TRAFFIC ENGINEERING STUDY
TRAFFIC CONTROL SIGNAL REMOVAL STUDY

DELAWARE ROUTE 9 / 6TH STREET (N378) & DELAWARE STREET
SIGNAL PERMIT NO. N459T

NEW CASTLE, NEW CASTLE COUNTY, DELAWARE

DECEMBER 2016

PREPARED FOR:

DELAWARE DEPARTMENT OF TRANSPORTATION
TRAFFIC SECTION

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EXECUTIVE SUMMARY

The Signal Removal Study was conducted to evaluate the continued need for the existing traffic control signal at the intersection of Delaware Route 9 / 6th Street (N378) and Delaware Street, located in the City of New Castle, New Castle County, Delaware. The request for the Traffic Signal Removal Study was made by the Delaware Department of Transportation (DelDOT). The Traffic Signal Removal Study included conducting field investigations, review of crash history data, analysis of traffic volumes, completing traffic operational analysis, assessment of safety using the Highway Safety Manual (HSM), and evaluation of pedestrian treatments. Taking into consideration operational and safety aspects at the intersection of DE Route 9 / 6th Street and Delaware Street, it has been determined that the traffic control signal may be removed, with the intersection recommended to operate under an all-way stop control condition.

While the intersection does currently operate at an acceptable level-of-service (LOS) under the existing signal control, the intersection and approaches to the intersection are reflected to operate with less delay to vehicles under the proposed all-way stop control condition. In addition to the review of traffic operations at the intersection, crash history data and existing traffic volumes were also evaluated. The crash history data did not reflect a crash pattern that would be a reason for the removal of the existing signal, or the installation of a traffic signal if one did not currently existing. Although, in regard to the traffic volumes, the current traffic using the intersection does not reflect the need for a traffic signal. This coincides with the above noted results of the operational analysis, that the intersection would actually operate with less delay to vehicles if the signal is replaced with an all-way stop control condition. Accordingly, based on the lower volumes at the intersection and the operational analysis completed as part of this traffic engineering study, it is recommended that the signal control at the intersection be removed and an all-way stop control be implemented.

Additional benefits for the replacement of the existing traffic signal with an all-way stop control at the intersection, is cost savings from maintenance of and upgrades to the existing traffic signal.

INTRODUCTION

The Traffic Signal Removal Study was conducted to evaluate the continued need for the existing traffic control signal (Signal Permit No. N459T) at the intersection of Delaware Route 9 / 6th Street (N378) and Delaware Street, located in the City of New Castle, New Castle County, Delaware. The request for the Traffic Signal Removal Study was made by the Delaware Department of Transportation (DelDOT) Traffic Section. The Traffic Signal Removal Study included conducting field investigations, review of crash history data, analysis of turning movement count data, completing traffic operational analysis, assessment of safety using the Highway Safety Manual (HSM), and evaluation of pedestrian treatments using NCHRP Report 562 methodology. Taking into consideration operational and safety aspects at the intersection of DE Route 9 / 6th Street and Delaware Street, it has been determined that the existing traffic control signal may be removed and the intersection operate under an all-way stop control condition.

The intersection of DE Route 9 / 6th Street (N378) and Delaware Street is a four leg intersection located in downtown New Castle. The existing traffic signal at the intersection includes a diagonal span wire design. For the purpose of the traffic engineering study, DE Route 9 / 6th Street is considered to run in the northbound and southbound direction, while Delaware Street is considered to run in the eastbound and westbound direction. According to the DelDOT 2005 Functional Classification Map, the segment of DE Route 9 / 6th Street (N378) at the intersection with Delaware Street is classified as a Major Collector within an urbanized area. With further review by referencing the Delaware Vehicle Volume Summary 2015 (Traffic Summary) the Traffic Pattern Group (TPG) for DE Route 9 / 6th Street (N378) is TPG 6, Rural Major Collector. DE Route 9 / 6th Street (N378) is reported as having an Average Annual Daily Traffic (AADT) of 3,245 vehicles per day south of the intersection Delaware Street, and 4,488 vehicles per day north of the intersection with Delaware Street. The DE Route 9 / 6th Street (N378) northbound and southbound approaches are considered the major street approaches for the study with slightly higher volumes than the Delaware Street eastbound and westbound approaches, which are considered the minor street approaches. Delaware Street is a municipality maintained Local roadway, for which the Delaware Traffic Summary does not provide an AADT. There is a 25 MPH statutory speed limit for both roads, with posted speed limit signs in the vicinity of the intersection.

PHOTO 1: SIGNALIZED INTERSECTION

View from northeast corner of the intersection facing westbound

Turning movement count data collected in October 2015 was provided for analysis as part of the study. As anticipated, the existing vehicular and pedestrian volumes at the intersection do not meet the

Delaware Manual on Uniform Traffic Control (DE MUTCD) volume warrants. Furthermore, while the intersection does currently operate at an acceptable level-of-service (LOS) under the existing signal control, the intersection and approaches to the intersection are reflected to operate with less delay (s/veh) under the all-way stop control condition.

In addition to the review of traffic volumes and operations at the intersection, crash history data was reviewed to determine if there were any existing crash patterns that may support either keeping the signal or removal of the signal. There was not a consistent crash pattern reflected in the three-years of crash history data reviewed that would be the reason for the removal of the existing signal, or the installation of a traffic signal if one did not currently existing.

With regard to pedestrian accommodations at the intersection, sidewalk exists along both sides of DE Route 9 / 6th Street (N378) on both the northbound and southbound approaches to the intersection, as well as on the both sides of Delaware Street on both the eastbound and westbound approaches to the intersection. At all four corners of the intersection there is existing brick in herringbone pattern. There are faded crosswalk markings, consisting of two traverse lines, on DE Route 9 / 6th Street (N378) across the north and south leg of the intersection. There are no crosswalk markings across the east and west legs of the intersection on Delaware Street. There are no pedestrian signal heads at the intersection.

PHOTO 2: PEDESTRIAN ACCOMODATIONS AT INTERSECTION

View from northwest corner of the intersection of faded crosswalk marking

Other existing conditions in the surrounding area include the signalized intersection of DE Route 273 / Chestnut Street (N55) and Delaware Street which is located approximately 0.10-mile west of the intersection of DE Route 9 / 6th Street (N378) and Delaware Street. In addition, the post office is located on the north side of Delaware Street at the intersection with 5th Street, east of the intersection with DE Route 9 / 6th Street. There is on-street parking along the south side of Delaware Street both to the east and west of the intersection with 6th Street, including in front of the post office. There is the 6th St-NC & Delaware St DART bus stop located at the southeast and southwest corner of the intersection of DE Route 9 / 6th Street (N378) and Delaware Street; the Dart bus stops include a posted sign.

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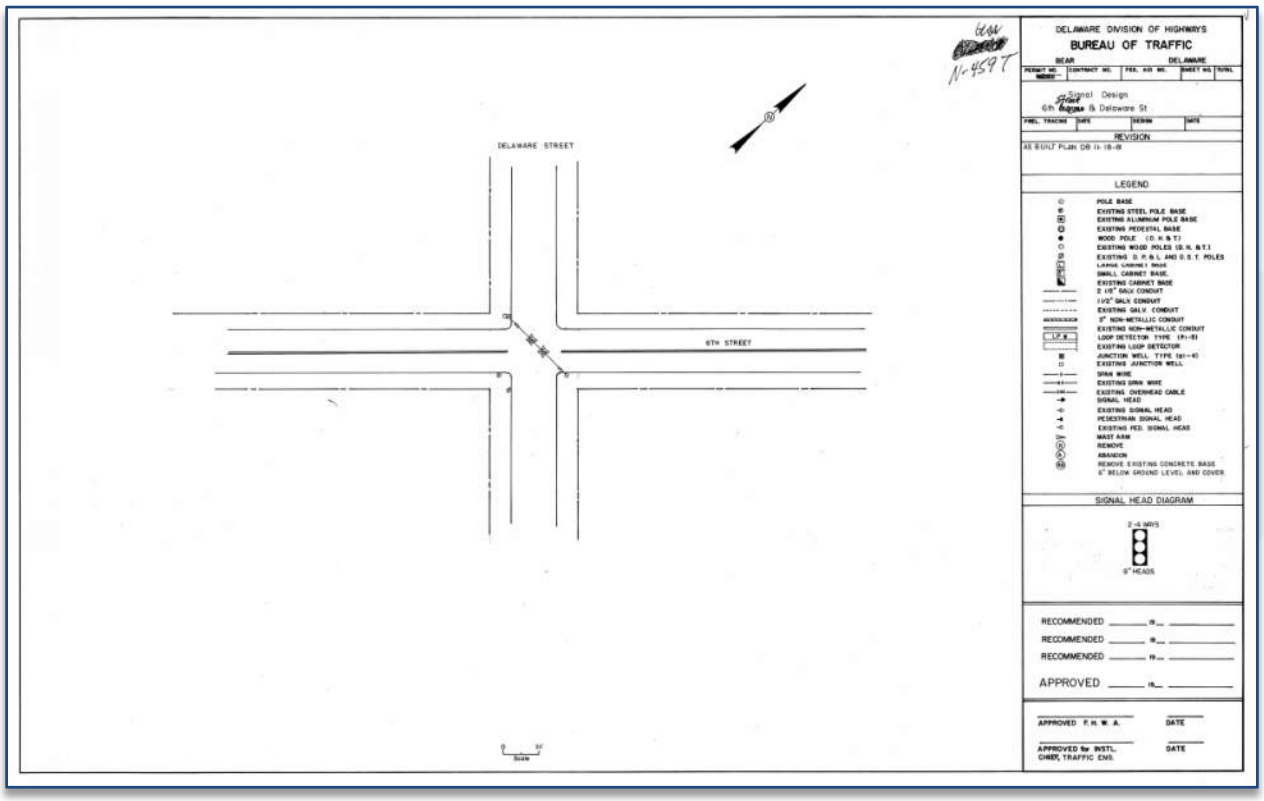
HISTORICAL INFORMATION / FILE RESEARCH

File Research was completed for the intersection of DE Route 9 / 6th Street (N378) and Delaware Street in order to collect historical information regarding any past traffic engineering studies conducted at the intersection and the dates of installation and any modifications of the existing traffic control signal. It was determined that there are no traffic engineering studies on file for the intersection at the Delaware Department of Transportation (DelDOT) Traffic Section. There is a Traffic Signal Resolution TR# SIN166-81, with an authorization date of December 16th, 1981, available on file indicating that the accepted warrants and engineering requirements for the installation of a signal at the intersection of 6th Street and Delaware Street within the City of New Castle were met.

In addition to the Signal Resolution on file, there is also an As-Built Signal Plan dated 11/18/1981 on file. The As-Built Signal Plan is reflected below in **Figure 1**.

FIGURE 1: AS-BUILT SIGNAL PLAN



Both the Signal Resolution and As-Built Signal Plan are included in **Appendix A**.

EXISTING CONDTIONS

The existing conditions at the signalized intersection of DE Route 9 / 6th Street (N378) and Delaware Street were verified during site visits and field observations occurring in September and November 2016. In general, the existing traffic control signal at the intersection should be considered for signal maintenance and construction upgrades if it is determined that the traffic control signal should remain. Some of the signal maintenance and construction upgrades to be taken into consideration should address the condition of signal heads, address signal head vertical clearance, upgrade the signal cabinet, and to include implementation of Opticom Receivers and Pedestrian Signal Heads which currently do not existing. The above signal maintenance and signal construction upgrades may be taken into consideration in determining whether the traffic control signal at the intersection should be replaced with a more appropriate form of intersection traffic control (i.e. all-way stop control).

PHOTO 3: EXISTING SIGNAL CABINET

View from southwest corner of the existing signal cabinet at the intersection

In regard to roadway maintenance responsibility, the northern leg of DE Route 9 / 6th Street is State maintained while the southern leg of DE Route 9 / 6th Street and the eastern and western legs of Delaware Street are municipally maintained.

