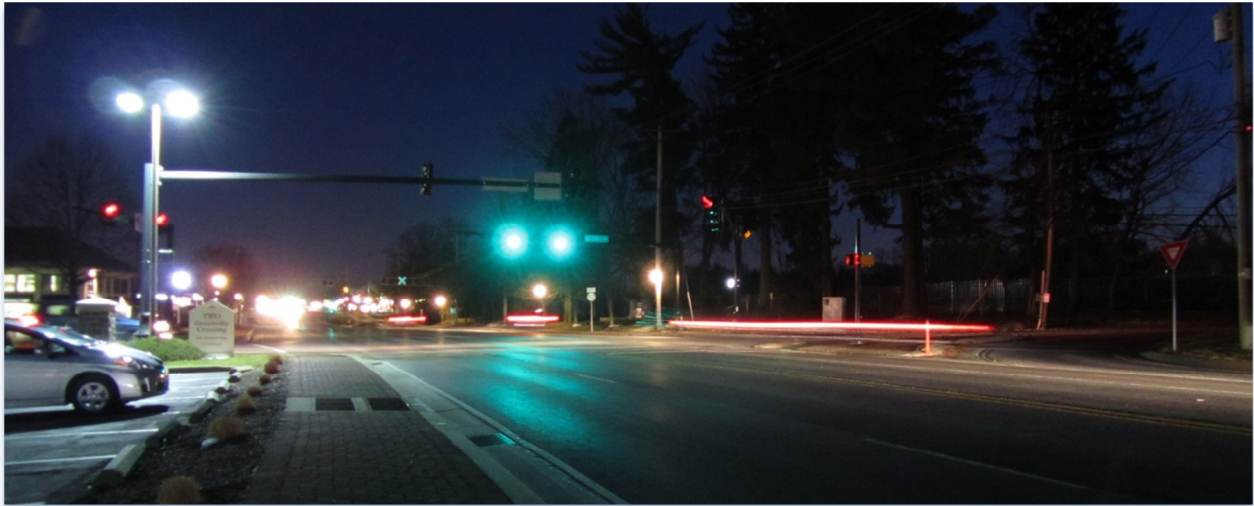


EVALUATION OF HIGH CRASH LOCATIONS (DARK CRITERIA) STUDY



**LOCATION #7:
SR 52 (Kenneth Pike)
MILEPOST 2.40 to 4.29
November 2012**



Prepared for:
Delaware Department of Transportation



By:
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EXECUTIVE SUMMARY

The purpose of this study was to evaluate locations with the highest ratios of crashes occurring during dark conditions throughout the state of Delaware. The study included reviewing crash history and existing conditions of the locations, identifying specific sites where crashes are occurring and providing recommendations to improve conditions.

The Hazard Elimination Program (HEP) site selection process was used to determine ten (10) locations statewide with a dark crashes Critical Ratio greater than one and ten (10) or more accidents occurring in the three year study period within a one-mile roadway segment. SR 52 (Kennett Pike), from Milepost 2.40 to 4.29, was determined to be one of the ten locations with the highest dark crashes Critical Ratios statewide.

Police crash reports were analyzed to identify high crash sites along SR 52 from Milepost 2.40 to 4.29. Crash clusters were identified at the following five (5) locations:

- Site #1: SR 52 (Kennett Pike) @ Private Drive (Methodist Country Home / Golf Club) Intersection (M.P. 2.84)
- Site #2: SR 52 (Kennett Pike) @ SR 82 (Campbell Road / Kirk Road) Intersection (M.P. 3.32)
- Site #3: SR 52 (Kennett Pike) @ Sunnyside Road Intersection (M.P. 3.57)
- Site #4: SR 52 (Kennett Pike) @ Stone Gate Entrance / Brook Valley Rd Intersections (M.P. 3.80 and 3.84)
- Site #5: SR 52 (Kennett Pike) @ Hillside Road / Greenville Crossing Shopping Center Intersection (M.P. 4.07)

Existing roadway lighting is present at one (1) of these locations. The intersection of SR 52 and Private Drive (Methodist Country Home / Golf Club) has partial intersection lighting. The intersection of SR 52 and Hillside Road / Greenville Crossing Shopping Center has no existing lighting at the intersection, but there is one commercial lighting pole for an adjacent parking lot on the northeast corner and existing post-top lighting for sidewalks on both sides of SR 52 just south of the intersection. Because the intersection features luminaires that appear to only cover part of the intersection, photometric calculations are recommended to evaluate the existing lighting. At a minimum, additional luminaires on the southwest corner of the intersection would improve lighting levels. Also, the lighting levels may benefit from increasing the wattage of the existing 250 Watt luminaires to 400 Watts.

A new W3-3 (Signal Ahead) sign is recommended on the southbound approach to the intersection.

It is recommended to change the lane marking on the left lane of the westbound approach to a left/through arrow from left only arrow.

It is also recommended that a utility-owned luminaire on the utility pole located on the northeast corner should receive maintenance attention, as the luminaire is malfunctioning.

The intersection of SR 52 and Hillside Road / Greenville Crossing Shopping Center does not have existing lighting, and was evaluated for potential nighttime safety improvements. Pavement marking improvements are recommended. Also, pedestrian push-buttons are recommended to be relocated to meet ADA standards. At the time of this report, a Pave & Rehab project is expected to include this intersection which would address the ADA concerns.

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1. INTRODUCTION

The purpose of this study was to evaluate locations with the highest ratios of crashes occurring during dark conditions throughout the state of Delaware. The study included reviewing crash history and existing conditions of the locations, identifying specific sites where crashes are occurring and providing recommendations to improve conditions.

The study included three parts:

Part 1: Location Selection – The Hazard Elimination Program (HEP) site selection process was used to determine ten (10) locations statewide with a dark crashes Critical Ratio greater than one and ten (10) or more accidents occurring in the three year study period within a one-mile roadway segment. Results from the location selection process were reviewed in coordination with DelDOT. Corridors that were already part of an ongoing HSIP or HEP project were not included in this study. The Critical Ratio methodology was used in the location selection process. The list of statewide 1.0 mile corridors ranked by Critical Ratio is included in Appendix D.

Part 2: Evaluation – After the list of the top ten locations was approved by DelDOT, an initial review was performed for each selected location. The evaluation included field visits to the sites; collecting information on existing roadway and traffic conditions; crash analysis; preliminary lighting evaluation; and this report. The report includes existing lighting analysis; concept lighting improvement alternatives; other signing, striping and signal recommendations in accordance with the Delaware Strategic Highway Safety Plan (SHSP), particularly related to dark crashes; potential design/implementation issues, and identification of the need for more detailed studies (Phase II studies).

Part 3: Coordination – Coordination of implementation with ongoing DelDOT projects (HEP, Pavement & Rehabilitation, PD, etc.). When possible, DelDOT-approved recommendations will be coordinated for inclusion into the construction of ongoing projects.

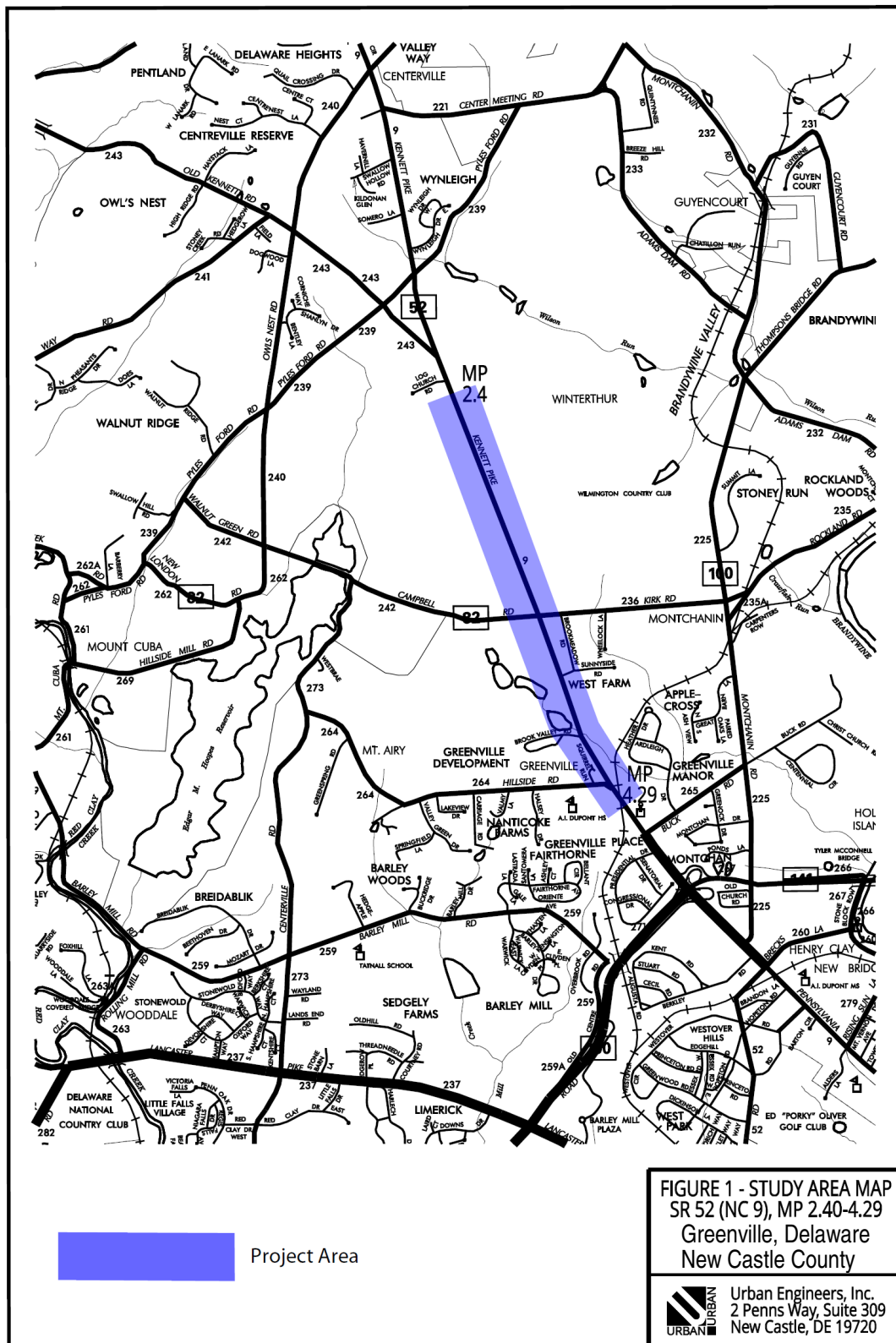
The location selection process resulted in a list of ten locations, including SR 52 (Kennett Pike) from Milepost 2.40 to 4.29.

SR 52 (Kennett Pike)

The study location is in Greenville, Delaware. SR 52 is a two-lane, undivided principal arterial roadway at north of Stone Gate Entrance. Between Stone Gate Entrance and Hillside Road, SR 52 is a two-lane, divided principal arterial roadway. South of Hillside Road, SR 52 is a four-lane, divided principal arterial roadway.

In 2010, SR 52 experienced an ADT of 12,797 vehicles north of SR 82, and 18,387 vehicles south of SR 82.

Shoulders are present on both sides of the road in each direction along the two-lane section north of Stone Gate Entrance in the project area. A study area map is provided in **Figure 1**.



2. CRASH DATA SUMMARY

This evaluation was based on crash data during the three year period from May 16, 2008 to May 16, 2011.

A total of 92 crashes occurred on SR 52 (Kennett Pike) from milepost 2.40 to 4.29 during the evaluation period.

Fifteen (15) crashes resulted in personal injuries, not including fatality crashes. Rear end collisions were the most predominant type of impact, with 53 of the 92 crashes (58%).

Of the 92 crashes, 65 of the crashes occurred during daylight (71%). Twenty-one (21) of the crashes occurred during dark conditions (23%). Fourteen (14) of the dark crashes occurred in dark-not lighted conditions (15%). Seven (7) of the dark crashes occurred in dark-lighted conditions (8%). Six (6) of the crashes occurred in dawn, dusk, and unknown conditions (7%).

The highest number of crashes (40) at an individual site occurred at the intersection of SR 52 (Kennett Pike) and SR 82 (Campbell Road / Kirk Road).

Crashes were grouped together into sites based on their location along SR 52.

Site #1: SR 52 (Kennett Pike) @ Private Drive (Methodist Country Home / Golf Club) Intersection (M.P. 2.84)

There were 4 total crashes at the site during the evaluation period. One (1) of the 4 crashes (25%) occurred during dark hours. This site has partial existing roadway lighting.

This site was selected for evaluation because of the crash history and because the intersection is only partially lit.

Site #2: SR 52 (Kennett Pike) @ SR 82 (Campbell Road / Kirk Road) Intersection (M.P. 3.32)

There were 40 total crashes at the site during the evaluation period. Five (5) of the 40 crashes (13%) occurred during dark hours. There is no roadway lighting at the intersection.

This site was not selected for evaluation based on the limited crash history during dark hours.

Additionally, construction is scheduled to begin in Summer 2013 for an intersection improvements project at this intersection. The project will include milling, overlaying and restriping the northbound and southbound SR 52 approaches to provide a separate left turn lane and a shared through/right turn lane.

Site #3: SR 52 (Kennett Pike) @ Sunnyside Road Intersection (M.P. 3.57)

There were 5 total crashes at the site during the evaluation period. One (1) of the 5 crashes (20%) occurred during dark hours. There is no roadway lighting at the intersection.

This site was not selected for evaluation based on the limited crash history during dark hours.

Site #4: SR 52 (Kennett Pike) @ Stone Gate Entrance / Brook Valley Rd Intersections (M.P. 3.80 and 3.84)

There were 9 total crashes at the site during the evaluation period. One (1) of the 9 crashes (11%) occurred during dark hours. This site has partial existing roadway lighting.

This site was not selected for evaluation based on the limited crash history during dark hours.

Site #5: SR 52 (Kennett Pike) @ Hillside Road / Greenville Crossing Shopping Center Intersection (M.P. 4.07)

There were 17 total crashes at the site during the evaluation period. Five (5) of the 17 crashes (29%) occurred during dark hours. There is no roadway lighting at the intersection, but there is one commercial lighting pole for an adjacent parking lot at the northeast corner and existing post-top lighting for sidewalks on both sides of SR 52 just south of the intersection.

This site was selected for evaluation based on the crash history and the combination of existing lighting surrounding the intersection and a lack of lighting at the intersection.

3. ROADWAY AND SITE CHARACTERISTICS

Site #1: SR 52 (Kennett Pike) @ Private Drive (Methodist Country Home / Golf Club) Intersection (M.P. 2.84)

SR 52 (Kennett Pike) and Private Drive (Methodist Country Home / Golf Club) meet at a signalized intersection at milepost 2.84 of SR 52.

