Technical Memorandum

Interstate 95 / Scudder Falls Bridge Traffic Study

September 2004

Delaware Valley Regional Planning Commission
The Bourse Building
111 South Independence Mall East
Philadelphia, PA 19106-2582

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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; and 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 sources including federal grants from the U.S. 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 Delaware River Joint Toll Bridge Commission (DRJTBC). The authors, however, are solely responsible for its findings and conclusions, which may not represent the official views or policies of the funding agencies.

On the cover: Aerial view of the Scudder Falls Bridge and NJ 29 (River Road) interchange.

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I. INTRODUCTION

The Delaware River Joint Toll Bridge Commission (DRJTBC), in cooperation with the New Jersey and Pennsylvania Departments of Transportation, and the Federal Highway Administration, is evaluating measures to improve safety and relieve congestion on the Scudder Falls Bridge and along Interstate 95 from PA Route 332 (Newtown - Yardley Road) in Lower Makefield Township, Bucks County, Pennsylvania to County Route 579 (Bear Tavern Road) in Ewing Township, Mercer County, New Jersey.

The Scudder Falls Bridge carries four lanes of Interstate 95 traffic across the Delaware River, connecting Pennsylvania and New Jersey, and providing a vital link between the states for commerce and commuters. Opened in 1961, the bridge was the first section of I-95 to be completed in the Delaware Valley Region and now serves the most traffic of the 20 DRJTBC-managed bridges connecting Pennsylvania and New Jersey.

In 1990, the *Traffic Study of Trenton-Morrisville Bridge Crossings over the Delaware River* identified congestion and safety problems on the Scudder Falls Bridge.[1] More recently, the *Southerly Crossings Corridor Study* concluded that the bridge's congestion and safety problems related to its narrow configuration, the proximity of adjoining interchanges, and ramps merging onto I-95.[2]

The existing Scudder Falls Bridge is 1,740 feet long and consists of two travel lanes in each direction, separated by a concrete median barrier. The bridge lacks shoulders and breakdown lanes and does not meet current highway design standards. Congestion at the bridge is exacerbated by the proximity of the Taylorsville Road and River Road interchanges, both within a half-mile of the bridge. Neither interchange is adequate to safely handle the current volume of traffic. The interchanges have substandard geometric features, such as acceleration and deceleration lanes that are too short, lack of sufficient spacing between ramps, and ramp radii that are too tight. These features create poor merging and weaving conditions.

DRJTBC has retained the Delaware Valley Regional Planning Commission (DVRPC) to develop traffic volume projections for the years 2015 and 2030. These volumes will be used to refine the design of an improved river crossing facility that addresses the safety and operational deficiencies of the existing Scudder Falls Bridge and its approaches. DVRPC is a bi-state transportation and regional planning organization. The region includes

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[1] *Traffic Study of Trenton-Morrisville Bridge Crossings over the Delaware River*, Delaware River Joint Toll Bridge Commission, Morrisville, Pennsylvania, 1990.

[2] *Southerly Crossings Corridor Study - Phase I Transportation Study*, The Louis Berger Group, Inc., East Orange, New Jersey, August 2002.

Bucks, Chester, Delaware, Montgomery, and Philadelphia counties in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer counties in New Jersey.

This technical memo summarizes the results of DVRPC's traffic forecasting effort. Chapter II includes a brief description of the existing Scudder Falls Bridge corridor, including current daily and peak hour traffic volumes and operational problems. Chapter III describes DVRPC's travel forecasting model and the socio-economic and land use assumptions used for this study. Finally, Chapter IV presents an analysis of future traffic volumes under the No-Build and Build alternatives for the Scudder Falls Bridge.

II. THE SCUDDER FALLS BRIDGE CORRIDOR

The Scudder Falls Bridge improvement project is intended to alleviate traffic congestion and improve operational and safety conditions in the I-95 corridor from PA 332 (Newton-Yardley Road) in Lower Makefield Township, Bucks County, Pennsylvania to CR 579 (Bear Tavern Road) in Ewing Township, Mercer County, New Jersey. This 4.4 mile corridor also includes interchanges at Taylorsville Road in PA and NJ 29 (River Road) and NJ 175 (Upper River Road) in New Jersey. These facilities are shown in Map 1.

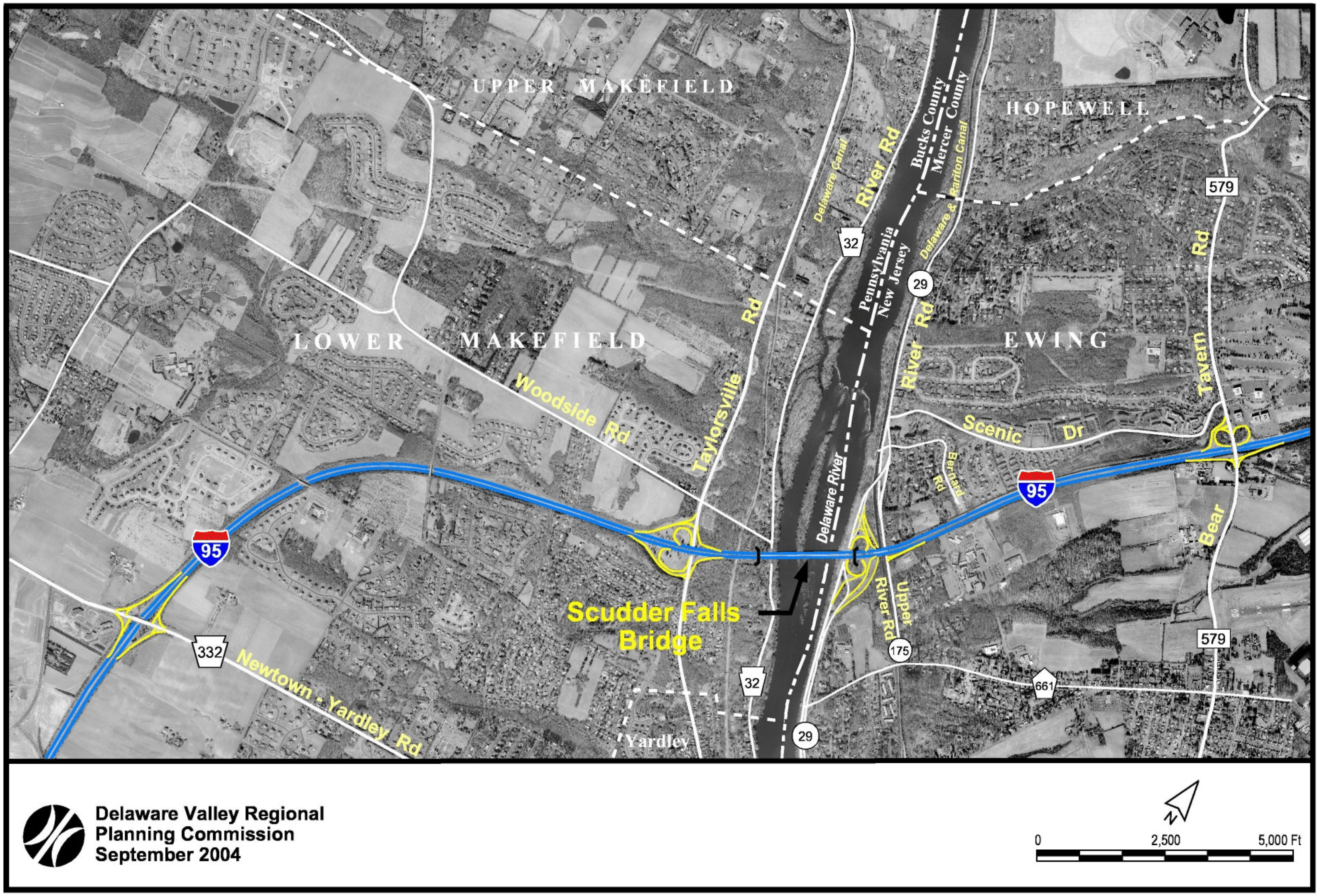
Within the study area, I-95 is two lanes by direction from PA 332 to NJ 29, including the Scudder Falls Bridge. The main bridge section provides two lanes of travel for each direction separated by a concrete median. Other cross-section features include narrow emergency sidewalks, no breakdown lanes and no shoulders. Route 29 marks the transition to three lanes by direction, which extends through the Bear Tavern Road interchange.

According to the *Highway Capacity Manual*, freeway on- and off-ramps can affect mainline traffic operations within a merge or diverge influence area, which extends 1,500 feet downstream of an on-ramp or upstream of an off-ramp.[3] Traffic in these influence areas is affected by vehicles changing lanes and adjusting speeds to complete the merge or diverge movement. The concentration of interchange ramps on either side of the Scudder Falls Bridge has a detrimental effect on traffic conditions.

Just on the Pennsylvania side of the Bridge is an interchange serving traffic movements to and from Taylorsville Road. Along I-95 northbound, there is an off-ramp to Taylorsville Road followed by a loop on-ramp from Taylorsville Road southbound and an additional on-ramp from Taylorsville Road northbound. These two on-ramps, in close proximity to one another, coupled with short acceleration lanes create turbulence in the traffic stream in the merge influence area which in turn leads to or exacerbates congestion on the I-95 mainline. Compounding this problem is the off-ramp to NJ 29 just across the Delaware River. The diverge influence area of this ramp overlaps with the merge influence area of the upstream on-ramp, which creates a weaving situation on the Scudder Falls Bridge. Following this off-ramp are two additional closely spaced on-ramps, one from NJ 29 and the other from NJ 175.

[3] *Highway Capacity Manual 2000*, Transportation Research Board, National Research Council, Washington, DC, 2000.

Map 1. Scudder Falls Bridge Corridor Area



Similar operational issues exist in the southbound direction. Although there is only one southbound on-ramp from NJ 29, this traffic must completely stop at the I-95 merge, leading to both safety hazards and operational issues due to the considerable difference in operating speeds between the on-ramp and mainline traffic flows in the merge area. Again, merge and diverge influence areas overlap on the bridge as separate off-ramps serve traffic to Taylorsville Road northbound and southbound.

A. Current Traffic Demand

In order to determine current traffic demand, DRJTBC's consultants (DMJM+Harris) conducted a traffic counting program within the study corridor in 2003. Daily traffic volumes were counted on the Scudder Falls Bridge, other I-95 locations, and all on- and off-ramps between PA 332 and Bear Tavern Road. DVRPC took additional daily traffic counts on PA 332 and Taylorsville Road in Lower Makefield Township and on NJ 29, Upper River Road, and Bear Tavern Road in Ewing Township. All traffic counts were seasonally adjusted to represent average annual daily traffic (AADT) conditions. Figure 1 displays the current daily traffic volumes in the study corridor.

Daily volumes in the I-95 corridor range from 53,800 between PA 332 and Taylorsville Road to 63,300 vehicles south of Newtown - Yardley Road. The Scudder Falls Bridge carries 59,500 vehicles on a typical day. On the New Jersey side, Interstate 95 volumes average about 57,000 vehicles per day (vpd). It is interesting to note that the four-lane sections of I-95 in Pennsylvania and on the Scudder Falls Bridge generally serve higher daily traffic volumes than the six-lane sections in New Jersey.

The I-95 / PA 332 interchange serves the most traffic by far of all the interchanges in the study area. Ramp volumes for this interchange total nearly 40,000 vehicles per day and range from 6,700 to 12,100 vpd. The highest volumes occur on the northbound off-ramp and southbound on-ramp. Other interchanges in the study area serve from 16,700 to 18,800 vehicles per day, with individual ramp volumes between 1,400 and 4,900 vpd.

Traffic volumes on the intersecting arterial streets range from 2,400 vpd on Upper River Road south of I-95 to 34,400 vpd on PA 332 west of I-95. However, most of the arterial facilities adjacent to I-95 serve volumes between 10,000 and 15,000 vehicles per day.

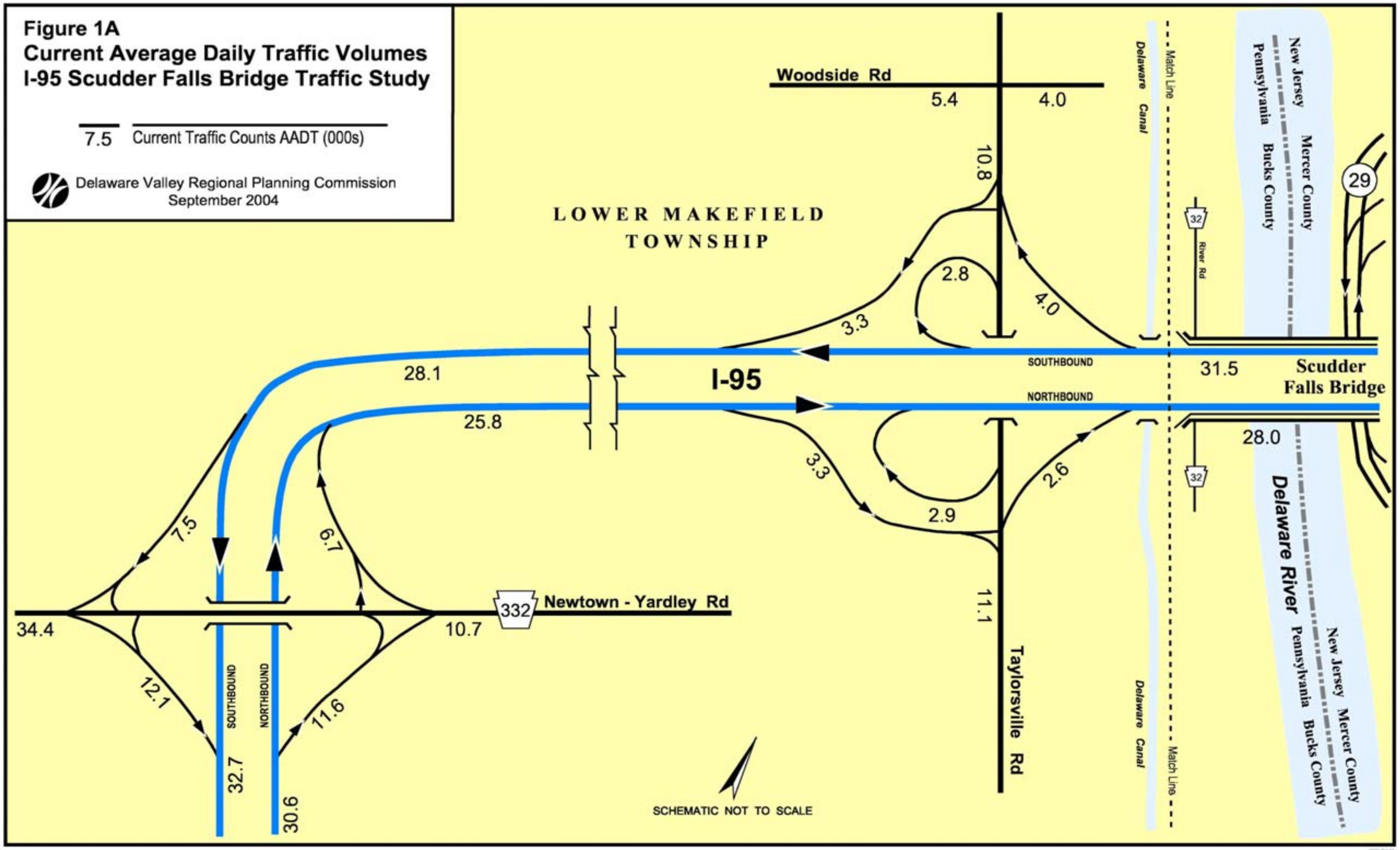


Figure 1A
Current Average Daily Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study