SITE DESCRIPTION / GEOMETRIC CONFIGURATION / TRAFFIC CONTROL

The signalized intersection of Delaware Route 9 / 6th Street (N378) and Delaware Street is a four-legged intersection located in downtown New Castle, New Castle County, Delaware. The existing traffic signal at the intersection includes a diagonal span wire design, and currently operates under pre-timed traffic signal control. Both the northbound and southbound DE Route 9 / 6th Street (N378) approaches and the eastbound and westbound Delaware Street approaches all have lane configurations that include a single shared left-turn/through/right-turn lane. There is on-street parking, including parking space markings, along the south side of Delaware Street both to the east and west of the intersection with 6th Street. Parking is also permitted on DE Route 9 / 6th Street (N378).

There is a 25 MPH statutory speed limit for both roads at the intersection, with speed limit signs posted within the vicinity of the intersection. There is also existing roadway lighting at the intersection.

PHOTO 4: EASTBOUND DELAWARE STREET APPROACH

View of eastbound approach to the intersection with on-street parking and roadway lighting.

PHOTO 5: ROADWAY LIGHTING AT INTERSECTION

View from northwest corner of intersection of roadway lighting at the intersection and eastbbound departure of with on-street parking and roadway lighting.

PHOTO 6: SOUTHBOUND 6TH STREET APPROACH

View of southbound approach to the intersection with single shared left-turn, through, right-turn lane, and concrete sidewalk.

PHOTO 7: WESTBOUND DELAWARE STREET APPROACH

View of westbound approach to the intersection with single shared left-turn, through, right-turn lane, no parking siging, and brick sidewalk.

Sidewalk exists along both sides of DE Route 9 / 6th Street (N378) on both the northbound and southbound approaches to the intersection, as well as on the both sides of Delaware Street on both the eastbound and westbound approaches to the intersection. At all four corners of the intersection there is existing brick in herringbone pattern. There are faded crosswalk markings, consisting of two traverse lines, on DE Route 9 / 6th Street (N378) across the north and south leg of the intersection. There are no crosswalk markings across the east and west legs of the intersection on Delaware Street. There are no pedestrian signal heads at the intersection.

PHOTO 8: NORTHEAST CORNER OF INTERSECTION

View of northeast corner of intersection with brick sidewalk and curb ramp, and crosswalk markings.

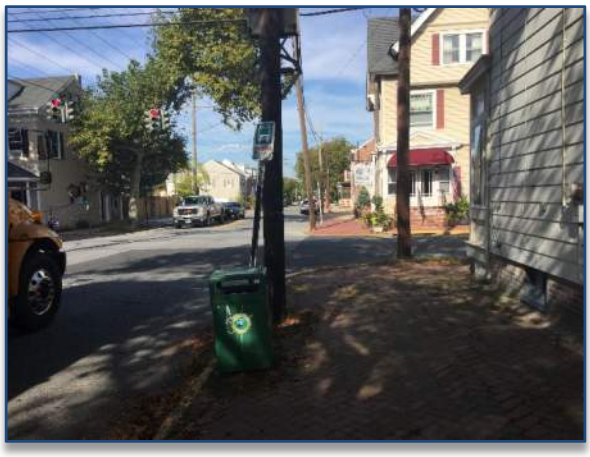
PHOTO 9: NORTHWEST CORNER OF INTERSECTION

View of northwest corner of intersection with concrete sidewalk, brick curb ramp, and crosswalk markings.

PHOTO 10: SOUTHWEST CORNER OF INTERSECTION

View of southwest corner of intersection with brick sidewalk and curb ramp. The tree routes have created verticle difference in the brick sidewalk.

PHOTO 11: SOUTHEAST CORNER OF INTERSECTION



View of southeast corner of intersection with brick sidewalk and curb ramp. Dart Bus stops are also located on northbound and southbound 6th Street south of the intersection.

FIELD OBSERVATIONS

Initial field observations were completed on September 9th, 2016, in which signing, pavement marking, and signal equipment inventory was completed. Additional, field observations were made on November 16th, 2016 to verify available sight distance at the intersection. During the field observations intersection operations and signal timing was observed. There were no conflicts observed at the intersection during the field observations.

TRAFFIC VOLUMES / TURNING MOVEMENTS

A 12-Hour Turning Movement Count was completed at the intersection of DE Route 9 / 6th Street (N378) and Delaware Street on Tuesday, October 20th through Thursday, October, 22nd, 2015. The turning movement count data was collected from 10:00AM to 2:00PM on Tuesday, October 20th, 2015, from 6:00AM to 10:00AM on Wednesday, October 21st, 2015, and from 2:00PM to 6:000PM on Thursday, October 22nd, 2015. All three days in which turning movement count data was collected occurred during clear weather and dry road surface conditions. In addition to general vehicle volumes, the turning movement count data included heavy vehicles, bicycles, and pedestrian counts. For the turning movement count data, and coinciding with the traffic engineering study summary, DE Route 9 / 6th Street (N378) is considered to be oriented in the northbound/southbound direction while Delaware Street is considered to be oriented in the eastbound/westbound direction. The turning movement count data is included in **Appendix B.**

In review of the total turning movement count data, as reflected in **Figure 2** below, it is noted that while the northbound and southbound approaches have relatively balanced volumes and eastbound and westbound approaches have relatively balanced volumes, there are higher volumes on the northbound and southbound approaches. The peak hour volumes were also provided as part of the turning movement count data for the morning peak period, midday peak period, and evening peak period. The AM peak hour is reflected as occurring from 7:00AM – 8:00AM (**Figure 3**), the Midday peak hour is reflected as occurring from 1:00PM – 2:00PM (**Figure 4**), and the PM peak hour is reflected as occurring from 4:30PM – 5:30PM (**Figure 5**).

FIGURE 2: 12-HOUR TOTAL VOLUMES

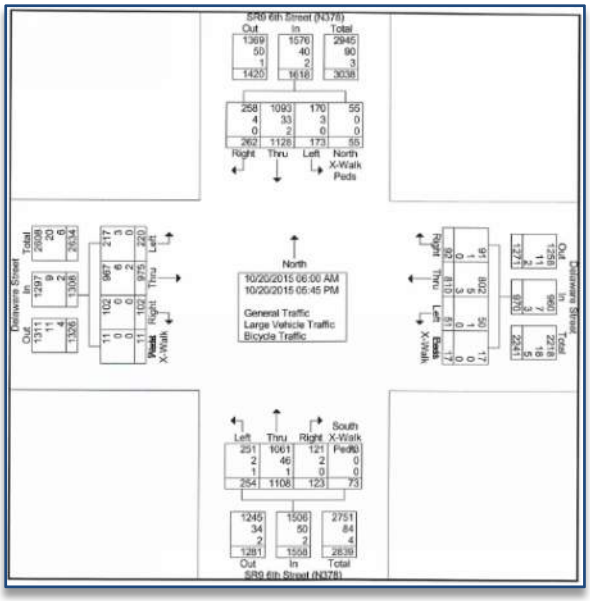


FIGURE 3: AM PEAK HOUR VOLUMES

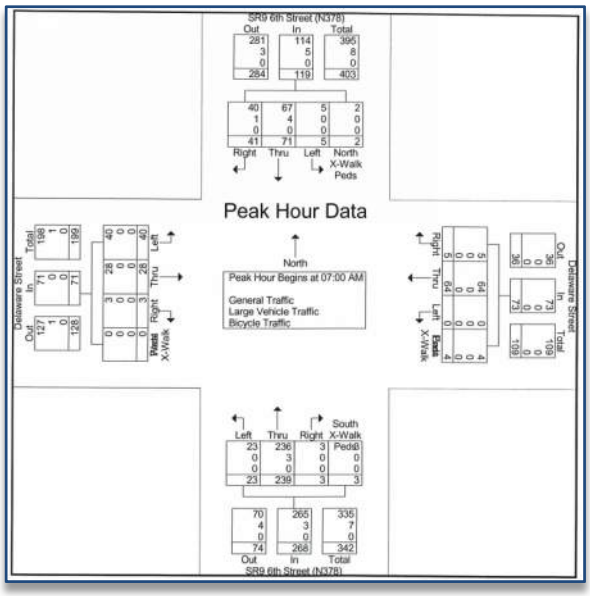


FIGURE 4: MIDDAY PEAK HOUR VOLUMES

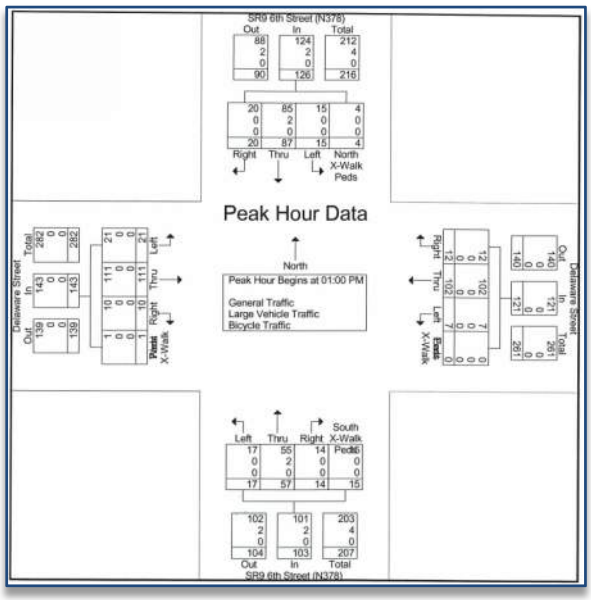
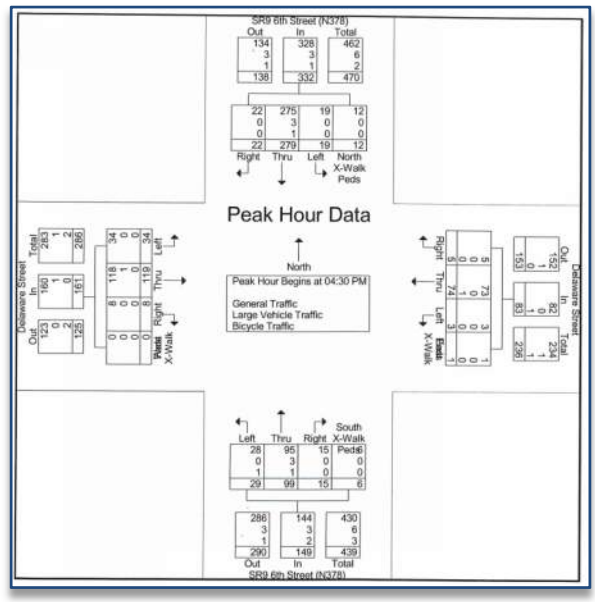


FIGURE 5: PM PEAK HOUR VOLUMES



SIGHT DISTANCE

Existing departure sight distances for vehicles stopped on the all four approaches were measured in the field. The existing 25 MPH statutory speed limits on both DE Route 9 / 6th Street (N378) and Delaware Street were also verified during the field investigation conducted for this traffic engineering study. The existing sight distances were compared to the American Association of State Highway and Transportation Officials (AASHTO) ***A Policy on Geometric Design of Highways*** (Green Book), 2011 required minimum sight distances for the posted speeds. The results are presented in **Table 1**.

TABLE 1: DEPARTURE SIGHT DISTANCE FROM TENTATIVE STOP CONTROLLED APPROACH

DEPARTURE SIGHT DISTANCE FROM STOP CONTROLLED APPROACH								
Location	Approach	Speed V_{major} (mph)	Sight Distance for Viewing Traffic Approaching from Left		Viewing Left Distance Met?	Sight Distance for Viewing Traffic Approaching from		Viewing Right Distance Met?
			AASHTO Required (ft)	Available (ft)		AASHTO Required (ft)	Available (ft)	
DE Route 9 / 6th Street (N378)	Northbound	25	280	150	No	240	385	Yes
	Southbound	25	280	135	No	240	410	Yes
Delaware Street	Eastbound	25	280	306	Yes	240	460	Yes
	Westbound	25	280	170	No	240	300	Yes
V_{major} = Existing Posted Speed on Major Road AASHTO minimum required Departure Sight Distances given are for passenger cars.								
For the approaches with a sight distance to the left that did not meet the AASHTO requirement, if moving up to a more natural stopping point, past the existing stop line marking toward the intersecting travel lane, the available sight distance is did not increase enough to meet the ASSHTO reguired sight distance for a 25 MPH design speed.								