SR 52 northbound has one through lane, a left turn lane and a right turn lane. SR 52 southbound has one through lane, a left turn lane and a right turn lane. Private Drive eastbound from Methodist County Home has a shared left/through lane and a right turn lane. Private Drive westbound from Golf Club has a shared left/through lane and a right turn lane. An aerial showing the intersection layout is shown in **Photo 1**.



Photo 1: SR 52 @ Private Drive (Methodist Country Home / Golf Club) Intersection

There are no pedestrian crosswalks present at the intersection. At the intersection, the posted speed limit for SR 52 northbound and SR 52 southbound is 50 miles per hour, and the posted

speed limit for eastbound Private Drive from Methodist Country Home is 20 miles per hour. There is no posted speed limit for westbound Private Drive from Golf Club approaching the intersection.



Photo 2: Facing south on SR 52 just north of Private Drive (Day)

Existing Lighting

One (1) 250 Watt, HPS luminaire is present on utility poles on both sides of SR 52 just north of the intersection. Another 250 Watt, HPS luminaire is present on an utility pole at the southeast corner of the intersection. However, there is no luminaire at the southwest corner of the intersection.

It was also found in the field visit that the light bulb in the luminaire attached on the utility pole located at the northeast corner (pole number 46991/45199) is getting old and malfunctioning shown in **Photo 3-1** and **Photo 3-2**. The luminaire may have a bulb problem to be replaced or has a ballast problem to be repaired. In either of the cases, the luminaire should receive maintenance attention.



Photo 3-1: Facing south on SR 52 just north of Private Drive (Night)



Photo 3-2: Facing south on SR 52 just north of Private Drive (Night)

Site #5: SR 52 (Kennett Pike) @ Hillside Road / Greenville Crossing Shopping Center Intersection (M.P. 4.07)

SR 52 (Kennett Pike) and Hillside Road / Greenville Crossing Shopping Center meet at a signalized intersection at milepost 4.07 of SR 52.

SR 52 northbound has two through lanes, a left turn lane and a right turn lane. SR 52 southbound has one through lane, a left turn lane and a right turn lane. There is a raised channelized right-turn island on the southbound approach. Hillside Road eastbound has a shared left/through/right lane. There is a painted channelized right-turn island on the eastbound approach. Private Drive westbound from Greenville Crossing Shopping Center has a shared left/through lane and a right turn lane. An aerial showing the intersection layout is shown in **Photo 4**.



Photo 4: SR 52 @ Hillside Road / Greenville Crossing S.C. Intersection

There are pedestrian crosswalks on the northern side of the intersection for crossing SR 52, the western side of the intersection for crossing Hillside Road, and the eastern side of the intersection for crossing Greenville Shopping Center Driveway. Existing sidewalks are present at the northeast, southeast and southwest corners at the intersection.

At the intersection, the posted speed limit for SR 52 northbound and SR 52 southbound is 35 miles per hour, and the posted speed limit for eastbound Hillside Road is 35 miles per hour. There is no posted speed limit for westbound driveway from Greenville Crossing Shopping Center approaching the intersection.



Photo 5: Facing north towards luminaires on northbound SR 52 (Day)



Photo 6: Facing north towards luminaires on northbound SR 52 (Night)

Existing Lighting

There is no existing roadway lights at this intersection. However, there are existing post-top decorative lights along SR 52 south of the intersection. There is also a commercial light pole for a parking lot located at the northeast corner. These luminaires are not designed for the intersection lighting, however some portions of the intersection receive light from these luminaires.

4. LIGHTING WARRANT EVALUATION

The DeIDOT Lighting Guidelines contain the conditions for determining if lighting is warranted at a given site. A warrant analysis is included below for each site that was selected for evaluation.

Site #1: SR 52 (Kennett Pike) @ Private Drive (Methodist Country Home / Golf Club) Intersection (M.P. 2.84)

Because the intersection has existing lighting for part of the intersection, the crash history is skewed compared to an unlit intersection. Therefore, the crash history cannot be relied upon in this circumstance for use in lighting warrant analysis. For informational purposes only, the crash patterns and percentage of nighttime accidents are evaluated below.

Crash Patterns

The Crash Data Summary and Evaluation showed that there were 4 total crashes near this intersection during the three year evaluation period. One (1) of these crashes occurred during dark conditions.

The manner of impact of the one (1) dark crashes was a rear-end crash on SR 52 southbound.

Percentage of Nighttime Crashes

Twenty-five percent (1 out of 4) of the crashes at the site occurred at the site were during dark conditions.

Lighting Warrant Results

Because the intersection has existing lighting for part of the intersection, the crash history is skewed compared to an unlit intersection. Therefore, the crash history cannot be relied upon in this circumstance for use in lighting warrant analysis.

Site #5: SR 52 (Kennett Pike) @ Hillside Road / Greenville Crossing Shopping Center Intersection (M.P. 4.07)

Section 2.3, *Lighting Warrants*, of the DeIDOT Lighting Guidelines states that lighting *may* be installed at “locations where crash patterns indicate that lighting may reduce crashes and where the percentage of nighttime accidents is 35 percent or greater.”

Crash Patterns

The Crash Data Summary and Evaluation showed that there were 17 total crashes near this intersection during the three year evaluation period. Five (5) of these crashes occurred during dark conditions.

The manner of impact of the five (5) dark crashes was as follows:

- 3 Run off the road
- 2 Rear end

An examination of the police crash reports for the run off the road crashes showed that two crashes were the result of a driver falling asleep. The other run off the road crash was the result of operating a vehicle under the influence of alcoholic beverages.

An examination of the police crash reports for the rear end crashes showed that one crash was the result of following too closely. The other rear end crash was the result of a driver who was travelling too close for the speed and struck a front vehicle in the rear on wet surface.

No crash patterns that would benefit from lighting were identified.

Percentage of Nighttime Crashes

Twenty-nine percent (5 out of 17) of the crashes at the site occurred at the site were during dark conditions. The crash history at this intersection does not meet the conditions for a location where lighting “may be installed,” as per Section 2.3 of the DelDOT Lighting Guidelines. However, there was one (1) crash occurred at this intersection during dusk. If this crash is also included for the roadway lighting condition, the percentage increases to thirty-five (6 out of 17) and the crash history meets the warrant.

Lighting Warrant Results

This site does not have greater than 35% of crashes occurring during dark conditions, however the percentage of crashes occurring during dark conditions is relatively high, 29%. Additionally, if a crash occurring during dusk is added, the site has greater than 35% of crashes for roadway lighting conditions. Therefore, based on the engineering judgment, one might conclude that this intersection meet part of the lighting warrant for a site where roadway lighting *may* be installed. However, no crash patterns that would benefit from lighting were identified.

5. RECOMMENDATIONS

Recommendations are included below, and recommended improvements are summarized in the following table.

Site #1: SR 52 (Kennett Pike) @ Private Drive (Methodist Country Home / Golf Club) Intersection (M.P. 2.84)

Roadway Lighting

Because the intersection features luminaires that appear to only cover part of the intersection, photometric calculations would be beneficial to evaluate the existing lighting.

The intersection should be evaluated for simple or complex intersection lighting as per Section 4.3.2 of the DelDOT Lighting Design Guidelines. The speeds of vehicles on SR 52 are 50 miles per hour (speed limit), however roadway geometry and numbers of lanes at the intersection indicate that simple intersection lighting may be more appropriate. Simple intersection lighting is limited to the area enclosed by the stop bars and crosswalks at the intersection, and does not typically include approach lighting.

At a minimum, an additional luminaire on the southwest corner of the intersection would improve lighting levels. Also, the lighting levels may benefit from increasing the wattage of the existing 250 Watt luminaires to 400 Watts.

Other Improvements

The dark crash at the intersection was a rear end crash, which occurred on the southbound approach. There is one (1) existing Signal Ahead (W3-3) sign on the right side of the northbound approach to the intersection. However, there is no existing Signal Ahead (W3-3) sign on the southbound approach to the intersection. Section 2C.36 of the Delaware Manual on Uniform Traffic Control Devices (MUTCD) provides the following support: “An Advance Traffic Control sign may be used for additional emphasis of the primary traffic control device, even when the visibility distance to the device is satisfactory.” It is recommended that a new W3-3 sign be installed north of the intersection on the right side at the road at the location of 325 feet from the stop bar based on 55 mph design speed based on Table 2C-4 in MUTCD 2009.

In the field visit, it was found that the lane markings on the westbound approach from the Golf Club do not show the lane for through movement shown in **Photo 7**. It is recommended that the lane marking on the left lane on the westbound approach be changed to left/through arrow from left only arrow.

It was also found in the field visit that the light bulb in the luminaire attached on the utility pole located at the northeast corner is getting old and malfunctioning as shown in **Photo 3-1** and

Photo 3-2. It is recommended that the light bulb be replaced or the ballast be repaired. At minimum it is recommended that the luminaire should receive the maintenance attention.



Photo 7: Facing west towards intersection of SR 52 @ Private Drive

Site #5: SR 52 (Kennett Pike) @ Hillside Road / Greenville Crossing Shopping Center Intersection (M.P. 4.07)

Roadway Lighting

The crash history at SR 52 @ Hillside Road / Greenville Crossing Shopping Center does not meet DelDOT's conditions for an intersection where lighting may be warranted. However, if dusk condition is included as the nighttime crashes, the intersection meets the warrant.

The intersection should be evaluated for simple or complex intersection lighting as per Section 4.3.2 of the DelDOT Lighting Design Guidelines. The crash history does not include a pattern of crashes that would be likely to benefit from lighting. However, there are existing post top decorative lights for sidewalks on both sides of SR 52 approaching the intersection from the south. The presence of this approach lighting makes lighting the intersection desirable.

The roadway section is composed of 4 lanes with a median at south of the intersection; however, the speeds of vehicles on SR 52 (35 miles per hour speed limit) and the geometry of the roadway section north of the intersection (2 lanes with a median) indicate that simple intersection lighting may be more appropriate. Simple intersection lighting is limited to the area enclosed by the stop bars and crosswalks at the intersection, and does not typically include approach lighting.

There are existing post-top decorative lights along SR 52 south of the intersection and two of them are located close to the intersection. However, these are designed for sidewalk lighting and the luminaires are too far away to light the center of the intersection. The commercial luminaires located northeast of the intersection are not designed for lighting the intersection. Two to four lighting poles and luminaires may need to be installed for achieving the minimum lighting levels for the intersection. Locations and number of poles and luminaires need to be determined with photometric analysis.

Other Improvements

The signal heads for the eastbound approach on Hillside Road indicate the approach has a shared left/through lane and a separate right-turn lane, however the lane striping shows only one lane on the approach although the lane is wide enough for two lanes as seen in **Photo 8**. The combination of the signal heads and lane striping confuses drivers and creates an unsafe condition. It is recommended that pavement markings be restriped with arrows on the eastbound approach.



Photo 8: Facing west towards intersection of SR 52 @ Hillside Road / Greenville Crossing Shopping Center

There are pedestrian crosswalks at the northern side of the intersection for crossing SR 52, the western side of the intersection for crossing Hillside Road, and the eastern side of the intersection for crossing Greenville Shopping Center Driveway. There are pedestrian signal heads for all three pedestrian crossings. However, many of the pedestrian push buttons located at corners of the intersection do not meet ADA standards. The existing push buttons are located either too far from the crosswalk landing area or too far from the sidewalk edges seen in **Photo 9-1** and **Photo 9-2**. Therefore, it is recommended that the pedestrian push buttons be

relocated to meet the current ADA standards. It may be necessary to install some pedestal poles for the push button relocations. At the time of this report, a Pave & Rehab project is expected to include this intersection which would address the ADA concerns.



Photo 9-1: Facing north towards the pedestrian push button located at southwest corner of SR 52 @ Hillside Road / Greenville Crossing Shopping Center intersection



Photo 9-2: Facing west towards the pedestrian push buttons located at northeast corner of SR 52 @ Hillside Road / Greenville Crossing Shopping Center intersection

Recommended Improvements

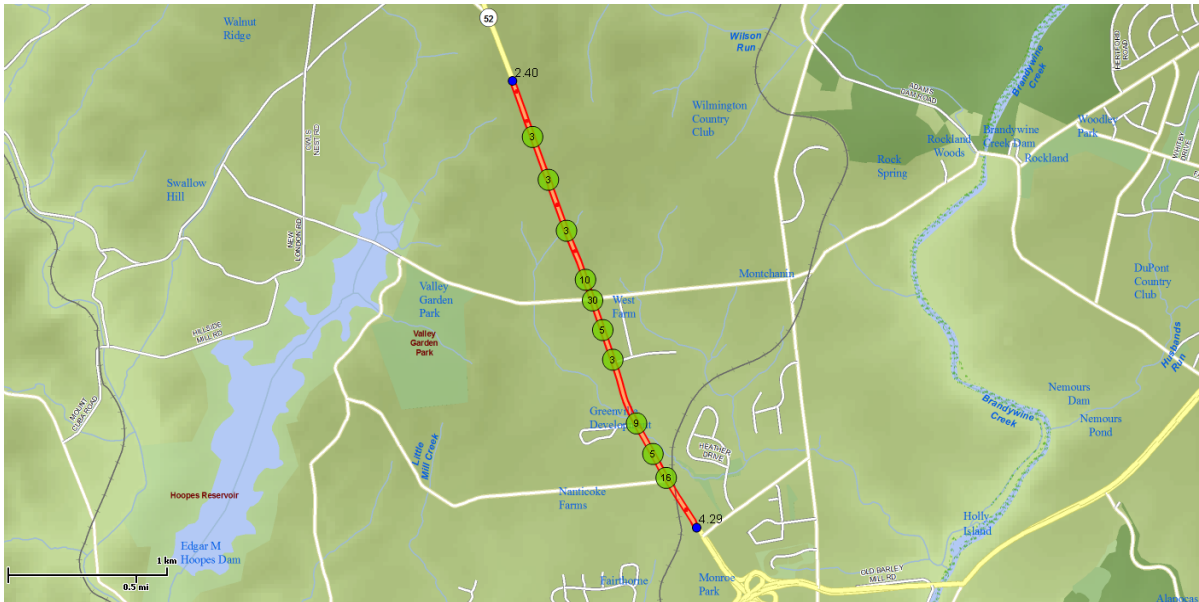
Site	Recommended Improvement
#1. SR 52 @ Methodist Country Home / Golf Club Intersection (MP 2.84)	Evaluate for simple or complex intersection lighting as per Section 4.3.2 of the DelDOT Lighting Design Guidelines. At a minimum, an additional luminaire on the southwest corner of the intersection would improve lighting levels. Also, the lighting levels may benefit from increasing the wattage of the existing 250 Watt luminaires to 400 Watts.
	Install a new W3-3 sign north of the intersection on the right side at the road (SB approach) at the location of 325 feet from the stop bar based on 55 mph design speed based on Table 2C-4 in MUTCD 2009.
	Change the lane marking on the left lane of the westbound approach to a left/through arrow from left only arrow.
	The utility-owned luminaire on the utility pole located on the northeast corner should receive maintenance attention, as the luminaire is malfunctioning.
#5. SR 52 @ Hillside Rd Intersection (MP 4.07)	Evaluate for simple or complex intersection lighting as per Section 4.3.2 of the DelDOT Lighting Design Guidelines. The roadway section is composed of 4 lanes with a median at south of the intersection; however, the speeds of vehicles on SR 52 (35 miles per hour speed limit) and the geometry of the roadway section north of the intersection (2 lanes with a median) indicate that simple intersection lighting may be more appropriate.
	Pedestrian pushbuttons should be relocated to meet ADA standards. <i>A Pave & Rehab project is expected to include this intersection, and would address the ADA concerns.</i>
	The signal heads for the eastbound approach on Hillside Road indicate the approach has a shared left/through lane and a separate right-turn lane, however the lane striping shows only one lane on the approach although the lane is wide enough for two lanes. The combination of the signal heads and lane striping confuses drivers and creates an unsafe condition. It is recommended that pavement markings be restriped with arrows on the eastbound approach.