Delaware Valley Regional Planning Commission
September 2004

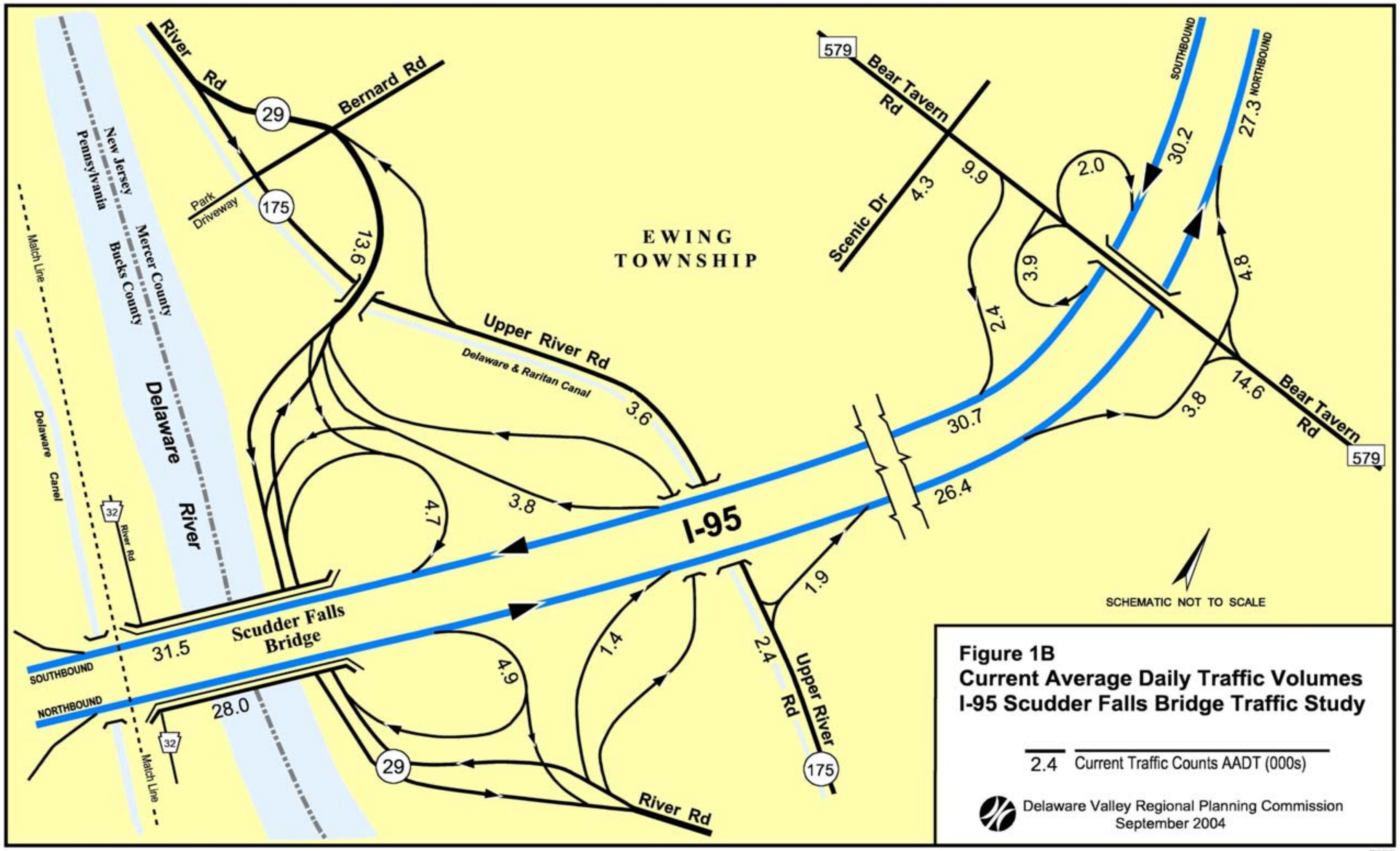


Figure 1B
Current Average Daily Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study

AM and PM peak hour traffic volumes were also recorded for the I-95 mainline and interchange ramps. In addition, peak hour turning movements were counted at key intersections within the study area, including the ramp/surface street junctions. These peak hour volumes were also seasonally adjusted to represent average annual conditions. Because peak hour traffic demand on several facilities in the corridor is currently over capacity, additional adjustments were made to the counted volumes so that they were representative of the demand, or the number of vehicles trying to access a given facility, rather than the counted number of vehicles passing that location. These adjustments were based on observations of queue length propagation at those locations where traffic currently operates at breakdown conditions. The adjusted AM and PM peak hour traffic volumes for current conditions are displayed in Figure 2.

Peak hour traffic volumes are generally heaviest in the AM peak in the northbound direction. On I-95, AM peak hour volumes increase from 2,834 vehicles per hour (vph) south of the PA 332 interchange, to 3,191 vph between PA 332 and Taylorsville Road, to 5,111 vph on the Scudder Falls Bridge. Northbound AM peak hour volumes in the New Jersey portion of the corridor do not vary as much as those on the Pennsylvania side, and range from 4,500 to 4,744 vehicles per hour.

PM peak hour volumes in the northbound direction are significantly lower than those of the morning peak. The highest volume, 2,265 vph, occurs just south of the PA 332 interchange. All other I-95 northbound volumes range from 1,278 to 1,745 vph; 1,570 vehicles cross the Scudder Falls Bridge northbound during the PM peak hour.

In the southbound direction, the heaviest volumes occur in the PM peak hour with lighter volumes in the AM peak. Interstate 95 carries 3,605 vehicles in the PM peak hour north of Bear Tavern Road. This volume increases to 4,074 vph between Bear Tavern Road and River Road and peaks at 4,183 vph on the Scudder Falls Bridge. PM peak hour volumes on the Pennsylvania side are 3,402 vehicles between Taylorsville Road and PA 332 and 3,523 vph south of PA 332.

During the AM peak hour, southbound volumes are mostly in the 1,400 to 1,500 vph range, expect for I-95 south of PA 332, which carries 2,440 vehicles. The lowest southbound volume during the AM peak is on the Scudder Falls Bridge, with 1,394 vehicles per hour.

In the peak direction of travel during both the AM and PM peak hours, traffic volumes on Interstate 95 are generally heavier on the New Jersey side of the river compared to the Pennsylvania side. In the off-peak direction of travel the opposite is true, with the Pennsylvania volumes higher in both AM and PM peaks.

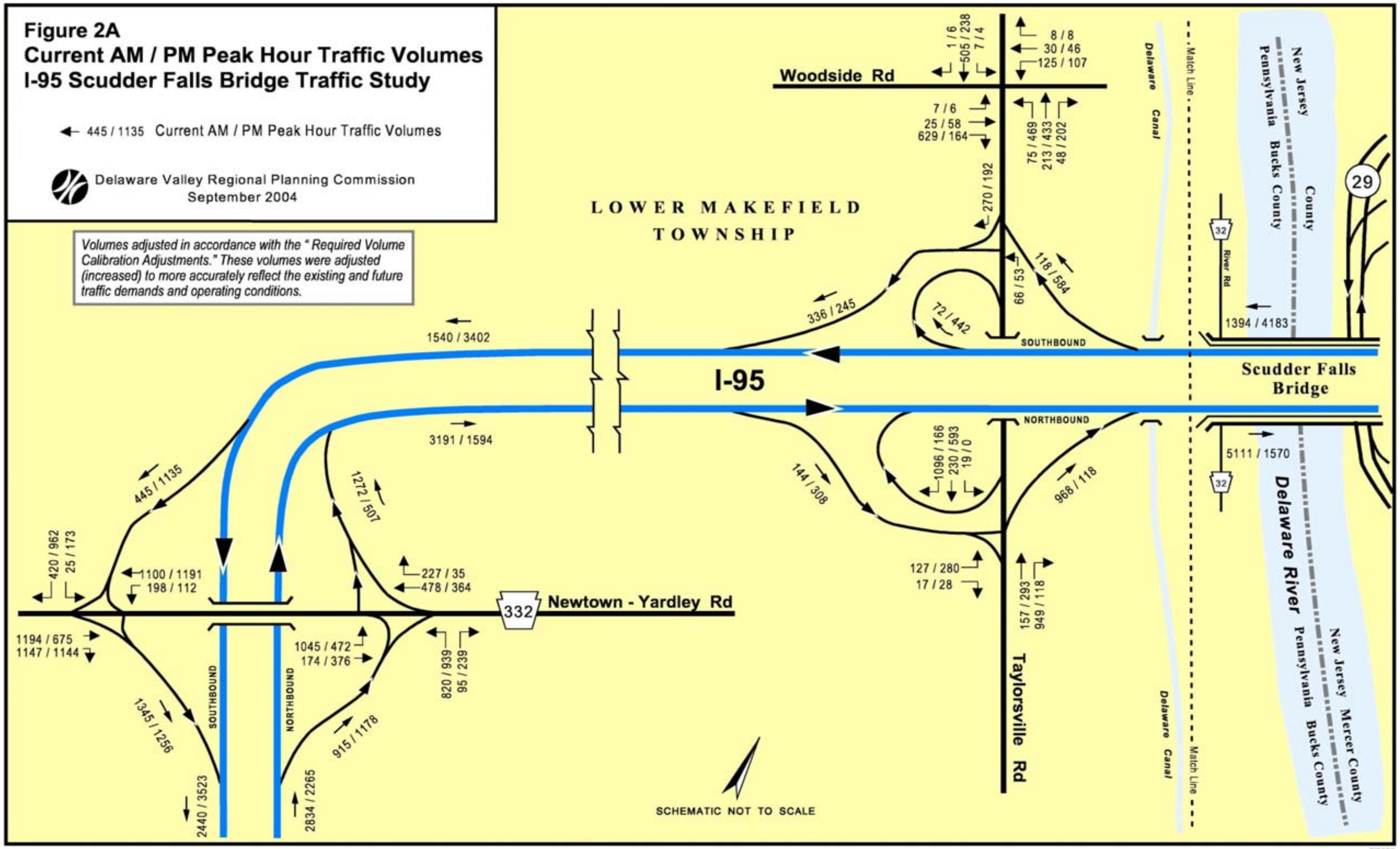


Figure 2A
Current AM / PM Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study
445 / 1135 Current AM / PM Peak Hour Traffic Volumes
Delaware Valley Regional Planning Commission
September 2004
Volumes adjusted in accordance with the " Required Volume Calibration Adjustments." These volumes were adjusted (increased) to more accurately reflect the existing and future traffic demands and operating conditions.
LOWER MAKEFIELD
TOWNSHIP
Woodside Rd
1 / 6
505 / 238
7 / 4
8 / 8
30 / 46
125 / 107
7 / 6
25 / 58
629 / 164
75 / 469
213 / 433
48 / 202
270 / 192
118 / 584
66 / 53
72 / 442
336 / 245
SOUTHBOUND
1540 / 3402
I-95
3191 / 1594
NORTHBOUND
1096 / 166
230 / 593
19 / 0
144 / 308
968 / 118
127 / 280
17 / 28
157 / 293
949 / 118
Taylorsville Rd
Delaware Canal
Match Line
New Jersey
Pennsylvania
Bucks County
County
29
32
River Rd
1394 / 4183
Scudder Falls
Bridge
5111 / 1570
Delaware River
New Jersey
Mercer County
Pennsylvania
Bucks County
445 / 1135
1272 / 507
420 / 962
25 / 173
1100 / 1191
198 / 112
227 / 35
478 / 364
332
Newtown - Yardley Rd
1194 / 675
1147 / 1144
1045 / 472
174 / 376
820 / 939
95 / 239
1345 / 1256
SOUTHBOUND
NORTHBOUND
915 / 1178
2440 / 3523
2834 / 2265
SCHEMATIC NOT TO SCALE

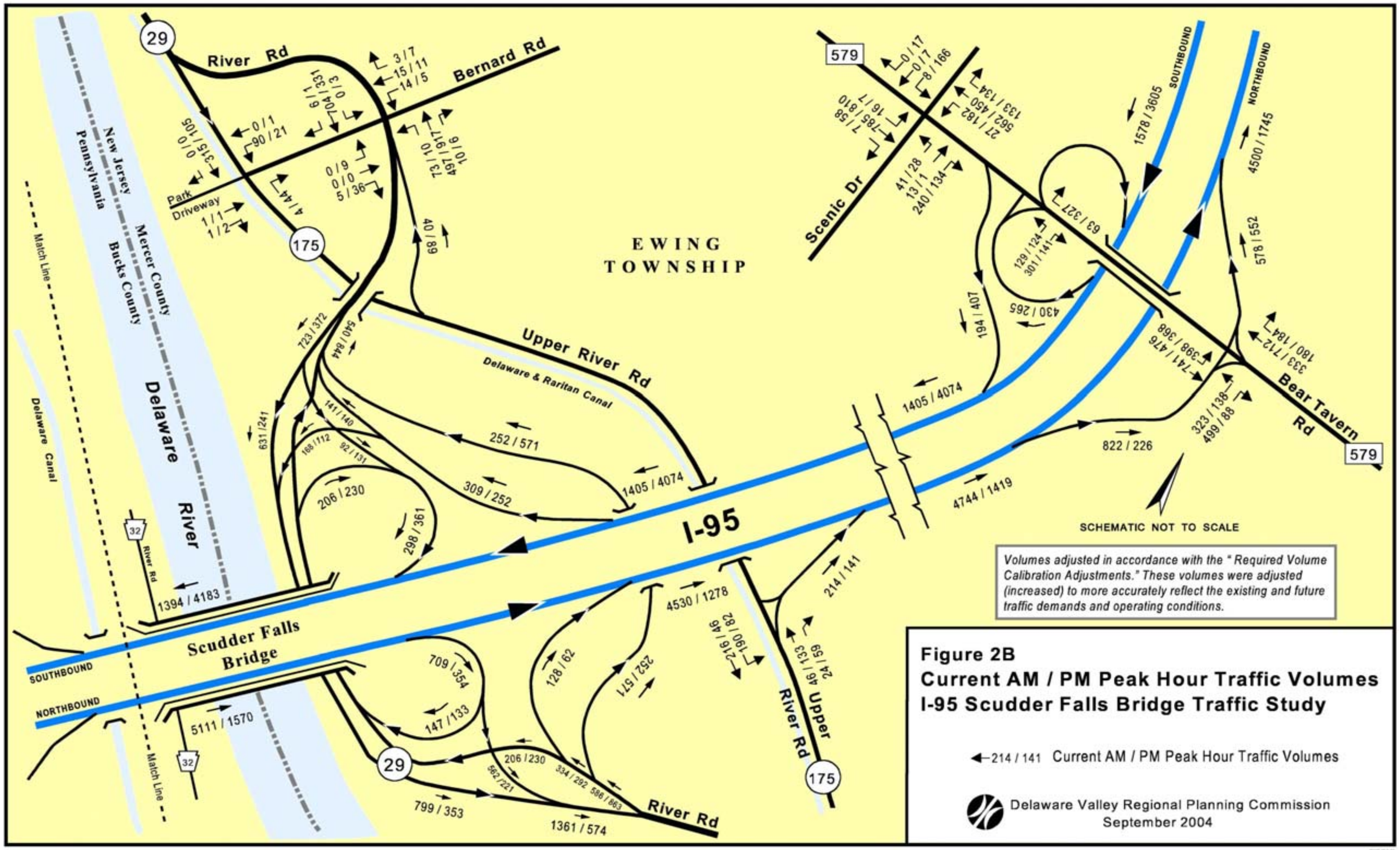


Figure 2B
Current AM / PM Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study

There are six ramps in the corridor that serve peak hour volumes close to, or greater than 1,000 vehicles per hour. All are on the Pennsylvania side. In the AM peak hour, the northbound on- and off-ramps at PA 332, both northbound on-ramps at Taylorsville Road, and the southbound on-ramp from PA 332 carry between 968 and 1,345 vph. In the PM peak hour, the northbound off-ramp to PA 332 and the southbound on- and off-ramps at PA 332 carry between 1,135 and 1,256 vph.

