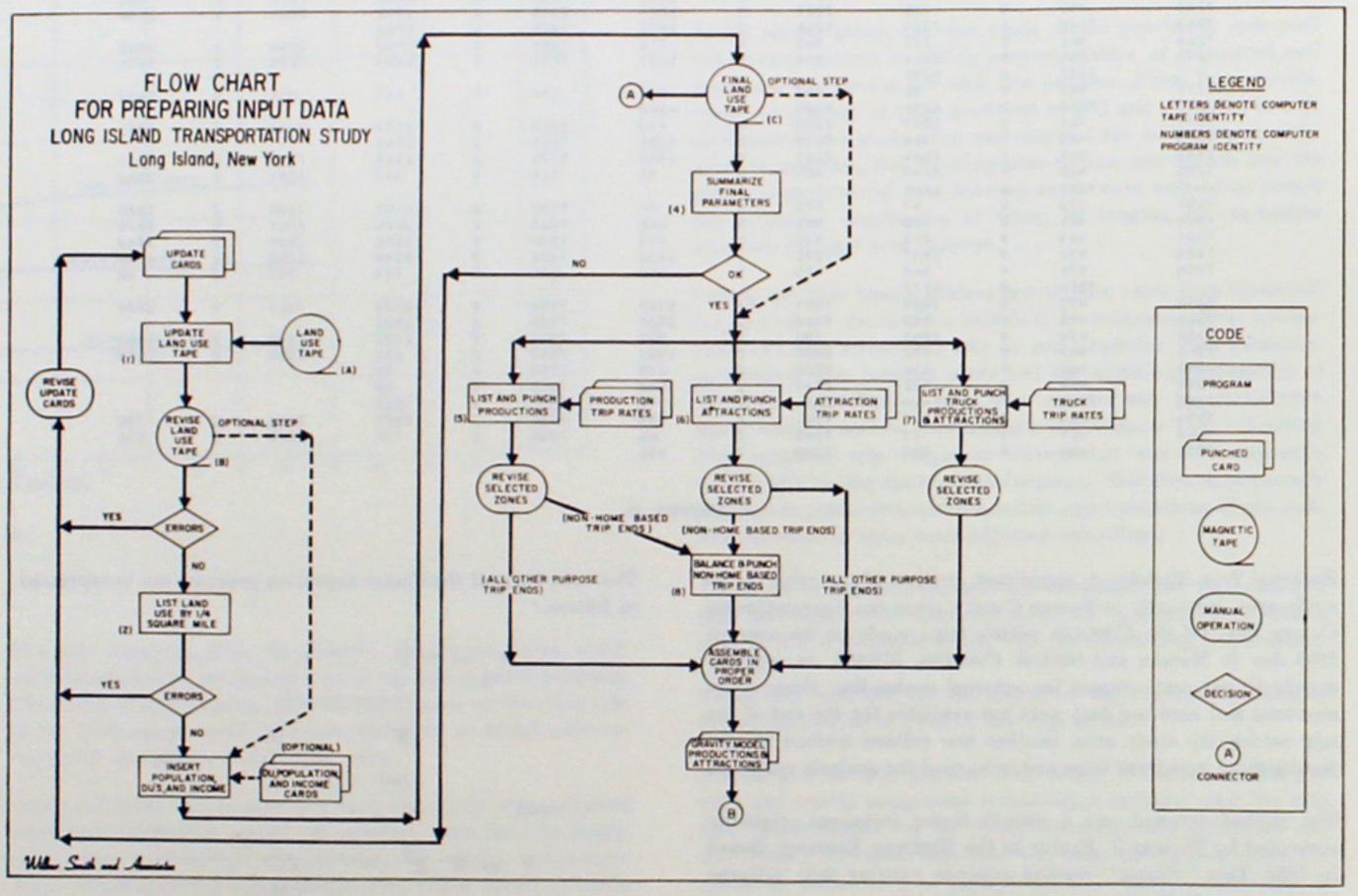


FIGURE 44

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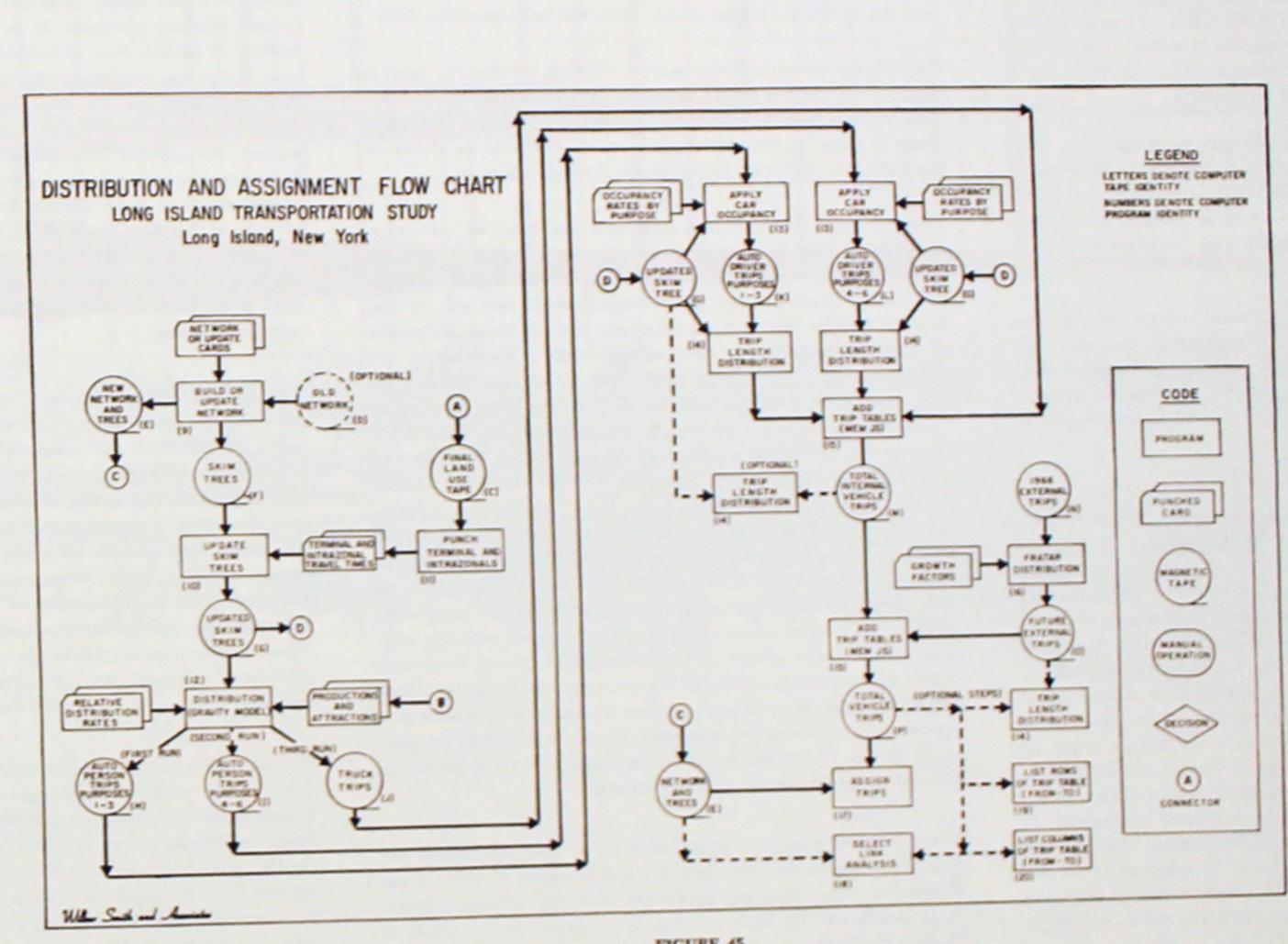


FIGURE 45

Highway System

Essentially, Nassau and Suffolk Counties have developed as a highway-oriented region. This has occurred because of relatively low density residential development and widely dispersed employment, shopping, cultural and recreational facilities. This has hampered the development of mass transportation facilities due to the lack of concentrated corridor movements.

The 1985 proposed land use plan attempts to reverse this trend toward automobile orientation by recommending the development of high density centers to concentrate trip productions and attractions. Hopefully, the interactions of these centers will develop strong corridor movements to justify and encourage the use of mass transit.

In 1967 approximately 570,000 vehicles crossed the Queens-Nassau line on the major highways included in this study. By 1985 this number is projected to increase to approximately 750,000 vehicles. The number of vehicles crossing the Nassau-Suffolk line will increase from 340,000 in 1967 to over 530,000 in 1985.

The 1985 Corridor Volume Map on the following page shows the corridor demands for vehicular movement which will result from the proposed highway improvements. Comparison with the Corridor Volume Map in Part I reveals a substantial increase in traffic through the Southern Corridor at the Queens-Nassau line. This reflects the provision of a Southern Corridor Expressway to satisfy a demand which is now partly accommodated in the Central Corridor by the Long Island Expressway and the existing north-south highway system. It is estimated that of the traffic crossing the Queens-Nassau Line on the Long Island Expressway, 14 percent of the existing traffic has an origin or destination in the Southern Corridor in Nassau County and 17 percent in Suffolk County, for a total of 31 percent. This demand will increase by 1985 resulting in the continued overloading of the existing limited access facilities in the Central Corridor and the supporting north-south feeder roads. In addition to the 450 miles of state and county highways that currently equal or exceed design capacities, 170 more miles will reach this status by 1985.

