

**An Investigation of Routing Strategies To Improve Transit  
Service**

**prepared for**

**The Delaware Transportation Institute**

**by**

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## **Comments About Data Used in the Research**

### ***Sources of Data***

The source for all origin/destination data is the 1990 Census Transportation Planning Package (CTPP). Where transit share is listed with origin/destination information, it also is from the CTPP. The 1996 Winter Ride Check conducted by DART First State was used to examine ridership by bus stop for the detailed study of local areas.

Geographical information system (GIS) representations of DART First State transit routes and bus stop inventories were produced in the Summer of 1996 by the Center for Applied Demography and Survey Research (CADSR) and DART First State. Network representations of the road network were derived from the DELDOT Centerline File (August 1996), the DELDOT Travel Demand Forecasting Model, and enhancements by CADSR.

Land Use information was from interpretations of Spring 1992 Orthophotography. Tax parcel centroids were taken from Spring 1992 data sets prepared by the Water Resources Agency for New Castle County, which were created for a number of environmental protection and emergency management applications in New Castle County. The locations of tax parcel centroids were updated using Spring 1992 digital orthophotography and were used to estimate the location of demand in suburban subdivisions. 1990 Census data was used to estimate housing unit types and to estimate the number of housing units in tax parcels containing multi-family dwellings. Locations for special trip attractors such as major employment centers, hospitals, shopping centers, and industrial parks were derived from inventories done as part of the DART First State 1995 to 2001 Service Development Project which was conducted in the Summer of 1994.

### ***Accuracy***

Much of the analysis to identify routing opportunities used the 1990 CTPP data. At the time of this research, travel demand forecasting models were undergoing major revisions and current estimates of flows between DELDOT Traffic Zone origins and destinations from models were not available to assist in assessing whether these travel patterns are still present. Travel surveys conducted in 1996 for the update of TDF models did not involve samples large enough to

check the validity of 1990 figures. While it is assumed that similar travel patterns still exist, the relevance and validity of conclusions in this research is dependent on the extent that this is true. CTPP origin / destination figures were taken from a 14% sample ( the 1990 Census long form ) and were prepared by the Bureau of the Census so that numbers would be in line with expected large area totals. Within a CTPP traffic zone, one person indicating that they traveled to a particular destination was considered to be representative of several people making that destination, perhaps 7 or more. **Totals shown in origin/destination tables then are not accurate to the single digit but are best viewed if they are rounded to the nearest fifty and as a general approximation to the true number of people traveling from one area to another.** Estimates are over six years old. Except in the case of the Route 40 corridor where transit service did not exist in 1990, current transit ridership is comparable to those figures indicated by the 1990 Census for areas studied in detail. The research shows the importance of having up to date travel pattern, data and methods which can be employed to use it to identify transit opportunities.

Estimates of the number of housing units were based on housing type and checks with the 1990 Census figures. As within a CTPP zone the distribution of housing units with respect to a particular destination is unknown and for the purposes of this research was distributed uniformly within suburban developments.

### **Information Structures**

Analysis was conducted in a sophisticated GIS environment. Most data was tied to traffic zone and network link representations as feature attribute tables. An effort was made to prepare data in a manner consistent with emerging standards in the representation of transportation facilities, and land features. Origins and destinations identified can be expressed in terms of aggregations of DELDOT traffic zones. Database formats for representing travel demand, the transportation network, and transit stops are shown in the appendix. For more information on data and analysis procedures contact the principal investigator.

## Executive Summary

The current transit system in Northern New Castle County maintains numerous stops on routes to all major employment and high density areas and can take an individual to and from any of these areas by one or several connecting routes. Yet the number of people using the system for the journey to work is estimated at 3% of the work force. Overall, transit systems account for less than 2% of all trips. The premise at the base of the research is that travel time is to many people an insurmountable modal barrier to using the current transit system. Also, that by decreasing door to door transit travel time, significant increases in ridership may be achieved by reaching a segment of the market which is for all practical purposes not served. The research was focused on understanding travel patterns in New Castle County and investigating opportunities for enhancing or adding transit service, and express service in particular.

A review of the current transit system revealed that transit service in New Castle County is in adherence to service guidelines based on housing densities. Data for all counties in the United States was reviewed and indicated that based on population data and other relevant demographic variables, New Castle County was offering a higher degree of transit service and was seeing a higher transit ridership than most counties of a similar makeup. A study of travel patterns at the Census County Division (CCD) and County level revealed that a large percentage of people live near where they work. About 50% work within 19 minutes or less travel time. The City of Wilmington which has the highest residential and employment densities, and has strong incentives to use transit in the form of parking fees and congestion, is the focus of the current transit system. 85% of the transit use for the journey to work is for trips to or from the Wilmington area. The CCD level analysis of journey to work also revealed that over 50% of the journey to work market is in suburb to suburb travel, less than 1% of which is currently served by transit. About 90% of the journey to work market involves travel to or from a low density area.

It is clear that any new or enhanced transit services must address the suburban market. Literature which described case studies of transit agencies serving suburban areas was gathered and studied to understand the elements and strategies for successful suburban transit. A distinguishing feature of the more successful suburban transit services has been the service of hubs. Moderate to low density and diverse origin-destination patterns require that services be focused so that diverse trip patterns can be concentrated. Park and Rides, and transit centers are the most appropriate approach to serving low density areas. Suburban transit success requires a

detailed knowledge of travel patterns and customer needs and preferences and services must be designed to fit those needs. Transit agencies will need to collect and manage market information in an efficient and effective manner. Services targeted to choice riders succeed only if appropriately supported and if they have a role to serve. Transit investments in suburban areas will have much lower returns than in urban settings, so innovative methods must be employed to keep costs down. Support of the community and the private sector is vital and incentives must be present to attract a sufficient number of riders to support services.

Origin/destination (OD) data for the journey to work was examined at a more detailed level to understand travel patterns and identify specific opportunities. New Castle County was divided into a number of local neighborhoods based on a knowledge of neighborhood character, land use, and orientation to the transportation network. These local places were made up of one to a few traffic zones. Central Wilmington was shown to be the single largest destination for most origins. With the exception of locations in Wilmington and Newark, there are no high density to high density origin/destination pairs which would be strong candidates for express routing in the absence of a very effective feeder strategy. The journey to work involves numerous diverse origins and destinations with traffic flows mostly unidirectional on transportation corridors. While some of the origins studied included thousands of workers, and moderate to high densities areas, travel is spread over a large number of OD pairs and the average number of workers for each pair is about 130. Where 10% is considered to be a relatively successful transit share, the resulting low number of potential riders spread out over one to a few traffic zones makes for challenging and expensive routing options.

The literature study revealed that express bus application involving suburban areas is best suited to trips of at least 30 minutes on the express bus itself, and only where the in-bus travel time can be competitive with the auto. “Competitive” in this research was considered to be a door to door trip time by bus which involved no more than a 50% time penalty (i.e door to door transit trip takes 30 minutes and SOV time takes 20). The OD studies indicate that most of the OD pairs involving 200 or more workers have travel times of 25 minutes or less. The number of people who will choose to travel by transit which door to door takes an additional 15 minutes or more, over a 20 to 25 minute SOV trip is expected to be very low in the absence of incentives. The current transit system captures about 11% of those who live and work in Wilmington but this area is unique in its density, high level of service, and in the presence of high parking costs.

Four local areas which contained large numbers of people who do not use transit were selected for further study; the western portion of Pike Creek<sup>\*</sup>, the western portion of Kirkwood Highway, Chestnut Hill Road south of Newark, and the area North of the City of New Castle. These areas were the subject of a very detailed approach to understanding and quantifying the travel market and the relation to transit and transportation facilities at the subdivision road and tax parcel level. Resource location and allocation models were used to view the location and relative size of demand centers within these locales for various destinations, and to determine the amount of demand which could be accessible to proposed or existing bus stops. This analysis showed that within the study areas a large percentage (34% to 68%) of housing units were not within walking distance of bus stops on adjoining major roads. Optimum routing procedures used on models of these local areas were used to determine how much travel distance and time it would take for a feeder route to visit the top demand centers. In some areas visiting only 5 of the top demand centers, which involved travel within subdivisions, would take a feeder bus 20 minutes or more while reaching less than a third of the housing. The analytical procedures clearly demonstrated how low and moderate housing density makes transit service expensive for transit agencies and impractical for many potential users.

The journey to work was the primary trip purpose examined since; it represents about 25% of all trips, most journey to work trips occur in the peak travel period, destinations are less diverse, and average trip length is greater than for other purposes. Also it is the only origin/destination data available for New Castle County. The 1990 Census Transportation Planning Package which addresses only the journey to work was the prime source of travel pattern information. It is assumed that most of the same travel patterns still exist but this cannot be verified until recent updates to the DELDOT Travel Demand Forecasting Model are available, or until trip survey efforts currently underway can provide a large enough sample to understand travel patterns at the traffic zone level. One major difference is that the Route 40 corridor is now serving several thousand passenger trips in the area each week, where as in 1990 there was no service on most of the corridor. The 1990 CTPP numbers clearly show a market for transit in the Route 40 corridor. Because of the predominance of the suburban travel market and because of the need to understand markets very well to even make modest increases in transit usage, the research strongly supports efforts to update and maintain information about travel patterns in Delaware, and demonstrates the usefulness of this information. A better understanding of other trip purposes may also identify opportunities to enhance transit.

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<sup>\*</sup> A map showing these areas is available in figure 4.

With a better understanding of the travel market and an insight into successful suburban transit strategies, the research suggests where efforts to improve transit in New Castle County should be focused. This is done in the context of future trends and transit goals.

Much of the new growth in the County is expected to be in the range of 0.5 to 1.5 dwelling units per acre in typical land use patterns which do not contain mixed uses, with large lots and setbacks, wide streets, a lack of connectivity to the street system, and few sidewalks. Most of the higher density areas and the best opportunities will involve service to existing development in New Castle County.

WILMAPCO's Metropolitan Transportation Plan (MTP) sets a goal of total transit trips of 95,000 passenger trips per day in the year 2020. DART First State currently serves between 23,000 and 24,000 trips per day. The MTP then calls for an additional 71,000 trips per day. At the current average per passenger trip subsidy of slightly less than \$2.00, reaching this goal could be very expensive. To make significant gains toward maintaining or increasing transit use, costs must be kept down and existing services must be more productive.

Research which describes case studies of transit service to low density areas reveals that success depends on transit incentives, and reaching traditional markets. Parking costs in the City of Wilmington and congestion on major roads are the primary incentives to transit use in New Castle County. There are currently areas which contain a number of people who work in Wilmington and where few people use transit. These areas should be targeted first and are listed in the project report. In particular there are several thousand workers who work in Wilmington and live in neighboring counties who do not use transit. If transit share for those who work in Wilmington could be brought up to at least 10% then it is estimated about 3000 additional passenger trips could be served by transit per day.

In line with keeping costs down and making the system more productive, would be to serve more of the market leaving Wilmington. CTPP Census County Division figures indicate that transit share of the journey to work from Wilmington to the suburbs is between 5 and 8 percent. This would be attributable to a high level of service, high population densities, and service to a lower income group which is more likely to take advantage of transit options. So given the right combination of factors the data demonstrates that it is possible to generate transit

ridership in the absence of parking fees and congestion. Perhaps minor changes in bus routes leaving Wilmington, marketing, and employer support could increase ridership for this market.

Capturing a greater share of the journey to work travel to and from Wilmington might serve an additional 5000 trips per day. This would be far short of transit goals and would not address the very large suburban to suburban travel market or future growth trends. Serving suburb to suburb travel will involve higher service costs, generally lower returns, and substantial market studies and experimentation. Innovation is necessary to keep costs down and appropriately address the market. Consistent with case studies of transit properties, the best approach is to identify niche markets or more traditional transit markets such as lower income, blue collar areas. The research identifies population attributes which would suggest persons more likely to use transit, and then suggests suburban origins and destinations which should be addressed first.

Finally the research addresses appropriate strategies for enhanced transit service in New Castle County. The primary recommendation is to focus on the establishment of park and rides and transit activity centers to meet riders half way. Park and rides provide the most cost efficient manner for transit agencies to provide service to low density areas, and they allow for the lowest door to door travel times for riders. A wide range of geographical information system data was used to demonstrate how locations for park and rides and transit centers could be determined. Transit centers can serve as a focal point for local transportation alternatives, and an example is offered by showing how the presence of a few transit stations can allow 70% of a suburban locale to be within a 6 minute bicycle ride of the transit system.

A survey was conducted at four park and rides to better understand where and why riders used the service. Over 2/3 of the respondents said they ride the bus specifically to save parking costs, with most of the remainder saying they ride because it is less expensive and easier than driving. Over 90% of the riders take the bus 4 to 5 days a week. Income levels of riders mirrored those of the surrounding community. Origins of respondents were mapped and were distributed in what could be viewed as a parabolic catchment area flaring away from the direction of the destination.





## Introduction

The premise at the base of the research is that travel time is to many people an insurmountable modal barrier to using the current transit system. Also, that by decreasing door to door transit travel time, significant increases in ridership may be achieved by reaching a segment of the market which is for all practical purposes is not served. The research was focused on understanding travel patterns in New Castle County and investigating opportunities for enhancing or adding transit service, and express service in particular.

This research was funded by the Delaware Transportation Institute and originated as planning concerns to answer the following questions

Is there a way to improve the transit system to offer a greater resource to the community and significantly increase ridership?

What modal incentives exist, and which additional types should be pursued? What modal barriers exist, and can we lower them for passengers.

What incentives would be effective in encouraging developers to produce developments that are more conducive to alternative modes of transportation, for example, by transit, by bicycle, and on foot?

Goals of the research included:

- Identify opportunities to use express routing to increase transit ridership
- Investigate approaches to serving suburban areas
- Address door to door travel time
- Develop an analysis and data management structure which can comprehensively address issues, and quantify markets and costs associated with existing and proposed improvements
- Acquire a better understanding of the potential and limitations of transit systems in New Castle County.

Chapter One reviews the current transit system and how it meets service guidelines. Travel patterns and transit service are viewed from the Census County Division (CCD) and County level. Journey to work is the primary trip purpose studied since it is considered to involve the largest number of travelers moving from each origin and destination at a regular time each day. Also, most of the data available concerns the journey to work.

Based on investigations at the CCD level it is clear that over 50% of the journey to work market is in suburb to suburb travel, much of which is not being reached by the current transit system. Enhancements of existing service would also require a better understanding of strategies to serve the suburbs. Chapter Two discusses a literature search of case studies of experience and innovations in addressing the growing suburban market, and identifies elements of success.

Chapter Three describes a more detailed study of origin/destination information for areas made up of one or more traffic zones which can be identified as somewhat homogeneous servicable locations. Origins and destinations were viewed in a number of ways to identify specific opportunities to add or enhance transit service. Four of the origin locations were the subject of an approach to understanding and quantifying the travel market and the relation to transit and transportation facilities at the subdivision road and tax parcel level. Location/allocation algorithms were employed to identify demand centers, and optimum routing procedures were employed to understand the time and costs involved in reaching potential transit markets by fixed feeder routes or by alternative modes of local transportation such as bicycling. The demand within walking distance of the current transit system was also studied and described.

Based on the study of travel patterns, an understanding of the current market served, and a knowledge of successful suburban transit strategies, the research suggests where efforts to improve transit should be focused, as described in Chapter Four. This is done in the context of future trends and goals, and a general estimate of transit costs.

Chapter Five discusses the most appropriate transit strategies for New Castle County. Case studies of successful suburban transit and the realities posed by the low to moderate density as exists in New Castle County underscore the need to focus diverse origin-destination patterns and service hubs. A study of four park and rides in New Castle County, and methods of using currently available geographical information system data to locate suitable locations for park and rides and transit activity centers are also discussed in Chapter Five.

# Chapter One, The Current Transit System in New Castle County and Markets Served

## 1.1 The Current Transit System

The Delaware Administration for Regional Transit (DART First State) is the central bus system in New Castle County. It is highly concentrated in the City of Wilmington with additional services provided along most major roadways in the county. DART First State bus routes serve approximately 22,000 to 23,000 passenger trips per day with the following distribution: <sup>1</sup>

### Weekdays

Morning, Before 9.00AM - 7000 passenger trips

Midday, 9.00AM to 3.00PM - 7 to 8000 passenger trips

Evening, after 3.00PM - 8000 passenger trips

Saturday, all day - 9000 passenger trips

Approximately 85% of the transit use for the journey to work is for trips to or from the Wilmington area<sup>2</sup>. For trips whose origin or destination is not Wilmington, a transfer is usually necessary. About 1 in 7 passenger trips involve a transfer. Midday destinations are primarily to malls and other shopping areas, medical facilities, Delaware Motor Vehicle, and community service locations. Midday origins are primarily in Wilmington and traditional markets for transit such as lower income areas.<sup>3</sup> While the perception might be that morning routes are much more productive than midday routes, this is not the case. Most transit trips to work have passengers only in one direction of the route, while midday buses are less full but are carrying passengers in both directions of the route. In the North Fixed Route District, average cost per passenger trip is about \$2.50 and can range from a little over a dollar to over \$10.00. Fairbox recovery can range from about 5% to 50% with an average at about 25%<sup>4</sup>. The primary reason Wilmington is the focus of transit service is that it is where the transit market is centered. Wilmington by far has the highest residential and employment densities, the greatest proximity to the traditional transit markets, and a strong transit incentive presented by parking costs and congestion.

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<sup>1</sup> Discussions with DART First State Personnel, March 1997.

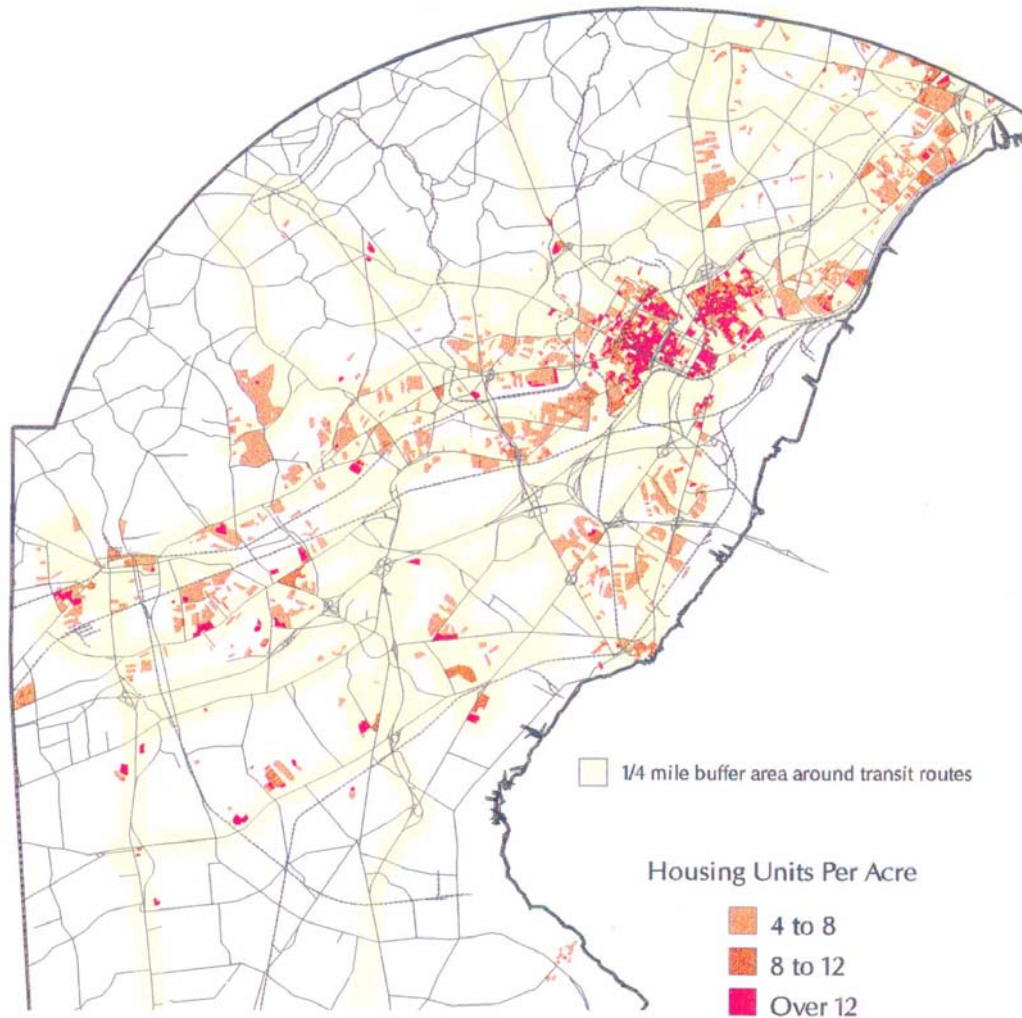
<sup>2</sup> Estimate based on 1990 Census Transportation Planning Package (CTPP).

<sup>3</sup> Examination of DART First State November 1996 Ride Check.