The highest hourly arterial volumes occur on Newtown-Yardley Road (PA 332) west of Interstate 95. PA 332 carries 2,341 vph eastbound in the AM peak and 2,153 vehicles westbound in the PM peak hour. Even in the off-peak direction, hourly volumes at this location are 1,819 vehicles eastbound and 1,520 vph westbound. PA 332 serves significantly lower volumes east of its interchange with I-95: in the AM peak hour it carries 269 vehicles eastbound and 705 vehicles westbound, and in the PM peak hour it carries 615 vehicles eastbound and 399 vehicles westbound.

Other arterial facilities that carry high traffic volumes during the peak hours include Taylorsville Road, Bear Tavern Road, and River Road. Taylorsville Road carries 1,106 vph and 1,259 vph approaching I-95 in the AM peak hour from the south and north, respectively and 1,104 vph northbound in the PM Peak hour north of I-95. In the southbound direction during the AM peak hour, Bear Tavern Road carries 1,033 vph approaching its interchange with I-95 and 1,240 vph away from I-95. It also carries 1,110 vph approaching I-95 in the PM peak hour, but only 564 vph away from I-95. South of Interstate 95, River Road serves 1,361 vph southbound in the AM peak hour.

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. Like most interstate highway facilities, the Scudder Falls Bridge serves local, regional, and long distance travelers. Although this traffic study is primarily concerned with the I-95 corridor between PA 332 and Bear Tavern Road, the travel simulation models must consider the traffic generating impacts of a much larger area. The travel models used for this study include the entire nine-county DVRPC region, with special attention focused on lower Bucks County and all of Mercer County. Map 2 displays the focused travel simulation study area.

For the Scudder Falls Bridge 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. Local streets not included in the regional network, but of interest in this study, are added to the highway network. Traffic zones inside the study area are subdivided so that traffic from existing and proposed land use developments may be loaded more precisely on the network.

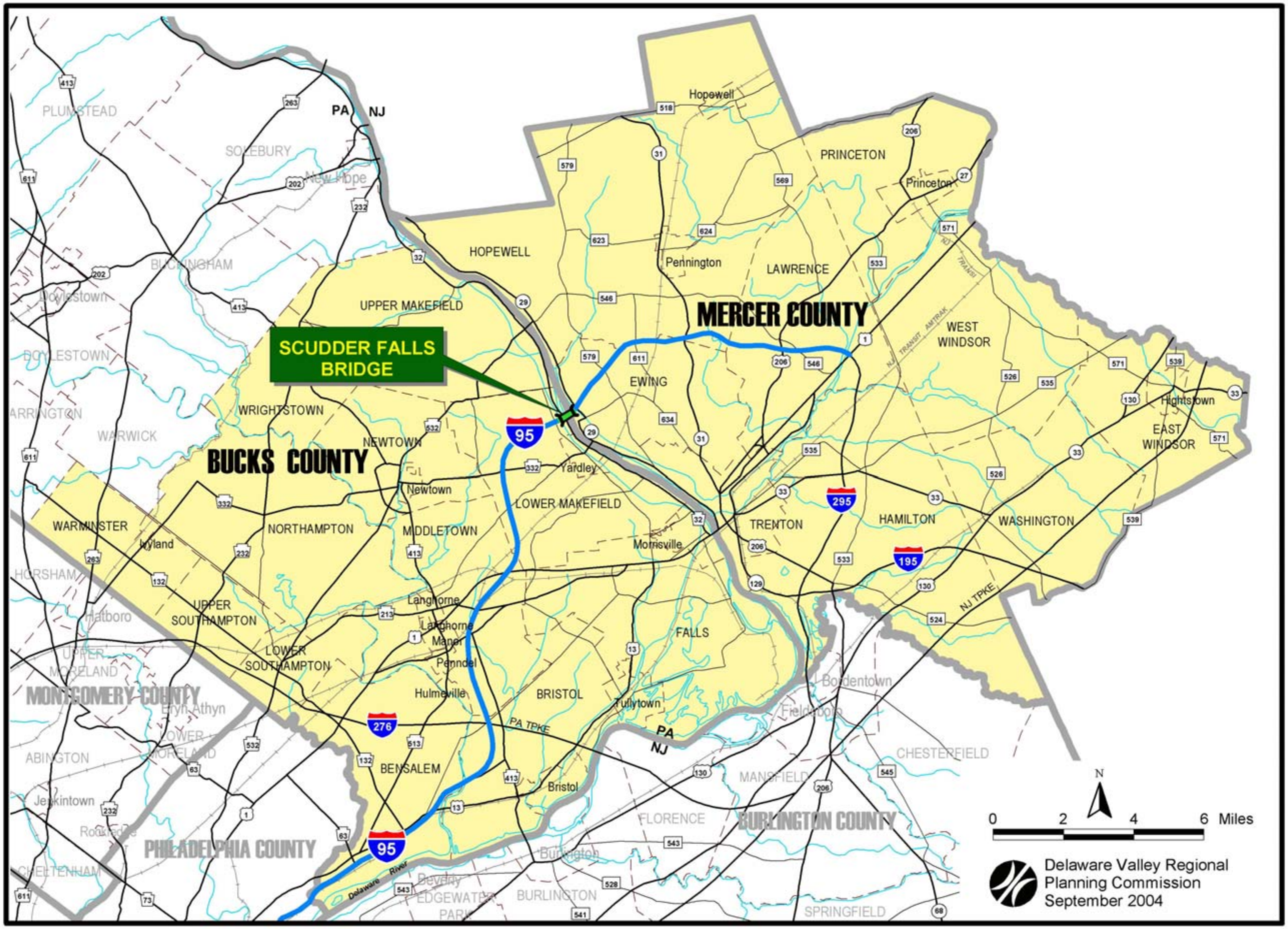
The focusing process increases the accuracy of the travel forecasts within the detailed study area. At the same time, all existing and proposed highways throughout the region, and their impact on both regional and interregional travel patterns, become an integral part of the simulation process.

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 available data. The completed forecasts reflect all reasonably known current information and the best professional judgment of predicted future conditions. The revised forecasts adopted by the DVRPC Board on February 28, 2002 reflect an update to municipal forecasts that were last completed in February 2000.

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.

Map 2. Travel Simulation Model Study Area



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 US Census and the US Census' recent Population Estimates program to determine the flow of individuals between the Delaware Valley and the outside world. For movement within the region, Census and IRS 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 U.S. 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. Scudder Falls Bridge Study Area Forecasts

As part of the Scudder Falls Bridge traffic study, DVRPC staff reviewed its most recent current population and employment estimates, its 2025 long-range population and employment forecasts, and all proposed land-use developments in the travel model study area shown in Map 2. The magnitude of any population and/or employment growth associated with each proposal was determined and compared to the Board-adopted forecast for each municipality in the study area. Based on this review, DVRPC developed revised 2025 municipal-level population and employment forecasts for use as inputs to the traffic simulation models. Table 1, below, summarizes the population and employment forecasts used for the Scudder Falls Bridge Traffic Study.

Table 1. Population and Employment in the Scudder Falls Study Area

Municipality	Population 2000	Population 2025	2000-2025 Change Absolute	2000-2025 Change Percent	Employment 2000	Employment 2025	2000-2025 Change Absolute	2000-2025 Change Percent
Bucks County (part)								
Bensalem Township	58,435	61,060	2,625	4.5%	37,661	40,358	2,697	7.2%
Bristol Borough	9,923	10,790	867	8.7%	6,868	7,784	916	13.3%
Bristol Township	55,521	57,730	2,209	4.0%	20,718	21,318	600	2.9%
Falls Township	34,865	35,460	595	1.7%	15,509	16,488	979	6.3%
Hulmeville Borough	895	1,000	105	11.7%	133	194	61	45.9%
Ivyland Borough	492	560	68	13.8%	1,368	1,449	81	5.9%
Langhorne Borough	1,980	1,980	0	0.0%	1,166	1,086	-80	-6.9%
Langhorne Manor Borough	925	1,070	145	15.7%	1,394	2,467	1,073	77.0%
Lower Makefield Township	32,691	42,310	9,619	29.4%	4,934	7,022	2,088	42.3%
Lower Southampton Township	19,275	22,170	2,895	15.0%	10,612	10,934	322	3.0%
Middletown Township	44,140	53,980	9,840	22.3%	20,884	27,181	6,297	30.2%
Morrisville Borough	10,020	11,190	1,170	11.7%	4,007	4,077	70	1.7%
Newtown Borough	2,310	2,310	0	0.0%	3,609	3,509	-100	-2.8%
Newtown Township	18,206	24,070	5,864	32.2%	9,295	12,484	3,189	34.3%
Northampton Township	39,384	44,670	5,286	13.4%	9,611	10,742	1,131	11.8%
Penndel Borough	2,420	2,420	0	0.0%	1,149	1,336	187	16.3%
Tullytown Borough	2,035	2,450	415	20.4%	2,039	3,767	1,728	84.7%
Upper Makefield Township	7,180	14,870	7,690	107.1%	1,521	3,018	1,497	98.4%
Upper Southampton Township	15,765	19,690	3,925	24.9%	8,075	13,443	5,368	66.5%
Warminster Township	31,383	35,740	4,357	13.9%	13,546	13,726	180	1.3%
Wrightstown Township	2,840	4,240	1,400	49.3%	1,276	1,304	28	2.2%
Yardly Borough	2,500	2,980	480	19.2%	2,105	2,325	220	10.5%
Bucks County (part) Subtotal	**393,185**	**452,740**	**59,555**	**15.1%**	**177,480**	**206,012**	**28,532**	**16.1%**
Mercer County								
East Windsor Township	24,915	35,150	10,235	41.1%	9,167	13,775	4,608	50.3%
Ewing Township	35,710	39,020	3,310	9.3%	28,473	31,996	3,523	12.4%
Hamilton Township	87,109	95,200	8,091	9.3%	33,104	39,653	6,549	19.8%
Hightstown Borough	5,215	5,220	5	0.1%	3,318	3,876	558	16.8%
Hopewell Borough	2,035	2,040	5	0.2%	698	1,325	627	89.8%
Hopewell Township	16,105	23,050	6,945	43.1%	8,025	29,086	21,061	262.4%
Lawrence Township	29,160	41,010	11,850	40.6%	25,419	30,745	5,326	21.0%
Pennington Borough	2,695	2,954	259	9.6%	1,158	2,549	1,391	120.1%
Princeton Borough	14,200	14,392	192	1.4%	15,864	17,968	2,104	13.3%
Princeton Township	16,025	17,530	1,505	9.4%	11,824	16,739	4,915	41.6%
Trenton City	85,403	89,049	3,646	4.3%	58,566	60,169	1,603	2.7%
Washington Township	10,275	15,791	5,516	53.7%	3,604	11,750	8,146	226.0%
West Windsor Township	21,905	29,780	7,875	36.0%	21,695	43,189	21,494	99.1%
Mercer County Subtotal	**350,752**	**410,186**	**59,434**	**16.9%**	**220,915**	**302,820**	**81,905**	**37.1%**
Study Area Total	**743,937**	**862,926**	**118,989**	**16.0%**	**398,395**	**508,832**	**110,437**	**27.7%**

In 2000, there were about 744,000 residents and 398,000 jobs within the Mercer County and lower Bucks County study area. Strong growth in both population and employment is forecast for this area. By 2025, the study area is expected to add 119,000 new residents and 118,000 additional jobs, increases of 16 and 28 percent, respectively.

This growth is not concentrated in one or two municipalities, but rather spread throughout the study area. In the Bucks County portion, large growth in both population and employment occurs in Upper and Lower Makefield, Middletown, Newtown, and Upper Southampton townships. In the Mercer County portion, East and West Windsor, Hamilton, Hopewell, and Lawrence townships also experience significant increases in both residents and jobs. Both Hopewell and West Windsor townships are forecast to add over 20,000 jobs between 2000 and 2025.

Although growth in Lower Makefield, Middletown, Ewing, and Lawrence townships has the most direct impact on traffic volumes in the Scudder Falls Bridge corridor, very large growth in surrounding municipalities attracts trips from a large area and affects I-95 and Scudder Falls Bridge traffic demand. For example, Hopewell Township is home to several large corporate employers, including Bristol Myers Squibb, Merrill Lynch, and Janssen Pharmaceutica, each of which is planning for, or pursuing, significant expansions of office and research space. Together these facilities represent several million square feet of new construction.

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 congestion levels used by the models when determining trip origins and destinations are equivalent to those that result from the traffic assignment step. 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.

The DVRPC travel simulation process uses the Evans Algorithm to iterate the model. Evans re-executes the trip distribution and modal split models based on updated highway speeds after each iteration of highway assignment and assigns a weight (λ) to each iteration. This weight is then used to prepare a convex combination of the link volumes and trip tables for the current iteration and a running weighted average of the previous iterations. This algorithm converges rapidly to the equilibrium solution on highway travel speeds and congestion levels. About seven iterations are required for the process to converge to the equilibrium state for Scudder Falls Bridge travel patterns. After equilibrium is achieved, the weighted average transit trip tables are assigned to the transit networks to produce link and route passenger volumes.

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 capacities and transit service levels are disaggregated to be reflective of time-period specific conditions. Capacity factors are used to allocate daily highway capacity to each time period. Separate transit networks were required to represent the difference in transit service.

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.

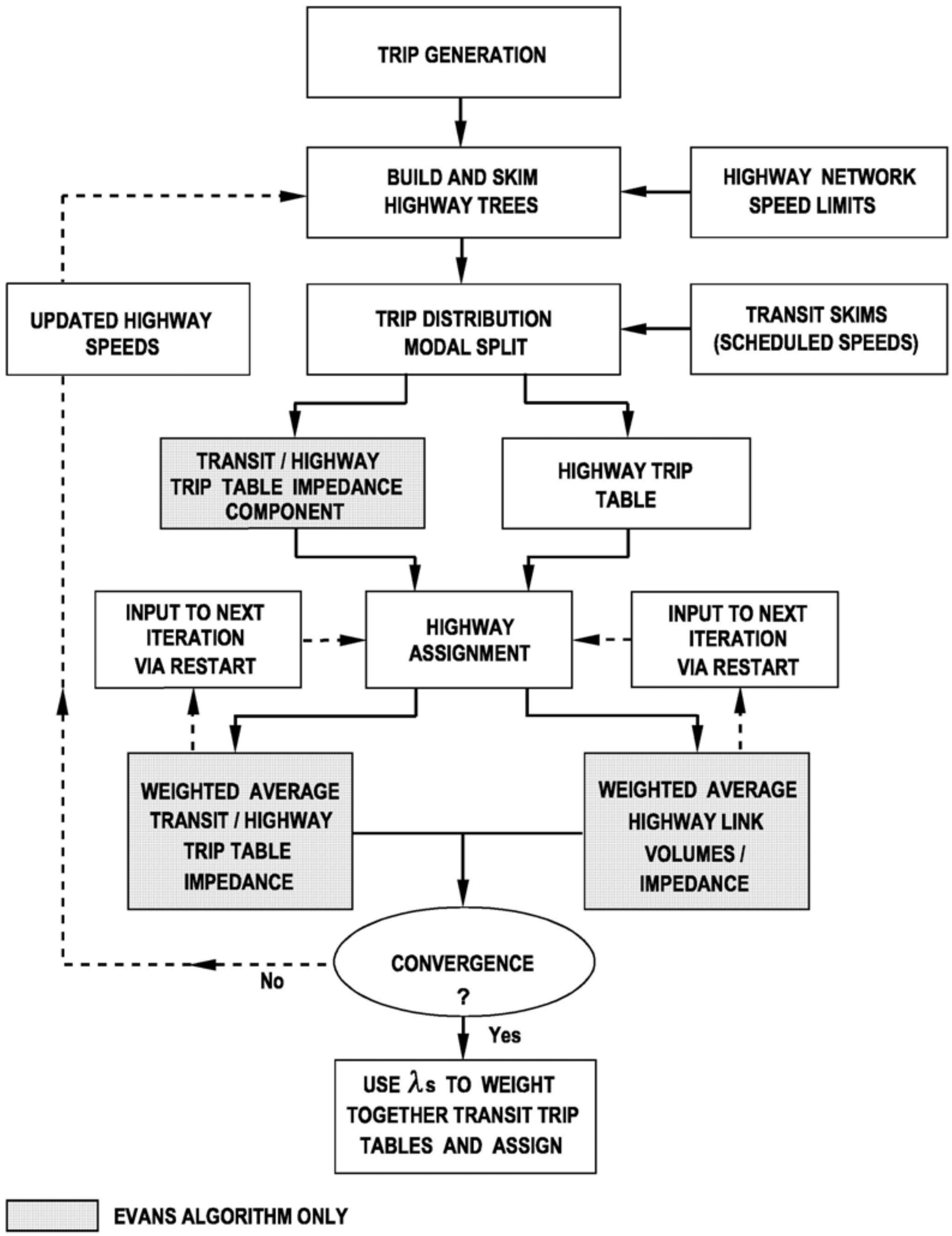
External-local productions at the nine-county cordon stations are disaggregated into peak, midday, and evening components using percentages derived from the temporal distribution of traffic counts taken at each cordon station.

