

TRAVEL DEMAND ANALYSIS OF SEPTA'S NEWTOWN LINE



**DELAWARE VALLEY
REGIONAL PLANNING COMMISSION**

February 1995

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**The Bourse Building
111 S. Independence Mall East
Philadelphia, PA 19106-2515**

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DELAWARE VALLEY REGIONAL PLANNING COMMISSION

Publication Abstract

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ABSTRACT

Two alternatives are considered for the restoration of service to SEPTA's Newtown Line. The first alternative considers a diesel shuttle train running between Newtown and a transfer station on the Warminster Line; and the second a limited diesel service to Suburban Station using a new connection to the Chestnut Hill West Line. Demographic and employment trends are examined for the study area, which includes corridors served by the line, as well as the adjacent Warminster and West Trenton rail lines. DVRPC's regional travel simulation process was used to forecast ridership for 1996 and 2005.

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EXECUTIVE SUMMARY

The Southeastern Pennsylvania Transportation Authority (SEPTA) asked DVRPC to estimate ridership under two alternative scenarios for the restoration of rail passenger service to Newtown in Bucks County. The line was last operated in 1983 as a diesel extension of the electrified R8 Fox Chase Line.

The first alternative consisted of reopening the line from Newtown to its intersection with Conrail's Morrisville Line, just south of the Bucks/Montgomery county line. A connection to the Conrail line would be built and its right-of-way used to lay new track two miles west to the intersection with the R2 Warminster Line near Fulmor. Passengers would take a diesel-powered shuttle to Fulmor, and then transfer to the existing R2 electric service to complete their trips. The existing Fulmor station would be closed and replaced with a new station at the transfer point. Schedules for the Newtown trains would be coordinated to provide an approximate ten-minute connecting time, and would consist of 18 weekday round trips, with six occurring the peak hours. Two versions of this alternative were considered, one in which capital investment is limited to restoring the track to a 30 mph standard, and the other a more capital intensive version in which speeds were raised to 50 mph.

In the second alternative, diesel trains would run from Newtown to Fox Chase, and then continue along the traditional R8 routing as far as Wayne Junction. There a new 0.8-mile connection would be built linking the former Reading trunk line with the Chestnut Hill West Line, thereby permitting access to Thirtieth Street and Suburban stations without passing through the Center City Commuter Tunnel. Trains would terminate at Suburban Station, with the low-emission diesel engine positioned near the tunnel mouth. Six round trips would be operated on weekdays, with two running during peak hours.

Because of their proximity to the Newtown Line, the study area included the R2 (Warminster) and R3 (West Trenton) lines. Trends in population, number of households, automobile ownership, resident workers, and employment were projected for 1996 and 2005. The model was calibrated by simulating 1990 ridership, and comparing with SEPTA station boardings and journey-to-work data from the 1990 Census. Ridership estimates were then prepared for the two horizon years for the No-Build Alternative, which assumed continuation of existing service on the R2 and R3 lines, and for the two build alternatives.

Total weekday boardings on the three lines is expected to grow from the 1990 base of 4,300 to more than 4,500 by 2005 in the absence of Newtown service. If service is restored to Newtown, total rail ridership to the study area is projected to increase by approximately 300. Although the limited direct service provided by Alternative 2 yields the highest ridership, the spread between the build alternatives is not large. The number of riders projected for 2005 on the Newtown Line ranges from 285 under the 30 mph scenario of Alternative 1 to 535 for

Alternative 2. Because the line draws some riders from the R2 and R3 lines, the number of new riders ranges from 285 to 345.

I. INTRODUCTION

Historically, the Reading Railroad operated its passenger service to Newtown as a diesel extension of its electrified service to Fox Chase. Station stops in Montgomery County were made at Walnut Hill, Huntingdon Valley, and Bryn Athyn; and in Bucks County at County Line, Southampton, Churchville, Holland, George School, and Newtown. After 1976 the trains were operated by Conrail under contract to the Southeastern Pennsylvania Transportation Authority (SEPTA). Service was terminated in July 1981 as part of SEPTA's overall elimination of service on non-electrified lines. However, protests in the Newtown area led to its restoration in October, a little more than two months later, this time with direct operation of the trains by SEPTA crews. Previously, the trains were operated under contract by Conrail. Winter weather combined with inadequate maintenance of the diesel rail cars forced a second termination in February 1983. Since then SEPTA has operated a Fox Chase-Newtown shuttle bus to act as a replacement for the rail service.

Ridership through most of the 1960s and 1970s hovered around 200 inbound boardings per weekday, with a maximum of 289 recorded in passenger counts taken during May 1971. By the spring of 1981, just before the first termination of service, ridership had fallen to 117 inbound boardings, and after service was resumed it failed to break 100. Since 1970, more than 90 percent of the boardings have arisen from stations in Bucks County, with the heaviest loadings coming from Southampton. Patronage on the Newtown shuttle bus proved to be less than that on the trains, with about 80 daily inbound boardings recorded in 1990.

Although ridership was never heavy and service has been absent since 1983, rapid growth in Bucks County around Newtown has stimulated recurring interest in reopening the line, and SEPTA is considering options that would restore service to the route. There is also opposition to resumption of service by property owners in Montgomery County. Accordingly, SEPTA asked DVRPC to conduct a travel demand analysis and forecast ridership for the years 1996 and 2005 for two alternatives developed for the restoration of service, one of which avoids most of the Montgomery County portion of the route. A no-build alternative was included for comparison. Routes and stations are shown on Map 1.

The following sections describe the selected alternatives; define and describe the study area, including an analysis of demographic, employment, and rail ridership trends; describe the travel simulation process, and summarize forecast demand for the no-build alternative and the two build alternatives for the horizon years of 1996 and 2005.

II. ALTERNATIVES

Map 1 shows the alternative routings and stations proposed for the Newtown Line, as well as other nearby rail lines.