APPENDIX A: Crash Data Summary

Delaware Crash Analysis Reporting System (CARS)

Crash Study Time Period: Study Period from 05-16-2008 to 05-16-2011
Query Type: roadBuffer
Description: N9 DE 52 Kennett Pike
MP 2.40-4.29

Study Requested By: LD
Study Generated By: tdtsswn
Number of Crashes: 92
Includes Non-Reportable Crashes: N
Study Code:



"Disclaimer for CARS: Crash data and associated police reports are intended for DelDOT use only and shall not be transmitted, copied, distributed or provided to any entity other than DelDOT unless written approval is received from the DelDOT Legal Section. Police reports are the property of the Delaware State Police."

State of Delaware Crash Study Summary

Study Period from 05-16-2008 to 05-16-2011

Summary		Classification			Manner Of Impact		
	# of Crashes		# of Crashes	% of Total Crashes		# of Crashes	% of Total Crashes
Total Crashes	92	Non-Reportable	0	0.00%	Front to rear	53	57.61%
Fatal Crashes	0				Front to front	4	4.35%
Total Alcohol-Related Crashes	2		77	83.70%	Angle	15	16.30%
Total Non Alcohol-Related Crashes	90		15	16.30%	Sideswipe, same direction	3	3.26%
Total Fatalities	0		0	0.00%	Sideswipe, opposite direction	1	1.09%
Total Pedestrian Fatalities	0	Total			92		
Total Pedestrian Injuries	0				Rear to side	0	0.00%
Total Pedestrian Crashes	0				Rear to rear	3	3.26%
Total Motorcycle Crashes	0				Other	2	2.17%
Total Pedalcyclist Crashes	1				Unknown	0	0.00%
					Not a collision between two vehicles	11	11.96%
					Total	92	

Alcohol Related Crashes by Classification					
	Non-reportable	Reportable	Personal Injury	Fatality	Total
Alcohol Related	0	1	1	0	2
Non-Alcohol Related	0	76	14	0	90
Total	0	77	15	0	92

Manner of Impact By Classification					
	Non-Reportable	Reportable	Personal Injury	Fatality	Total
Front to rear	0	49	4	0	53
Front to front	0	2	2	0	4
Angle	0	9	6	0	15
Sideswipe, same direction	0	3	0	0	3
Sideswipe, opposite direction	0	1	0	0	1
Rear to side	0	0	0	0	0
Rear to rear	0	3	0	0	3
Other	0	2	0	0	2
Unknown	0	0	0	0	0
Not a collision between two vehicles	0	8	3	0	11
Total	0	77	15	0	92

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Day Of Week		
	# of Crashes	% of Total Crashes
Sunday	4	4.35%
Monday	17	18.48%
Tuesday	17	18.48%
Wednesday	19	20.65%
Thursday	16	17.39%
Friday	13	14.13%
Saturday	6	6.52%
Total	92	

Time Of Day (AM)		
	# of Crashes	% of Total Crashes
00:00 - 00:59	1	1.09%
01:00 - 01:59	1	1.09%
02:00 - 02:59	0	0.00%
03:00 - 03:59	3	3.26%
04:00 - 04:59	0	0.00%
05:00 - 05:59	0	0.00%
06:00 - 06:59	2	2.17%
07:00 - 07:59	12	13.04%
08:00 - 08:59	15	16.30%
09:00 - 09:59	2	2.17%
10:00 - 10:59	0	0.00%
11:00 - 11:59	5	5.43%
Total	41	

Time Of Day (PM)		
	# of Crashes	% of Total Crashes
12:00 - 12:59	5	5.43%
13:00 - 13:59	5	5.43%
14:00 - 14:59	5	5.43%
15:00 - 15:59	8	8.70%
16:00 - 16:59	7	7.61%
17:00 - 17:59	15	16.30%
18:00 - 18:59	1	1.09%
19:00 - 19:59	0	0.00%
20:00 - 20:59	1	1.09%
21:00 - 21:59	3	3.26%
22:00 - 22:59	1	1.09%
23:00 - 23:59	0	0.00%
Total	51	
Unknown Time	0	

Surface Conditions		
	# of Crashes	% of Total Crashes
Dry	71	77.17%
Wet	18	19.57%
Snow	1	1.09%
Ice/Frost	0	0.00%
Sand	1	1.09%
Water (standing,mo'	0	0.00%
Slush	1	1.09%
Oil	0	0.00%
Mud, Dirt, Gravel	0	0.00%
Other	0	0.00%
Unknown	0	0.00%
Total	92	

Lighting Conditions		
	# of Crashes	% of Total Crashes
Daylight	65	70.65%
Dawn	2	2.17%
Dusk	4	4.35%
Dark-Lighted	7	7.61%
Dark-Not Lighted	14	15.22%
Dark-Unknown Lighting	0	0.00%
Other	0	0.00%
Unknown	0	0.00%
Total	92	

Weather Conditions		
	# of Crashes	% of Total Crashes
Clear	63	68.48%
Cloudy	15	16.30%
Fog, Smog, Smoke	0	0.00%
Rain	11	11.96%
Sleet, Hail (freezing rain or drizzle)	1	1.09%
Snow	2	2.17%
Blowing Snow	0	0.00%
Severe Crosswinds	0	0.00%
Blowing Sand, Soil, Dirt	0	0.00%
Other	0	0.00%
Unknown	0	0.00%
Total	92	

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First Harmful Event		
	# of Crashes	% of Total Crashes
Overturn/Rollover, Non-Collision	0	0.00%
Fire/Explosion, Non-Collision	0	0.00%
Immersion, Non-Collision	0	0.00%
Jackknife, Non-Collision	0	0.00%
Cargo/Equipment Loss or Shift, Non-Collision	0	0.00%
Fell/Jumped From Motor Vehicle, Non-Collision	0	0.00%
Thrown or Falling Object, Non-Collision	0	0.00%
Other Non-Collision, Non-Collision	0	0.00%
Pedestrian, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Pedalcycle, Collision With Person, Motor Vehicle, or Non-Fixed Object	1	1.09%
Railway Vehicle (train, engine), Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Animal, Collision With Person, Motor Vehicle, or Non-Fixed Object	4	4.35%
Motor Vehicle in Transport, Collision With Person, Motor Vehicle, or Non-Fixed Object	79	85.87%
Legally Parked Motor Vehicle, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Struck by Falling, Shifting Cargo or Anything Set in Motion by Motor Vehicle, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Work Zone / Maintenance Equipment, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Other Non-Fixed Object, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Impact Attenuator/Crash Cushion, Collision With Fixed Object	0	0.00%
Bridge Overhead Structure, Collision With Fixed Object	0	0.00%
Bridge Pier or Support, Collision With Fixed Object	0	0.00%
Bridge Rail, Collision With Fixed Object	0	0.00%
Cable Barrier, Collision With Fixed Object	0	0.00%
Culvert, Collision With Fixed Object	0	0.00%
Curb, Collision With Fixed Object	2	2.17%
Ditch, Collision With Fixed Object	0	0.00%
Embankment, Collision With Fixed Object	0	0.00%

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Guardrail Face, Collision With Fixed Object	1	1.09%
Guardrail End, Collision With Fixed Object	0	0.00%
Concrete Traffic Barrier, Collision With Fixed Object	0	0.00%
Other Traffic Barrier, Collision With Fixed Object	0	0.00%
Tree (standing), Collision With Fixed Object	1	1.09%
Utility Pole, Collision With Fixed Object	2	2.17%
Light Support, Collision With Fixed Object	0	0.00%
Traffic Sign Support, Collision With Fixed Object	0	0.00%
Overhead Sign Support, Collision With Fixed Object	0	0.00%
Traffic Signal Support, Collision With Fixed Object	0	0.00%
Fence, Collision With Fixed Object	0	0.00%
Mailbox, Collision With Fixed Object	0	0.00%
Other Post, Pole or Support, Collision With Fixed Object	1	1.09%
Other Fixed Object (wall, building, tunnel, etc.), Collision With Fixed Object	1	1.09%
Illegally Parked Motor Vehicle, Collision with person, vehicle, or object not fixed	0	0.00%
Stopped Motor Vehicle, Collision with person, vehicle, or object not fixed	0	0.00%
Unknown, Collision With Fixed Object	0	0.00%
Total	92	

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Primary Contributing Circumstance		
	# of Crashes	% of Total Crashes
Speeding	0	0.00%
Failed to yield right of way	5	5.43%
Passed Stop Sign	0	0.00%
Disregard Traffic Signal	2	2.17%
Wrong side or wrong way	1	1.09%
Improper passing	0	0.00%
Improper lane change	1	1.09%
Following too close	7	7.61%
Made improper turn	0	0.00%
Driving under the influence	1	1.09%
Driver inattention, distraction, or fatigue	14	15.22%
Driving in a careless or reckless manner	3	3.26%
Driving in an aggressive manner	0	0.00%
Improper backing	0	0.00%
Other improper driving	1	1.09%
Mechanical defects	0	0.00%
Animal in Roadway - Deer	0	0.00%
Animal in Roadway - Other Animal	0	0.00%
Other environmental circumstances - weather, glare	1	1.09%
Roadway circumstances - debris, holes, work zone	0	0.00%
Other	1	1.09%
Unknown	2	2.17%
Total	39	

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Driver Contributing Circumstance		
	# of Drivers	% of Total Drivers
No Contributing Action		0.00%
Failed to yield right of way		12.82%
Ran Red Light		0.00%
Ran Stop Sign		5.13%
Disregard other traffic sign		2.56%
Disregard other road markings		0.00%
Exceeded authorized speed limit		2.56%
Driving too fast for conditions		17.95%
Made an improper turn		0.00%
Improper backing		2.56%
Wrong side or wrong way		35.90%
Followed too closely		7.69%
Failure to keep in proper lane		0.00%
Ran off roadway		0.00%
Operating vehicle in erratic, reckless, careless, negligent or aggressive manner		2.56%
Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.		0.00%
Over-correcting/over-steering		0.00%
Improper Passing		0.00%
Other Contributing Action		2.56%
Unknown		5.13%
Total		

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CTY	RD	MP	C-MP	DIR	COMP/HQ#	Date	Time	Day	Fat	Inj	AL	LC	WC	SC	FHE	PC	Class	MOI
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2008

N	9	3.32	3.32	5	0108069868	7/29/08	0747	3	0	0	N	01	01	01	13		02	01
N	9	4.07	4.07	5	0108044849	5/20/08	1725	3	0	0	N	01	04	02	13		02	01
N	9	3.28	3.28	5	0108047243	5/27/08	1650	3	0	0	N	01	01	01	13		02	01
N	9	3.32	3.32	5	0108047552	5/28/08	1433	4	0	0	N	01	01	01	13		02	01
N	9	3.82	3.82	5	0108079927	8/27/08	0722	4	0	0	N	01	01	01	13		02	01
N	9	3.12	3.12	5	0108056296	6/22/08	0145	1	0	0	Y	05	02	01	40		03	00
N	9	3.32	3.32	5	0108077219	8/19/08	1249	3	0	0	N	01	01	01	13		02	01
N	9	3.32	3.32	5	0108104984	11/11/08	0858	3	0	0	N	01	01	01	13		02	03
N	9	3.32	3.32	5	0108118189	12/22/08	1415	2	0	0	N	01	01	01	13		02	01
N	9	4.07	4.07	5	0108091226	9/29/08	1513	2	0	0	N	01	01	01	13		02	01
N	9	2.92	2.92	5	0108117722	12/21/08	0730	1	0	0	N	02	05	07	13		02	02
N	236	0	0	5	0108088881	9/22/08	1244	2	0	0	N	01	01	01	13		02	03
N	9	3.26	3.26	5	0108094289	10/9/08	0715	5	0	0	N	01	01	02	13		02	01
N	9	4.07	4.07	5	0108089289	9/23/08	1517	3	0	0	N	01	01	01	13		02	04
N	9	3.31	3.31	5	0108111368	12/1/08	1427	2	0	0	N	01	01	01	13		02	07
N	9	4.09	4.09	5	0108109438	11/25/08	0813	3	0	0	N	01	04	02	13		02	01
N	242	1.59	1.59	5	0108120584	12/30/08	1445	3	0	0	N	01	01	01	13		02	03
N	9	3.32	3.32	5	0108086319	9/15/08	0836	2	0	0	N	01	01	01	13		03	03
N	9	4.07	4.07	5	0108113953	12/10/08	0024	4	0	0	Y	04	04	02	32		02	00
N	9	3.29	3.29	5	0108117332	12/20/08	1143	7	0	0	N	01	02	01	13		02	01
N	9	3.32	3.32	5	0108111430	12/1/08	1700	2	0	0	N	05	04	02	13		03	01
N	9	3.32	3.32	5	0108101110	10/30/08	0704	5	0	0	N	01	01	01	12		02	00
N	9	3.41	3.41	5	0108101258	10/30/08	1531	5	0	0	N	01	01	01	13		02	01
N	9	3.23	3.23	5	0108100182	10/27/08	0845	2	0	0	N	01	01	01	13		02	01

