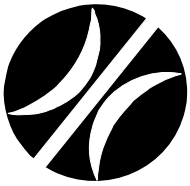
Technical Memorandum

QUAKERTOWN RAIL RESTORATION TRAVEL FORECASTS STUDY

Delaware Valley Regional Planning Commission
190 N. Independence Mall West, 8TH Floor
Philadelphia, PA 19106-1520

June 2008

Created in 1965, the Delaware Valley Regional Planning Commission (DVRPC) is an interstate, intercounty, and intercity agency which provides continuing, comprehensive, and coordinated planning to shape a vision for the future growth of the Delaware Valley region. The region includes Bucks, Chester, Delaware, and Montgomery counties, as well as the City of Philadelphia in Pennsylvania. It also includes Burlington, Camden, Gloucester, and Mercer counties in New Jersey. DVRPC provides technical assistance and services, conducts high priority studies that respond to the request and demands of member state and local governments, fosters cooperation among various constituents to forge a consensus on diverse regional issues, determines and meets the needs of the private sector, and practices public outreach efforts to promote two-way communication and public awareness of regional issues and the commission.



Our logo is adapted from the official DVRPC seal, and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the US Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. This report was primarily funded by the Pennsylvania Department of Transportation and the Federal Highway Administration. The authors, however, are solely responsible for its findings and conclusions, which may not represent the official views or policies of the funding agencies.

DVRPC fully complies with Title VI of the Civil Rights Act of 1964 and related statutes and regulations in all programs and activities. DVRPC's website may be translated into Spanish, Russian, and Traditional Chinese online by visiting www.dvrpc.org. Publications and other public documents can be made available in alternative languages or formats, if requested. For more information, please call (215) 238-2871.

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I. INTRODUCTION

Quakertown Borough lies in upper Bucks County at the northern extremity of the PA 309 corridor. The corridor stretches from North Philadelphia through Montgomery and Bucks counties toward Allentown/Bethlehem and runs roughly parallel to I-476 Northeast Extension. This study is concerned with the sub-corridor from North Wales Borough to the Bucks County border with Lehigh County.

SEPTA R5 Doylestown regional rail serves the area as far as Lansdale; however, passenger service further north on the Bethlehem branch was discontinued in 1981. Currently, the line serves freight traffic alone.

The PA 309 Corridor is listed as one of the region's fifteen most congested corridors as determined by the DVRPC Congestion Management Process (CMP). This identifies the study area as a priority for congestion-reducing projects, including enhanced transit service. The CMP prescribes extension or changes in bus routes as a "Very Appropriate Strategy" to mitigate congestion within the corridor and recommends local fixed rail service (new, extensions, or added stations) as a "Secondary Appropriate Strategy" to mitigate congestion within the corridor.

The purpose of the Quakertown Rail Restoration Alternatives Analysis (QRRAA) is to study transit service options including use of the deactivated rail line extending north from Lansdale to Bethlehem/Allentown. This study will generate data for long-term transit planning in the region and will help stakeholders choose a locally preferred alternative. The work will build on the *Lehigh Valley and Philadelphia Rail Study* (LANTA 1997) as well as the *Quakertown- Stony Creek Rail Study* (DVRPC 2000).

Bucks County Planning Commission (BCPC) and Montgomery County Planning Commission (MCPC), together with TMA Bucks, Edwards and Kelcey, and in cooperation with Southeastern Pennsylvania Transportation Authority (SEPTA), and the Regional Improvement Consortium (RIC) requested Delaware Valley Regional Planning Commission (DVRPC) to develop ridership and parking demand forecasts for the year 2030 as part of the QRRAA. As required by the Federal Transit Authority (FTA) New Starts evaluation procedure, the alternatives analysis includes four alternatives: No-Build, Baseline, and two Build alternatives.

This technical memorandum describes DVRPC's participation in the QRRAA. Chapter II defines the study area and existing conditions including demographics and major transportation facilities. Chapter III explains DVRPC's travel demand model and methodology. Chapter IV defines the alternatives. Chapter V presents the simulation results.

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II. DESCRIPTION OF STUDY AREA

The study area is generally the area of the PA 309 corridor in Montgomery and Bucks counties bounded by: Milford and Springfield townships in the north; Haycock and Hilltown townships in the east; Salford and Lower Salford townships in the west; and Towamencin, Upper Gwynedd, and Montgomery townships to the south (see **Figure 1**).

The following Minor Civil Divisions comprise the QRRAA study area:

BUCKS COUNTY

East Rockhill Township
Haycock Township
Hilltown Township
Milford Township
Perkasie Borough
Quakertown Borough
Richland Township
Richlandtown Borough
Sellersville Borough
Silverdale Borough
Springfield Township
Telford Borough (part)
Trumbauersville Borough
West Rockhill Township

MONTGOMERY COUNTY

Franconia Township
Hatfield Township
Hatfield Borough
Lansdale Borough
Lower Salford Township
Montgomery Township
North Wales Township
Salford Township
Souderton Borough
Telford Borough (part)
Towamencin Township
Upper Gwynedd Township

A. Existing Highway Facilities and Current Volume

Pennsylvania Route 309 is a major north/south artery providing access to and mobility within the sub-corridor. More than 35,000 vehicles per day were recorded on PA 309 in 2005. The area is also served by PA Turnpike/Northeast Extension accessed in Milford Township via PA 663. Approximately 48,500 vehicles per day (vpd) were recorded at Interchange 44 (Quakertown) by DVRPC in 2005.

Three DVRPC screenlines pass through or nearby to the study area (see **Figure 2**). The D-4 Screenline bisects the study area, following the Bucks/Montgomery county line. Just over 268,000 vehicles per day were recorded crossing the screenline in 2005. The Inner Cordon line passes south of the study area and in 2005 recorded slightly less than 287,000 vehicles per day in Bucks County and about 555,000 vehicles per day in Montgomery County. The Outer Cordon line follows the northern boundary of Bucks County, continues along the Montgomery County northern boundary, and detours around Colebrookdale and Douglass townships in Berks County. The Outer Cordon line,