In the first alternative, SEPTA would operate a diesel-powered shuttle on the line between Newtown and its intersection with Conrail's Morrisville Line, just south of the Bucks/Montgomery county line. From there, a new two-mile connection would be built on Conrail's right-of-way to reach a new station near Fulmor on the R2 Warminster Line. Passengers would then transfer to the electric R2 service for the remainder of their journey. The shuttle schedule would be coordinated to that of the R2 trains, in order to minimize the transfer time. Estimates are to be prepared for both a low-investment scenario, in which speeds will be limited to 30 mph on the restored line, and one which permits 50 mph speeds. This alternative minimizes the additional train-miles required and minimizes the need to operate through Montgomery County.

The second alternative entails restoring diesel service on the full line between Newtown and Fox Chase. The peak-hour trains would be extended to Center City Philadelphia by continuing down the R8 Fox Chase Line to Wayne Junction, and the using a new 0.8-mile "Midvale" connection to access the existing R8 Chestnut Hill West Line. [This connection crosses the site of the former Midvale-Heppenstahl steel plant.] The trains would then continue on through 30th Street Station to Suburban Station, where it would terminate. This alternative provides a one-seat ride to Center City, avoids the cost of new electrification, and keeps diesel trains out of the Center City Commuter Tunnel. Since low-emission diesel units would be used, it was felt their presence at Suburban Station, just inside the tunnel portal, could be tolerated.

Stations on the Newtown Line would remain at the same locations as they were prior to the cessation of service, with the exception that George School would be replaced by a new station at Village Shires, 3/4 mile to the south. Alternative 2 would add a new station just north of the Newtown Bypass (PA 332/413). In Alternative 1 the existing R2 Fulmor station would be closed and replaced by the new transfer station 0.3 mile to the south.

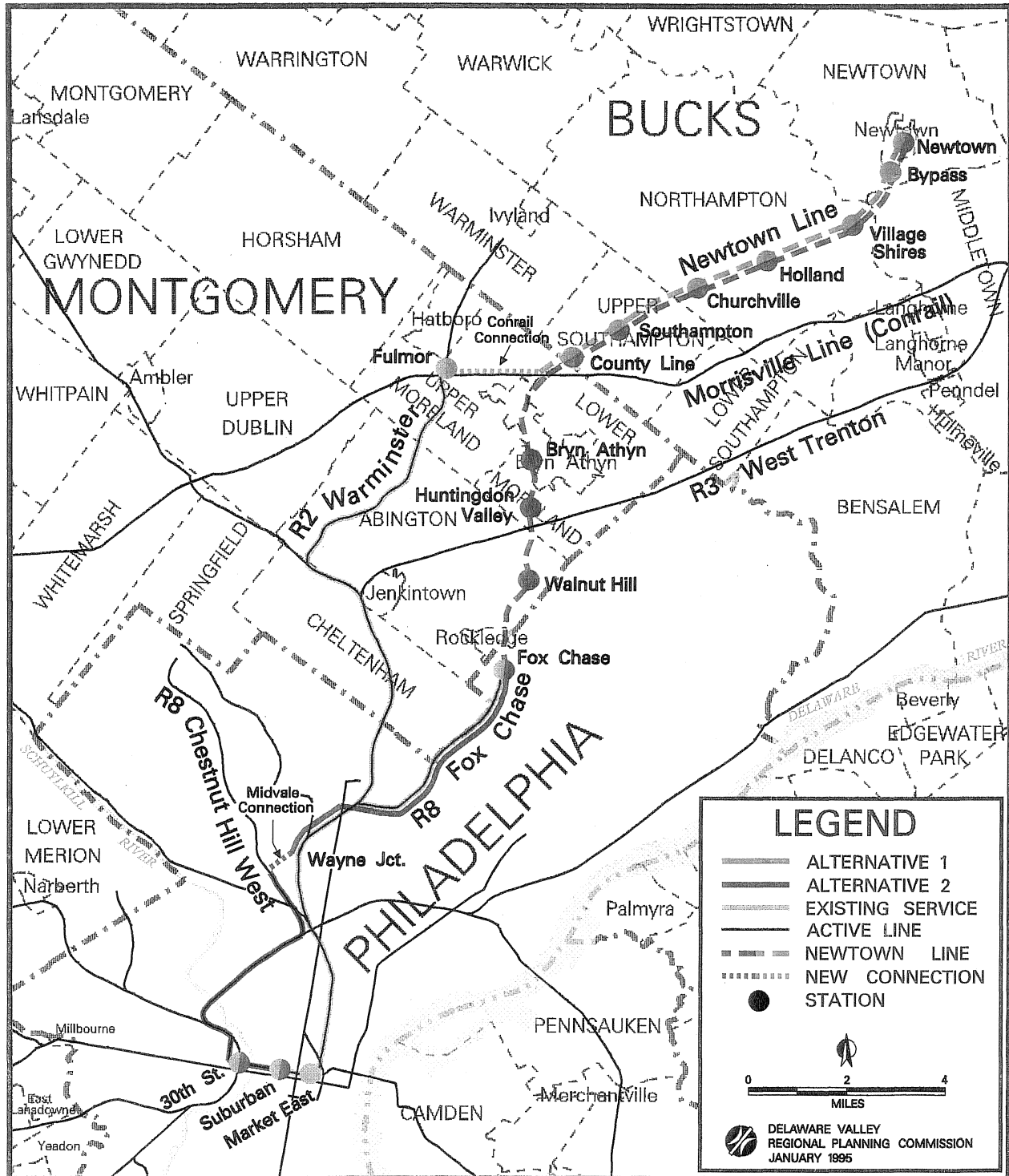
The transit network as it existed in 1990 was used to simulate ridership for the no-build alternative. The only service to Newtown was provided by the shuttle bus from Fox Chase. The bus shuttle was removed from the network for the two build alternatives.

The parameters for both alternatives are tabulated below:

	ALTERNATIVE 1	ALTERNATIVE 2
Stations	Newtown Village Shires Holland Churchville Southampton County Line Fulmor* (new, close old station) [transfer to R2]	Newtown Newtown Bypass Village Shires Holland Churchville Southampton County Line Bryn Athyn Huntington Valley Walnut Hill Fox Chase* 30th Street* Suburban*
	* alighting only inbound; boarding only outbound	
Running times: Newtown to Suburban Station	a) 30 mph option on Newtown Line: 81 min b) 50 mph option on Newtown Line: 77 min	71 min
Number of Weekday Trips Each Direction	18 All Day (6 during Peak Hours)	6 All Day (2 during Peak Hours)
Fares	All Newtown Line stations in Zone 3; Fulmor on R2 moved from Zone 4 to 3.	Bucks County stations in Zone 4; Montgomery County stations in Zone 3;

Bus Service: Keep Fox Chase-Newtown Shuttle Bus for No-Build; eliminate shuttle for Build Alternatives.