2009

N	9	4.05	4.05	5	0109075436	8/24/09	0844	2	0	0	N	01	01	01	13		02	01
N	9	2.6	2.6	5	0109072439	8/15/09	0857	7	0	0	N	01	01	01	10		03	00
N	9	3.21	3.21	5	0109057981	7/2/09	1736	5	0	0	N	01	01	01	13		03	03
N	9	3.27	3.27	5	0109033850	4/23/09	0830	5	0	0	N	01	01	01	13		02	01
N	9	3.83	3.83	5	0109013905	2/18/09	0736	4	0	0	N	01	01	01	13		02	01
N	9	3.5	3.5	5	0109040168	5/12/09	0844	3	0	0	N	01	01	01	13		02	01
N	9	3.32	3.32	5	0109009802	2/4/09	1804	4	0	0	N	03	01	01	13		02	01
N	9	3.35	3.35	5	0109008248	1/29/09	2245	5	0	0	N	05	01	01	12		02	00
N	9	3.32	3.32	5	0109027456	4/3/09	1101	6	0	0	N	01	04	02	13		02	05
N	9	3.98	3.98	5	0109002052	1/8/09	1404	5	0	0	N	01	01	01	13		02	01
N	9	3.04	3.04	5	0109115185	12/28/09	0656	2	0	0	N	05	01	01	12		02	00
N	9	3.97	3.97	5	0109012290	2/12/09	1639	5	0	1	N	01	01	01	13		03	03
N	9	3.21	3.21	5	0109111777	12/18/09	1708	6	0	0	N	05	01	01	13		02	01
N	9	3.4	3.4	5	0109114435	12/25/09	0341	6	0	0	N	05	01	01	31		02	00
N	9	3.32	3.32	5	0109105349	11/28/09	1316	7	0	0	N	01	01	01	13		02	03
N	9	3.45	3.45	5	0109021925	3/16/09	1141	2	0	0	N	01	01	01	13		02	01

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CTY	RD	MP	C-MP	DIR	COMP/HQ#	Date	Time	Day	Fat	Inj	AL	LC	WC	SC	FHE	PC	Class	MOI
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2009

N	9	3.04	3.04	5	0108017793	3/2/09	0700	2	0	0	N	02	06	03	13		02	00
N	9	3.86	3.86	5	0109025373	3/27/09	1544	6	0	0	N	01	01	01	13		02	01
N	9	3.31	3.31	5	0109049219	6/6/09	1200	7	0	0	N	01	01	01	32		02	00
N	9	3.98	3.98	5	0109018191	3/4/09	0728	4	0	0	N	01	01	01	13		02	07
N	9	3.32	3.32	5	0109042722	5/19/09	1159	3	0	0	N	01	01	01	13		03	03
N	9	4.03	4.03	5	0109085418	9/25/09	0621	6	0	0	N	05	01	01	27		03	00
N	9	3.84	3.84	5	0109089070	10/7/09	0739	4	0	0	N	01	02	02	13		02	03
N	9	4.07	4.07	5	0109099973	11/11/09	0857	4	0	0	N	01	04	02	13		02	01
N	9	3.92	3.92	5	0109105041	11/27/09	1304	6	0	0	N	01	02	01	13		02	01
N	9	2.61	2.61	5	0109073768	8/19/09	1251	4	0	0	N	01	01	01	13		02	01
N	9	4.07	4.07	5	0109085693	9/25/09	2136	6	0	0	N	04	01	01	13		02	01
N	9	3.01	3.01	5	0109105492	11/28/09	2115	7	0	0	N	05	01	01	12		02	00
N	9	4.08	4.08	5	0109102631	11/19/09	1753	5	0	0	N	05	04	02	13		02	01

2010

N	00264	1.45			0110003556	1/13/10	2054	4	0	0	N	04	01 - 01	01	13	07	02	04
N	00009	4.07			0110007374	1/27/10	1734	4	0	0	N	03	01 -	01	13	02	02	03
N	00009	3.33			0110033888	4/22/10	1333	5	0	0	N	01	01 -	01	13	08	02	01
N	00009	3.2			0110015969	2/24/10	0851	4	0	0	N	01	02 -	02	13	11	02	01
N	00009	2.84	2.84	3	0110044724	5/24/10	0758	2	0	0	N	01	04 -	02	13	12	02	01
N	00009	2.44	2.44	3	0110055054	6/22/10	1350	3	0	1	N	01	02 -	01	13	02	03	03
N	00242	1.59	1.59	3	0110046842	5/30/10	1221	1	0	4	N	01	01 -	01	13	02	03	02
N	00009	3.57			0110009692	2/4/10	0743	5	0	0	N	01	01 -	01	13	08	02	01
N	00009	3.32	3.32	3	0110055495	6/23/10	1700	4	0	0	N	01	01 -	01	13	99	02	01
N	00009	3.41	3.41	3	0110090538	10/5/10	1608	3	0	0	N	01	02 -	01	13	11	02	01
N	00009	3.43			0110018221	3/3/10	1750	4	0	0	N	05	01 -	01	13	11	02	01
N	00009	3.33	3.33	3	0110042514	5/17/10	1517	2	0	2	N	01	02 -	01	13	11	03	01
N	00009	3.94	3.94	3	0110084076	9/17/10	1121	6	0	0	N	01	01 -	01	24	10	02	03
N	00242	1.59	1.59	3	0110076172	8/23/10	1640	2	0	0	N	01	02 -	01	13	02	02	02
N	00009	3.35	3.35	3	0110056284	6/25/10	1741	6	0	0	N	01	01 -	01	13	11	02	01
N	00009	3.31	3.31	3	0110105047	11/16/10	1630	3	0	0	N	03	02 -	02	13	99	02	07
N	00009	3.8	3.80	3	0110067515	7/28/10	2121	4	0	0	N	05	01 -	01	13	08	02	01
N	00009	3.32	3.32	3	0110051578	6/12/10	1658	7	0	0	N	01	01 -	01	13	04	02	03
N	00009	3.34	3.34	3	0110100148	11/2/10	1516	3	0	0	N	01	01 -	01	13	11	02	01
N	00009	4.03			0110011337	2/9/10	0859	3	0	0	N	01	01 -	05	13	19	02	01
N	00009	3.59	3.59	3	0110091151	10/7/10	1534	5	0	0	N	01	01 -	01	13	12	02	01
N	00009	3.32	3.32	3	0110105160	11/17/10	1722	4	0	1	N	04	01 -	01	13	04	03	03
N	00009	3.86			0110021622	3/15/10	0924	2	0	0	N	01	04 -	02	13	12	02	01
N	00009	4.05	4.05	3	0110088352	9/29/10	1701	4	0	2	N	01	02 -	01	13	15	03	02
N	00009	2.56	2.56	3	0110093489	10/14/10	0930	5	0	1	N	01	04 -	02	13	11	03	01
N	00009	3.45	3.45	3	0110114559	12/16/10	1724	5	0	0	N	03	06 -	02	13	08	02	01
N	00009	4.21	4.21	3	0110114959	12/17/10	1504	6	0	0	N	01	01 -	01	13	08	02	01

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CTY	RD	MP	C-MP	DIR	COMP/HQ#	Date	Time	Day	Fat	Inj	AL	LC	WC	SC	FHE	PC	Class	MOI
-----	----	----	------	-----	----------	------	------	-----	-----	-----	----	----	----	----	-----	----	-------	-----

2010

N	00009	3.54	3.54	3	0110109833	12/2/10	1717	5	0	0	N	05	01 -	01	13	08	02	01
N	00009	3.22	3.22	3	0110095206	10/19/10	0849	3	0	0	N	01	02 -	02	13	11	02	01
N	00009	2.82	2.82	3	0110116060	12/20/10	1646	2	0	1	N	04	02 -	01	13	11	03	01
N	00009	3.79	3.79	3	0110097712	10/27/10	0309	4	0	0	N	05	01 -	02	24	05	02	88
N	00009	3.8	3.80	3	0110116652	12/22/10	1351	4	0	0	N	01	02 -	01	13	08	02	04

2011

N	00009	2.67	2.67	3	0111009439	1/31/11	1758	2	0	0	N	05	01 -	01	13	11	02	01
N	00009	3.38	3.38	3	0111012698	2/11/11	0846	6	0	0	N	01	01 -	01	13	11	02	01
N	00009	4.02	4.02	3	0111035013	4/26/11	0850	3	0	0	N	01	02 -	01	13	11	02	01
N	00009	4.07	4.07	3	0111017782	2/27/11	0354	1	0	0	N	04	01 -	01	39	11	02	88
N	00009	3.26	3.26	3	0111035952	4/29/11	0859	6	0	0	N	01	01 -	01	13	88	02	01
N	00009	3.86	3.86	3	0111019404	3/4/11	1733	6	0	0	N	04	01 -	01	13	02	02	03
N	00009	2.78	2.78	3	0111020881	3/10/11	0738	5	0	0	N	01	04 -	02	13	11	02	01

Report generated by tdtsswn at 2011-05-23 10:08:30.584

Report Legend

Cty - County
Rd - Maintenance Road
MP - Milepoint
C-MP - Continuous Milepoint
Dir - Direction of Highway
COMP/HQ# - Complaint Number/Headquarters Number
DAY - Day Of Week Code
Fat - Fatality
Inj - Injury
AL - Alcohol Involved
LC - Lighting Condition
WC - Weather Condition
SC - Surface Condition
MHE - Most Harmful Event
PC - Primary Contributing Circumstance
Class - Report Classification
MOI - Manner of Impact

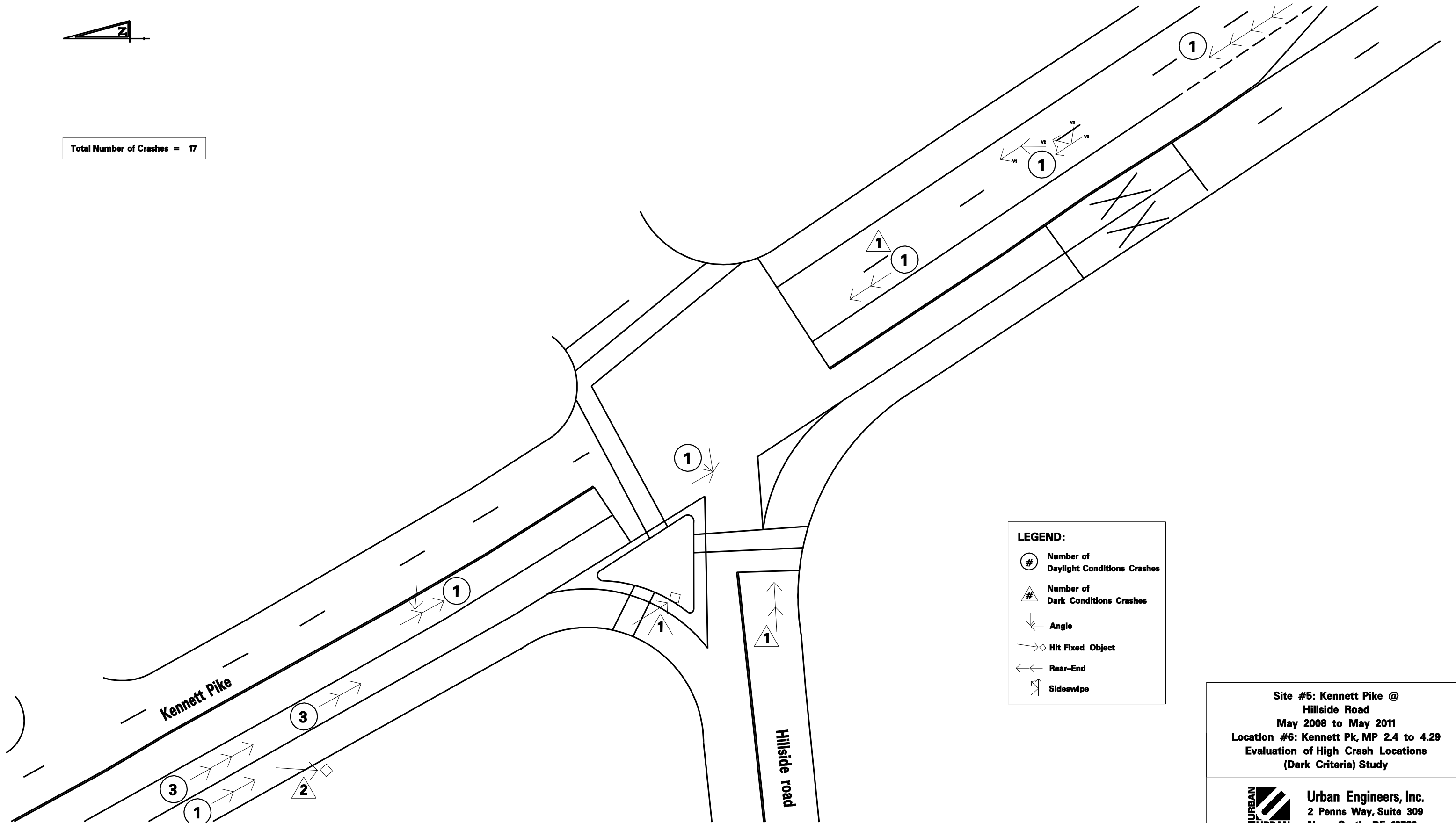
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APPENDIX B: Crash Diagram

*Site #5: SR 52 (Kennett Pike) @ Hillside Road / Greenville Crossing Shopping Center
Intersection (M.P. 4.07)*



Total Number of Crashes = 17



LEGEND:

- Number of Daylight Conditions Crashes
- Number of Dark Conditions Crashes
- Angle
- Hit Fixed Object
- Rear-End
- Sideswipe

Site #5: Kennett Pike @ Hillside Road
May 2008 to May 2011
Location #6: Kennett Pk, MP 2.4 to 4.29
Evaluation of High Crash Locations (Dark Criteria) Study



Urban Engineers, Inc.
2 Penns Way, Suite 309
New Castle, DE 19720

APPENDIX C: Previous Studies

2001 HSIP – Site N Report

2003 HSIP – Site E Report

INTRODUCTION

Site N is a 0.89-mile corridor in Centerville along Kennett Pike, SR52 (N9) from 0.04 miles south of Burnt Mill Road to 0.13 miles north of Center Meeting Road. From just south of Twaddell Mill Road to Center Avenue, Kennett Pike is a two-lane closed section roadway with bike lanes, shoulders and brick sidewalks. From Center Avenue to Snuff Mill Road, Kennett Pike is a two-lane open section roadway with bike lanes and a varying shoulder width. North of Snuff Mill Road, Kennett Pike is a two-lane open section roadway with ten-foot shoulders. There are eight unsignalized intersections, one signalized intersection at The Centerville School, and several points of direct access to commercial businesses and residences throughout the corridor. The ADT is approximately 11,500 vehicles per day.

At the request of DelDOT Planning, the study limits were extended to include the Center Meeting Road intersection location south of the Twaddell Mill Road/Owls Nest Road intersection, just outside of Centerville to address community safety concerns.