There were restricted sight distances as measured in the field when comparing the ASSHTO required minimum sight distances for the 25 MPH design speed. If the traffic control at the intersection was to

be modified to a two-way stop control (TWSC) condition, with the Delaware Street approaches stop controlled at DE Route 9 / 6th Street, there would be sight distance restrictions for the westbound approach to the left. To mitigate safety concerns of sight distance restrictions, an all-way stop control (AWSC) condition should be considered.

SPEED DATA

Speed Data was not collected for the approaches to the intersection of DE Route 9 / 6th Street (N378) and Delaware Street. There is a 25 MPH statutory speed limit for both roads, with posted speed limit signs in the vicinity of the intersection.

PHOTO 12: SOUTHBOUND DE ROUTE 9 / 6TH STREET

View of posted 25 MPH Speed Limit sign on southbound DE Route 9 / 6th Street.

PHOTO 13: NORTHWEST CORNER OF INTERSECTION

View of posted 25 MPH Speed Limit sign on eastbound Delaware Street.

DELAYS

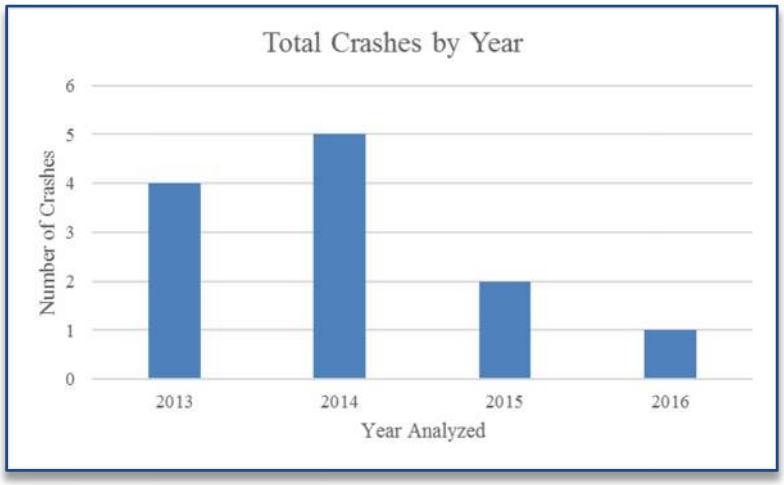
While conducting field observations at the intersection, there was minimal delay and queuing observed. The maximum queue observed during the field investigations was five (5) vehicles in the eastbound direction at approximately 1:36 PM, during the midday peak hour. The next longest queues to occur during observations included three (3) vehicles in the eastbound direction at 1:13 PM, and two (2) vehicles in the westbound direction at 1:06 PM; both occurring with the midday peak hour period.

In addition to observations made at the intersection, Level of Service (LOS) and delay (sec/veh) at the intersection was also analyzed as part of the traffic engineering study. Highway Capacity Software (HCS 2010) was used, applying turning movement count data from counts conducted in October 2015, for the existing signal control and for both an all-way stop control (AWSC) and a two-way stop control (TWSC). The intersection operating under the existing signal control is reflected to operate with a LOS B for the AM, Midday, and PM peak hour with no delay greater than 16.6 (sec/veh).

CRASH DATA

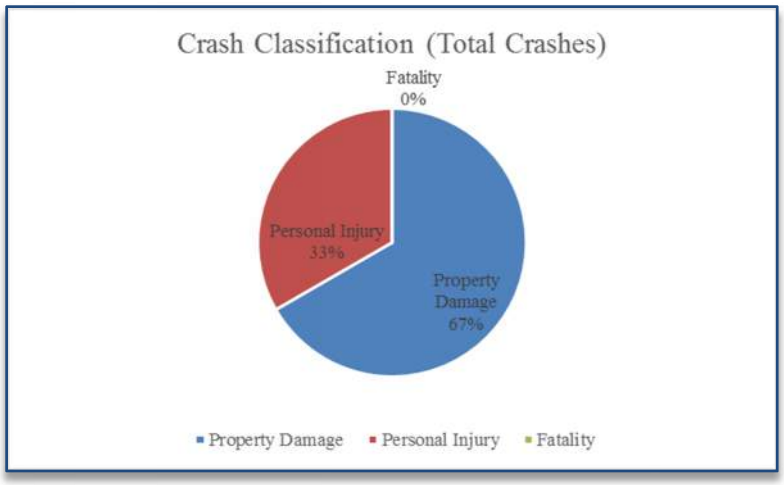
Crash statistics and reports for greater then a three-year study period from January 1st, 2013 through September 28th, 2016 were obtained from DelDOT, reviewed, and summarized for this report. The crash reports reviewed covered all crashes within 0.10-mile radius of the intersection of DE Route 9 / 6th Street (N378) and Delaware Street located in the City of New Castle. There were a total of 12 reported crashes in the approximately three-year study period. The 12 crashes included four (4) occurring in 2013, five (5) occurring in 2014, two (2) in 2015, and one (1) in 2016 from the beginning of the year till September 28th, 2016, as reflected in **Figure 6**.

FIGURE 6: CRASHES PER YEAR (TOTAL CRASHES)



Of the 12 crashes, there were eight (8) classified as property damage only, four (4) classified as personal injury, and zero (0) reported as fatal crashes, as reflected in **Figure 7**. Per the crash data, there were no alcohol /driving under the influence (DUI) related crashes.

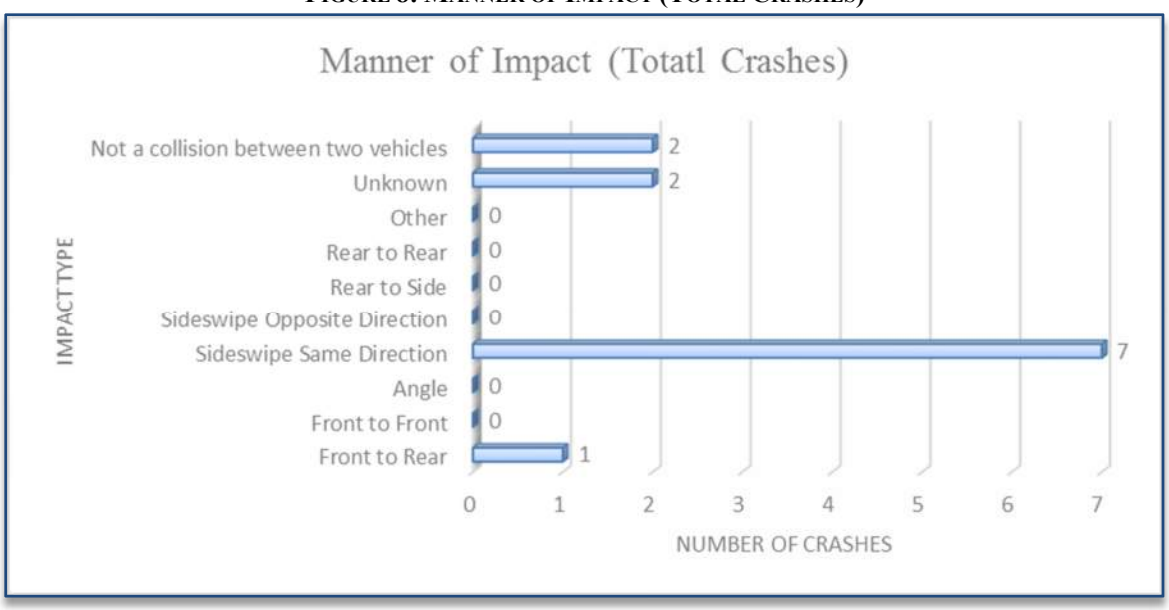
FIGURE 7: CRASH CLASSIFICATION (TOTAL CRASHES)



The majority of crashes occurred during dry road surface conditions with clear or cloudy weather. In regard to lighting conditions, the intersection does include roadway lighting. There were six (6) crashes occurring during daylight hours, four (4) crashes occurring during dark-lighted conditions, and two (2) reported with unknown lighting conditions. Six (6) of the twelve (12) crashes occurred during the weekend, including four (4) on Friday and two (2) on Saturday, with five (5) of the remaining occurring on Monday and one (1) on Wednesday. Although there were spikes in the crash data, there were no specific trends occurring in reference to road surface conditions, weather conditions, lighting conditions, or day of the week the crash occurred.

While an appropriately implemented traffic signal control can reduce crashes of the type susceptible to correction through the installation of a traffic signal, such as angle impact collisions, an improper or unjustified traffic control signal can result in a significant increase in the frequency of certain types of collisions, including rear-end collisions. The manner of impact of the twelve (12) total reported crashes are reflected in **Figure 8**, with the largest identifiable groupings of crashes by manner of impact including seven (7) sideswipe-same direction crashes, one (1) front-to-rear ("rear end") type crash, two (2) not-a-collision-between-two-vehicles, and two (2) collisions reported with unknown manner of impact. The types of collisions used to justify either the signalization of an intersection or the removal of an existing traffic control signal were insignificant with no angle collisions occurring and one (1) "rear-end" type collision. With that noted, there was a vehicle-pedestrian impact collision, as well as a trend of sideswipe same direction collisions.

FIGURE 8: MANNER OF IMPACT (TOTAL CRASHES)



With the review of the individual crash reports and narratives it was determined that the of the twelve (12) collisions that were included within the 0.10-mile radius query, five (5) are considered to have occured at surrounding intersections, away from the intersection of DE Route 9 / 6th Street (N378) and Delaware Street. Of the seven (7) remaining crashes, three (3) occurred at the intersection and four (4)

occurred along the approach and departure legs. The three (3) crashes occurring at the intersection included two (2) sideswipe-same direction impacts, and one (1) rear-end collision. The four (4) collisions occurring on the approach and departure legs included sideswipe-same direction impact collisions with vehicles that were parked or were entering into the travel way from a parked location.

The 2011 Delaware Manual on Uniform Traffic Control Devices (DE MUTCD) Traffic Signal Warrant 7, Crash Experience states that the need for a traffic control signal shall be considered if an engineering study finds that five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period. Although the traffic control signal is already existing, it should be noted that there is not a pattern of crashes that include five (5) or more reported crashes within a 12-month period of the type susceptible to correction at the study intersection.

There was not a consistent crash pattern reflected in the three-years of crash history data reviewed that would be the reason for the removal of the existing signal, or the installation of a traffic signal if one did not currently existing. Crash data is included in **Appendix C.**

TRAFFIC SIGNAL WARRANT ANALYSIS

A signal warrant analysis was completed for the intersection of DE Route 9 / 6th Street (N378) and Delaware Street as set out in the Delaware Manual on Uniform Traffic Control Devices, 2011 (DE MUTCD) to ascertain whether the existing traffic control signal is warranted. The DE MUTCD provide nine (9) warrants for evaluating the need for a traffic control signal. As reflected in the DE MUTCD, the satisfaction of a traffic signal warrant or warrants does not necessarily require the installation of a traffic control signal. While not all of the traffic signal warrants are applicable to the intersection of DE Route 9 / 6th Street (N378) and Delaware Street, each warrant is addressed in the traffic engineering study summary. As reflected on the worksheet for the traffic signal warrant analysis located in **Appendix D** for the volume and crash experience warrants, the 100 percent volume requirements were used in the signal warrant analysis as the intersection neither lies within the built up areas of an isolated community having a population of less than 10,000 nor do the speed limits on any of the approaches to the intersection exceed 40 MPH.

Of the nine (9) signal warrants, five (5) of the warrants were not satisfied while the remaining four (4) warrants were not applicable. Further details on the individual signal warrants are provided below, along with the signal warrant worksheets are located in Appendix D.