Figure 1

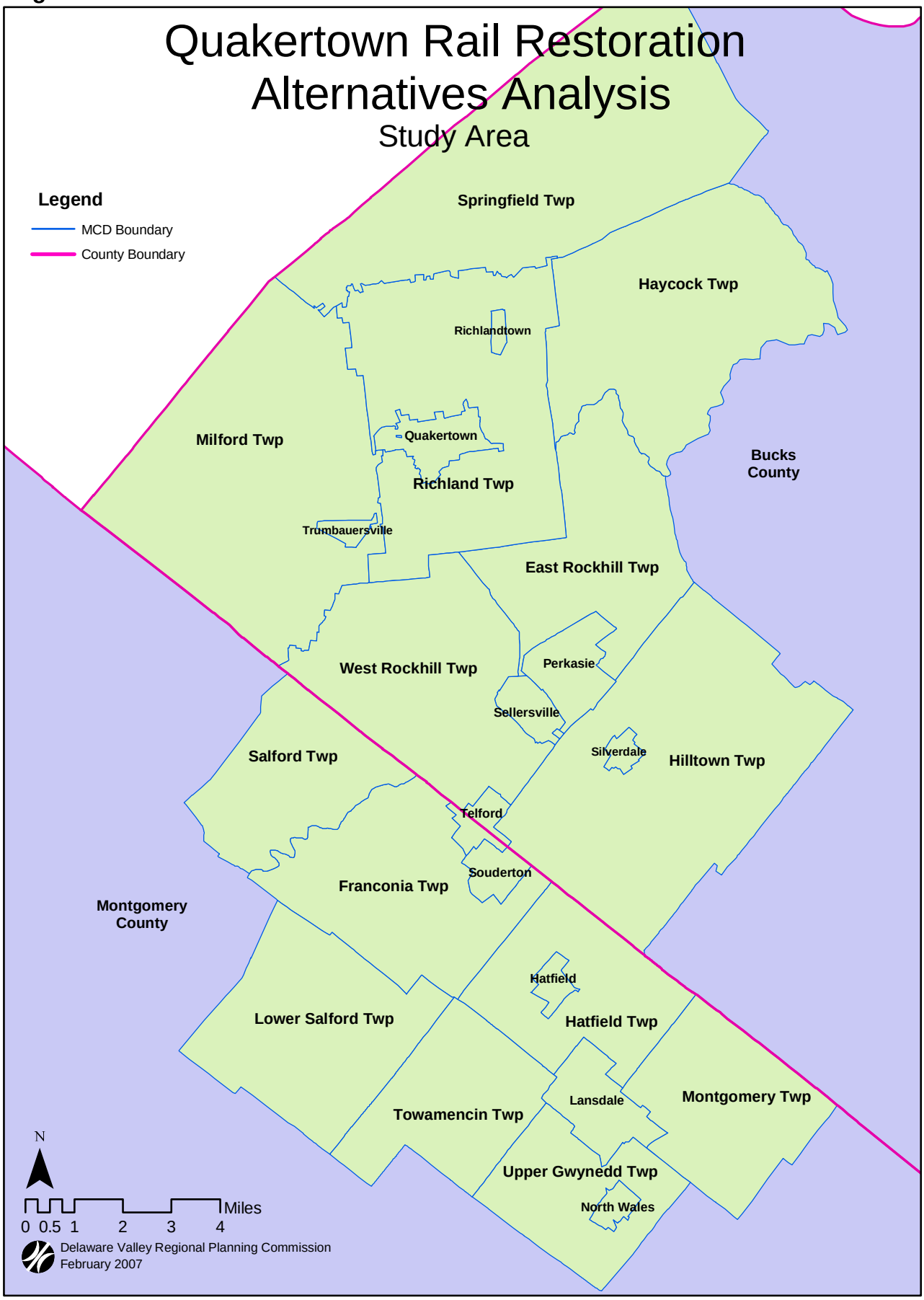
Quakertown Rail Restoration
Alternatives Analysis
Study Area
Legend
MCD Boundary
County Boundary
Springfield Twp
Haycock Twp
Richlandtown
Milford Twp
Quakertown
Richland Twp
Bucks
County
Trumbauersville
East Rockhill Twp
West Rockhill Twp
Perkasie
Sellersville
Salford Twp
Silverdale
Hilltown Twp
Telford
Souderton
Franconia Twp
Montgomery
County
Hatfield
Lower Salford Twp
Hatfield Twp
Lansdale
Montgomery Twp
Towamencin Twp
Upper Gwynedd Twp
North Wales
N
0 0.5 1 2 3 4
Miles
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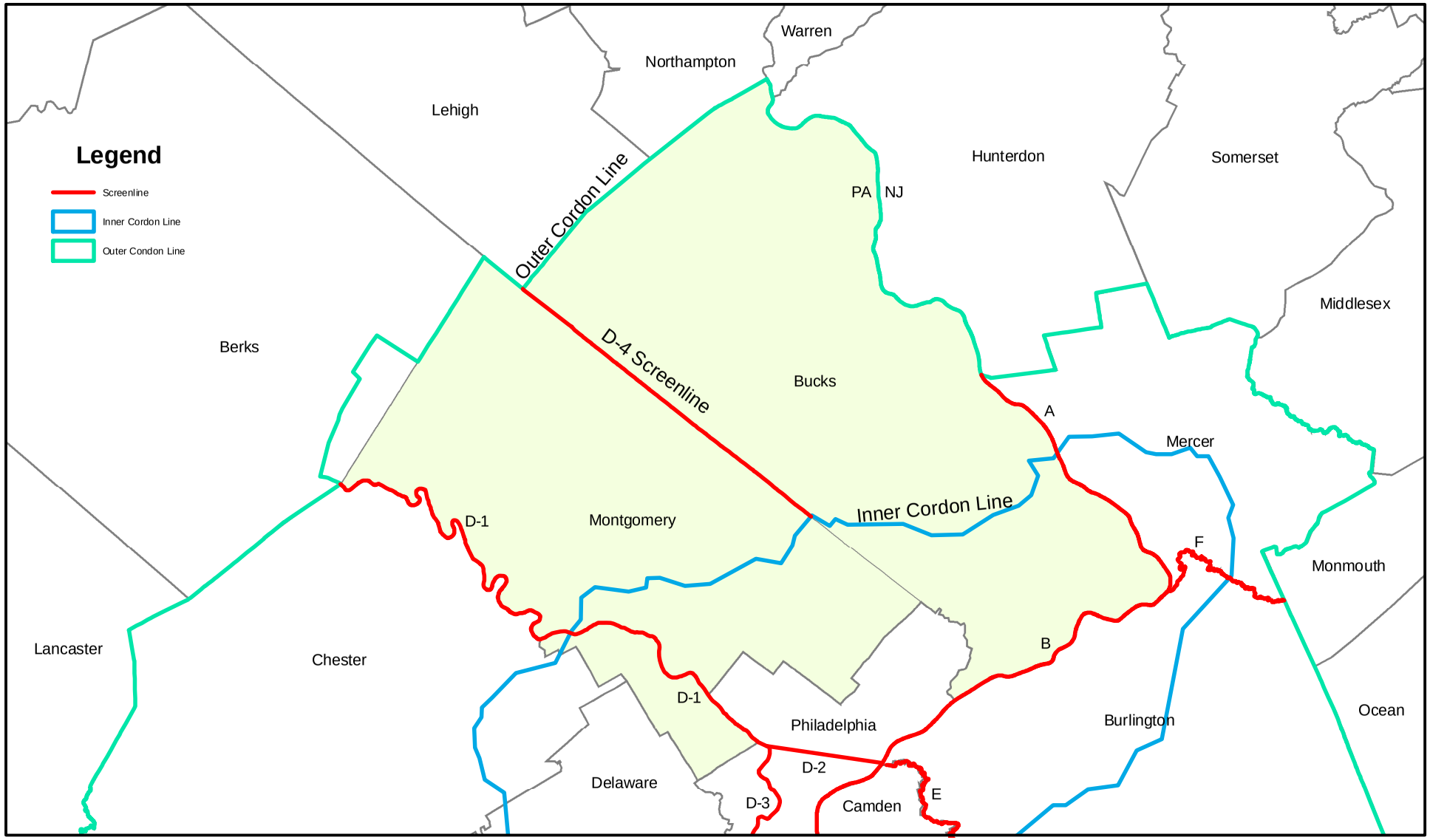
Figure 2



Quakertown Rail Restoration Alternatives Analysis
Screen/Cordon Lines

0 2.5 5 10 15 20 Miles

N

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in 2005, recorded 159,000 vehicles per day in Bucks County and 19,000 vehicles per day in Montgomery/Berks counties

Regional facilities and 2005 volumes:

PA 309 (35,076 vpd)	Bethlehem Pike (17,513 vpd)
PA 663 (18,177 vpd)	Township Line Road (11,146 vpd)
PA 113 (20,579 vpd)	US 202 (17,746 vpd)

B. Existing Transit Facilities and Current Ridership

The southern portion of the study area is served by the SEPTA R5 Doylestown line. Existing stations within the study area include: North Wales, Pennbrook, Lansdale, Fortuna, Colmar, and Link Belt. SEPTA 2005 Regional Rail Ridership Census reports, on an average weekday, a total of 16,645 person trips on the R5 north of Market East Station. The stations within the study area accommodate 5,153 person trips on an average weekday. Lansdale and North Wales together contribute about 3,500 daily person trips. SEPTA operates one bus route in the study area, Route 132, that provides service from Montgomery Mall in Montgomery Township to Telford Borough (Bucks County) through Lansdale, Hatfield, and Souderton. The route provides transfers to the R5 regional rail at Lansdale and bus routes 94, 96, 134 at Montgomery Mall. SEPTA preliminary ridership surveys indicate the route carries approximately 820 trips per day on an average weekday.

C. Existing Parking

According to the SEPTA Parking Operations 2005 survey, there are a total of 4,543 parking spaces, combined free and fee, available at SEPTA owned and operated stations on the R5 Doylestown line from Melrose Park north. In 2005, the total parking utilization at stations on the R5 Doylestown was 84.1 percent of maximum capacity.

Within the study area, utilization rates range from 64.7 percent at Pennbrook to 92.7 percent at Lansdale. A total of 1,468 spaces are available within the study area and a total of 1,230 cars were observed in those lots on an average weekday. Total parking usage within the study area was also 85.5 percent in 2005.

III. TRAVEL FORECASTING PROCEDURES

Regional travel simulation models are used to forecast future travel patterns. They utilize a system of traffic zones that follow census tract and block group boundaries and rely on demographic and employment data, land use, and transportation network characteristics to simulate trip-making patterns throughout the region. The travel models used for this study include the entire nine-county DVRPC region, with special attention focused on the study area.

For this study, a focused simulation process is employed. A focused simulation process allows the use of DVRPC's regional simulation models but includes a more detailed representation of the study area. Traffic zones inside the study area are subdivided so that traffic from existing and proposed land use developments may be loaded more precisely on transit routes and individual stations. The system of split zones developed for the Quakertown Rail Restoration Study Area is shown in **Figure 3**. The primary motivation for zone splitting is to be able to accurately delineate the service areas of existing and proposed rail stations and to differentiate between walk and auto approaches for the nested modal split and transit assignment. Overall, eleven traffic zones were added within the study area as a result of the zone splitting process.

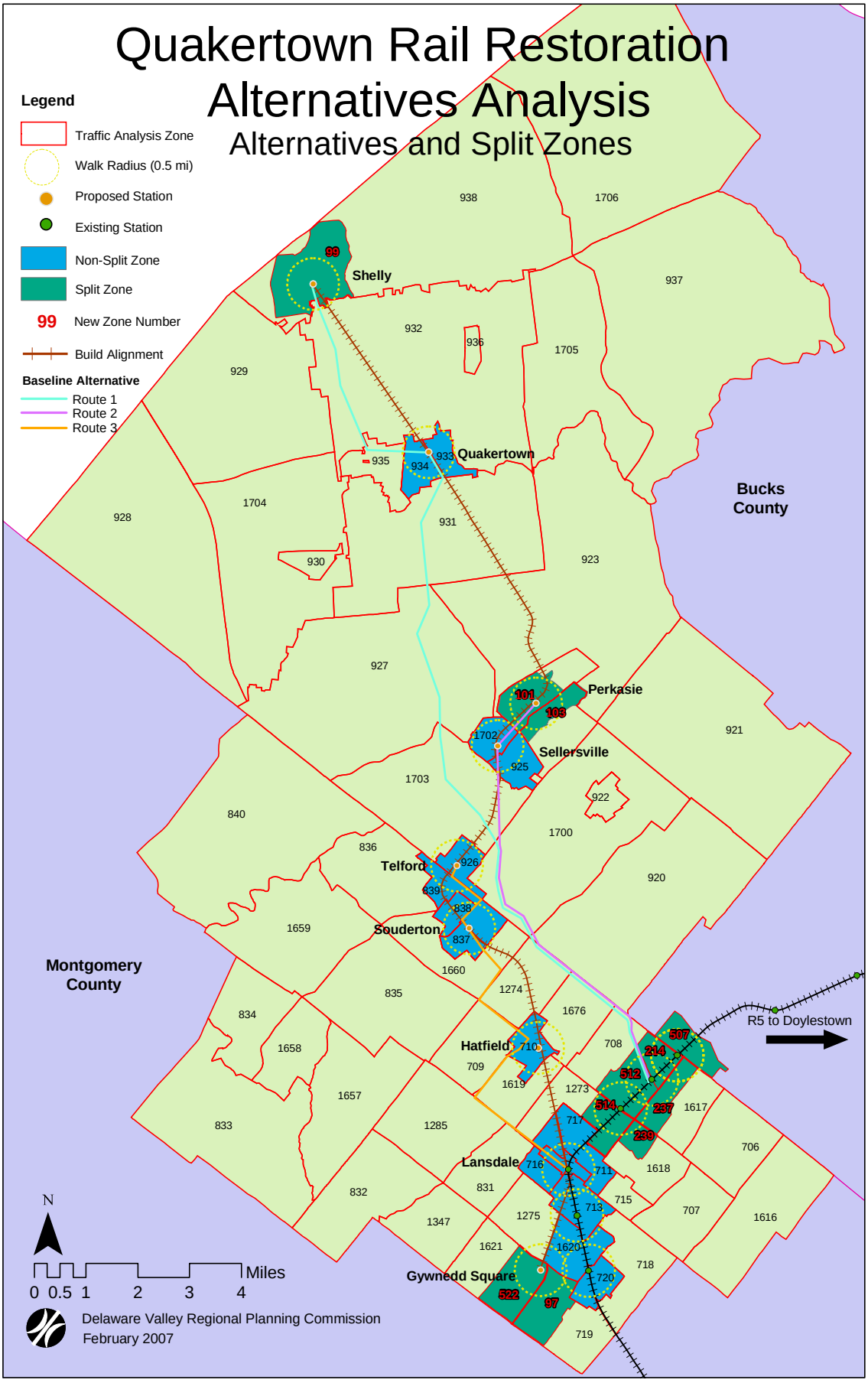
The focusing process increases the accuracy of the travel forecasts within the detailed study area. At the same time, all existing and proposed transportation projects throughout the region, their impact on the study area, and regional and interregional travel patterns, are retained as an integral part of the simulation process.

