
YEAR 2000 RIDERSHIP FORECAST FOR THE FRANKFORD ELEVATED LINE

JULY 1988



**DELAWARE VALLEY REGIONAL PLANNING COMMISSION
THE BOURSE BUILDING
21 SOUTH 5TH STREET, PHILADELPHIA, PA 19106**

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DELAWARE VALLEY REGIONAL PLANNING COMMISSION

Publication Abstract

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ABSTRACT

Updates the Year 2000 demand forecast for the Frankford Elevated Line. The new simulation incorporates population and employment data from the revised Regional Development Guide, recent transit route and schedule changes in Northeast Philadelphia, and a refined delineation of catchment areas for individual stations.

For More Information Contact:



Delaware Valley Regional Planning Commission
Regional Information Services Center

The Bourse Building
21 South 5th Street
Philadelphia Pa. 19106
(215) 592-1800

TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	
I. INTRODUCTION	1
II. METHODOLOGY.	3
III. RIDERSHIP.	9
IV. CONCLUSION	17
 Map 1 - Frankford Elevated Line Station Catchment Areas.	 5
Table 1 - Demographic Changes in Market Area for Frankford Elevated	 6
Table 2 - Frankford Elevated Weekday Station Boarding Trends . . .	10
Figure 1 - Average Weekday Boarding Trends by Station	11

EXECUTIVE SUMMARY

The Market-Frankford Line, which runs for 13.2 miles between 69th Street in Upper Darby and Frankford Terminal (Bridge-Pratt) in Northeast Philadelphia, was originally built in 1922, and the 5.2 miles of elevated structure at the eastern end is now undergoing major reconstruction, so that service may be maintained into the foreseeable future. The project consists of six line sections and eleven stations with all system components, including signals and power. The total cost of \$637 million makes it the largest transit reconstruction project in the Philadelphia area. The station at Margaret-Orthodox has already been rebuilt and work has commenced on the elevated structure east of Girard. In view of the scope of the project and a declining ridership trend, the Southeastern Pennsylvania Transportation Authority (SEPTA) asked the Delaware Valley Regional Planning Commission (DVRPC) to produce a new Year 2000 ridership projections using the latest available data.

DVRPC made the following changes to the model used for the earlier ridership projections made in 1978:

- o Year 2000 population and employment projections were based on the Regional Development Guide adopted in 1983, which incorporated data from the 1980 Census.
- o The transit network in Northeast Philadelphia was revised to reflect Phase 3 route restructuring, and headways were adjusted to match April 1988 schedules.
- o Census tracts in the vicinity of the line were split in order to more precisely define the station catchment areas and access links.

Though the simulation predicts a continuing decline in ridership through the Year 2000, the rate should be relatively modest at -0.3 percent per year, which is significantly less than the -1.6 percent observed between 1970 and 1976, and -0.8 percent between 1976 and 1987. Basically, expected growth in Center City employment and the reverse commute market should largely counterbalance loss of population and employment along the line.

The Frankford Elevated portion of the line is expected to generate about 50,000 boardings per weekday in the Year 2000. When return trips from the remainder of the line are included, total daily ridership on this segment rises to 91,400. While all stations are expected to experience some decline in boardings, the losses are not distributed uniformly. At Dauphin-York, Somerset, Berks, and Huntingdon stations, the decline between 1987 and the Year 2000 is expected to exceed ten percent, whereas at Girard, Church, Margaret-Orthodox, and Bridge-Pratt stations the losses should be one percent or less. Some decline notwithstanding, the Market-Frankford should remain as SEPTA's most heavily traveled line and an integral component of Philadelphia's transit network.

I. INTRODUCTION

The reconstruction of the Frankford Elevated (Blue) Line between Wilkey Street, located one block west of Girard Avenue, and its eastern terminus at Bridge Street is the largest transit capital project now underway in the Philadelphia area, and it is currently consuming all of the capital funds available to SEPTA's City Transit Division from traditional sources. (Officially the Market-Frankford Line is considered an east-west line and directions in this report will be so indicated, even though the Frankford Elevated portion is more nearly aligned north-south.) Phase I of the project, which covers reconstruction of the Margaret-Orthodox station and Line Sections 1 and 2, is costing \$203 million. It is estimated that an additional \$434 million will be required to bring the project through the second and final phase.

Built in 1922 the line, considered in its entirety from 69th Street to Bridge Street, is SEPTA's most heavily patronized line. Daily ridership has been declining for several decades and now stands at approximately 185,000, though the rate of decline has slowed in recent years. Ridership on the Frankford Elevated portion currently averages about 52,000 weekday boardings. When this number is factored to include eastbound trips originating west of Girard Avenue, total patronage on the Frankford end rises to approximately 95,000, almost half of total line ridership.