<sup>4</sup> DART First State July 95 to June 96 statistics.



Figure 1, Housing Densities in New Castle County with  
with 1/4 mile buffers around transit routes.  
1990 Census data at the block level.



of suburb to suburb travel is generally much less than the level of service to Wilmington in terms of trip travel time.

**Table 2, Service Type Guidelines** <sup>7</sup>

<i>Residential Density (Households per acre)</i>	<i>Service Type</i>
Less than 4	Demand Response
	Park-n-Ride
4 to 12	Fixed Route
Over 12	Express Routes

**Table 3, Service Frequency Guidelines**

<i>Residential Density (Households per acre)</i>	<i>Service Type</i>
Less than 4	2 hour advance
4 to 12	30/60 <sup>8</sup>
Over 12	15/30

***1.2 Transit Success Relative To Other Areas; A National Model of Transit Share***

One of the questions that is almost always asked, in issues like transit use, is how we are doing relative to other states or counties in the United States. There are 3,141 counties in the country and most are far less populous than New Castle County. The County is the 112<sup>th</sup> most populous county in the country and it has the 117<sup>th</sup> highest population density. In terms of the number taking public transit to work, New Castle County ranks 97<sup>th</sup>.

In order to better understand the use of transit in the journey to work, a database was constructed from the 1990 Census, Summary Tape File 3A (STF3A), which contains information on the journey to work from a sample of 15% of the United States households. The information is extensive and includes all of the socio-economic information collected in the Census. Most importantly, information is provided on the mode of transportation that residents of each county use to go to work. This data set was used to model as the dependent variable, the percentage of people taking public transportation to work<sup>\*\*</sup>.

After a significant amount of analysis, the decision was made to limit the study to those reporting at least 500 persons using public transportation for the journey to work. This reduced the sample size from 3141 to 401, and provided a range of riders from 500 to 527,000 with New Castle County reporting 7,300. The percent using public transportation varies from 0.28% to 61.7% with a mean of 4.3%. For New Castle County, approximately 3.3% of those working outside the home use public transportation in their journey to work. Obviously, the range and variance in the dependent variable is significant, and produces a skewed distribution which poses some problem for the analysis. To partially correct for this skew, the dependent variable used was

<sup>7</sup> WILMAPCO Regional Transit Service Needs Study.

<sup>8</sup> Morning peak and midday headways in minutes.

<sup>\*\*</sup> It is important to note that this analysis is residence-based and is not concerned with the place of work. Not distinction is made between rail and bus. Many counties have some rail service without having a fixed route bus system. This means that even very small counties report having some type of public transportation. In addition, since the Census asked how one got to work in a particular week, some of the responses may include those using public transportation for long distance trips as opposed to their daily commute.

the square root of the percentage using transit. This corrects for most but not all of the abnormalities in the distribution.

Many different independent variables in different functional forms were considered in the model. The most powerful variable by far in predicting transit use is population density, i.e. persons per square mile. As density increases, the modal choice becomes more and more oriented toward public transportation. This variable also exhibits some non-linearity in that as it increases it becomes harder to increase the public transit share. That is, more density is required to get a 1% increase in share at higher levels of density than at lower levels. To compensate for that, a new variable was created which is the population density squared. This variable absorbs the non-linear component observed in the data. Two other variables were added to the model to capture other features of the modal choice. First, the proportion of people using carpooling was introduced both to capture the affect of competition for transit and to measure the desire for shared travel. Second, the percent working in the central city was added to measure the centralization of the labor force which can drastically affect the utility of public transit.

The final model estimated with ordinary least squares regression explained more than 70% of the total variation in the dependent variable. The model containing the four variables described above was highly significant ( $F=240$ ) and each independent variable coefficient was significant at the .01 level. The coefficient for the proportion carpooling was positively related to the percentage taking transit suggesting that they are more complementary than substitutes. Population density was strongly and positively related as expected. Similarly, the coefficient for the squared density variable was negative as expected since it becomes harder and harder to increase the transit share after it reaches a high level. The coefficient for the proportion working in the central city was negative in contrast to the hypothesis offered above. However, this may be difficult to separate from the population density variable.

After arriving at the final version of the model, the predicted market share for transit in New Castle County was calculated. This value was 3.26% in comparison to the 3.28% share actually observed in 1990. This means that relative to other counties, the transit programs in the New Castle County are achieving about what would be expected.

### 1.3 Markets Served

The journey to work was the primary trip purpose examined for express routing opportunities since; it represents about 25% of all trips, most journey to work trips occur in the peak travel period, average trip length is greater than other purposes, destinations are less diverse, and origin/destination data is more available. Also, if transit could capture more of the peak period travel, congestion would to some degree be alleviated. A study of the 1990 Census Transportation Planning Package yields information about regional journey to work travel patterns and the share which transit realizes.

In New Castle County, at the Census County Division (CCD, Figure 2), origin / destination (OD) pairs with more than 500 workers and transit share at 2% or greater all involve trips to or from Wilmington (Table 4). Suburb to suburb travel to work accounts for almost ¾ of

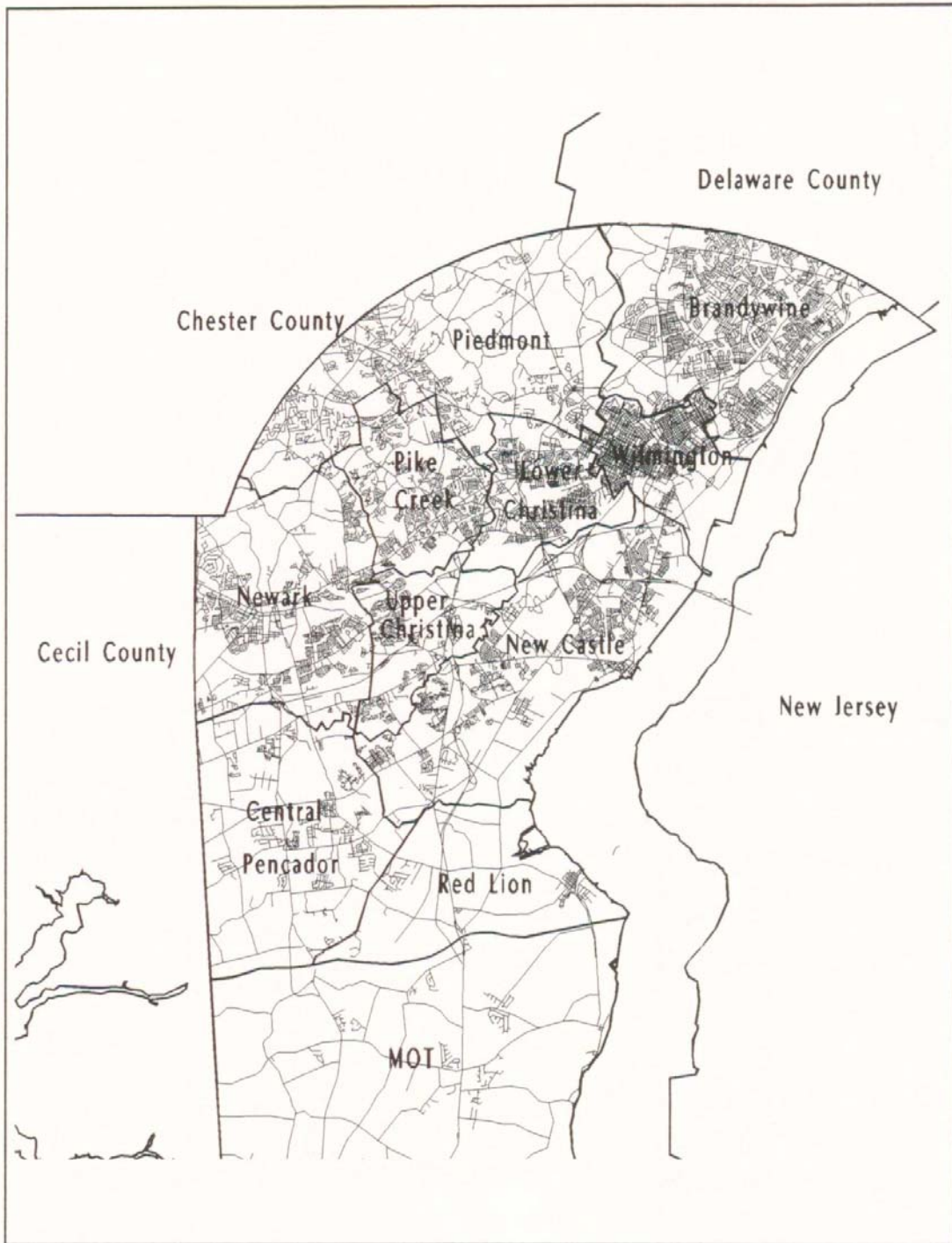
**Table 4, CCD origin destination pairs with total workers greater than 500 and 2% transit share or better, worker who do not work and live in the same CCD.**

Orig name	dest name	total workers	transit share
Kent	Wilmington	760	4.21
Wilmington	Pike Creek	798	8.77
Wilmington	Piedmont	958	8.25
Cecil	Wilmington	1277	2.98
Wilmington	Upper Christina	1390	7.27
Wilmington	Greater Newark	1510	6.89
Wilmington	New Castle	1661	5.90
New Jersey	Wilmington	1874	2.51
Upper Christina	Wilmington	2360	2.33
Wilmington	Lower Christina	2368	7.56
Piedmont	Wilmington	3473	4.95
Wilmington	Brandywine	3944	7.51
Greater Newark	Wilmington	4144	6.64
Lower Christina	Wilmington	4832	8.46
Pike Creek	Wilmington	4900	4.65
New Castle	Wilmington	7359	6.32
Brandywine	Wilmington	10799	8.51
TOTALS		54,407	6.6

the daily trips with transit servicing only about 1% of these trips (see Figure 3). Incentives such as parking costs to not exist for this large suburb to suburb market and use of the current transit system would generally involve a transfer and much greater travel time than a personal auto. Table 5 shows CCD origin /destination pairs which represent where new transit markets may be. Of particular interest is the large number of people coming from outside of New Castle County to work in Wilmington. Park and Ride facilities located near the county borders may

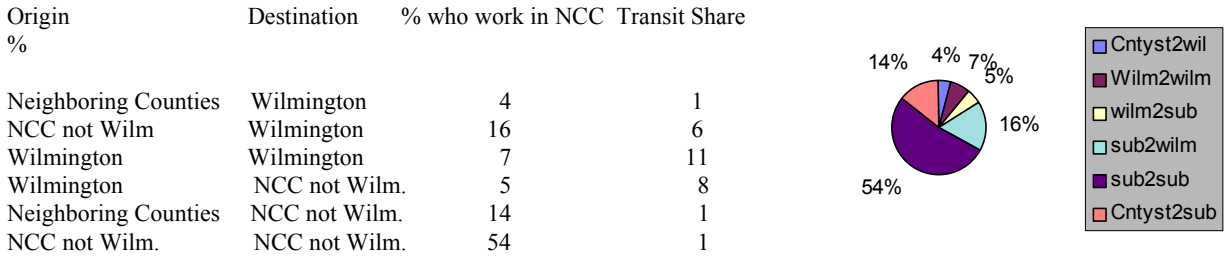


Figure 2, Census County Divisions in New Castle County



encourage these riders to use transit. A complete tabulation of CCD and neighboring county origin/destination information is provided in the Appendix of this report.

**Figure 3, Travel between Wilmington, New Castle County suburbs, and neighboring counties, for those who work in New Castle County.**



**Table 5, CCD origin/destination pairs, total workers greater than 2000 and transit share less than 2%**

origin	destination	workers	transit share (%)
Greater Newark	New Castle	2010	0.4
Pike Creek	Upper Christina	2075	0.5
Central Pencador	Greater Newark	2114	0.2
Brandywine	Lower Christina	2147	0.7
Lower Christina	Brandywine	2209	0.4
Pike Creek	Greater Newark	2231	0.8
Greater Newark	Lower Christina	2260	0
Chester County	Brandywine	2290	0
Upper Christina	Greater Newark	2385	0.4
Delaware County	Wilmington	2463	0.4
Delaware	Brandywine	2507	0.2
Pike Creek	Brandywine	2524	0.8
Pike Creek	Lower Christina	2626	0.6
Greater Newark	Brandywine	2822	0
New Castle	Greater Newark	2886	0.3
Greater Newark	Upper Christina	3150	0.7
Chester County	Wilmington	3168	0.8
New Castle	Lower Christina	3185	0.7
New Castle	Upper Christina	4142	1.8
New Castle	Brandywine	4165	1.2
		53359	.61 ( 326 riders)

Data at the CCD level also show that many people live near where they work. In New Castle County , 25% of the workers live and work in the same CCD (see Table 6 ), and about 50% of workers have travel time less than 19 minutes. Transit share for those who live and work in Wilmington is approximately 11%, almost a third of total ridership. Wilmington has high employment and residential densities, parking costs, and a high level of transit service which other areas to not have. Intra CCD transit shares for Newark which includes high density areas and a large student population are only 2% or less.

**Table 6, Workers who live and work in the same Census County Division in New Castle County.**

CCD	Total Workers	%Using Transit
Red Lion	270	0
Central Pencador	334	0
Piedmont	1082	0
MOT	1235	0
Pike Creek	1954	0
Upper Christina	2122	0
Lower Christina	3664	1.04
New Castle	7267	0.80
Brandywine	11456	0.80
Greater Newark	11542	1.68
Wilmington	16688	11.20
<hr/>		
	57,614	

### ***1.4 Conclusions***

- Transit service in New Castle County is focused on the City of Wilmington which has the highest residential and employment densities, and has strong incentives to use transit in the form of parking fees and congestion.
- Compared to other counties in the country, New Castle County has average to above average use of the transit system. Transit services adhere to guidelines expressed in terms of housing densities.
- Over 50% of the journey to work market is in suburb to suburb travel. About 90% of the journey to work market involves travel to or from a low density area.
- In New Castle County, a large percentage of people live near where they work. About 50% work within 19 minutes or less travel time.
- Any new transit services must address the suburban market.

## Chapter 2, Serving The Suburbs

### 2.1 Elements of Success

Maintaining or increasing transit share in Northern New Castle County depends on how well the suburban market can be addressed. A literature review was conducted to determine current understanding of transit service in the suburbs. A recurring theme is that to have successful transit service in the suburbs demands an understanding of travel patterns, and a diverse set of travel options that fit the needs of customers. Simply putting service on highly traveled roads is not enough. Studies conducted as part of the Transit Cooperative Research Program have identified success factors and service strategies for the suburbs; through case studies of transit agencies across the country.<sup>9</sup>

Elements of success include<sup>10</sup> :

- Develop services around focal points (hubs).
- Serve transit's more traditional markets
- Target markets appropriately. Services targeted to choice riders succeed only if appropriately supported and if they have a role to serve.
- Economize on expenses. Costs per trip must be kept down.
- Obtain private sector support. Direct marketing via representative personal contact with employers is essential. The private sector can support new service in a number of ways.
- Plan with the community. Best services are those initiated by transit operators working closely with the local community.
- Establish realistic goals, objectives, and standards. Measure implemented services against specific service criteria.

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<sup>9</sup> TCRP B-6:Improving Transit Connections for Enhanced Suburban Mobility, Draft Report-Guidelines for Enhancing Suburban Mobility Using Public Transportation, Transit Research Program, Transportation Research Board, by Urbitran Associates Inc, January 1997 **and** TCRP Synthesis 14, Innovative Suburb-to-Suburb Transit Practices, A Synthesis of Transit Practice, Transit Cooperative Research Program, Transportation Research Board, 1995.

These two documents were the most informative found, and this chapter is based primarily on a review of their results.

<sup>10</sup> TCRP B-6, pgs 18-21 and TCRP Synthesis 14, pgs 25-27

(Elements of Success continued)

- Develop supportive policies, plans, and regulations (i.e. land use policies, parking fees, mandatory auto-occupancy, etc.)
- Adapt vehicle fleets to customer demand.
- Distribute transit information to offset poor visibility of service in low density areas.
- Pursue opportunities for Park and Rides.
- Offer safe, sheltered stops.
- Guaranteed ride home programs contribute to success.

In contrast to the traditional approach for the planning of fixed route service to serve urban areas which is focused primarily on population densities, developing transit service in the suburbs requires a much more detailed knowledge of customer needs and preferences, and requires a wider range of strategies to fit the customer's needs. Returns on transit investments in the suburbs will be less than what is seen in the urban environment, and service planning and marketing must be extensive. Transit planners must act as mobility managers rather than bus operators. The use of multiple incentives supplemented by marketing on a route, corridor, and employer by employer basis is crucial to the success of suburban services. Incentives include guaranteed ride home programs, transit pass programs, merchandise discounts, and special outreach to the business community<sup>11</sup>.

## ***2.2 Service Strategies***

The literature references several transit service strategies to reach the suburban market as summarized below.

### *Transit Centers*

A distinguishing feature of the more successful suburban transit services has been the service of hubs. Moderate to low density and diverse origin-destination patterns require that services be focused so that diverse trip patterns can be concentrated. Park and Rides and transit centers are the most appropriate approach to serving low density areas. Transit centers can range from simple shelters and park and rides to full service structures. They provide visibility for the transit service and can help focus development patterns. As described in Delaware's Route 40 studies, they provide a "sense of place". Walking, biking and other modes which are a more local means of travel are encouraged by facilities offered by the transit center with connections to

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<sup>11</sup> TCRP Synthesis 14, pg.27.

transportation resources. The transit agency does not have to finance the collection of passengers in low density areas, and riders can access a point in the primary transit network in the quickest possible manner.

An ideal transit center takes advantage of existing conditions and infrastructure and is circumscribed by a local circulation system designed to accommodate trips and the widest range of transportation options. A concentration of mixed use development is favored as a location for transit centers, and they should include a local road and pedestrian/bicycle network that safely and efficiently connects facilities with neighborhoods. As a focus of suburban transit service, transit centers should be located to best serve travel patterns and minimize trip length. Conditions of success include the development of the transit center as part of a coordinated land use and transportation strategy which has the support of the local community. Transit centers should be safe and clean<sup>12</sup>.

In many suburban areas, as exist in New Castle County, there is no one location which will be in walking distance of a large population. In this case Park and Rides can provide a simpler and less expensive form of transit center. Shelter is not necessary since riders can wait in the comfort of their own cars. If and when ridership increases, or the area becomes more developed, additional facilities and infrastructure can be added.

#### *Express Service and Limited Routes*

Express bus service generally consists of long-haul, moderate to high speed routes with few stops. With less stops, limited access highways can be used. Application is best suited to trips of at least 30 minutes on the express bus itself, and only where the in-bus travel time can be competitive with the auto. Express buses do provide distribution and collection at the work trip end but most of the time must be spent in express operation. Corridor enhancement and service of high density origins to high density destinations are the two general applications among suburban operations. Corridors need to be densely developed with both significant numbers of residents and activity centers. Case study examples operate from Park and Rides and serve major suburban sites. Speed, reliability, and comfort are key determinants of the success of these services, along with pricing and availability<sup>13</sup>. Success is promoted when there are congestion

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<sup>12</sup> TCRP B-6, pgs 30,31.

<sup>13</sup> TCRP B-6, 32, 39-40

and parking fees, high density destinations, reasonably populated residential marketsheds, supportive local and regional planning, and transit dependent populations.

### *Local Area Circulators and Shuttles*

Circulators are most often designed to supplement or substitute for line haul services, where line haul routes may be impractical due to street patterns, terrain, densities, or operating cost. Developed to connect key activity centers and trip generators to bus network, circulators provide the missing link<sup>14</sup>. There are three types of local circulators: fixed route circulators (service routes), route deviation services, and demand response (dial a ride). An example of a fixed route circulator in New Castle County is the Wilmington Down Towner Bus Line, which circulates the center portions of the City of Wilmington with connections to the Wilmington train station. Circulator effectiveness is greatest where there is a high population density, a mixed land use, high service level, low operating cost and fare, and good connections to regional bus or rail systems.

Route deviation allows for more flexible routing than fixed route. Passengers can board buses at designated stops or can call a dispatcher to request a pick up off route. Buses will also drop passengers off of the route. Time must be allowed in the route schedule to allow for these deviations, which can sometimes be a problem.

General public demand response service has a history of large subsidies and unsuccessful ventures. In order to succeed dial-a-ride (DAR) services need to be focused with tightly defined territories and guidelines which help create cost-effective runs<sup>15</sup>. Public DAR has worked best where it has functioned as a shuttle to mainline rail, airport, and bus services. Use of new technologies for real time scheduling, service to a dependent population, and focus on realistic goals and objectives contribute to effectiveness of this strategy<sup>16</sup>.