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 3, below, displays a flowchart of the travel simulation modeling process.

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.

Figure 3. DVRPC's Travel Simulation Modeling Process



Evans Iterations. The iterative portion of the Evans forecasting process involves updating the highway network restrained link travel speeds, rebuilding the minimum time paths through the network, and skimming the interzonal travel time for the minimum paths. Then the trip distribution, modal split, and highway assignment models are executed in sequence for each pass through the model chain. After convergence is reached, the transit trip tables for each iteration are weighted together and the weighted average table is assigned to the transit network. The highway trip tables are loaded onto the network during each Evans iteration. For each time period, seven iterations of the Evans process are performed to ensure that convergence on travel times is reached.

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. For each Evans iteration, a series of seven 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, and then assigns the residual to the highway side. 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.

Highway Assignment. For highway trips, 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.

For each Evans iteration, 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 interzonal 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 Evans equilibrium assignment method is used to implement the capacity constraint. When the assignment and associated trip table reach equilibrium, no path faster than the one actually assigned can be found through the network, given the capacity restrained travel times on each link.

Transit Assignment. After equilibrium is achieved, the weighted average transit trip tables (using the λs calculated from the overall Evans process as weights) 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.

C. Improvement Alternatives

Separate model runs are preformed for each future-year alternative to be tested. For this study, DRJTBC requested that DVRPC prepare traffic forecasts for a No-Build and a Build alternative. 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.

1. The No-Build Alternative

Under the No-Build Alternative, no operational improvements to the Scudder Falls Bridge or its Interstate 95 approaches are considered. The No-Build Alternative does, however, assume the implementation of various planned improvements to other regional facilities. Generally, the facility improvements coded into the travel simulation model networks are projects included in DVRPC's Transportation Improvement Programs (TIP) for Pennsylvania and New Jersey and its Long Range Transportation Plan. Examples of significant projects that impact the Scudder Falls Bridge corridor include an additional on-ramp from PA 332 (Newtown - Yardley Road) to I-95 northbound, a new interchange between I-95 and the Pennsylvania Turnpike (I-276) and associated Turnpike widening, and new rail service between West Trenton and Newark, New Jersey.

2. The Build Alternative

The Build Alternative also assumes construction of all TIP and Long Range Plan projects in the region. Additionally, the following proposed improvements to the Scudder Falls Bridge and its I-95 approaches are included:

- Widening I-95 to three lanes per direction between the PA 332 and NJ 29 (River Road) interchanges, including a third through lane between the northbound on-ramps from NJ 29 and NJ 175 (Upper River Road);

- Consolidating the two northbound on-ramps from Taylorsville Road into a single on-ramp, and consolidating the two southbound off-ramps to Taylorsville Road into a single off-ramp; both consolidated ramps are loop ramps with signalized T-Intersections on the western side of Taylorsville Road;

- Providing auxiliary lanes on the Scudder Falls Bridge connecting the northbound on-ramp from Taylorsville Road to the northbound off-ramp to NJ 29, and connecting the southbound on-ramp from NJ 29 to the southbound off-ramp to Taylorsville Road; and

- Providing a two-lane on-ramp from Taylorsville Road to I-95 northbound with a lane-drop before reaching the northbound auxiliary lane.

This Build Alternative specification is intended to allow DRJTBC and their consultants to evaluate its ability to improve safety and alleviate congestion in the corridor. Further refinements may result from the impacts associated with the traffic forecasts presented in this technical memo, or other environmental impacts such as air quality, noise quality, or construction impacts on local communities.

IV. PROJECTED TRAFFIC VOLUMES

Projected daily and peak hour traffic volumes for selected highway facilities within the corridor are presented and analyzed in this chapter. Forecasts for two future years are presented: a design year of 2030 and an interim year of 2015. Following standard practice, the design year is taken to be twenty years beyond the anticipated opening year (2010). Because DVRPC's Long Range Plan has an horizon year of 2025, design year forecasts are extrapolated from current and 2025 model runs. Interim year traffic forecasts are prepared by interpolating between a current, calibration run and the 2025 runs. While the interim year forecasts provide a reference to gauge traffic volume changes over time and can be useful in developing traffic plans during construction, the analysis presented in this chapter is primarily focused on the design year traffic volumes and their associated impacts in the corridor.

A. No-Build Alternative Traffic Forecasts

Average annual daily traffic forecasts (AADT) under the No-Build Alternative are provided in Figure 4. In the figure, current average daily traffic volumes are shown in black, underneath the lines representing the highway links. No-Build volumes for 2015 are shown in red, above the highway links, and above those are the 2030 volumes, shown in green. Table 2 also lists these traffic volumes along with comparisons between current and future conditions.

The continued growth in land-use developments in Bucks and Mercer counties results in significantly higher traffic volumes compared to the present day. By 2030 under the No-Build Alternative, traffic volumes along I-95 increase by 14,093 to 19,423 vehicles per day (vpd) throughout the corridor, with the largest increases in the New Jersey portion of the study area. These increases range from 22.3 to 33.8 percent above current volumes. The average daily traffic volume on the Scudder Falls Bridge increases by 28.6 percent, or 17,025 vpd, to 76,500 vpd. Although the largest increases in traffic occur on the New Jersey side of the river, the highest daily volume in the corridor, 77,400 vpd, continues to occur south of PA 332.

The traffic volume increases on the ramps to and from I-95 range from 534 to 2,259 vpd, representing growth of 11.4 to 67.6 percent. At the PA 332 interchange in 2030, the new northbound on-ramp from PA 332 eastbound carries 7,000 vpd, which the volume on the existing northbound on-ramp to I-95 (which serves only traffic from PA 332 westbound in the future), is reduced to 1,900 vpd.

The arterial streets that have an interchange with I-95 also experience significant traffic volume increases by 2030 under the No-Build Alternative. These increases range from 1,570 vpd on Upper River Road south of I-95 to 5,316 vpd on PA 332 west of I-95.

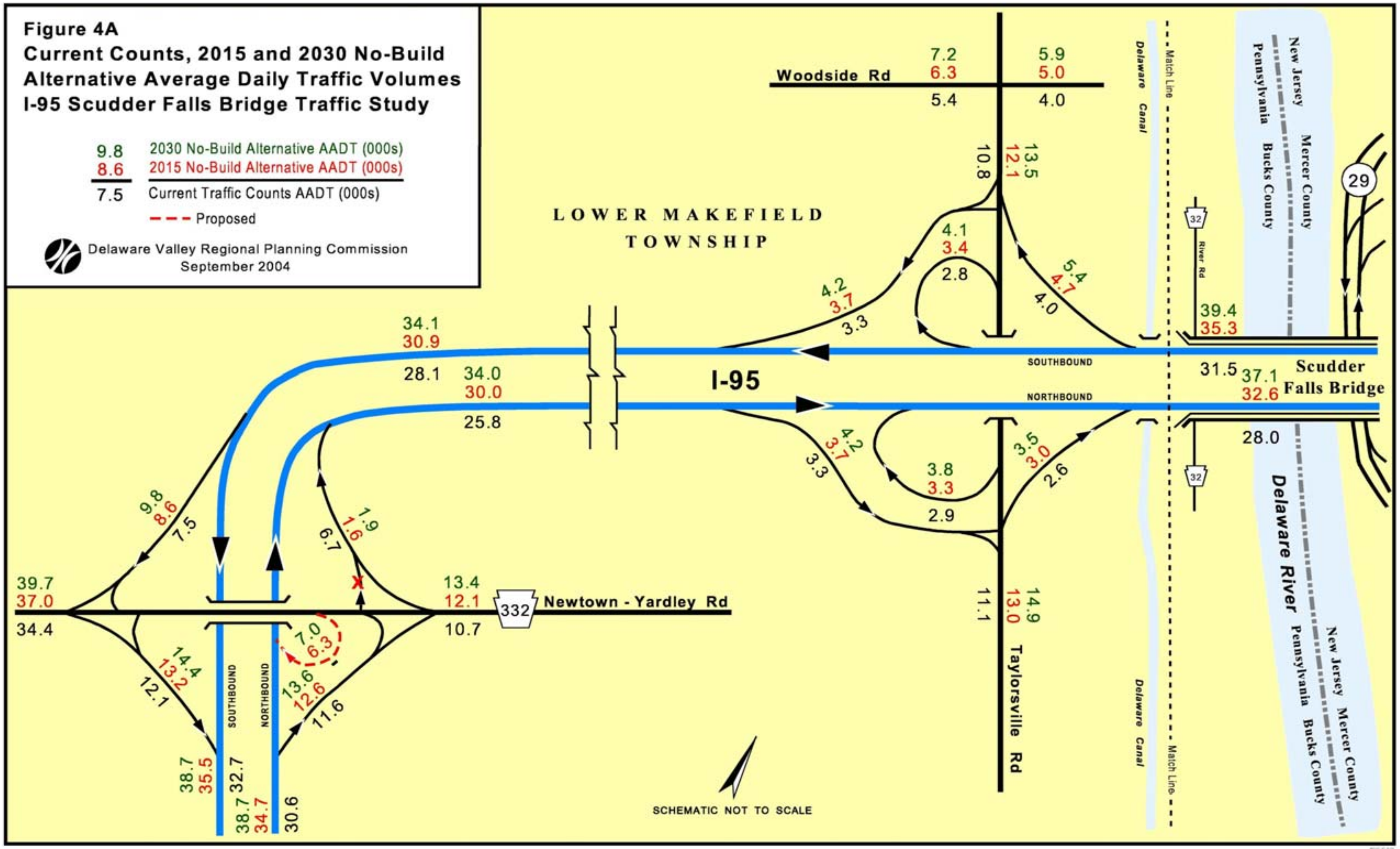


Figure 4A
Current Counts, 2015 and 2030 No-Build Alternative Average Daily Traffic Volumes I-95 Scudder Falls Bridge Traffic Study

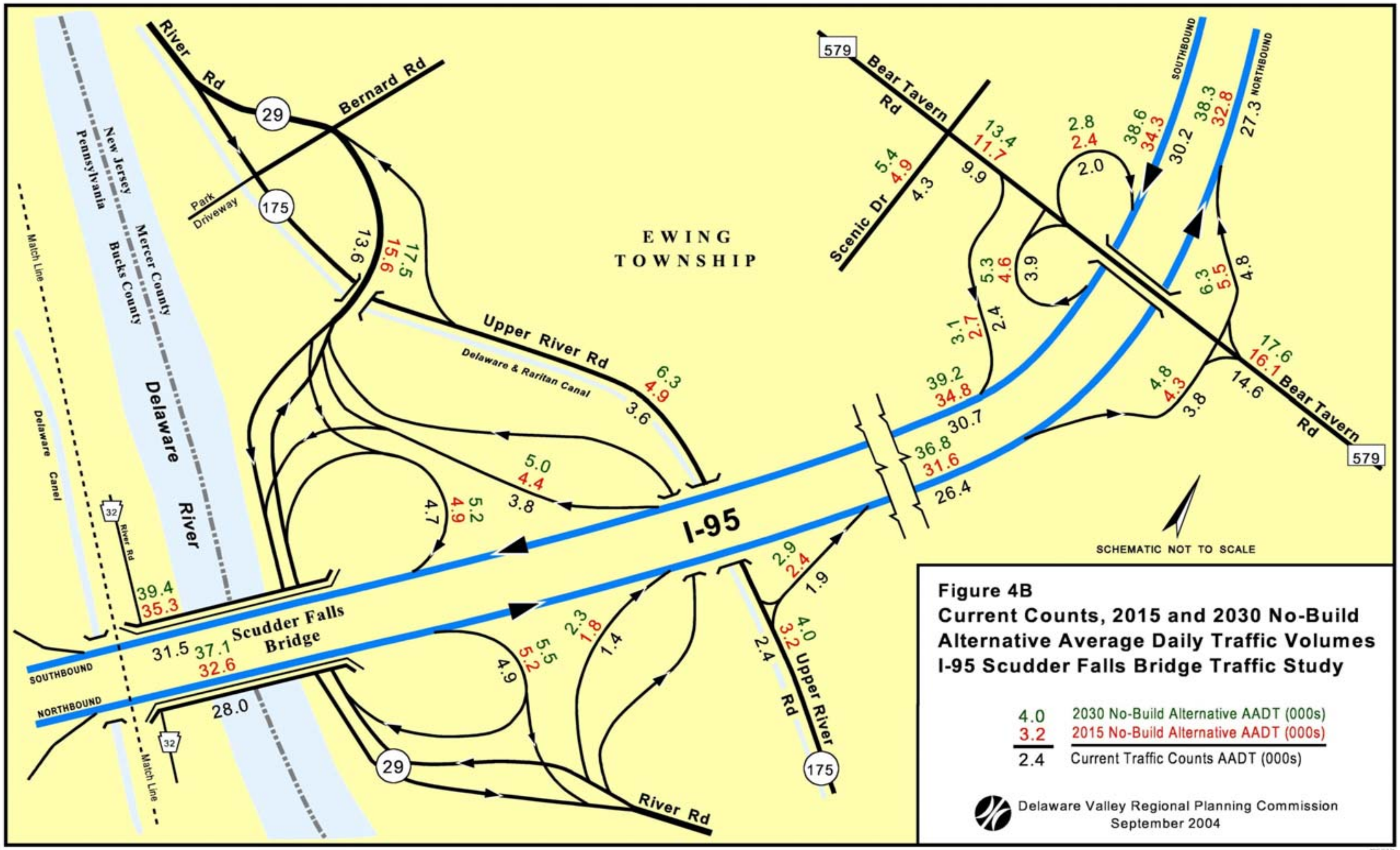


Figure 4B
Current Counts, 2015 and 2030 No-Build Alternative Average Daily Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study