Warrant 1, Eight-Hour Vehicular Volume is considered one of the volume warrants provided in the DE MUTCD, and is **<u>not satisfied</u>** for the intersection of DE Route 9 / 6th Street (N378) and Delaware Street. Warrant 1 provides conditions to consider installation of a traffic control signal based on large volumes of intersecting traffic or heavy major street traffic that causes excessive delays to the minor street approaches for any eight (8) hours of an average day. There were zero (0) hours met for Condition A due to major street hourly approach volumes being less than 500vph and the majority of minor street hourly approach volumes being less than 150vph (only one (1) hour was greater than 150 vehicles). There were zero (0) hours met for Condition B due to the major street hourly approach volumes not meeting the minimum 750vph threshold. There is also a combination of Conditions A and B that can be

taken into consideration using 80 percent volume thresholds, although as provided as guidance in the DE MUTCD, "should be applied only after an adequate trial of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems". Taking the combination of Conditions A and B into consideration, there was one (1) hour met for Condition A and zero (0) hours met for Condition B when applying the combination of Conditions A and B; still not satisfying the eight (8) hours.

Warrant 2, Four-Hour Vehicular Volume is also considered a volume warrant provided in the DE MUTCD, and is **not satisfied** for the intersection of DE Route 9 / 6th Street (N378) and Delaware Street. Warrant 2 provides minimum traffic volume thresholds for both the major and minor street approaches to be met for any four (4) hours of an average day. There were zero (0) hours met for Warrant 2.

Warrant 3, Peak Hour also takes into consideration traffic volumes, as well as stopped time delay, but according to the DE MUTCD is only applicable in unusual cases (i.e. office complexes, manufacturing plants, industrial complexes, schools, etc.) in which a facility discharges a large number of vehicles over a short time. Warrant 3 is not applicable to the intersection of DE Route 9 / 6th Street (N378) and Delaware Street, although the analysis was still completed and it was determined that Warrant 3 is **not satisfied.**

Warrant 4, Pedestrian Volume takes into consideration vehicle volume on the major street and pedestrians per hour crossing the major street for any four (4) hours of an average day and/or the pedestrian peak hour. The minimum pedestrian volume thresholds (100 or more pedestrians per hour for any four (4) hours or 107 pedestrians for any one (1) hour) were not met at the intersection of DE Route 9 / 6th Street (N378) and Delaware Street. Warrant 4 is **not satisfied**.

Warrant 5, School Crossing is **not applicable** as the intersection of DE Route 9 / 6th Street (N378) and Delaware Street is not within an established school zone and the principle reason for the need of a traffic signal is that school children cross the major street.

Warrant 6, Coordinated Signal System provides consideration for installation of a traffic signal based on providing the necessary degree of platooning to maintain progressive movement in a coordinated system. Warrant 6 is **not applicable** as vehicular platooning is not a necessity along DE Route 9 / 6th Street (N378) or on Delaware Street in the vicinity of the intersection.

Warrant 7, Crash Experience provides consideration for installing a traffic signal based on the severity and frequency of crashes. As previously stated in the report, Warrant 7 provides a minimum crash threshold of five or more reported crashes of the types susceptible to correction by a traffic control signal within a 12-month period. There was not a crash pattern reflected in the crash history data, nor were there five or more reported crashes within a 12-month period. Accordingly, Warrant 7 is **not satisfied.**

Warrant 8, Roadway Network is **not applicable** as this intersection is not the common intersection of two or more major routes.

Warrant 9, Intersection Near a Grade Crossing is **not applicable** to the intersection of DE Route 9 / 6th Street (N378) and Delaware Street as it is not in proximity to a grade crossing on an intersection approach.

HIGHWAY CAPACITY SOFTWARE ANALYSIS

In conducting highway capacity analysis for the intersection of DE Route 9 / 6th Street (N378) and Delaware Street under the existing signal control condition, as well as under the proposed all-way stop control (AWSC) condition and two-way stop control (TWSC) condition, Highway Capacity Software (HCS 2010) was used. The intersection was evaluated under existing conditions as well as proposed stop control conditions for the AM, Midday, and PM peak hours. The 12-Hour Turning Movement Count data, that was collected on Tuesday, October 20th through Thursday, October, 22nd, 2015, was used for the analysis. As throughout the traffic engineering study, DE Route 9 / 6th Street (N378) is considered to run in the northbound and southbound direction, while Delaware Street is considered to run in the eastbound and westbound direction. The HCS 2010 reports for the below highway capacity software analyses are included in **Appendix E**.

EXISTING SIGNAL CONDITIONS

The intersection of DE Route 9 / 6th Street (N378) and Delaware Street currently operates under pre-timed traffic signal control, with the northbound and southbound approaches and the eastbound and westbound approaches operating concurrently. The analyses were completed with the phasing input reflected as a pre-timed uncoordinated signal operating with Max Green times for a cycle length of 77-seconds. The intersection is reflected as operating with an acceptable level-of-service (LOS) B for all three (3) peak hours analyzed, with an intersection delay of 14.5s/veh for the AM and Midday peak hour and 15.2s/veh for the PM peak hour. All four (4) approaches were also reflected as operating with an acceptable LOS B during all three (3) peak hour periods, with the approach delay ranging from 12.3s/veh for the northbound 6th Street approach during the Midday peak hour to 16.6s/veh for the eastbound Delaware Street approach during the PM peak hour. Further details on the LOS and Delays (s/veh) for each approach and the intersection are reflected below in **Figure 9.**

FIGURE 9: SIGNALIZED INTERSECTION LOS & DELAY SUMMARY

Signal Control LOS and Delay (s/veh)										
Peak Hour	Approach								Intersection	
	Eastbound Delaware Street		Westbound Delaware Street		Northbound SR9 6th Street (N378)		Southbound SR9 6th Street (N387)			
	Concurrent		Concurrent		Concurrent		Concurrent		Signalized	
	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)
AM Peak Hour (7:00AM-8:00AM)	B	15.5	B	15.3	B	14.7	B	12.9	B	14.5
Midday Peak Hour (1:00PM-2:00PM)	B	16.2	B	15.8	B	12.3	B	12.7	B	14.5
PM Peak Hour (4:30PM-5:30PM)	B	16.6	B	15.3	B	13.0	B	15.4	B	15.2

PROPOSED STOP CONTROL SCENARIOS

Highway capacity analyses was also completed for two (2) proposed stop controlled scenarios at the intersection of DE Route 9 / 6th Street (N378) and Delaware Street, including an all-way stop control (AWSC) condition and a two-way stop control (TWSC) condition. For both the AWSC and TWSC conditions the intersection was analyzed for the AM, Midday, and PM peak hours using the October 2015 turning movement count data.

All-Way Stop Control (AWSC)

When evaluating the intersection of DE Route 9 / 6th Street (N378) and Delaware Street under the proposed all-way stop control (AWSC) condition versus the existing signal control condition, there is a reflected improvement in delay (s/veh) for the intersection and on all approaches for the AM, Midday, and PM peak hours. In addition to a reflected improvement in delay (s/veh), there is also an improvement in the level-of-service from LOS B to and LOS A for the intersection during the AM and Midday peak hour. There was also an improvement in the level-of-service from LOS B to LOS A for the eastbound approach during the AM and Midday peak hours, the westbound approach during the AM, Midday, and PM peak hours, the northbound approach during the Midday and PM peak hours, and the southbound approach during the AM and Midday peak hours. Further detail on the reflected improvements in LOS and Delays (s/veh) for each approach and the intersection when operating under an AWSC condition are reflected below in **Figure 10.**

FIGURE 10: AWSC INTERSECTION LOS & DELAY SUMMARY

All Way Stop Control LOS and Delay (s/veh)										
Peak Hour	Approach								Intersection	
	Eastbound Delaware Street		Westbound Delaware Street		Northbound SR9 6th Street (N378)		Southbound SR9 6th Street (N387)			
	Stop-Controlled		Stop-Controlled		Stop-Controlled		Stop-Controlled		AWSC	
	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)
AM Peak Hour (7:00AM-8:00AM)	A	8.8	A	8.6	B	10.2	A	8.5	A	9.4
Midday Peak Hour (1:00PM-2:00PM)	A	8.6	A	8.4	A	8.3	A	8.5	A	8.5
PM Peak Hour (4:30PM-5:30PM)	B	10.2	A	9.2	A	9.5	B	11.9	B	10.7

Two-Way Stop Control (TWSC)

The intersection of DE Route 9 / 6th Street (N378) and Delaware Street was also evaluated for a two-way stop control (TWSC) condition, with the eastbound and westbound Delaware Street approaches considered the stop-controlled minor-street approaches, and the northbound and southbound 6th Street approaches operating freely as the major-street approaches. The intersection operating under a two-way stop control (TWSC) condition versus the existing signal control condition reflected improvements in level-of-service (LOS) from LOS B to LOS A for the free northbound and southbound approaches for

the AM, Midday, and PM peak hours. Although, for the stop-controlled eastbound and westbound Delaware Street approaches the level-of-service remained LOS B for the AM and Midday peak hours while declining to a LOS C for the PM peak hour. Although the level-of-service (LOS) for the PM peak hour reflected a decline from LOS B under signal control to LOS C under TWSC, the approach delay (s/veh) remained the same for the westbound Delaware Street approach at 15.3s/veh, while it did increase for the eastbound Delaware Street approach from 16.6s/veh to 19.6s/veh. Further detail on the LOS and delays (s/veh) for each approach of the intersection when operating under a TWSC condition are reflected below in **Figure 11.**

FIGURE 11: TWSC INTERSECTION LOS & DELAY SUMMARY

Two Way Stop Control LOS and Delay (s/veh)								
Peak Hour	Approach							
	Eastbound Delaware Street		Westbound Delaware Street		Northbound SR9 6th Street (N378)		Southbound SR9 6th Street (N387)	
	Stop-Controlled		Stop-Controlled		Free		Free	
	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)
AM Peak Hour (7:00AM-8:00AM)	B	14.6	B	13.8	A	0.8	A	0.4
Midday Peak Hour (1:00PM-2:00PM)	B	12.2	B	11.7	A	1.5	A	0.9
PM Peak Hour (4:30PM-5:30PM)	C	19.6	C	15.3	A	1.8	A	0.6

Overall, the highway capacity analysis completed for the intersection of DE Route 9 / 6th Street (N378) and Delaware Street reflects that the intersection under the existing signal control operates at an acceptable level-of-service (LOS). When evaluating the proposed all-way stop control condition, the delay (s/veh) improved from operating under signal control, whether a minimal decrease in delay (s/veh) or an improvement in level-of-service (LOS) from LOS B to LOS A. Although there were some improvements in level-of-service (LOS) and delay (s/veh) when evaluating the two-way stop control (TWSC) condition versus the existing signal control, it was not across the board and the stop-controlled eastbound and westbound approach actually saw a decline from LOS B to LOS C during the PM peak hour.

While the intersection does currently operate at an acceptable level-of-service (LOS) under the existing signal control, the intersection and approaches to the intersection are reflected to operate with less delay (s/veh) under the all-way stop control. Accordingly, based on the highway capacity software analysis, it is recommended that the signal control at the intersection be removed and an all-way stop control be implemented.

HIGHWAY SAFETY MANUAL ANALYSIS

The 2010 Highway Safety Manual (HSM) was consulted as part of this study to assist in performing a safety assessment of the intersection of DE Route 9 / 6th Street (N378) and Delaware Street to evaluate both the existing traffic signal control and the proposed future all-way stop control (AWSC) condition. It was determined that there are currently no applicable HSM Predictive Methods available for the intersection of DE Route 9 / 6th Street (N378), based on functional classification and area of location. Furthermore, it was determined that there are no available Crash Modification Factors (CMF) that can be applied directly to the crash history data for the proposed modification to the traffic control at the signalized intersection. Below is further detail on investigation of the applicability of the HSM for conducting a safety assessment at the intersection.