A. Socio-Economic Projections

DVRPC's long-range population and employment forecasts are revised periodically to reflect changing market trends, development patterns, local and national economic conditions, and other available data. The completed forecasts reflect all reasonably known current information and the best professional judgment of predicted future conditions.

DVRPC uses a multi-step, multi-source methodology to produce its population and employment forecasts at the county-level. County forecasts serve as control totals for municipal forecasts, which are disaggregated from county totals. Municipal forecasts are based on an analysis of historical data trends adjusted to account for infrastructure availability, environmental constraints to development, local zoning policy, and development proposals. Municipal forecasts are constrained using density ceilings and floors. County and where necessary, municipal input is used throughout the process to derive the most likely population and employment forecasts for all geographic levels.

Figure 3


Quakertown Rail Restoration Alternatives Analysis
Alternatives and Split Zones
Legend
Traffic Analysis Zone
Walk Radius (0.5 mi)
Proposed Station
Existing Station
Non-Split Zone
Split Zone
99 New Zone Number
Build Alignment
Baseline Alternative
Route 1
Route 2
Route 3
Shelly
Quakertown
Perkasie
Sellersville
Telford
Souderton
Hatfield
Lansdale
Gwynedd Square
Bucks County
Montgomery County
R5 to Doylestown
N
0 0.5 1 2 3 4 Miles
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1. Population Forecasting

Population forecasting at the regional level involves review and analysis of six major components: births, deaths, domestic in-migration, domestic out-migration, international immigration, and changes in group quarters populations (e.g., dormitories, military barracks, prisons, and nursing homes). DVRPC uses both the cohort survival concept to age individuals from one age group to the next, and a modified Markov transition probability model based on the most recent census and the US Census Bureau's recent population estimates program to determine the flow of individuals between the Delaware Valley and neighboring regions. For movement within the region, census and Internal Revenue Service migration data coupled with population estimates data are used to determine migration rates between counties. DVRPC relies on county planning offices to provide information on any known, expected, or forecasted changes in group quarters populations. These major population components are then aggregated and the resulting population forecasts are reviewed by member counties for final adjustments based on local knowledge.

2. Employment Forecasting

Employment is influenced by local, national, and global political and socio-economic factors. The Bureau of Economic Analysis provides the most complete and consistent time series data on county employment by sector, and serves as DVRPC's primary data source for employment forecasting. Employment sectors include mining, agriculture, construction, manufacturing, transportation, wholesale, retail, finance/insurance, service, government, and military. Other supplemental sources of data include the US Census, Dun & Bradstreet; Bureau of Labor Statistics' unemployment insurance covered employment (ES 202), Occupational Privilege Tax data, and other public and private sector forecasts. As in the population forecasts, county level total employment is used as a control total for sector distribution and municipal level forecasts. Forecasts are then reviewed by member counties for final adjustments based on local knowledge.

3. Study Area Forecasts

As part of this study, DVRPC staff reviewed its current population and employment estimates, its 2030 long-range population and employment forecasts, and all proposed land-use developments in the study area. The magnitude of any population and/or employment growth associated with each proposal was determined and compared to the DVRPC Board-adopted forecast for each municipality in the study area. Based on this review, DVRPC developed revised 2030 municipal-level population and employment forecasts for use as inputs to the traffic simulation models.

Table 1 summarizes the household forecasts used for this study. In 2005, there were 80,906 households within the study area. Strong growth in both population and employment is forecast for this area. By 2030, the study area is expected to add 25,778 new households and 70,004 additional jobs, increases of 31.9 and 58.9 percent, respectively.

Table 1
2030 Households Forecasts by Municipality

BUCKS COUNTY Municipality	DVRPC Board Adopted Households 2005	2030	Quakertown Study Surcharge	Projected 2030	Growth 2005-2030	Percent Growth w/ Surcharge
East Rockhill Twp	1,975	2,774	-	2,774	799	40.5%
Haycock Twp	882	1,293	-	1,293	411	46.6%
Hilltown Twp	4,637	6,670	190	6,860	2,223	47.9%
Milford Twp	3,397	5,349	-	5,349	1,952	57.5%
Perkasie Boro	3,385	3,726	230	3,956	571	16.9%
Quakertown Boro	3,470	3,560	-	3,560	90	2.6%
Richland Twp	4,794	5,916	546	6,462	1,668	34.8%
Richlandtown Boro	440	474	-	474	34	7.7%
Sellersville Boro	1,798	1,970	-	1,970	172	9.6%
Silverdale Boro	341	385	-	385	44	12.9%
Springfield Twp	1,953	3,019	-	3,019	1,066	54.6%
Telford Boro (Bucks)	1,027	1,164	-	1,164	137	13.3%
Trumbauersville Boro	387	431	-	431	44	11.4%
West Rockhill Twp	1,841	3,154	21	3,175	1,334	72.5%
Bucks County Sub-Total	**30,327**	**39,885**	**987**	**40,872**	**10,545**	**34.8%**
MONTGOMERY COUNTY						
Franconia Twp	4,437	7,352	691	8,043	3,606	81.3%
Hatfield Boro	1,120	1,083	113	1,196	76	6.8%
Hatfield Twp	6,539	7,621	746	8,367	1,828	28.0%
Lansdale Boro	6,685	6,889	225	7,114	429	6.4%
Lower Salford Twp	4,830	6,739	543	7,282	2,452	50.8%
Montgomery Twp	8,408	9,994	1,165	11,159	2,751	32.7%
North Wales Boro	1,288	1,279	2	1,281	(7)	-0.5%
Salford Twp	862	1,195	381	1,576	714	82.8%
Souderton Boro	2,624	2,655	11	2,666	42	1.6%
Telford Boro (Mont)	943	944	514	1,458	515	54.6%
Towamencin Twp	7,480	8,307	189	8,496	1,016	13.6%
Upper Gwynedd Twp	5,363	5,922	1,252	7,174	1,811	33.8%
Montgomery County Sub-Total	**50,579**	**59,980**	**5,832**	**65,812**	**15,233**	**30.1%**
Total Study Area	**80,906**	**99,865**	**6,819**	**106,684**	**25,778**	**31.9%**

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Absolute household growth is higher in the Montgomery County portion than in Bucks County portion of the study area. However, because of the larger base value there, the percentage growth in each county is similar; 34.8 and 30.1 percent, respectively. In Bucks County, Hilltown, Milford, and Richland townships grow by the largest margins and together account for half of all the Bucks study area growth.

Table 2 summarizes the employment forecasts; there were a total of 118,909 jobs in the study area. Bucks County municipalities grow faster on average (81.7 percent) than Montgomery (48.9 percent) County municipalities, though Bucks grows by a larger margin, again because Montgomery has such a large base value. Richland Township and Milford Township, where large surcharges result in growth rates of 189.9 and 404.9 percent between 2005 and 2030 together, account for 64.3 percent of all growth in the Bucks portion of the study area. In Montgomery County, Montgomery, Upper Gwynedd, and Hatfield townships together account for 65.1 percent of all growth in the Montgomery portion of the study area. The large surcharges result from planned industrial and commercial developments in each municipality.

B. DVRPC's Travel Simulation Models

DVRPC's travel models follow the traditional steps of trip generation, trip distribution, modal split, and traffic assignment. However, an iterative feedback loop is employed from traffic assignment to the trip distribution step. The feedback loop ensures that the highway and surface transit roadway congestion levels, used by the models when determining trip origins and destinations, are similar to those that result from the highway and transit assignment steps. Additionally, the iterative model structure allows trip making patterns to change in response to changes in traffic patterns, congestion levels, and improvements to the transportation system. A single iteration is sufficient to produce reasonable estimates of future highway congestion levels for purposes of estimating projected travel patterns.

For the build alternatives, the FTA currently requires that the no-build person trip table be utilized. This limits the feedback iterations to the modal split and transit/highway assignment model steps, resulting in separate iterative processes. Transit operator scheduled transit times and highway times taken from a travel time survey are used for model calibration. Both the No-Build and Build alternative future iterative processes start current scheduled transit and surveyed highway times.