Table 2. Comparison of Current and No-Build Alternative Daily Traffic Volumes

Facility	Limits	Current Volume	2015 No-Build AADT	Current to 2015 Change Difference	Current to 2015 Change Percent	2030 No-Build AADT	Current to 2030 Change Difference	Current to 2030 Change Percent
Interstate 95 Mainline								
I-95	US 1 to PA 332 (Newtown-Yardley Rd)	63,307	70,200	6,893	10.9%	77,400	14,093	22.3%
I-95	PA 332 (Newtown-Yardley Rd) to Taylorsville Rd	53,827	60,900	7,073	13.1%	68,100	14,273	26.5%
Scudder Falls Bridge	Taylorsville Rd to NJ 29 (River Rd)	59,475	67,900	8,425	14.2%	76,500	17,025	28.6%
I-95	NJ 175 (Upper River Rd) to CR 579 (Bear Tavern Rd)	57,030	66,400	9,370	16.4%	76,000	18,970	33.3%
I-95	CR 579 (Bear Tavern Rd) to CR 611 (Scotch Rd)	57,477	67,100	9,623	16.7%	76,900	19,423	33.8%
Interstate 95 Ramps								
Northbound Off-Ramp	I-95 to PA 332 (Newtown-Yardley Rd)	11,606	12,600	994	8.6%	13,600	1,994	17.2%
Northbound On-Ramp(s)	PA 332 (Newtown-Yardley Rd) to I-95	6,720	7,900	1,180	17.6%	8,900	2,180	32.4%
Southbound On-Ramp	PA 332 (Newtown-Yardley Rd) to I-95	12,141	13,200	1,059	8.7%	14,400	2,259	18.6%
Southbound Off-Ramp	I-95 to PA 332 (Newtown-Yardley Rd)	7,547	8,600	1,053	14.0%	9,800	2,253	29.9%
Northbound Off-Ramp	I-95 to Taylorsville Rd	3,260	3,700	440	13.5%	4,200	940	28.8%
Northbound On-Ramp	Taylorsville Rd Southbound to I-95	2,914	3,300	386	13.2%	3,800	886	30.4%
Northbound On-Ramp	Taylorsville Rd Northbound to I-95	2,549	3,000	451	17.7%	3,500	951	37.3%
Southbound On-Ramp	Taylorsville Rd to I-95	3,321	3,700	379	11.4%	4,200	879	26.5%
Southbound Off-Ramp	I-95 to Taylorsville Rd Southbound	2,775	3,400	625	22.5%	4,100	1,325	47.7%
Southbound Off-Ramp	I-95 to Taylorsville Rd Northbound	3,991	4,700	709	17.8%	5,400	1,409	35.3%
Northbound Off-Ramp	I-95 to NJ 29 (River Rd)	4,857	5,200	343	7.1%	5,500	643	13.2%
Northbound On-Ramp	NJ 29 (River Rd) to I-95	1,372	1,800	428	31.2%	2,300	928	67.6%
Northbound On-Ramp	NJ 175 (North River Rd) to I-95	1,883	2,400	517	27.5%	2,900	1,017	54.0%
Southbound On-Ramp	NJ 29 (River Rd) to I-95	4,666	4,900	234	5.0%	5,200	534	11.4%
Southbound Off-Ramp	I-95 to NJ 29 (River Rd)	3,823	4,400	577	15.1%	5,000	1,177	30.8%
Northbound Off-Ramp	I-95 to CR 579 (Bear Tavern Rd)	3,795	4,300	505	13.3%	4,800	1,005	26.5%
Northbound On-Ramp	CR 579 (Bear Tavern Rd) to I-95	4,753	5,500	747	15.7%	6,300	1,547	32.5%
Southbound On-Ramp	CR 579 (Bear Tavern Rd) Southbound to I-95	2,359	2,700	341	14.5%	3,100	741	31.4%
Southbound Off-Ramp	I-95 to CR 579 (Bear Tavern Rd)	3,860	4,600	740	19.2%	5,300	1,440	37.3%
Southbound On-Ramp	CR 579 (Bear Tavern Rd) Northbound to I-95	2,012	2,400	388	19.3%	2,800	788	39.2%
Crossing Streets & Local Roads								
PA 332 (Newtown-Yardley Rd)	West of I-95 Interchange	34,384	37,000	2,616	7.6%	39,700	5,316	15.5%
PA 332 (Newtown-Yardley Rd)	East of I-95 Interchange	10,719	12,100	1,381	12.9%	13,400	2,681	25.0%
Taylorsville Road	North of I-95 Interchange	10,799	12,100	1,301	12.0%	13,500	2,701	25.0%
Taylorsville Road	South of I-95 Interchange	11,113	13,000	1,887	17.0%	14,900	3,787	34.1%
Woodside Road	West of Taylorsville Road	5,400	6,300	900	16.7%	7,200	1,800	33.3%
Woodside Road	East of Taylorsville Road	4,000	5,000	1,000	25.0%	5,900	1,900	47.5%
NJ 29 (River Road)	North of I-95 Interchange	13,647	15,600	1,953	14.3%	17,500	3,853	28.2%
NJ 175 (Upper River Rd)	North of I-95 Interchange	3,600	4,900	1,300	36.1%	6,300	2,700	75.0%
NJ 175 (Upper River Rd)	South of I-95 Interchange	2,430	3,200	770	31.7%	4,000	1,570	64.6%
CR 579 (Bear Tavern Rd)	North of I-95 Interchange	9,944	11,700	1,756	17.7%	13,400	3,456	34.8%
CR 579 (Bear Tavern Rd)	South of I-95 Interchange	14,626	16,100	1,474	10.1%	17,600	2,974	20.3%
Scenic Drive	NJ 29 (River Rd) to CR 579 (Bear Tavern Rd)	4,300	4,900	600	14.0%	5,400	1,100	25.6%

As can be seen in Table 2, approximately half of the increase in traffic between current and 2030 conditions occurs by 2015. For example, in 2015 the Scudder Falls Bridge is forecast to carry 67,900 vpd, or 8,400 more than currently. Between 2015 and 2030 its daily volume increases by an additional 8,600 vehicles. Similar relationships exist for most other facilities in the study corridor.

Figures 5 and 6 display AM and PM peak hour volumes, including intersection turning movements under the No-Build Alternative for 2015 and 2030, respectively. The future year peak hour volumes included in this chapter are analogous to the current peak hour volumes shown in Figure 2, in that they represent peak hour demand volumes at a given location and may be greater than the hourly capacity at that location, leading to stop-and-go driving conditions and propagating traffic backups.

The future year peak hour traffic volumes follow the general trends of current peak hour volumes. That is, they are heaviest in the northbound direction in the AM peak and heaviest in the southbound direction in the PM peak hour. Also, in the peak directions, the highest hourly volumes in the corridor occur on the Scudder Falls Bridge, itself. In the morning peak, the Bridge volume increases from a current volume of 5,111 vph to 5,550 vph in 2015 and to 5,810 vph by 2030.

The peak hour volumes tend to increase at a slower rate in the peak direction of travel compared to the daily traffic volumes, and increase at a faster rate in the off-peak direction of travel. The growth rates in the peak direction are inhibited because worsening congestion levels tend to spread trips into the “shoulders” of the peak and other off-peak hours. Increasing volumes in the off-peak direction of travel during the peak hours are partly driven by a growing trend towards reverse commuting, as suburban employment is increasing at a faster rate than that of urban areas.

By 2030, Interstate 95 AM peak hour volumes in the peak direction (northbound) are 3,500 vph south of the PA 332 interchange, 3,750 vph between PA 332 and Taylorsville Road, and 5,810 vph on the Scudder Falls Bridge. Northbound AM peak hour volumes in the New Jersey portion of the corridor range from 5,250 to 5,540 vehicles per hour.

In the southbound direction during the PM peak hour, I-95 carries 4,500 vehicles north of Bear Tavern Road. This volume increases to 4,930 vph between Bear Tavern Road and NJ 29 and peaks at 4,970 vph on the Scudder Falls Bridge. In 2030, PM peak hour volumes on the Pennsylvania side are 3,920 vehicles between Taylorsville Road and PA 332 and 3,940 vph south of PA 332.

Like the current traffic counts, the largest peak hour ramp volumes in 2015 and 2030 tend to occur at the PA 332 / I-95 interchange. The highest arterial volumes also occur on PA 332 west of I-95 and on Taylorsville Road north of its interchange with I-95.

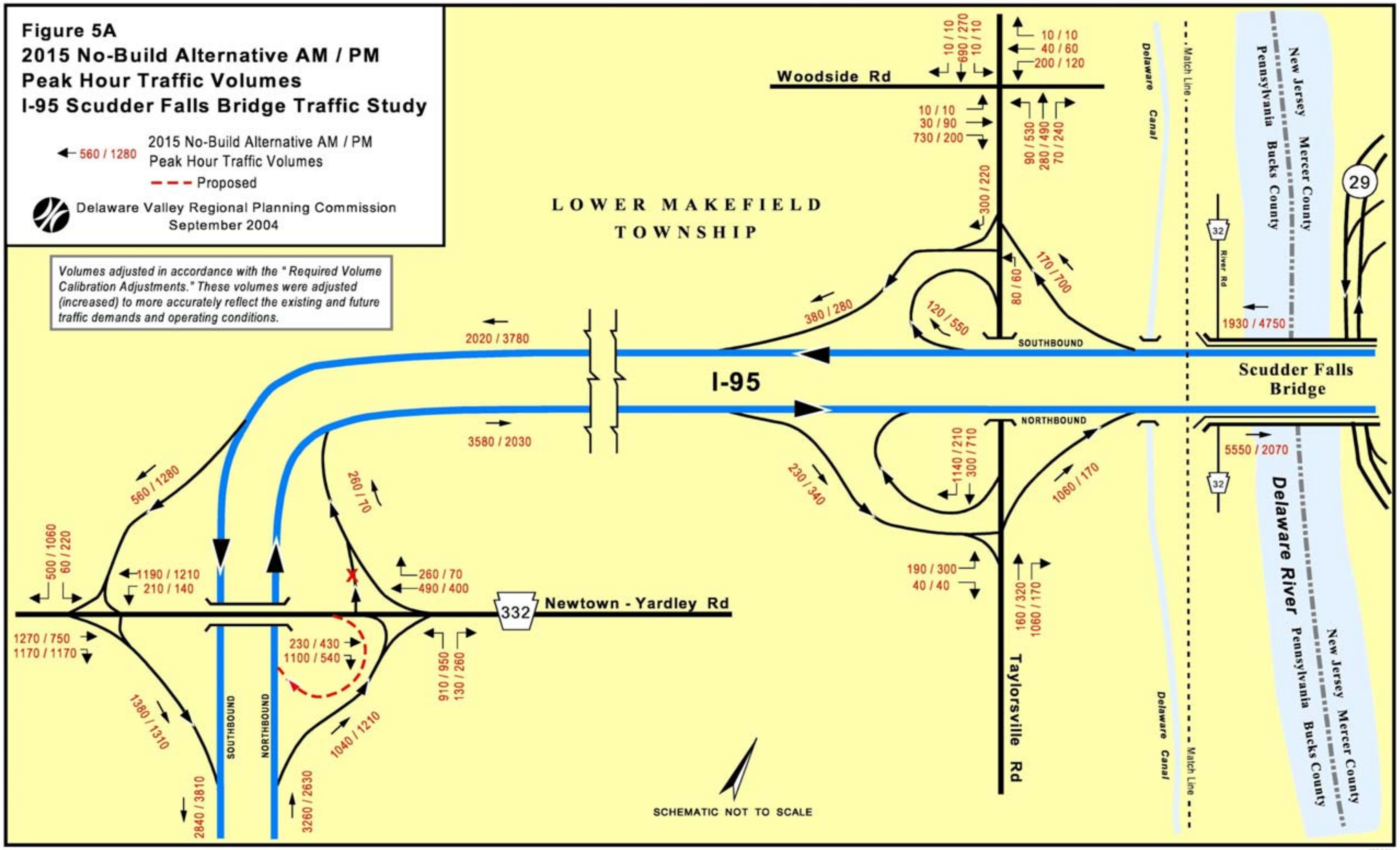


Figure 5A
2015 No-Build Alternative AM / PM
Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study
560 / 1280 2015 No-Build Alternative AM / PM Peak Hour Traffic Volumes
Proposed
Delaware Valley Regional Planning Commission
September 2004
Volumes adjusted in accordance with the "Required Volume Calibration Adjustments." These volumes were adjusted (increased) to more accurately reflect the existing and future traffic demands and operating conditions.
LOWER MAKEFIELD TOWNSHIP
Woodside Rd
Taylorsville Rd
Newtown - Yardley Rd
332
I-95
Scudder Falls Bridge
Delaware Canal
Match Line
River Rd
32
29
Delaware River
New Jersey
Mercer County
Pennsylvania
Bucks County
SOUTHBOUND
NORTHBOUND
2020 / 3780
3580 / 2030
380 / 280
120 / 550
80 / 60
170 / 700
300 / 220
10 / 10
690 / 270
10 / 10
40 / 60
200 / 120
30 / 90
730 / 200
90 / 530
280 / 490
70 / 240
1930 / 4750
5550 / 2070
230 / 340
1140 / 210
300 / 710
1060 / 170
190 / 300
40 / 40
160 / 320
1060 / 170
560 / 1280
500 / 1060
60 / 220
1190 / 1210
210 / 140
1270 / 750
1170 / 1170
1380 / 1310
2840 / 3810
3260 / 2630
1040 / 1210
230 / 430
1100 / 540
260 / 70
490 / 400
910 / 950
130 / 260
SCHEMATIC NOT TO SCALE

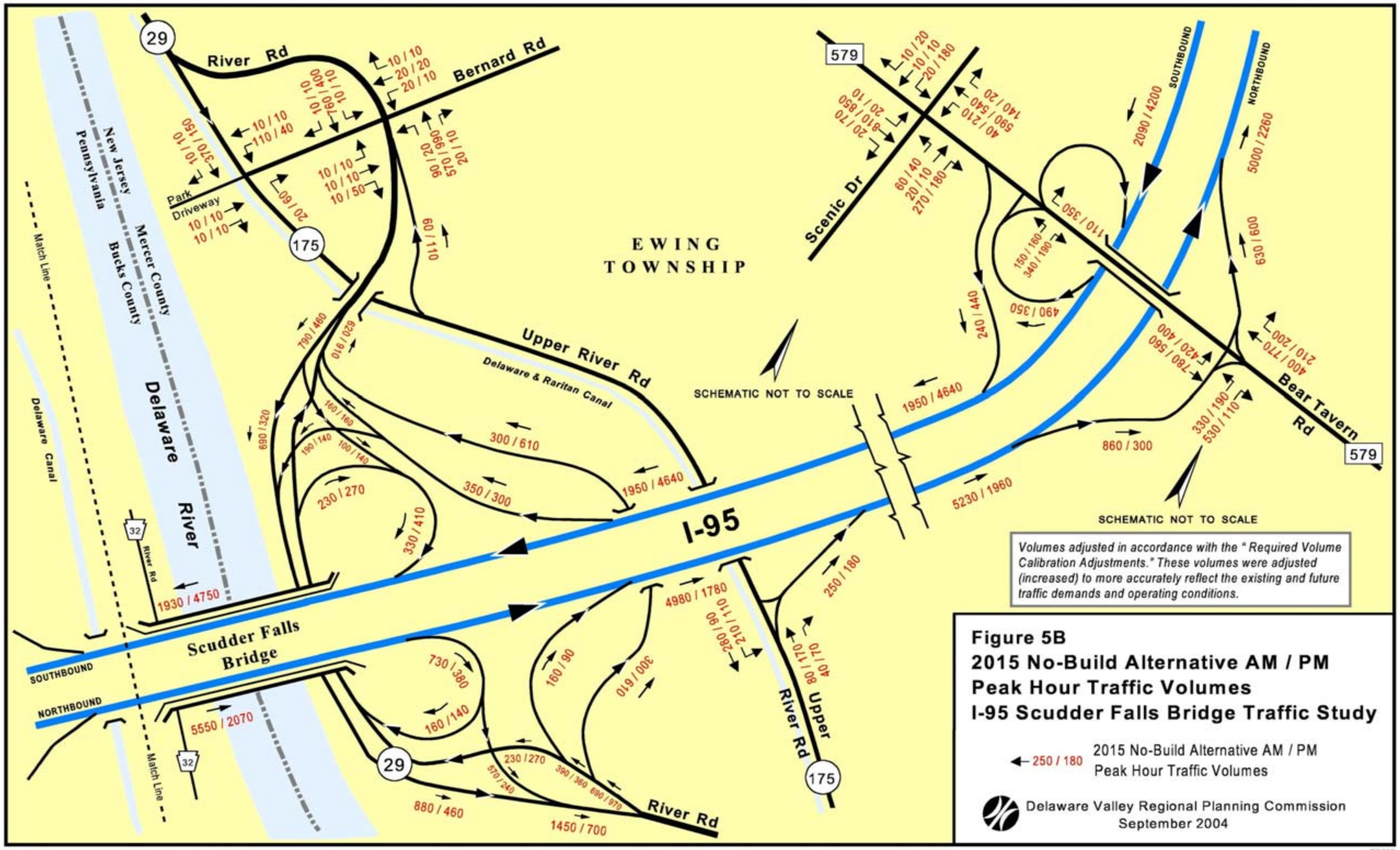


Figure 5B
2015 No-Build Alternative AM / PM Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study