Most of the existing east-west highways crossing the Queens-Nassau line are currently deficient. In 1968 the total volume using these roads exceeded the combined design capacity of the roads by approximately 96,000 vehicles per day. Assuming that 10 percent of this traffic represents the design hour and that 60 percent of the traffic at this hour is in the direction of heavier flow, it would require eight additional lanes limited access at the Queens-Nassau line to provide level of service C at an estimated design capacity of 1500 vehicles per lane. By 1985 this deficiency will be increased to 14 limited access lanes. At the Nassau-Suffolk line, six additional limited access lanes will be required by 1985.

The limited access highway system will not obviate the need to improve non-limited access highways such as the Hempstead and Jericho Turnpikes which serve as access to abutting land uses. Some of these improvements are already scheduled as shown on the 1969-1974 Highway Improvement Program Map.

The additional highway lane proposals are essential, not withstanding the Plan's recommendations for mass transit to meet the overall growth requirements anticipated in the Region. This is particularly true in terms of the requirements that will be created by specific land use developments such as the development of Mitchel Field. This project will generate a doubling of the current traffic in the Garden City-Hempstead area. These trips will emanate from all parts of the Bi-County Region, making an impact on the overall road system and especially on those roads serving the immediate vicinity of Mitchel Field, such as Old Country Road, Hempstead Turnpike, Stewart Avenue, Merrick Avenue, Clinton Avenue-Glen Cove Road, Washington Avenue, and Franklin Avenue. A direct connection from Meadowbrook Parkway to the Mitchel Field site and an additional north-south limited access highway to the west to reduce the traffic loads on the existing streets are necessary to accommodate the anticipated traffic. The limited access highway should connect with the eastwest limited access system. It is proposed that County Boulevard which was originally designed for construction along the Long Island Railroad right-of-way between Franklin and Washington Avenues, be extended as suggested above. In addition, an adequate system of internal roads at the Field be built to minimize circulatory traffic on the existing streets.