DVRPC staff has developed several ridership forecasts for the Frankford Elevated. The projections used by the City of Philadelphia in the cost-benefit portion of their study were prepared in 1978 and based on the Regional Development Guide (RDG) adopted by the DVRPC Board in 1977. The population and employment forecasts contained therein were overly optimistic for Philadelphia. For this and other reasons, DVRPC prepared an alternate Year 2000 forecast for use in project level analyses, and this became the basis for most highway and transit studies conducted in the late 1970's and early 1980's. This alternate Year 2000 forecast produced projections for the Frankford Elevated that were considerably lower than those used in the cost-benefit analysis and are reflective of the ridership given in the alternatives analysis portion of the replacement study.

Ridership and employment data collected by the 1980 Census suggest that the alternate Year 2000 projections were still on the high side. In view of the overall size of the reconstruction project, SEPTA asked DVRPC in April 1988 to take another look at station boardings on this portion of the line and produce a new ridership projection to reflect the new Year 2000 RDG. This was adopted by the DVRPC Board in 1983 and reflected 1980 census data.

II. METHODOLOGY

For purposes of travel simulation, the region is divided into zones to which trip production, based on demographic characteristics, and trip attraction, based on employment, can be assigned. Demographic variables of interest include population, household size, auto ownership, and number of employed residents. In order to forecast travel demand, population and employment must first be projected at the census tract level to the horizon year. These projections are based on observed trends, as well as planned residential and commercial development.

The travel simulation models at DVRPC follow the traditional steps of trip generation, trip distribution, modal split and travel assignment, and utilize programs included in the Federally sponsored Urban Transportation Planning System (UTPS). Generally the models are similar to those used in other large urban areas and by the City of Philadelphia in their study of the Frankford Elevated, but they have been subjected to an extensive validation/recalibration analysis based on the 1980 Census.

Trip generation is the first step in the modeling process. Person trips are generated from estimates at the census tract level of households and employment through the use of trip rates disaggregated by purpose, auto ownership, and area type. Travel from census tracts is then allocated to destinations with a gravity model, which assumes that the propensity to travel increases with the attractiveness of the destination, as measured by employment, and decreases as the difficulty of traveling between tracts increases. This travel effort, or impedance, is measured by travel time and cost for both highway and transit modes.

The modal split model divides travel between census tracts into transit and highway components. Generally, the propensity to use transit increases with the relative service levels, which are estimated through frequency of service, and travel time and costs. In addition, auto ownership, transit submode (bus, rail, etc.), household income, and trip purpose further define the choice between highway and transit.

The auto occupancy model determines the average number of persons per automobile based on trip purpose and trip length. This value is used to convert auto person trips to vehicle trips.

The final step in the process is to assign the estimated transit trips to specific facilities. This is accomplished by allocating travel to the minimum time and cost route through the transit network. The assignment also unlinks multi-vehicle trips, so that boardings per route may be calculated. A full description of the process can be found in the DVRPC report, Year 2000 Travel Forecasts for the Delaware Valley Region, published in March 1987.

Access to Frankford El stations is gained primarily by either walking from surrounding neighborhoods, or by transferring from a connecting bus, trackless trolley, or trolley route. Most of the connecting traffic comes from Northeast Philadelphia, either via Bridge-Pratt or Margaret-Orthodox,

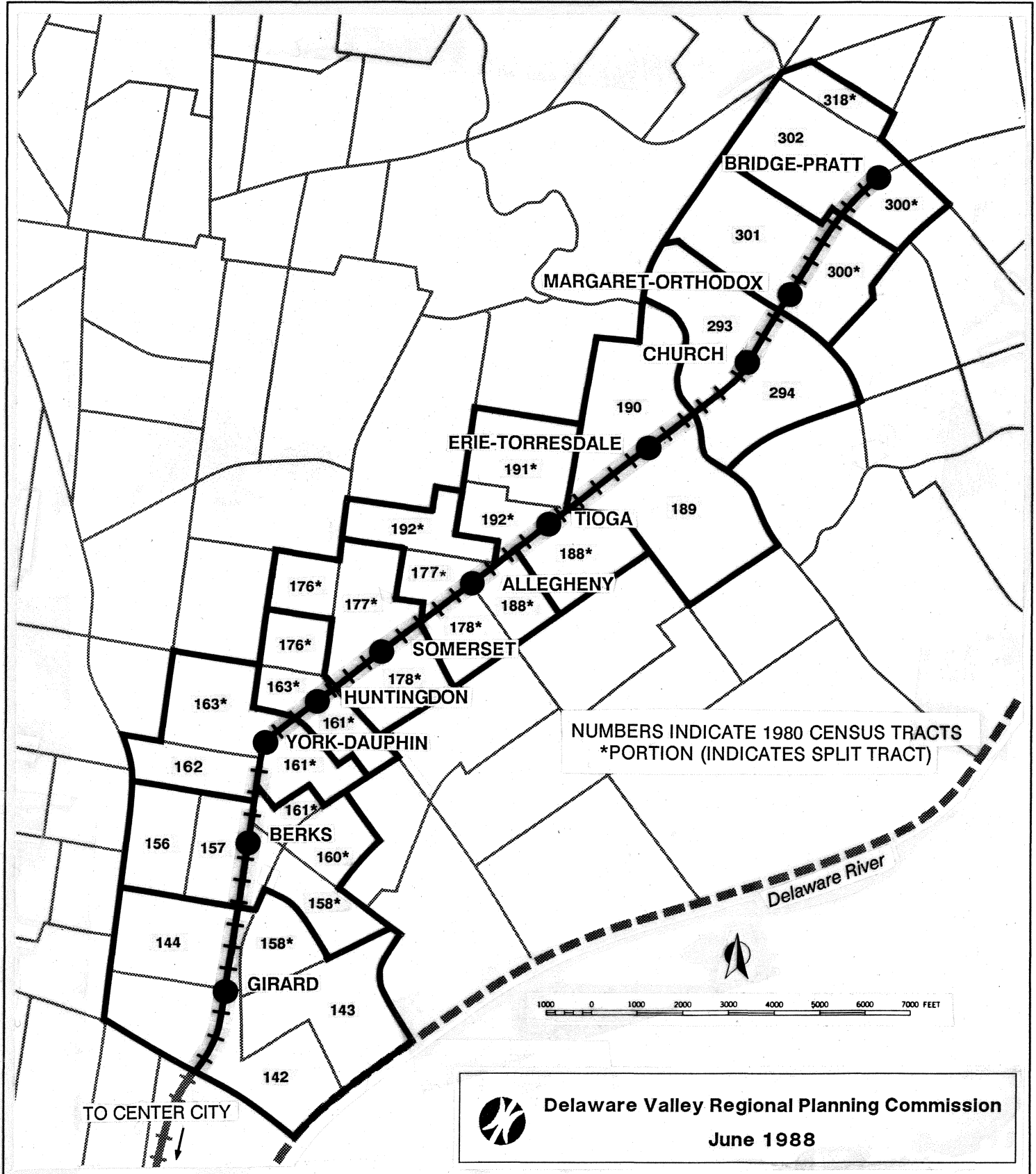
but important crosstown connections exist at Erie-Torresdale, Allegheny, and Girard.