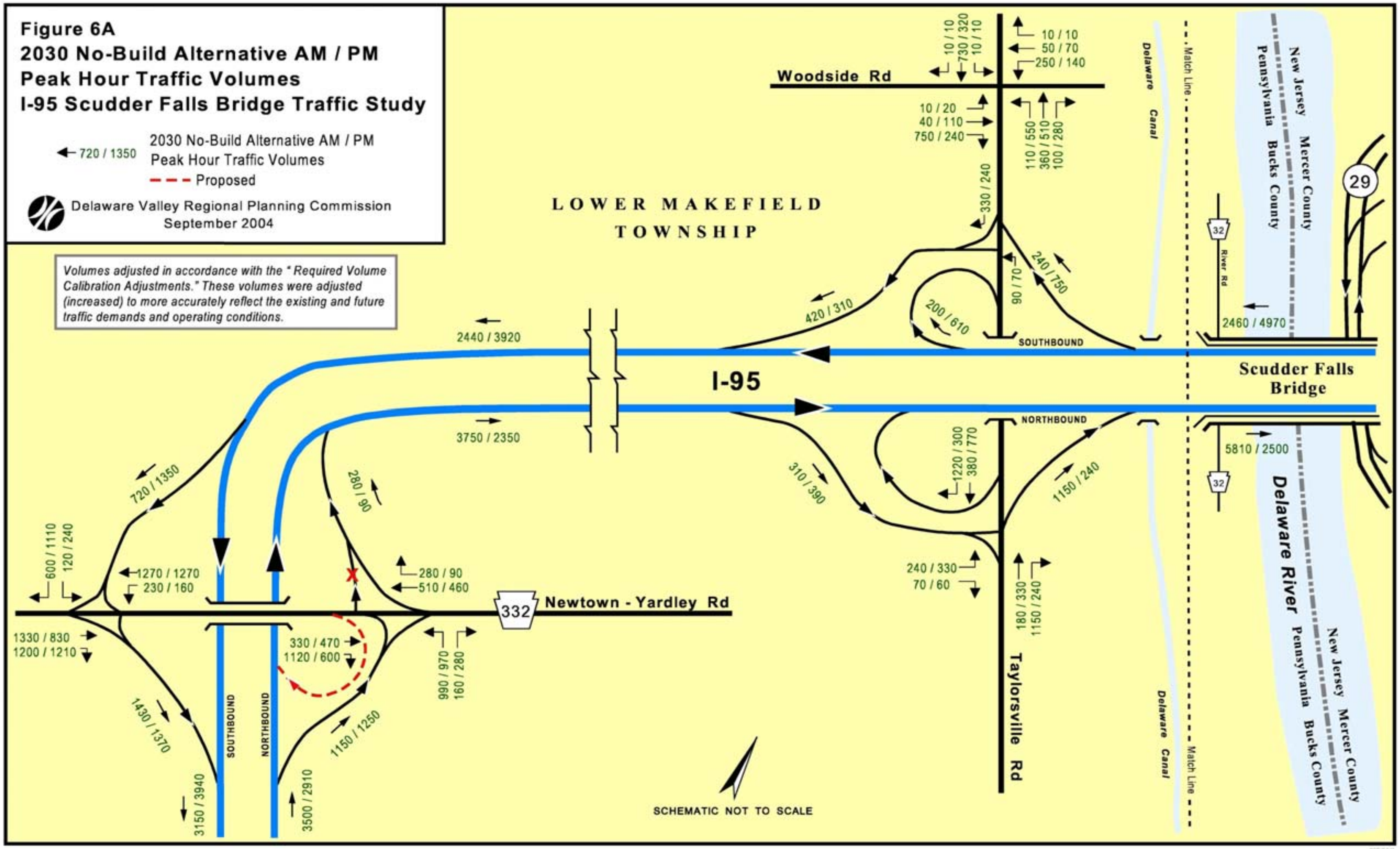


Figure 6A
2030 No-Build Alternative AM / PM
Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study
720 / 1350
2030 No-Build Alternative AM / PM
Peak Hour Traffic Volumes
Proposed
Delaware Valley Regional Planning Commission
September 2004
Volumes adjusted in accordance with the " Required Volume Calibration Adjustments." These volumes were adjusted (increased) to more accurately reflect the existing and future traffic demands and operating conditions.
LOWER MAKEFIELD
TOWNSHIP
Woodside Rd
10 / 10
730 / 320
10 / 10
10 / 10
50 / 70
250 / 140
10 / 20
40 / 110
750 / 240
110 / 550
360 / 510
100 / 280
330 / 240
240 / 750
90 / 70
200 / 610
420 / 310
SOUTHBOUND
2440 / 3920
I-95
3750 / 2350
NORTHBOUND
310 / 390
1220 / 300
380 / 770
1150 / 240
240 / 330
70 / 60
180 / 330
1150 / 240
Taylorsville Rd
Delaware Canal
Match Line
32
River Rd
2460 / 4970
29
5810 / 2500
Scudder Falls
Bridge
New Jersey
Mercer County
Pennsylvania
Bucks County
Delaware River
720 / 1350
600 / 1110
120 / 240
1270 / 1270
230 / 160
280 / 90
280 / 90
510 / 460
332
Newtown - Yardley Rd
1330 / 830
1200 / 1210
330 / 470
1120 / 600
990 / 970
160 / 280
1430 / 1370
SOUTHBOUND
NORTHBOUND
1150 / 1250
3150 / 3940
3500 / 2910
SCHEMATIC NOT TO SCALE

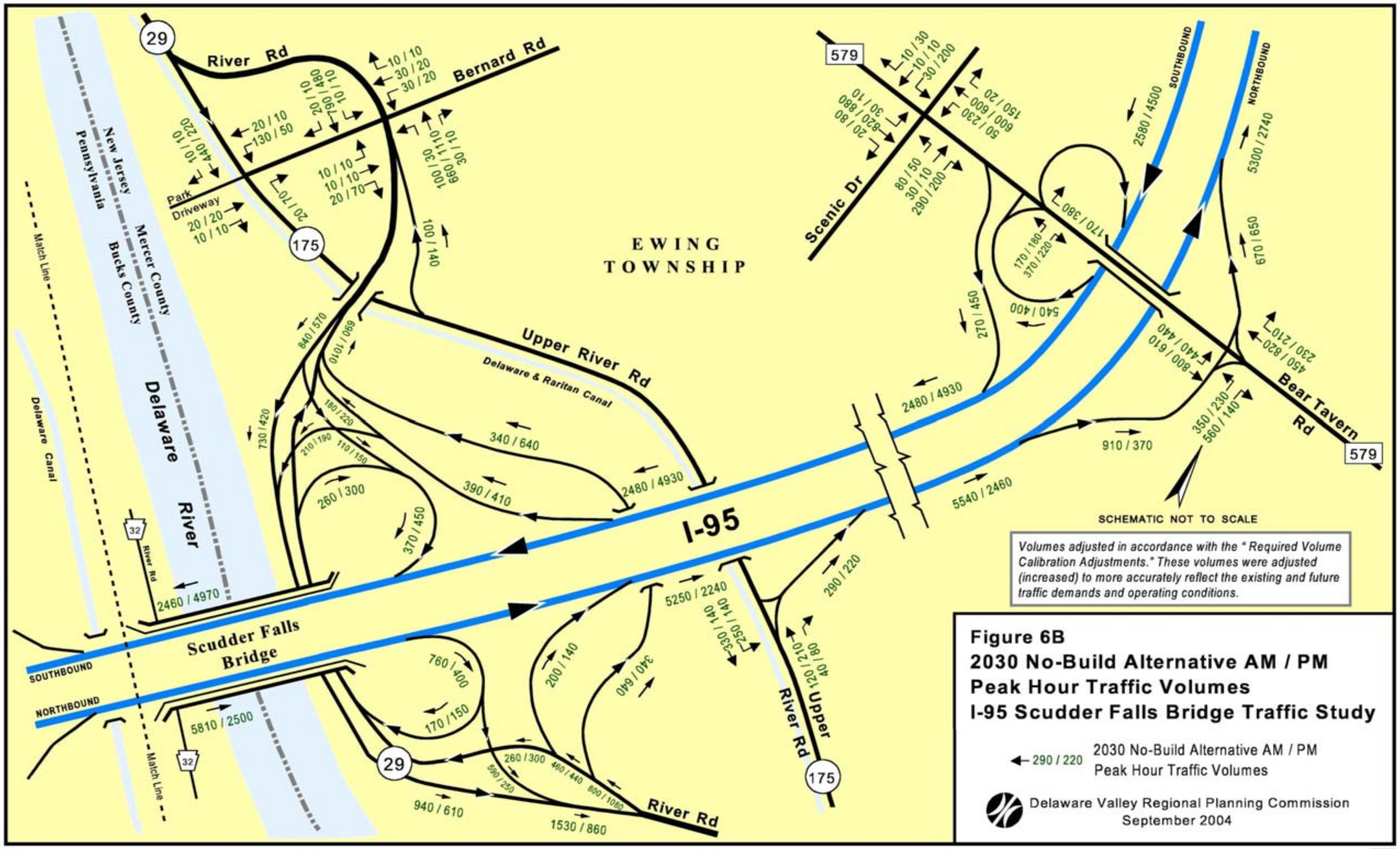


Figure 6B
2030 No-Build Alternative AM / PM Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study

B. Build Alternative Traffic Forecasts

Average annual daily traffic forecasts under the Build Alternative are provided in Figure 7. Figure 7 follows the same conventions as Figure 4, which displays the No-Build daily forecasts. In Figure 7, current average daily traffic volumes are shown in black, underneath the lines representing the highway links. Build volumes for 2015 are shown in brown, above the highway links, and above those are the 2030 volumes, shown in blue. Table 3 also lists these traffic volumes along with comparisons between No-Build and Build conditions for 2015 and 2030.

Adding highway capacity to a given facility tends to reduce the travel time for trips served by that facility, which in turn increases the demand for travel on that facility. This increase in demand is due to both diversion of trips from other routes and modes (if there is competing transit service), and also an overall increase in the demand for travel between origin-destination pairs served by that facility. In the Scudder Falls Bridge corridor, most of the increase in traffic between the No-Build and Build alternatives is due to diversion from other routes served by the adjacent bridges between Bucks and Mercer county. The additional capacity, and corresponding reduction in congestion, increases the attractiveness of the Scudder Falls Bridge relative to the other river crossing facilities.

A small portion of the Build / No-Build difference is due to new demand that results from the additional cross-river capacity provided under the Build Alternative. The new cross-river demand represents trips that do not cross the river under the No-Build Alternative, but do so under the Build Alternative. The origin-destination patterns of these trips change in response to the overall increase in river crossing capacity and corresponding decrease in congestion levels.

By 2030 under the Build Alternative, traffic volumes along the I-95 corridor range from 75,900 vehicles per day between PA 332 and Taylorsville Road to 85,000 vpd on the Scudder Falls Bridge. These volumes are between 6,900 and 8,500 vpd higher than the corresponding volumes under the No-Build Alternative. In percentage terms, the difference between No-Build and Build volumes in the Interstate 95 corridor range from 9.0 to 11.5 percent.

At the Taylorsville Road interchange, the single southbound off-ramp carries 9,500 vpd, which is the same volume carried by the two southbound off-ramps of the No-Build Alternative. The northbound on-ramp carries 8,000 vpd, or 700 vpd more than total of the two No-Build Alternative on-ramps. In 2030, most other ramps in the study area carry between 100 and 600 vpd more than their corresponding ramps of the No-Build Alternative.

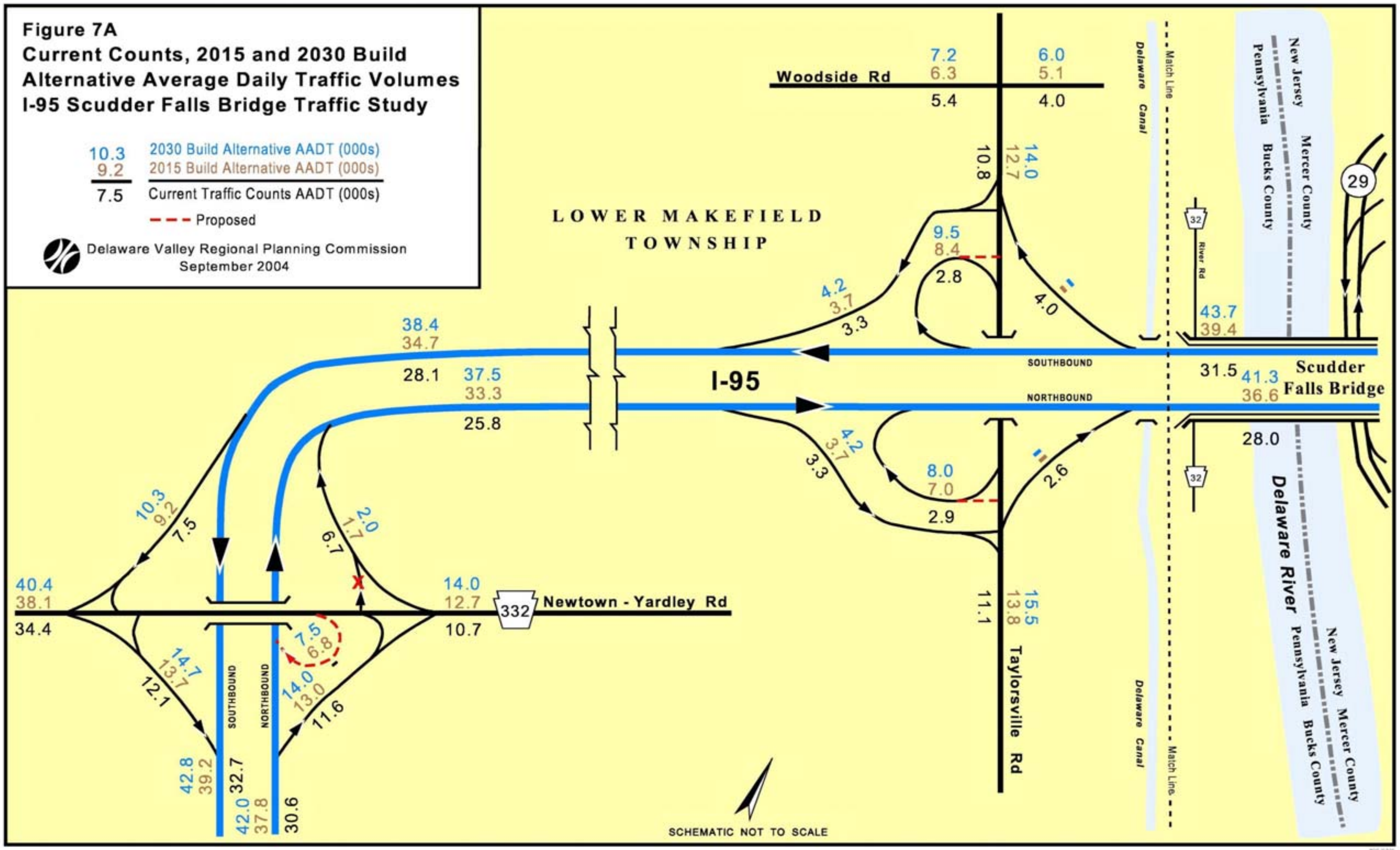


Figure 7A
Current Counts, 2015 and 2030 Build Alternative Average Daily Traffic Volumes I-95 Scudder Falls Bridge Traffic Study