Other areas of expected higher intensity of land use include the Port Washington sandpits and the communities of Glen Cove, Hicksville, Lake Success, Lawrence—Inwood, Atlantic Beach, Long Beach, and the Rockville Centre—Freeport sectors south of Sunrise Highway.

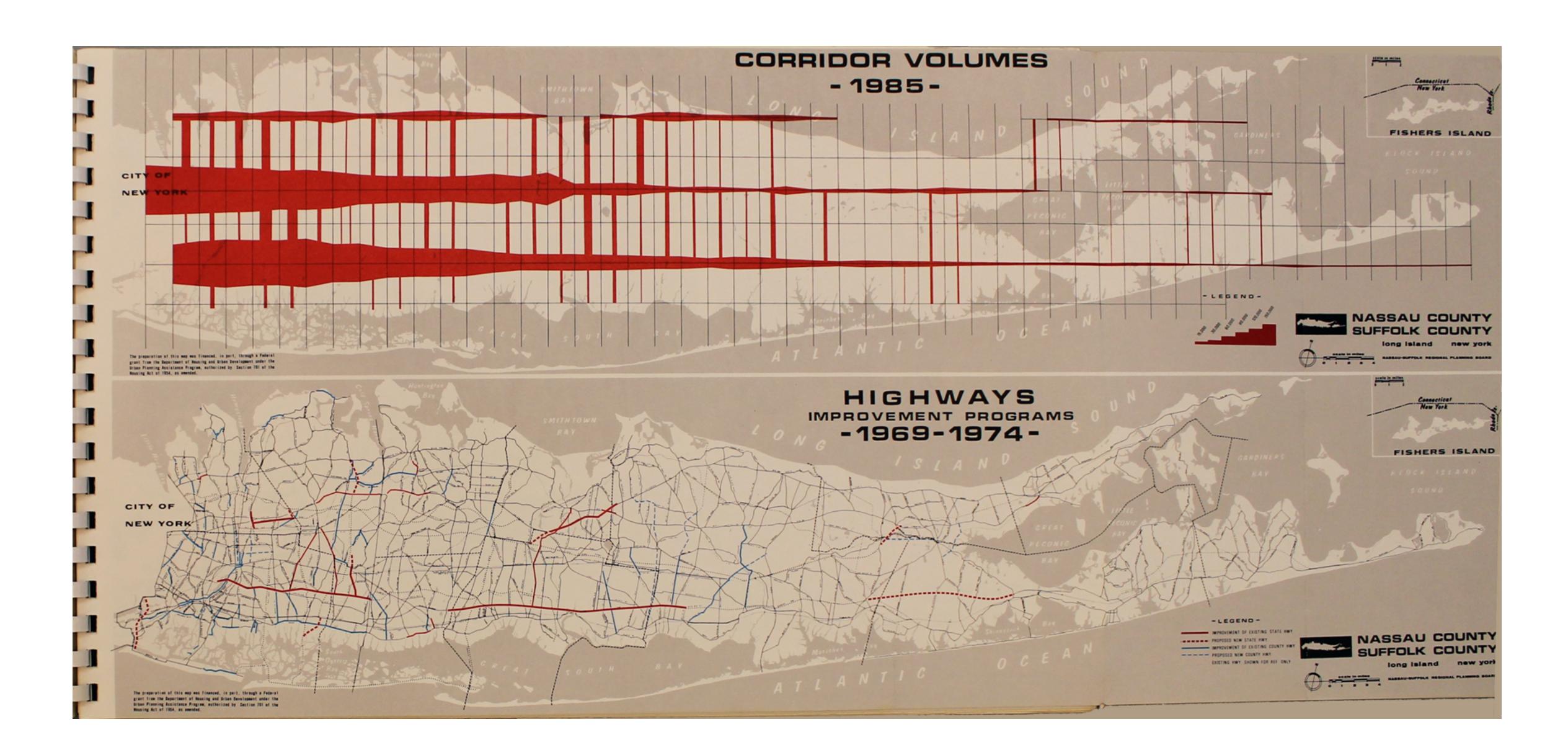
In Suffolk County, the Route 110 corridor from Sunrise Highway to the Long Island Expressway will continue to develop and will be unable to handle the anticipated traffic volumes without substantial improvement. Expansion of the governmental center in Hauppauge and accelerated land development adjacent to the Long Island Expressway corridor will generate substantial traffic increases in these areas.