DelDOT's preferred method for conducting the safety assessment is to use the HSM "predictive method" to estimate anticipated crash frequency. The HSM provides predictive methods for rural two-lane, two-way roads (HSM Chapter 10 – Predictive Method for Rural Two-Lane, Two-Way Road), and for urban and suburban arterials (HSM Chapter 12 – Predictive Method for Urban and Suburban Arterial). In determining the applicable predictive method for the intersection, the functional classification of DE Route 9 / 6th Street (N378) was referenced as a Rural Major Collector (Traffic Pattern Group (TPG) 6), as provided in the Delaware Vehicle Volume Summary 2015 (Traffic Summary). Accordingly, the predictive method for urban and suburban arterials (HSM Chapter 12) is not applicable to the intersection. Furthermore, while DE Route 9 / 6th Street (N378) is classified as a rural major collector, the intersection is located within an urban boundary, the City of New Castle, with a population greater than 5,00 persons (according to the 2010 census). As such, the predictive method for two-lane, two-way roads (HSM Chapter 10) is also not applicable to the intersection. Neither of the predictive methods are applicable to the intersection of DE Route 9 / 6th Street (N378) and Delaware Street as there are no Safety Performance Function (SPF) available for the particular base condition when considering functional classification and location within an urban area. Furthermore, neither HSM Chapter 10 or Chapter 12 provides a SPF for a four-leg intersection with stop control on all approaches to the intersection (i.e. all-way stop control). Accordingly, the alternative method of applying Crash Modification Factors (CMF) directly to the observed crash history data was investigated.

Through reference of the HSM and research using the CMF Clearinghouse website (http://www.cmfclearinghouse.org/index.cfm), it was determined that there are no available CMFs that apply directly to the proposed modifications to the traffic control at the signalized intersection of DE Route 9 / 6th Street (N378) and Delaware Street, such as "remove unwarranted signal on two-way street (i.e. convert from signal to stop control on two-way street)".

As there were no applicable CMFs available and as it was determined that there are no "best fit" applications of the predictive method for this location and the proposed modifications to the traffic control at the intersection, no further Highway Safety Manual Analysis was completed at this time.

GUIDELINES FOR PEDESTRIAN CROSSING TREATMENT

For possible pedestrian treatment options at DE Route 9 / 6th Street (N378) and Delaware Street, the National Cooperative Highway Research Program (NCHRP) Report 562 methodology for selecting possible pedestrian treatment options was used. The pedestrian volume during the PM Peak Hour, the highest intersection total volume, did not meet the minimum pedestrian volume per hour threshold for a roadway with a speed limit of 35 MPH or less. Therefore, additional traffic control device type treatment for pedestrian activity at the intersection is not recommended. The worksheet for NCHRP Report 562 is included in **Appendix F.**

CONCLUSION & RECOMMENDATIONS

The Signal Removal Study was conducted to evaluate the continued need for the existing traffic control signal at the intersection of Delaware Route 9 / 6th Street (N378) and Delaware Street located in the City of New Castle, New Castle County. The results of the traffic engineering study show that the signal at the intersection of DE Route 9 / 6th Street and Delaware Street is **not warranted** under existing conditions, and that an all-way stop control (AWSC) condition will satisfy safety concerns, operational expectations, and field condition considerations. Accordingly, it has been determined that the traffic control signal may be removed and the intersection control modified to an AWSC condition with all four approaches stop-controlled.

The investigation of the need for a traffic control signal at the intersection of DE Route 9 / 6th Street and Delaware Street included a traffic signal warrant analysis for existing conditions based on provisions in the ***Delaware Manual on Uniform Traffic Control Devices,*** 2011 (DE MUTCD) traffic signal warrants. The traffic signal warrant analysis involved the analysis of existing vehicular and pedestrian volumes, crash history data for a three-year study period, and stopped time delay. Of the nine (9) traffic signal warrants, five (5) were not satisfied and four (4) were not applicable to this intersection. The traffic control signal is therefore not warranted under existing conditions.

Safety consideration were also evaluated during the completion of the traffic engineering study through the review and analysis of crash history data as noted above. Although there was not a consistent crash pattern reflected in the three-years of crash history data reviewed that would be the reason for the removal of the existing signal, there was also no identifiable crash patterns that would be the reason for the installation of a traffic signal if one did not currently existing. The 2010 Highway Safety Manual (HSM) was consulted as part of this study, although it was determined that there are no applicable HSM Predictive Methods available for the intersection, and no available Crash Modification Factors (CMF) that can be applied directly to the crash history data for the proposed modification to the traffic control at the signalized intersection. Additional potential safety concerns were addressed in taking into consideration field conditions.

An intersection operational analysis was also conducted as part of the traffic engineering study utilizing Highway Capacity Software (HCS 2010) for the existing signal control condition, as well as for the proposed all-way stop control (AWSC) condition and two-way stop control (TWSC) condition for the AM, Midday, and PM peak hours. Overall, the highway capacity analysis completed for the intersection

of DE Route 9 / 6th Street (N378) and Delaware Street reflects that the intersection under the existing signal control operates at an acceptable level-of-service (LOS). When evaluating the proposed all-way stop control condition, the delay (s/veh) improved from operating under signal control, whether a minimal decrease in delay (s/veh) or an improvement in level-of-service (LOS) from LOS B to LOS A. Although there were some improvements in level-of-service (LOS) and delay (s/veh) when evaluating the two-way stop control (TWSC) condition versus the existing signal control, it was not across the board and the stop-controlled eastbound and westbound approach actually saw a decline from LOS B to LOS C during the PM peak hour. While the intersection does currently operate at an acceptable level-of-service (LOS) under the existing signal control, the intersection and approaches to the intersection are reflected to operate with less delay (s/veh) under the all-way stop control. Accordingly, based on the highway capacity software analysis, it is recommended that the signal control at the intersection be removed and an all-way stop control be implemented.

Field condition considerations included the existing available departure sight distance for all approaches to the intersection. There were restricted sight distances as measured in the field when comparing the ASSHTO required minimum sight distances for the 25 MPH design speed. If the traffic control at the intersection was to be modified to a two-way stop control (TWSC) condition, with the Delaware Street approaches stop controlled at DE Route 9 / 6th Street, there would be sight distance restrictions for the westbound approach to the left. To mitigate safety concerns of sight distance restrictions, an all-way stop control (AWSC) condition is recommended.

Based on the results of the traffic engineering study which included evaluation of traffic signal warrants, safety, operations, and field conditions as described above, it is recommended that the traffic control signal at the intersection of DE Route 9 / 6th Street (N378) and Delaware Street be removed as it is no longer justified under current conditions. It is recommended that an all-way stop control condition be implemented at the intersection. A plan reflecting the recommendations made as part of this traffic engineering study to be completed, as well as potential future improvements is included in **Appendix G**.

Additionally, it is recommended that the removal of the signal and installation of the all-way stop control condition be completed following the DelDOT guidelines for signal deactivation.

APPENDIX A – SIGNAL HISTORY

TRAFFIC SIGNAL RESOLUTION

TRAFFIC SIGNAL PLAN

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
DOVER, DELAWARE

TR# SIN166-81 Date Authorized: 12-16-81

TRAFFIC SIGNAL RESOLUTION
DELAWARE AVE. & 6TH ST.

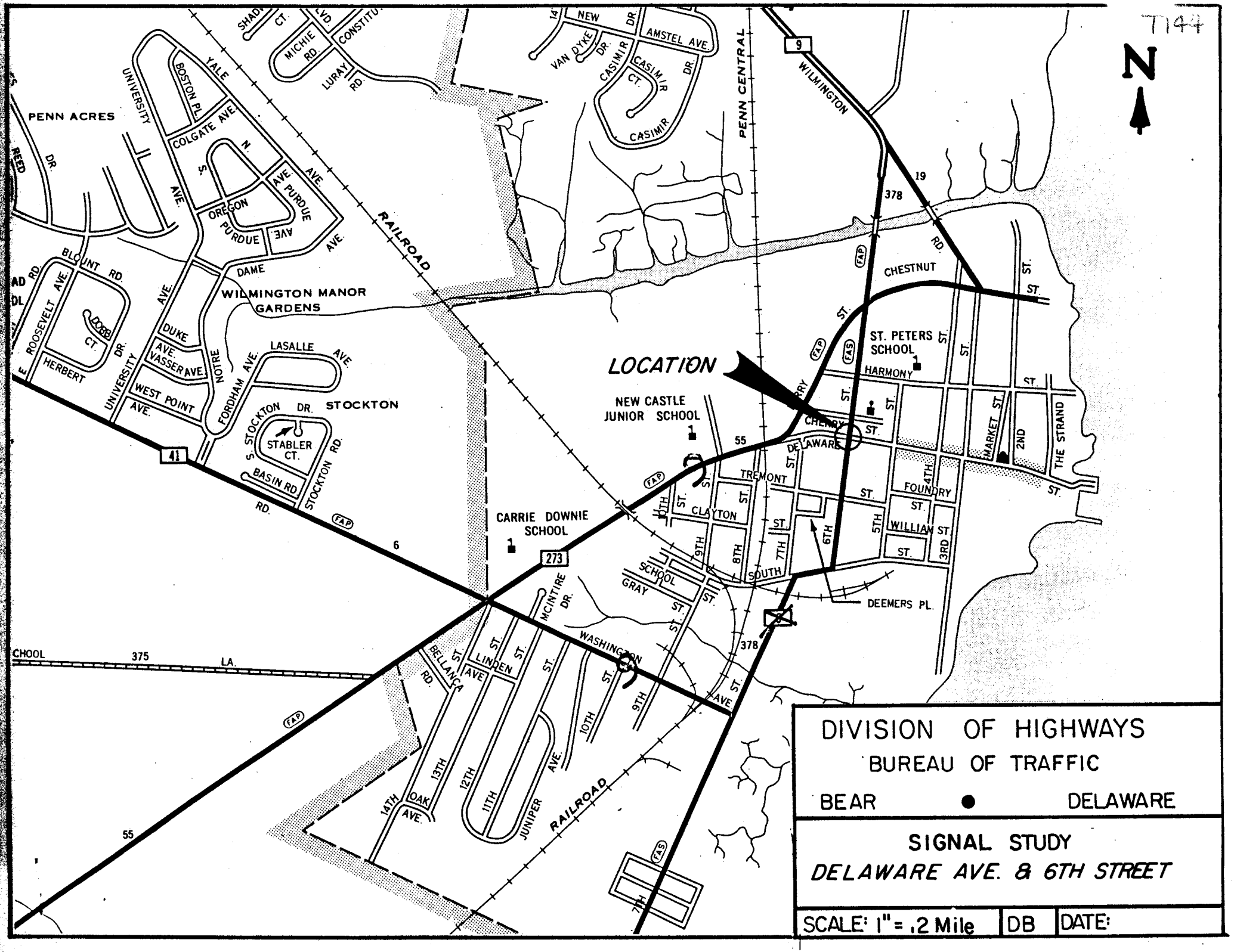
WHEREAS, Chapter I, Title 17, Section 134, Delaware Code of 1976, as amended, requires the Department of Transportation to approve traffic control signals erected upon State highways within incorporated areas; and

WHEREAS, an engineering and traffic investigation at the intersection of Delaware Ave. & 6th St., New Castle County, shows that the accepted warrants and engineering requirements for the installation of a signal are met.