Map 1 SERVICE RESTORATION ALTERNATIVES FOR NEWTOWN LINE



III. CORRIDOR DESCRIPTION

To some extent the catchment area for the Newtown Line overlaps those of the adjacent R2 (Warminster) and R3 (West Trenton) lines, implying that some of the trips generated by a restored Newtown service will come at the expense of the other two lines. Hence, it is necessary to treat all three lines as a package throughout the ensuing analysis.

The first step was to define the corridors served by each line in terms of the Transportation Analysis Zones (TAZ) used by DVRPC in its trip simulation. This was an iterative process in which the model was run for zones chosen to represent the R2 and R3 corridors for the base year 1990. The simulated station loadings were then compared with actual station activity, and if necessary, the zonal assignments were adjusted and the model rerun.

After satisfactory agreement was reached for the R2 and R3 corridors, i.e., absent Newtown service, a third corridor was defined for the Newtown Line. At the outer end of the corridors the zones are uniquely assigned to stations, but moving toward Philadelphia the lines converge and zones can be connected to stations on more than one line. In effect, this allows the simulation to choose which line will be used. The final zonal assignments by station are shown in Table 1, with the corridor catchment areas delineated in Map 2. The zones marked with an asterisk in the R2 and R3 corridors are also assigned to stations on the Newtown Line. The zones in the Newtown corridor that are needed for Alternative 2, but not for Alternative 1, are marked by crosses.

Demographic and Employment Trends

Growth will not be even across the study area. The R2 corridor and the inner portions of the R3 and Newtown corridors are mature stable areas with little prospect for growth. In contrast the outer end of the R3 and Newtown lines serve growth areas in Bucks County, and can be expected to generate new trips. Corridor trends are shown in Table 2. [In this application the R2 and R3 corridors do not include TAZs connected to Newtown Line stations (i.e., those marked with an asterisk in Table 1).] In general, the number of households will grow faster than the population, which is a consequence of diminishing household size, and number of automobiles available will grow even faster.

In the R2 corridor, population fell by almost six percent between 1980 and 1990. The 2005 forecast projects a continuing decline, but at a much lower rate, declining by less than two percent over the fifteen-year period following 1990. Slow growth is projected for the other indicators, with the number of automobiles available to residents rising by more than nine percent. During the 1980s the number of jobs in the corridor passed the number of residents workers, and as a consequence, the corridor became a net importer of workers. This trend should also continue, and by 2005 the number of jobs will exceed the number of workers by almost 10,000, suggesting a growing market for reverse commutation. However, most of these jobs will not be located within walking distance of a station, and will as a consequence require

Table 1
RAIL CAPTURE ZONES

<u>R2 – Warminster</u>		<u>R3 – West Trenton</u>		<u>Newtown</u>	
<u>Zone</u>	<u>Station</u>	<u>Zone</u>	<u>Station</u>	<u>Zone</u>	<u>Station</u>
692	Willow Grove	418	Philmont	687	County Line
693	Hatboro	419	Philmont	+690	Huntingdon Valley
694	Fulmor	420	Forest Hills	+691	Bryn Athyn
695	Willow Grove	421	Forest Hills	+731	Walnut Hill
696	Willow Grove	427	Somerton	906	County Line
697	Willow Grove	*687	Philmont	907	County Line
698	Willow Grove	688	Somerton	908	Southampton
699	Hatboro	689	Bethayres	909	Southampton
700	Hatboro	*690	Bethayres	958	Churchville
701	Hatboro	*691	Bethayres	959	Holland
702	Hatboro	*731	Meadowbrook	961	Bypass
732	Willow Grove	742	Noble	962	Newtown
733	Roslyn	743	Rydal	1296	Churchville
734	Roslyn	875	Trevose	1297	Village Shires
735	Roslyn	876	Trevose	1298	Holland
736	Roslyn	892	Langhorne	1299	Bypass
737	Crestmont	893	Langhorne	1350	Bypass
738	Ardsley	894	Langhorne		
741	Ardsley	896	Woodbourne		
*907	Hatboro	897	Woodbourne		
*909	Warminster	898	Neshaminy Falls		
910	Warminster	899	Langhorne		
911	Warminster	900	Langhorne		
912	Warminster	901	Langhorne		
913	Warminster	902	Langhorne		
914	Warminster	903	Somerton		
1289	Warminster	904	Trevose		
1290	Warminster	905	Neshaminy Falls		
1291	Warminster	*906	Somerton		
		*908	Trevose		
		964	Yardley		
		965	Woodbourne		
		966	Yardley		
		1000	West Trenton		
		1020	West Trenton		
		1021	West Trenton		
		1022	West Trenton		
		1023	West Trenton		
		1278	Meadowbrook		
		1286	Neshaminy Falls		
		1300	Yardley		
		1301	Yardley		
		1351	Yardley		

* Also connected to stations on the Newtown Line.

+ Not used in Alternative 1.