1. Separate Peak, Midday, and Evening Models

The DVRPC travel simulation models are disaggregated into separate peak, midday, and evening time periods. This disaggregation begins in trip generation where factors are used to separate daily trips into time-period specific travel. The enhanced process then utilizes completely separate model chains for peak, midday, and evening travel simulation runs. Time of day sensitive inputs to the models such as highway speeds schedules by time period. Separate transit networks were required to represent the difference in transit service.

Table 2
2030 Employment Forecasts by Municipality

BUCKS COUNTY Municipality	2005	DVRPC Board Adopted Employment 2030	Quakertown Study Surcharge	Projected 2030	Growth 2005-2030	Percent Growth w/ Surcharge
East Rockhill Twp	1,873	2,755	766	3,521	1,648	88.0%
Haycock Twp	88	127	-	127	39	44.3%
Hilltown Twp	5,026	6,401	1,413	7,814	2,788	55.5%
Milford Twp	2,007	4,064	6,069	10,133	8,126	404.9%
Perkasie Boro	3,377	3,708	258	3,966	589	17.4%
Quakertown Boro	7,945	8,096	431	8,527	582	7.3%
Richland Twp	5,708	10,955	5,595	16,550	10,842	189.9%
Richlandtown Boro	193	231	36	267	74	38.3%
Sellersville Boro	3,596	3,957	136	4,093	497	13.8%
Silverdale Boro	315	294	-	294	(21)	-6.7%
Springfield Twp	688	990	138	1,128	440	64.0%
Telford Boro (Bucks)	1,030	1,128	-	1,128	98	9.5%
Trumbauersville Boro	506	603	-	603	97	19.2%
West Rockhill Twp	3,758	5,912	1,538	7,450	3,692	98.2%
Bucks County Sub-Total	**36,110**	**49,221**	**16,380**	**65,601**	**29,491**	**81.7%**
MONTGOMERY COUNTY						
Franconia Twp	5,791	7,950	625	8,575	2,784	48.1%
Hatfield Boro	2,073	2,000	28	2,028	(45)	-2.2%
Hatfield Twp	13,187	19,681	2,347	22,028	8,841	67.0%
Lansdale Boro	10,620	11,200	604	11,804	1,184	11.1%
Lower Salford Twp	6,939	9,400	2,155	11,555	4,616	66.5%
Montgomery Twp	17,995	24,103	5,061	29,164	11,169	62.1%
North Wales Boro	1,770	1,800	33	1,833	63	3.6%
Salford Twp	314	350	-	350	36	11.5%
Souderton Boro	2,780	2,800	63	2,863	83	3.0%
Telford Boro (Mont)	1,047	1,050	-	1,050	3	0.3%
Towamencin Twp	5,706	9,505	1,585	11,090	5,384	94.4%
Upper Gwynedd Twp	14,577	17,900	3,072	20,972	6,395	43.9%
Montgomery County Sub-Total	**82,799**	**107,739**	**15,573**	**123,312**	**40,513**	**48.9%**
Total Study Area	**118,909**	**156,960**	**31,953**	**188,913**	**70,004**	**58.9%**

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The enhanced model is disaggregated into separate model chains for the peak (combined AM and PM), midday (the period between the AM and PM peaks), and evening (the remainder of the day) periods for the trip distribution, modal split, and travel assignment phases of the process. The peak period is defined as 7:00 AM to 9:00 AM and 3:00 PM to 6:00 PM. Peak period and midday travel are based on a series of factors which determine the percentage of daily trips that occur during those periods. Evening travel is then defined as the residual after peak and midday travel are removed from daily travel.

External-local transit and highway productions at the nine-county cordon stations are disaggregated into peak, midday, and evening components using percentages derived from the temporal distribution of traffic counts taken at each cordon station.

2. The Model Chain

The first step in the process involves generating the number of trips that are produced by and destined for each traffic zone and cordon station throughout the nine-county region Origin-destination patterns are then established and trips are proportioned between highway and transit modes. Finally, the most appropriate route for each trip is determined, and traffic volumes are assigned to individual facilities. **Figure 4** displays a flowchart of the travel simulation modeling process for No-Build alternative and **Figure 5** the iterative process utilized for the build alternatives.

Trip Generation

Both internal trips (those made within the DVRPC region) and external trips (those which cross the boundary of the region) must be considered in the simulation of regional travel. For the simulation of current and future travel demand, internal trip generation is based on zonal forecasts of population and employment, whereas external trips are extrapolated from cordon line traffic counts and other sources. The latter also include trips which pass through the Delaware Valley region. Estimates of internal trip productions and attractions by zone are established on the basis of trip rates applied to the zonal estimates of demographic and employment data. This part of the DVRPC model is not iterated on highway travel speed. Rather, estimates of daily trip making by traffic zone are calculated and then disaggregated into peak, midday, and evening time periods.

No-Build and Build Alternative Model Iterations

For future simulations, the iterative portion of the forecasting process involves updating the highway and surface transit network restrained link travel speeds, rebuilding the minimum time paths through the networks, and skimming the inter-zonal travel time from the new congested minimum paths. Then the trip distribution, modal split, transit and highway assignment models are executed in sequence for the No-Build alternative.