The line portion under study is shown in Map 1, with catchment areas indicated with heavy lines for each of the stations from Girard through Bridge-Pratt. Catchment areas represent those areas deemed to have direct walking access to the station, and are nominally set at a half-mile radius. As a practical matter, the areas are based on census tracts, but since tracts are too coarse for this purpose and in addition are not centered on stations, many have been split and combined with others in order to better delineate realistic areas with walking access to individual stations. Number labels on the map identify 1980 census tracts. Beyond the station zones, trip assignment is based on census tracts.

While the simulation process provides a trip assignment to the individual links in the transit network, it is useful to step back and look briefly at some of the macroscopic changes that are taking place in the market area for riders on the Frankford elevated line. The largest market segment comprises residents of Northeast Philadelphia who are traveling to and from jobs in Center City. The driving parameters for this market are population in Northeast and employment in Center City. A second segment consists of those traveling to employment locations in Northeast, the reverse commuters, and this potential is measured by employment in that portion of the city. Here Center City population is irrelevant, as these commuters are mainly coming from other portions of the city, either riding through on the Market Street line from West Philadelphia, or connecting from other lines. Other segments include Northeast residents traveling to jobs outside of Center City and those traveling for non-work purposes. Table 1 delineates the changes that have taken place between 1970 and 1980 and expected by the Year 2000. Center City is defined as County Planning Area No. 1 and Northeast by County Planning Areas Nos. 11 and 12, which represent the areas northeast of Frankford Creek. Demographic variables for the zones immediately contiguous to the line are tabulated separately.

A transit shed was used in 1978 to define the hinterland that can be expected to feed traffic to the line. This area was refined for the purpose of this report for the following reasons. First, the shed used earlier did not include County Planning Area No. 12, which covers the portion of the city beyond Pennypack Creek. Development in far Northeast is generating ridership for the Frankford Elevated and it needs to be included. Second, the shed included census tracts south of Poplar Street. These tracts are properly part of the catchment area for the Spring Garden station, which is west of the impact area under consideration. However, DVRPC's simulation used the full transit network as the basis for generating ridership. This model assigns riders to the most direct route that reaches their destination, and does not rely on a transit shed to define acceptable origins and destinations. For this analysis the areas with direct walking access were defined more precisely, and the access links to stations were adjusted accordingly. These changes affected impedances at stations and thus shifted some station assignments, particularly with respect to connecting links.

FRANKFORD ELEVATED LINE STATION CATCHMENT AREAS



Several trends can be readily noted. First, the population with direct walking access to the stations is expected to fall by 28 percent in the thirty years between 1970 and 2000, and immediately adjacent employment will fall at an even faster rate, 42 percent. Many of the manufacturing jobs have left or will leave, and they are not being replaced through new commercial development. Population is declining through mortality and out migration. In Northeast Philadelphia the situation is somewhat different. Though population is still declining, it is at a slower rate, and employment is slowly growing. Jobs in the service, retail, and wholesale sectors are more than replacing the loss in manufacturing. Employment in Center City is expected to remain healthy and grow slightly.