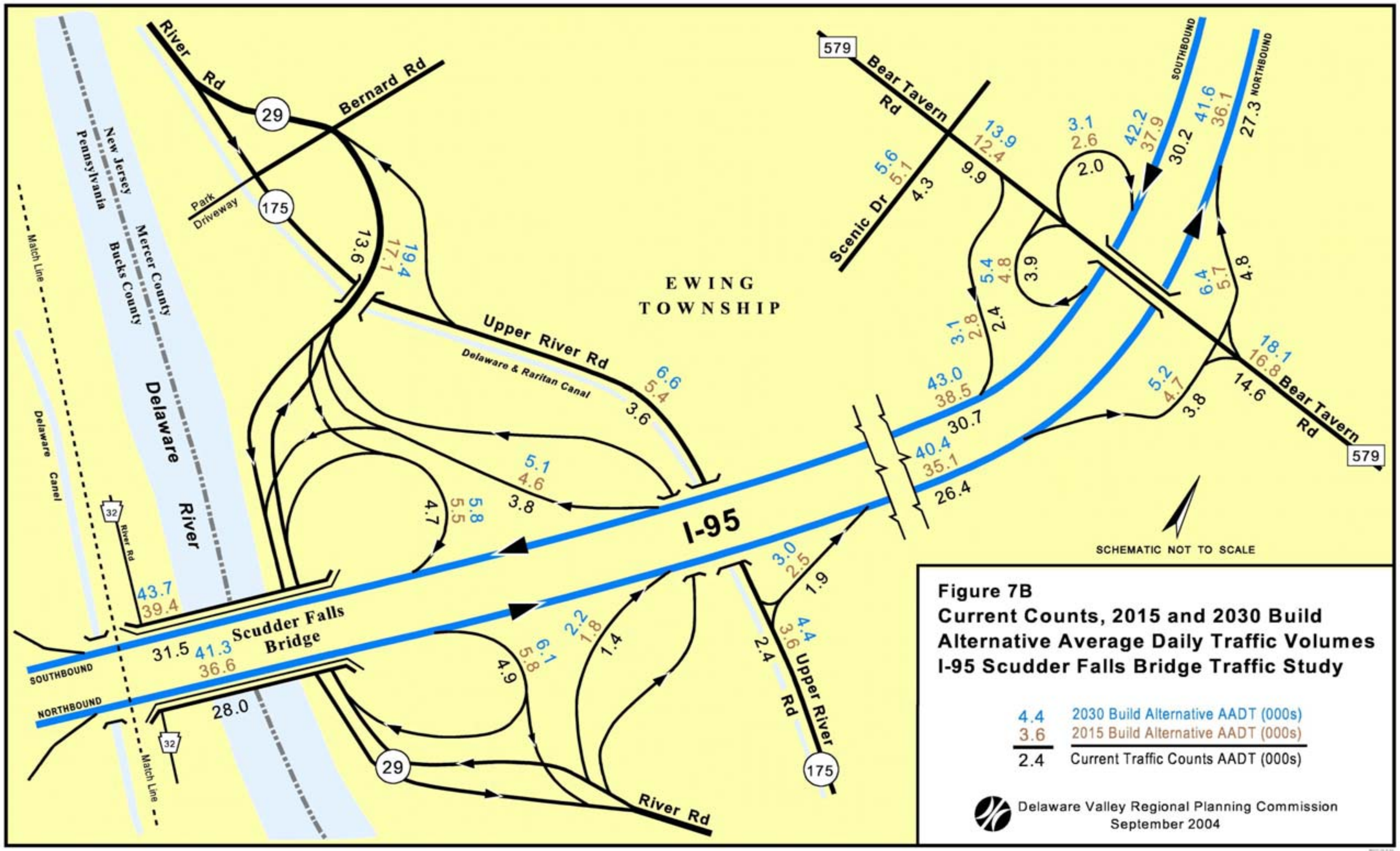


Figure 7B
Current Counts, 2015 and 2030 Build Alternative Average Daily Traffic Volumes I-95 Scudder Falls Bridge Traffic Study

Table 3. Comparison of No-Build and Build Alternative Daily Traffic Volumes

Facility	Limits	Current Volume	2015 AADTs No-Build	2015 AADTs Build	2015 Build / No-Build Difference	2015 Build / No-Build Percent	2030 AADTs No-Build	2030 AADTs Build	2030 Build / No-Build Difference	2030 Build / No-Build Percent
Interstate 95 Mainline										
I-95	US 1 to PA 332 (Newtown-Yardley Rd)	63,307	70,200	77,000	6,800	9.7%	77,400	84,800	7,400	9.6%
I-95	PA 332 (Newtown-Yardley Rd) to Taylorsville Rd	53,827	60,900	68,000	7,100	11.7%	68,100	75,900	7,800	11.5%
Scudder Falls Bridge	Taylorsville Rd to NJ 29 (River Rd)	59,475	67,900	76,000	8,100	11.9%	76,500	85,000	8,500	11.1%
I-95	NJ 175 (Upper River Rd) to CR 579 (Bear Tavern Rd)	57,030	66,400	73,600	7,200	10.8%	76,000	83,400	7,400	9.7%
I-95	CR 579 (Bear Tavern Rd) to CR 611 (Scotch Rd)	57,477	67,100	74,000	6,900	10.3%	76,900	83,800	6,900	9.0%
Interstate 95 Ramps										
Northbound Off-Ramp	I-95 to PA 332 (Newtown-Yardley Rd)	11,606	12,600	13,000	400	3.2%	13,600	14,000	400	2.9%
Northbound On-Ramp(s)	PA 332 (Newtown-Yardley Rd) to I-95	6,720	7,900	8,500	600	7.6%	8,900	9,500	600	6.7%
Southbound On-Ramp	PA 332 (Newtown-Yardley Rd) to I-95	12,141	13,200	13,700	500	3.8%	14,400	14,700	300	2.1%
Southbound Off-Ramp	I-95 to PA 332 (Newtown-Yardley Rd)	7,547	8,600	9,200	600	7.0%	9,800	10,300	500	5.1%
Northbound Off-Ramp	I-95 to Taylorsville Rd	3,260	3,700	3,700	0	0.0%	4,200	4,200	0	0.0%
Northbound On-Ramp	Taylorsville Rd Southbound to I-95	2,914	3,300	7,000	700	11.1%	3,800	8,000	700	9.6%
Northbound On-Ramp	Taylorsville Rd Northbound to I-95	2,549	3,000				3,500			
Southbound On-Ramp	Taylorsville Rd to I-95	3,321	3,700	3,700	0	0.0%	4,200	4,200	0	0.0%
Southbound Off-Ramp	I-95 to Taylorsville Rd Southbound	2,775	3,400	8,400	300	3.7%	4,100	9,500	0	0.0%
Southbound Off-Ramp	I-95 to Taylorsville Rd Northbound	3,991	4,700				5,400			
Northbound Off-Ramp	I-95 to NJ 29 (River Rd)	4,857	5,200	5,800	600	11.5%	5,500	6,100	600	10.9%
Northbound On-Ramp	NJ 29 (River Rd) to I-95	1,372	1,800	1,800	0	0.0%	2,300	2,200	-100	-4.3%
Northbound On-Ramp	NJ 175 (North River Rd) to I-95	1,883	2,400	2,500	100	4.2%	2,900	3,000	100	3.4%
Southbound On-Ramp	NJ 29 (River Rd) to I-95	4,666	4,900	5,500	600	12.2%	5,200	5,800	600	11.5%
Southbound Off-Ramp	I-95 to NJ 29 (River Rd)	3,823	4,400	4,600	200	4.5%	5,000	5,100	100	2.0%
Northbound Off-Ramp	I-95 to CR 579 (Bear Tavern Rd)	3,795	4,300	4,700	400	9.3%	4,800	5,200	400	8.3%
Northbound On-Ramp	CR 579 (Bear Tavern Rd) to I-95	4,753	5,500	5,700	200	3.6%	6,300	6,400	100	1.6%
Southbound On-Ramp	CR 579 (Bear Tavern Rd) Southbound to I-95	2,359	2,700	2,800	100	3.7%	3,100	3,100	0	0.0%
Southbound Off-Ramp	I-95 to CR 579 (Bear Tavern Rd)	3,860	4,600	4,800	200	4.3%	5,300	5,400	100	1.9%
Southbound On-Ramp	CR 579 (Bear Tavern Rd) Northbound to I-95	2,012	2,400	2,600	200	8.3%	2,800	3,100	300	10.7%
Crossing Streets & Local Roads										
PA 332 (Newtown-Yardley Rd)	West of I-95 Interchange	34,384	37,000	38,100	1,100	3.0%	39,700	40,400	700	1.8%
PA 332 (Newtown-Yardley Rd)	East of I-95 Interchange	10,719	12,100	12,700	600	5.0%	13,400	14,000	600	4.5%
Taylorsville Road	North of I-95 Interchange	10,799	12,100	12,700	600	5.0%	13,500	14,000	500	3.7%
Taylorsville Road	South of I-95 Interchange	11,113	13,000	13,800	800	6.2%	14,900	15,500	600	4.0%
Woodside Road	West of Taylorsville Road	5,400	6,300	6,300	0	0.0%	7,200	7,200	0	0.0%
Woodside Road	East of Taylorsville Road	4,000	5,000	5,100	100	2.0%	5,900	6,000	100	1.7%
NJ 29 (River Road)	North of I-95 Interchange	13,647	15,600	17,300	1,700	10.9%	17,500	19,400	1,900	10.9%
NJ 175 (Upper River Rd)	North of I-95 Interchange	3,600	4,900	5,200	300	6.1%	6,300	6,600	300	4.8%
NJ 175 (Upper River Rd)	South of I-95 Interchange	2,430	3,200	3,600	400	12.5%	4,000	4,400	400	10.0%
CR 579 (Bear Tavern Rd)	North of I-95 Interchange	9,944	11,700	12,400	700	6.0%	13,400	13,900	500	3.7%
CR 579 (Bear Tavern Rd)	South of I-95 Interchange	14,626	16,100	16,800	700	4.3%	17,600	18,100	500	2.8%
Scenic Drive	NJ 29 (River Rd) to CR 579 (Bear Tavern Rd)	4,300	4,900	5,100	200	4.1%	5,400	5,600	200	3.7%

The 2030 traffic volumes on the study area arterials under the Build Alternative are also generally higher than the corresponding volumes for the No-Build Alternative. These increases are typically less than five percent. Only NJ 29 (River Road) experiences an increase of over 1,000 vpd compared to the No-Build Alternative.

Under the Build Alternative, about 60 percent of the increase in traffic between current and 2030 conditions occurs by 2015, compared to only about half of that increase for the No-Build Alternative. In 2015, under the Build Alternative, the Scudder Falls Bridge is forecast to carry 76,000 vpd, or 16,500 more than current traffic. Between 2015 and 2030 its daily volume increases by an additional 9,000 vehicles. The faster growth between current and 2015 conditions under the Build Alternative is due to the sudden increase in I-95 corridor capacity that occurs once this alternative is opened to traffic. The increased capacity reduces travel times in the corridor and diverts cross-river trips from other facilities.

Figures 8 and 9 display AM and PM peak hour volumes under the Build Alternative for 2015 and 2030, respectively. Like the current and No-Build peak hour volumes, these are also heaviest in the northbound direction in the AM peak and heaviest in the southbound direction in the PM peak hour. The highest hourly volumes in the peak direction once again occur on the Scudder Falls Bridge.

By 2030, Interstate 95 AM peak hour volumes in the peak direction are 3,900 vph south of the PA 332 interchange, 4,210 vph between PA 332 and Taylorsville Road, and 6,470 vph on the Scudder Falls Bridge. Northbound AM peak hour volumes in the New Jersey portion of the corridor range from 5,640 to 6,050 vehicles per hour. Northbound PM peak hour volumes range from 2,490 vpd between the NJ 29 and NJ 175 on-ramps to 3,140 vpd south of PA 332.

In the southbound direction during the PM peak hour, there are 4,870 vehicles approaching the Bear Tavern Road interchange, 5,330 vehicles between Bear Tavern Road and NJ 29, 5,510 on the Scudder Falls Bridge, 4,340 vehicles between Taylorsville Road and PA 332, and 4,320 vehicles south of PA 332. Southbound volumes in the AM peak hour range from 2,660 vph between Taylorsville Road and PA 332 to 3,360 vph south of PA 332, with 2,730 vph on the Bridge.

Under the Build Alternative, the ramps with the highest volumes become the new, consolidated northbound on- and southbound off-ramps at Taylorsville Road. The two-lane, northbound on-ramp carries 2,570 vehicles in the AM peak hour, while the southbound off-ramp carries 1,480 vehicles in the PM peak hour.

