

Fernwood-Bushkill SR/US 209 Traffic Analysis Summary

INTRODUCTION

PennDOT's Bushkill Conservation Plan addresses transportation planning and land use issues creating a plan to revitalize Bushkill Village in the context of a national park setting. Bushkill Village and US Route 209 (US 209) are the gateway into Pike County at the southern end of the Delaware Water Gap National Recreation Area (DEWA). The plan focuses among others, on intermodal connections, including trail connections and pedestrian improvements. Within this context, Lehman Township's Comprehensive Plan Update (Final Draft dated May 21, 2021) investigates a future Pike County transit service," River *Line*" bus service between Matamoros towards the northern end of US 209 and East Stroudsburg towards the southern and of US 209.

Park and Ride (P&R) facilities provide convenient and safe locations for commuters to leave their automobiles and carpool, vanpool or ride public transit to their destinations. These reduce the number of motorists on the road, thereby reducing vehicle miles of travel. A conceptual P&R location has been identified near Fernwood Lane on west side of US 209 near the intersection with Winona Falls Road. The Fernwood Multi-Modal Park and Ride entrance is proposed to be located across from Golf Drive.

Traffic operational analysis was performed for the following intersections:

1. US 209 at the Proposed Fernwood P&R/Golf Drive
2. US 209 at Bushkill Falls Road

Estimated traffic from the proposed Fernwood Development adjacent to the proposed P&R was taken into consideration in the operational analysis.

PROPOSED DEVELOPMENTS

Trips were generated for the proposed P&R and the developments identified for the proposed Fernwood Development using the 11th Edition of the ITE Trip Generation Manual. Identified developments for the Fernwood Development included are as follows:

1. Outdoor Plaza/Fountain/Market Space
2. Jinyin Temple
3. Hotel
4. Recreational Community Center
5. Shopping Center
6. High Turnover Restaurant

TRAFFIC DATA

The most recent Annual Average Daily Traffic (AADT) for US 209 was obtained from PennDOT's Map website. The 2021 AADT for US 209 from Winona Falls Road to Pike County Line is 10,000

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vehicles per day¹. The 2021 AADT for US 209 in Pike County is 2,600 vehicles per day². Intersection Turning Movement Counts (TMC) for existing summer weekday conditions were conducted on Tuesday August 10, 2021, and for summer Saturday conditions on August 13, 2022. The higher summer traffic was utilized for the traffic analysis due to the recreational setting of the study area. The intersections at which the traffic counts were obtained are US209 (Milford Road) at Winona Falls Road / River Road, and US209 (Federal Road) at Bushkill Falls Road. The TMC for Winona Falls Road was used to derive the traffic volumes at US209 and the proposed Park & Ride.

The existing TMC for weekday A.M. and P.M. peak hours and for the Saturday peak hour were projected to future year 2040 using a growth rate of 1% per annum. Trips from the Fernwood P&R and other developments were added on to the projected 2040 traffic to obtain the total estimated traffic presented in **Figure 1**, **Figure 2** and **Figure 3**.