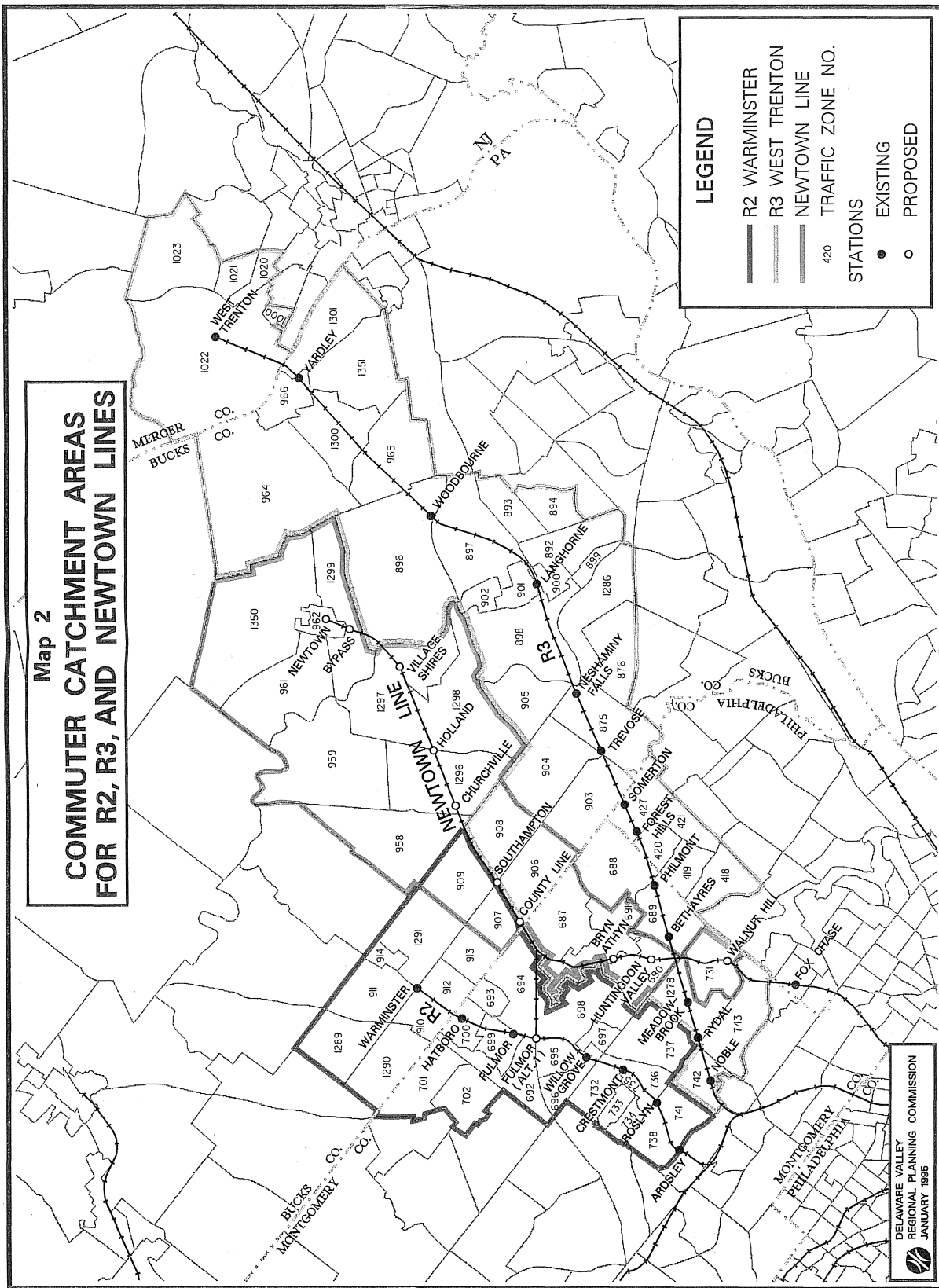


Table 2
DEMOGRAPHIC AND EMPLOYMENT TRENDS

R2 (Warminster) Corridor

Variable	1980	1990	2005	Percentage Change	
				1980-1990	1990-2005
Population	111,427	105,165	103,155	-5.6%	-1.9%
Households	36,762	38,487	39,413	4.7%	2.4%
Automobiles	61,072	69,451	75,830	13.7%	9.2%
Residents Workers	53,939	57,898	58,429	7.3%	0.9%
Employment	51,602	65,047	68,260	26.1%	4.9%

R3 (West Trenton) Corridor

Variable	1980	1990	2005	Percentage Change	
				1980-1990	1990-2005
Population	167,050	187,824	202,477	12.4%	7.8%
Households	55,606	67,441	76,119	21.3%	12.9%
Automobiles	93,437	121,482	147,465	30.0%	21.4%
Residents Workers	76,721	97,411	110,105	27.0%	13.0%
Employment	80,900	87,575	98,421	8.3%	12.4%

Newtown Corridor

Variable	1980	1990	2005	Percentage Change	
				1980-1990	1990-2005
Population	52,706	74,948	88,429	42.2%	18.0%
Households	15,796	25,960	32,972	64.3%	27.0%
Automobiles	29,722	51,815	69,890	74.3%	34.9%
Residents Workers	23,397	39,884	49,484	70.5%	24.1%
Employment	17,211	27,540	30,984	60.0%	12.5%

Combined – Three Corridors

Variable	1980	1990	2005	Percentage Change	
				1980-1990	1990-2005
Population	331,183	367,937	394,061	11.1%	7.1%
Households	108,164	131,888	148,504	21.9%	12.6%
Automobiles	184,231	242,749	293,184	31.8%	20.8%
Residents Workers	154,057	195,193	218,018	26.7%	11.7%
Employment	149,713	180,162	197,664	20.3%	9.7%

a bus shuttle. This and a generally adequate supply of free parking at the work site tend to limit development of a reverse commute market to workers who are transit dependent.

In contrast to the corridor defined by the R2 line, the R3 corridor experienced moderate growth during the 1980s, with the number of resident workers increasing roughly four times faster than the number of jobs, thereby strengthening the corridor's residential character. However, the pace of job growth is expected to increase, with both resident workers and employment growing by 12 to 13 percent between 1990 and 2005.

Although the absolute numbers were smaller than the others, the highest growth rates are occurring in the Newtown corridor. During the 1980s, the population grew by 42 percent, the number of households by 64 percent, and the number of automobiles by 74 percent. Not surprisingly, commutation to and from the corridor also increased markedly, with the number of resident workers and jobs having grown by 70 and 60 percent, respectively. These growth rates are expected to moderate during the 1990 to 2005 period, but still, the number of resident workers should increase by 24 percent and employment by 12 percent.