Shuttle services provide tailored high quality connecting services between major activity centers or transit facilities. Shuttle services as currently identified in case studies can be categorized by trip purpose; rail station to employment center, residence to transit station, or

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<sup>14</sup> IBID, pg. 44

<sup>15</sup> IBID, pg. 65

<sup>16</sup> IBID, pgs 70,71

midday employee shuttles. Shuttle programs have to be carefully designed and tailored to the niche markets they serve to be effective. Routes need to be carefully designed. Where shuttles provide connection to rail or other transit services timed transfers should be used to minimize wait times. As with other low ridership services, costs must be kept down either by the use of contractors, partnership with the private sector, or other means.<sup>17</sup>

### *Subscription Buses and Van Pools*

Where large numbers of individuals share common hours of travel and common origins and destinations, subscription buses and van pools can be an effective form of suburban transit. Often employers or other organization will assist in sponsoring a portion of the costs. Sponsors contract for the service with an operator at a set rate, and offset that rate through fares collected from subscribers. Successful implementation requires low operating costs, and an accurate estimate of the size of the market. Transit agencies must communicate with the market population to ensure interest and needs. Subscription buses and van pools should be competitive with the auto in comfort, convenience, and travel times. Emergency or guaranteed ride home are also important features.<sup>18</sup>

A number of transit properties offer van pool services, most of which focus on suburban commutation to large employment centers. Seattle Metro in 1993, operated over 500 vans. The average publicly supported van pool in 1993 recovered an estimated 60 % of costs through fares. PACE, the suburban bus division of the Regional Transportation Authority in Chicago have established van pool incentive programs. The service provides passenger vans to small groups (5 to 15 people) for commuting. About 170 vans are in use and are cited as recovering more than 100 percent of their operating costs<sup>19</sup>.

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<sup>17</sup> IBID, pg. 73

<sup>18</sup> IBID, pgs 98-101

<sup>19</sup> TCRP Synthesis 14, pg. 8



## *Planning for Suburban Transit*

The development of suburban transit facilities is typically an after thought once housing developments and roads are built. Retrofitting is expensive and often sacrifices functionality. The development of suburban land use strategies is a way of promoting future transit systems and use. Land use strategies include: 1) development transit supportive design guidelines, 2) promotion of transit oriented development 3) regional growth management. Transit oriented development supports transit by facilitating local travel and by providing a high level of connection to outside transportation facilities and destinations. Regional planning focuses infrastructure investments and development patterns which makes transit service to the localities more viable. In some parts of the country programs are undertaken which educate planners, developers, and the public in the features of transit oriented development. A 1993 national survey found that about 25% of U.S. transit agencies have some form of transit-supportive design guidelines<sup>20</sup>.

High levels of transit use are supported by urban densities having a limited number of significant employment centers in the region that generate bi-directional flows on the transit system. Employment and residences should be concentrated in transit corridors, with particular attention given to locating residents near stations linked to employment centers. Transit patronage is best served by station area development of the following character<sup>21</sup>:

- Designs of stations to relate entrances as directly as possible to adjoining uses and neighborhoods.
- Densities within a half mile of station areas that approach 7 to 12 residential units per acre and 50 or more employees per acre, with lower but still substantial densities as far as one mile from stations.
- Designs of areas and buildings that promote pedestrian movements between uses and between stations and adjoining areas.
- Mixes of activities that allow satisfaction within a walkable distance from stations.
- Policies that reduce incentives for parking, including lowering of multiple needs parking requirements, increasing parking costs, and provision of bicycle paths and storage facilities.

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<sup>20</sup> TCRP B-6, pg. 20

<sup>21</sup> TCRP Synthesis 20, Transit-Focused Development, TRB 1997.

### ***2.3 Conclusions***

In regards to transit service in the suburbs;

- A distinguishing feature of the more successful suburban transit services has been the service of hubs. Moderate to low density and diverse origin-destination patterns require that services be focused so that diverse trip patterns can be concentrated. Park and Rides and transit centers are the most appropriate approach to serving low density areas.
- Transit success requires a detailed knowledge of travel patterns and customer needs and preferences. Services must be designed to fit those needs. Transit agencies will need to collect and manage market information in an efficient and effective manner.
- Costs must be kept down. Support of the community and the private sector is vital.
- Transit investments in suburban areas will have much lower returns than in urban settings.
- Realistic goals, objectives, and standards must be established.
- It would seem that from the users perspective time costs are the dominant issue for workable suburban service.

## Chapter 3, A More Detailed Look At Potential Transit Markets

### 3.1 Journey to Work at the Neighborhood Level

For a more detailed view of transit markets and potential routing opportunities, Northern New Castle County was divided into to a number of local neighborhoods based on a knowledge of neighborhood character, land use, and orientation to the transportation network. These new local “Places” were given familiar names and are shown in Figures 4 and 5. Each Place is made up of one to four traffic zones.

Total workers and transit share for the journey to work was tabulated from aggregations of DELDOT Traffic Zones for the largest 50 origins and 25 destinations using the data from the 1990 CTPP. As seen when the data was viewed at the Census County Division level, the greatest share of transit riders all involve Wilmington as a destination. Table 7 shows where transit is most successful. Higher density and lower income areas are represented in Table 7,

**Table 7, Total workers greater than 200 and share 10% or more**

ORIGIN	DESTINATION	WORKERS	RIDERS	TRANSIT SHARE %
Upper Washington St.	Wilmington	593	60	10
Washington St.	East of Newark	241	24	10
West Newark	Wilmington	404	39	10
Arden Area	Wilmington	365	40	11
Newport	Wilmington	633	68	11
West Pike Creek	Wilmington	897	110	12
Maryland Ave	Wilmington	462	55	12
DuPont CC / 202	Wilmington	390	46	12
West Wilmington	Wilmington	995	116	12
Delaware Ave	Wilmington	1205	160	13
Washington St.	Delaware Ave	412	52	13
Elsmere	Wilmington	641	90	14
Brandywine Twn Cntr	Wilmington	273	39	14
Browntown	Wilmington	875	124	14
City of New Castle	Wilmington	325	49	15
East Naamons	Wilmington	522	83	16
Bellevue	Wilmington	1230	224	18
S.Silverside/E.202	Wilmington	225	41	18
Minquedale	Wilmington	794	151	19
Washington St.	Wilmington	1886	370	20
North East Blvd.	Wilmington	950	253	27

but there are some lower density, more affluent areas which show a good transit share such as West Pike Creek, Arden, DuPont Country Club/ Rt202, and S.Silverside / Rt.202. Areas where transit share is between 5 and 10% mostly serve Wilmington also (see Table 8).

Figure 4, Origins for local areas in New Castle County

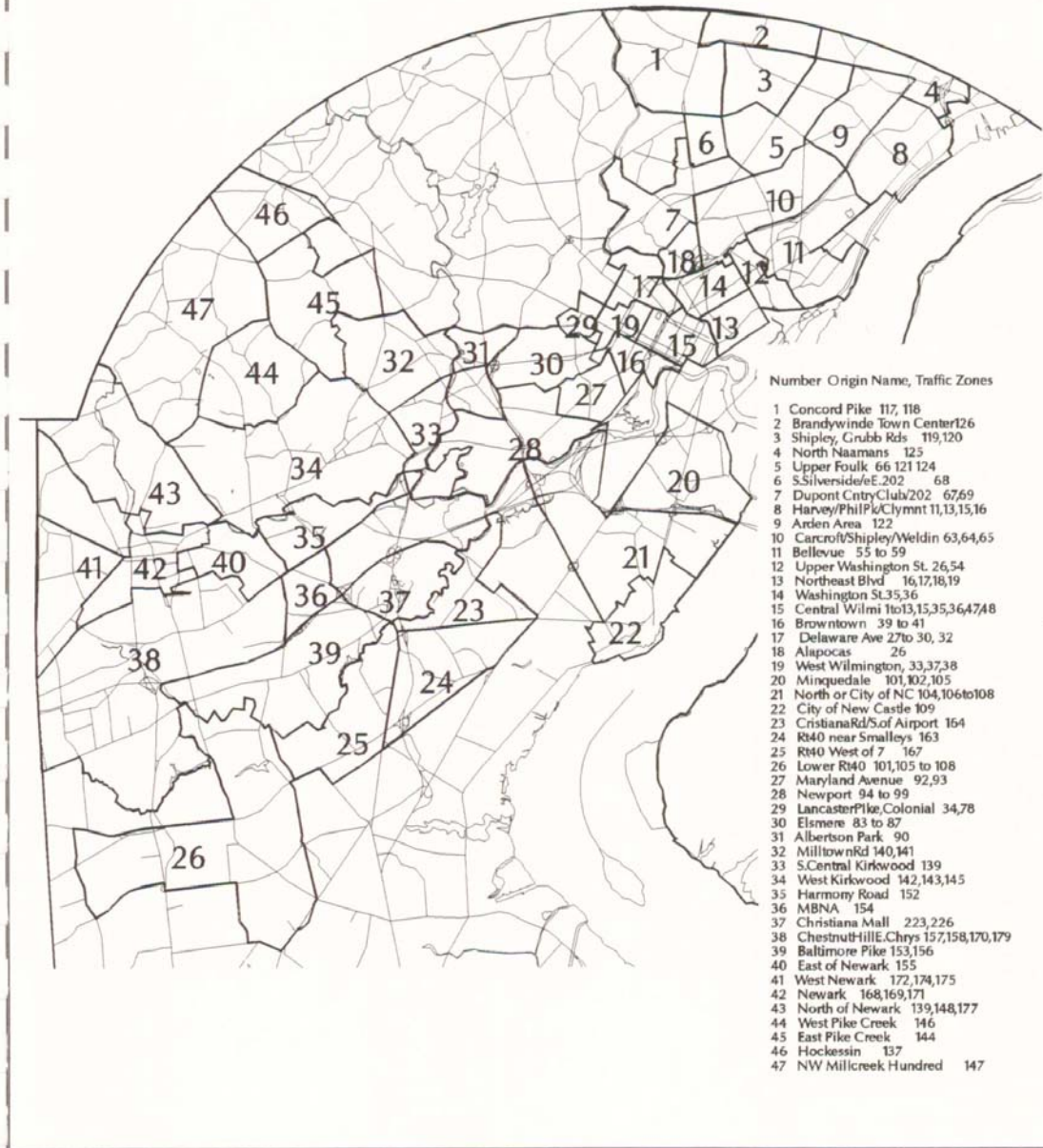
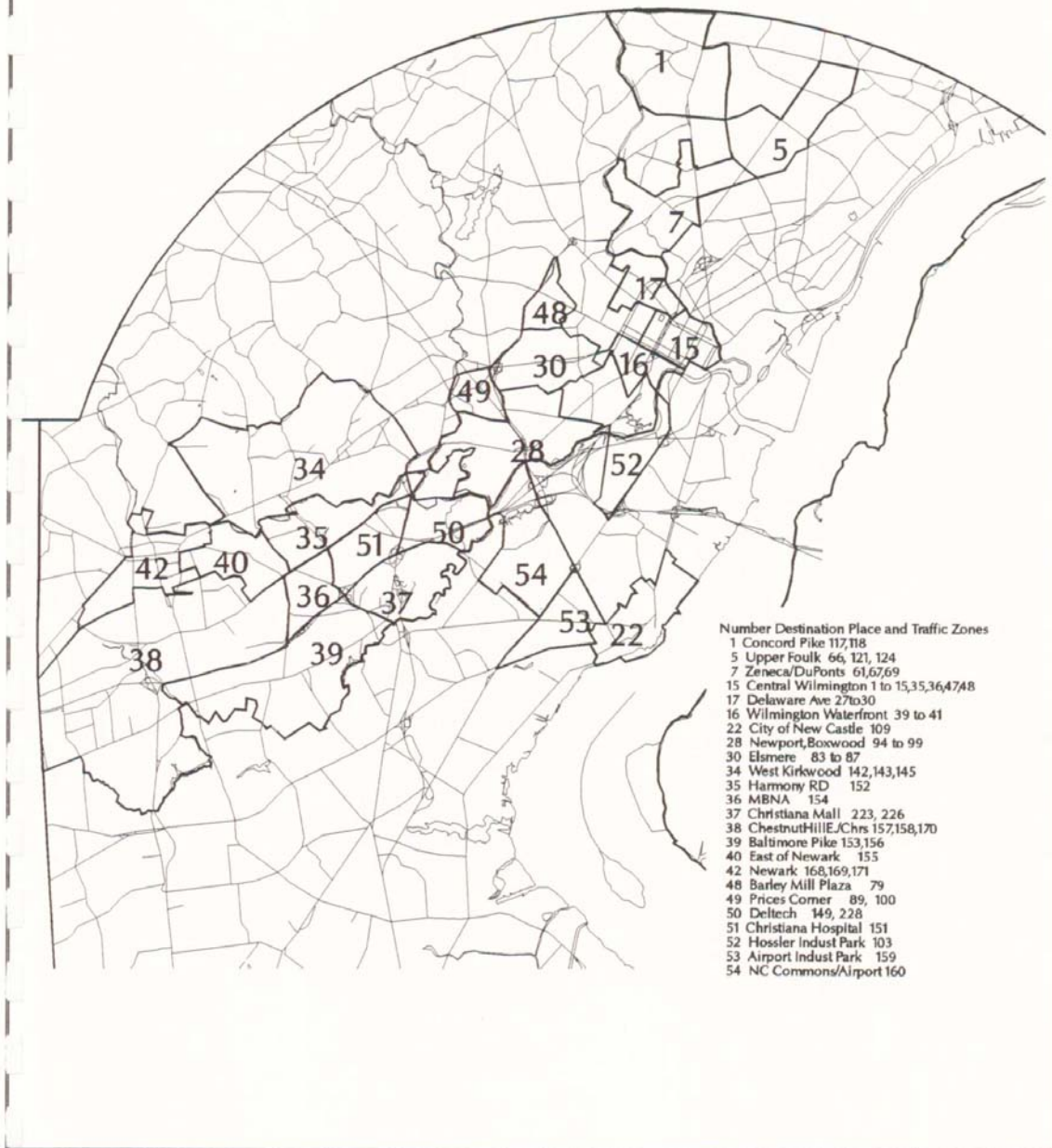


Figure 5, Destinations for local areas in New Castle County



**Table 8, Total workers greater than 200 and 5% <= share < 10%**

ORIGIN	DESTINATION	WORKERS	RIDERS	TRANSIT SHARE
Elsmere	Christiana Mall	216	14	6
Concord Pike	Wilmington	218	15	7
Central Wilmington	West Wilmington	219	15	7
Washington Street	West Wilmington	222	21	9
Washington Street	Newport/Boxwood	231	19	8
Christiana Mall	Wilmington	254	12	5
LancastePk/ColHghts	Wilmington	340	22	6
MBNA	Wilmington	445	24	5
ChristianaRD/S.Arprt	Wilmington	483	27	6
NW Millcreek Hund.	Wilmington	502	33	7
Shipley/Grubb Rds.	Wilmington	503	23	5
Upper Foulk	Wilmington	598	52	9
East Pike Creek	Wilmington	730	41	9
Harvey/PhilPK/Claymnt	Wilmington	970	67	7
Rt.40 near Smalleys	Wilmington	1054	76	7
Chestnut Hill E./Chry	Wilmington	1085	93	9
North of City of NC	Wilmington	1155	77	7
Central Wilmington	Wilmington	3185	271	9

**Table 9 Total workers ge 300 and share lt 5%**

ORIGIN	DESTINATION	WORKERS	BUS	SHARE (%)
Sth.Central Kirkwood	Wilmington	303	11	4
W.Kirkwood	Barley Mill Plaza	303	0	0
North of City of NC	Harmony Road	307	0	0
Harmony Road	Newark	309	0	0
Albertson Park	Wilmington	316	7	2
North of City of NC	Newark	318	0	0
Chestnut Hill E./Chry	Newport/Boxwood	321	0	0
West Kirkwood	Elsmere	326	0	0
Hockessin	Wilmington	329	11	3
Newark	East of Newark	330	9	3
Chestnut Hill E./Chry	West Kirkwood Hy.	340	0	0
West Kirkwood	Christiana Mall	342	0	0
North of City of NC	Newport/Boxwood	347	0	0
Upper Foulk	Zeneca/DuPont	352	0	0
Chestnut Hill E.	Harmony Road	352	0	0
Chestnut Hill E.	Zeneca/DuPont	353	0	0
Harvey/PhilPk/Clymnt	Zeneca/DuPont	354	0	0
Chestnut Hill E.	MBNA	384	0	0
North of City of NC	City of New Castle	395	0	0
West Kirkwood	Newport/Boxwood	405	0	0
Delaware Ave	Delaware Avenue	426	11	3
North of City of NCC	Airport Indust Park	430	0	0
Newport	Newport/Boxwood	489	2	0
North of City of NCC	NC Commons/Airprt	503	9	2
Elsmere	Elsmere	504	4	1
Chestnut Hill E./Chry	East of Newark	512	7	1
West Kirkwood	Zeneca/DuPont	526	0	0
Rt.40 West of Rt 7	Wilmington	527	0	0
North of Newark	Newark	542	22	4
Lower Rt. 40	East of Newark	557	0	0
West Wilmington	West Wilmington	560	0	0
West Kirkwood	West Kirkwood	568	0	0
Baltimore Pike	Wilmington	597	8	1
Lower Rt.40	Wilmington	614	11	2
Milltown Road	Wilmington	679	23	3
ChestnutHillE.Chry	ChestnutHillE.Chry	706	0	0
WestKirkwood	Newark	918	12	1
West of Newark	Newark	1322	42	3
West Kirkwood	Wilmington	1559	67	4
ChestnutHillE.Chry	Newark	1865	0	0
Newark	Newark	1878	60	3

Candidates for new or improved service would be those travel patterns where there was a large number of workers traveling from particular origins and destinations, and where transit service was very low, as shown in Table 9.

An illustrative way of viewing New Castle County journey to work patterns is as a origin/destination table as shown in Table 10. Numbers are shown for all pairs which involve 70 or more workers. The Wilmington Central Business District is the largest destination for almost all origins. Many of the OD pairs which involve larger numbers of workers are where the origin area and destination area are the same, or nearby. 1990 CTPP figures indicate that in New Castle County, 48% of workers live less than 20 minutes from work and many of the OD pairs in Table 10 reflect this proximity. Not only are the origins spread at low densities across New Castle County, but the bulk of the employment is also distributed across more than two dozen locations. Another indication of diverse origins and destinations is that the numbers shown in Table 10, in total, represent only about 50% of the journey to work trips for those who live and work in New Castle County. About 25% of the journey to work is spread in small numbers involving origins / destination pairs not shown in Table 10.

A view of how journey to work origin destination pairs can be examined in relation to the transportation network is shown in Figure 6. In this view, a probable travel path for each origin/destination pair is shown for those pairs which involve more than 200 workers. The location of peak demand on transportation corridors is clearly visible.

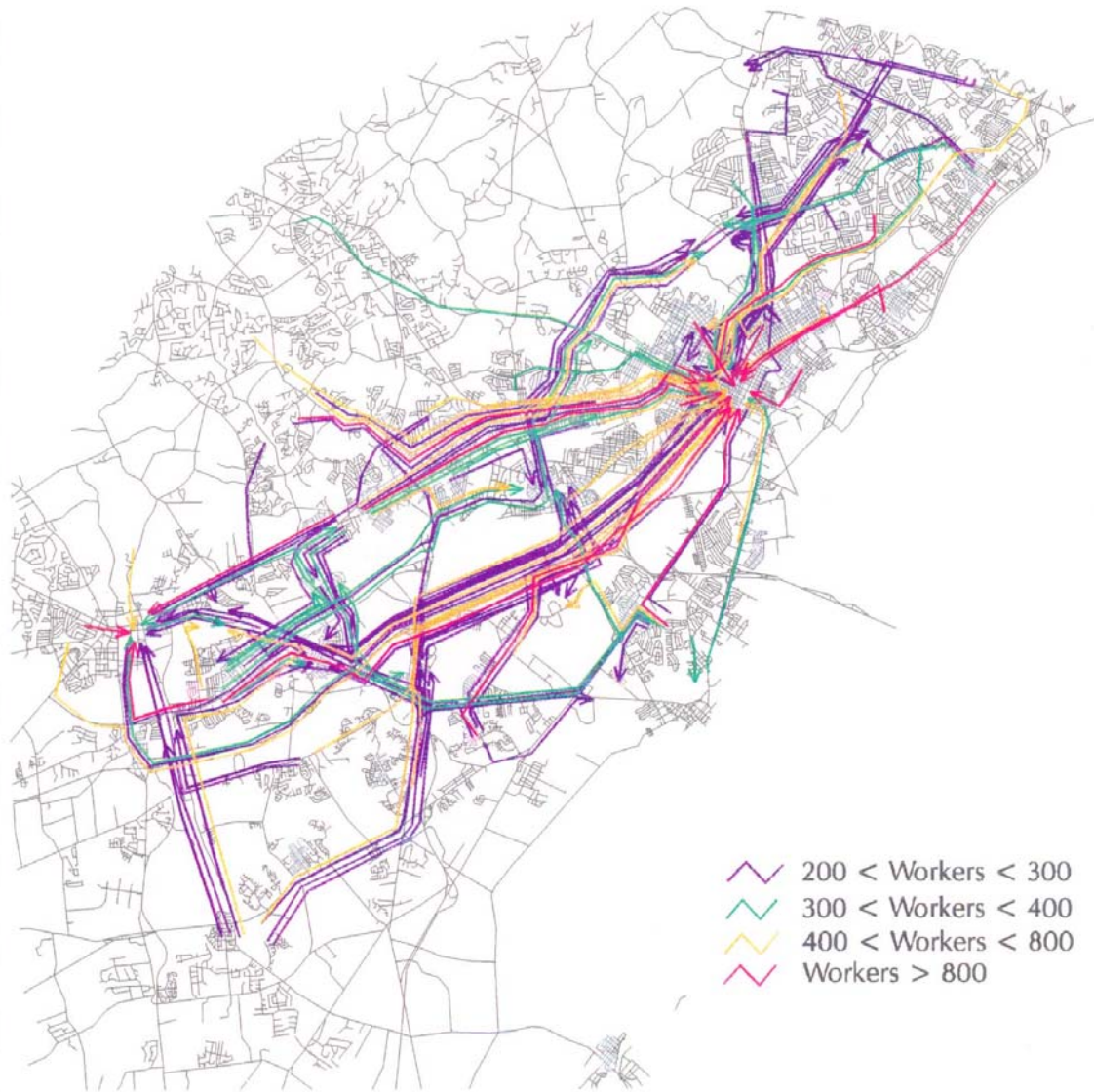
With the exception of locations in Wilmington and Newark, there are no high density to high density OD pairs which would be strong candidates for express routing in the absence of some type of complementary local collection strategy. Origins of particular interest from Table 10 are; areas north of the City of New Castle, West Kirkwood Highway, areas along Route 40, and Chestnut Hill Road south of Newark. Major destinations in addition to Wilmington are; Dupont/Zeneca, Newport, areas around Christiana Mall and MBNA facilities, Newark, and East of Newark.