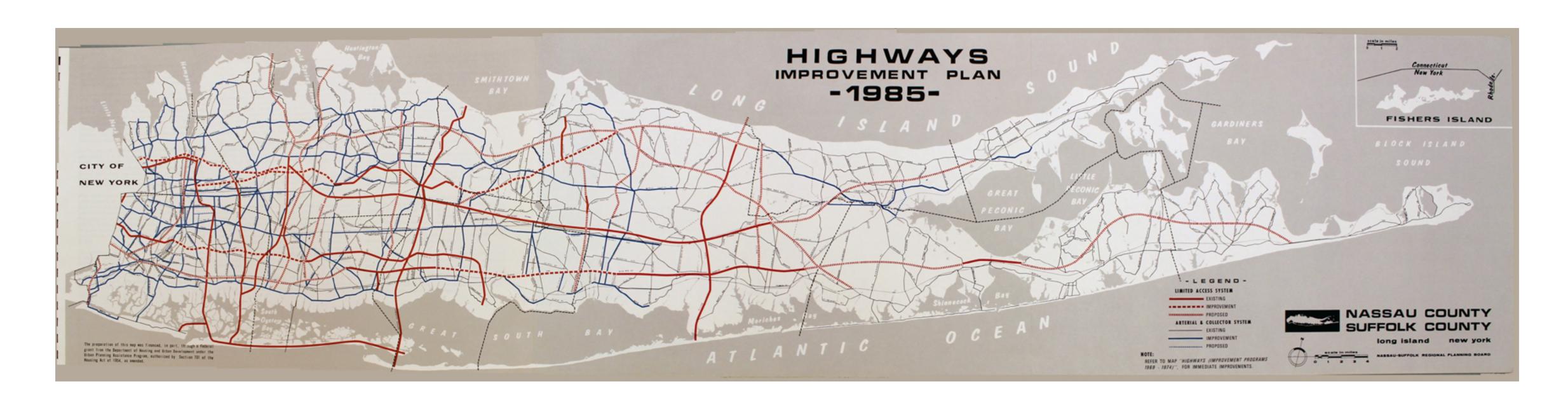
Truck Freight—Heavy increases in truck traffic will further compound highway problems. It is estimated that by 1985 approximately 41 million tons of freight will be hauled by truck in, out, and within the Bi-County Region resulting in over one-half million truck trips per day. This does not include the additional rail freight tonnage. Should the Long Island Railroad be unable to absorb the growth in transportation demands, external truck trips could increase by an additional 11,000 trips per day. This would result in a 60 percent increase over the projected 1985 volume of 18,600 external daily truck trips which will occur due to normal growth. Although external truck trips appear to be relatively small in relation to the total movements, they are the trips most likely to use the limited access facilities causing further overloading.

Bus Transportation—Public transportation is also dependent upon an adequate highway system. The Transportation Plan proposes an improved and extended bus system for both counties. The success of the plan rests, in part, on the ability of this system to provide reasonably efficient service in terms of time and cost. Obviously, congestion on the highways used by bus operators will affect both of these elements. Buses run on fixed routes and cannot use other paths when congestion occurs. It is necessary, therefore, that improvements be made as are needed to ensure the relatively unimpeded movement of buses along their routes. These improvements include the use of exclusive bus lanes, prohibition of on-street parking and preferential movements at intersections, such as left turns for buses only.

Bridges—The question of the need and desirability of connecting Long Island to Westchester and Connecticut by bridging Long Island Sound has been the subject of much discussion. The locations for bridges shown on the Plan, reflect the results of bridge studies authorized by the New York State Legislature. In response to a proposal submitted by Dr. William J. Ronan to Governor Rockefeller, calling for two Long Island Sound crossings, the Nassau-Suffolk Regional Planning Boara, by a resolution adopted March 30, 1967, recommended in principle the construction of a bridge from Oyster Bay to Rye, N. Y., and another from central Suffolk to Connecticut. Before any bridge plans are complete, however, it is important that the generally low-intensity development of the North Shore of both counties be protected. Otherwise, the open character of these areas will be impaired.

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Recommendations—The Highway Improvement Plan, 1985, on the preceding page indicates the improvements to the highway systems necessary to accommodate the projected traffic loads. The critical feature of the plan is the limited access system.

In Nassau County it is recommended that a limited access east-west highway be built through the southern corridor from the proposed Clearview Expressway to the Sunrise Expressway in Babylon. The purpose of this route would be to obtain additional east-west capacity in the corridor where it is needed. This route would help to relieve the burden on the Long Island Expressway through Nassau and Suffolk as well as on the Northern and Southern State Parkways and reduce the demands placed on the north-south feeders which currently serve them.

Further relief for the north-south roads could be realized by the construction of a north-south expressway in western Nassau County to tie together the limited access system and provide additional capacity and access to the Hempstead—Mineola and Mitchel Field areas. This route could be the proposed County Boulevard extended north to the Long Island Expressway and south to the Southern Corridor Expressway.

Other limited access improvements indicated are currently proposed or have been proposed in the past by the New York State Department of Transportation. They include the widening of the Long Island Expressway from Queens to the Seaford Oyster Bay Expressway to ten lanes and the widening of the Southern State Parkway to eight lanes. Widening of Northern State Parkway to six lanes through Nassau County is also recommended. These improvements would satisfy the required limited access laneage by 1985.

The arterial and collector roads which will require improvement by 1985 are shown in blue. Most of these roads are presently deficient in whole or in part as indicated in Part I of the Highway Deficiency Map. In many cases these improvements may involve reconstruction of the intersections ranging from minor approach widenings to grade separations. In Nassau County, based on volume and/or high accident experience, further investigation as to the feasibility of grade separation is warranted at Port Washington Blvd. and Route 25A, Merrick Avenue and Stewart Avenue, Old Country Road and Merrick Avenue, Hempstead Turnpike and Merrick Avenue, Glen Cove Road and Route 25A, Hempstead Turnpike and Wantagh Avenue, Hempstead Turnpike and Hicksville Road, Sunrise Highway and Broadway, Sunrise Highway and Ocean Avenue and Sunrise Highway and Peninsula Boulevard. The estimated accident and delay costs for these intersections averaged \$88,000 per year for the three-year period of 1966 to 1968. However, due to the high density of existing land uses at some of these locations, additional detailed studies e.g., relocation aspects, loss of community tax base, and impact on community character should be undertaken.