The regional DVRPC simulation model predicted reasonable aggregate ridership for the Frankford Elevated, but some of the individual station loadings were wide of the mark. This was primarily caused by assigning whole census tracts to station catchment areas, rather than splitting zones where warranted. For this reason, a focused simulation process was developed for this station by splitting tracts in the vicinity of the line in order to better delineate these areas. This permitted a refinement of the process by which riders were assigned to station access links. Map 1 shows the final alignment of the catchment areas. The second major change was to revise the transit network in Northeast Philadelphia to reflect route restructuring through Phase 3 of SEPTA's Northeast Improvement Program and scheduled headways as operated in April 1988.

The next step was to run the focused simulation using 1987 population and employment figures, and to compare the station loadings to actual counts. Though the network used was that for Spring 1988, the differences with Fall 1987 were minor and would have minimal impact on boardings at individual stations. While the distribution by station now provided a much closer match to reality than before, a few stations still showed significant discrepancies, and in aggregate, boardings were about three percent too high. The simulation was now run for the Year 2000, but forecasts of individual station boardings were adjusted by multiplying the original estimates by the ratios of 1987 actual to predicted loadings. This procedure scaled the aggregate error and corrected for simulation error at the station level.

III. RIDERSHIP

The focused Year 2000 simulation process predicted aggregate ridership for stations from Girard through Bridge-Pratt for the Year 2000 at approximately 53,600 boardings for an average weekday. Population and employment along the line are expected to continue to decline, and the population of Northeast Philadelphia is not growing either, but countering this to some extent is growing employment in Center City, which is expected to continue through the Year 2000. After balancing these trends, it was felt that some downward adjustment to the simulated volume would be in order.

Two members of DVRPC's staff walked major portions of the line in order to obtain a feel for the state of the neighborhoods, where ridership is likely to decline, and where it will remain stable or grow. Based on these observations and recent trends in station usage, it was felt that stations from Somerset to Berks, inclusive, would experience larger declines than the rest of the line in a way not adequately measured by the RDG. These areas traditionally housed workers for nearby factories and the Delaware River docks, but with the loss of manufacturing jobs and the decline in waterfront activity, many of the residents have moved away and the demand for transportation has correspondingly declined. While the remaining stations are expected to lose some ridership, their declines should be relatively modest and in accordance to the RDG.

With the foregoing adjustments, an aggregate station forecast of boardings of 50,000 for the Year 2000 was prepared, which is three percent less than that counted in 1987. Average weekday ridership by station are tabulated in Table 2, with trends displayed graphically in Figure 1.

Some comment is required as to what is being counted. To the extent that trips on the Frankford elevated portion extend to points beyond the study area, counting boardings provides an actual count of riders using the line. As the return trips are not counted, the actual number of trips on this segment is approximately double the number of boardings. However, local or internal trips are counted in both directions, and hence here boardings represent total line trips. For this reason, an estimate of line patronage, i.e., the total number of unlinked trips, was also calculated from the on and off station counts for the Frankford elevated portion of the line. For the Year 2000, average weekday patronage is projected at 91,400 trips. This figure counts one-way trips made in both directions.

The ridership projections resulting from this study are 10.5 percent lower than those predicted in the earlier 1977 study. Considering the admittedly optimistic population and employment forecasts used at that time, the results of the current study seem reasonably in line. The 1983 RDG, which enjoyed the benefit of the 1980 Census data and on which this study is based, did scale back the earlier projections.

As the major transfer point for bus and trackless trolley routes to Northeast Philadelphia and adjacent Bucks County, as well as some cross-city routes to North Philadelphia and Montgomery County, Bridge-Pratt now handles about 42 percent of the boardings made on the Frankford Elevated

Table 2

FRANKFORD ELEVATED WEEKDAY STATION BOARDING TRENDS

<u>Station</u>	<u>October Counts (1)</u>			<u>Forecast(2)</u>	<u>Change</u>
	<u>1970</u>	<u>1976</u>	<u>1987</u>	<u>2000</u>	<u>1987- 2000</u>
Bridge-Pratt	24,280	22,117	21,768	21,560	-1.0%
Margaret-Orthodox	7,520	6,607	5,243	5,203	-0.8%
Church	1,440	725	964	957	-0.7%
Erie-Torresdale	5,220	5,939	4,724	4,615	-2.3%
Tioga	2,410	1,903	1,631	1,522	-6.7%
Allegheny	7,330	7,206	6,384	6,124	-4.1%
Somerset	3,225	2,556	2,270	1,948	-14.2%
Huntingdon	2,165	2,155	1,591	1,431	-10.1%
Dauphin-York	2,600	1,925	1,598	1,311	-18.0%
Berks	1,835	1,560	1,403	1,225	-12.7%
Girard	4,470	3,909	4,148	4,122	-0.6%
Total	62,495	56,602	51,724	50,018	-3.3%