Origin and destination information at the level offered by the 1990 CTPP provides a very informative view of travel patterns and focuses investigations for enhanced or new transit





Figure 6, Paths For Origin/Destination Pairs With > 200 Workers



service. While the data is now 6 years old it is suspected that many of the travel patterns are similar. One major difference is that in 1990, transit service did not exist in the Route 40 corridor. Transit lines introduced in the Route 40 corridor have been fairly successful. When updated traffic zone to traffic zone estimates are available from DELDOT travel demand forecasting models, 1990 CTPP figures can be compared to current travel pattern estimates. Origin / destination tables such as Table 10 summarize travel patterns and point to where transit markets may be. Identifying and successfully serving new transit markets will rely heavily on up to date and detailed information about suburban markets, and through surveys and modeling efforts, origin / destination tables should be produced for each trip purpose.

### ***3.2 Service Within Local Neighborhoods***

Based on the number of workers, transit share, and research interests, a few of these local places shown in Table 10 were selected for further study. The places selected were West Pike Creek\*, West Kirkwood Highway, Chestnut Hill Road south of Newark, and the area North of the City of New Castle. These areas were the subject of a very detailed approach to understanding and quantifying the travel market and the relation to transit and transportation facilities at the subdivision road and tax parcel levels. The analysis will be discussed using tables and figures for West Kirkwood and West Pike Creek areas. Similar tables and figures are available for the other study areas in the Appendix.

The tax parcel distributions for West Kirkwood are shown in relation to Winter 1996 ridership in figure 7, and in relation to Spring 1992 land use in figure 8. Travel demand was represented primarily by the number of housing units which could be assigned to each tax parcel. This demand was then assigned to the nearest point on a geographic information system model of the suburban transportation network. The ability to further describe housing units was accomplished by classifying them by housing type and associating them with 1990 Census Blocks.

Resource location and allocation models were used to view the location and relative size of demand centers, and to determine the amount of demand which could be accessible to proposed or existing bus stops. Demand centers were determined using a maximum coverage

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\* Pike Creek West and West Kirkwood were combined and analyzed together.

allocation algorithm.\* The objective of this algorithm is usually to maximize the population covered within a desired distance or time threshold by locating a fixed number of facilities. It answers questions such as; “Given a required response time, what is the fewest number of facilities required to cover everyone?” or “What is the trade-off between the number of facilities and the amount of coverage?”. The algorithm was used in this research to locate demand centers within suburban areas, and to determine the population which was in walking or biking distance of proposed or existing transit stops or stations.

Demand is considered to be covered by a bus stop or station if it is within the distance or time threshold of where the demand is assigned to the road network. The distance which could be covered in 6 minute walk as measured along the curvilinear path of the local road network was the threshold which defined accessibility to transit facilities by walking. Six minutes was used for ease of calculations, and because at an assumed walking speed of 3 miles per hour the corresponding distance is 0.3 miles, which is fairly close to the ¼ mile distance typically used. Access to proposed stations by a six minute bicycle ride was also studied with a distance of 1.2 miles (bike speed of 12 mph). Six minutes for a bike access is a distance assumed not to require an exertion beyond most people’s ability and would not require a change of clothes\*\*. Walking and bicycling distances were measured on a road network model which was a combination of the DELDOT Centerline File, DELDOT TRANPLAN Travel Demand Forecasting (TDF) Model, and enhancements by the Center for Applied Demography and Survey Research (CADSR).

Figures 9 thru 12 show the results of applying location algorithms to determine housing unit demand centers for the areas under study. The same algorithms were used to determine the number of housing units which were within walking distance of DART First State Bus Stops. The results show that a large percentage of housing units in each area are not in walking distance of bus stops (see table 11) .

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\* In the literature this is called the maximal covering location problem (MCLP) and several references are in the bibliography of this report.

\*\* The Netherlands is known for its alternative transportation facilities and the number of people using bicycles for commuting. When Professor Bach from the University of Delft in the Netherlands presented a talk on bicycle facilities in Holland, at the University of Delaware and was asked how far people generally biked in each trip, his response was “about 2 kilometers” (1.25 miles). Travel share by bicycle was reported to drop off quickly once trip length demanded a further distance

Figure 7, Tax parcel distributions in relation to Winter 1996 Ride Check.

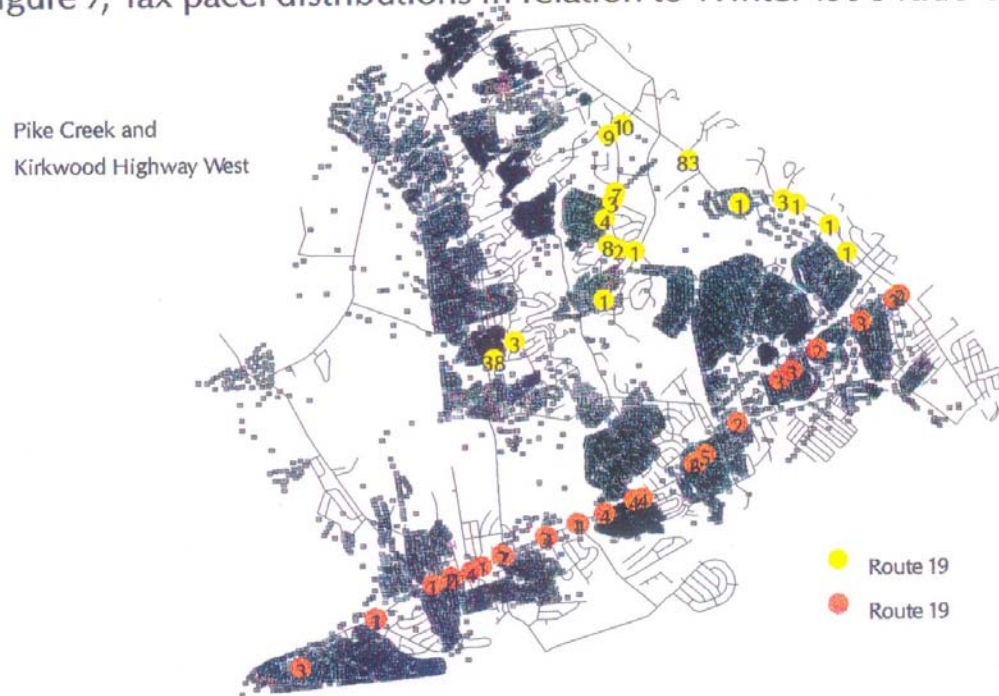


Figure 8, Tax parcel distributions in relation to Spring 1992 land use.

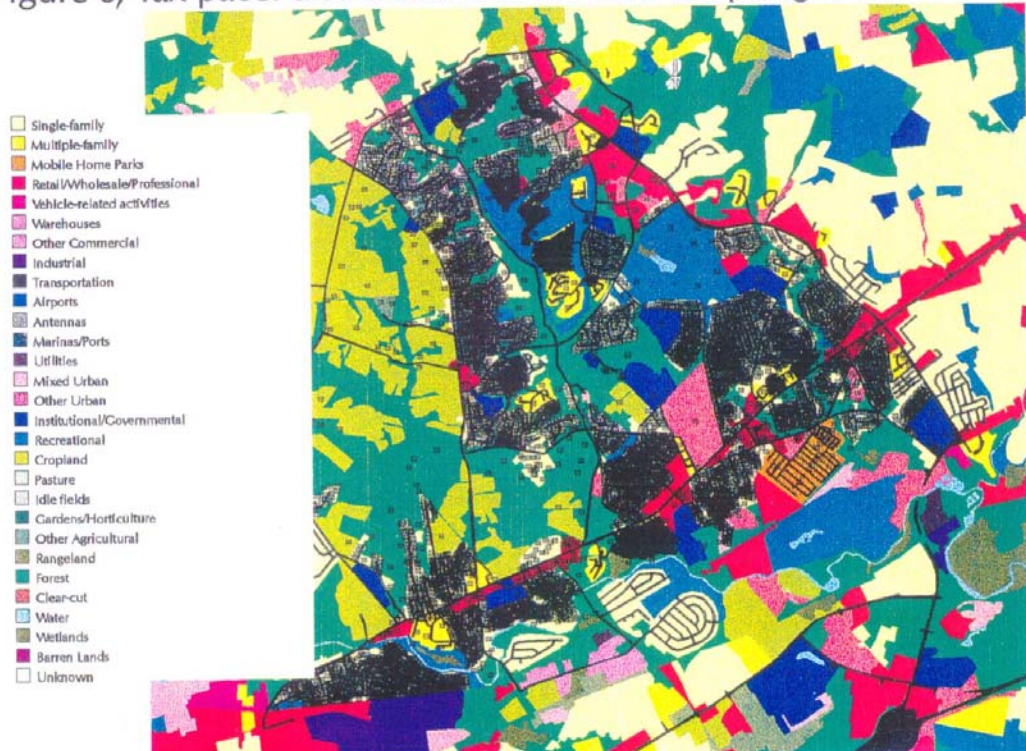




Figure 9, Concentrations of Housing Units, Pike Creek/Kirkwood.



Figure 10, Housing units within a 6 minute walk of bus stops.



Figure 11, Estimated concentrations of housing units, destination Wilmington.



Figure 12, Estimated housing units near bus stops, destination Wilmington.



**Table 11, Summary of local areas under study.**

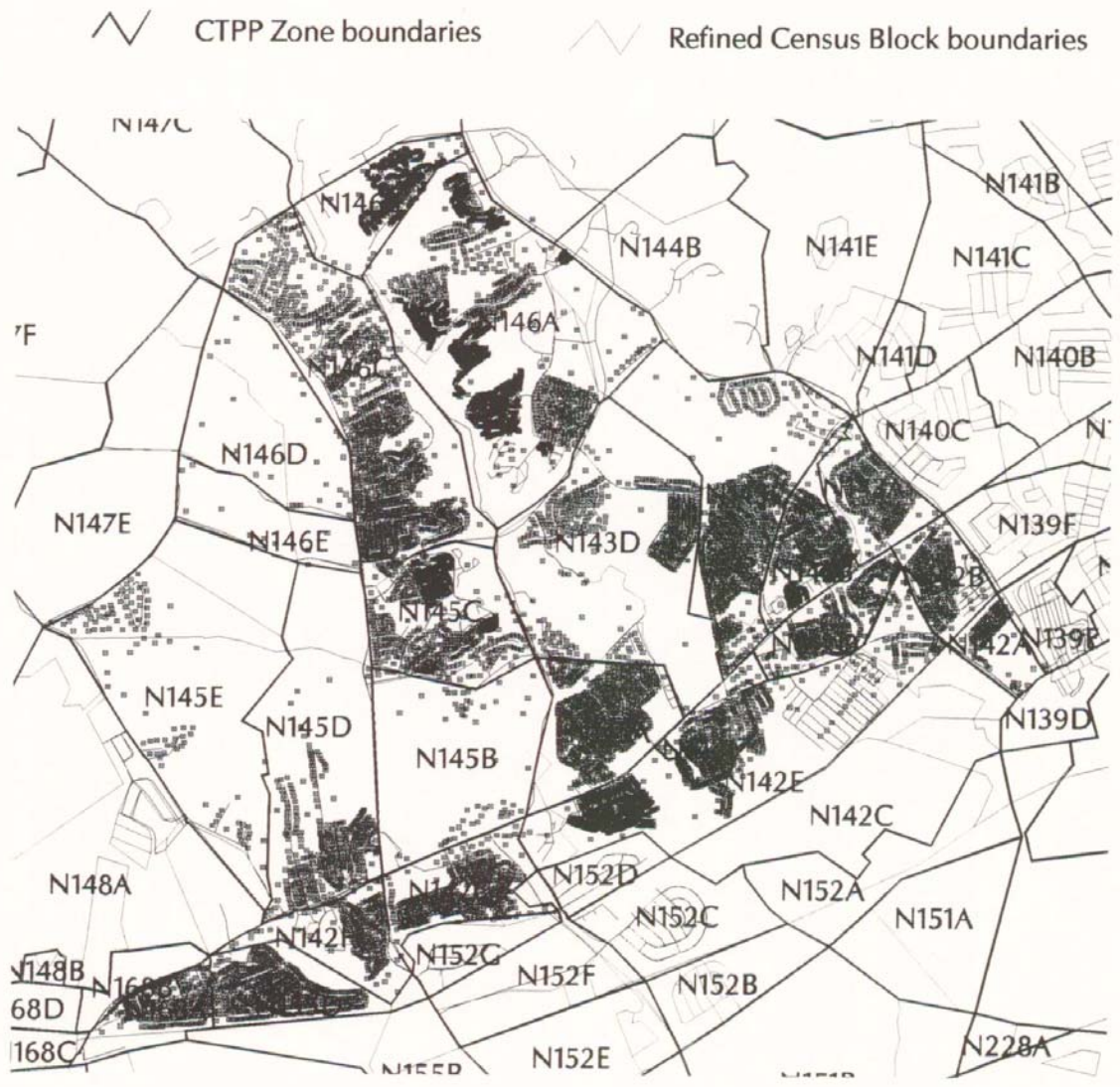
Study Area	Housing Single		MultiFamily	Mobile	HU/acre	HU Walk	Workers	Morning
	Units (HU)	Family HU	HU	Home HU				
West Kirkwood and Pike Creek West	12,759	8,870	2,998	891	1.7	43%	14,253	216
Chestnut Hill Road East	10,203	8,006	1,880	317	1.6	32%	15,685	291
North of the City of New Castle	7,177	6217	960	0	2.2	66%	7,554	191

To use the same algorithms to view demand centers relative to a particular destination, it is necessary to associate a probability of traveling to a particular destination with each housing unit. Places such as West Kirkwood Highway represent relatively large suburban areas. They are comprised of one or more DELDOT traffic zones and several CTPP zones. Travel to a particular destination is not distributed evenly. The CTPP zones for the West Kirkwood Highway area are shown in Figure 13. The CTPP journey to work data provides estimates at the CTPP zone level for various destinations. The fraction of demand for

**Table 12, Factors used to allocate travel demand within CTPP zones, Kirkwood, Pike Creek**

Wilm	Zeneca	Newark	New Castle	Chrst Mall	Foulk	CTPP	Workers
0.30	0.13	0.13	0.00	0.00	0.00	N145B	40
0.00	0.00	0.00	0.16	0.21	0.00	N142C	68
0.17	0.00	0.19	0.15	0.08	0.00	N145E	103
0.60	0.00	0.00	0.00	0.00	0.00	N142A	108
0.24	0.02	0.00	0.14	0.05	0.03	N143A	246
0.05	0.05	0.25	0.02	0.14	0.00	N168A	298
0.18	0.08	0.06	0.08	0.06	0.04	N142F	367
0.20	0.08	0.00	0.14	0.04	0.05	N142D	452
0.15	0.08	0.09	0.11	0.02	0.04	N145D	456
0.16	0.05	0.06	0.08	0.14	0.03	N143D	622
0.21	0.03	0.19	0.03	0.11	0.00	N155D	628
0.16	0.10	0.11	0.15	0.08	0.01	N142G	733
0.23	0.08	0.04	0.04	0.10	0.03	N143B	795
0.24	0.08	0.06	0.05	0.08	0.01	N143C	837
0.19	0.10	0.08	0.04	0.16	0.03	N142B	841
0.25	0.08	0.06	0.05	0.07	0.02	N145A	1021
0.10	0.04	0.12	0.05	0.10	0.03	N142H	1356
0.16	0.10	0.13	0.04	0.07	0.02	N145C	1665
0.14	0.06	0.08	0.05	0.09	0.02	N142E	1705

Figure 13, CTPP zones in Pike Creek and Kirkwood Highway areas.





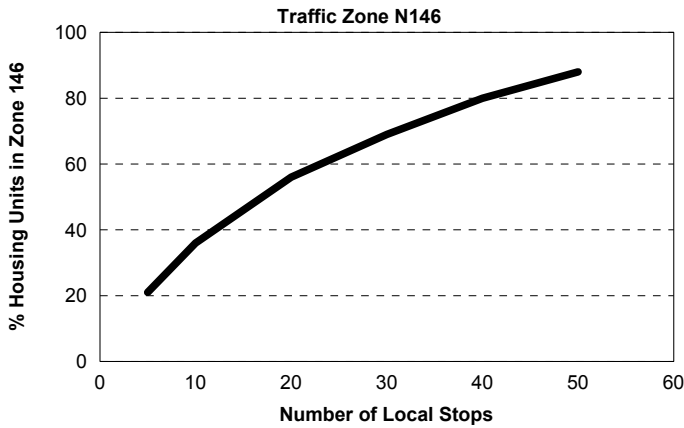
each destination by each CTPP zone was tabulated as shown in Table 12. These factors were then multiplied by the housing unit demand for each tax parcel within each CTPP zone to distribute the travel demand for a particular location among the housing units within the CTPP zone.

The factors shown in Table 12 themselves speak to the demand density with respect to particular destinations. For example, if only 5% of the workers in a CTPP zone travel to a particular destination and there are, say 500 workers in the CTPP zone, then there are 25 workers which you are trying to reach. If 20% of those 25 workers will consider transit use (a very high percentage) then you are left with designing a routing strategy and bus stop locations which will meet the needs of 5 workers. Some of these 5 may not be within walking distance of a current bus stop and circulating the zone could take 10 minutes, resulting in low or no ridership, or long travel times and high subsidies per passenger trip.

As described, the allocation of demand for particular destinations within the local areas is done so that housing units within a CTPP zone have an equal probability for generating a trip to a particular destination. This allocation is more justified in a homogeneous CTPP zones involving a large number of workers, but within a zone which involves a number of different types and values of housing, the distribution of demand with respect to a particular destination will not be uniform. Employers do not employ an even socioeconomic mix of people and this will be reflected in their housing distribution. The procedures described primarily illustrate how in general, low density and diverse origins make transit service difficult. Analyzing a market at the subdivision level requires more information.

Optimum routing algorithms were applied to better understand the effect of locating transit stops near housing or demand centers. The time necessary to travel to reach various numbers of stops was calculated to investigate the viability of collecting passengers within suburban areas as the initial phase of a route. Figures 14 and 15 below show the result of this analysis for the area designated as Pike Creek West (Traffic Zone 146). The estimated time to visit 5 to 10 of the top housing centers in this zone before going onto the express portion of the route is about 30 minutes. If this were the first phase of a bus route to Wilmington the trip could take almost twice as long for transit riders as taking a personal vehicle, and then only about 30 percent of the zone would be within walking distance of bus stops.

**Figure 14**  
**% "Housing Units" Within 6 Minute Walk vs.**  
**Number of Local Stops**



\* Assumes Walking Speed of 2 MPH

DRAFT Jan 1997

**Figure 15**  
**Demand Reached and Collector Miles Traveled**  
**By Number of Local Stops in Traffic Zone N146**

Number of Stops	Housing Units Within 6 Min. Walk	Circuit Miles	Circuit Travel Time*
5	950	11.9	28 minutes + stop time
10	1750	14.3	34 minutes +
20	2650	19.9	48 minutes +
30	3300	25.2	60 minutes +
40	3800	30.6	73 minutes +
50	4200	34.1	82 minutes +

\* Assumes Avg. Speed of 25MPH

Circuit Includes Stops at Poly Drummand Shopping Center and Pike Creek Office Campus (PR)

### 3.3 Conclusions

Subject to how well 1990 CTPP data reflects current conditions the following conclusions can be drawn.