Taking the three corridors in aggregate, growth should be moderate during the fifteen years between 1990 and 2005. Population is expected to grow by 7 percent, the number of households by 13 percent, and the available automobiles by 21 percent. Growth in resident workers should continue to outstrip growth in employment, although the differential should narrow.

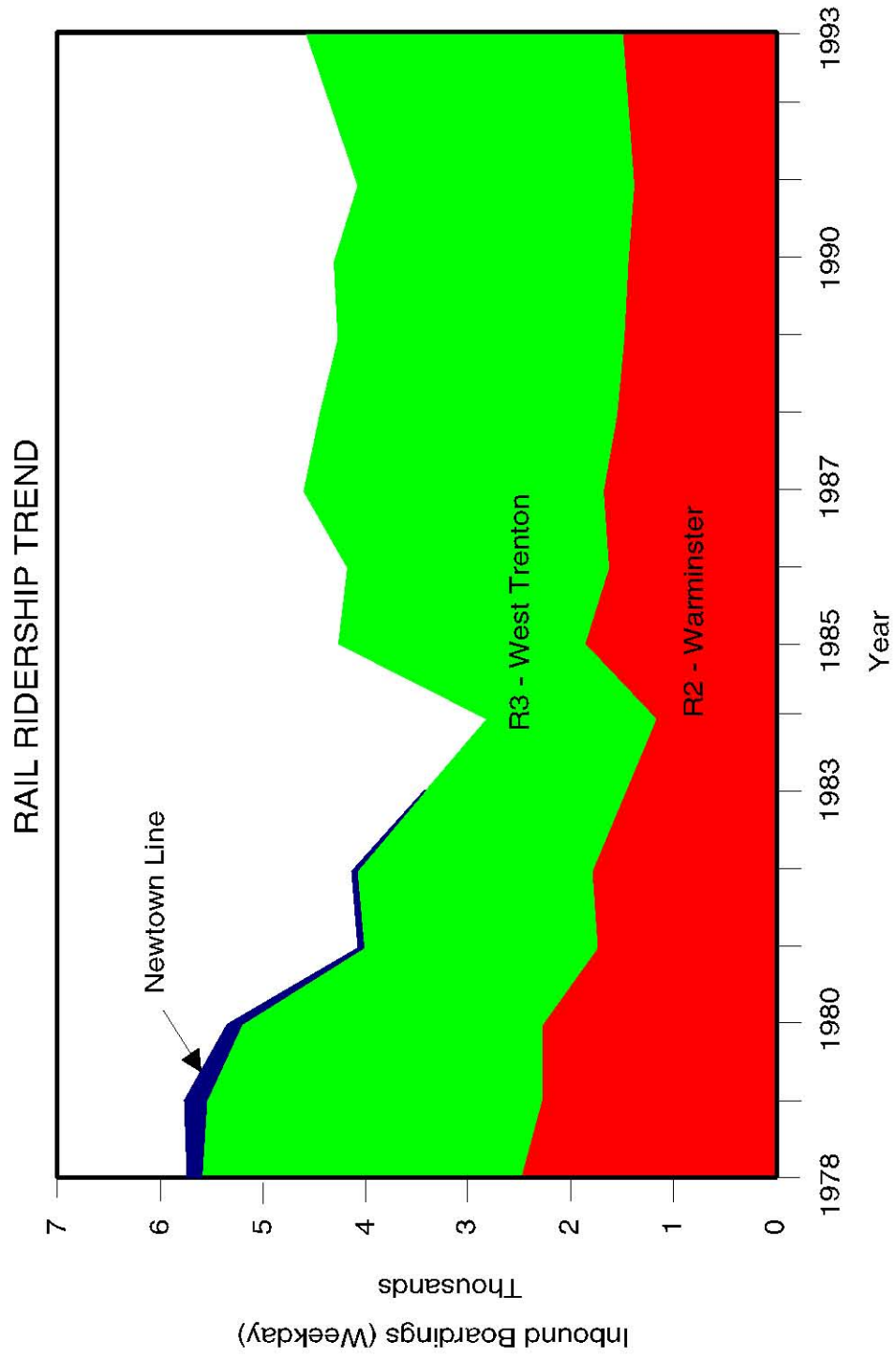
Ridership Trend

Passenger counts, which SEPTA has collected on a semi-regular basis since 1978, can be used to discern long-term ridership trends in the Newtown and adjacent corridors. For consistency in the following discussion, weekday inbound boardings will be used as the measure of ridership. Since the study area reaches to the end of all three lines, inbound boardings are equivalent to round trips and equal the number of daily riders. The number of one-way trips is twice this number.

Ridership, shown in Figure 1, generally declined during the early 1980s, reaching a nadir in 1984. In April of 1983, SEPTA assumed responsibility from Conrail for direct operation of its trains, and as a consequence incurred a lengthy strike. Ridership for the lines in the study area rebounded in 1985, and since then has fluctuated around 4,500 round trips per weekday.

On the R2 Warminster Line, weekday ridership at stations beyond Glenside fell from 2,500 to less than 1,200 by 1984. However, it quickly rebounded to almost 1,900 the following year, but then fell back to just above 1,600 by 1986. Since then weekday ridership has fluctuated between 1,400 and 1,600. Warminster, the last station on the line, has traditionally commanded the largest share of the inbound boardings, and in 1993 boarded 520 weekday riders, more than one-third of the line total. Before 1985 Hatboro ranked second with respect to boardings, but since then that position has been held by Willow Grove.

Figure 1



Driven by population growth near its outer end, ridership on the R3 West Trenton Line generally has outperformed the Warminster Line, which serves a more mature stable area. During the late 1970s, inbound boardings at stations beyond Jenkintown totaled more than 3,100, but by 1984 this had dropped to just above 1,600. However, by 1987 line ridership had rebounded to 2,900, where it has since remained. Over the years Somerton, in northeast Philadelphia, has consistently boarded the most riders, with Langhorne holding second place in most years. Woodbourne, with its location adjacent to I-95, has seen rapid growth in boardings, but is currently constrained by parking capacity. Parking is also a problem at several other stations on this line, and in response SEPTA is currently planning to add 670 spaces at R3 stations. As can be seen in the Fig. 1, about two-thirds of the rail ridership in the study area is accommodated on the West Trenton line.