The Suffolk County portion of the limited access system includes recommendations for the westerly extension of the Sunrise Expressway from its present terminus at New York State Route 109 to tie in with the Southern Corridor Expressway in Nassau County.

A proposed expressway along the general alignment of New York State Route 110 from Sunrise Highway to the Long Island Expressway is also proposed. Its purpose is to accommodate the anticipated high growth of traffic through this corridor.

This study supports the New York State Department of Transportation proposals for the Hauppauge Spur; linking the Long Island Expressway with the Nesconset—Port Jefferson Highway, the reconstruction of the Nesconset—Port Jefferson Highway into a six-lane limited access facility, the extension of the Long Island Expressway to Mattituck, and the extension of the Sunrise Expressway to Amagansett. This study further recommends for limited access construction, Nichols Road, North Ocean Avenue, County Road 111 (Port Jefferson—Hamptons) and an additional north-south expressway along the general alignment of Wading River Road.

The portions of surface arterial and collectors anticipated to require improvement by 1985 are shown in blue. These improvements are not necessarily total widenings but could involve intersections in terms of accident and delay costs over the 1966-68 period include the intersections of Jericho Turnpike; with Route 110, Deer Park Avenue, Larkfield Road, Commack Road, Indian Head Road, and Nesconset Highway. In addition, the Route 111 and Nesconset Highway, and the Route 27-27A intersections should be reconstructed. Many of these will be grade separated under current New York State Department of Transportation programs. Consideration should be given to early scheduling of these portions of the total improvement program as a means of reducing highway accidents at the earliest possible date.

In Nassau and Suffolk Counties a reclassification of the County road systems should be undertaken. In general, these systems should complement the State major arterial and expressway network and provide access between the major system and the local street systems. Minor town and village roads should not be included in the county systems. Those roads to be left on the system will normally carry relatively high volumes in developed areas, and be of fairly substantial length. Frequently they will transcend town boundaries. They should be of relatively high structural and geometric standards.

The continued urbanization of the Region, particularly in Nassau County, requires that consideration be given to the elimination of railroad grade crossings to avoid the growing congestion and hazard which are the result of crossings at grade. It is recommended that a long range program for the grade separation of the railroad be developed in all areas where high population densities exist or are anticipated or where the railroad crosses primary arterial and secondary highways.

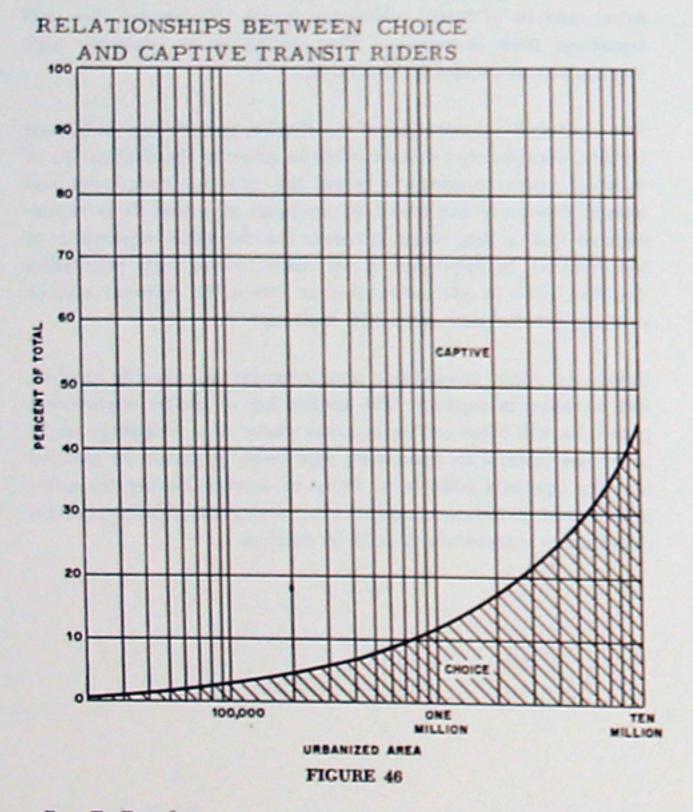
Relatively, minor intersection improvements can provide substantial increases in capacity. The application of traffic engineering principles will often suffice in areas where road widenings might prove detrimental to community objectives. It should be realized that the optimum solution in terms of accommodating the automobile must be balanced against other important objectives and a satisfactory compromise should be reached.

Bus Transportation

Introduction—Long Island is faced with a choice between a greatly enlarged highway and parking system or the development of public mass transit facilities. This choice must be consciously made now since land use and transportation planning are interdependent.

The challenge presented is to determine to what degree the current trend of automobile usage can be changed. An entire generation has grown to adulthood geared to the mobility and convenience of private transportation except for that period of their lives when they were obliged to use school buses.

The majority of current bus users are captive riders who do not have automobiles available to them. In Nassau County, seventy percent of those people interviewed in an on-board bus survey, were not licensed to drive.²⁹



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Our consultants have developed a curve, Figure 46, showing the relationship between choice and captive transit riders in respect to urban area size. The curve illustrates that as urban areas increase in size, the downtowns generally increase in intensity, and central business district travel becomes more aligned in corridors, suggesting better transit service and a rising proportion of "choice" riders. The trend of development in the Bi-County area continues in the direction of relatively low densities and numerous widely dispersed generators. Most trips are of comparatively short duration and take place in a multitude of directions.