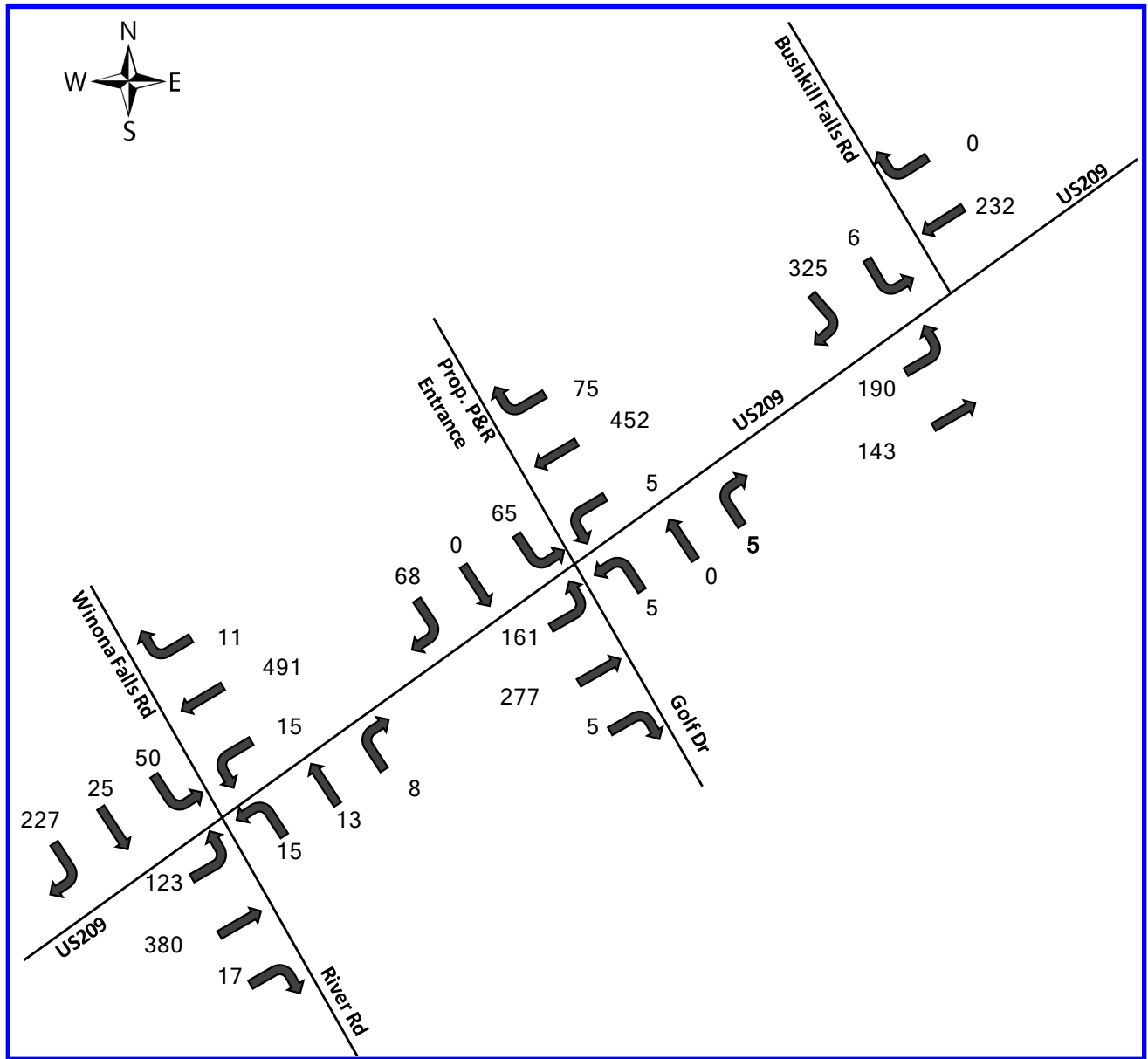
¹ https://gis.penndot.gov/BPR_PDF_FILES/MAPS/Traffic/Traffic_Volume/County_Maps/Monroe_tv.pdf

² https://gis.penndot.gov/BPR_PDF_FILES/MAPS/Traffic/Traffic_Volume/County_Maps/Pike_tv.pdf