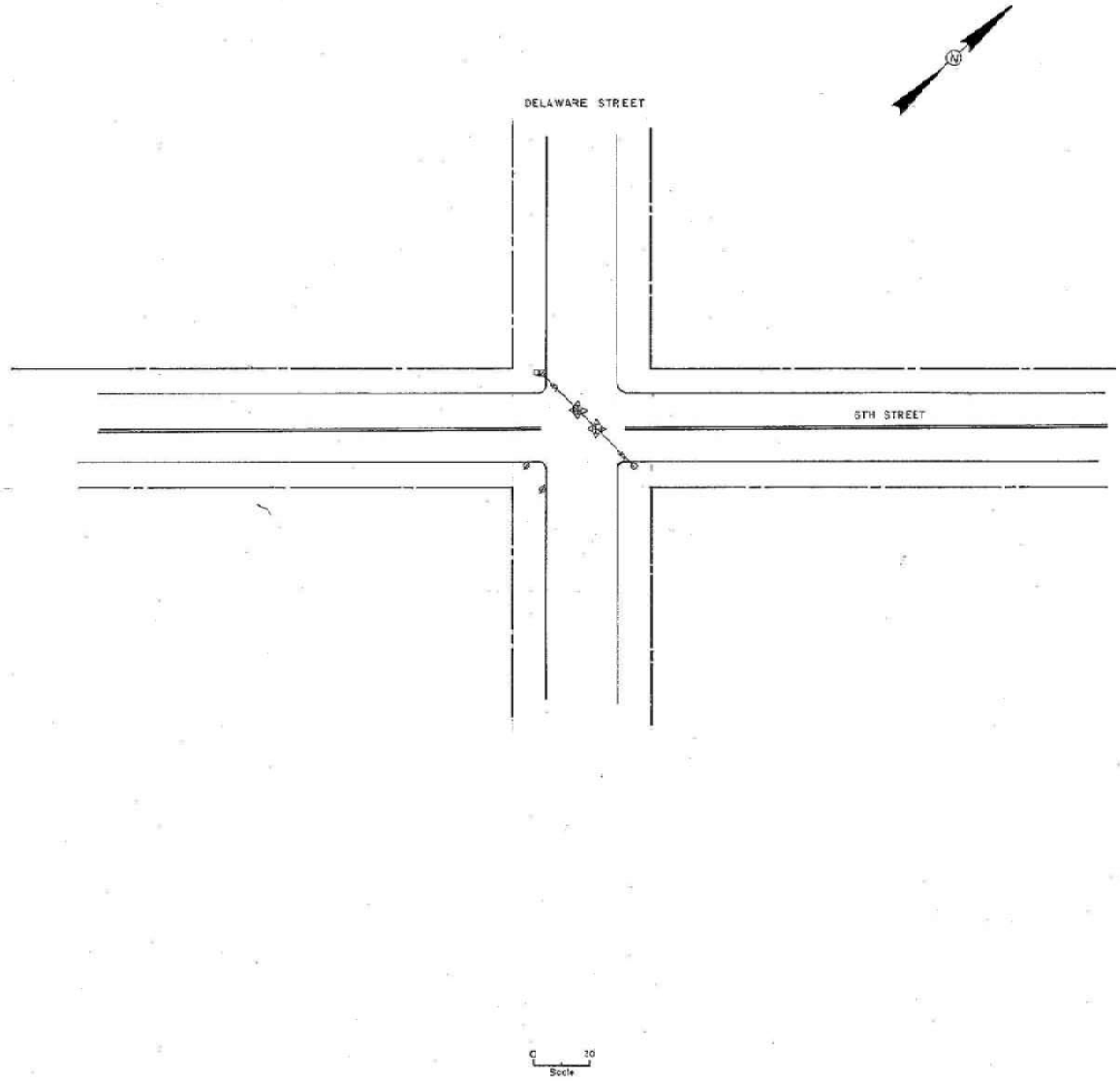
NOW, THEREFORE, BE IT RESOLVED, that the Department, in accordance with the authority so vested, does hereby declare that at the above mentioned intersection, a traffic control signal of type and operation, including flashing operation, as established by the Bureau of Traffic of the Department may be installed and shall become effective on the date energized; and

BE IT FURTHER RESOLVED, that copies of this resolution be forwarded to the proper officials of the Department of Transportation and the Delaware State Police.

Kermit H. Justice
Secretary


T144
N
LOCATION
PENN ACRES
WILMINGTON MANOR GARDENS
STOCKTON
NEW CASTLE JUNIOR SCHOOL
CARRIE DOWNIE SCHOOL
ST. PETERS SCHOOL
PENN CENTRAL
RAILROAD
WILMINGTON
CHESTNUT
HARMONY
CHERRY
DELAWARE
TREMONT
CLAYTON
FOUNDRY
WILLIAM
SOUTH
GRAY
SCHOOL
WASHINGTON
LINDEN
DEEMERS PL.
MARKET ST.
2ND
THE STRAND
DIVISION OF HIGHWAYS
BUREAU OF TRAFFIC
BEAR
DELAWARE
SIGNAL STUDY
DELAWARE AVE. & 6TH STREET
SCALE: 1" = .2 Mile
DB
DATE:

N-459T



DELAWARE DIVISION OF HIGHWAYS

BUREAU OF TRAFFIC

BEAR DELAWARE

PERMIT NO.	CONTRACT NO.	FED. AID NO.	SHEET NO	TOTAL

Signal Design
6th Street & Delaware St

PREL. TRACING	DATE	DESIGN	DATE

REVISION

AS BUILT PLAN 08 1-18-81

LEGEND

- POLE BASE
- EXISTING STEEL POLE BASE
- EXISTING ALUMINUM POLE BASE
- EXISTING PEDESTAL BASE
- WOOD POLE (D. H. & T.)
- EXISTING WOOD POLES (D. H. & T.)
- EXISTING D. P. & L. AND D. S. T. POLES
- LARGE CABINET BASE
- SMALL CABINET BASE.
- EXISTING CABINET BASE
- 2 1/2" GALV. CONDUIT
- 1 1/2" GALV. CONDUIT
- EXISTING GALV. CONDUIT
- 3" NON-METALLIC CONDUIT
- EXISTING NON-METALLIC CONDUIT
- LP # — LOOP DETECTOR TYPE (#1-5)
- EXISTING LOOP DETECTOR
- JUNCTION WELL TYPE (#1-4)
- EXISTING JUNCTION WELL
- SPAN WIRE
- EXISTING SPAN WIRE
- EXISTING OVERHEAD CABLE
- SIGNAL HEAD
- EXISTING SIGNAL HEAD
- PEDESTRIAN SIGNAL HEAD
- EXISTING PED. SIGNAL HEAD
- MAST ARM
- R — REMOVE
- A — ABANDON
- RB — REMOVE EXISTING CONCRETE BASE 6" BELOW GROUND LEVEL AND COVER.

SIGNAL HEAD DIAGRAM

2-4 WAYS

8" HEADS

RECOMMENDED _____ 19__ _____

RECOMMENDED _____ 19__ _____

RECOMMENDED _____ 19__ _____

APPROVED _____ 19__ _____

APPROVED F. H. W. A. _____ DATE _____

APPROVED for INSTL. CHIEF, TRAFFIC ENG. _____ DATE _____

APPENDIX B – TRAFFIC COUNT DATA

TURNING MOVEMENT COUNT DATA

Turning Movement Field Data

Requestor:	Mark Luszcz
Counter Name / Number:	Christopher McNelis / TU-1214
County / City:	New Castle County / New Castle
Road Number / Name:	SR9 6th Street (N378) @ Delaware Street
Signalized?	**Yes** **No**

Notes:

Pedestrian Count	Day 1
	Date
	10/20/15
Bicycle Count	Tuesday
	Daylight / Clear / Dry
	Time
Turning Movement Count	10:00 - 2:00
	Day 2
	Date
Vehicle Separation	10/21/2015
	Wednesday
	Daylight / Clear / Dry
	Time
Classification Count	6:00 - 10:00
	Day 3
	Date
Intersection Delay Study	10/22/2015
	Thursday
	Daylight / Clear / Dry
	Time
	2:00 - 6:00

Delaware Department of Transportation

169 Brick Store Landing Road
Smyrna, DE 19977
Telephone: (302) 659-4082

Counter # : TU-1214
Counted By : Christopher McNelis
Weather : Daylight/Clear/Dry
Day of Week: Tuesday

File Name : 6th st. @ delaware st.
Site Code : N/A
Start Date : 10/20/2015
Page No : 1

Groups Printed- General Traffic - Large Vehicle Traffic - Bicycle Traffic

	SR9 6th Street (N378) Southbound					Delaware Street Westbound					SR9 6th Street (N378) Northbound					Delaware Street Eastbound					
Start Time	Right	Thru	Left	North X-Walk Peds	App. Total	Right	Thru	Left	East X-Walk Peds	App. Total	Right	Thru	Left	South X-Walk Peds	App. Total	Right	Thru	Left	West X-Walk Peds	App. Total	Int. Total
06:00 AM	2	9	0	0	11	0	5	0	0	5	1	13	0	0	14	0	1	0	1	2	32
06:15 AM	2	10	0	0	12	0	7	0	0	7	1	11	2	2	16	1	2	1	1	5	40
06:30 AM	4	16	1	0	21	0	10	1	0	11	1	23	4	1	29	0	4	1	0	5	66
06:45 AM	5	15	1	2	23	0	10	0	0	10	0	22	3	0	25	1	3	2	0	6	64
Total	13	50	2	2	67	0	32	1	0	33	3	69	9	3	84	2	10	4	2	18	202
07:00 AM	6	14	1	2	23	1	18	0	4	23	1	44	6	1	52	1	6	8	0	15	113
07:15 AM	9	20	1	0	30	1	15	0	0	16	1	56	7	0	64	1	5	10	0	16	126
07:30 AM	18	17	0	0	35	1	14	0	0	15	0	74	4	0	78	1	7	16	0	24	152
07:45 AM	8	20	3	0	31	2	17	0	0	19	1	65	6	2	74	0	10	6	0	16	140
Total	41	71	5	2	119	5	64	0	4	73	3	239	23	3	268	3	28	40	0	71	531
08:00 AM	3	11	1	0	15	1	12	1	0	14	4	52	4	0	60	0	8	2	0	10	99
08:15 AM	4	15	0	1	20	1	7	1	0	9	1	35	3	0	39	3	8	0	0	11	79
08:30 AM	7	10	6	1	24	5	13	0	1	19	2	27	2	0	31	0	13	0	0	13	87
08:45 AM	5	12	1	1	19	2	5	0	0	7	1	13	3	0	17	4	12	0	0	16	59
Total	19	48	8	3	78	9	37	2	1	49	8	127	12	0	147	7	41	2	0	50	324
09:00 AM	3	11	1	1	16	0	12	4	0	16	0	12	3	2	17	1	7	4	0	12	61
09:15 AM	3	9	1	0	13	0	8	0	0	8	7	15	9	1	32	4	27	2	0	33	86
09:30 AM	3	14	3	0	20	1	8	1	0	10	0	24	3	0	27	1	25	1	0	27	84
09:45 AM	2	10	2	0	14	2	17	1	0	20	5	13	4	3	25	2	21	3	1	27	86
Total	11	44	7	1	63	3	45	6	0	54	12	64	19	6	101	8	80	10	1	99	317
10:00 AM	3	19	5	0	27	2	16	1	0	19	1	10	7	0	18	5	12	2	0	19	83
10:15 AM	4	11	2	3	20	0	8	0	1	9	3	15	2	0	20	2	19	3	0	24	73
10:30 AM	2	11	4	2	19	1	22	1	0	24	6	21	4	1	32	3	16	2	0	21	96
10:45 AM	7	11	4	1	23	8	17	2	0	27	6	12	12	0	30	2	21	2	0	25	105
Total	16	52	15	6	89	11	63	4	1	79	16	58	25	1	100	12	68	9	0	89	357
11:00 AM	3	6	3	0	12	0	19	0	2	21	3	10	5	4	22	2	17	4	0	23	78
11:15 AM	4	13	6	3	26	2	7	1	0	10	3	14	3	5	25	4	22	6	1	33	94
11:30 AM	3	7	6	1	17	3	20	2	0	25	3	13	8	0	24	5	35	4	0	44	110
11:45 AM	3	16	3	0	22	2	21	3	0	26	1	10	6	1	18	2	26	5	0	33	99
Total	13	42	18	4	77	7	67	6	2	82	10	47	22	10	89	13	100	19	1	133	381
12:00 PM	7	13	6	2	28	0	22	0	0	22	1	13	4	0	18	1	28	2	2	33	101
12:15 PM	5	11	5	0	21	2	18	0	0	20	1	12	6	1	20	2	36	2	1	41	102
12:30 PM	18	24	7	1	50	2	26	0	0	28	2	14	10	3	29	2	26	4	0	32	139