Figure 4

DVRPC FTA Compliant Iterative Structure No-Build Alternative

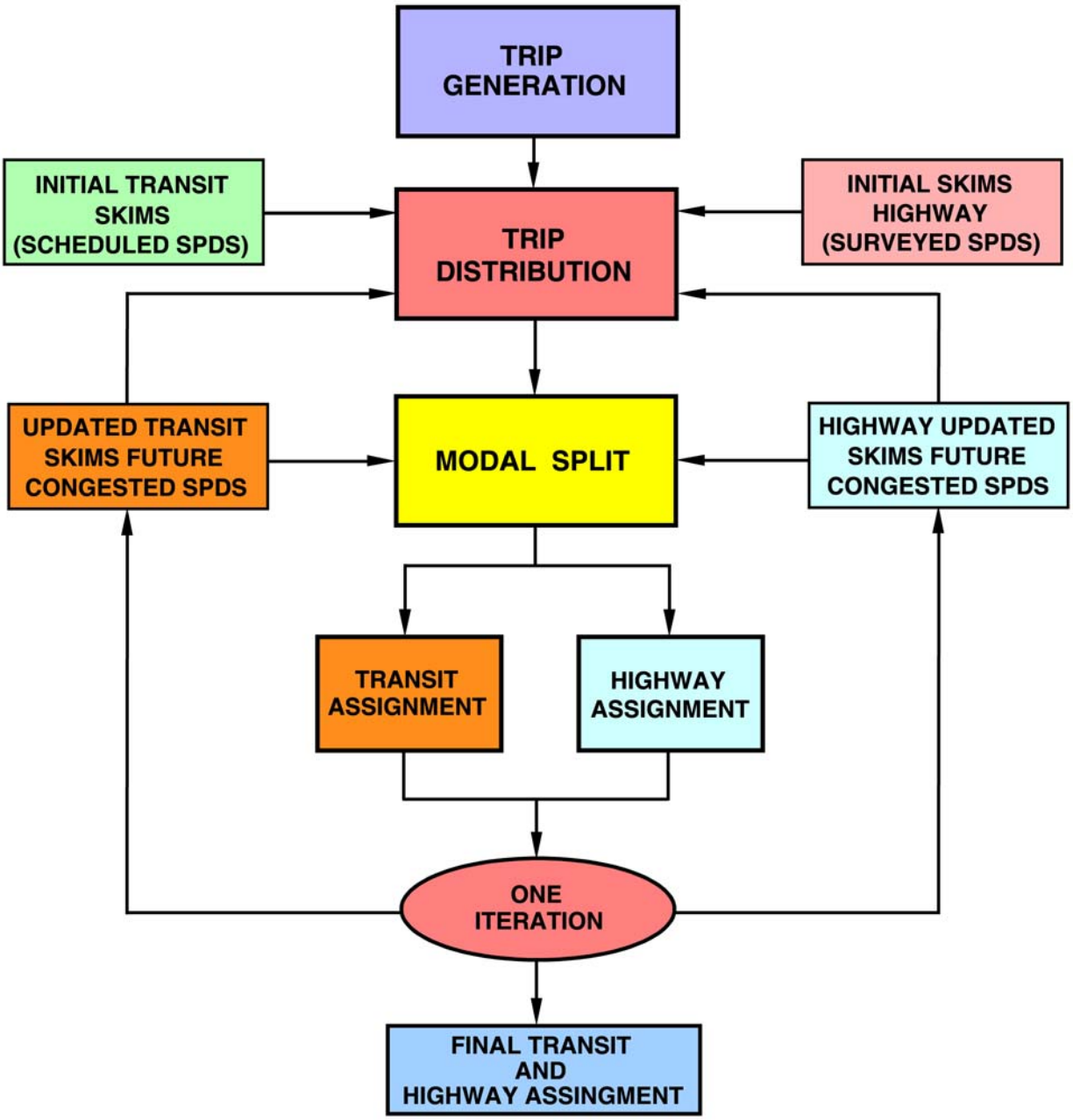

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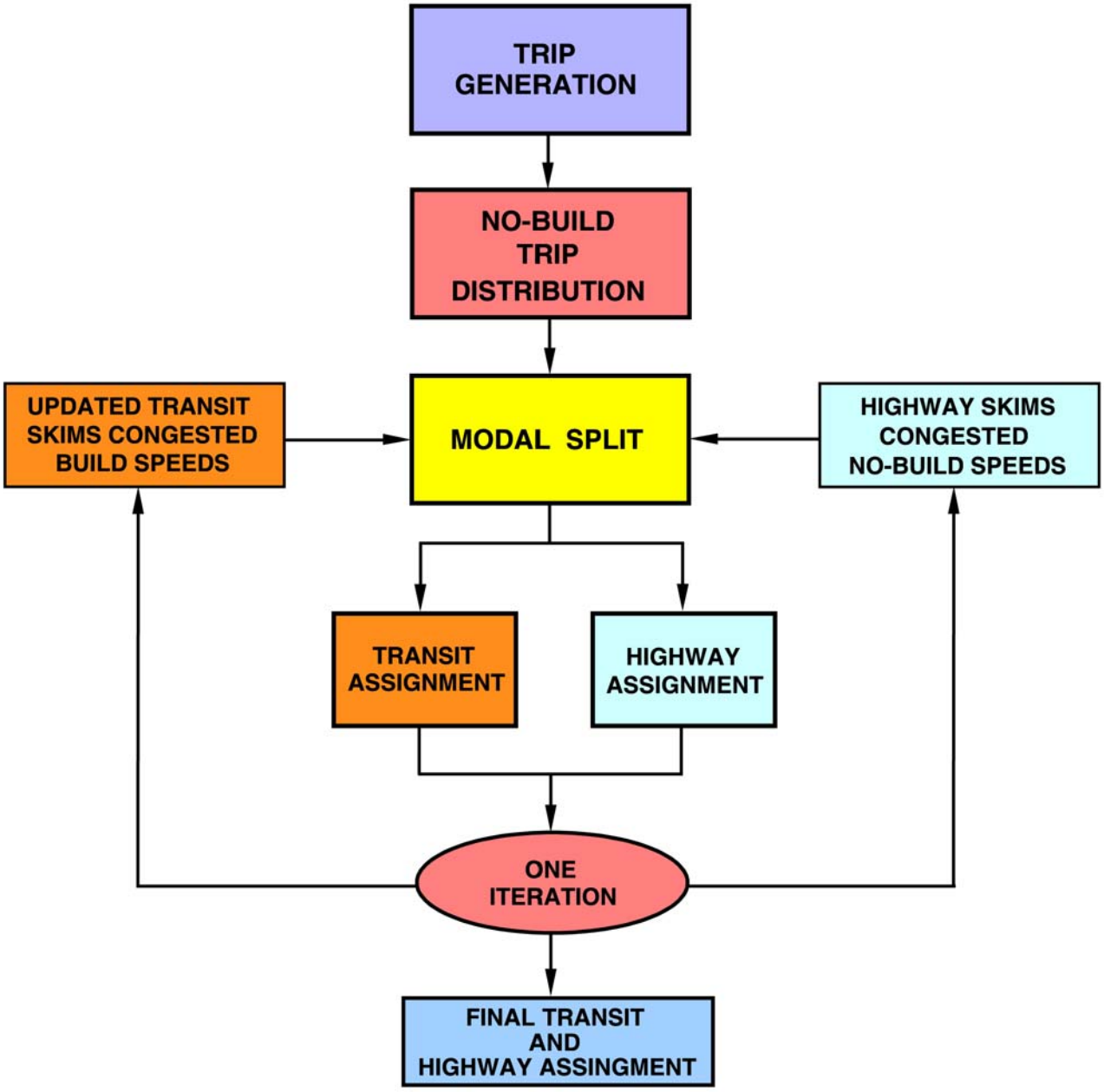
Figure 5

DVRPC FTA Compliant Iterative Structure Build Alternative



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In response to FTA requirements, congested No-Build alternative highway and transit skims were utilized for trip distribution for each build alternative to force the model to reproduce no-build person trip travel patterns. Subsequent to trip distribution, one iteration on future congested highway and surface transit times was performed in the modal split and transit/highway model steps to insure that the impact of the proposed transit facilities on future highway and surface transit congestion patterns is considered.

Trip Distribution

Trip distribution is the process whereby the zonal trip ends established in the trip generation analysis are linked together to form origin-destination patterns in trip table format. Peak, midday, and evening trip ends are distributed separately with each time period. A series of eight gravity-type distribution models are applied at the zonal level. These models follow trip purpose and vehicle type stratifications established in trip generation.

Modal Split

The modal split model is also run separately for the peak, midday, and evening time periods. The modal split model calculates the fraction of each person-trip interchange in the trip table which should be allocated to transit using a binary logit formulation, and then assigns the residual to the highway side. The model is nested by mode of approach (auto versus walk/bus) and stratified by trip purpose (home based work, home based non-work, and non-home based), transit sub-mode (commuter rail, subway elevated, or surface), and auto ownership (zero-vehicle or one-plus vehicle households). The choice between highway and transit usage is made on the basis of comparative cost, travel time, and frequency of service, with other aspects of modal choice being used to modify this basic relationship. In general, the better the transit service, the higher the fraction assigned to transit, although trip purpose and auto ownership also affect the allocation. The model subdivides highway trips into auto drivers and passengers. Auto driver trips are added to the truck, taxi, and external vehicle trips in preparation for assignment to the highway network.

Transit Assignment

After each model iteration, the transit trip tables are assigned to the transit network to produce link and route passenger volumes. The transit person trips produced by the modal split model are "linked" in that they do not include any transfers that occur either between transit trips or between auto approaches and transit lines. The transit assignment procedure accomplishes two major tasks. First, the transit trips are "unlinked" to include transfers, and second, the unlinked transit trips are associated with specific transit facilities to produce link, line, and station volumes. These tasks are accomplished simultaneously within the transit assignment model, which assigns the transit trip matrix to the minimum impedance paths built through the transit network. There is no capacity restraining procedure in the transit assignment model.

Highway Assignment

The final step in the focused simulation process is the assignment of current or future vehicle trips to the highway network representative of the appropriate scenario. For

peak, midday, and evening travel, the assignment model produces the future traffic volumes for individual highway links that are required for the evaluation of the alternatives. The regional nature of the highway network and trip table underlying the focused assignment process allow the diversion of travel into and through the study area to various points of entry and exit in response to the improvements made in the transportation system.

Highway trips are assigned to the network representative of a given alternative by determining the best (minimum time) route through the highway network for each zonal interchange and then allocating the inter-zonal highway travel to the highway facilities along that route. This assignment model is "capacity restrained" in that congestion levels are considered when determining the best route. The equilibrium assignment method is used to implement the capacity constraint. When the assignment reaches equilibrium, no path faster than the one actually assigned can be found through the network, given the capacity restrained travel times on each link.

C. Model Calibration

For the Quakertown Rail Reactivation Study, the simulation model parameters were fine-tuned as part of the model calibration to accurately reproduce transit route and station volumes and highway screenline volumes throughout the study area. Most of these parameter adjustments were in the sub-mode strata of the modal split model. Within the study area, the regionally validated model parameters tended to significantly underestimate current R5 commuter rail ridership and over-estimate patronage on existing bus routes. The results of the re-calibrated modeling chain are displayed in **tables 3**, **4**, and **5**. **Table 3** compares 2005 passenger counts with simulated average weekday boardings for the SEPTA transit system by operating division and sub-mode. The re-calibrated model is able to reproduce regional SEPTA system totals within acceptable levels of accuracy. The model predicts 2005 SEPTA City Transit and Total Transit to within one percent of surveyed volume.

Highway Screenline Checks

Table 4 displays the results of the 2005 highway sceenline validation for the system of study area screenlines. The totals for each screenline represent the sum of all counted or simulated traffic volumes for the roadways crossing the cordon line. The purpose of the highway screenline analysis is to insure that the model estimates the correct number of highway trips that could be potentially diverted to new transit services.

Rail Station Volumes

Simulated 2005 station trips (boardings and alightings) are compared with SEPTA platform counts taken from the 2005 Railroad Census in **Table 5**. These comparisons show that the recalibrated model is reproducing the study area SEPTA platform counts within 100 trips or 10 percent of observed, an acceptable level of accuracy to test the Quakertown Study alternatives.

Table 3
2005 Transit Calibration Daily Volume by Operating Company

Company/Division	Submode	2005 Assigned Boardings	2005 Passenger Counts	Difference Number	Difference Percent
SEPTA City Transit	Subway-Elevated	276,441	283,200	(6,759)	-2.4%
	Bus & Trolley	527,251	514,352	12,899	2.5%
City Sub-total		**803,692**	**797,552**	**6,140**	**0.8%**
Victory Division	Heavy Rail	6,605	8,057	(1,452)	-18.0%
Victory Division	Bus & Light Rail	33,388	36,216	(2,828)	-7.8%
Victory Division	Bus/Lt. Rail	39,998	44,273	(4,275)	-9.7%
Frontier Division	Bus	13,134	12,590	544	4.3%
Suburban Sub-Total		**53,135**	**56,863**	**(3,728)**	**-6.6%**
SEPTA Regional Rail	Commuter Rail	**107,126**	**101,200**	**5,926**	**5.9%**
SEPTA Total		**964,288**	**955,615**	**8,673**	**0.9%**

Table 4
2005 Screenline Highway Calibration Average Annual Daily Traffic Volumes

Study Area Screenlines	2005 Counted Volumes	2005 Simulated Volumes	Difference Number	Difference Percent
Bucks County Inner Cordon	286,892	297,901	11,009	3.8%
Montgomery County Inner Cordon	554,989	564,441	9,452	1.7%
Subtotal Inner Cordon	**841,881**	**862,342**	**20,461**	**2.4%**
Bucks County Outer Cordon	159,010	159,587	577	0.4%
Montgomery County Outer Cordon	18,959	19,179	220	1.2%
Subtotal Outer Cordon	**177,969**	**178,766**	**797**	**0.4%**
Bucks-Montgomery County Screenline	268,091	290,109	22,018	8.2%
Total Cordon	**1,019,850**	**1,041,108**	**21,258**	**2.1%**
Grand TOTAL	**1,287,941**	**1,331,217**	**43,276**	**3.4%**

Table 5
2005 Study Area Transit Calibration Volume by Station

Study Area R5 Rail Stations	Average Weekday Board and Alight			
	2005 Count	2005 Simulated	Difference Number	Difference Percent
Link Belt	144	137	(7)	-4.9%
Colmar	532	600	68	12.8%
Fortuna	134	147	13	9.7%
Lansdale	2,106	2,145	39	1.9%
Pennbrook	826	834	8	1.0%
North Wales	1,411	1,416	5	0.4%
Subtotal Study Area	**5,153**	**5,279**	**126**	**2.4%**
Doylestown/Lansdale Branch Total	**16,645**	**15,468**	**(1,177)**	**-7.1%**
Bus Route 132	860	820	(40)	-4.7%

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Comparison of Model Output with 2000 CTPP Philadelphia CBD Work Trips

The FTA recommends verification of the DVRPC model Gravity model output by comparing study area work travel to the Philadelphia CBD with corresponding estimates from the 2000 Census CTPP. The travel simulation model calibrated for the Quakertown Rail Study very closely replicates observed 2000 CTPP worker flows. The Philadelphia CBD is defined as the area bounded by Vine Street, South Street, and the Delaware and Schuylkill rivers.