ACCIDENT DATA SUMMARIES

A total of 27 accidents were reported during the three-year study period between January 1997 and December 1999. A majority of the accidents were concentrated between Twaddell Mill Road/Owls Nest Road and Center Avenue including five accidents involving vehicles parked along the east side of Kennett Pike and four accidents where the primary cause was unsafe U-turns. Additionally, there were two accidents involving deer crossing the roadway north of Snuff Mill Road. Additional accident data was obtained for the Center Meeting Road intersection, since it was not included in the original study limits.

The following is a summary of the accidents by location and type:

- Snuff Mill Road - 6 accidents
 - 3 angle accidents
 - 2 northbound rear end accidents
 - 1 left-turn accident
- Twaddell Mill Road/Owls Nest Road – 2 accidents
 - 2 angle accidents
- Center Meeting Road – 3 accidents
 - 2 rear end accidents
 - 1 head on accident

TABLE 1
Accident Data Summary

Accident Severity		Year		Collision Type		Surface		Lighting	
Fatal	1 (4%)	1997	10 (37%)	Rear End	9 (33%)	Dry	23 (85%)	Daylight	19 (70%)
Injury	6 (22%)	1998	10 (37%)	Sideswipe	0	Wet	4 (15%)	Dawn/Dusk	3 (11%)
PDO	20 (74%)	1999	7 (26%)	Angle	13 (48%)	Snowy	0	Dark/Lit	0
				Head on	0	Icy	0	Dark/Unlit	5 (19%)
				Other	5 (19%)			Unknown	0
Total	27		27		27		27		27

Primary Cause				
Speed too Fast – 2 (7%)	Fail to Yield Right of Way – 4 (15%)	Pass STOP Sign – 2 (7%)	Following too Closely – 3 (11%)	Made Improper Turn – 2 (7%)
Driving Under the Influence – 1 (4%)	Inattentive – 7 (26%)	Other – 6 (22%)		

FIELD OBSERVATIONS

Snuff Mill Road

- Snuff Mill Road approaches Kennett Pike on an upgrade with two ten-foot lanes and no shoulders. Corner sight distance looking to the north is restricted by a horizontal curve just north of the intersection.
- During the morning peak period, maximum observed queues on the eastbound Snuff Mill Road approach reached ten vehicles.

Twaddell Mill Road/Owls Nest Road

- The westbound Twaddell Mill Road and eastbound Owls Nest Road approaches to Kennett Pike are offset by approximately 20 feet. A crosswalk is located on Kennett Pike between Twaddell Mill Road and Owls Nest Road.

Center Meeting Road

- During the evening peak hour, maximum observed queue lengths on the westbound Center Meeting Road approach exceeded 20 vehicles. Westbound left-turning vehicles often block right-turning vehicles. The approach widens to accommodate storage for one left-turning vehicle while still allowing right-turning vehicles to bypass a queued left-turning vehicle.
- Southbound Kennett Pike motorists were observed passing queued left-turning vehicles destined for eastbound Center Meeting Road in the shoulder, which creates a conflict between vehicles and bicyclists.
- During evening peak hour observations, northbound Kennett Pike queues extended beyond the Center Meeting Road intersection due to a motorist stopped in the through lane, waiting to turn left into a private driveway.

Remainder of the Corridor

- One-hour parallel parking is permitted along both sides of Kennett Pike between Twaddell Mill/Owls Nest Road and Center Avenue.
- A five-foot bike lane is striped on both northbound and southbound Kennett Pike between the travel lane and on street parking. Regulatory signs are posted along the northbound and southbound approaches indicating “No Passing On The Right;” however, several vehicles were observed illegally passing left-turning vehicles on the right, creating potential conflicts with bicyclists and parked vehicles.

- Several bicyclists were observed riding along Kennett Pike in areas where there is a designated bike lane; however, most bicyclists were observed riding along the shoulder, outside the limits of the bicycle lane striping.
- Several vehicles were observed making mid-block U-turns on Kennett Pike between Twaddell Mill Road and Center Avenue, the primary cause of four reported accidents during the study period.
- A deer crossing warning sign is posted on southbound Kennett Pike between the entrance to Centerville School and Snuff Mill Road; however, there is no warning sign on northbound Kennett Pike.
- Approximately 50 feet north of the Snuff Mill Road intersection, the pavement widens on the east side of the roadway to accommodate a bus “turnaround.” Both DART and school buses were observed making northbound U-turns on Kennett Pike to continue southbound.

TRAFFIC VOLUMES, SPEEDS AND PEAK HOUR DELAY

Traffic Volumes: Manual turning movement counts were conducted at the Center Meeting Road, Twaddell Mill Road/Owls Nest Road and Snuff Mill Road intersections from 6:00 AM to 7:00 PM on December 19, 2000. Southbound Kennett Pike left-turns onto Center Meeting Road are heavy (513 vph) during the morning peak hour. Similarly, during the evening peak hour, westbound right-turns onto northbound Kennett Pike reached 496 vph. This pattern could be attributed to diversion from Kennett Pike to SR 100 via Center Meeting Road due to construction on SR 52, approximately 2 ½ miles to the south in Greenville. The Appendix contains the count data, including summaries for weekday morning and evening peak hours.

Vehicle Speeds: The posted speed limit on southbound Kennett Pike is 35 miles per hour (mph). Northbound Kennett Pike is posted at 50 mph, until north of Center Meeting Road, where the speed limit is reduced to 35 mph. Vehicle speeds were measured on the approaches to the Center Meeting Road, Twaddell Mill Road/Owls Nest Road and Snuff Mill Road intersections on January 26, 2001. During this period vehicle speeds ranged from 22 to 62 mph. Radar speed distributions are included in the Appendix, and the results are summarized in Table 2. As indicated, the majority of the vehicles exceed the 35 mph speed limit at the Snuff Mill Road intersection. Approximately one-third of motorists exceed the 35 mph speed limit at Twaddell Mill Road in the center of the town. At Center Meeting Road, the majority (93%) of southbound drivers exceed the 35-mile per hour speed limit after leaving Centerville, while no motorists were observed exceeding the 50-mph speed limit on northbound Kennett Pike.

TABLE 2
Speed Data Summary

Criteria	Snuff Mill Rd		Twaddell Mill Rd		Center Meeting Rd	
	NB	SB	NB	SB	NB	SB
Posted Speed Limit	35 mph	35 mph	35 mph	35 mph	50 mph	35 mph
85th Percentile Speed	44 mph	45 mph	38 mph	38 mph	46 mph	46 mph
% Exceeding Speed Limit	95%	75%	34%	29%	0%	93%
Mean Speed	41 mph	39 mph	34 mph	33 mph	41 mph	41 mph

Peak Hour Delay: On Wednesday, February 7, 2001 vehicle delays and queues were measure from 7:15 to 8:15 AM and from 5:00 to 6:00 PM, on the eastbound Snuff Mill Road approach and westbound Center Meeting Road approaches to Kennett Pike, respectively. These time periods were chosen because they correspond with the period

of highest side street demand for the two intersections. Peak hour delay is included in the Appendix and is summarized in Table 3.

TABLE 3
Peak Hour Delay Summary

Location	Peak Period	Total Delay	Average Delay	Longest Queue
Eastbound Snuff Mill Road	7:15-8:15 AM	1.5 Veh.-Hours	30.2 seconds	10 vehicles
Westbound Center Meeting Road	5:00 – 6:00 PM	4.9 Veh.-Hours	42.2 seconds	23 vehicles

SIGHT DISTANCE

Table 4 summarizes sight distance criteria and available stopping sight distance on Kennett Pike and corner sight distances from Snuff Mill Road. Corner sight distances were measured from the observed vehicle stopping points. Sight distance criteria are shown for passenger vehicles travelling on Kennett Pike at the 45-mph 85th-percentile speed as measured in speed studies. As indicated, sight distance requirements are not met for eastbound Snuff Mill Road motorists looking to the north on Kennett Pike and for southbound SR 52 motorists approaching the intersection. Corner and stopping sight distance are restricted by a horizontal curve and a berm on the west side of the roadway, north of the intersection.

TABLE 4
Sight Distances

Type	Approach – Direction	Criteria	Available Sight Distance	Criteria Met
Corner Sight Distance	Snuff Mill Road – Eastbound			
	Left Turn	450'	425' left	No
		700'	>800' right	Yes
	Right Turn	700'	425' left	No
Stopping Sight Distance	SR 52 - NB	475'	>800'	Yes
	SR 52 - SB	475'	425'	No

TRAFFIC SIGNAL WARRANT STUDY

Signal warrant analyses for the Kennett Pike at Center Meeting Road, Twaddell Mill Road/Owls Nest Road and Snuff Mill Road intersections were conducted in accordance with the 1988 edition of the *Manual on Uniform Traffic Control Devices (MUTCD)*. A summary of the complete warrant analyses for each intersection is presented in Tables 5, 6 and 7. The Appendix contains analysis of volume Warrants 1, 2, 8, 9, and 11.

SR 52/Kennett Pike @ Center Meeting Road

The 85th percentile speeds on Kennett Pike exceed 40 mph at the Center Meeting Road intersection; therefore, *MUTCD*'s reduced volume criteria were applied. As shown in Table 5, criteria for Warrant 1 – Minimum Vehicular Volume, Warrant 2 – Interruption of Continuous Traffic, Warrant 8 – Combination of Warrants, Warrant 9 – Four Hour Volumes, Warrant 10 – Peak Hour Delay and Warrant 11 – Peak Hour Volume are satisfied. Although six warrants are met, significant diversion to Center Meeting Road could have occurred as a result of construction on Kennett Pike to the south in Greenville. This potential diversion has resulted in a substantial increase in minor street volumes, affecting the six warrants that were satisfied. Additionally, based on observations during the peak hour delay study, the majority of the delay was caused by westbound Center Meeting Road right-turning vehicles.

TABLE 5
Traffic Signal Warrant Analyses Summary – SR 52 and Center Meeting Road

MUTCD ¹ Warrant	Criteria			No. of Hours Meets Criteria	Satisfies Warrant
	Major Street Volume (VPH) ²	Minor Street Volume (VPH) ²	No. Of Hours Required		
1 – Minimum Vehicular Volume ⁴	350	105	8	11	Yes
2 – Interruption of Cont. Traffic ⁴	525	53	8	12	Yes
3 – Minimum Pedestrian Volume	100 Pedestrians/Hour or 190 Pedestrians/Hour		4 1	0 0	No
4 – School Crossing	# Adequate Gaps During x-Minute Time Period < x Minutes			-	NA ³
5 – Progressive Movement	(Refer to MUTCD p.4C-6 for Criteria)			-	NA ³
6 – Accident Experience	(Refer to MUTCD p.4C-6 for Criteria)			-	No
7 – Systems Warrant	(Refer to MUTCD p.4C-7 for Criteria)			-	NA ³
8 – Combination of Warrants ⁴ : - 80% of Warrant 1	280	84	8 (Both)	13	Yes
- 80% of Warrant 2	424	42			
9 - Four Hour Volumes ⁴	(Refer to MUTCD p.4C-12 for Figure)		4	12	Yes
10 – Peak Hour Delay	Delay ≥ 4.0 Veh.Hrs. Approach Volume ≥ 100 VPH Entering Volume ≥ 650 VPH		1	4.9 Veh. Hrs.	Yes
11 – Peak Hour Volume ⁴	(Refer to MUTCD p.4C-10 for Figure)			11	Yes

¹ Source: U.S.D.O.T., F.H.W.A.; *Manual on Uniform Traffic Control Devices (MUTCD)*; Washington, D.C., 1988 Edition

² VPH - Vehicles Per Hour

³ NA – Not applicable

⁴ 85th percentile speed greater than 40 mph - 70% volume reduction criteria applies

SR 52/Kennett Pike @ Twaddell Mill Road/Owls Nest Road

The 85th percentile speeds on Kennett Pike do not exceed 40 mph at the Twaddell Mill Road/Owls Nest Road intersection; therefore, the *MUTCD*'s reduced volume criteria were NOT applied. As shown in Table 6, criteria for Warrant 11 – Peak Hour Volume are satisfied.

TABLE 6
Traffic Signal Warrant Analyses Summary – SR 52 and Twaddell Mill Road/Owls Nest Road

MUTCD ¹ Warrant	Criteria			No. of Hours Meets Criteria	Satisfies Warrant
	Major Street Volume (VPH) ²	Minor Street Volume (VPH) ²	No. Of Hours Required		
1 – Minimum Vehicular Volume ⁴	500	150	8	0	No
2 – Interruption of Cont. Traffic ⁴	750	75	8	4	No
3 – Minimum Pedestrian Volume	100 Pedestrians/Hour or 190 Pedestrians/Hour		4 1	0 0	No
4 – School Crossing	# Adequate Gaps During x-Minute Time Period < x Minutes			-	NA ³
5 – Progressive Movement	(Refer to MUTCD p.4C-6 for Criteria)			-	No
6 – Accident Experience	(Refer to MUTCD p.4C-6 for Criteria)			-	No
7 – Systems Warrant	(Refer to MUTCD p.4C-7 for Criteria)			-	NA ³
8 – Combination of Warrants ⁴ :					
- 80% of Warrant 1	280	84	8 (Both)	0	No
- 80% of Warrant 2	424	42			
9 – Four Hour Volumes ⁴	(Refer to MUTCD p.4C-12 for Figure)		4	2	No
10 – Peak Hour Delay	Delay ≥4.0 Veh.Hrs. Approach Volume ≥100 VPH Entering Volume ≥650 VPH		1	N/A	No
11 – Peak Hour Volume ⁴	(Refer to MUTCD p.4C-10 for Figure)			1	Yes

¹ Source: U.S.D.O.T., F.H.W.A.; *Manual on Uniform Traffic Control Devices (MUTCD)*; Washington, D.C., 1988 Edition

² VPH - Vehicles Per Hour

³ NA – Not applicable

⁴ 85th percentile speed greater than 40 mph - 70% volume reduction criteria applies

SR 52/Kennett Pike @ Snuff Mill Road

The 85th percentile speeds on Kennett Pike exceed 40 mph at the Snuff Mill Road intersections; therefore, the *MUTCD*'s reduced volume criteria were applied. As shown in Table 7, criteria for Warrant 2 – Interruption of Continuous Traffic, Warrant 8 – Combination of Warrants, Warrant 9 – Four Hour Volumes, Warrant 11 – Peak Hour Volume are satisfied.