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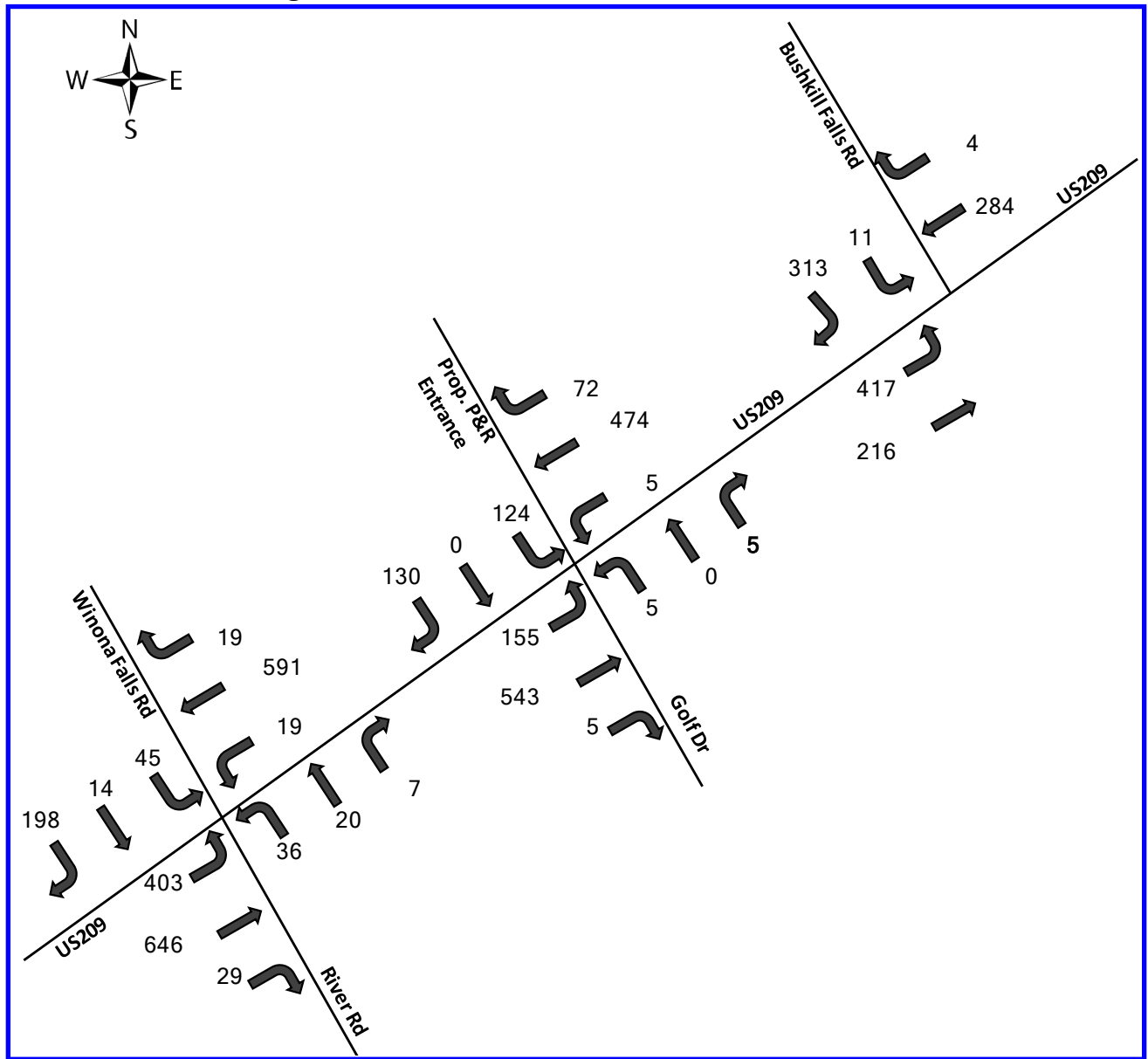
Figure 1: 2040 Total A.M. Peak Hour Traffic Volumes