By 1985 it is estimated that the average trip time by automobile in Nassau County will be 14 minutes. In Suffolk County it will be 17 minutes. For most trips, mass transportation will be unable to compete in the time-cost aspect of modal choice. But reduced highway congestion and air pollution, lower highway expenditures and a reduction in the rate at which the land is being consumed for road building are obvious benefits to be derived from the increased use of mass transportation. An examination of the factors which determine individual choice of transportation modes provides the basis for estimating the potential use of mass transportation. The major factors are: family income, automobile ownership, residential density, travel time and cost, and the availability of alternate modes. The latter depends upon population density and the magnitude of trip desires along limited width corridors. A generally accepted maximum walking distance to transit facilities is 1/4 of a mile. This means that a single rail or bus line serves a corridor 1/2 of a mile wide.

Our consultants, in their studies of a number of cities throughout the United States and Canada, found the following rail rapid transit relationships."

- Rail systems generally require gross population densities of 14,000 to 20,000 persons per square mile throughout extensive corridors.
- Rapid transit systems are found in cities where: down-town destinations exceed 300,000 people daily; peak-hour volume of persons leaving downtown at the cordon exceeds 100,000 people; daily C. B. D. destinations per corridor exceed 70,000; and C. B. D. floor space exceeds 50 million square feet.
- Minimum, though not necessarily sufficient, conditions for bus or rail rapid transit include at least 150,000 persons destined to the C. B. D. per square mile and C. B. D. person destinations per approach corridor should exceed

- 40,000 per day. In addition, C. B. D. employment should exceed 100,000 persons before rapid transit is considered.
- The urban travel factor or transit use factor which is the product of the urbanized area population density and households per car, divided by 1,000 should exceed seven for rapid transit.

None of these conditions are satisfied in the Bi-County area except for New York City bound commuter movements. The Metropolitan Transportation Authority is committed to a two-stage, one-half billion dollar program to improve the Long Island Rail Road facilities to satisfy this demand. Since traffic to and from Manhattan constitutes a relatively minor part of the total movements, the inter and intra-county trips and trips to Queens and Brooklyn will continue to present a problem. Therefore, the provision of mass transportation within the two counties must rely on bus facilities, which reflects the degree of transit use relative to population densities and automobile ownership. Figure 47 is a generalized travel mode curve representing a composite of experience in a number of cities depicting the relationship between transit use and travel factors. Since the curve was developed from urban area and central city business district data, it reflects stronger corridor movements than are experienced in the Bi-County Region. Comparison of actual transit ridership in this area with the volume which would be predicted by the curve indicates that the actual ridership is substantially lower than estimated from the curve. For the Nassau-Suffolk Region travel factors of 7 are reached only in the most densely populated areas and then only for limited distances-not for extensive corridors. In most areas the transit use factor was substantially less, ranging from 1 to 5.

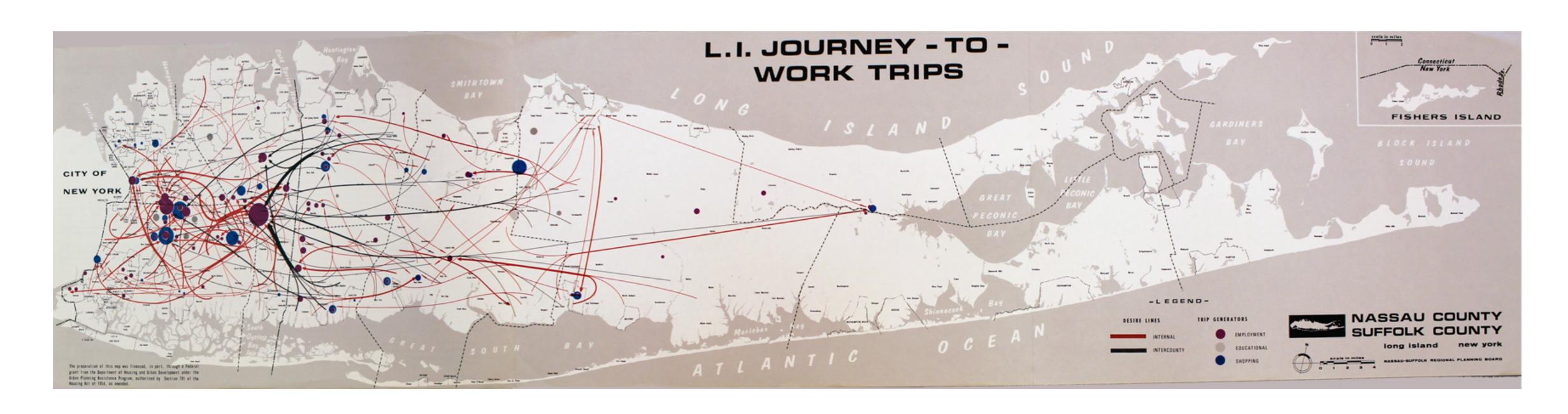
Similar curves were developed by the Traffic Research Corporation for Nassau County as part of its bus study in 1963.³² A series of three curves indicated the percentage of bus work trips in respect to total work trips based on relative travel time, cost, and service categories for three average family income levels in Nassau County. Nassau values, when compared with the cities of Washington, Philadelphia, and Toronto, generally indicated low transit usage. This was attributed to the absence of a large central business district in Nassau County.