- Central Wilmington is the largest single destination for most origins.
- With the exception of locations within Wilmington and Newark, there are no high density to high density OD pairs which would be strong candidates for express routing in the absence of an effective local collection strategy.
- A large percentage (34% to 68%) of housing units in the suburban areas studied were not within walking distance of bus stops located on adjoining major roads.
- Most of the origin destination pairs involving 200 or more workers involve travel times of 25 minutes or less.
- The journey to work involves a number of diverse origins and destinations with traffic flows mostly unidirectional on transportation corridors.
- There are large areas in New Castle County which are served very little including; West Kirkwood, Chestnut Hill Road East, Milltown Road, and North of the City of New Castle. Transit is used very little to reach suburban destinations involving thousands of workers including; Zeneca/Dupont, East of Newark, and Newport/Boxwood.
- Transit ridership in the New Castle County suburbs tends to be near commercial areas and at park and rides.
- Fixed feeder routes designed to reach population within suburban developments will involve high service costs and long trips relative to use of the personal auto.
- Enhancements to the current transit system or new service in New Castle County will have to better address the suburban market. Serving suburban populations requires an intensive study of their needs, and it is important to support programs to continually gather data on travel patterns and monitor service. Collection of up to date market data such as origin / destination information is necessary to formulate and prioritize transit improvements.
- At the suburban development level this project has shown that use of tax parcel data, DELDOT road network representations of suburban roads, and location / allocation and routing models, can be effectively employed to illustrate and quantify access to transit systems and travel demand. The effects of diverse origins and destinations and low suburban densities on the extent that transit systems can meet travel needs is

clearly illustrated. The approach can provide measures of access by walking, biking, or motor vehicle, and can be used to study the effects of additions or improvements to access paths. By using tax parcel data, markets can be more clearly described and has potential to support focused marketing initiatives. Impacts of proposed developments can be appropriately addressed at the tax parcel level.

## **Chapter 4, Where Efforts To Improve Transit Should Be Focused**

Previous chapters examined travel patterns in New Castle County and current transit service to determine where opportunities are for enhancing or adding transit service. In the context of goals for transit and future trends in New Castle County, this chapter identifies more specifically where transit efforts should be focused.

### ***4.1 Future Trends in New Castle County***

Residential location and land consumption trends as seen in the 1980 thru 1990 are expected to continue if no new land use regulations or growth management are in effect. The Central Pencador region is predicted to add 37,000 and MOT 15,000 to the expected population growth of 99,000 people by the year 2020. New residential densities are expected to be in the range of .5 to 1.5 dwelling units per acre. Typical design features include homogeneous uses, large lots and setbacks, wide streets, lack of connectivity in the street system, and few sidewalks. Land uses are of low density and are generally not mixed, forcing more frequent and longer vehicle trips, and isolating those without access to personal vehicles Current transportation improvements encourage sprawling development because the highways have improved access to outlying areas and shortened trip times between cities and suburbs.<sup>9</sup>

While transit usage has increased by 15% between 1990 and 1994, long range projections for transit share of trips in New Castle County are down from 9% in 1960 to 3% in 1990 to a predicted 1% by the year 2020 as a result of urban sprawl, suburbanization of employment, increase in non-work related trips, and other factors. New residential landuse and employment will be outside of the City of Wilmington and the bulk of the current transit market<sup>11</sup>. Not only are origins becoming more spread out but employment is suburbanizing as well.

There are a few expected trends which may encourage transit use. As roads become more congested, some may opt for transit to avoid the stress of driving. In the near term, construction on Interstate 95 may encourage travelers to use transit, particularly if access and service to the transit system are improved (i.e. park and rides).

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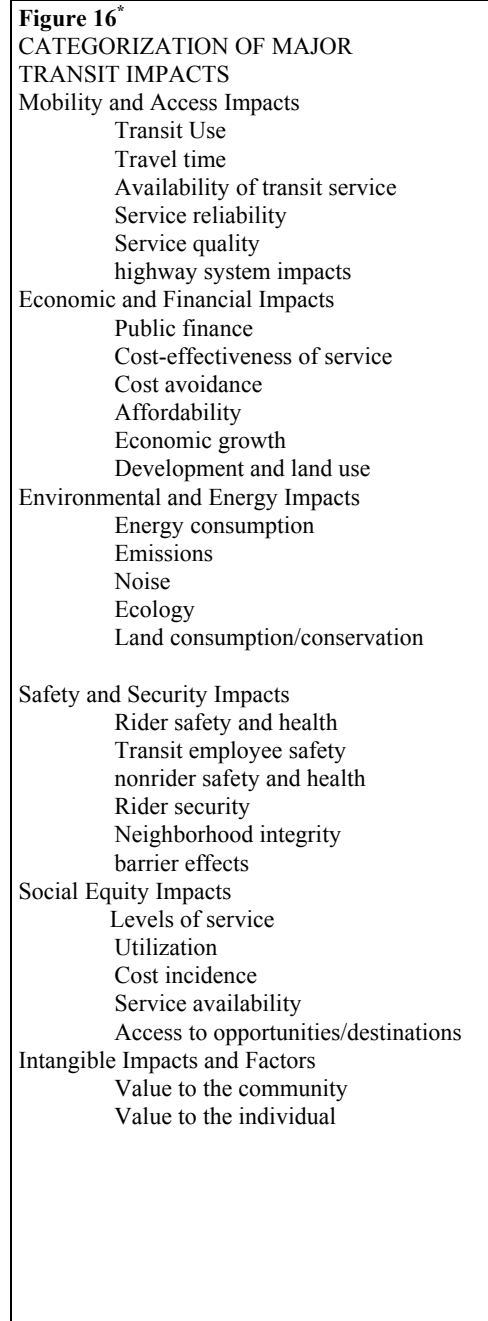
<sup>9</sup> WILMAPCO Metropolitan Transportation Plan (MTP), March 1996, pgs. 2-2, 4-6

#### 4.2 Goals for Transit

Current practice in defining transit goals is to focus on the operating characteristics and impacts of transit investments at the project or corridor level with most attention on the comparative impacts of continued reliance on automobile oriented investments and improvements. The most pronounced shortcoming in traditional analysis is the inability to quantify the full range of transit benefits that are referenced in policy and goal statements. Transit improvements like most transportation improvements are viewed primarily for their short term benefit. Questionable individual transit improvements and land use measures in the short term may be invaluable to a region over the long term, just as seemingly justifiable individual highway projects and improvements may have cumulative long term consequences that are undesirable and unsustainable.<sup>12</sup>

In Delaware, transit has been offered as a solution to minimizing congestion and air pollution as well as a way to improve mobility and accessibility. As part of a long range growth strategy for the region, WILMAPCO's Metropolitan Transportation Plan in the year 2020 in regards to Intra Regional trips calls for an additional 31,000 transit trips per day as a result of enhancements on existing services, an additional 31,000 transit trips per day as a result of new services, and 9,600 transit trips per day to maintain 1993 share. These approximately 71,000 new transit trips are approximately triple the current transit service which is about 23,000 trips per day.

Transit will account for 6% share of trips under the 2020 MTP. The WILMAPCO MTP also calls for an additional 54,000 car pool trips.



<sup>11</sup> WILMAPCO MTP, pg 4-11

\* Measuring and Valuing Transit Benefits and Disbenefits, TCRP Report 20, Transportation Research Board, pg. 5

**Table 13, Levels of service on road in metropolitan planning area. Current, projected, projected MTP.**

LOS	LOS Criteria V/C Ratio	%NCC Lane Miles Existing	% NCC Lane Miles Anticipated 2020	MPO AREA % Lane Mls. WILMAPCO MTP 2020
A	< 0.36	50%	42%	47%
B	0.36 TO 0.54	17%	15%	14%
C	0.55 TO 0.77	19%	16%	16%
D	0.78 TO 0.93	7%	9%	9%
E	0.94 TO 1.00	3%	5%	4%
F	> 1.00	3%	13%	11%

per day.<sup>13</sup> Tables 13 and 14 show estimated effects on Level of Service (LOS)<sup>14</sup> and Vehicle Miles Traveled (VMT) that successful implementation of the MTP would yield.

**Table 14, VMT in metropolitan planning area. Current, projected, transit improvement scenario, full MTP.**

VMT Current	VMT 2020MTP Scenario 2020 Do Nothing.	2020 MTP Transit Improvements	2020 MTP Full Program
10.82M	17.99M	17.09	16.77

### 4.3 Where To Focus Efforts

The research leads to conclusions concerning how transit efforts should be focused, as described below.

Providing transit service in an area like New Castle County involves subsidies for all transit routes. Reaching goals as described in the WILMAPCO MTP could be very expensive. DART First State current average cost per passenger trip is approximately \$2.50 with an average of 25% fare box recovery<sup>15</sup>. At approximately \$1.90 average subsidy per trip, the MTP goal of a total transit trips of 95,000 trips per day in 2020 (24,000 today plus and additional 71,000) would require a total subsidy of about \$180,000 per day. This essentially would be four times the current DART First State budget. Particularly with the decrease in federal support for transit systems, such resources may not be available. **To make significant gains toward maintaining**

<sup>12</sup> Measuring and Valuing Transit Benefits and Disbenefits, TCRP Report 20, Transportation Research Board, pgs. 4-5.

<sup>13</sup> WILMAPCO MTP, March 1996, pg 6-7.

<sup>14</sup> WILMAPCO MTP, March 1996, pg 5-44

<sup>15</sup> DART First State Documents for June 1996

**or increasing transit use, costs must be kept down and existing services must be more productive.**

New development has been at lower densities than in the past and this trend is expected to continue. Serving less dense areas will involve a greater subsidy. This research demonstrates that there are a number of moderately dense areas which currently have a low level of service and few people use transit. **The best opportunities for transit will involve service to existing development in New Castle County.** Areas with moderate to high density are in the vicinity of current DART routes.

Research which describes case studies of transit service to low density areas reveal that success depends on transit incentives, and reaching traditional markets. Parking costs in the City of Wilmington and congestion on major roads are the primary incentives to transit use in New Castle County. There are currently areas which contain a number of people who work in Wilmington and where few people use transit. These areas should be targeted first.

**Enhancements to the current system should focus on where transit incentives exist and toward increasing the productivity of the current system.**

Case studies reveal that suburban transit is more successful when it serves those who portions of the population which are more likely to use transit, such as those who are dependent on transit, or have lower incomes. As part of the research the demand for transit was modeled to identify factors which would indicate a greater probability for using transit. The number of workers traveling between each CTPP zone, the percent using transit, the percentage of households that had no vehicles, and demographic variables such as age, income, race, and others were used to develop a predictive model of transit share<sup>\*</sup>. In addition the transit routes as existed in 1990 were used to tabulate the type of service available between each possible origin/destination pair; no service, direct service, or service by way of a transfer. In this way a factor for level of service was incorporated into the model. **Income, and percentage of non-white population were 2 of the 3 most powerful factors in the model as expected. The single most powerful variable in the model was having direct service.**

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\* A discussion of the development of this model is available in the appendix.



Over the past decade there has been a tremendous growth in cross-town, circumferential trip making in most areas of the country due to road construction that allowed extensive growth in suburban employment. Incentives, such as guaranteed ride home programs, transit pass programs, and merchandise discounts would be important elements of any suburban to suburban service. These incentives would need to be supplemented by marketing on a route, corridor, and employer-by- employer basis. With no parking fees and relatively low congestion to most destinations, suburb to suburb travel in New Castle County is a difficult market for transit to penetrate. Also since the distance between most suburban origins and destinations is so short ( less than 20 minutes travel time ), any transit service must be as direct as possible. Within each suburban area, densities with regard to a particular suburban destination are so low that more innovative service such as subscription buses or van pools are more appropriate. Transit dependent populations should be identified. **A suburb to suburb route in New Castle County to be successful must include incentives, a service to fit the needs of customers, a substantial marketing effort, and support of employers.**

#### **4.4 Conclusions**

■ ***Minimize Costs.***

Contracted services, private sector support, and other measures which can keep costs down for marketing and operating routes should be employed. Efforts should be prioritized in terms of costs and benefits.

■ ***Focus on Service to Wilmington and Improving the Productivity of Current Routes***

Table 15 shows areas which have the largest numbers of workers and the least transit share. Table 8 in Chapter 3 lists origins for workers traveling to Wilmington with transit share between 5% and 10%.

ORIGIN	DESTINATION	WORKERS	TRANSIT SHARE (%)
East of Newark	Wilmington	205	4
Newark	Wilmington	259	3
Harmony Road	Wilmington	283	4
S. Central Kirkwood	Wilmington	303	4
Albertson Park	Wilmington	316	2
Hockessin	Wilmington	329	3
Baltimore Pike	Wilmington	597	1
Milltown Rd.	Wilmington	679	3
West Kirkwood	Wilmington	1559	4

Travel to Wilmington from outside of New Castle County represents a large market as shown in Table 16.

**Table 16 Journey to Wilmington from Outside New Castle County**

Place	Workers	Transit Share (%)
Cecil County	1277	3
New Jersey	1874	2.5
Delaware County	2463	0.4
Chester County	3168	0.8
Kent County	760	4.2

■ ***Examine possibilities to increase ridership for those traveling from Wilmington to the suburbs.***

In line with keeping costs down and making the system more productive would be to serve more of the market leaving Wilmington. CTPP Census County Division figures indicate that transit share of the journey to work from Wilmington to the suburbs is between 5 and 8 percent. This would be attributable to a high level of service, high population densities, and service to a lower income group which is more likely to take advantage of transit options.

The high density area represented by Central Wilmington, Northeast Boulevard, and Washington Street origins is suggested as the area to examine first.

■ ***Offer Express services to Wilmington during Interstate 95 renovation .***

A large number of journey to work trips involve travel on I-95. Maintenance on I-95 is expected to cause congestion and delays, which may encourage those traveling to Wilmington to transit if it is provided. This will also be an opportune time to market service to Wilmington from the Newark rail station.

■ ***Identify Suburb to Suburb Routes Which Can Be Targeted for Innovative Transit Solutions***

Suburb to suburb routes considered for transit service must involve a large number of potential passengers (ideally over 1000). The research suggests the following origins and destinations.

**Table 17, suburb to suburb origin destination pairs involving the greatest numbers of workers.**

Origin	Destination	Workers
West Kirkwood	Zeneca/DuPont	526
Harvey/PhilPk/Clymt	Zeneca/DuPont	354
Chestnut Hill E.	Zeneca/DuPont	353
Lower Route 40	East of Newark	557
West Kirkwood	Newark	918
Chestnut Hill E.	Newark	1865
Chestnut Hill E.	Harmony Road	352
Chestnut Hill E.	West Kirkwood	340
Chestnut Hill E.	MBNA	384
West Kirkwood	Newport/Boxwood	405
North of City of NC	NC Commons	503
North of City of NC	Newport/Boxwood	347
North of City of NC	Christiana Mall	275
North of City of NC	Harmony Road	307
North of City of NC	Newark	318

The focus should be initially in reaching those areas which have a demographic profile which would indicate a greater likelihood of using transit.

- Target those populations which have a higher likelihood of using transit. Focus on direct service.

## **Chapter 5, Transit Strategies for New Castle County**

This chapter discusses strategies which would be appropriate for the markets identified in the previous chapter. It begins with a discussion of the benefits and applicability of park and ride facilities and transit centers.

### ***5.1 Park and Rides and Transit Centers***

Travel patterns in New Castle County involve a large number of diverse origins and destinations. Enhancing existing services or adding new services requires addressing low density suburban areas. In any given area the market density with respect to any particular destination is low, and in some areas much of the market is not within walking distance of bus stops located along adjacent major roads. The research has demonstrated through the use of optimum routing methods that collecting transit riders in these areas by fixed feeder routes would be very costly for transit agencies to reach a substantial portion of the market, and would involve long travel times for the riders.

Research of case studies of transit properties across the country has shown that a distinguishing feature of successful suburban transit operations is the service of hubs. Moderate to low density and diverse origin-destination patterns require that services be focused so that diverse trip patterns can be concentrated. The transit agency's role in this approach is to provide a long haul transit back bone which can complement a range of interconnections and local alternative travel modes such as walking, bicycling, and car pooling.

Park and Ride facilities allow riders dispersed across a suburban area to access a point in the transit system in the least amount of time. Passengers reach the transit system directly and can wait for the bus in the comfort and shelter of their personal vehicle. When returning home they can proceed directly from the park and ride, rather than spending time on a circulator portion of the route. They do not have to walk long distances in suburban environments which are often not built for pedestrians. Park and rides and transit centers are the most effective way of reaching the New Castle County suburban market.

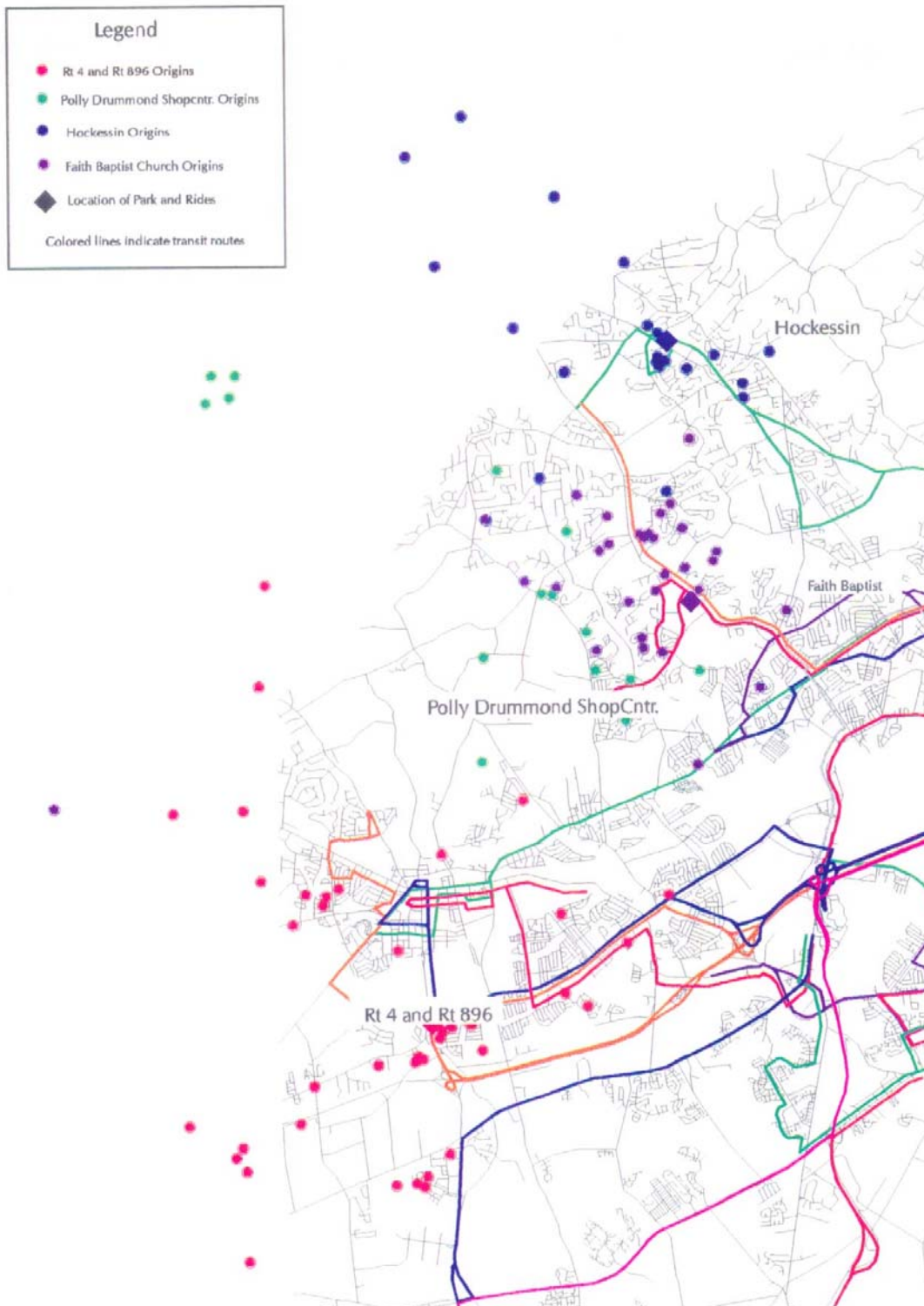
A park and ride can begin with an area with sufficient parking spaces and basic safety features. Costs have been minimized through the use of existing facilities such as commercial centers, community centers, and churches. As use of the park and ride increases, other investments can be made toward the development of a transit activity center. Transit agency resources can be focused on long haul services rather than the service and maintenance of numerous bus stops and shelters, many of which serve only a small portion of the population. Focus on hubs allows the transit agency to meet the customer halfway.