Source: (1) SEPTA Turnstile Counts
(2) DVRPC

FIGURE 1

AVERAGE WEEKDAY BOARDING TRENDS BY STATION

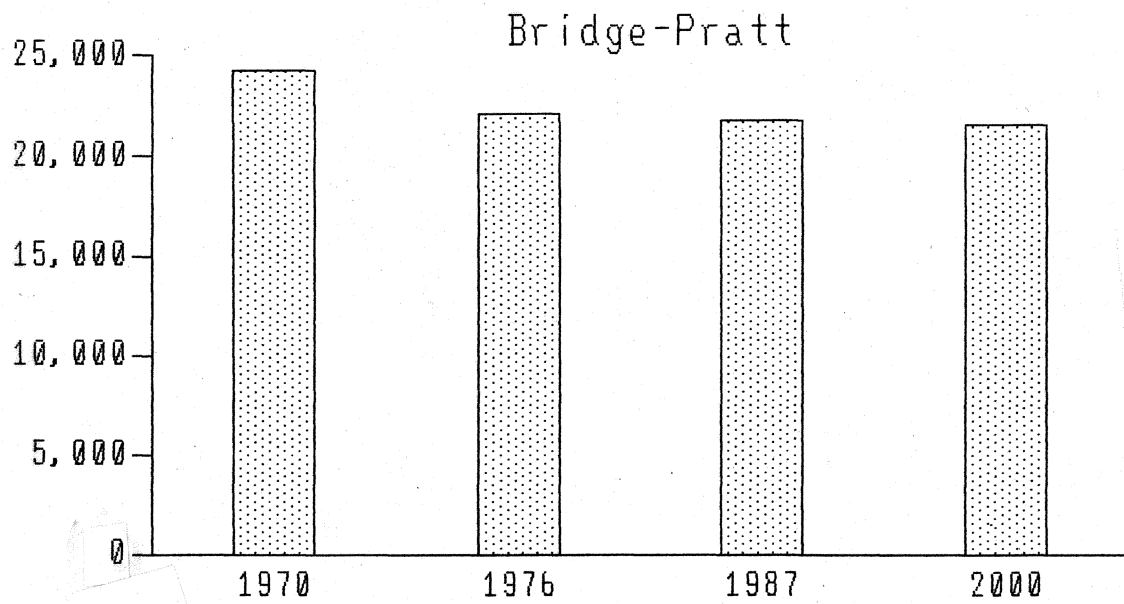


FIGURE 1 (CONTINUED)

AVERAGE WEEKDAY BOARDING TRENDS BY STATION

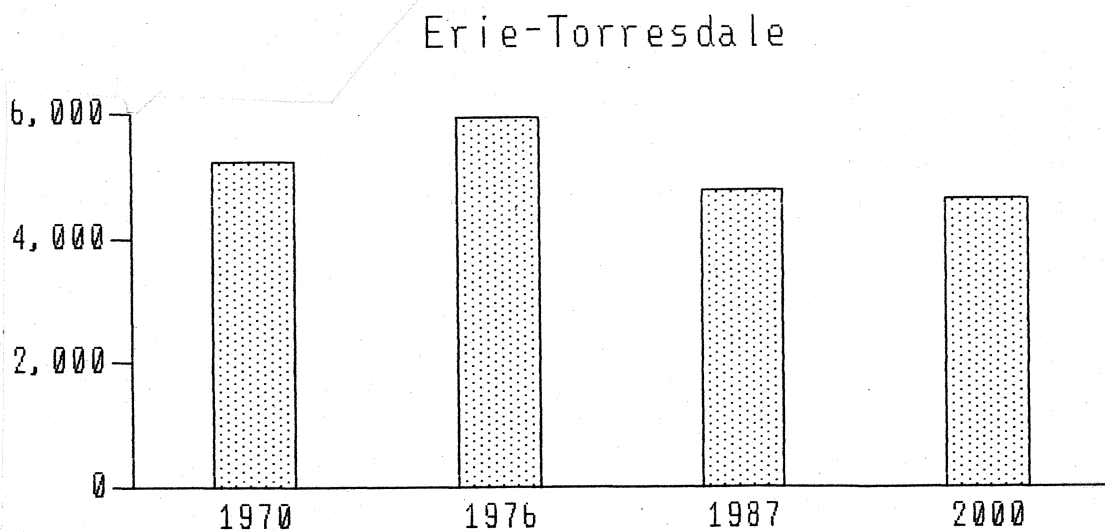
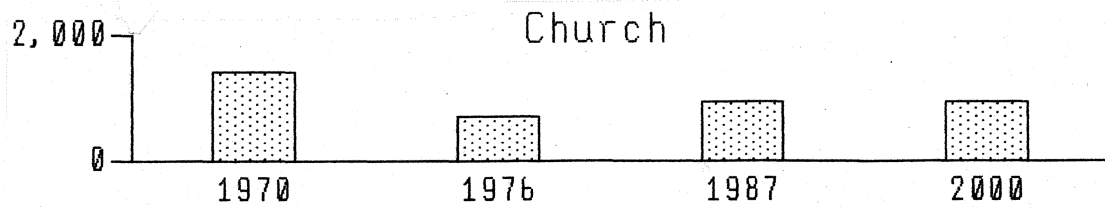
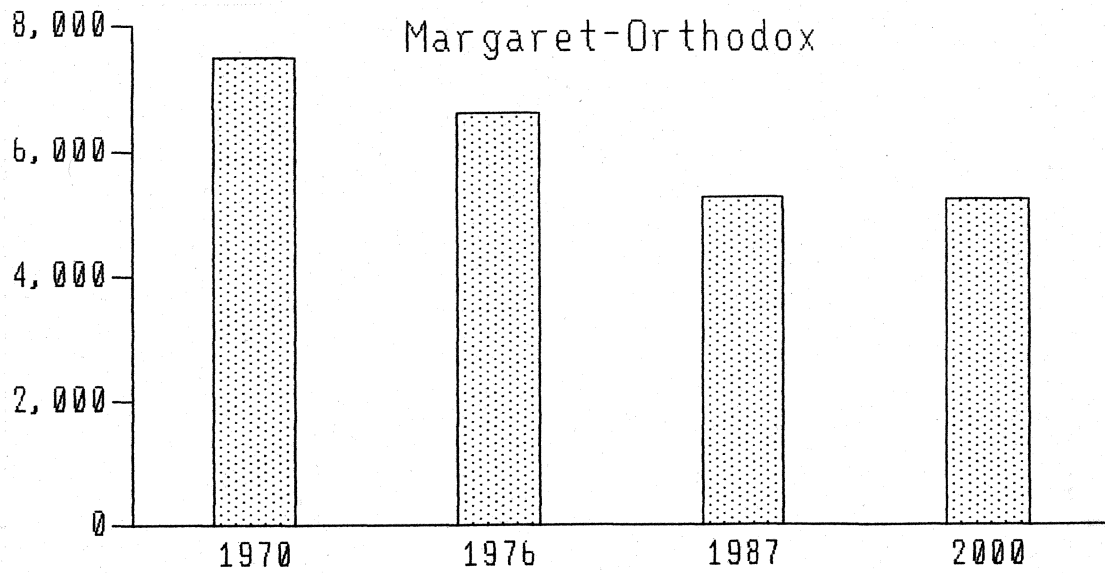