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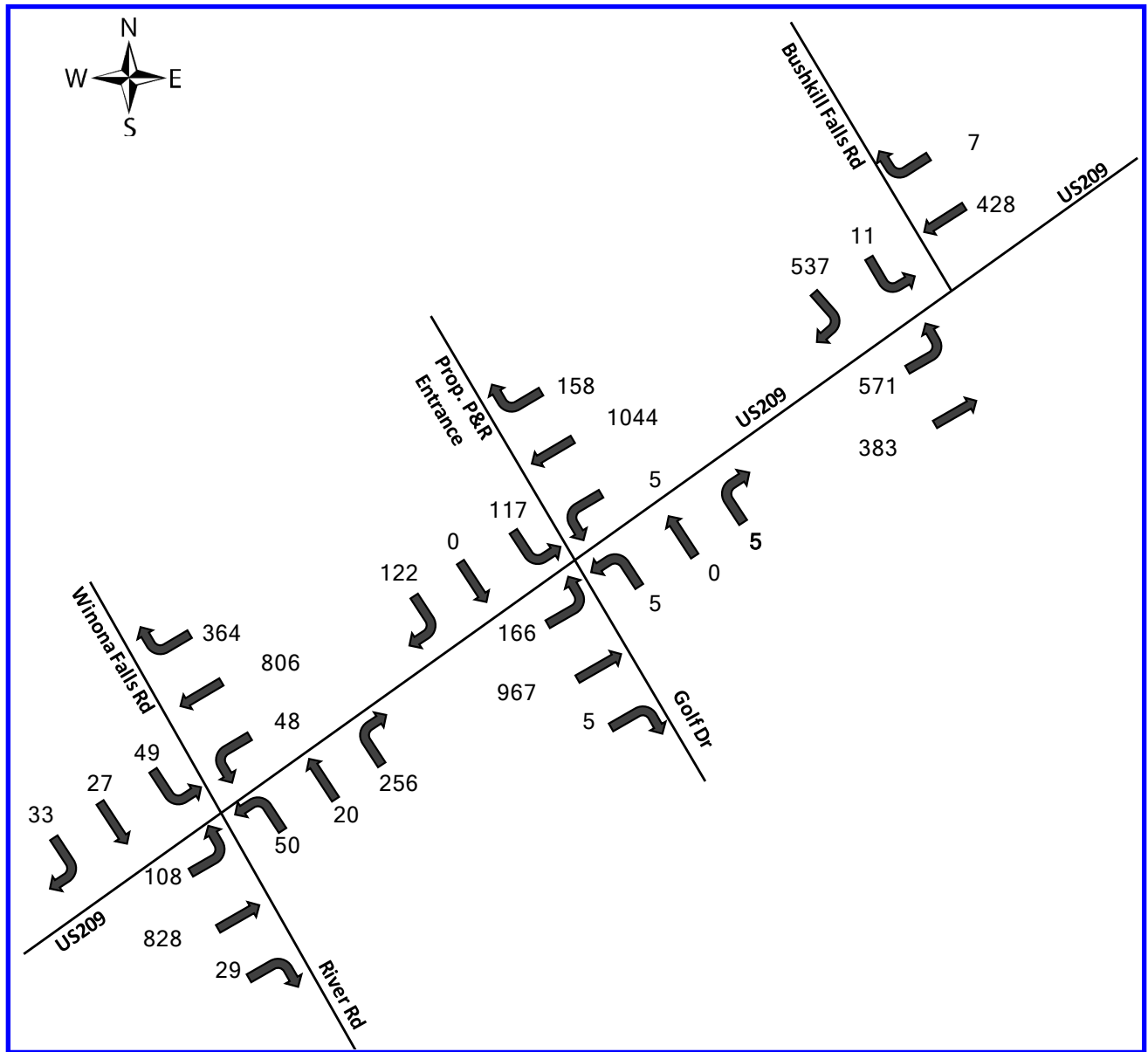
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Figure 2: 2040 Total P.M. Peak Hour Traffic Volumes



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Figure 3: 2040 Total Saturday Peak Hour Traffic Volumes



TRAFFIC OPERATIONAL ANALYSIS

A traffic operational analysis was performed for the three intersections for future year 2040 with all the developments using Synchro 11 software. It is anticipated that the Proposed P&R Entrance intersection with US 209 will serve as the main access for the Fernwood Development and will therefore be signalized. It is therefore expected that the existing traffic signal at the intersection of US 209 and Fernwood Lane, approximately 400 feet south of the Proposed P&R Entrance will be removed. The intersection will be reconfigured to operate as an unsignalized rights-in, rights out only intersection. This will eliminate the need for the existing northbound left-turn lane at this intersection and create more storage room for southbound traffic at the existing 4-legged intersection of US209

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and Winona Falls Road / River Road during the red signal interval eliminating the potential queue spillback into what would have been an upstream signalized intersection. This will help improve future traffic growth accommodations at this signalized intersection.

The intersection of US 209 and Proposed P&R Entrance / Golf Drive was analyzed with signalized crosswalks on the south US 209 leg, west Proposed P&R Entrance leg, and east Golf Drive leg to accommodate safe crossing for all non-motorized traffic. The signalized intersection of US 209 at Bushkill Falls Road was analyzed with signalized pedestrian crosswalks on the south US 209 leg and the west Bushkill Falls Road leg. Both intersections were analyzed to run 24-7 free. The signalized pedestrian crosswalks on all four legs at the intersection of US 209 with Winona Falls Road / River Road were maintained in the operational analysis. The existing signal timings were adjusted to accommodate the increase increased traffic volumes.