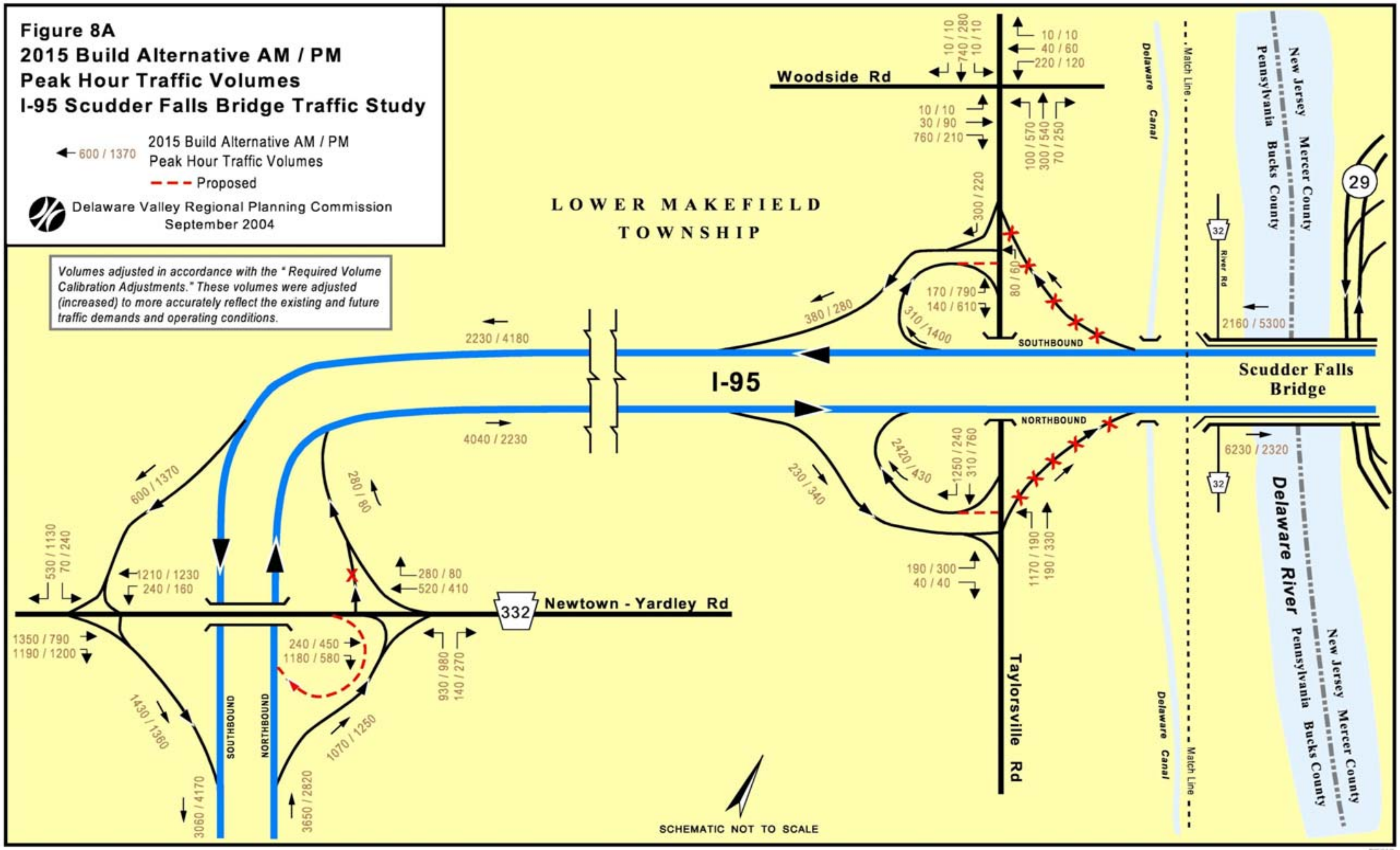


Figure 8A
2015 Build Alternative AM / PM
Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study
600 / 1370
2015 Build Alternative AM / PM
Peak Hour Traffic Volumes
Proposed
Delaware Valley Regional Planning Commission
September 2004
Volumes adjusted in accordance with the " Required Volume Calibration Adjustments." These volumes were adjusted (increased) to more accurately reflect the existing and future traffic demands and operating conditions.
LOWER MAKEFIELD
TOWNSHIP
Woodside Rd
I-95
Scudder Falls
Bridge
Newtown - Yardley Rd
332
Taylorsville Rd
Delaware Canal
Match Line
River Rd
32
29
New Jersey Mercer County
Pennsylvania Bucks County
Delaware River
SOUTHBOUND
NORTHBOUND
2230 / 4180
4040 / 2230
2160 / 5300
6230 / 2320
380 / 280
310 / 1400
170 / 790
140 / 610
80 / 60
300 / 220
10 / 10
740 / 280
10 / 10
10 / 10
40 / 60
220 / 120
10 / 10
30 / 90
760 / 210
100 / 570
300 / 540
70 / 250
230 / 340
2420 / 430
1250 / 240
310 / 760
190 / 300
40 / 40
1170 / 190
190 / 330
600 / 1370
530 / 1130
70 / 240
1210 / 1230
240 / 160
1350 / 790
1190 / 1200
1430 / 1360
3060 / 4170
280 / 80
280 / 80
520 / 410
240 / 450
1180 / 580
930 / 980
140 / 270
1070 / 1250
3650 / 2820
SCHEMATIC NOT TO SCALE

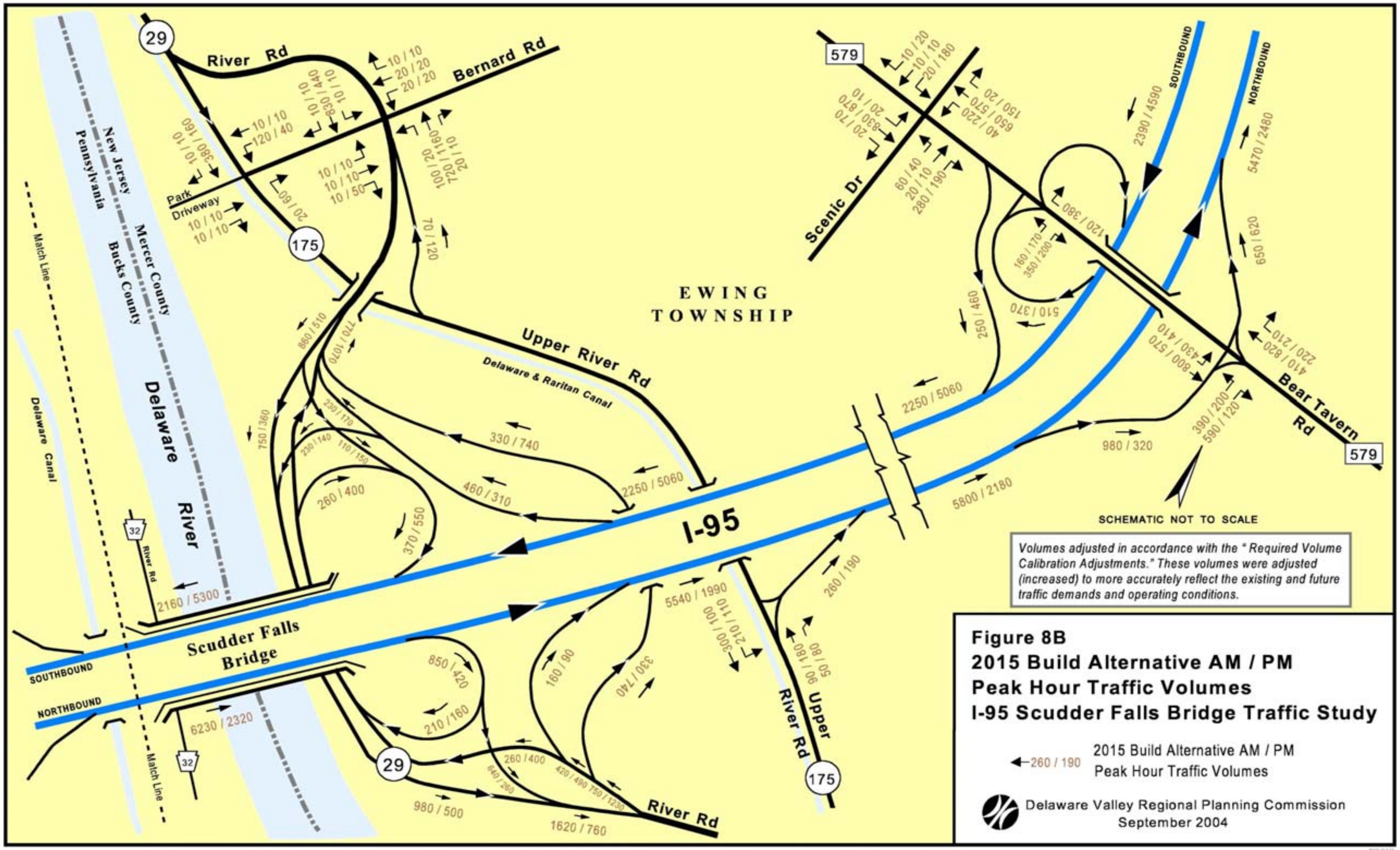


Figure 8B
2015 Build Alternative AM / PM Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study

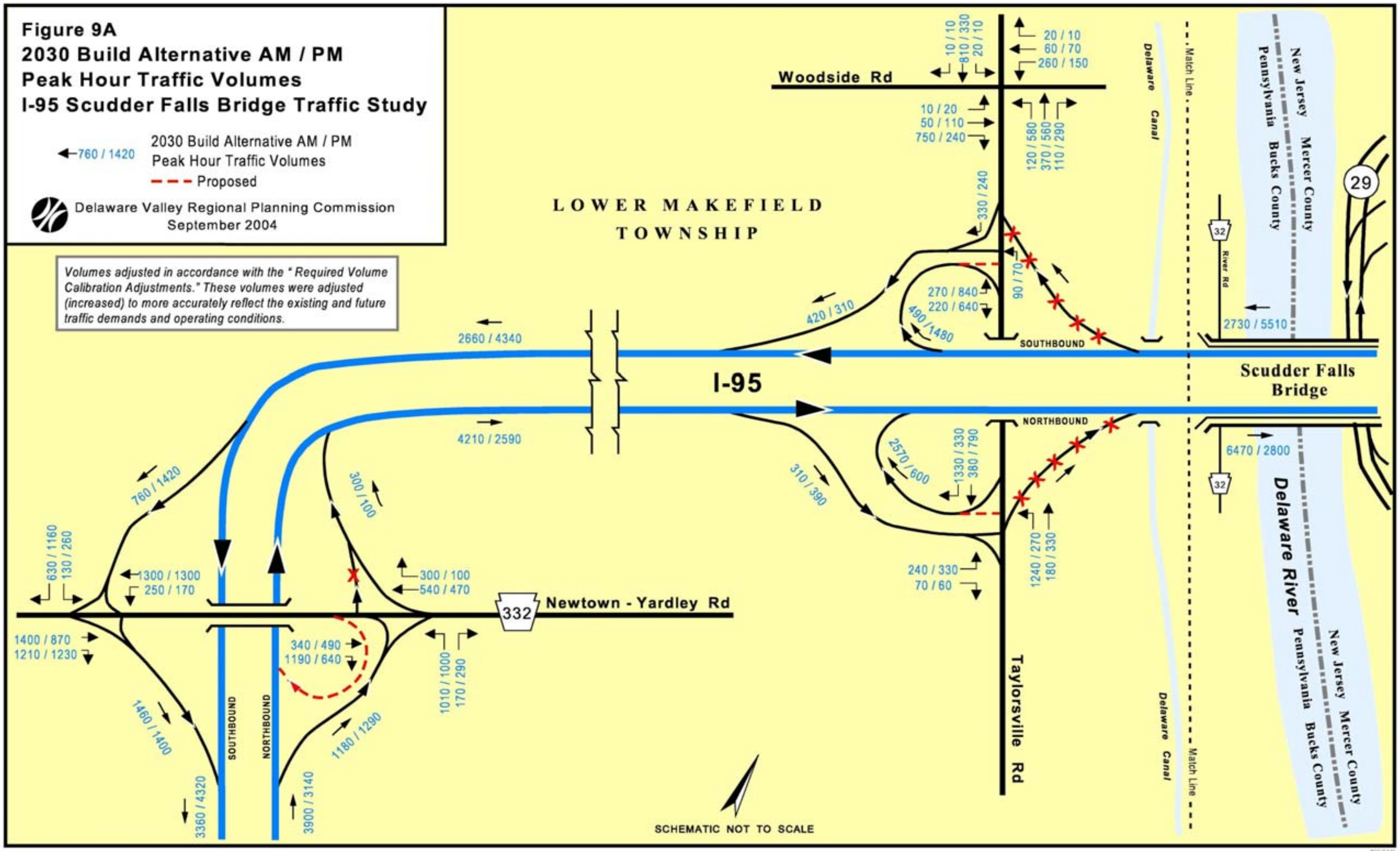


Figure 9A
2030 Build Alternative AM / PM
Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study
760 / 1420
2030 Build Alternative AM / PM
Peak Hour Traffic Volumes
Proposed
Delaware Valley Regional Planning Commission
September 2004
Volumes adjusted in accordance with the " Required Volume Calibration Adjustments." These volumes were adjusted (increased) to more accurately reflect the existing and future traffic demands and operating conditions.
LOWER MAKEFIELD
TOWNSHIP
Woodside Rd
10 / 10
810 / 330
20 / 10
20 / 10
60 / 70
260 / 150
10 / 20
50 / 110
750 / 240
120 / 580
370 / 560
110 / 290
330 / 240
270 / 840
220 / 640
90 / 70
420 / 310
490 / 1480
SOUTHBOUND
NORTHBOUND
2660 / 4340
4210 / 2590
I-95
Scudder Falls
Bridge
2730 / 5510
6470 / 2800
Delaware Canal
Match Line
New Jersey
Pennsylvania
Mercer County
Bucks County
29
32
River Rd
Delaware River
760 / 1420
300 / 100
310 / 390
2570 / 600
1330 / 330
380 / 790
1240 / 270
180 / 330
240 / 330
70 / 60
630 / 1160
130 / 260
1300 / 1300
250 / 170
300 / 100
540 / 470
332
Newtown - Yardley Rd
1400 / 870
1210 / 1230
340 / 490
1190 / 640
1010 / 1000
170 / 290
1460 / 1400
SOUTHBOUND
NORTHBOUND
1180 / 1290
3360 / 4320
3900 / 3140
Taylorsville Rd
SCHEMATIC NOT TO SCALE

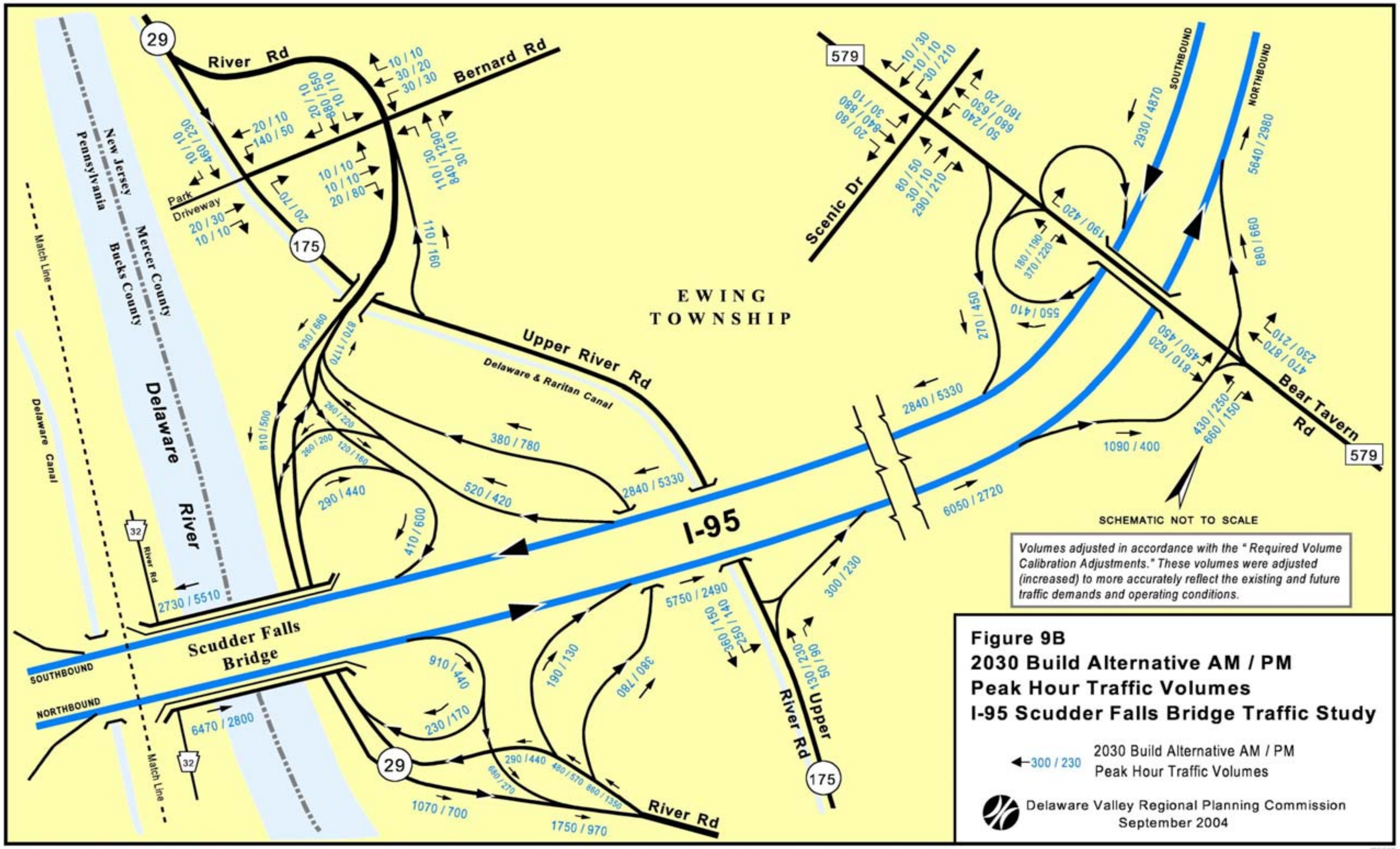


Figure 9B
2030 Build Alternative AM / PM
Peak Hour Traffic Volumes
I-95 Scudder Falls Bridge Traffic Study

300 / 230 — 2030 Build Alternative AM / PM Peak Hour Traffic Volumes

Delaware Valley Regional Planning Commission
September 2004