A comparison of 2000 CTPP and the home-based work travel from the Study Area to the Philadelphia follows:

2000 CTPP Study Area employed residents who work in the Philadelphia CBD: **1,829**

Factor to convert 2000 CTPP workers to home-based work trip productions: **1.78**

2000 CTPP home-based work Study Area productions to Philadelphia CBD: **3,256**

2005 Quakertown Calibrated Model home-based work Study Area productions to Philadelphia CBD: **3,249**

It is clear from the above figures, that the calibrated Quakertown Study Area model very closely replicates the observed 2000 CTPP Study Area to Philadelphia CBD worker flows.

D. Station Parking Requirements

An estimation procedure was developed and calibrated to estimate station parking requirements from simulated station passenger volumes. This procedure is based on special tabulations of simulation model outputs that isolate home to station trips by walk and auto approach modes from the simulated model output. Home to station trips were then categorized by approach mode as walk, park and ride, or kiss and ride. Station parking requirements were then estimated from the park and ride approaches assuming an average vehicle occupancy. The station parking model was calibrated using parking lot utilization data provided by SEPTA.

Table 6 displays the 2005 results of the calibrated station approach model for the existing stations within the study area. Overall, there is a great deal of variation in the percentage distribution of approach modes by station, depending on the characteristics of each station (parking availability, walk proximity to residential neighborhoods, etc.). Overall, **Table 6** shows that the calibrated station approach model reproduced parking lot utilization counts with an acceptable level of accuracy.

Table 6
2005 Study Area Parking Requirements and Station Approach Calibration

Station	Simulated Total	Home-to-Station Walk	Percent Walk	Home-to-Station Park & Ride	Percent Park & Ride	Home-to-Station Kiss & Ride	Percent Kiss & Ride	2005 Simulated	2005 Count	Difference Number	Difference Percent
Link Belt	144	48	100%	-	0%	-	0%	-	-	-	na
Colmar	600	5	2%	228	90%	20	8%	222	218	(4)	-2.0%
Fortuna	147	0	2%	18	75%	6	23%	18	25	7	29.7%
Lansdale	2,145	216	24%	477	53%	207	23%	459	461	2	0.5%
Pennbrook	834	62	20%	172	55%	78	25%	165	158	(7)	-4.7%
North Wales	1,416	53	10%	361	68%	117	22%	350	368	18	4.9%
Total	**5,286**	**384**	**19%**	**1,254**	**61%**	**427**	**21%**	**1,214**	**1,230**	**16**	**1.3%**

E. Improvement Alternatives

Separate model runs are performed for each future-year alternative to be tested. For this study, DVRPC prepared traffic forecasts for a No-Build and three Build alternatives. The No-Build alternative provides a useful future-year reference against which any impacts associated with the build alternative may be compared and quantified. The traffic forecasts and analysis are presented in Chapter IV.

IV. TRANSIT ALTERNATIVES

This study includes four alternatives: No-Build, Baseline, and two Build alternatives. To qualify as an FTA New Starts projects, the Baseline alternative functions as the Transit Service Maintenance (TSM) alternative and assumes the expansion of bus service in the study area. The two Build alternatives model incremental service improvements to the rail line; one using diesel powered rail cars, the other uses fully electrification of the line. The future highway network includes all committed projects on the Transportation Improvement Program (TIP) in the study area. Projects that impact the DVRPC Travel Demand Model are listed here (see *Table 1* of Edwards and Kelcey; QRRAA Baseline Description Technical Memorandum for a complete list of study area projects):

Project #:	**Project Name:**	**Project Description:**
57635	Quakertown Joint Closed Loop	Install closed loop signal system for US 309, California Rd, Main St
16438	PA 309 Connector Project	Realign PA 63 from Old Forty Foot Rd to Freed Rd, upgrade Wambold Rd from PA 63 to Allentown Rd
16731	US 202 Parkway	Section 701 of the US 202 Parkway between PA 63 and PA 309
16742	PA 63, Forty Foot Road	Widen Forty Foot Rd to four lanes, widen Sumneytown Pike intersection
63491	US 202 , Morris Road-PA 63	Widen US 202 from 2 lanes to 5 lanes
63492	US 202, PA 63-PA 309	Widen US 202 from 2 lanes to 5 lanes
64811	PA 463 Horsham Road, North Wales Road to General Hancock Road	Widen limited 1,148 meter section to 4 lanes
60255	R5 Glenside to Lansdale Signal Improvements	New bi-directional, cab train control signaling system, 70 mph max speed

A. No-Build Alternative

The No-Build scenario does not incorporate any of the network improvements being modeled in this study. The network, however, is enhanced with all of the projects in the Transportation Improvement Program (TIP) for Pennsylvania as well as the Long Range Transportation Plan. The US 202 Parkway and widening of existing US 202 are likely to have the greatest impact on the study area.

B. Baseline Alternative: Transit Service Maintenance

The Baseline Alternative includes the addition of three express bus routes to connect the study area to existing stations along the R5 Doylestown line. See **Figure 3** for route alignment.

Route 1- Provides express service from Shelly and Quakertown to Colmar with headways ranging from 30 to 60 minutes throughout the day designed to meet R5 trains arriving at Colmar. Travel time from Shelly to Colmar is approximately 30 minutes and from Colmar to 30th Street Station is approximately 80 minutes for express trains or 90 minutes for local trains during peak hours.

Route 2- Provides service from Perkasie and Sellersville to Colmar with headways ranging from 30 to 60 minutes throughout the day designed to meet R5 trains arriving at Colmar. Travel time from Perkasie to Colmar is approximately 16 minutes and from Colmar to 30th Street Station is approximately 80 minutes for express trains or 90 minutes for local trains during peak hours.

Route 3- Provides service from Telford (Bucks), Souderton, and Hatfield to Lansdale with headways ranging from 30 to 60 minutes throughout the day designed to meet R5 trains arriving at Lansdale. Travel time from Telford to Lansdale is approximately 20 minutes and from Lansdale to 30th Street Station is approximately 45 minutes for express trains or 50 minutes local trains during peak hours.

C. Build Alternative 1: Diesel Rail Shuttle

This alternative provides diesel shuttle service from Shelly to Lansdale over the existing rail right-of-way currently used exclusively for freight traffic. The service will make stops at Shelly, Quakertown, Perkasie, Sellersville, Telford, Souderton, Hatfield, and Lansdale stations. Also included in this alternative, is a spur down the Stony Creek Line to the Merck facilities at Gywnedd Square station. This alternative will be referred to as the "Shuttle" alternative.

Service frequency and headways are designed to meet R5 trains at Lansdale to provide for easy transfer downtown. Travel time from Shelly to Lansdale is approximately 35

minutes and from Shelly to 30th Street Station is approximately 100 minutes during peak hours including transfer time at Lansdale.

Existing SEPTA Zone 5 fare is surcharged $0.50 for service on the rail extension beyond Lansdale.

D. Build Alternative 2: Regional Rail Extension (Electric Multiple Unit Direct)

This alternative models full reactivation and provides direct R5 service extension from Lansdale to Shelly making intermediate stops at Hatfield, Souderton, Telford, Sellersville, Perkasie, and Quakertown stations. Service frequency provides for 30 minute headways during peak travel hours and 60 minute headways off-peak. Travel time from Quakertown to Lansdale is approximately 25 minutes and from Quakertown to 30th Street Station is approximately 85 minutes. This alternative will be referred to as the "Regional Rail" alternative.

Existing SEPTA Zone 5 fare is surcharged $0.50 for service on the rail extension beyond Lansdale.

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V. PROJECTED TRAVEL DEMAND

Travel and parking demands were forecast for the year 2030. Findings for each of the four alternatives are presented and analyzed in this chapter. Data for transit demand is presented as boardings, plus alightings, indicating the number of 'trip-ends' generated at each station. As a result, local riding can cause individual station and study area totals to exaggerate trip production/attraction changes across alternatives. To account for this inflation, total commuter rail person trip data are provided for each alternative to compare alternatives.

A. No-Build Alternative

The No-Build alternative model assumes only committed improvements in the Transportation Improvement Program. **Table 7** presents the highway forecast for the year 2030 under the No-Build scenario. The highway network, as a whole, experiences a 19.8 percent increase in traffic volume; however, the Bucks-Montgomery (D-4) Screenline experiences a 25.8 percent increase in traffic volume growth. Strong population and employment growth fuel this increased traffic volume within the study area.

1. Station Volume

Population growth is expected to fuel increased transit riding throughout the transit network. Results for the No-Build alternative are presented in **Table 8**. Overall riding on the regional rail system is forecast to increase by 2,845 trips per day (2.7 percent) over the 2005 survey volume. Total station volume within the study is forecast to increase by 11.1 percent, from 5,279 trips per day to 5,867 trips per day, from 2005 surveyed volumes; the existing bus Route 132 is expected to increase by 21.5 percent, from 820 trips per day to 996 trips per day, from 2005 surveyed volume.