Park and rides and transit activity centers can serve as a focal point for local transportation alternatives and can offer much needed transit system visibility in the suburbs. The range of local transportation strategies including walking, biking, community shuttles, employee shuttles, car pool, and passenger drop off, all are supported by suburban transit activity centers. Investments toward pedestrian walk ways and bicycle paths can be focused.

Park and rides already contribute substantially to the use of transit in New Castle County. About 10% of transit ridership originates at park and rides. In some areas, park and rides play a large role. In the Pike Creek East area the number of riders originating at Faith Baptist Church and at Polly Drummond Shopping Center account for almost 70% of the morning ridership in the area ( see figure 8 on page 34).

To better understand where transit riders using park and rides originated and why they used transit, surveys were conducted at four park and ride locations; Hockessin, Polly Drummond Shopping Center, RT4 and RT896, and Faith Baptist Church at Rt. 7. Over 2/3 of the respondents said they ride the bus specifically to save money on parking in Wilmington, with most of the remainder saying that they ride because it is less expensive and easier than driving. Over 90% take the bus 4 to 5 days a week. Income levels of riders mirrored those of the surrounding community. Origins of respondents were mapped and were distributed in what could be viewed as a parabolic catchment area flaring away from the direction of the destination. For most riders the park and ride was on the way to the destination (Wilmington) coming from as far away as 10 miles. Average distance from the park and ride was about two miles. Figure 17 presents approximate origins for the four park and rides surveyed. The survey and a summary of responses is provided in the Appendix.

Figure 17, Rider Origins For Four Park and Rides



## ***5.2 Journey to Work From Suburban Areas To Wilmington***

Central Wilmington is the largest destination for most suburban areas. Incentives exist in terms of parking costs and congestion. Most suburban origins are of low density and bus stops are not within walking distance of large portions of local areas. The most appropriate strategy for capturing more of the in town traffic from the suburbs is the establishment and enhancements of park and rides, and transit centers. Accessing this market could boost the productivity of the current transit routes, and from an operating standpoint make more cost efficient use of resources.

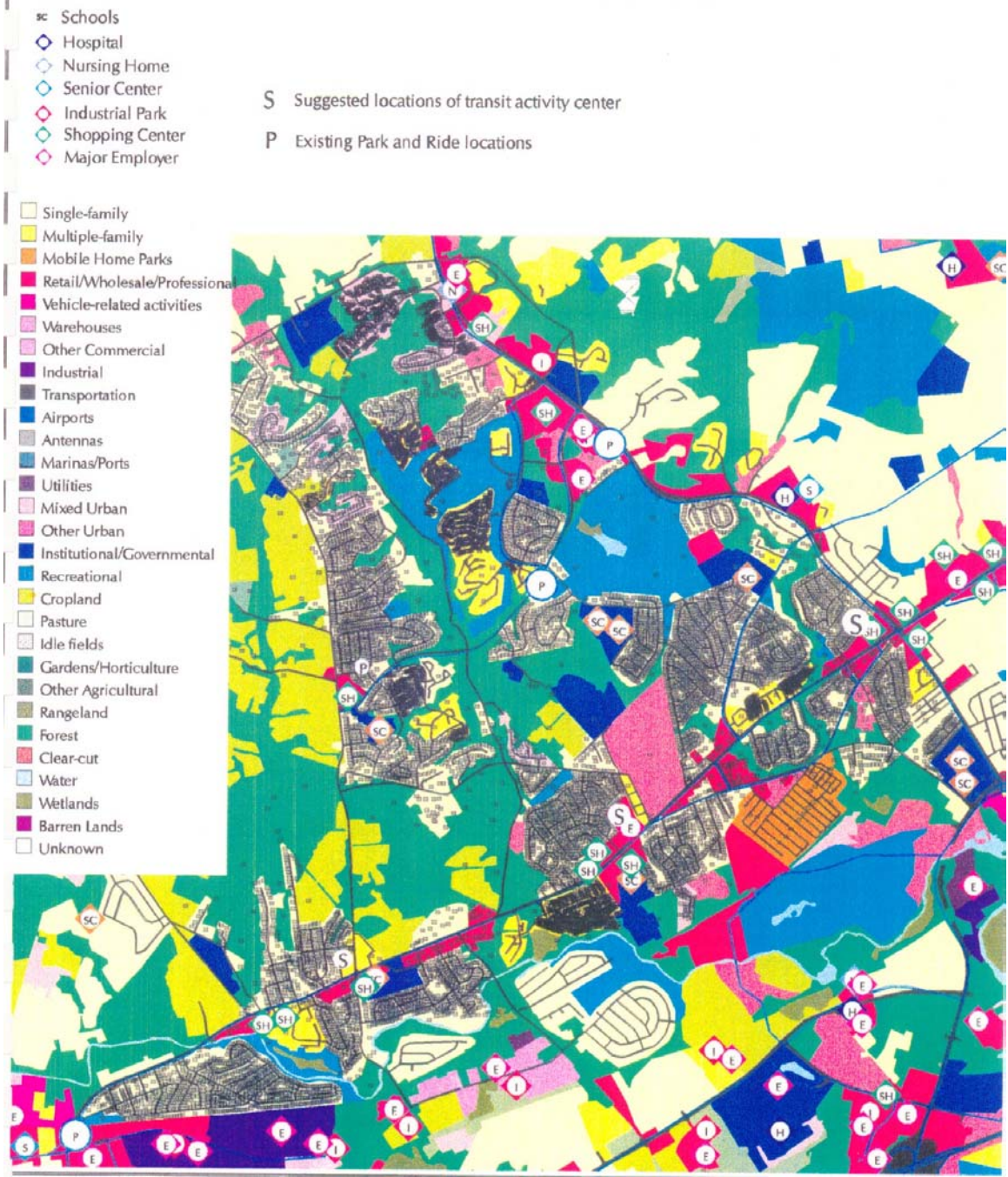
While employment levels have not grown in the past decade in the Central Wilmington, The number of workers traveling to Central Wilmington from the 1 to 4 traffic zones making up the origins areas studied, averages about 700. Routes serving East Naamons, Bellevue, Mingquedale, Washington St., and North East Boulevard areas were estimated to serve 18% of the journey to work or higher. Locations in northeast New Castle County show a over a 10% transit share. Other areas are served at a lower rate. The West Kirkwood area has an estimated 1559 workers traveling to Central Wilmington with only a 4% transit share.

Locating ideal locations for park and ride facilities or transit activity centers involves an understanding of travel patterns, housing densities, local character of the community, special trip attractors or producers, and opportunities to secure land for the purpose. The process can be assisted by a range of data now available for Delaware in geographical information system (GIS) format. Figures 18 thru 20 show land use, tax parcel centroids, the road and transit system, and the locations of hospitals, industrial parks, shopping centers, and major employers, as were inventoried as part of the DART 1995-2001 Service Plan Development Project. An ideal location is one which would be the most strategically placed for access by the major trip producers and employment centers in the area and one which takes into account travel patterns. Existing and suggested locations for park and rides or transit activity centers are marked with a large “S” in these figures.

As an illustration of how a transit activity center could encourage other modes of travel, the number of households which were within a six minute bicycle ride of suggested locations of park and rides and transit centers was calculated using methods described in Chapter 3. Results



Figure 18, Information used to locate transit centers  
 Pike Creek and Kirkwood West





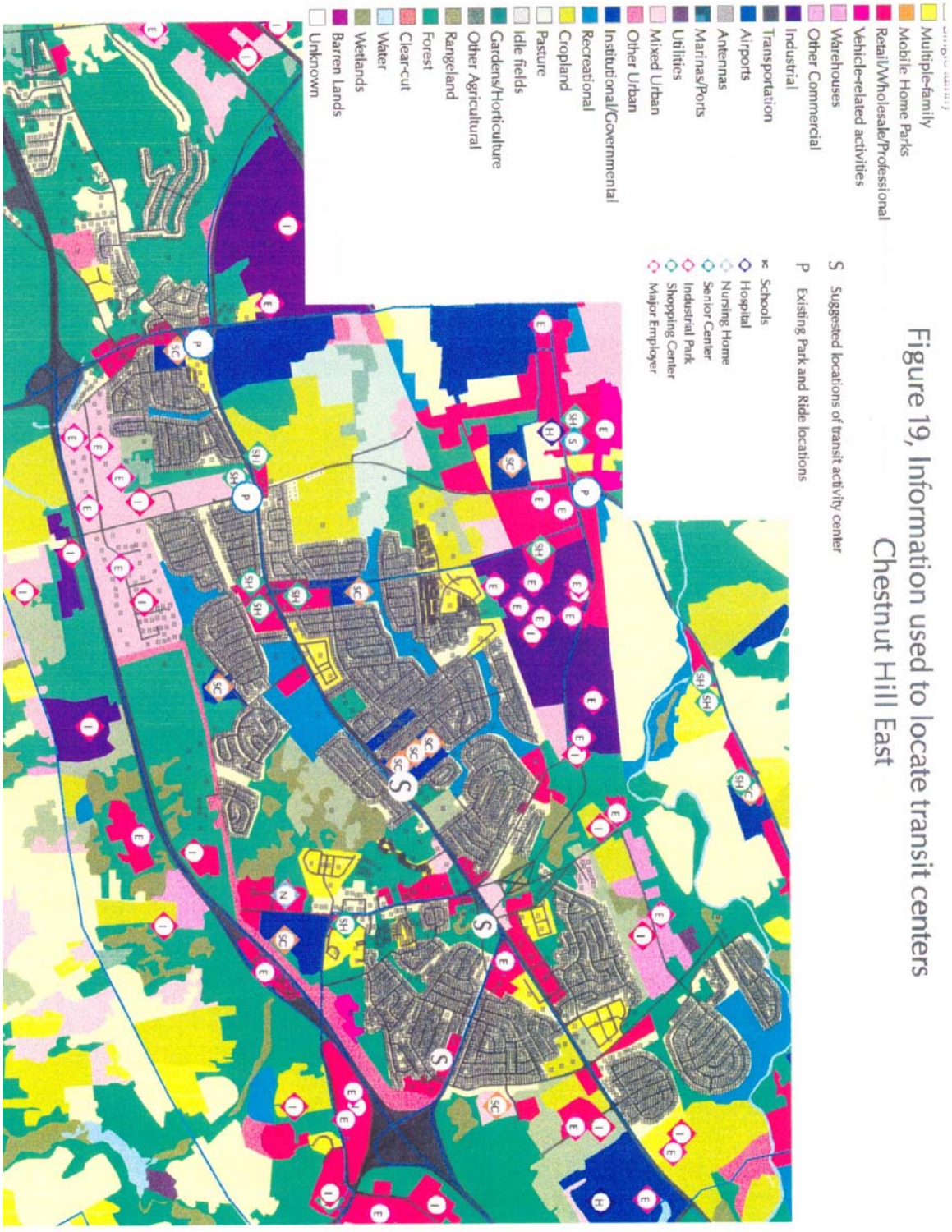
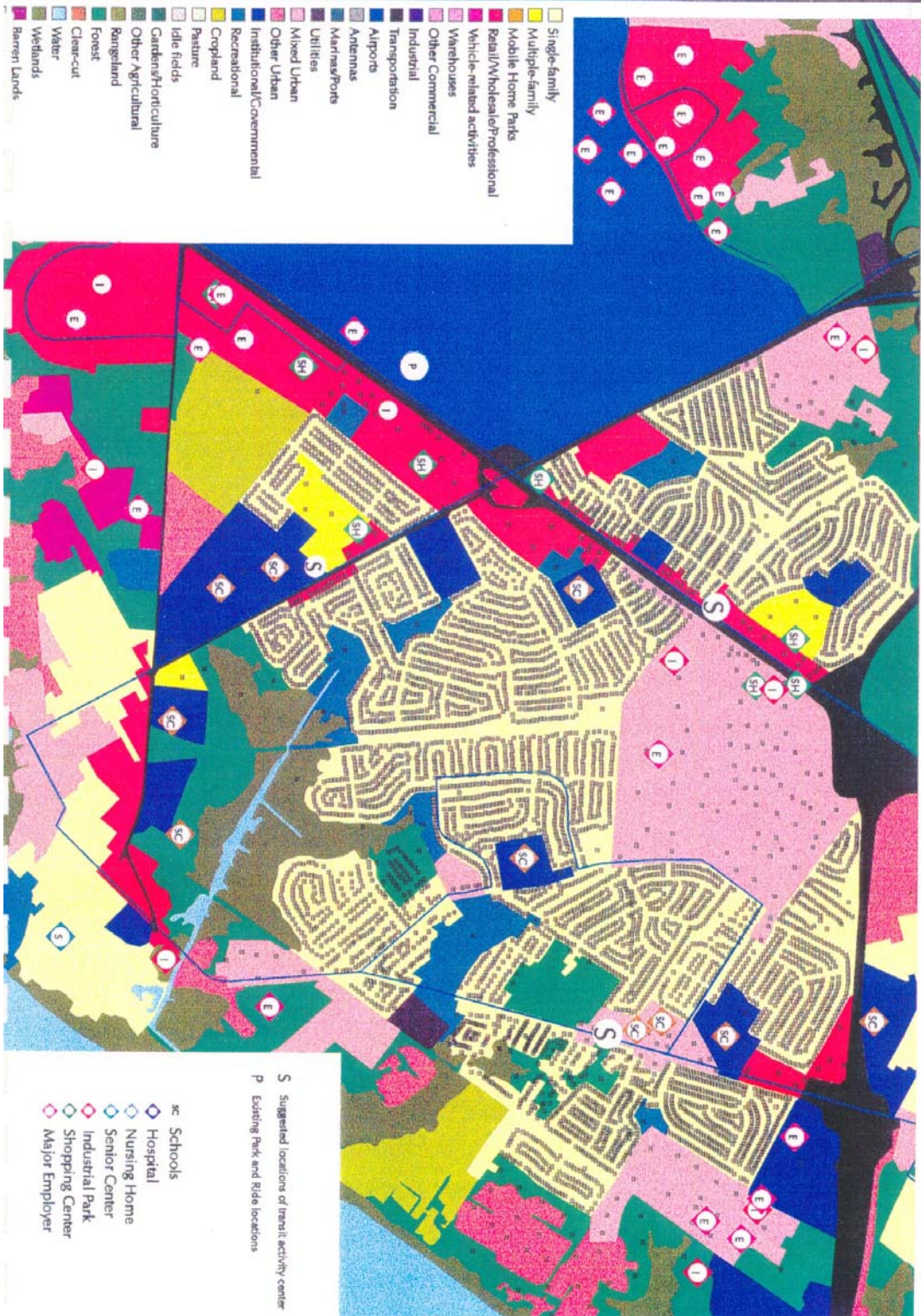


Figure 19, Information used to locate transit centers  
Chestnut Hill East

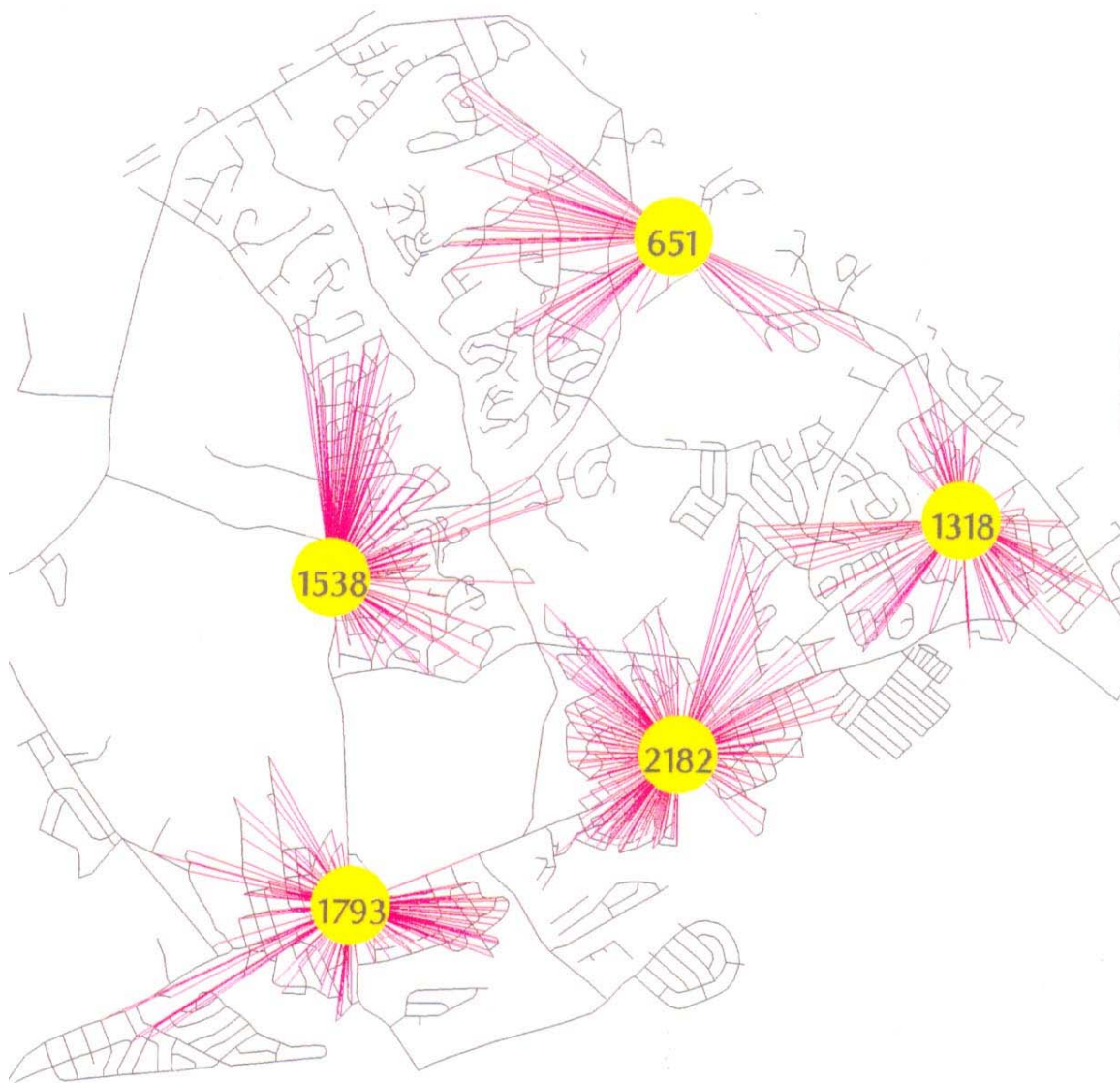


Figure 20, Information used to locate transit centers  
North of New Castle



are shown in Figure 21 for the Kirkwood Highway West and Pike Creek area. Over sixty percent of the housing units are within a 6 minute bike ride of the 5 locations, with an average bicycle trip time of about 3.5 minutes. While for most the journey to work by bicycle can be a strenuous or impossible trip on high speed suburban roads, a short trip to a park and ride that included a place to store a bicycle might be a safe and suitable alternative for many. This could also capture local, non journey to work trips. Efforts to improve bicycle access could be focused at the local level and could draw on local support.

Figure 21, Number of Housing Units within a 6 minute bicycle ride to 5 suggested transit activity locations in the Pike Creek Kirkwood West areas



### ***5.3 Journey to Work From Neighboring Counties to Wilmington***

About 7000 people from neighboring counties worked in Wilmington by 1990 CTPP estimates, and transit share is only about 2%. With the transit incentives present in Wilmington and the greater distances along sometimes congested corridors, more of this market might be captured by visible well marketed park and rides located near the County borders. An idea proposed in the past is to place park and ride facilities on the New Jersey side of the Delaware Memorial Bridge allowing riders to avoid the bridge toll as well as saving parking fees in Wilmington.

### ***5.4 Corridor Relief***

Interstate 95 will go through a major maintenance program over the next years. The expected congestion resulting could act as an incentive for people to use transit. Since much of the I-95 traffic is traffic traveling through Wilmington, transit is not expected to relieve congestion considerably however. The construction may be an opportunity to get workers who live near Newark and work in Wilmington to use the new Newark rail service to Wilmington and points north. If more east flowing traffic is loaded onto Kirkwood Highway, park and rides there may encourage people to use transit.

A park and ride near the county line at Route 202 could serve those traveling from Delaware County to Wilmington. Transit to relieve congestion on Route 141 would depend on the success of innovative suburb to suburb transit strategies.

### ***5.5 Rail Service***

A market for service to and from Philadelphia exists presently and the new City of Newark rail station may encourage more people living in the area to use the train. With a nearby student population, and several hundred people traveling to Wilmington, the Newark Station is the best chance of success of any rail alternative for New Castle County. The two highest density employment and housing areas are now linked with a \$2.50 fare and a 10 minute ride from the station. Timed transfer will be available at the Wilmington Train Station to circulate the downtown area. While passenger subsidies could run high, there may be other important benefits including the encouragement of urban development, and some small relief to congestion on roadways.