The Newtown line never contributed a significant fraction of the total rail ridership in the study area, remaining consistently at about 200 daily passengers until service began to deteriorate around 1980. From that point on, ridership dwindled until little was left by the time operation ceased in 1983.

IV. TRAVEL FORECASTING METHODOLOGY

The process used to generate Year 2010 travel forecasts for the alternatives of the Newtown Rail line is a straightforward application of DVRPC's regional travel simulation process. Following the execution of the travel simulation process, the 2010 forecasts were factored using straight line techniques to produce estimates of 1996 and 2005 travel. As part of this study, the public transit simulation was subjected to validation and recalibration, based on the average of SEPTA boarding counts taken during October 1989 and October 1990, and socio-economic and journey to work data from the U.S. Census taken in April 1990. Basically, the process consists of applying the following models in sequence within the TRANPLAN micro-computer travel simulation package.

Trip Generation

Both internal trips (those made within the region) and external trips (those which cross the boundary of the region) must be considered to simulate regional travel. Internal trip generation is based on zonal forecasts of population and employment, whereas external trips are extrapolated from cordon line traffic counts. The latter also include trips which pass through the Delaware Valley Region. Estimates of internal trip productions and attractions by zone are established on the basis of trip rates applied to the zonal estimates of demographic and employment data.

Trip generation 1990 and 2010 totals for the study area are presented in Table 3. These three categories -- home based work, home based non-work, and non-home based -- represent person-trips internal to the region. In total, about 1.5 million person-trips originating from the study area were made on an average weekday in 1990. Of these, 289,000 were home based work trips. Total trip making in the study area is projected to increase by 16 percent over the 20-year period between 1990 and 2010. Total Center City Philadelphia trip destinations are projected to increase by about 2.9 percent to 485,300 by 2010. These trip destinations come from all parts of the region. Of these, over one-half (55%) are home-to-work trips.

Trip Distribution

Trip distribution is the process whereby the zonal trip ends established in the trip generation analysis are linked together to form origin and destination patterns in the trip table format. For the simulation of 1990 and 2010 travel demands, a series of three gravity-type distribution models were applied at the zonal level. These models follow the trip purpose stratifications established in trip generation. Overall, average trip times are projected to increase slightly as a result of disproportionate increases in travel in the suburban and rural parts of the region.

Modal Split

The modal split model calculates the fraction of each person-trip interchange in the trip table which should be allocated to transit, and then assigns the residual to the highway side. [In this context, transit refers to all travel on public transportation, including regional or commuter rail.]

Table 3
**PERSON AND TRANSIT TRIPS
 FOR 1990 AND 2010 TRIP ORIGINS
 IN THE STUDY AREA**

Trip Purpose	Person - Trips			Transit Trips (No Build)		
	1990	2010	Diff.	1990	2010	Diff.
Home Based Work	288,573	344,812	19.5%	9,038	10,724	18.7%
Home Based Non - Work	838,350	972,141	16.0%	3,152	3,627	15.1%
Non - Home Based	347,374	392,852	13.1%	542	615	13.5%
Total	1,474,297	1,709,805	16.0%	12,732	14,966	17.5%

The choice between highway and transit usage is made on the basis of comparative cost, travel time, and frequency of service, with other aspects of modal choice being used to modify this basic relationship. In general, the better the transit service, the higher the fraction assigned to transit, although trip purpose and auto ownership also affect the allocation. The transit fares used generally reflect tariffs that were in effect in 1990 when the rail station counts used for model validation were collected. Table 3 also shows the transit trips resulting from the modal split process for the Newtown Line study area. The estimates for transit trips include bus and subway-elevated, as well as rail travel. The 1990 work trip modal split (3.1%) compares reasonably well with the 3.5 percent modal split measured by the 1990 Census. The census modal split estimate should be higher than the simulated value because the Census includes private and interstate operator bus service, and SEPTA and NJ TRANSIT rail service on the Northeast Corridor not included in the simulation model output. Overall, the model projects that transit's share of study area trips will remain constant (just under 1%) between 1990 and 2010, although the number of transit trips will increase as a result of residential and commercial activity in nearby suburban and rural areas. Transit ridership is projected to increase by about 2,200 daily trips (17.5%) to about 15,000 trip origins on an average weekday, but total trip demand is expected to increase by 236,000 daily trips to over 1.7 million daily trips. Most of the travel demand increase in the study area will be accommodated by private automobiles.

The model also subdivides highway trips into auto drivers and passengers. Auto driver trips are added to the truck, taxi, and external vehicle trips in preparation for assignment to the highway network. The average automobile trip from the study area now carries about 1.43 persons, and in the absence of effective policies to encourage ridesharing, this is expected to change little over the next 20 years. Residents are most likely to drive alone when traveling to or from work, averaging an occupancy of only 1.14, and least likely when traveling between home and non-work destinations, when the occupancy is 1.68.

Transit Assignment

The final step in the travel forecasting process involves assigning transit trips to the transit network to obtain facility volumes. Public transit riders are assigned to the specific facility that provides the best service (measured by waiting time, travel time and fare) from the traveler's origin to his/her destination. During this assignment process, a best transit submode (bus, subway or railroad) is selected and transit trips are "unlinked" into assigned boardings by station or stop. For instance, a subway elevated trip into center city Philadelphia might be unlinked into a bus trip to Fern Rock Station followed by a subway trip on the Broad Street Line to downtown. Park-and-ride railroad trips are unlinked into an auto approach to the nearest station followed by a railroad trip to the Center City station nearest to the destination.

To estimate transit demand for the Newtown Line alternatives, a probable catchment area for each station was defined based on approach patterns taken from previously conducted transit on-board and station surveys. Auto approach and walk/bicycle links were then coded into the transit network to connect the zones inside each catchment area to the appropriate station. The definition of these station service areas were then checked by tabulating the 1990 Census Journey

to Work railroad trips from these areas to the existing Warminster and West Trenton Lines. These journey-to work trips were then factored to represent total daily travel using the results of recent on-board railroad surveys. The results of this comparison are shown in Table 4. Overall, railroad ridership is overestimated by 9.4 percent, with the overestimate being slightly larger for the Warminster Line. These Census results should be higher than the corresponding SEPTA counts because some of the rail riders in these totals may be using other rail lines in the area. Station catchment area overlaps are not directly considered in this calibration, but as noted below, the simulated line riderships were adjusted to account for this problem and other simulation model errors.