2. Parking Demand

Currently available parking at all stations, save North Wales, is adequate to handle increased riding under the No-Build scenario. At North Wales, the current available parking falls 11 spaces short of forecast parking demand for station volume in the year 2030. Results from the No-Build parking demand analysis are presented in **Table 9**.

Station approaches by mode are presented in **Table 10**. Park and Ride accounts for 61.2 percent of study area approaches while Kiss and Ride accounts for 19.2 percent. Total walk approaches comprise 16.9 percent of study area station approaches. The model estimates 41 transfers from the existing bus to the regional rail network at Lansdale or 1.9 percent of study area approaches.

Table 7
2005 and 2030 No-Build Highway Screenline Forecasts

R5 Study Area Screenlines	2005 Simulated	2030 Simulated	Difference Number	Difference Percent
Bucks County Inner Cordon	297,901	344,222	46,321	15.5%
Montgomery County Inner Cordon	564,441	661,878	97,437	17.3%
Subtotal Inner Cordon	**862,342**	**1,006,100**	**143,758**	**16.7%**
Bucks County Outer Cordon	159,587	201,044	41,457	26.0%
Montgomery County Outer Cordon	19,179	22,639	3,460	18.0%
Subtotal Outer Cordon	**178,766**	**223,683**	**44,917**	**25.1%**
Bucks-Montgomery County Screenline	290,109	364,873	74,764	25.8%
Total Cordon	**1,041,108**	**1,229,783**	**188,675**	**18.1%**
Grand TOTAL	**1,331,217**	**1,594,656**	**263,439**	**19.8%**

Table 8
2030 No-Build Rail Ridership by Station

Study Area Station	2005 Count	Weekday Board and Alight 2030 No Build	Difference Number	Difference Percent
Shelly	-	-	-	na
Quakertown	-	-	-	na
Perkasie	-	-	-	na
Sellersville	-	-	-	na
Telford	-	-	-	na
Souderton	-	-	-	na
Hatfield	-	-	-	na
Subtotal New Station	**-**	**-**	**-**	**na**
Link Belt	137	177	40	29.2%
Colmar	600	687	87	14.5%
Fortuna	147	196	49	33.3%
Lansdale	2,145	2,214	69	3.2%
Pennbrook	834	917	83	10.0%
North Wales	1,416	1,676	260	18.4%
Subtotal Study Area	**5,279**	**5,867**	**588**	**11.1%**
Total Commuter Rail Persons Trips	**107,126**	**109,971**	**2,845**	**2.7%**

Table 9
2030 No-Build Rail Station Parking Requirements

Study Area Station	Weekday Parking			
	2030 Station Riding	2030 Parking Requirement	2005 Existing Parking	Additional Parking
Shelly	-	-	-	na
Quakertown	-	-	-	na
Perkasie	-	-	-	na
Sellersville	-	-	-	na
Telford	-	-	-	na
Souderton	-	-	-	na
Hatfield	-	-	-	na
Gywnedd Square	-	-	-	na
Subtotal New Stations	**-**	**-**	**-**	**na**
Link Belt	177	-	-	0
Colmar	687	229	291	0
Fortuna	196	16	33	0
Lansdale	2,214	472	497	0
Pennbrook	917	137	244	0
North Wales	1,676	414	403	11
Subtotal Existing Stations	**5,867**	**1,267**	**1,468**	**11**
Total Study Area	**5,867**	**1,267**	**1,468**	**11**

Table 10
2030 No-Build Rail Station Approaches

Station	Total Approach	Home to Station Approaches[1]			
		Walk	Park and Ride	Kiss and Ride	Feeder Bus
Link Belt	55	40	-	15	-
Colmar	261	5	235	21	-
Fortuna	23	1	16	5	-
Lansdale	909	198	490	180	41
Pennbrook	258	52	142	64	-
North Wales	609	61	426	122	-
Total	**2,114**	**356**	**1,309**	**407**	**41**

[1]Excludes reverse commuting

B. Baseline Alternative

This alternative models three feeder buses that provide access to the R5 Doylestown/Lansdale line. The model assumes 100 percent walk approach to the bus stations. This assumption rests on regional experience with feeder bus routes, such as the discontinued Newtown shuttle.

1. Station Volume

The Baseline alternative produces a negligible increase in total regional rail system riding over the No-Build scenario. Results for the Baseline alternative are presented in **Table 11**. Total station volume in the study area is expected to increase by 9.4 percent over the No-Build scenario. The three feeder buses are forecast to carry 527 daily trips in total with Souderton and Telford accounting for nearly half of all daily riding on the new buses, 110 additional bus riders, versus the No-Build, transfer to the regional rail. Riders who transfer to the regional rail network account for 20.8 percent of study area bus ridership. Declining station volumes at Fortuna, Lansdale, and Pennbrook stations indicate that some riders have rerouted to use the two buses feeding Colmar station.

2. Parking Demand

Currently available parking is adequate to accommodate the increased parking demand under the Baseline: TSM alternative. Results from the parking demand analysis are presented in **Table 12**.

Station approaches by mode are presented in **Table 13**. Park and Ride accounts for 57.6 percent of all station approaches and are down 3.6 percent from the No-Build scenario. Kiss and Ride, as well as, Walk account for 18.4 percent and 16.8 percent, respectively, of all study are approaches; virtually unchanged from the No-Build alternative. The model estimates 151 transfers from the feeder buses to the regional rail network and account for 7.1 percent of study area approaches, up 5.2 percent from the No-Build scenario.

C. Diesel Shuttle Alternative

This alternative models a diesel powered shuttle operating from Shelly in Springfield Township, Bucks County to Gywnedd Square in Upper Gwynedd Township, Montgomery County with headway and service frequency designed to meet R5 trains at Lansdale for transfer to the regional rail network. This alternative includes one station on the Stoney Creek line providing shuttle access to the Merck facility at Gywnedd Square.

1. Station Volume

Under this alternative, total regional rail volume is expected to increase to 113,685 person trips by the year 2030 representing a 3,694 person trip improvement over the

Table 11
2030 Baseline Rail Station Ridership

Study Area Station	2030 No-Build	Weekday Board and Alight		
		2030 Baseline	Difference Number	Difference Percent
Shelly (bus)	-	7	7	na
Quakertown (bus)	-	42	42	na
Perkasie (bus)	-	79	79	na
Sellersville (bus)	-	90	90	na
Telford (bus)	-	120	120	na
Souderton (bus)	-	129	129	na
Hatfield (bus)	-	60	60	na
Subtotal New Station	**-**	**527**	**527**	**na**
Link Belt	177	187	10	5.6%
Colmar	687	845	158	23.0%
Fortuna	196	183	(13)	-6.6%
Lansdale	2,214	2,112	(102)	-4.6%
Pennbrook	917	865	(52)	-5.7%
North Wales	1,676	1,700	24	1.4%
Subtotal Existing Stations	**5,867**	**6,419**	**552**	**9.4%**
Total Commuter Rail Person Trips	**109,971**	**109,982**	**11**	**0.0%**

Table 12
2030 Baseline Rail Station Parking Requirements

Study Area Station	2030 Station Volume	Weekday Parking		
		2030 Parking Requirement	2005 Existing Parking	Additional Parking
Shelly (bus)	-	-	-	na
Quakertown (bus)	-	-	-	na
Perkasie (bus)	-	-	-	na
Sellersville (bus)	-	-	-	na
Telford (bus)	-	-	-	na
Souderton (bus)	-	-	-	na
Hatfield (bus)	-	-	-	na
Subtotal New Stations	**-**	**-**	**-**	**na**
Link Belt	187	-	-	0
Colmar	845	220	291	0
Fortuna	183	16	33	0
Lansdale	2,112	411	497	0
Pennbrook	865	131	244	0
North Wales	1,700	400	403	0
Subtotal Existing Stations	**5,892**	**1,178**	**1,468**	**0**
Total Study Area	**5,892**	**1,178**	**1,468**	**0**

Table 13
2030 Baseline Rail Station Approaches

Station	Total Approach	Home to Station Approaches[1]			
		Walk	Park and Ride	Kiss and Ride	Feeder Bus
Link Belt	63	47	-	16	-
Colmar	318	6	225	26	61
Fortuna	22	1	16	5	-
Lansdale	875	194	429	162	90
Pennbrook	248	50	136	62	-
North Wales	588	59	411	118	-
Total	**2,113**	**356**	**1,217**	**389**	**151**

[1]Excludes reverse commuting

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No-Build; a 3.5 percent increase in total regional rail riding. Within the study area, station volumes are forecast to increase to 9,766 daily person trips, a 66.5 percent increase over the No-Build. New stations along the reactivated line host 3,694 new person trips, 37.8 percent of study area person trips. Individual station volumes for new stations range from 575 daily person trips at Perkasie Station to 197 daily person trips at Gwynedd Square Station. All existing stations experience increased volume with the exception of Colmar Station where the opening of new stations has drawn away some riders. Results from the Diesel Shuttle Alternative are presented in **Table 14**.

2. Parking Demand

Station parking requirements under the Shuttle Alternative presented in **Table 15**. Demand for parking at new stations varies greatly from 28 spaces at Gwynedd Square to 154 spaces at Shelly Station. A total of 749 new spaces will be required along the reactivated line. Existing station parking is adequate to accommodate the increased riding under this alternative with the exception of North Wales; eight additional spaces will be required at this station.

Station approaches by mode are presented in **Table 16**. Park and Ride accounts for 57.7 percent of study area approaches, down from 61.9 percent in the No-Build scenario. Walk approaches account for 22.5 percent of study area approaches, up from 16.8 percent in the No-Build alternative. In percentage terms, Kiss and Ride approaches are unchanged from the No-Build alternative and transfers from the existing bus route are negligible.