To understand rail opportunities, documents from the DELDOT Regional Rail Study were reviewed, in particular *Phase II: Additional Stations on AMTRAK's Northeast Corridor*, and *Phase III : Transit Opportunities Along Rail Corridors Within Northern New Castle County*. A station at Metroform was recommended for implementation in the Phase II work, the success of which depends in large part on whether significant levels of development anticipated for Metroform are realized. No other stations on the AMTRAK Northeast Corridor were recommended primarily because of low patronage forecasts. The Newark to Wilmington U-Line Corridor and the Porter to Wilmington Line (vicinity of Route 40 corridor) were recommended for further consideration for low cost busway or possibly light rail transit in the Phase III work. Given the low population densities, short trip distances, and diverse travel patterns that exist in New Castle, rail service would be limited to these possibilities.

### ***5.6 Journey to Work From Wilmington***

In line with getting more productivity out of the current system and minimizing costs , the journey from Wilmington to the suburbs is an important market . The Wilmington areas which may have the highest potential are Central Wilmington, Northeast Boulevard, and Washington Street areas. Transit share for the out of town direction is considerably higher than for the 2-3% share for the incoming direction. By 1990 figures, transit share for workers out of Central Wilmington is typically between 5 and 15% (example in Table 22) The Wilmington to Newark trip estimated a transit share of 50%. The traditional fixed route system is doing well in a high density area with about 20,000 workers, which to a larger extent use transit. Perhaps adjustments to the transit patterns of buses may yield even more riders.

This area could also be receptive to van pool or subscription services. As one of the lowest per capita income areas will be a higher fraction of transit dependent riders. Major destinations for Wilmington workers are listed in the table below.

**Table 18, Destinations for Area Represented By Central Wilmington, Northeast Blvd, and Washington St. Places**

Destination	Workers	Transit Users
Christiana Mall	213	30
Concord Pike	251	70
Chestnut Hill Rd E./Chrysler	259	6
Upper Foulk	276	25
Wilmington Waterfront	348	68
East of Newark	386	38
Newport/Boxwood	422	31
West Wilmington	520	36
Zeneca/DuPont	594	45
Delaware Ave.	736	60
Dests.not listed in Table 10	3032	304
Central Wilmington	6021	894

### ***5.7 Journey to Work From Suburban Area to Suburban Area***

The suburb to suburb travel market in New Castle County is well over half of the current travel and it will increase quickly relative to increases in population over the next two decades. To make significant increases in transit usage requires that portions of this market be reached. Without a major incentive to using transit such as a fuel shortage or paralyzing congestion, investments in this area are expected to yield low returns. Congestion is relatively low, trip distances short, and parking plentiful. Suburban living requires an auto, and life styles and travel patterns are based around the convenience of the personal auto.

Given the predominance and growth of low volume suburb to suburb travel patterns, strategies which involve smaller vehicles serving niche markets may have some success. The literature cites several van and subscription bus programs which have had some degree of success in attracting riders in more densely populated areas than New Castle County. Any programs undertaken by transit agencies must be tailored to fit customers needs, involve incentives, and a high degree of private and public support. Service will require more overhead to research market needs and maintain optimum efficiency. Service to those populations most likely to use transit should be the initial focus. New information technologies have made demand response services more viable, though operation is still much more costly than traditional fixed services operating in moderately dense environments.

The focus on suburban services is relatively new, and developing suburban transit strategies requires some degree and experimentation accompanied by comprehensive service monitoring and evaluation programs. Car pooling programs because of their relatively low implementation costs and competitiveness with travel times offered by single occupancy vehicle may be the best option in New Castle County to reduce the number of cars on the road where travel to other locations than Wilmington is concerned.

As the second largest journey to work destination in New Castle County, the Newark area has few transit users by 1990 CTPP figures. The following origin destination pairs could be the target of enhanced transit service. A high frequency, highly visible service, from a locations within walking or biking distance of bus stops, might have some success in the Newark Area. The low distances involved are a disincentive to using the system. Further research would be necessary to say more.

**Table 19, Origins and destinations within Newark.**

Origin	Destination	Workers	Transit Share (%)
North of Newark	Newark	542	4
West Kirkwood	Newark	918	1
West of Newark	Newark	1322	3
Chestnut Hill E.	Newark	1865	0
Newark	Newark	1878	3
Newark	East of Newark	330	3
Chestnut Hill E.	East of Newark	512	1

### **5.8 Conclusions**

- The most appropriate strategy to serve the New Castle County suburban market is to enhance and establish park and ride facilities and transit activity centers.
- There is a large amount of data available to determine ideal locations for park and rides and transit centers, and to support market studies.
- In most moderately dense suburban areas, a few park and rides would be within a 6 minute bicycle ride of most of the local population. A pilot program which includes the addition of bicycle storage facilities at a park and ride facility, and a marketing program should be considered.
- I-95 construction and congestion along major arteries is an opportunity for transit.
- Current fixed routing strategies should be optimized to reach the market around Central Wilmington

- A suburb to suburb journey to work route which involves innovative methods to keep costs down and meet customer needs should be piloted.

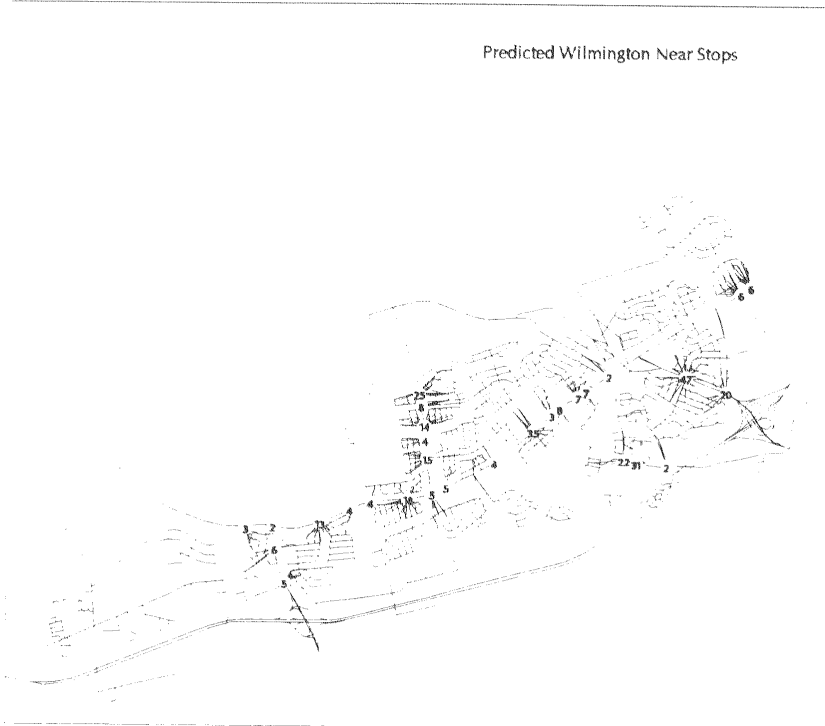
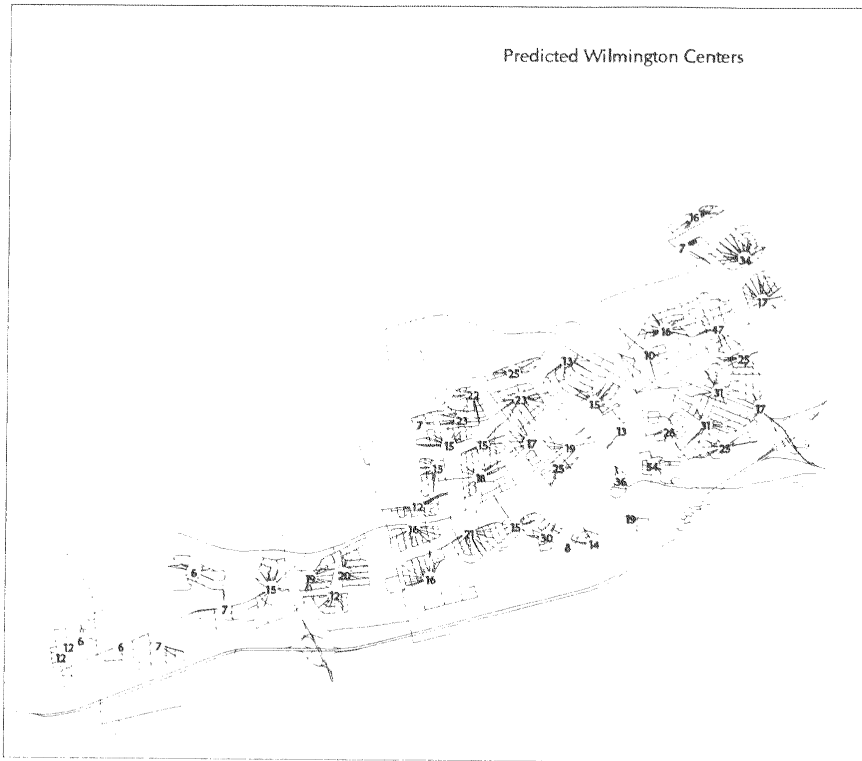


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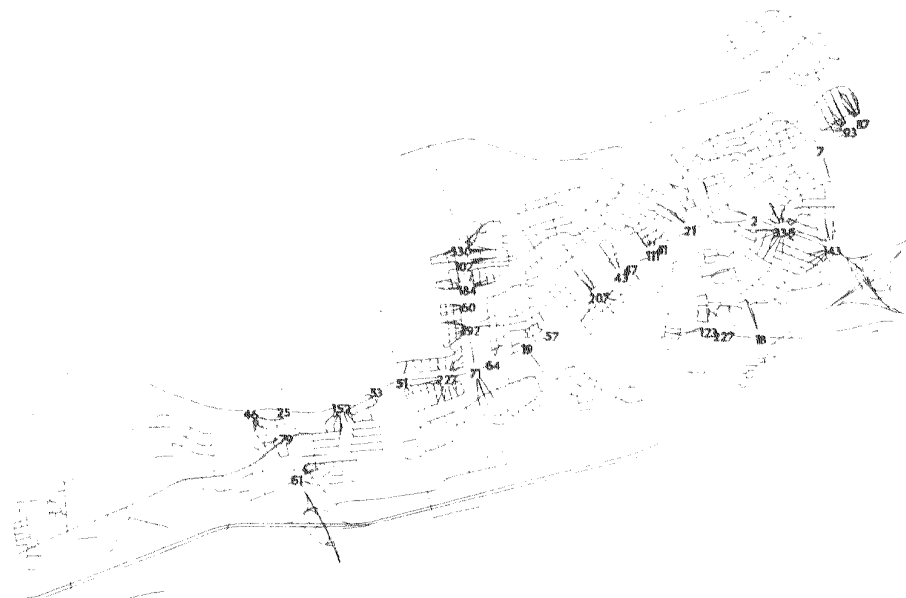
**APPENDIX A , Figures for North of New Castle, and Chestnut Hill East Areas**



Housing Unit Centers



HUs in Walking Dist of Transit Stops



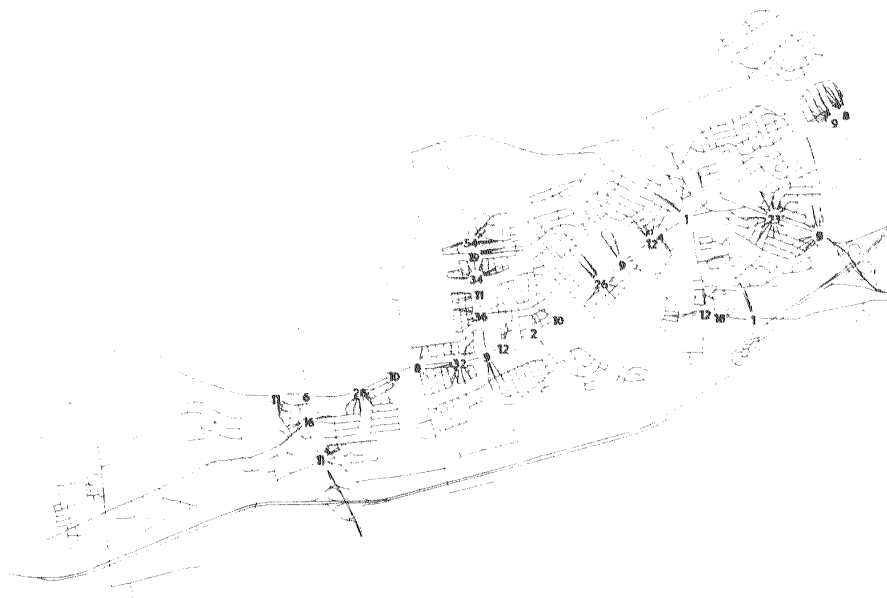
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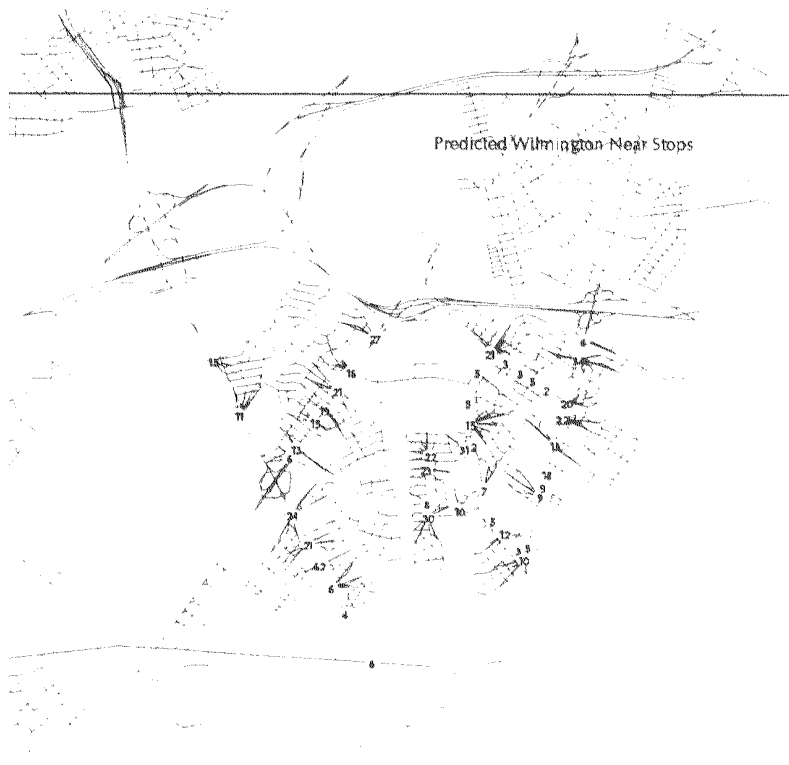
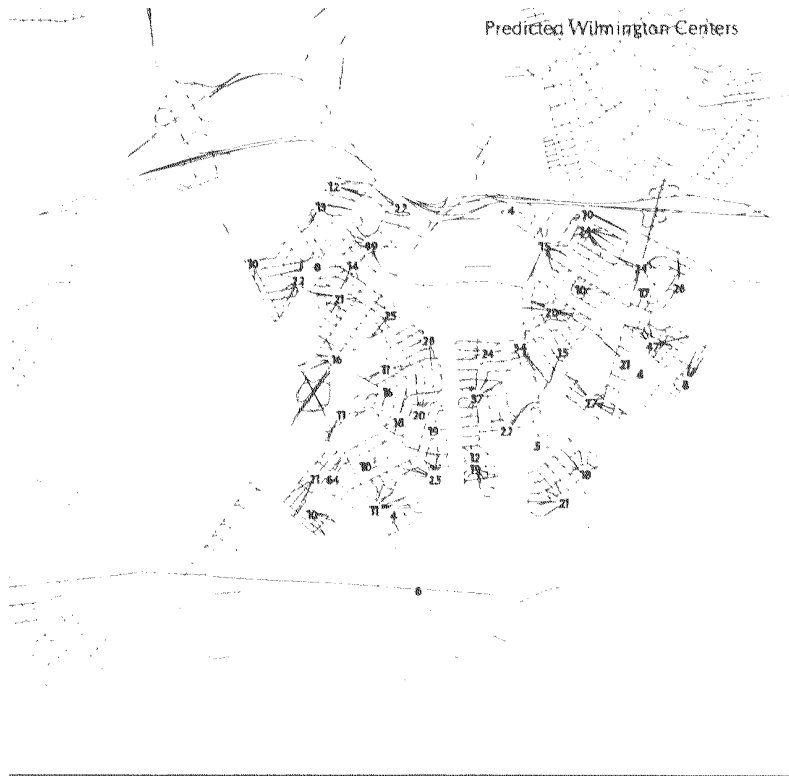
Predicted Newark Centers

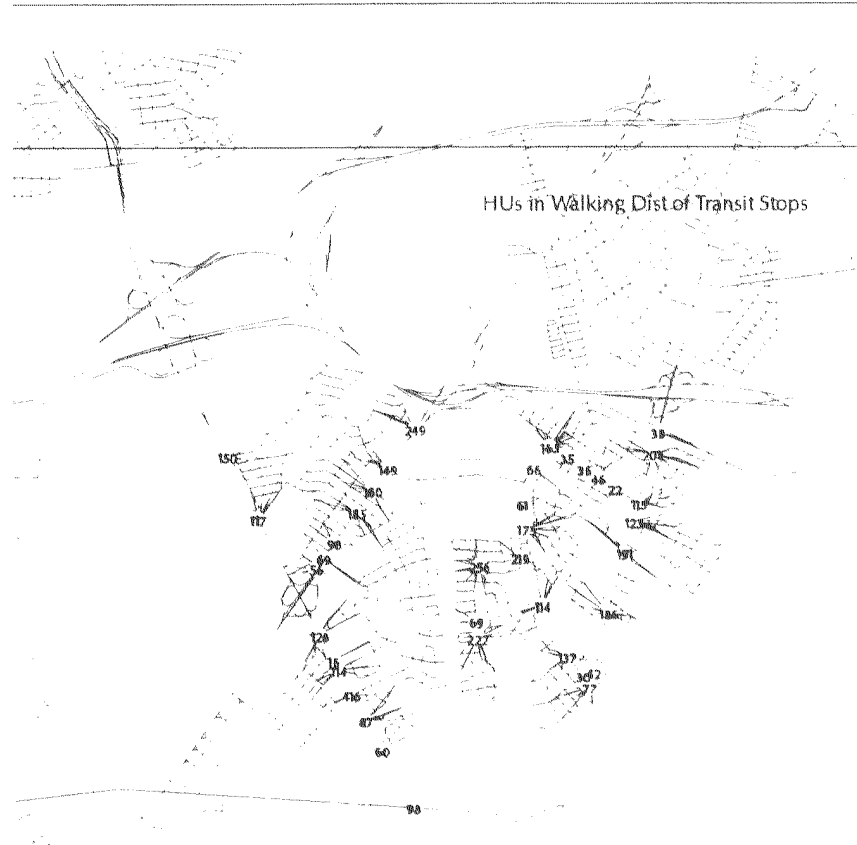
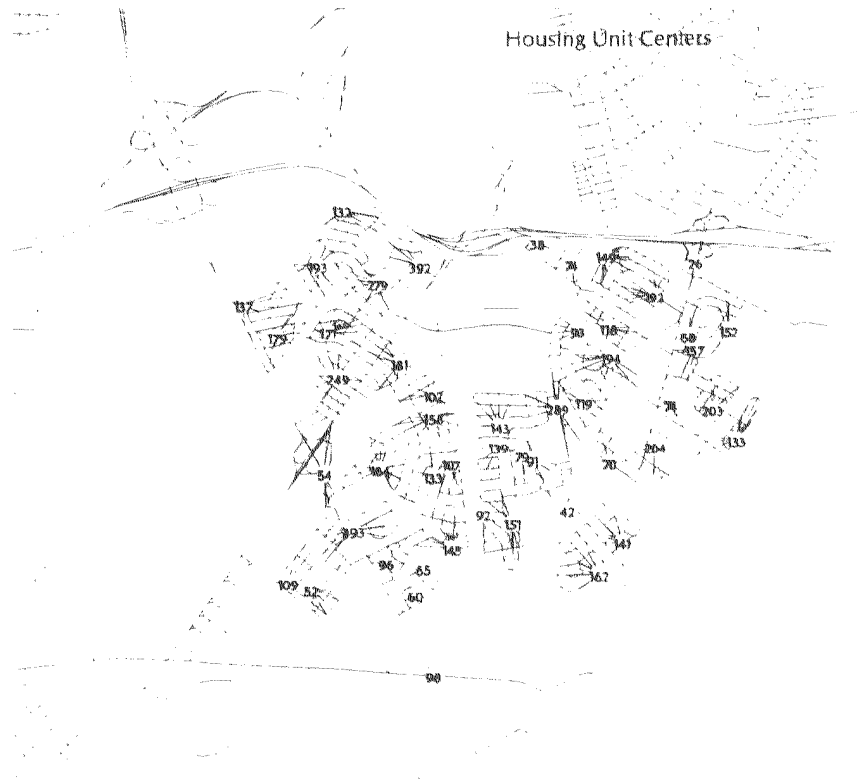