Delaware Department of Transportation

169 Brick Store Landing Road
Smyrna, DE 19977
Telephone: (302) 659-4082

Counter # : TU-1214
Counted By : Christopher McNelis
Weather : Daylight/Clear/Dry
Day of Week: Tuesday

File Name : 6th St. @ Delaware St.
Site Code : N/A
Start Date : 10/20/2015
Page No : 2

Groups Printed- General Traffic - Large Vehicle Traffic - Bicycle Traffic

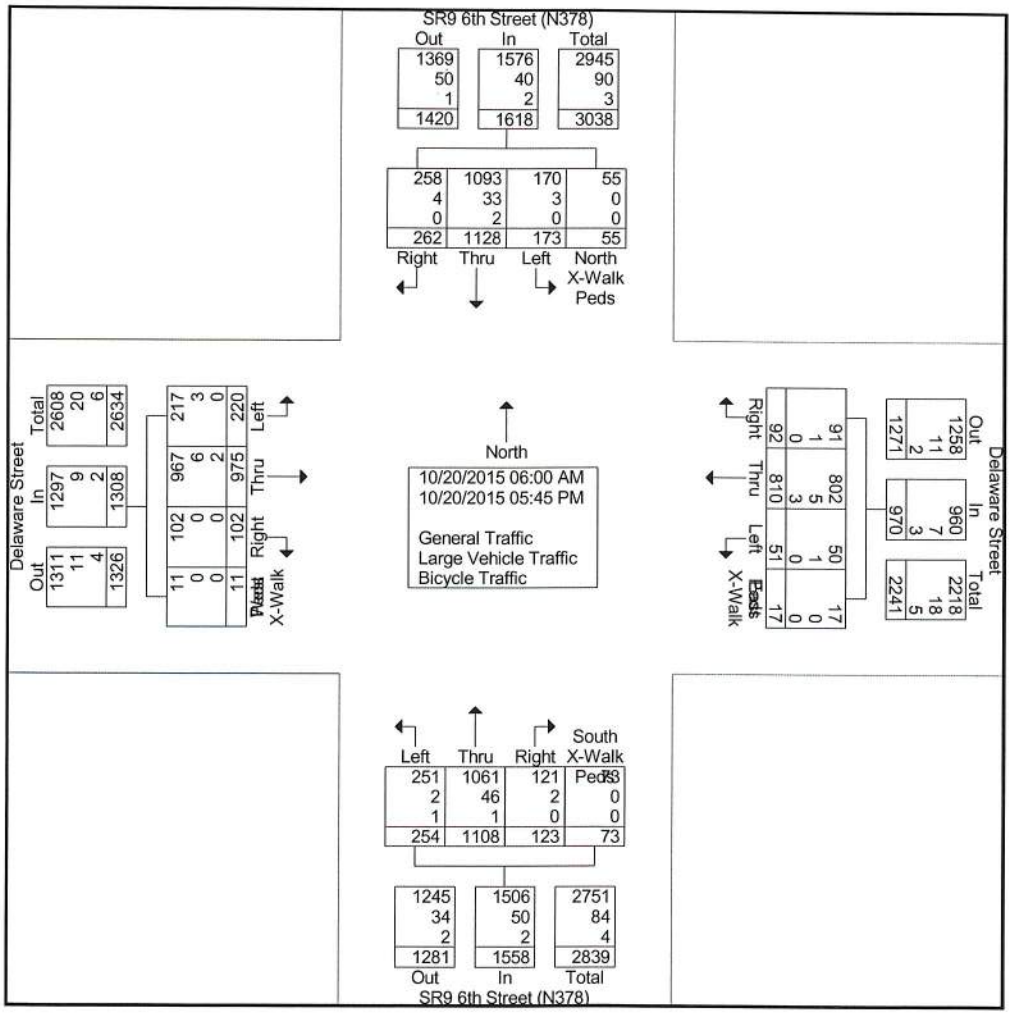
	SR9 6th Street (N378) Southbound					Delaware Street Westbound					SR9 6th Street (N378) Northbound					Delaware Street Eastbound					
Start Time	Right	Thru	Left	North X-Walk Peds	App. Total	Right	Thru	Left	East X-Walk Peds	App. Total	Right	Thru	Left	South X-Walk Peds	App. Total	Right	Thru	Left	West X-Walk Peds	App. Total	Int. Total
12:45 PM	3	12	5	0	20	3	21	1	0	25	3	20	1	0	24	3	23	7	0	33	102
Total	33	60	23	3	119	7	87	1	0	95	7	59	21	4	91	8	113	15	3	139	444
01:00 PM	8	19	6	0	33	8	29	2	0	39	2	10	5	3	20	1	21	7	0	29	121
01:15 PM	2	21	4	3	30	4	35	1	0	40	3	14	5	4	26	6	22	3	0	31	127
01:30 PM	6	19	1	0	26	0	19	2	0	21	4	18	5	7	34	2	31	7	1	41	122
01:45 PM	4	28	4	1	37	0	19	2	0	21	5	15	2	1	23	1	37	4	0	42	123
Total	20	87	15	4	126	12	102	7	0	121	14	57	17	15	103	10	111	21	1	143	493
02:00 PM	3	19	5	7	34	5	19	3	0	27	4	19	6	0	29	1	20	4	0	25	115
02:15 PM	4	17	3	0	24	2	20	2	1	25	3	17	5	1	26	3	30	6	0	39	114
02:30 PM	4	20	4	4	32	9	26	3	0	38	4	20	11	3	38	1	31	9	0	41	149
02:45 PM	4	32	2	0	38	4	15	2	2	23	4	22	10	2	38	0	24	5	0	29	128
Total	15	88	14	11	128	20	80	10	3	113	15	78	32	6	131	5	105	24	0	134	506
03:00 PM	29	34	7	0	70	3	23	2	2	30	3	15	6	0	24	6	28	3	2	39	163
03:15 PM	1	35	6	1	43	2	32	1	0	35	1	23	5	0	29	4	18	3	0	25	132
03:30 PM	1	36	9	2	48	1	13	1	0	15	3	25	6	5	39	3	25	2	0	30	132
03:45 PM	8	44	2	0	54	2	19	1	0	22	6	33	7	3	49	4	22	7	0	33	158
Total	39	149	24	3	215	8	87	5	2	102	13	96	24	8	141	17	93	15	2	127	585
04:00 PM	6	40	4	1	51	2	18	1	2	23	1	39	7	5	52	1	27	3	1	32	158
04:15 PM	8	31	9	1	49	1	25	1	0	27	4	28	6	1	39	3	18	8	0	29	144
04:30 PM	5	57	6	3	71	2	19	1	0	22	0	22	6	1	29	3	27	8	0	38	160
04:45 PM	7	69	4	4	84	0	16	0	1	17	7	26	4	3	40	2	31	9	0	42	183
Total	26	197	23	9	255	5	78	3	3	89	12	115	23	10	160	9	103	28	1	141	645
05:00 PM	4	75	6	3	88	1	19	2	0	22	2	26	10	2	40	1	32	12	0	45	195
05:15 PM	6	78	3	2	89	2	20	0	0	22	6	25	9	0	40	2	29	5	0	36	187
05:30 PM	1	40	5	0	46	0	17	2	0	19	1	22	6	1	30	2	35	5	0	42	137
05:45 PM	5	47	5	2	59	2	12	2	1	17	1	26	2	4	33	3	27	11	0	41	150
Total	16	240	19	7	282	5	68	6	1	80	10	99	27	7	143	8	123	33	0	164	669
Grand Total	262	1128	173	55	1618	92	810	51	17	970	123	1108	254	73	1558	102	975	220	11	1308	5454
Apprch %	16.2	69.7	10.7	3.4		9.5	83.5	5.3	1.8		7.9	71.1	16.3	4.7		7.8	74.5	16.8	0.8		
Total %	4.8	20.7	3.2	1	29.7	1.7	14.9	0.9	0.3	17.8	2.3	20.3	4.7	1.3	28.6	1.9	17.9	4	0.2	24	
General Traffic	258	1093	170	55	1576	91	802	50	17	960	121	1061	251	73	1506	102	967	217	11	1297	5339
% General Traffic	98.5	96.9	98.3	100	97.4	98.9	99	98	100	99	98.4	95.8	98.8	100	96.7	100	99.2	98.6	100	99.2	97.9
Large Vehicle Traffic	4	33	3	0	40	1	5	1	0	7	2	46	2	0	50	0	6	3	0	9	106
% Large Vehicle Traffic	1.5	2.9	1.7	0	2.5	1.1	0.6	2	0	0.7	1.6	4.2	0.8	0	3.2	0	0.6	1.4	0	0.7	1.9
Bicycle Traffic	0	2	0	0	2	0	3	0	0	3	0	1	1	0	2	0	2	0	0	2	9
% Bicycle Traffic	0	0.2	0	0	0.1	0	0.4	0	0	0.3	0	0.1	0.4	0	0.1	0	0.2	0	0	0.2	0.2

Delaware Department of Transportation

169 Brick Store Landing Road
Smyrna, DE 19977
Telephone: (302) 659-4082

Counter # : TU-1214
Counted By : Christopher McNelis
Weather : Daylight/Clear/Dry
Day of Week: Tuesday

File Name : 6th St. @ Delaware St.
Site Code : N/A
Start Date : 10/20/2015
Page No : 3



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File Name : 6th St. @ Delaware St.
Site Code : N/A
Start Date : 10/20/2015
Page No : 4

	SR9 6th Street (N378) Southbound					Delaware Street Westbound					SR9 6th Street (N378) Northbound					Delaware Street Eastbound					
Start Time	Right	Thru	Left	North X-Walk Peds	App. Total	Right	Thru	Left	East X-Walk Peds	App. Total	Right	Thru	Left	South X-Walk Peds	App. Total	Right	Thru	Left	West X-Walk Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 09:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	6	14	1	**2**	23	1	**18**	0	**4**	**23**	**1**	44	6	1	52	**1**	6	8	0	15	113
07:15 AM	9	**20**	1	0	30	1	15	0	0	16	1	56	**7**	0	64	1	5	10	0	16	126
07:30 AM	**18**	17	0	0	**35**	1	14	0	0	15	0	**74**	4	0	**78**	1	7	**16**	0	**24**	**152**
07:45 AM	8	20	**3**	0	31	**2**	17	0	0	19	1	65	6	**2**	74	0	**10**	6	0	16	140
Total Volume	41	71	5	2	119	5	64	0	4	73	3	239	23	3	268	3	28	40	0	71	531
% App. Total	34.5	59.7	4.2	1.7		6.8	87.7	0	5.5		1.1	89.2	8.6	1.1		4.2	39.4	56.3	0		
PHF	.569	.888	.417	.250	.850	.625	.889	.000	.250	.793	.750	.807	.821	.375	.859	.750	.700	.625	.000	.740	.873
General Traffic	40	67	5	2	114	5	64	0	4	73	3	236	23	3	265	3	28	40	0	71	523
% General Traffic	97.6	94.4	100	100	95.8	100	100	0	100	100	100	98.7	100	100	98.9	100	100	100	0	100	98.5
Large Vehicle Traffic	1	4	0	0	5	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	8
% Large Vehicle Traffic	2.4	5.6	0	0	4.2	0	0	0	0	0	0	1.3	0	0	1.1	0	0	0	0	0	1.5
Bicycle Traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycle Traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delaware Department of Transportation