TABLE 7
Traffic Signal Warrant Analyses Summary – SR 52 and Snuff Mill Road

MUTCD ¹ Warrant	Criteria			No. of Hours Meets Criteria	Satisfies Warrant
	Major Street Volume (VPH) ²	Minor Street Volume (VPH) ²	No. Of Hours Required		
1 – Minimum Vehicular Volume ⁴	350	105	8	1	No
2 – Interruption of Cont. Traffic ⁴	525	53	8	9	Yes
3 – Minimum Pedestrian Volume	100 Pedestrians/Hour or 190 Pedestrians/Hour		4 1	0 0	No
4 – School Crossing	# Adequate Gaps During x-Minute Time Period < x Minutes			-	NA ³
5 – Progressive Movement	(Refer to MUTCD p.4C-6 for Criteria)			-	NA ³
6 – Accident Experience	(Refer to MUTCD p.4C-6 for Criteria)			-	No
7 – Systems Warrant	(Refer to MUTCD p.4C-7 for Criteria)			-	NA ³
8 – Combination of Warrants ⁴ : - 80% of Warrant 1	280	84	8 (Both)	12	Yes
- 80% of Warrant 2	424	42			
9 - Four Hour Volumes ⁴	(Refer to MUTCD p.4C-12 for Figure)		4	6	Yes
10 – Peak Hour Delay	Delay ≥4.0 Veh.Hrs. Approach Volume ≥100 VPH Entering Volume ≥650 VPH		1	1.5 Veh. Hrs.	No
11 – Peak Hour Volume ⁴	(Refer to MUTCD p.4C-10 for Figure)			2	Yes

¹ Source: U.S.D.O.T., F.H.W.A.; *Manual on Uniform Traffic Control Devices (MUTCD)*; Washington, D.C., 1988 Edition

² VPH - Vehicles Per Hour

³ NA – Not applicable

⁴ 85th percentile speed greater than 40 mph - 70% volume reduction criteria applies

LEFT-TURN LANE WARRANTS

DelDOT's *Entrance Manual* presents guidelines for determining the need for separate left-turn lanes. Left-turn lanes are recommended on approaches to intersections for which the combination of through, left, and opposing volumes exceed the warrants shown in Figure A.2 in the Appendices.

- **Center Meeting Road** – Existing volumes during the morning and evening peak periods warrant a left-turn bay on the southbound Kennett Pike approach to the intersection. As previously stated, as a result of construction on Kennett Pike to the south, a significant portion of the southbound left-turns onto Center Meeting Road could be attributed to diversion of motorists to SR 100.
- **Snuff Mill Road** – Existing volumes during the morning and evening peak periods warrant a left-turn bay on the northbound Kennett Pike approach to the intersection.
- **Twaddell Mill Road/Owls Nest Road** - Existing volumes during the morning and evening peak periods warrant left-turn bays on the northbound and southbound approaches to the intersection.

CAPACITY ANALYSES

Capacity analyses were performed using Highway Capacity Manual methodologies during the morning and evening peak hours to determine levels of service (LOS) with the existing unsignalized intersection configuration and future LOS with traffic signalization and left-turn bays on Kennett Pike. As shown in Table 8, under existing conditions all three intersections have at least one approach that operates at an unacceptable LOS 'F' during one or more of the peak hours. Signalizing the intersections without geometric improvements would result in acceptable LOS at both the Twaddell Mill Road/Owls Nest Road and Snuff Mill Road intersection; however, the Center Meeting Road intersection would continue to fail during the morning peak period due to a heavy southbound left-turn volume. Installing a southbound left-turn bay with exclusive/permissive left-turn phasing at Center Meeting Road improves operations during the morning and evening peak hours to acceptable LOS 'A', and 'C', respectively.

TABLE 8
Capacity Analyses Summary

Location	Condition	AM Peak Hour		PM Peak Hour	
		LOS ¹	Delay ²	LOS ¹	Delay ²
Center Meeting Road	Unsignalized	B	WB - 11.1 sec	F	WB - 60.9 sec
	Signalized	E	77.8 sec	C	26.5 sec
	Signalized w/ Left-Turn Bay ³	A	7.4 sec	C	24.1 sec
Twaddell Mill Road/ Owls Nest Road	Unsignalized ¹	F	EB - 111.3 sec	F	EB - 251.1 sec
	Signalized	B	15.8 sec	C	23.2 sec
	Signalized w/ Left-Turn Bays	A	8.4 sec	A	6.9 sec
Snuff Mill Road	Unsignalized ¹	F	EB - 69.1 sec	D	EB - 29.7 sec
	Signalized	A	8.0 sec	A	7.1 sec
	Signalized w/ Left-Turn Bay	A	7.8 sec	A	3.9 sec

¹Represents the worst level of service by approach for unsignalized intersections and the overall intersection level of service for signalized intersections

²Represents the highest average delay by approach for unsignalized intersections and the overall intersection average delay for signalized intersections

³ Includes exclusive/permissive left-turn phasing on the southbound approach

FINDINGS

SR 52/Kennett Pike @ Center Meeting Road: Although only three accidents were reported at this intersection during the three-year study period, heavy movements from southbound Kennett Pike onto eastbound Center Meeting Road during the morning peak period, and westbound right-turns during the evening peak period contribute to congestion at the intersection. As a result, traffic signal Warrants 1, 2, 8, 9, 10 and 11 are satisfied and peak hour volumes satisfy DelDOT's warrants for a southbound left-turn lane. However, potential diversion of traffic due to construction on Kennett Pike to the south may account for several of the traffic signal and left-turn lane warrants being met. Additionally, accident data does not support the need for traffic signalization, nor was this intersection identified as an HSIP site. We therefore recommend that additional counts and traffic signal warrant analyses be performed after completion of construction on Kennett Pike in Greenville to determine the need for operational improvements.

SR 52/Kennett Pike @ Twaddell Mill Road/Owls Nest Road: Two accidents were reported during the three-year study period. Traffic signal Warrant 11 – Peak Hour Volumes is met; however, the installation of a traffic signal at Center Meeting Road, located approximately 900 feet to the south of the intersection will create gaps in the Kennett Pike traffic stream for motorists turning from Twaddell Mill Road and Owls Nest Road.

DelDOT's warrants for left-turn bays are met on both the northbound and southbound approaches; however, due to potential impacts to historic properties and the Canby Grove Park, located on the southeast corner of the intersection, widening the existing 52-foot pavement section to accommodate additional turn lanes is not recommended due to relatively low left-turn volumes. Restriping and/or possible reconstruction of the existing shoulders to accommodate the left-turn bay would require eliminating on street parking, north of the intersection, which is likely to be met with resistance from the community; we therefore recommend no safety improvements to this intersection.

SR 52/Kennett Pike @ Snuff Mill Road: Traffic signal Warrants 2, 8, 9, and 11 are met; however, the delay study indicates that motorists do not experience enough delay to warrant a signal and only four accidents were reported during the three-year study period that are susceptible to correction by a traffic signal. The *MUTCD*'s specifies that five or more accidents must occur within a twelve-month period to warrant a traffic signal for safety reasons. Additionally, the installation of a traffic signal at this location could increase the potential for rear end accidents, specifically on the southbound approach where stopping sight distance is limited. The horizontal curve on the southbound approach would also restrict visibility of the signal indications. For these reasons, the installation of a traffic signal is not recommended.

DelDOT's warrants for left-turn bays are met on the northbound approach to the intersection; however, only three accidents occurred during the three-year study period that are susceptible to correction by the installation of a left-turn bay. Restriping and/or reconstructing the shoulders of the existing 42-foot pavement section to accommodate three 11-foot lanes (2 through lanes and 1 left-turn lane) would move the centerline to the west, worsening already substandard corner sight distance. Widening on the east side of the intersection to accommodate the left-turn bay would require impacting a significant tree located approximately 200 feet south of the intersection, 5 feet from the edge of pavement; therefore, the installation of a left-turn bay is not recommended.

Increasing corner sight distance for eastbound Snuff Mill Road vehicles would require removing the 10 to 15 foot high embankment on a 2:1 slope on the northeast corner of the intersection, relocating the utility poles at the top of the embankment and purchasing right-of-way or alternately, constructing a retaining wall. Since only two accidents were reported involving southbound approaching vehicles, we recommend no sight distance improvements.

REMEDIAL IMPROVEMENTS

We recommend the following improvements:

- Install W11-3, deer crossing warning sign along northbound Kennett Pike between Mount Airy Drive and Snuff Mill Road.
- Install “Watch for Turning Vehicles” sign on the northbound Kennett Pike approach to Snuff Mill Road.
- Install R1-1 (Stop) sign on the eastbound Center Avenue approach to Kennett Pike.
- Install R1-1 (Stop) sign on the eastbound Chandler Avenue approach to Kennett Pike.
- Install a stop bar on the eastbound Snuff Mill Road approach to Kennett Pike.

In addition, we recommend monitoring accidents at the Kennett Pike @ Snuff Mill Road intersection to determine the need for additional studies and/or safety improvements.



Photo 1: Northbound SR 52 approaching Center Meeting Road



Photo 2: Northbound SR 52 north of Center Meeting Road, entering Centerville



Photo 3: Northbound SR 52 approaching Twaddell Mill Road/Owls Nest Road



Photo 4: Northbound SR 52 approaching Snuff Mill Road



Photo 5: Looking northbound at the bus pull-off just north of Snuff Mill Road, approx. 75 feet pavement width



Photo 6: Looking north at SR 52 southbound from Snuff Mill Road, object at 300 feet north



Photo 7: Looking northbound at SR 52 southbound from Snuff Mill Road, object at 400 feet north



Photo 8: Looking northbound at SR 52 southbound from Snuff Mill Road, object at 425 feet north



Photo 9: Southbound SR 52, approximately 425 feet north of Snuff Mill Road



Photo 10: Southbound SR 52 at Snuff Mill Road



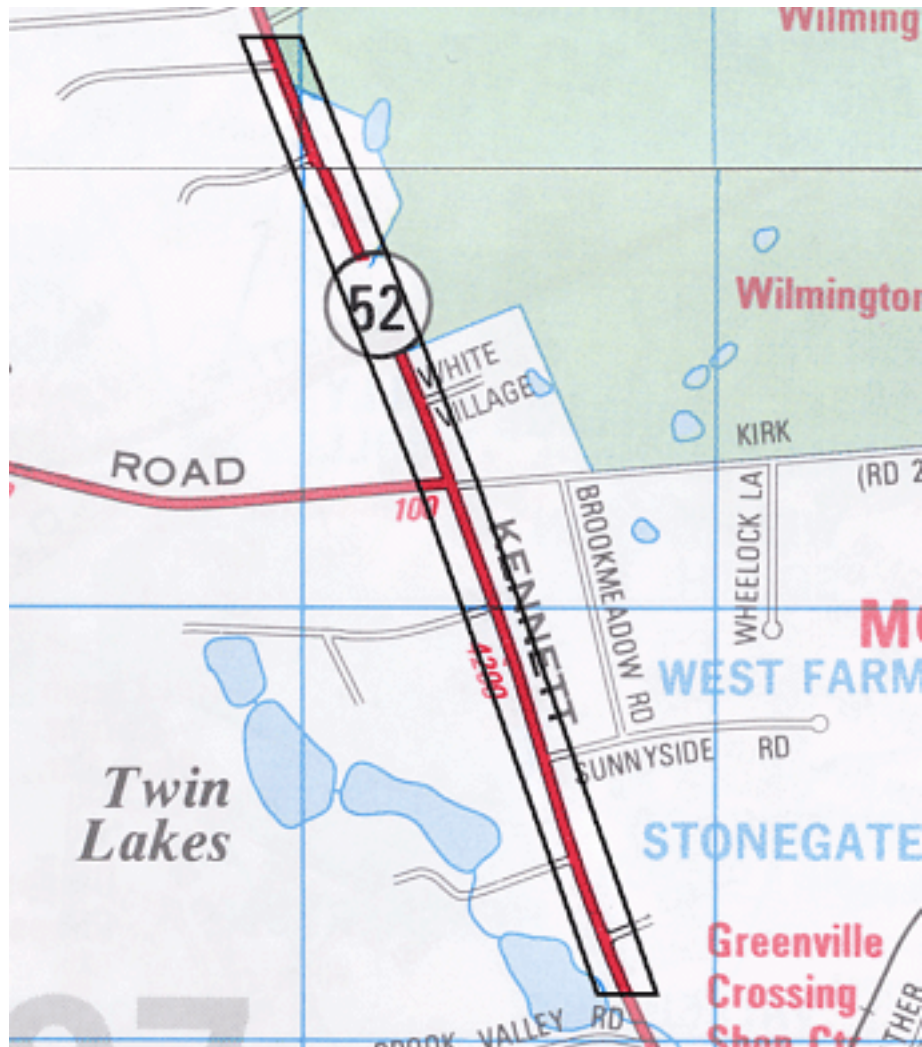
Photo 11: Southbound SR 52, south of Center Avenue



Photo 12: Southbound SR 52 at Twaddell Mill Road/Owls Nest Road



Photo 13: Southbound SR 52 approaching Center Meeting Road



INTRODUCTION

Site E is a 0.89-mile corridor located northwest of Wilmington along SR 52/Kennett Pike from 0.55 mile north of Brookvalley Road to 0.42-mile north of SR 82/Cambell Road/Kirk Road. SR 52/Kennett Pike is a two-lane, undivided, open-section roadway with shoulders. The posted speed limit is 50 miles per hour throughout the corridor. The ADT is approximately 15,000. Within the limits of the site, there is one signalized intersection at SR 82/Cambell Road and one unsignalized intersection at Sunnyside Road.

ACCIDENT DATA SUMMARIES

A total of 40 accidents were reported during the three-year study period between January 1999 and December 2001 including 27 (68 percent) rear end accidents. Thirteen of the seventeen southbound rear end accidents at the SR 52 and SR 82 intersection occurred on the approach to the signal. Four (31 percent) of the thirteen accidents involved a southbound left-turning vehicle waiting for an adequate gap in northbound through traffic. Five (38 percent) of the thirteen accidents occurred during the morning peak hour.

The following is a summary of the accidents by location and type:

- SR 52/SR 82 - 32 accidents
 - 17 southbound rear end accidents
 - 7 northbound rear end accidents
 - 3 northbound/eastbound angle accidents
- SR 52/Sunnyside Road - 6 accidents
 - 3 northbound deer-related accidents

A categorical summary of the accidents by type, severity, surface condition, lighting condition, year, and primary cause is shown in Table 1.

SR 52 @ SR 82/CAMPBELL ROAD/KIRK ROAD LEFT-TURN STUDY

Traffic Volumes: Peak hour turning movement counts were conducted at the SR 52 and SR 82 intersection from 7:00 to 9:00 AM, 11:00 to 1:00 PM, and 3:00 to 6:00 PM on Thursday, January 30, 2003. The count summaries are included in the Appendix. Peak hour turning movements at the SR 52 @ SR 82 intersection are shown in Figure 1. As indicated, the predominant movement on SR 52 is southbound in the morning toward Wilmington. The reverse occurs during the evening peak hour.