Evaluation of the 1990 Railroad Assignment Results

All sample based census and transportation planning data, as well as the models derived from these data, have errors associated with them. Good planning practice requires that these errors be quantified to the extent possible, and that corrections be made to the resulting forecasts. The primary transit output that is needed for the evaluation of the Newtown Rail Line alternatives is simulated station boardings. In order to evaluate the accuracy of the transit simulation model, the 1990 assignment results were compared with actual railroad station boarding counts collected by SEPTA in 1990. Table 5 compares the aggregated total of predicted with actual station boardings for the 20 existing railroad stations within the overall service area. By line, these aggregate errors range from 5.9 percent for the West Trenton Line to 21.6 percent for the Warminster Line, with about 11 percent overestimate overall. The average station error for this 20-station group was 11.4 percent which corresponds to about 49 daily boardings per station. This station error resulted in part from the service area overlaps noted above and other factors. In order to insure that the results were sufficiently accurate to evaluate the Newtown Rail alternatives, the calibration error was used as a basis to adjust forecasted volumes.

This error correction process reduced the error in the DVRPC forecasts for the Newtown Line alternatives to levels of 5 to 10 percent - much smaller than the average of simulation model error statistics for the Warminster and West Trenton lines. Any residual errors in the forecasts are very small in both percentage and absolute terms, and will not affect the decision to accept or reject a given alternative.

Table 4

**1990 CENSUS VS. ACTUAL BOARDINGS
FOR THE R2 AND R3 LINES IN THE STUDY AREA**

Line	No. of Stations	Boardings		Difference	
		Actual	Census	Absolute	Percent
R2 (Warminster)	7	1,503	1,663	160	10.6%
R3 (West Trenton)	13	2,795	3,039	244	8.7%
Total	20	4,298	4,702	404	9.4%

Table 5

**1990 SIMULATED VS. ACTUAL BOARDINGS
FOR THE R2 AND R3 LINES IN THE STUDY AREA**

Line	No. of Stations	Boardings		Difference	
		Actual	Simulated	Absolute	Percent
R2 (Warminster)	7	1,503	1,828	325	21.6%
R3 (West Trenton)	13	2,795	2,960	165	5.9%
Total	20	4,298	4,788	490	11.4%

V. FORECAST TRAVEL DEMANDS

Each of the proposed Newtown rail alternatives was tested to determine projected boardings for 2010. The alternatives include the no-build, a 30 mph shuttle to the Fulmor station on the Warminster Line, a 50 mph shuttle along the same alignment, and diesel service directly to Suburban Station in Center City Philadelphia during the peak hours and shuttle service to Fox Chase during the off-peak. The service level, fare and operation speed assumptions associated with these alternatives are described in detail in Section II of this report.

Following the simulation of average weekday boardings in 2010 for each alternative, the patronage estimates for each line were adjusted for calibration errors noted above, and year 1996 and 2005 estimates of line boardings made by straight line interpolation between the 1990 base volumes and those of the 2010 alternatives. Separate estimates of line boardings were prepared for stations on the Newtown, Warminster, and West Trenton lines that lie within the study area. The total number of daily trips on the line will be approximately twice the number of boardings. The boardings at Fulmor Station under Alternative 1 do not include transfers from the Newtown trains.

Table 6 presents the 1996 and 2005 forecasts of daily boardings by line in the study area, together with 1980 and 1990 SEPTA boarding counts. The forecasts include all boardings, outbound as well as inbound, but historically only about two percent of the rail boardings in the study area were outbound. The number of new rail riders attracted by each of the build alternatives is also shown in Fig. 2. New riders are the riders from the study area that would not be on the trains had the alternative not been built.