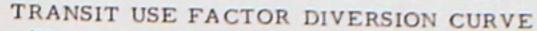
Nassau County Bus System—An Analysis of Present Service, Technical Report No. 1, July 1968.

Transportation and Parking for Tomorrows' Cities, Wilbur Smith & Associates, New Haven, Connecticut, 1966.

³¹ Ibid.

Bus Route Planning Study-Nassau County, New York, Traffic Research Corporation, 1963.





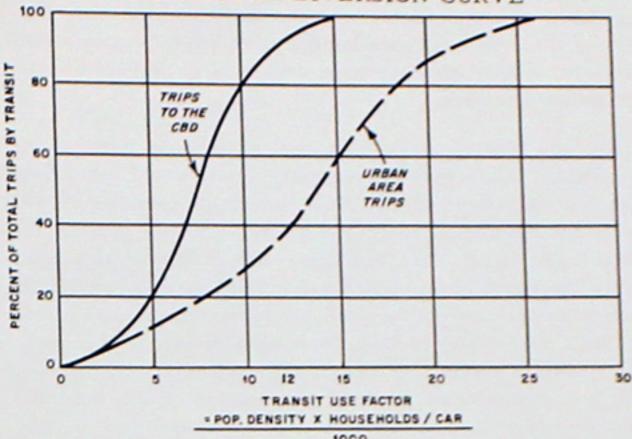


FIGURE 47

The influence of the density of development and automobile ownership on transit use is well documented. High population densities and strong corridor movements to a central core are necessary for the economic justification of mass transportation facilities. The land use proposals of the Comprehensive Plan recognize these constraints in the recommendation for a central transportation—industrial corridor and the development of properly located activity centers such as Mitchel Field.

Development of the Bus Plan—The journey-to-work trip is the most amenable to diversion to mass transit of all the daily house-hold trips. These trips are mainly point to point, from origin to destination. They are destined for higher traffic generating areas and occur at regular periods each day with about 60 percent of the trips taking place during a two-hour peak period in the morning and evening.

The value of diverting such trips to bus transit is obvious. Since these trips occur during peak hour traffic, substantial diversion to bus transit could vastly decrease the load on highways. Most highways are capable of carrying off-peak loads. If peak period volumes can be significantly reduced, the need for widenings and new construction will be lessened. The preceding map is representation of the major journey-to-work trips to the primary generators in the region, including industrial, commercial, and institutional facilities. The arrow heads are directed to the destination and the tails of the arrows indicate the general area of trip origin.

An examination of the residential density patterns in the two counties will indicate the areas with the strongest potential for supporting a bus system. Since each route will serve a limited corridor it is readily apparent that an extensive network will be required. The logical configuration for such a system should essentially follow a north-south and east-west grid pattern due to the geography of Long Island. This is the recommended system proposed for Nassau County by the Traffic Research Corporation in 1963. This is in general conformance with existing bus routing.

The map on the following page depicts the proposed 1985 transit plan. In Nassau County, any number of combinations of proposed routes could have been made. All would have resulted in a similar grid pattern. The objective is to provide adequate bus coverage to those areas where mass transit service is possible.

Independent estimates of bus ridership on the existing bus system in Nassau County were made based on residential land use densities, and automobile ownership. Transit use factors were estimated through the corridors currently served by buses and theoretical values of ridership obtained from the modal split curves. The curves were then adjusted to conform to the actual ridership and reestimates were made until a satisfactory agreement between actual and theoretical values was obtained. The adjusted values were then used to estimate the potential ridership for the proposed Nassau County bus system.

Staff estimates of potential ridership for the proposed bus system in Nassau County were in substantial agreement with the 1963 Traffic Research Corporation estimate of approximately 41 million passengers annually for their recommended system. This would, according to the 1963 report, represent a 37 percent increase in bus ridership resulting from a 27 percent increase in bus miles.

The report also estimated that a first year subsidy of \$800,000 would be required until the full ridership potential was reached. However, since 1963 the increase in operating costs now require an initial subsidy of \$3,000,000. As potential ridership is reached the required subsidy will diminish, providing the relationship between operating costs and transit fares is maintained.

The same procedures were used to estimate bus ridership in Suffolk County. The minimum system shown on the Transit Plan includes a thirty percent increase in route miles over the existing bus routes. Approximately eighty percent of the proposed system will have peak headways of 31 to 45 minutes. Peak headways of 16 to 30 minutes are recommended for some routes in western

Suffolk County. Many existing routes not shown on the Transit Plan would be retained since they provide feeder service to the major system. They would not, however, be a part of the subsidized system as presently recommended. It should be recognized, however, that the plan as presented is general. The specific routing is left to those agencies which will implement the plan.

It is estimated that the proposed bus system would increase ridership from approximately 3.7 million riders in 1965 to about 6.9 million after the plan has been instituted and full potential ridership has been realized.

Estimated revenues for the first year, assuming that potential ridership is reached during this period, are approximately \$3,000,000. Operating costs for the same period, based on 1965 costs adjusted to reflect cost increases of about 33 percent in Suffolk County, would be about \$5,000,000, thereby requiring a subsidy of \$2,000,000.

The plan also depicts the relationship of bus routes to low income areas. This is in order to insure that job opportunities will not be hampered by the lack of transportation. The wider spacing of the grid pattern and the increased headway time in bus service as one proceeds easterly reflects the diminishing population density between Nassau and Suffolk Counties.