TABLE 1
Accident Data Summary

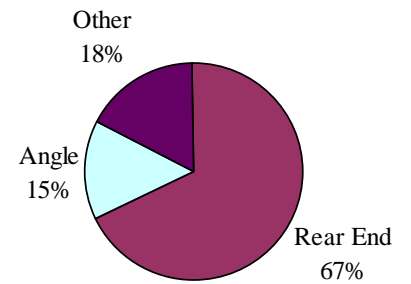
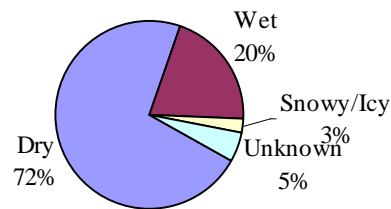
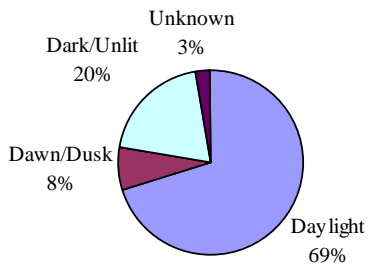
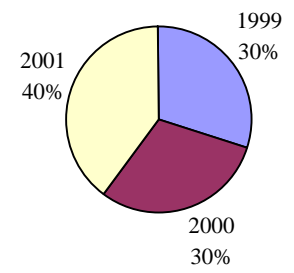
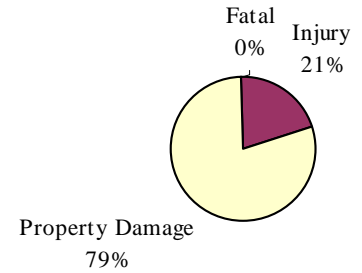
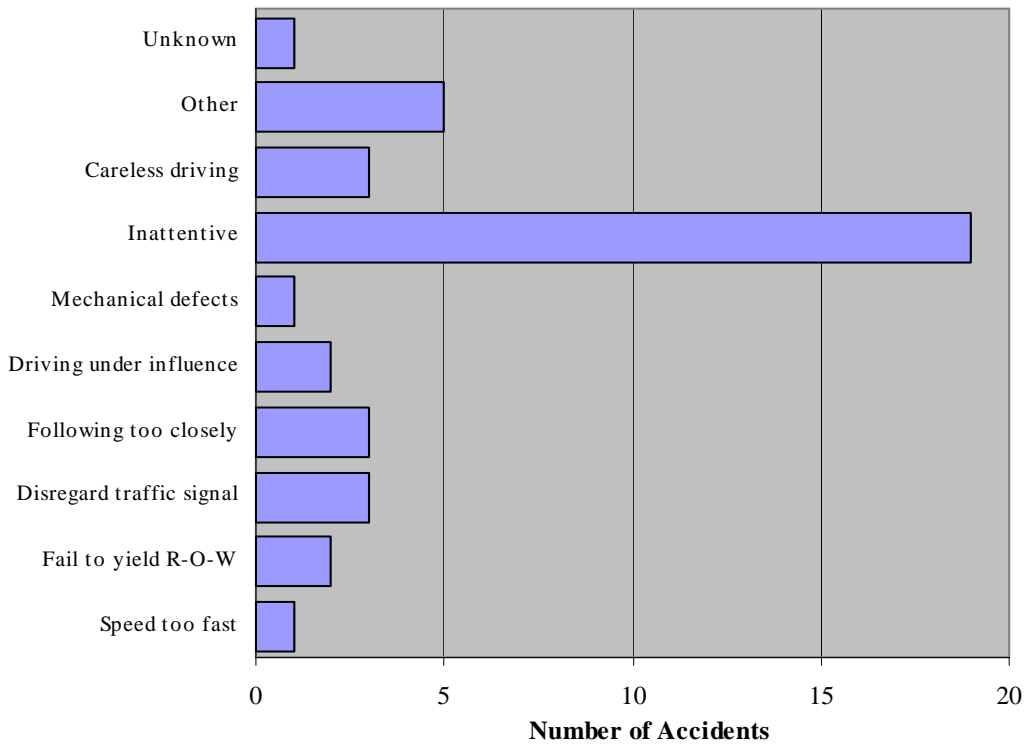
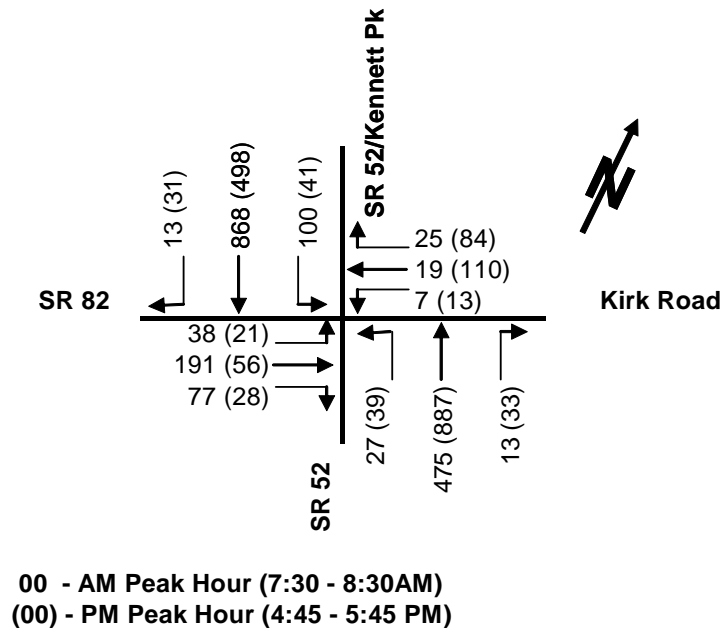


FIGURE 1
Peak Hour Volumes



Field Observations

- The intersection operates with concurrent phasing on the eastbound and westbound SR 82/Cambell Road/Kirk Road approaches and protected/permissive left-turn phasing on the northbound and southbound SR 52 approaches. SR 52 currently operates under lead/lag left-turn phasing with the northbound left-turn movement receiving the green-arrow first. The need for the lead/lag left-turn phasing is due to the shared through/left-turn lanes on SR 52/Kennett Pike.
- The eastbound pavement markings indicate a shared through/left-turn lane and a right-turn lane. The westbound approach includes a shared left/through/right-turn lane. The northbound and southbound approaches include a shared left/through lane and a right-turn lane.
- Both northbound and southbound SR 52 motorists were observed using the right-turn lane to bypass left-turning vehicles, creating a potential for sideswipe accidents.
- During the AM peak hour, southbound queues extended to the next traffic signal to the north at the Methodist Country House (~0.4 mile). Queues did not clear every cycle.
- “Signal ahead” warning signs are posted on all four approaches to the intersection. The westbound sign is leaning and the northbound sign is obstructed by a tree branch. AASHTO minimum sight distance requirements are met on the northbound and southbound SR 52 approaches. A vertical curve located approximately 250-feet from the intersection on the eastbound SR 82/Cambell Road approach may restrict sight distance (a minimum sight distance of 390 feet is required).
- The thermoplastic pavement markings along SR 52 are worn, cracking, and in poor condition.

Capacity Analyses: Signalized intersection capacity analyses were performed using *Highway Capacity Manual* methodologies (SYNCHRO software) to assess the impacts of modifying the lane configuration to provide exclusive left-turn lanes and lead left-turn phasing on the northbound and southbound SR 52/Kennett Pike approaches. As shown in Table 2, changing the lane configuration and left-turn phasing results in similar operations to existing conditions.

TABLE 2
Intersection Capacity Analyses Summary

Condition	Weekday					
	AM Peak Hour			PM Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS
Existing (Lead/Lag Left-Turn Phasing)	0.85	18.7	B	0.77	13.1	B
Proposed (Left-Turn Bay and Lead Left-Turn Phasing)	0.74	19.8	B	0.79	19.6	B

Discussion: Modifying the northbound and southbound SR 52 lane configuration to provide a separate left-turn lane and lead left-turn phasing results in similar operations compared to existing conditions; however, providing separate left-turn lanes and shared through/right-turn lanes on the SR 52 approaches will improve driver expectancy by providing a storage area for left-turning vehicles. Northbound and southbound through vehicles will no longer have to stop for queued left-turning vehicles, resulting in four rear end accidents during the three year study period. In addition, separate left-turn lanes will eliminate through vehicles from bypassing left-turning vehicles in the right-turn lane. Therefore, we recommend modifying the lane configuration and left-turn phasing due to its operational and safety benefits.

REMEDIAL IMPROVEMENTS

- Mill, overlay and restripe the northbound and southbound SR 52 approaches to the SR 82/Campbell Road/Kirk Road intersection to provide a left-turn lane and a shared through/right-turn lane on both the northbound and southbound approaches to the intersection (see figure). This will also require reconstructing the northwest, northeast and southwest shoulders on the approaches to the intersection.
- Modify the SR 52 and SR 82 traffic signal to remove the current lead/lag left-turn phasing and to provide concurrent protected/permissive left-turn phasing on the northbound and southbound approaches to SR 82.
- Repost the westbound SR 82 “Signal Ahead” sign.
- Trim branches obstructing the “Signal Ahead” sign on the northbound SR 52 approach to SR 82.
- Trim branches on the northwest corner of the SR 52 and SR 82 intersection obstructing the westbound SR 82/Campbell Road “Hidden Entrance” sign.

ADDITIONAL STUDIES

The HSIP committee recommends no additional studies.

HSIP 2003
Site E

In-House Working Document (Not for external distribution)





APPENDIX D: Statewide 1.0 Mile Corridors Ranked by Critical Ratio

Delaware - Statewide

Accident Date Range

01/01/2007 - 12/31/2009

Interval Length

1.0 mile

Parameters

AMBIENT_LIGHT_PARAMETER-05

Rank	Crit. Ratio	County	Road	Road Name	Beg MP	End MP	# Accs	Notes
1	10.12	1	355D	Harmony Road	0	0.05	1	<10 accidents - Did not meet criteria
2	5.93	1	34H	US 13	0	0.1	1	<10 accidents - Did not meet criteria
3	4.48	1	367	Welsh Tract Road	0	0.99	19	Location #1
4	4.48	1	367	Welsh Tract Road	0.1	1.09	19	Location #1
5	4.01	1	367	Welsh Tract Road	0.2	1.19	17	Location #1
6	4.01	1	367	Welsh Tract Road	0.3	1.29	17	Location #1
7	3.78	1	367	Welsh Tract Road	0.4	1.39	16	Location #1
8	3.76	1	367	Welsh Tract Road	0.5	1.49	16	Location #1
9	3.7	3	199	Fowlers Beach Road	1.2	2.15	4	<10 accidents - Did not meet criteria
10	3.6	1	11A	Delaware Park Road	0	0.15	4	<10 accidents - Did not meet criteria
11	3.56	3	246	Albury Avenue	0.9	1.89	7	<10 accidents - Did not meet criteria
12	3.55	3	199	Fowlers Beach Road	1.1	2.09	4	<10 accidents - Did not meet criteria
13	3.51	3	396		1.8	2.79	6	<10 accidents - Did not meet criteria
14	3.51	3	396		1.9	2.89	6	<10 accidents - Did not meet criteria
15	3.46	2	14	SR 42	3	3.91	5	<10 accidents - Did not meet criteria
16	3.43	1	31A	Old Limestone Road	0	0.31	1	<10 accidents - Did not meet criteria
17	3.43	3	14C		0	0.29	1	<10 accidents - Did not meet criteria
18	3.27	3	60	SR 54	3.1	4.09	7	<10 accidents - Did not meet criteria
19	3.27	3	60	SR 54	3.2	4.19	7	<10 accidents - Did not meet criteria
20	3.27	3	60	SR 54	3.3	4.29	7	<10 accidents - Did not meet criteria
21	3.25	1	38	St. Andrews School Road	0	0.99	7	<10 accidents - Did not meet criteria
22	3.23	2	429	Mechanic Street	3.1	4.09	6	<10 accidents - Did not meet criteria
23	3.23	2	429	Mechanic Street	3.2	4.19	6	<10 accidents - Did not meet criteria
24	3.23	2	429	Mechanic Street	3.3	4.29	6	<10 accidents - Did not meet criteria
25	3.18	1	429	Mechanic Street	3.8	4.79	7	<10 accidents - Did not meet criteria
26	3.14	2	14	SR 42	2.9	3.89	5	<10 accidents - Did not meet criteria
27	3.09	2	14	SR 42	2.8	3.79	5	<10 accidents - Did not meet criteria
28	3.05	2	14	SR 42	2.7	3.69	5	<10 accidents - Did not meet criteria
29	3.05	3	246	Albury Avenue	1	1.99	6	<10 accidents - Did not meet criteria
30	3.04	2	14	SR 42	2.6	3.59	5	<10 accidents - Did not meet criteria
31	3.02	1	367	Welsh Tract Road	0.6	1.59	13	Location #1
32	3.02	3	396		2.2	3.16	5	<10 accidents - Did not meet criteria
33	3	3	542A		0	0.18	1	<10 accidents - Did not meet criteria
34	2.93	3	396		2	2.99	5	<10 accidents - Did not meet criteria
35	2.93	3	396		2.1	3.09	5	<10 accidents - Did not meet criteria
36	2.83	1	355B		0	0.26	1	<10 accidents - Did not meet criteria
37	2.83	3	361	West Avenue	2.3	3.29	8	<10 accidents - Did not meet criteria
38	2.81	1	12A	Farrand Drive Ext.	0	0.1	2	<10 accidents - Did not meet criteria
39	2.8	3	60	SR 54	4.8	5.79	6	<10 accidents - Did not meet criteria
40	2.8	3	60	SR 54	4.9	5.89	6	<10 accidents - Did not meet criteria
41	2.8	3	60	SR 54	5	5.99	6	<10 accidents - Did not meet criteria
42	2.79	3	361	West Avenue	2.2	3.19	8	<10 accidents - Did not meet criteria
43	2.78	3	361	West Avenue	2.1	3.09	8	<10 accidents - Did not meet criteria
44	2.75	3	261		1.1	2.09	8	<10 accidents - Did not meet criteria
45	2.71	1	429	Mechanic Street	3.7	4.69	6	<10 accidents - Did not meet criteria
46	2.71	3	544		0.2	1.19	6	<10 accidents - Did not meet criteria
47	2.69	1	224	Upper Snuffmill Road	0	0.95	6	<10 accidents - Did not meet criteria
48	2.69	1	429	Mechanic Street	3.6	4.59	6	<10 accidents - Did not meet criteria
49	2.69	2	429	Mechanic Street	2.8	3.79	5	<10 accidents - Did not meet criteria
50	2.69	2	429	Mechanic Street	2.9	3.89	5	<10 accidents - Did not meet criteria
51	2.69	2	429	Mechanic Street	3	3.99	5	<10 accidents - Did not meet criteria
52	2.66	3	199	Fowlers Beach Road	0.8	1.79	3	<10 accidents - Did not meet criteria
53	2.66	3	199	Fowlers Beach Road	0.9	1.89	3	<10 accidents - Did not meet criteria
54	2.66	3	199	Fowlers Beach Road	1	1.99	3	<10 accidents - Did not meet criteria
55	2.65	1	315A		0	0.08	1	<10 accidents - Did not meet criteria
56	2.65	3	261		1.2	2.19	7	<10 accidents - Did not meet criteria
57	2.58	1	318A	St. James Church Road	0	0.24	1	<10 accidents - Did not meet criteria
58	2.58	3	246		0.5	1.49	5	<10 accidents - Did not meet criteria
59	2.58	3	544		0.1	1.09	6	<10 accidents - Did not meet criteria
60	2.56	3	246	Albury Avenue	0.6	1.59	5	<10 accidents - Did not meet criteria
61	2.55	2	127		0	0.41	1	<10 accidents - Did not meet criteria
62	2.55	3	246	Albury Avenue	0.7	1.69	5	<10 accidents - Did not meet criteria
63	2.55	3	246	Albury Avenue	0.8	1.79	5	<10 accidents - Did not meet criteria
64	2.55	3	246	Albury Avenue	1.1	2.09	5	<10 accidents - Did not meet criteria