FIGURE 1 (CONTINUED)

AVERAGE WEEKDAY BOARDING TRENDS BY STATION

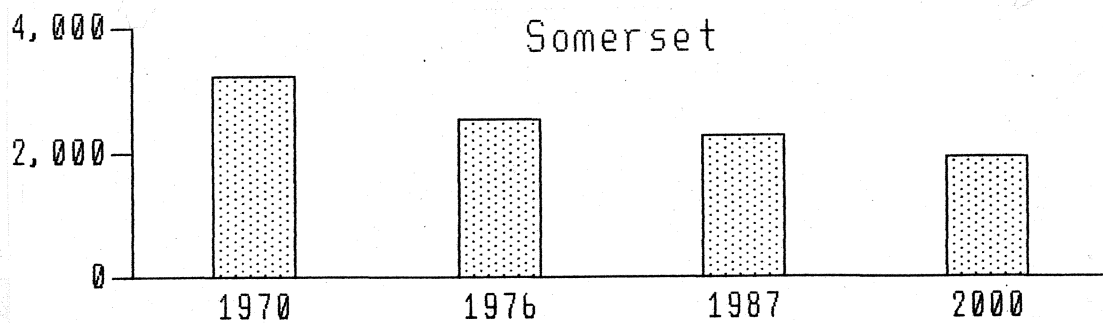
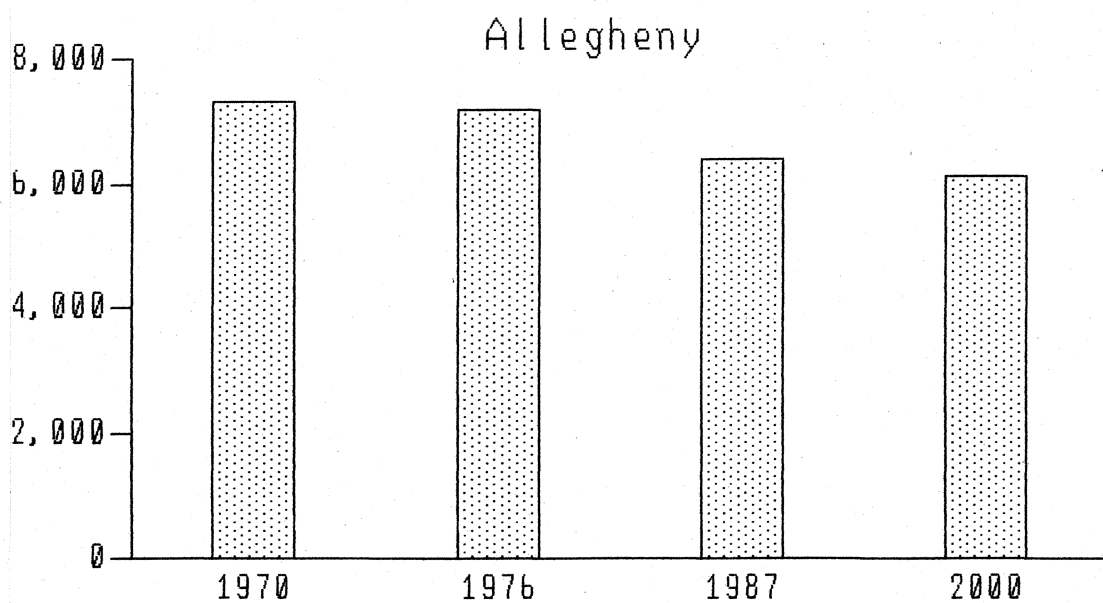
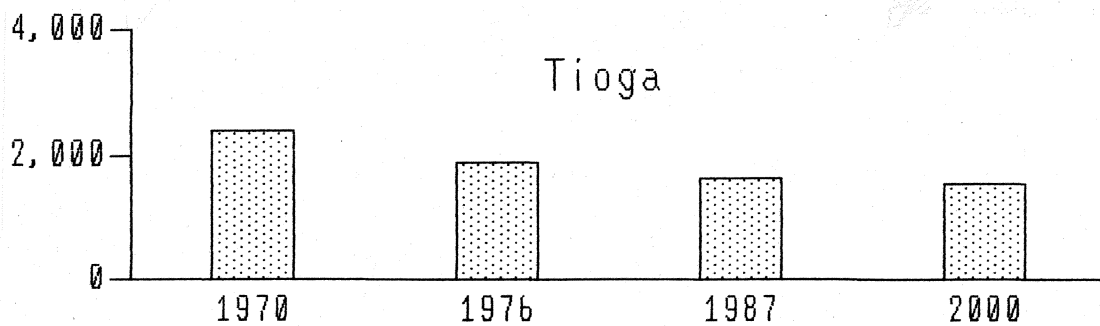