At the existing signalized intersections, the existing protected + permitted signal phasing for left turn traffic on US 209 was maintained for the future conditions. At the intersection of US 209 and Winona Falls Road / River Road, the existing concurrent phasing for the eastbound Winona Falls Road approach and the westbound River Road approach was maintained.

For the proposed intersection of US 209 and Proposed Park & Ride Entrance northbound and southbound US 209 left-turn traffic were analyzed with protected + permitted signal phasing. The eastbound Proposed Park & Ride Entrance approach and westbound Golf Drive approach were analyzed with concurrent signal phasing.

TRAFFIC OPERATIONAL ANALYSIS RESULTS

Highway Capacity Manual (HCM) 6 signalized operational analysis delay and level of service (LOS) were generated from Synchro 11. Table 1 presents the LOS criteria for HCM 6. Table 2 through Table 4 present the approach and intersection delay and LOS for the A.M., P.M., and Saturday peak hour at each of the three intersections analyzed. Delay is measured in seconds per vehicle.

Table 1: HCM 6 Signalized LOS Criteria

LOS	Delay (Seconds per Vehicle)
A	0 to 10
B	>10 to 20
C	>20 to 35
D	>35 to 55
E	>55 to 80
F	>80

As provided in the tables, except for the summer Saturday peak hour at the intersection of US 209 at Winona Falls Road, the intersections would operate at LOS D or better for all peak hours at the three intersections analyzed. For the summer Saturday peak hour at the intersection of US 209 at Winona Falls Road, both minor road approaches would operate at LOS F. Additionally, the US 209 southbound

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approach would operate at LOS E, and the overall intersection would also operate at LOS E. This is driven in part by the high southbound right-turn volume in the US209 southbound shared through lane. If it is feasible to provide an exclusive southbound right-turn lane, all approaches at the intersection would operate at LOS D or better, and the overall intersection would operate at LOS C. Based on the 95th percentile queue, if provide, the storage length (excluding taper) for the right-turn lane should be 225 feet.

Table 2: US 209 at Winona Falls Road 2040 Traffic Operational Analysis Results

Approach / Intersection	Weekday AM Peak Hour		Weekday PM Peak Hour		Summer Saturday Peak Hour		Summer Saturday Peak Hour with SBR Turn Ln	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
NB US 209	12.1	B	18.0	B	23.3	C	35.1	D
SB US 209	19.9	B	28.9	C	60.7	E	26.7	C
EB Winona Falls F	22.0	C	29.2	C	100.6	F	33.1	C
WB River Rd	19.5	B	28.8	C	144.5	F	38.5	D
Intersection	17.4	B	23.1	C	58.6	E	31.5	C

Table 3: US 209 at Proposed Park & Ride Entrance 2040 Traffic Operational Analysis Results

Approach / Intersection	Weekday AM Peak Hour		Weekday PM Peak Hour		Summer Saturday Peak Hour	
	Delay	LOS	Delay	LOS	Delay	LOS
NB US 209	8.4	A	13.3	B	27.2	C
SB US 209	13.0	B	16.6	B	44.9	D
EB P&R Entrance	18.9	B	20.1	C	64.1	E
WB Golf Drive	16.5	B	15.6	B	42.8	D
Intersection	11.9	B	15.6	B	38.9	D

Table 4: US 209 at Bushkill Falls Road 2040 Traffic Operational Analysis Results

Approach / Intersection	Weekday AM Peak Hour		Weekday PM Peak Hour		Summer Saturday Peak Hour	
	Delay	LOS	Delay	LOS	Delay	LOS
NB US 209	8.8	A	27.1	C	53.3	D
SB US 209	16.3	B	17.2	B	39.5	D
EB P&R Entrance	12.6	B	12.6	B	18.5	B
Intersection	12.1	B	21.0	C	40.4	D

For the proposed intersection of US 209 and Proposed Park & Ride Entrance, based on the 95th percentile queue length for the Saturday peak hour, a northbound left-turn lane storage (excluding taper) length of 225 feet, and a southbound right-turn lane storage (excluding taper) length of 100 feet would be needed.