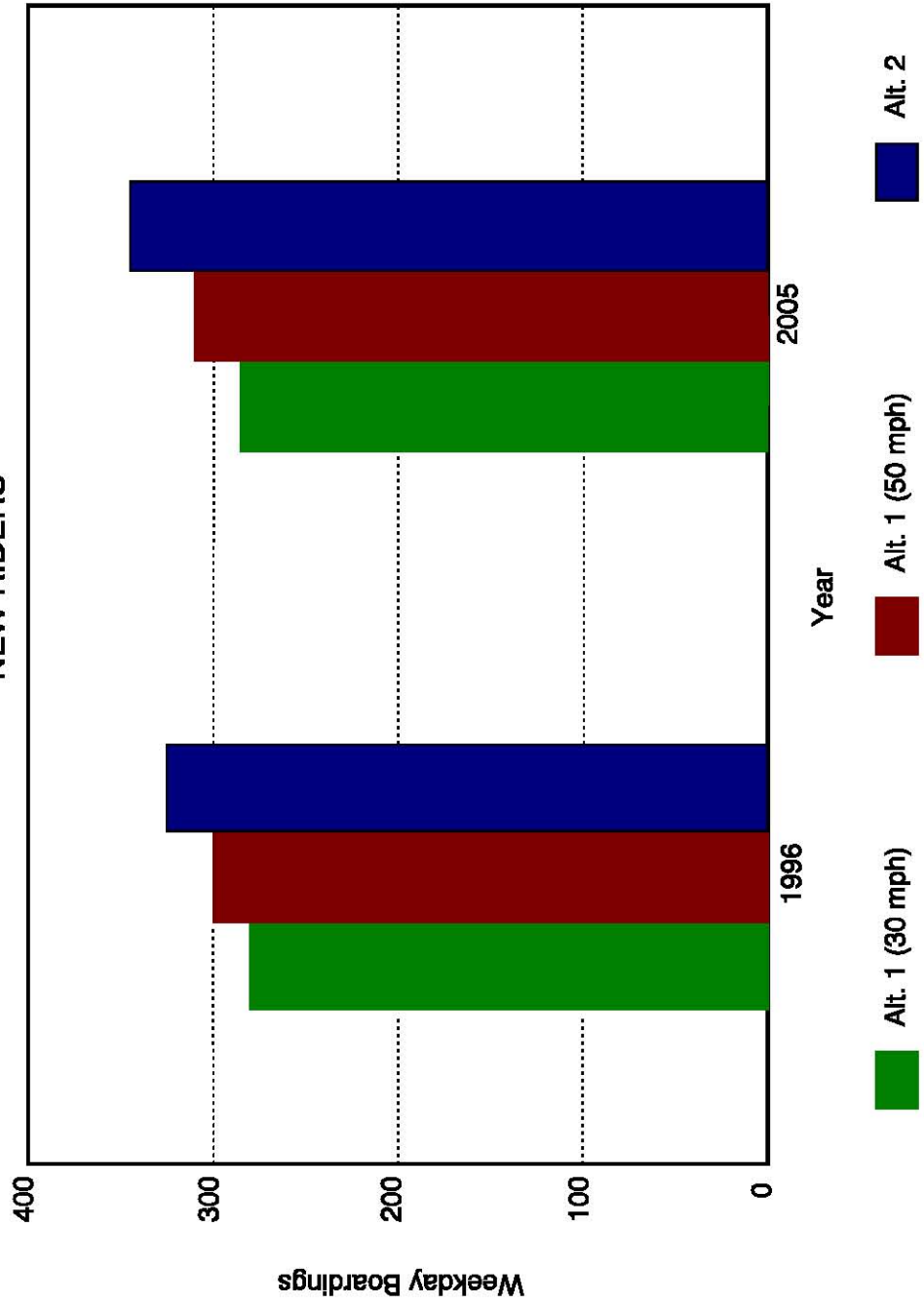
Under the No-build Alternative, total study area rail boardings are projected to grow slowly, by 3.1 percent between 1990 and 1996 and by 5.7 percent by 2005. Under this alternative, ridership on the West Trenton line grows somewhat faster than that on the Warminster Line. Essentially, the latter is projected to remain stable at 1990 ridership levels, reflecting a bottoming of past trends, which saw the Warminster Line decline significantly (36%) between 1980 and 1990 while the West Trenton Line declined slightly by 3.1 percent. Ridership on the Newtown shuttle bus remains stable, hovering around 80 daily round trips, about where it was in 1990.

Under Alternative 1, total weekday rail boardings in the study area are projected to increase by 280 in 1996 and 285 in the year 2005 for the 30 mph shuttle alternative, and by 300 and 310 daily boardings assuming the 50 mph shuttle service. Daily boardings on the shuttle trains are projected to be somewhat higher - 315 in 1996 and 355 in 2005 - under the 30 mph service assumption, and 355 to 400 boardings assuming 50 mph operations. The shuttle boardings are higher than the number of new corridor riders, because a small number of persons currently using the R2 and R3 lines are diverted to the Newtown service.

Table 6
STUDY AREA RAIL RIDERSHIP
Daily Boardings (Weekday)

Line	SEPTA Counts		1996 Forecast						2005 Forecast						
	1980	1990	No Build		Alt. 1		Alt. 2		No Build		Alt. 1		Alt. 2		
			30 mph	50 mph	30 mph	50 mph	30 mph	50 mph	30 mph	50 mph	30 mph	50 mph	30 mph	50 mph	
R2	2,369	1,503	1,520	1,510	1,505	1,440	1,440	1,535	1,520	1,515	1,440	1,535	1,520	1,515	1,440
R3	2,884	2,795	2,910	2,885	2,870	2,860	2,860	3,010	2,945	2,940	2,915	3,010	2,945	2,940	2,915
Newtown	229	-	-	315	355	455	455	-	365	400	535	-	365	400	535
Total	5,482	4,298	4,430	4,710	4,730	4,755	4,755	4,545	4,830	4,855	4,890	4,545	4,830	4,855	4,890
New Trips	-	-	-	280	300	325	325	-	285	310	345	-	285	310	345

Figure 2
NEW RIDERS



Ridership under Alternative 2 (direct diesel service to Suburban Station) is slightly higher than that of the shuttle service, 455 and 535 in 1996 and 2005, respectively. Most of this increase can be attributed to increased diversions from the R2 and R3 lines as a result of the direct service to the Philadelphia central business district during peak periods. The increase in total corridor boardings over the 50 mph shuttle is only 25 in 1995 and 35 in 2005, although it should be noted that Alternative 2 involved relatively limited service.

VI. CONCLUSION

Historically, the Newtown Line carried only a small share of the total rail ridership originating from the study area, which is also served by the R2 Warminster and R3 West Trenton lines. In 1980, this share amounted to a little more than four percent (230 out of 5,500 inbound boardings). Nevertheless, the area served by the line has been growing rapidly, with population increasing by 42 percent during the 1980s, and a restored service should be able to attract stronger patronage.

Total weekday boardings on the three lines are expected to grow from the 1990 base of 4,300 to more than 4,500 by 2005 in the absence of Newtown service. If service is restored to Newtown, total rail ridership to the study area is projected to increase by approximately eight percent, to almost 4,900. The number of riders projected for 2005 on the Newtown Line ranges from 285 under the 30 mph scenario of Alternative 1 to 535 for Alternative 2. Because the line draws some riders from the R2 and R3 lines, the number of new riders is somewhat less and ranges from 285 to 345. Although Alternative 2 attracts the highest ridership, there is not a lot of spread between the build alternatives. However, each of these alternatives exhibits major weaknesses, the first requiring a transfer to the Warminster Line, and the second providing a limited service via a circuitous routing to Center City.

To be successful a rail service must compete effectively with a steadily improving highway product. Compounding the difficulty of building markets for rail travel is the general dispersion of trip ends. Although destinations are no longer focussed on Center City Philadelphia as once was the case, Center City still offers the largest concentration of jobs in the region, as well as cultural, entertainment, and educational attractions; and it is here that congestion and parking impediments render highway travel least attractive. It may be possible to design alternatives that mitigate the weaknesses noted above, and which can attract a larger number of new riders.