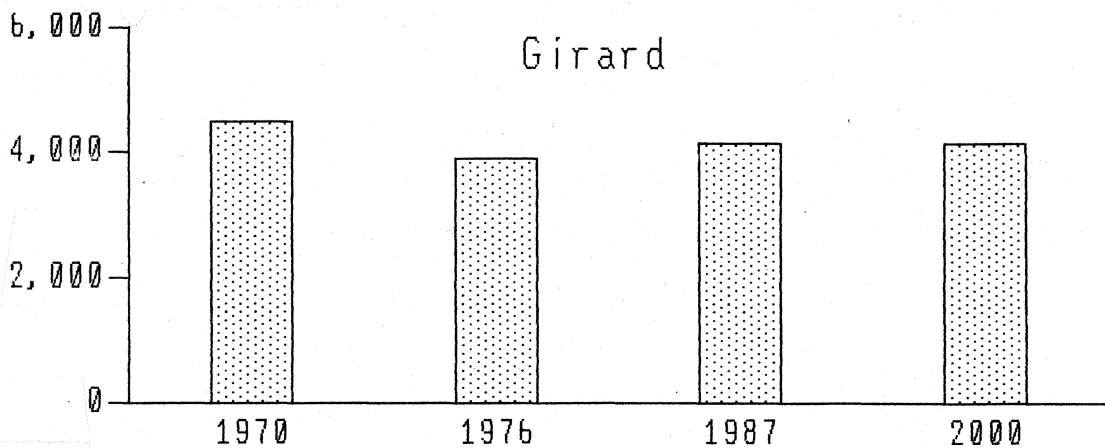
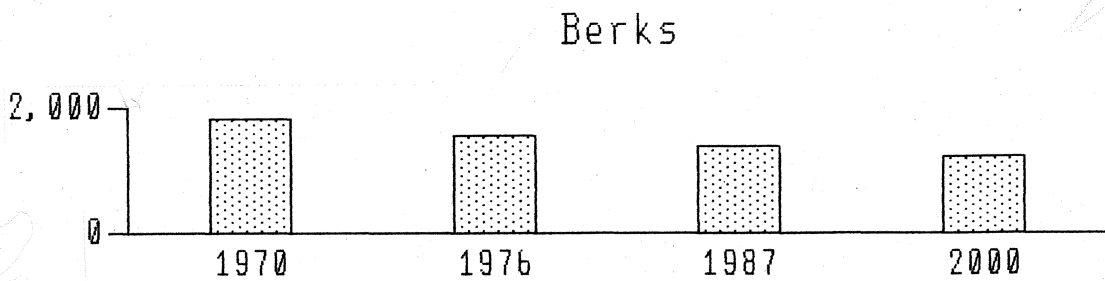
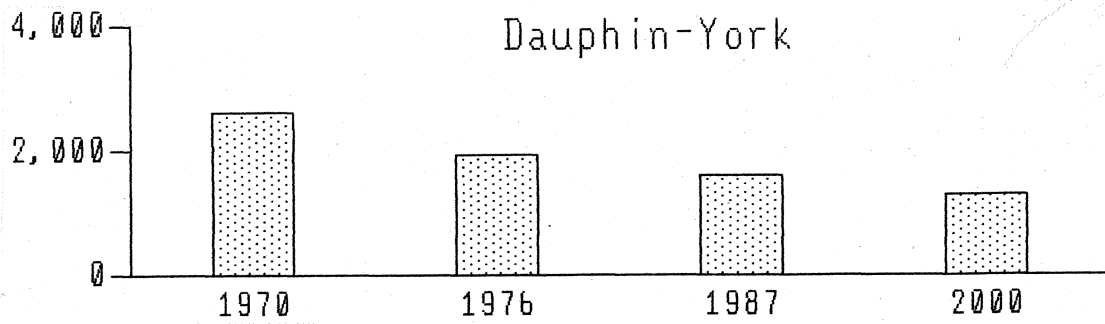
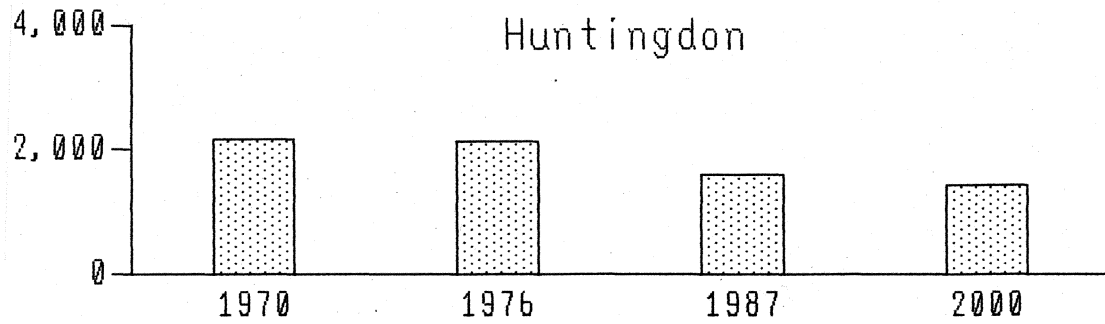