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Predicted Newark Near Stops







**Factors used to distribute travel to destinations within the North of New Castle Area**

NORTH OF NEW CASTLE AREA

	WILMFAC	CITYFAC	AIRFAC	COMFAC	NPRTFAC	MALL	HARFAC	NEWFAC	Workers
N104A	0.08	0.05	0.05	0.07	0.08	0.00	0.06	0.00	277
N104B	0.18	0.02	0.11	0.06	0.04	0.02	0.03	0.02	811
N106A	0.13	0.05	0.05	0.03	0.04	0.03	0.03	0.02	592
N106B	0.14	0.04	0.06	0.07	0.03	0.00	0.00	0.03	168
N106C	0.09	0.06	0.03	0.05	0.04	0.02	0.09	0.04	711
N106D	0.16	0.05	0.04	0.04	0.02	0.03	0.04	0.06	1653
N107A	0.07	0.02	0.03	0.07	0.08	0.09	0.02	0.01	341
N107B	0.17	0.04	0.04	0.10	0.11	0.04	0.00	0.02	291
N107C	0.17	0.09	0.03	0.07	0.06	0.01	0.03	0.06	1032
N107D	0.22	0.00	0.12	0.04	0.00	0.00	0.05	0.03	220
N108A	0.11	0.05	0.02	0.10	0.05	0.05	0.06	0.03	895
N108B	0.11	0.02	0.09	0.05	0.01	0.06	0.03	0.04	888
N108D	0.10	0.03	0.05	0.06	0.04	0.03	0.01	0.01	682
N109B	0.14	0.09	0.04	0.08	0.01	0.02	0.02	0.04	353
N109D	0.13	0.08	0.05	0.00	0.01	0.02	0.02	0.04	564
N159B	0.16	0.06	0.11	0.02	0.09	0.02	0.04	0.03	905

**Factors used to distribute travel to destinations within the Chestnut Hill East Area**

WORKER	NEWFAC	ENEWFAC	WILMFAC	HARFAC	MBNAFAC	ZENFAC	FACSUM
	C	C	C	C	C		
485 N152B	0.10	0.02	0.07	0.06	0.03	0.08	0.37
552 N152C	0.10	0.04	0.13	0.07	0.02	0.06	0.42
359 N152D	0.04	0.03	0.10	0.06	0.03	0.03	0.28
1822 N152E	0.07	0.01	0.06	0.08	0.08	0.03	0.33
1159 N154A	0.06	0.02	0.14	0.04	0.09	0.00	0.36
2009 N154B	0.08	0.03	0.14	0.02	0.04	0.03	0.35
367 N155A	0.14	0.08	0.03	0.06	0.04	0.00	0.36
801 N155C	0.11	0.03	0.07	0.04	0.02	0.03	0.30
1589 N157A	0.10	0.05	0.19	0.03	0.05	0.03	0.45
1591 N157B	0.12	0.06	0.08	0.03	0.03	0.03	0.35
1055 N157E	0.19	0.03	0.09	0.02	0.03	0.03	0.39
85 N158A	0.19	0.07	0.13	0.00	0.20	0.06	0.65
4197 N158B	0.19	0.04	0.08	0.04	0.03	0.04	0.42
240 N170C	0.25	0.03	0.08	0.11	0.08	0.00	0.54
308 N179D	0.14	0.02	0.05	0.06	0.04	0.06	0.37
474 N179E	0.13	0.05	0.12	0.05	0.05	0.04	0.45
628 N179L	0.20	0.05	0.08	0.04	0.01	0.01	0.39



**APPENDIX B, Complete Census County Division level origin and destination table**

Complete CCD/County Level origin and destination table

Brandywine	Sussex	13	0
Brandywine	MOT	52	0
Brandywine	Cecil	57	0
Brandywine	Maryland	82	0
Brandywine	Red Lion	86	0
Brandywine	Central Pencador	99	0
Brandywine	Kent	121	0
Brandywine	OUTSIDE	534	6
Brandywine	Other PA	674	0
Brandywine	Pike Creek	748	6
Brandywine	New Jersey	891	0
Brandywine	Chester	897	0
Brandywine	Piedmont	1,136	0
Brandywine	Greater Newark	1,393	7
Brandywine	New Castle	1,781	22
Brandywine	Upper Christina	1,937	16
Brandywine	Lower Christina	2,147	15
Brandywine	Philadelphia	2,284	2
Brandywine	DeCounty	3,545	6
Brandywine	Wilmington	10,799	919
Brandywine	Brandywine	11,456	92
Kent	Cecil	29	0
Kent	Central Pencador	33	0
Kent	Chester	34	0
Kent	DeCounty	69	0
Kent	Other PA	73	0
Kent	Philadelphia	122	8
Kent	Red Lion	122	0
Kent	Piedmont	137	0
Kent	New Jersey	206	0
Kent	Pike Creek	216	0
Kent	Lower Christina	427	0
Kent	Brandywine	433	0
Kent	MOT	450	0
Kent	OUTSIDE	468	26
Kent	Upper Christina	477	0
Kent	New Castle	626	0
Kent	Greater Newark	626	0
Kent	Wilmington	760	32
Kent	Maryland	862	11
Kent	Sussex	3,462	88
Kent	Kent	43,512	101
Sussex	Central Pencador	4	0
Sussex	Piedmont	5	0
Sussex	MOT	5	0
Sussex	Pike Creek	7	0
Sussex	Cecil	9	0
Sussex	Chester	15	0
Sussex	New Castle	40	0
Sussex	Upper Christina	44	0
Sussex	Greater Newark	46	0
Sussex	New Jersey	53	0
Sussex	Lower Christina	58	0
Sussex	Wilmington	75	0
Sussex	Brandywine	78	0
Sussex	Other PA	79	2
Sussex	Philadelphia	93	10
Sussex	OUTSIDE	331	0
Sussex	Kent	3,745	42
Sussex	Maryland	5,777	14
Sussex	Sussex	39,207	321
Central Pencador	OUTSIDE	10	0
Central Pencador	Sussex	16	0
Central Pencador	MOT	37	0
Central Pencador	Maryland	42	0
Central Pencador	Other PA	43	0
Central Pencador	Chester	91	0
Central Pencador	DeCounty	102	0
Central Pencador	Red Lion	106	0

Central Pencador	Kent	117	0
Central Pencador	New Jersey	142	0
Central Pencador	Philadelphia	153	0
Central Pencador	Cecil	262	0
Central Pencador	Central Pencador	334	0
Central Pencador	Pike Creek	340	0
Central Pencador	Piedmont	410	0
Central Pencador	Lower Christina	824	0
Central Pencador	New Castle	851	0
Central Pencador	Brandywine	1,078	0
Central Pencador	Upper Christina	1,160	0
Central Pencador	Wilmington	1,389	11
Central Pencador	Greater Newark	2,114	4
Greater Newark	Sussex	52	9
Greater Newark	MOT	101	0
Greater Newark	Kent	154	0
Greater Newark	Red Lion	157	0
Greater Newark	Other PA	163	0
Greater Newark	OUTSIDE	175	6
Greater Newark	Maryland	220	0
Greater Newark	New Jersey	236	0
Greater Newark	DeCounty	248	0
Greater Newark	Philadelphia	313	0
Greater Newark	Central Pencador	390	0
Greater Newark	Chester	472	0
Greater Newark	Cecil	708	0
Greater Newark	Piedmont	778	10
Greater Newark	Pike Creek	1,255	0
Greater Newark	New Castle	2,010	9
Greater Newark	Lower Christina	2,260	0
Greater Newark	Brandywine	2,822	0
Greater Newark	Upper Christina	3,150	21
Greater Newark	Wilmington	4,144	275
Greater Newark	Greater Newark	11,542	194
Lower Christina	Sussex	14	0
Lower Christina	Maryland	17	0
Lower Christina	OUTSIDE	21	0
Lower Christina	MOT	48	0
Lower Christina	Red Lion	49	0
Lower Christina	Other PA	58	0
Lower Christina	Kent	69	0
Lower Christina	Cecil	74	0
Lower Christina	Central Pencador	107	0
Lower Christina	New Jersey	160	0
Lower Christina	Chester	222	0
Lower Christina	Philadelphia	230	5
Lower Christina	DeCounty	239	0
Lower Christina	Pike Creek	864	15
Lower Christina	Piedmont	911	12
Lower Christina	Greater Newark	1,218	0
Lower Christina	New Castle	1,368	19
Lower Christina	Upper Christina	1,601	20
Lower Christina	Brandywine	2,209	8
Lower Christina	Lower Christina	3,664	38
Lower Christina	Wilmington	4,832	409
Cecil	Kent	62	0
Cecil	Sussex	69	0
Cecil	Red Lion	118	0
Cecil	MOT	172	0
Cecil	OUTSIDE	178	6
Cecil	Central Pencador	193	0
Cecil	New Jersey	256	0
Cecil	DeCounty	258	0
Cecil	Philadelphia	324	0
Cecil	Piedmont	328	0
Cecil	Other PA	359	0
Cecil	Pike Creek	439	0
Cecil	Chester	796	0
Cecil	Brandywine	981	0
Cecil	New Castle	1,016	0
Cecil	Lower Christina	1,073	0
Cecil	Upper Christina	1,180	10

Cecil	Wilmington	1,277	38
Cecil	Greater Newark	3,984	0
Cecil	Maryland	4,701	6
Cecil	Cecil	16,018	7
MOT	Sussex	25	0
MOT	Chester	27	0
MOT	Other PA	35	0
MOT	Philadelphia	37	0
MOT	OUTSIDE	40	0
MOT	DeCounty	54	0
MOT	Maryland	68	0
MOT	Central Pencador	103	0
MOT	Red Lion	105	0
MOT	Pike Creek	129	0
MOT	New Jersey	131	0
MOT	Piedmont	146	0
MOT	Cecil	193	8
MOT	Lower Christina	722	0
MOT	Wilmington	785	15
MOT	Upper Christina	807	0
MOT	Brandywine	855	7
MOT	New Castle	875	0
MOT	Greater Newark	938	0
MOT	Kent	987	4
MOT	MOT	1,235	0
New Castle	Sussex	33	0
New Castle	MOT	120	0
New Castle	OUTSIDE	149	0
New Castle	Maryland	154	0
New Castle	Other PA	181	0
New Castle	Kent	244	0
New Castle	Red Lion	245	0
New Castle	Cecil	254	0
New Castle	Central Pencador	274	0
New Castle	Chester	327	0
New Castle	Philadelphia	590	7
New Castle	DeCounty	688	0
New Castle	Piedmont	770	0
New Castle	New Jersey	939	0
New Castle	Pike Creek	1,177	0
New Castle	Greater Newark	2,886	9
New Castle	Lower Christina	3,185	21
New Castle	Upper Christina	4,142	73
New Castle	Brandywine	4,165	50
New Castle	New Castle	7,267	58
New Castle	Wilmington	7,359	465
Piedmont	Sussex	7	0
Piedmont	Kent	10	0
Piedmont	MOT	12	0
Piedmont	Red Lion	16	0
Piedmont	Maryland	33	0
Piedmont	Cecil	52	0
Piedmont	Other PA	60	0
Piedmont	Central Pencador	81	0
Piedmont	Philadelphia	93	0
Piedmont	OUTSIDE	106	0
Piedmont	DeCounty	170	0
Piedmont	New Jersey	231	0
Piedmont	Chester	297	0
Piedmont	New Castle	720	7
Piedmont	Pike Creek	742	6
Piedmont	Upper Christina	855	0
Piedmont	Piedmont	1,082	0
Piedmont	Lower Christina	1,114	13
Piedmont	Greater Newark	1,159	0
Piedmont	Brandywine	1,489	8
Piedmont	Wilmington	3,473	172
Pike Creek	Red Lion	44	0
Pike Creek	OUTSIDE	99	8
Pike Creek	MOT	104	0
Pike Creek	Kent	127	0
Pike Creek	Maryland	156	0

Pike Creek	Central Pencador	161	0
Pike Creek	Other PA	195	0
Pike Creek	Cecil	213	0
Pike Creek	Philadelphia	224	0
Pike Creek	DeCounty	318	0
Pike Creek	New Jersey	338	0
Pike Creek	Chester	549	0
Pike Creek	Piedmont	941	17
Pike Creek	New Castle	1,517	0
Pike Creek	Pike Creek	1,954	0
Pike Creek	Upper Christina	2,075	11
Pike Creek	Greater Newark	2,231	19
Pike Creek	Brandywine	2,524	21
Pike Creek	Lower Christina	2,626	17
Pike Creek	Wilmington	4,900	228
Chester	Sussex	7	0
Chester	MOT	32	0
Chester	Kent	37	0
Chester	Red Lion	46	0
Chester	Central Pencador	86	0
Chester	Pike Creek	291	0
Chester	Upper Christina	361	0
Chester	Cecil	479	0
Chester	Piedmont	617	2
Chester	New Castle	676	0
Chester	Lower Christina	1,151	0
Chester	Greater Newark	1,636	0
Chester	Brandywine	2,290	0
Chester	Wilmington	3,168	24
DeCounty	MOT	4	0
DeCounty	Cecil	34	0
DeCounty	Sussex	34	0
DeCounty	Kent	36	0
DeCounty	Red Lion	56	0
DeCounty	Pike Creek	72	0
DeCounty	Piedmont	172	0
DeCounty	Upper Christina	240	0
DeCounty	New Castle	622	0
DeCounty	Greater Newark	643	0
DeCounty	Lower Christina	777	0
DeCounty	Wilmington	2,463	10
DeCounty	Brandywine	2,507	4
Philadelphia	Cecil	11	0
Philadelphia	Piedmont	28	0
Philadelphia	Pike Creek	35	0
Philadelphia	New Castle	37	0
Philadelphia	Upper Christina	37	0
Philadelphia	Kent	55	18
Philadelphia	Lower Christina	107	0
Philadelphia	Greater Newark	138	10
Philadelphia	Brandywine	283	10
Philadelphia	Wilmington	493	39
Red Lion	OUTSIDE	2	0
Red Lion	MOT	6	0
Red Lion	Kent	14	0
Red Lion	DeCounty	18	0
Red Lion	New Jersey	23	0
Red Lion	Central Pencador	28	0
Red Lion	Chester	28	0
Red Lion	Philadelphia	29	0
Red Lion	Cecil	43	0
Red Lion	Piedmont	51	0
Red Lion	Pike Creek	61	0
Red Lion	Upper Christina	179	0
Red Lion	Lower Christina	191	0
Red Lion	Wilmington	198	0
Red Lion	Brandywine	269	0
Red Lion	Red Lion	270	0
Red Lion	Greater Newark	285	7
Red Lion	New Castle	288	0
Upper Christina	Sussex	8	0
Upper Christina	Red Lion	36	0

Upper Christina	Other PA	49	0
Upper Christina	OUTSIDE	54	0
Upper Christina	Maryland	63	0
Upper Christina	Central Pencador	92	0
Upper Christina	Kent	94	0
Upper Christina	MOT	98	0
Upper Christina	Cecil	153	0
Upper Christina	Philadelphia	167	0
Upper Christina	Chester	186	0
Upper Christina	DeCounty	258	0
Upper Christina	New Jersey	286	7
Upper Christina	Piedmont	382	0
Upper Christina	Pike Creek	416	0
Upper Christina	Lower Christina	1,174	0
Upper Christina	New Castle	1,271	0
Upper Christina	Brandywine	1,473	0
Upper Christina	Upper Christina	2,122	0
Upper Christina	Wilmington	2,360	55
Upper Christina	Greater Newark	2,385	10
Wilmington	MOT	7	0
Wilmington	Sussex	28	0
Wilmington	Maryland	57	0
Wilmington	Red Lion	66	0
Wilmington	Central Pencador	68	0
Wilmington	Kent	91	0
Wilmington	Cecil	95	0
Wilmington	Other PA	207	0
Wilmington	OUTSIDE	230	13
Wilmington	New Jersey	290	18
Wilmington	Chester	418	0
Wilmington	DeCounty	548	0
Wilmington	Philadelphia	577	20
Wilmington	Pike Creek	798	70
Wilmington	Piedmont	958	79
Wilmington	Upper Christina	1,390	101
Wilmington	Greater Newark	1,510	104
Wilmington	New Castle	1,661	98
Wilmington	Lower Christina	2,368	179
Wilmington	Brandywine	3,944	296
Wilmington	Wilmington	16,688	1,875
Maryland	Central Pencador	18	0
Maryland	Red Lion	36	0
Maryland	Piedmont	77	0
Maryland	MOT	107	0
Maryland	New Castle	137	0
Maryland	Pike Creek	146	0
Maryland	Brandywine	160	8
Maryland	Lower Christina	164	0
Maryland	Upper Christina	228	0
Maryland	Wilmington	257	0
Maryland	Greater Newark	617	5
Maryland	Kent	1,230	0
Maryland	Cecil	2,330	7
Maryland	Sussex	3,821	106
New Jersey	MOT	20	0
New Jersey	Central Pencador	42	0
New Jersey	Sussex	42	0
New Jersey	Cecil	61	0
New Jersey	Red Lion	107	0
New Jersey	Pike Creek	109	0
New Jersey	Kent	113	0
New Jersey	Piedmont	164	0
New Jersey	Upper Christina	190	0
New Jersey	Lower Christina	671	0
New Jersey	New Castle	680	0
New Jersey	Greater Newark	925	7
New Jersey	Brandywine	1,236	0
New Jersey	Wilmington	1,874	47
Other PA	Red Lion	2	0
Other PA	MOT	9	0
Other PA	Central Pencador	16	0
Other PA	Pike Creek	33	0

Other PA	Upper Christina	37	0
Other PA	Sussex	41	0
Other PA	Piedmont	62	0
Other PA	Kent	144	0
Other PA	New Castle	168	0
Other PA	Lower Christina	180	0
Other PA	Cecil	255	0
Other PA	Greater Newark	329	10
Other PA	Wilmington	362	0
Other PA	Brandywine	423	0
OUTSIDE	Upper Christina	6	0
OUTSIDE	Piedmont	18	0
OUTSIDE	Lower Christina	44	0
OUTSIDE	Red Lion	44	0
OUTSIDE	Pike Creek	57	0
OUTSIDE	Cecil	63	7
OUTSIDE	New Castle	148	0
OUTSIDE	Sussex	171	15
OUTSIDE	Greater Newark	196	24
OUTSIDE	Kent	197	2
OUTSIDE	Brandywine	216	0
OUTSIDE	Wilmington	466	0

**APPENDIX C, Park and Ride survey form and tabulation of results**



## 9) PARK and RIDE Pilot Survey Summary

### Park and Rides

	Hockessin	Rt4/Rt896	PollyDrummond	Faith Baptist	Totals
<b>Trip Purpose</b>					
Work	17	46	15	33	111
School	4				4
Shopping		1			1
Other		1			1
<b>How did they get to the park and ride</b>					
Drove	11	29	11	29	70
Walked	1	6		2	9
Dropped off	9	6	4	2	21
Bus Transfer		3			3
<b>Number of days riding the bus</b>					
five	11	38	12	25	86
four	7	7	1	5	20
three		3	1	3	7
two		1			1
one	1				1
<b>Improvements to ride more often</b>					
Later buses	1			1	1
Faster trips		4		3	7
On time	1			1	2
More comfort		2		2	4
Lower fares		5		1	6
Better shelter		3		1	4
More frequent	1	8		5	14
<b>Reasons to ride</b>					
Convenience	1	7		7	15
Cheaper, Parking faster	7	30	7	23	67
don't drive one car	1	1		1	2
	3	1			4
<b>Sex</b>					
Male	13	13	9	12	47
Female	9	28	6	20	63
<b>Age</b>					
Less 15	3				3
16 < < 24	2	3		3	8
25 < < 64	15	43	15	27	100

**PARK and RIDE Pilot Survey Summary (continued)**

	<b>Hockessin</b>	<b>Rt4/Rt896</b>	<b>PollyDrummond</b>	<b>Faith Baptist</b>	<b>Totals</b>
<b>Income Level</b>					
01		1			1
02		1			1
03	1	4			5
04	1	2		4	7
05		4	1	2	7
06	1	8	1		11
07	2	6		1	9
08	3	9	7	7	26
09	1	3	5	10	19
10	6	4	2	3	15

**NOTE:**

The survey was primarily conducted to gain a better understanding of where park and ride user origins. These are mapped in figure 17 of the report. At the same time a few questions were additional questions were asked as summarized above. As riders were often at the park and ride for less than 5 or 10 minutes, it was expedient to allow respondents to fill out the questionnaire on their own. There was no response to some questions, and the sample size and procedures does not allow for a statistical analysis, but there are some general trends.