At the intersection of US 209 and Bushkill Falls Road, based on the 95th percentile queue length for the Saturday peak hour, a northbound left-turn lane storage (excluding taper) length of 625 feet would be needed. This would extend to the bridge over the Bushkill Creek which would therefore need to

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be widened. Bushkill Village and US 209 are the gateway into Pike County at the southern end of DEWA as recognized in PennDOT's Bushkill Conservation Plan which includes creating a plan to revitalize Bushkill Village in the context of a national park setting. This bridge is a critical portion of US 209 that must be rehabilitated / reconstructed to ensure that US 209 can reliably meet the intermodal connection needs of the plan. In tandem with this, for Lehman Township's plan for a future Pike County transit service, "*River Line*" bus service between Matamoras towards the northern end of US 209 and East Stroudsburg towards the southern end of US 209 to succeed, the structural integrity of all US 209 structural elements, including the bridge over Bushkill Creek is required.

CONCLUSIONS

Except for the summer Saturday peak hour at the existing intersection of US 209 at Winona Falls Road, all three intersections analyzed would operate at LOS D or better for 2040 weekday A.M. and P.M., and Saturday peak hours. At the intersection of US 209 at Winona Falls Road a southbound right-turn lane would be needed to yield LOS D or better for the Saturday peak hour.

Intersection of US 209 and Proposed Park & Ride

1. The intersection would need to be signalized.
2. A 225-foot minimum storage length left-turn (excluding taper) would be needed on northbound US 209
3. A 100-foot minimum storage length right-turn (excluding taper) would be needed on southbound US 209
4. All crosswalks should be controlled with pedestrian signals

Intersection of US 209 and Winona Falls Road

1. Signal timings would need adjustment to accommodate future traffic.
2. A 225-foot minimum storage length right-turn (excluding taper) should be considered for southbound US 209 if feasible.

Intersection of US 209 and Bushkill Falls Road

3. Signal timings would need adjustment to accommodate future traffic.
4. A 625-foot minimum storage length left-turn (excluding taper) would be needed for northbound US 209.

Bridge Over Bushkill Creek

The bridge over the Bushkill Creek should be rehabilitated/rebuilt/widened to accommodate the traffic needs from the developments, intermodal and transit connections to revitalize Bushkill Village as envisioned by PennDOT and Lehman Township. This would include the provision of the aforementioned 625-foot northbound left-turn lane on US 202 at the intersection with Bushkill Falls Road.

**Bushkill Village
Park and Ride
Demand and Site Characteristics Analysis**

October 2022

To better understand the demand and site characteristics of park and ride facilities, the AASHTO *Guide for Park and Ride Facilities*, October 2004 (the *Guidebook*) was used as a reference. The original intent of this analysis was to determine the appropriate capacity of a park and ride facility based on numerous factors such as traffic volumes, population densities, as well as origins and destinations in the area that could influence its size. However, after review of the *Guidebook*, it was determined that such a ratio does not exist. What this analysis did discover however, are many of those factors, as well as several others, do influence the location and demand of a successful park and ride facility.

According to the *Guidebook*, park and-ride-facilities are more effective when they are a part of a comprehensive and coordinated land use and multimodal transportation system. The *Guidebook* states:

“It is typically more effective to plan park-and-ride facilities as part of a coordinated and multi-modal transportation and land use system, than to plan individual facilities and try to tie these facilities together after the fact. Park-and-ride facilities cannot function on their own without direct linkages to the surrounding transit and highway infrastructure. It is important to develop a comprehensive system plan inclusive of park-and-ride facilities before developing the individual elements or facilities within the overall system plan. Success of the individual park-and-ride lies in its ability to connect with the regional transportation network and the selection of a site location within the network.”

Post modeling techniques is one method for determining demand forecasts. According to the *Guidebook*, “...the first step in post modeling techniques revolves around identifying the production (home) and attraction (employment) ends of potential trips that might use a proposed park-and-ride facility. Studies from California indicate that the primary home influence area extends between 3-5 miles from the individual park-and-ride facility but is strongly influenced by such factors as the presence of competing lots, the distance to the primary destination activity center, and the existence of unique conditional characteristics such as downstream traffic congestion.”