FIGURE 1 (CONTINUED)

AVERAGE WEEKDAY BOARDING TRENDS BY STATION



portion of the line. This is expected to continue and should increase another percent by the Year 2000. Absolute traffic levels declined at an annual rate of 1.5 percent between 1970 and 1976, but this has since eased to 0.1 percent per year. If service patterns continue to follow their current format, traffic should be essentially flat until the Year 2000.

Margaret-Orthodox is also an important transfer point for bus and trackless trolley routes, though the routes do not penetrate as far into Northeast Philadelphia as those from Bridge-Pratt. Boardings have fallen at an annual rate of 2.1 percent since 1970, but this too is expected to level off. Traffic at this station is approximately one-quarter that at Bridge-Pratt.

Church carries the lightest traffic of any in the study area, but after losing half its riders in the early 1970's, traffic has recovered and in the last decade has increased by 2.6 percent per year. This rising trend is not expected to continue and ridership should be flat until the end of the century. The neighborhoods east of Frankford (Tacony) Creek are basically stable with a strong ethnic complexion. The infrastructure is older, but generally maintained, with land use thoroughly mixed between commercial, residential, industrial, and institutional. Though not a growing area, the large number of destinations with walking access should maintain the local market.

Proceeding westward, the character of the neighborhoods changes. Loss of employment and population has reduced demand for transportation, though several stations retain importance as transfer points. Erie-Torresdale is served by Route 56, one of the three surviving surface trolley routes in North Philadelphia. An important crosstown route, it connects local neighborhoods, such as Tacony and Wissinoming, with both the Market-Frankford and Broad Street lines. Route 60 on Allegheny Avenue also connects the two rail transit lines and extends eastward to Richmond. The just concluded Philadelphia Trolley Feasibility Study (Final Report, Urban Engineers, Inc., May 1988) has recommended that light rail service be reinstated on this line, which is currently operated with buses. The Route 15 trolley on Girard Avenue is another major cross-town route, which runs from Richmond through Fishtown past both rail lines to West Philadelphia where it also connects with the Subway-Surface lines. Along the way it passes Girard College and the Philadelphia Zoo. Fishtown can expect some renewal as redevelopment spreads northeastward from Center City, and this too should help maintain ridership at Girard.

IV. CONCLUSION

Since the City of Philadelphia completed the Alternatives Analysis for the Frankford Elevated Line, the ridership projections prepared by DVRPC have been revised to reflect population and employment changes measured by the 1980 Census. Overall, average weekday station boardings on the Frankford Elevated segment are expected to fall to 50,000 by the Year 2000, which represents a relatively modest 3.3 percent decline from 1987. This corresponds to 91,400 total trips (both directions) on the segment, which is more ridership than SEPTA carries on any other single line, excepting the Broad Street Subway taken in its entirety.

As a result of the simulation and subsequent analysis, it is expected that the decline in boardings between 1987 and 2000 will exceed 10 percent at Somerset, Huntingdon, Dauphin-York, and Berks, range between 2 and 7 percent for Erie-Torresdale, Tioga, and Allegheny, and be essentially flat at the remaining stations. Basically, ridership declines caused by the loss of population and employment along the line are being partially negated by continuing strong employment in Center City. There is also potential for increasing the market for reverse commutation to jobs in Northeast Philadelphia. The net effect is almost stable ridership extending into the next century.