Delaware - Statewide

Accident Date Range

01/01/2007 - 12/31/2009

Interval Length

1.0 mile

Parameters

AMBIENT_LIGHT_PARAMETER-05

Rank	Crit. Ratio	County	Road	Road Name	Beg MP	End MP	# Accs	Notes
65	2.55	3	261		1	1.99	8	<10 accidents - Did not meet criteria
66	2.51	3	28	US 9	6	6.99	14	Location #2
67	2.5	2	295		0	0.99	3	<10 accidents - Did not meet criteria
68	2.5	2	295		0.1	1.09	3	<10 accidents - Did not meet criteria
69	2.46	3	361	West Avenue	1.9	2.89	8	<10 accidents - Did not meet criteria
70	2.44	2	88		0.2	1.19	4	<10 accidents - Did not meet criteria
71	2.43	2	14	SR 42	2.4	3.39	4	<10 accidents - Did not meet criteria
72	2.43	2	14	SR 42	2.5	3.49	4	<10 accidents - Did not meet criteria
73	2.42	2	88		0.3	1.29	4	<10 accidents - Did not meet criteria
74	2.4	2	88		0.4	1.39	4	<10 accidents - Did not meet criteria
75	2.4	3	544		0.3	1.29	5	<10 accidents - Did not meet criteria
76	2.38	2	14	SR 42	2.3	3.29	4	<10 accidents - Did not meet criteria
77	2.37	1	454	Sawmill Branch Road	0.5	1.46	3	<10 accidents - Did not meet criteria
78	2.37	3	28	US 9	5.9	6.89	13	Location #2
79	2.35	1	275	Golden Ring Road	1.4	2.39	8	<10 accidents - Did not meet criteria
80	2.35	1	275	Golden Ring Road	1.5	2.49	8	<10 accidents - Did not meet criteria
81	2.35	3	261		0.9	1.89	8	<10 accidents - Did not meet criteria
82	2.34	2	88		0.5	1.49	4	<10 accidents - Did not meet criteria
83	2.34	3	396		1.7	2.69	4	<10 accidents - Did not meet criteria
84	2.34	3	60	SR 54	3	3.99	5	<10 accidents - Did not meet criteria
85	2.34	3	60	SR 54	3.4	4.39	5	<10 accidents - Did not meet criteria
86	2.34	3	60	SR 54	3.5	4.49	5	<10 accidents - Did not meet criteria
87	2.34	3	60	SR 54	3.6	4.59	5	<10 accidents - Did not meet criteria
88	2.34	3	60	SR 54	3.7	4.69	5	<10 accidents - Did not meet criteria
89	2.34	3	60	SR 54	3.8	4.79	5	<10 accidents - Did not meet criteria
90	2.34	3	60	SR 54	5.1	6.09	5	<10 accidents - Did not meet criteria
91	2.32	3	361		2	2.99	7	<10 accidents - Did not meet criteria
92	2.31	2	271		3.1	4.01	2	<10 accidents - Did not meet criteria
93	2.28	1	260	Brecks Lane Road	0	0.57	2	<10 accidents - Did not meet criteria
94	2.28	2	384		3	3.99	7	<10 accidents - Did not meet criteria
95	2.27	2	88		0.1	1.09	4	<10 accidents - Did not meet criteria
96	2.22	1	429	Mechanic Street	3.5	4.49	5	<10 accidents - Did not meet criteria
97	2.22	2	207		2.9	3.89	4	<10 accidents - Did not meet criteria
98	2.22	2	207		3	3.99	4	<10 accidents - Did not meet criteria
99	2.21	1	429	Mechanic Street	3.3	4.29	5	<10 accidents - Did not meet criteria
100	2.21	1	82	SR 1	5.5	6.49	12	Location #3
101	2.19	3	261		0.8	1.79	8	<10 accidents - Did not meet criteria
102	2.17	1	275	Golden Ring Road	1.6	2.59	7	<10 accidents - Did not meet criteria
103	2.17	1	469	Black Diamond Road	0.4	1.39	3	<10 accidents - Did not meet criteria
104	2.17	1	469	Black Diamond Road	0.5	1.49	3	<10 accidents - Did not meet criteria
105	2.17	1	469	Black Diamond Road	0.6	1.59	3	<10 accidents - Did not meet criteria
106	2.17	1	469	Black Diamond Road	0.7	1.69	3	<10 accidents - Did not meet criteria
107	2.16	3	28	US 9	9.1	10.09	13	Location #4
108	2.15	2	30	Main Street	1.5	2.49	9	<10 accidents - Did not meet criteria
109	2.15	2	429		2.7	3.69	4	<10 accidents - Did not meet criteria
110	2.15	2	429		3.4	4.39	4	<10 accidents - Did not meet criteria
111	2.15	2	429		3.6	4.59	4	<10 accidents - Did not meet criteria
112	2.15	3	353		2.3	3.29	3	<10 accidents - Did not meet criteria
113	2.15	3	525		1.8	2.79	7	<10 accidents - Did not meet criteria
114	2.15	3	525		1.9	2.89	7	<10 accidents - Did not meet criteria
115	2.15	3	525		2	2.99	7	<10 accidents - Did not meet criteria
116	2.15	3	525		2.1	3.09	7	<10 accidents - Did not meet criteria
117	2.15	3	525		2.2	3.19	7	<10 accidents - Did not meet criteria
118	2.14	3	28	US 9	6.1	7.09	12	Location #2
119	2.14	3	361		2.4	3.39	6	<10 accidents - Did not meet criteria
120	2.13	1	452	Fieldsboro Road	0	0.99	3	<10 accidents - Did not meet criteria
121	2.13	1	452	Fieldsboro Road	0.1	1.09	3	<10 accidents - Did not meet criteria
122	2.13	1	452	Fieldsboro Road	0.2	1.19	3	<10 accidents - Did not meet criteria
123	2.13	1	452	Fieldsboro Road	0.3	1.29	3	<10 accidents - Did not meet criteria
124	2.13	1	452	Fieldsboro Road	0.4	1.39	3	<10 accidents - Did not meet criteria
125	2.13	1	452	Fieldsboro Road	0.5	1.49	3	<10 accidents - Did not meet criteria
126	2.13	1	452	Fieldsboro Road	0.6	1.59	3	<10 accidents - Did not meet criteria
127	2.13	2	30	Main Street	1.6	2.59	9	<10 accidents - Did not meet criteria
128	2.13	3	353		2.4	3.39	3	<10 accidents - Did not meet criteria

Delaware - Statewide

Accident Date Range

01/01/2007 - 12/31/2009

Interval Length

1.0 mile

Parameters

AMBIENT_LIGHT_PARAMETER-05

Rank	Crit. Ratio	County	Road	Road Name	Beg MP	End MP	# Accs	Notes
129	2.12	2	8	US 113	9.6	10.59	13	Location #5
130	2.12	3	24	SR 24	18.2	19.19	7	<10 accidents - Did not meet criteria
131	2.12	3	24	SR 24	18.4	19.39	7	<10 accidents - Did not meet criteria
132	2.12	3	24	SR 24	18.5	19.49	7	<10 accidents - Did not meet criteria
133	2.11	3	246	Albury Avenue	0.3	1.29	4	<10 accidents - Did not meet criteria
134	2.11	3	261		1.3	2.29	5	<10 accidents - Did not meet criteria
135	2.11	3	353		2.1	3.09	3	<10 accidents - Did not meet criteria
136	2.11	3	477		0	0.99	3	<10 accidents - Did not meet criteria
137	2.1	1	26	Old Baltimore Pike	2.5	3.49	21	Location #6
138	2.1	3	48		7.2	8.19	7	<10 accidents - Did not meet criteria
139	2.1	3	48		7.3	8.29	7	<10 accidents - Did not meet criteria
140	2.1	3	48		7.4	8.39	7	<10 accidents - Did not meet criteria
141	2.1	3	48		7.5	8.49	7	<10 accidents - Did not meet criteria
142	2.1	3	48		7.6	8.59	7	<10 accidents - Did not meet criteria
143	2.1	3	48		7.7	8.69	7	<10 accidents - Did not meet criteria
144	2.1	3	48		7.8	8.79	7	<10 accidents - Did not meet criteria
145	2.1	3	48		7.9	8.89	7	<10 accidents - Did not meet criteria
146	2.1	3	48		8	8.99	7	<10 accidents - Did not meet criteria
147	2.09	2	30	Main Street	0.7	1.69	7	<10 accidents - Did not meet criteria
148	2.09	3	246	Albury Avenue	0.4	1.39	4	<10 accidents - Did not meet criteria
149	2.09	3	28	US 9	8.9	9.89	12	Location #4
150	2.07	3	246	Albury Avenue	1.8	2.7	3	<10 accidents - Did not meet criteria
151	2.07	3	326	State Street	0.8	1.79	8	<10 accidents - Did not meet criteria
152	2.06	2	188		0	0.32	1	<10 accidents - Did not meet criteria
153	2.06	3	353		2	2.99	3	<10 accidents - Did not meet criteria
154	2.06	3	353		2.5	3.49	3	<10 accidents - Did not meet criteria
155	2.05	1	26	Old Baltimore Pike	2.8	3.79	21	Location #6
156	2.05	3	594		0	0.99	6	<10 accidents - Did not meet criteria
157	2.04	2	30	Main Street	0.4	1.39	7	<10 accidents - Did not meet criteria
158	2.04	3	246		1.2	2.19	4	<10 accidents - Did not meet criteria
159	2.04	3	28	US 9	9	9.99	12	Location #4
160	2.04	3	544		0.4	1.39	4	<10 accidents - Did not meet criteria
161	2.03	2	303		1.2	2.19	2	<10 accidents - Did not meet criteria
162	2.02	1	301	Thompson's Station Road	0.3	1.29	9	<10 accidents - Did not meet criteria
163	2.02	1	301	Thompson's Station Road	0.4	1.39	9	<10 accidents - Did not meet criteria
164	2.02	2	54	Main Street	0.1	1.09	6	<10 accidents - Did not meet criteria
165	2.02	2	54	Main Street	0.2	1.19	6	<10 accidents - Did not meet criteria
166	2.02	2	54	Main Street	0.3	1.29	6	<10 accidents - Did not meet criteria
167	2.02	2	54	Main Street	0.4	1.39	6	<10 accidents - Did not meet criteria
168	2.02	2	54	Main Street	0.5	1.49	6	<10 accidents - Did not meet criteria
169	2.01	3	28	US 9	5.8	6.79	11	Location #4
170	2.01	3	488		2.8	3.79	4	<10 accidents - Did not meet criteria
171	2.01	3	488		2.9	3.89	4	<10 accidents - Did not meet criteria
172	2	1	82	SR 1	5.6	6.59	12	Location #3
173	2	1	9	SR 52	3.2	4.19	16	Location #7
174	2	2	8	US 113	9.7	10.69	12	Location #5
175	1.99	3	361		1.8	2.79	7	<10 accidents - Did not meet criteria
176	1.99	3	479A		0	0.6	2	<10 accidents - Did not meet criteria
177	1.98	1	26	Old Baltimore Pike	2.6	3.59	20	Location #6
178	1.98	1	26	Old Baltimore Pike	2.9	3.89	20	Location #6
179	1.98	1	9	SR 52	3.1	4.09	16	Location #7
180	1.98	2	325	Big Oak Road	1.4	2.39	4	<10 accidents - Did not meet criteria
181	1.98	2	73	North Street	4.3	5.29	7	<10 accidents - Did not meet criteria
182	1.98	3	207		1.3	2.29	7	<10 accidents - Did not meet criteria
183	1.98	3	353		1.9	2.89	3	<10 accidents - Did not meet criteria
184	1.98	3	544		1	1.99	2	<10 accidents - Did not meet criteria
185	1.97	1	26	Old Baltimore Pike	2.7	3.69	20	Location #6
186	1.97	2	30	Main Street	1.4	2.39	8	<10 accidents - Did not meet criteria
187	1.97	3	2	US 13	3.6	4.59	18	Location #8
188	1.96	1	383	Church Road	0.4	1.37	8	<10 accidents - Did not meet criteria
189	1.96	2	30	Main Street	0.3	1.29	7	<10 accidents - Did not meet criteria
190	1.96	2	384		3.1	4.09	6	<10 accidents - Did not meet criteria
191	1.96	3	16	SR 16	25.8	26.79	5	<10 accidents - Did not meet criteria
192	1.96	3	16	SR 16	25.9	26.89	5	<10 accidents - Did not meet criteria

Delaware - Statewide**Accident Date Range**

01/01/2007 - 12/31/2009

Interval Length

1.0 mile

Parameters

AMBIENT_LIGHT_PARAMETER-05

Rank	Crit. Ratio	County	Road	Road Name	Beg MP	End MP	# Accs	Notes
193	1.96	3	16	SR 16	26	26.99	5	<10 accidents - Did not meet criteria
194	1.96	3	16	SR 16	26.1	27.09	5	<10 accidents - Did not meet criteria
195	1.96	3	353		2.6	3.59	3	<10 accidents - Did not meet criteria
196	1.95	2	73	North Street	4.2	5.19	7	<10 accidents - Did not meet criteria
197	1.95	3	326	State Street	0.7	1.69	8	<10 accidents - Did not meet criteria
198	1.94	1	32	US 40	4.2	5.19	25	Location #9
199	1.94	2	73	North Street	4.4	5.39	7	<10 accidents - Did not meet criteria
200	1.94	3	213	Walnut Street	8.1	9.09	5	<10 accidents - Did not meet criteria
201	1.94	3	484		2.7	3.69	4	<10 accidents - Did not meet criteria
202	1.92	1	17	SR 92	0	0.99	17	Location #10