Impact of the System—It is estimated that when the potential ridership is reached there will be a diversion of 3 to 4 percent in peak period auto work trips to the bus mode based on existing residential land use densities and automobiles per household. Obviously both of these elements could be affected by an improved transit system. With good bus service the need for multi-car ownership would diminish. In addition, the availability of such a system could lead to denser residential development along the bus corridors. In time the influence of these two factors could further increase ridership potential and reduce, if not eliminate, the need for bus subsidies.

Aside from purely economic considerations there are strong social and ecological factors involved. For example, it is estimated that in 1968, 36 percent of the Bi-County population was in the 0-16 year age bracket and, hence, unlicensed to drive. In addition, 6 percent of the population was 65 years of age or older. Further, an estimated 45,000 households were without automobiles. For many of these people public transportation is a necessity. It is evident that private enterprise, caught between the squeeze of rising costs and public resistance to increase fares, cannot effectively provide a competitive level of service without some form of public

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assistance. The survival of mass transportation is vital. The plan presented herein is modest. It proposes a basic system of bus transportation. The existing bus operators provide the nucleus to build a vastly improved system, with public assistance. The future development in both counties may eventually develop high density corridors capable of sustaining rail rapid transit facilities including one of the more sophisticated high speed ground transportation systems currently in the research and development stage.

Implementation—In order to implement the Bus Plan, several major steps must be taken as follows: establishment of a Suffolk County or Bi-County Department of Franchises; detailed routing studies must be finalized; and a public bus subsidy program initiated.

The establishment of a Suffolk County or Bi-County Department of Franchises is absolutely essential if a coordinated system of bus transit is to be developed. The department would have overall responsibility for the establishment and coordination of franchises, routes, route continuity, fares, transfers, and levels of service.

The franchise agency should be able to achieve a number of highly desirable objectives. These are set forth in the Nassau County Omnibus Consent which is, in essence, an agreement between the County and the omnibus corporations spelling out broad service objectives to be provided by the carrier in consideration of granting the carrier the right to operate a specific route or routes. These service objectives are as follows:

- Extension of bus routes to eliminate bus transfers, both inter and intra-county company;
- Revision of routes so as to provide convenient and timely service to program operations at railroad stations with railroad time schedules;
- Provision of service at designated interchange points to facilitate transfers-with a minimum of inconvenience and delay;
- Connect with Omnibus Corporations operating during similar periods each day to facilitate coordination at interchange points when ridership warrants;
- Provide transfers between routes within a system, even though different companies may be involved;

- Provide a uniform information service in each system under which each company would provide service information on all of the other companies (see following paragraphs re: information system);
- Adjust fare zones to minimize inequities and provide for charges on a reasonably uniform basis;
- Consider provision of special services to high traffic generators (universities, hospitals, courts, etc.) and connecting these to interchange points; consider also provision of special fare rates to children, senior citizens poverty groups.

While the above objectives are unquestionably desirable, it should be realized that they will add to the cost of the plan. For example, present fares charged reflect the operating costs of the individual carriers without regard to fares charged by another carrier. Therefore, if a carrier operating at a low profit margin is obliged to reduce fares to conform to those charged by a carrier with a more profitable operation, the continuance of the service might be jeopardized without some form or subsidy. In addition, the cost of providing reduced fares to special groups would have to be borne by the public where the financial position of specific operators is marginal.

The provision of an information service could be provided more effectively by a county Bi-County agency. Consideration should be given to providing information service for all public transportation modes.

The Franchise Department must also have the right to regulate and standardize the location and placement of bus stops, signs, shelters, etc., in order to provide the maximum degree of efficiency, clarity and comfort for the bus riding public.

Structurally, the Franchise Department should have an advisory board consisting of representatives of the County Departments of Labor, Commerce, Planning, Public Works, Police, Traffic Safety, Economic Opportunity Councils, and the bus industry.

It should have the exclusive right to grant franchises in the entire county, or counties, with the possible exclusion of those routes operated wholly within an incorporated village or city. One of the first tasks will be the detailing of specific routes in accordance with the general recommendations of the plan. Connections, extensions and consolidation of routes to provide a comprehensive system will have to be developed in conjunction with the various operators.

Finally, the funding of the Plan will have to be initiated. As conceived in this report the necessary funds would come from State, Federal, and County sources. Direct fare subsidies are not eligible for State and Federal aid but subsidies are possible for capital improvements. In effect this is being achieved in Nassau County through a grant of \$900,000 for the purchase of 35 new buses to be operated by four bus companies under service contract with the County. In turn, the companies involved agree to provide certain services to benefit the system. In this fashion desirable improvements to the system can be made, since the Franchise Department will have an effective lever for negotiating such improvements.

The Franchise Department should strive for the development of adequate terminal facilities at existing and proposed transportation centers. The utilization of air rights, particularly over rail facilities in order to provide for better integration of multi-modal terminal facilities should be explored.

The preservation of existing public rights of way for possible future transportation use in order to avoid a recurrence of the conditions which led to the loss of much of the Old Motor Parkway and the Kennedy Spur should be the concern of the Franchise Department. This is especially true where such abandoned rights of way might serve as exclusive express bus corridors to high trip generating areas.

The feasibility of providing specialized bus service to high generating areas such as colleges and universities, high employment areas, and major shopping facilities should continue to be explored.

The concept of replacing rail facilities with buses along some of the lesser used Long Island Railroad branches should be given consideration. Some advantages to be gained would be that the buses could leave the right-of-way at the communities now being served and pick up passengers closer to their origins. This would help reduce traffic to the rail stations and lessen the demand for commuter parking at the stations. A dual railroad vehicle, such as the one tested by the Long Island Railroad could accomplish the same objective.

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