“Based on the identification of the production and attraction zones, the trip interchange characteristics between the two influence areas can be determined using a regional travel demand model. This destination center should be limited to those areas served directly by the facility (e.g. served by transit service between the lot and the activity center). However, it should be remembered that non-transit HOV’s might also be using the park-and-ride lot as a formation or staging location, this necessitates that other large potential destination zones should not be ignored. However, for modeling and demand purposes, destination zones should be limited to two or three major centers for any given park-and-ride.”

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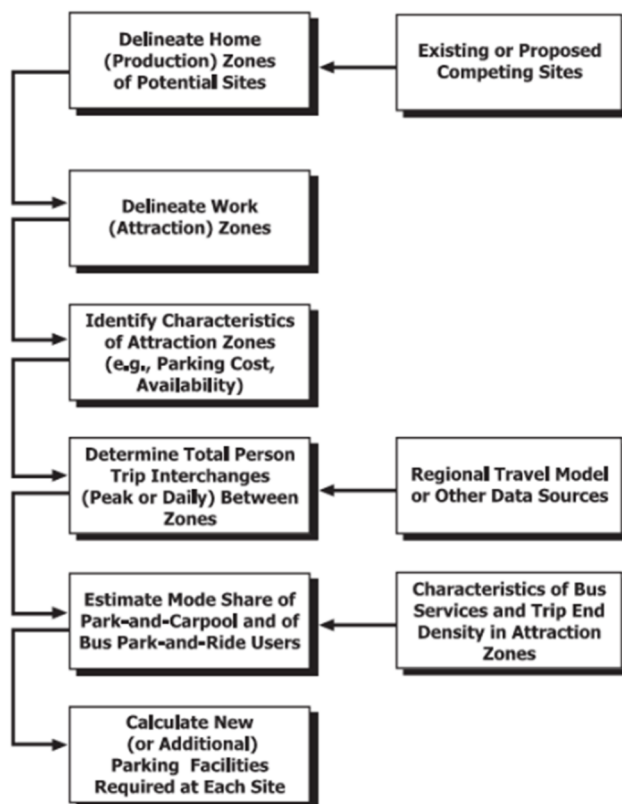
Once modal splits are determined, the resulting park-and-ride demand shares can be applied to developed trip interchange tabulations, and the number of parking spaces required for a site can be determined. Placement of individual park-and-ride sites within a service area becomes a task best handled in a comprehensive system planning process.

Regional forecasting is an approach in which the park-and-ride trip is modeled as a chained trip directly within the regional modeling process. According to the *Guidebook*, "...the direct forecasting approach is best illustrated by the Puget Sound Regional Council (PSRC) example. The PSRC uses a direct forecasting methodology based on a transportation modeling platform and provides both highway and transit modeling capabilities. Within this region there are approximately 170 park-and-ride lots with a total of 25,000 spaces. Fifty of these lots can be termed major facilities, having in excess of 150 spaces each."

"...the Puget Sound region is divided into traffic analysis zones. Each zone is connected to the regional centers via a roadway network comprised of approximately 14,000 one-way roadway links."

"Modal splits within the PSRC model are based on utility functions between the various modes available. Utility functions are typically dependent on the travel time and cost characteristics of the competing modes and are employed within a multimodal logit modeling format."

The following chart from the *Guidebook* provides an **Overview of Park-and-Ride Demand Estimation Methodology**.



As described previously, park-and-ride lots typically function more effectively when they are part of a comprehensive multimodal transportation network. The Monroe County Transit Authority provides bus

service along PA 611 with Bus Route 102. The closest bus stop to the proposed Bushkill Park and Ride Lot is located at the Great Wolf Lodge on PA 611 W in E. Scotrun, PA. The distance between this bus stop and the proposed Bushkill Park and Ride Lot is approximately 32 miles. Extension of this service, or additional bus service, to the proposed Bushkill Park and Ride Lot would greatly increase the effectiveness of the proposed facility and is a critical recommended element to the development of the Bushkill Park and Ride Lot.