D. Regional Rail Alternative

This alternative models a full electrified reactivation of the heavy rail to Springfield Township at Shelly in Bucks County. This alternative provides direct, multiple-unit service from Shelly to Center City. This alternative does not include the Gwynedd Square station on the Stony Creek line.

Table 14
2030 Shuttle Rail Station Ridership

Study Area Station	Weekday Board and Alight			
	2030 No-Build	2030 Shuttle	Difference Number	Difference Percent
Shelly[1]	-	519	519	na
Quakertown	-	503	503	na
Perkasie	-	575	575	na
Sellersville	-	466	466	na
Telford	-	544	544	na
Souderton	-	427	427	na
Hatfield	-	463	463	na
Gwynedd Square	-	197	197	na
Subtotal New Station	**-**	**3,694**	**3,694**	**na**
Link Belt	177	192	15	8.5%
Colmar	687	511	(176)	-25.6%
Fortuna	196	233	37	18.9%
Lansdale[2]	2,214	2,375	161	7.3%
Pennbrook	917	973	56	6.1%
North Wales	1,676	1,788	112	6.7%
Subtotal Existing Stations	**5,867**	**9,766**	**3,899**	**66.5%**
Total Commuter Rail Person Trips	**109,971**	**113,685**	**3,714**	**3.4%**

1. Shelly Station under the Shuttle Alternative includes external-local 324 boardings+ alightings from Lehigh and Northampton counties.

2. Lansdale Station volume under the Shuttle Alternative excludes 1573 transfers to/from the Shuttle to the Regional Rail.

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Table 15
2030 Shuttle Rail Station Parking Requirements

Study Area Station	2030 Station Volume	Weekday Parking		
		2030 Parking Requirement	2005 Existing Parking	Additional Parking
Shelly	519	154	-	154
Quakertown	503	80	-	80
Perkasie	575	138	-	138
Sellersville	466	76	-	76
Telford	544	110	-	110
Souderton	427	78	-	78
Hatfield	463	85	-	85
Gwynedd Square	197	28	-	28
Subtotal New Stations	**3,694**	**749**	**-**	**749**
Link Belt	192	-	-	-
Colmar	511	127	291	-
Fortuna	233	15	33	-
Lansdale	2,375	352	497	-
Pennbrook	973	191	244	-
North Wales	1,788	411	403	8
Subtotal Existing Stations	**6,072**	**1,096**	**1,468**	**8**
Total Study Area	**9,766**	**1,845**	**1,468**	**757**

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Table 16
2030 Shuttle Rail Station Approaches

Station	Total Approach	Home to Station Approaches[1]			
		Walk	Park and Ride	Kiss and Ride	Feeder Bus
Shelly	226	16	158	52	-
Quakertown	151	39	83	29	-
Perkasie	233	44	142	47	-
Sellersville	152	46	79	27	-
Telford	240	84	115	41	-
Souderton	149	46	81	22	-
Hatfield	160	42	88	30	-
Gwynedd Square	39	-	29	10	-
Subtotal	**1,350**	**317**	**775**	**258**	**-**
Link Belt	71	53	-	18	-
Colmar	145	3	131	11	-
Fortuna	24	3	15	6	-
Lansdale	782	243	368	164	7
Pennbrook	330	66	198	66	-
North Wales	604	60	423	121	-
Subtotal	**1,956**	**428**	**1,135**	**386**	**7**
Total	**3,306**	**745**	**1,910**	**644**	**7**

[1]Excludes reverse commuting

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1. Station Volume

Under this alternative, total regional rail volume is expected to increase to 114,280 person trips by the year 2030 representing a 4,309 person trip improvement over the No-Build; a 3.9 percent increase. Within the study area, station volumes are forecast to increase to 11,855 daily person trips, a 102.1 percent increase over the No-Build. New stations along the reactivated line host 5,270 new person trips, 44.4 percent of study area person trips. Individual station volumes for new stations range from 902 daily person trips at Perkasie Station to 636 daily person trips at Quakertown Station. All existing stations experience increased volume with the exception of Colmar Station where the opening of new stations has drawn riders away. Results from the Regional Rail Alternative are presented in **Table 17**.

Table 17
2030 Regional Rail Station Ridership

	Weekday Board and Alight			
	2030	2030	Difference	
Study Area Station	No-Build	Regional Rail	Number	Percent
Shelly[1]	-	726	726	na
Quakertown	-	636	636	na
Perkasie	-	902	902	na
Sellersville	-	697	697	na
Telford	-	892	892	na
Souderton	-	654	654	na
Hatfield	-	763	763	na
Gwynedd Square	-	-	-	na
Subtotal New Stations	**-**	**5,270**	**5,270**	**na**
Link Belt	177	207	30	16.9%
Colmar	687	554	(133)	-19.4%
Fortuna	196	225	29	14.8%
Lansdale	2,214	2,391	177	8.0%
Pennbrook	917	1,207	290	31.6%
North Wales	1,676	2,001	325	19.4%
Subtotal Study Area	**5,867**	**11,855**	**5,988**	**102.1%**
Total Commuter Rail Person Trips	**109,971**	**114,280**	**4,309**	**3.9%**

1. Shelly Station under the Regional Rail Alternative includes external-local 461 boardings+ alightings from Lehigh and Northampton counties.

2. Parking Demand

Station parking requirements under the Regional Rail Alternative are presented in **Table 18**. Demand for parking at new stations varies greatly from 91 spaces at Souderton Station to 225 spaces at Shelly Station. A total of 1,077 new spaces will be required along the reactivated line. Existing station parking is adequate to accommodate the increased riding under this alternative with the exception of North Wales; 39 additional spaces will be required at this station.

Station approaches by mode are presented in **Table 19**. The approaches under the Regional Rail alternative are virtually unchanged from the Shuttle alternative. Park and Ride is down 4.6 percent from the No-Build; Kiss and Ride is up less than one percent from the No-Build; and Walk approaches are up 5.5 percent from the No-Build.

Table 18
2030 Regional Rail Station Parking Requirements

Study Area Station	2030 Station Volume	Weekday Parking		
		2030 Parking Requirement	2005 Existing Parking	Additional Parking
Shelly	726	225	-	225
Quakertown	636	105	-	105
Perkasie	902	215	-	215
Sellersville	697	119	-	119
Telford	892	176	-	176
Souderton	654	91	-	91
Hatfield	763	146	-	146
Gywnedd Square	-	-	-	-
Subtotal New Stations	**5,270**	**1,077**	**-**	**1,077**
Link Belt	207	-	-	-
Colmar	554	135	291	-
Fortuna	225	19	33	-
Lansdale	2,391	352	497	-
Pennbrook	1,207	195	244	-
North Wales	2,001	442	403	39
Subtotal Existing Stations	**6,585**	**1,144**	**1,468**	**39**
Total Study Area	**11,855**	**2,220**	**1,468**	**1,116**

Table 19
2030 Regional Rail Station Approaches

Station	Total Approach	Home to Station Approaches[1]			
		Walk	Park and Ride	Kiss and Ride	Feeder Bus
Shelly	331	23	232	76	-
Quakertown	194	48	109	37	-
Perkasie	358	64	222	72	-
Sellersville	228	64	123	41	-
Telford	375	131	184	60	-
Souderton	212	85	95	32	-
Hatfield	265	64	151	50	-
Subtotal	**1,963**	**479**	**1,116**	**368**	**-**
Link Belt	77	59	-	18	-
Colmar	154	3	138	13	-
Fortuna	27	1	20	6	-
Lansdale	818	251	368	188	11
Pennbrook	369	74	203	92	-
North Wales	651	46	455	150	-
Subtotal	**2,095**	**433**	**1,184**	**467**	**11**
Total	**4,058**	**912**	**2,300**	**835**	**11**

[1]Excludes reverse commuting

Delaware Valley Regional Planning Commission

Technical Memorandum: Quakertown Rail Restoration Travel Forecasts Study

Publication No. : 08097

Date Published: June 2008

Geographic Area Covered: The study area spans the Bucks/Montgomery county line and includes the following municipalities in Bucks County: East Rockhill Township, Haycock Township, Hilltown Township, Perkasie Borough, Quakertown Borough, Richland Township, Richlandtown Borough, Sellersville Borough, Silverdale Borough, Springfield Township, Telford Borough, Milford Township, Trumbauersville Borough, and West Rockhill Township. The study area includes the following municipalities in Montgomery County: Franconia Township, Hatfield Borough, Hatfield Township, Lansdale Borough, Lower Salford Township, Montgomery Township, North Wales Borough, Salford Township, Telford Borough, Souderton Borough, Towamencin Township, and Upper Gywnedd Township.

Key Words: Quakertown Rail Service Restoration, SEPTA, R-5 Doylestown, New Starts, Travel Demand, TDM, Modeling, Transit, Simulation, Forecast, TMA, FTA.

ABSTRACT: This study describes DVRPC travel demand forecasting efforts for the Quakertown Rail Restoration Alternatives Analysis consistent with FTA program requirements for a New Starts application. The study presents the 2005 transit model calibration along with 2030 station volume and parking requirements for six existing stations and eight proposed stations across four alternatives: no build, baseline, and two build alternatives.

This technical memorandum summarizes the methodology, results and findings of DVRPC's study.

Delaware Valley Regional Planning Commission
190 North Independence Mall West, 8th Floor
Philadelphia, PA 19106-1520

Phone: 215-592-1800
Fax: 215-592-9125
Internet: www.dvrpc.org

Staff contacts:	Direct Phone:	E-mail:
Thomas Walker, Ph.D. Manager, Office of System Planning	215-238-2886	twalker@dvrpc.org
K. Jonathan Kugel Transportation Planner	215-238-2912	kkugel@dvrpc.org

Technical Memorandum

QUAKERTOWN RAIL RESTORATION TRAVEL FORECASTS STUDY

Delaware Valley Regional Planning Commission

June 2008