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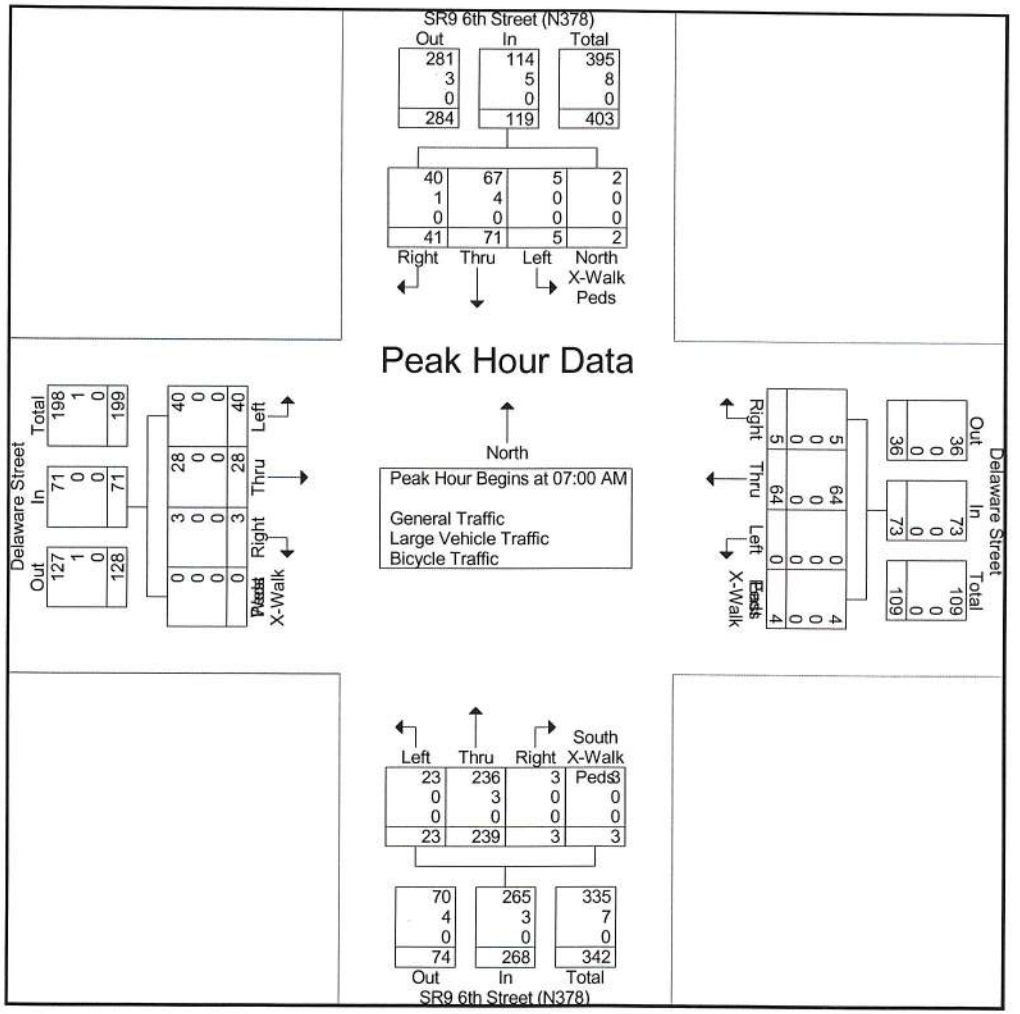
Weather : Daylight/Clear/Dry
Day of Week: Tuesday

File Name : 6th St. @ Delaware St.
Site Code : N/A
Start Date : 10/20/2015
Page No : 5



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Counted By : Christopher McNelis
Weather : Daylight/Clear/Dry
Day of Week: Tuesday

File Name : 6th St. @ Delaware St.
Site Code : N/A
Start Date : 10/20/2015
Page No : 6

	SR9 6th Street (N378) Southbound					Delaware Street Westbound					SR9 6th Street (N378) Northbound					Delaware Street Eastbound					
Start Time	Right	Thru	Left	North X-Walk Peds	App. Total	Right	Thru	Left	East X-Walk Peds	App. Total	Right	Thru	Left	South X-Walk Peds	App. Total	Right	Thru	Left	West X-Walk Peds	App. Total	Int. Total
Peak Hour Analysis From 10:00 AM to 01:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 01:00 PM																					
01:00 PM	**8**	19	**6**	0	33	**8**	29	**2**	0	39	2	10	**5**	3	20	1	21	**7**	0	29	121
01:15 PM	2	21	4	**3**	30	4	**35**	1	0	**40**	3	14	5	4	26	**6**	22	3	0	31	**127**
01:30 PM	6	19	1	0	26	0	19	2	0	21	4	**18**	5	**7**	**34**	2	31	7	**1**	41	122
01:45 PM	4	**28**	4	1	**37**	0	19	2	0	21	**5**	15	2	1	23	1	**37**	4	0	**42**	123
Total Volume	20	87	15	4	126	12	102	7	0	121	14	57	17	15	103	10	111	21	1	143	493
% App. Total	15.9	69	11.9	3.2		9.9	84.3	5.8	0		13.6	55.3	16.5	14.6		7	77.6	14.7	0.7		
PHF	.625	.777	.625	.333	.851	.375	.729	.875	.000	.756	.700	.792	.850	.536	.757	.417	.750	.750	.250	.851	.970
General Traffic	20	85	15	4	124	12	102	7	0	121	14	55	17	15	101	10	111	21	1	143	489
% General Traffic	100	97.7	100	100	98.4	100	100	100	0	100	100	96.5	100	100	98.1	100	100	100	100	100	99.2
Large Vehicle Traffic	0	2	0	0	2	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	4
% Large Vehicle Traffic	0	2.3	0	0	1.6	0	0	0	0	0	0	3.5	0	0	1.9	0	0	0	0	0	0.8
Bicycle Traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycle Traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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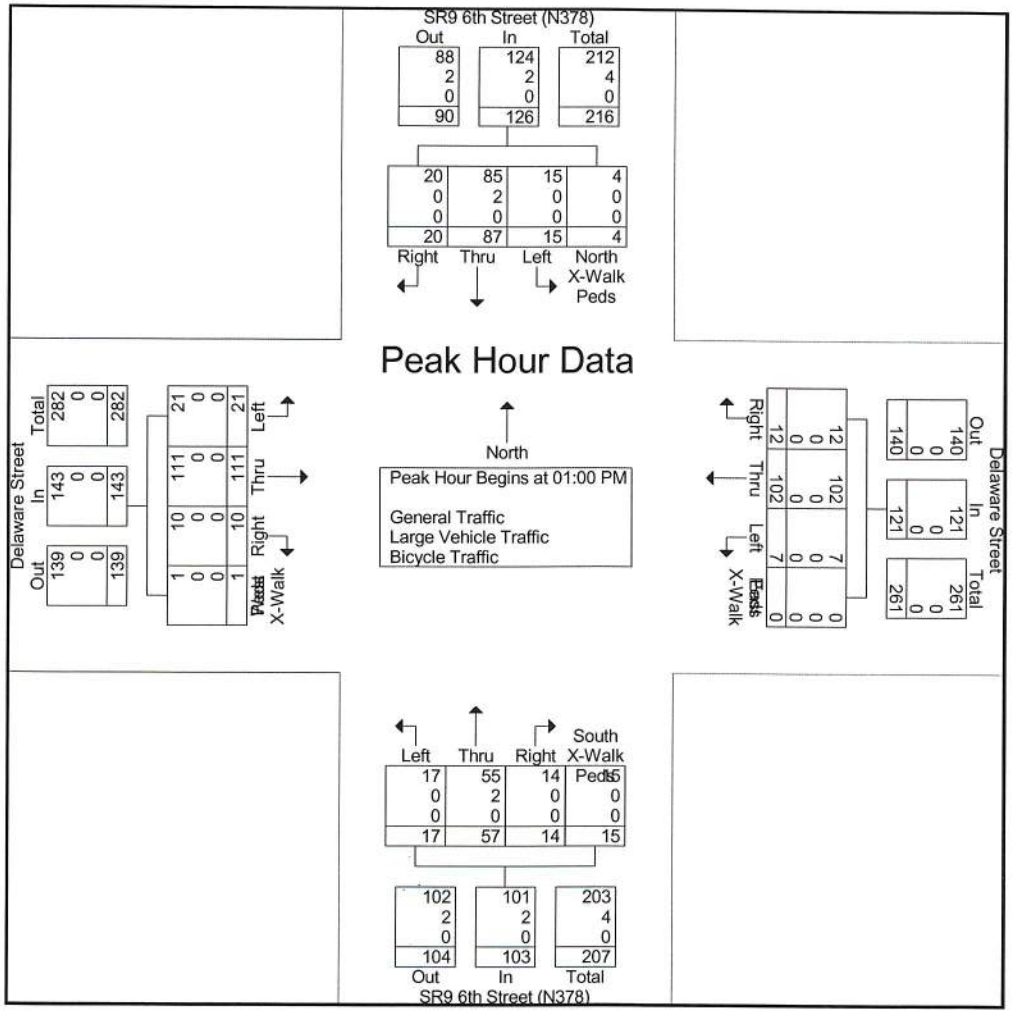
File Name : 6th St. @ Delaware St.
Site Code : N/A
Start Date : 10/20/2015
Page No : 7



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Weather : Daylight/Clear/Dry
Day of Week: Tuesday

File Name : 6th St. @ Delaware St.
Site Code : N/A
Start Date : 10/20/2015
Page No : 8

	SR9 6th Street (N378) Southbound					Delaware Street Westbound					SR9 6th Street (N378) Northbound					Delaware Street Eastbound					
Start Time	Right	Thru	Left	North X-Walk Peds	App. Total	Right	Thru	Left	East X-Walk Peds	App. Total	Right	Thru	Left	South X-Walk Peds	App. Total	Right	Thru	Left	West X-Walk Peds	App. Total	Int. Total
Peak Hour Analysis From 02:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	5	57	**6**	3	71	**2**	19	1	0	**22**	0	22	6	1	29	**3**	27	8	0	38	160
04:45 PM	**7**	69	4	**4**	84	0	16	0	**1**	17	**7**	**26**	4	**3**	**40**	2	31	9	0	42	183
05:00 PM	4	75	6	3	88	1	19	**2**	0	22	2	26	**10**	2	40	1	**32**	**12**	0	**45**	**195**
05:15 PM	6	**78**	3	2	**89**	2	**20**	0	0	22	6	25	9	0	40	2	29	5	0	36	187
Total Volume	22	279	19	12	332	5	74	3	1	83	15	99	29	6	149	8	119	34	0	161	725
% App. Total	6.6	84	5.7	3.6		6	89.2	3.6	1.2		10.1	66.4	19.5	4		5	73.9	21.1	0		
PHF	.786	.894	.792	.750	.933	.625	.925	.375	.250	.943	.536	.952	.725	.500	.931	.667	.930	.708	.000	.894	.929
General Traffic	22	275	19	12	328	5	73	3	1	82	15	95	28	6	144	8	118	34	0	160	714
% General Traffic	100	98.6	100	100	98.8	100	98.6	100	100	98.8	100	96.0	96.6	100	96.6	100	99.2	100	0	99.4	98.5
Large Vehicle Traffic	0	3	0	0	3	0	0	0	0	0	0	3	0	0	3	0	1	0	0	1	7
% Large Vehicle Traffic	0	1.1	0	0	0.9	0	0	0	0	0	0	3.0	0	0	2.0	0	0.8	0	0	0.6	1.0
Bicycle Traffic	0	1	0	0	1	0	1	0	0	1	0	1	1	0	2	0	0	0	0	0	4
% Bicycle Traffic	0	0.4	0	0	0.3	0	1.4	0	0	1.2	0	1.0	3.4	0	1.3	0	0	0	0	0	0.6

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Day of Week: Tuesday

File Name : 6th St. @ Delaware St.
Site Code : N/A
Start Date : 10/20/2015
Page No : 9

Peak Hour Data

Peak Hour Begins at 04:30 PM

General Traffic
Large Vehicle Traffic
Bicycle Traffic

North

SR9 6th Street (N378)

	Out	In	Total
	134	328	462
	3	3	6
	1	1	2
	138	332	470

Right	Thru	Left	North X-Walk Peds
22	275	19	12
0	3	0	0
0	1	0	0
22	279	19	12

Delaware Street

	Out	In	Total
	123	160	283
	0	1	1
	2	0	2
	125	161	286

Right	Thru	Left	X-Walk
8	118	34	0
0	1	0	0
0	0	0	0
8	119	34	0

Delaware Street

	Out	In	Total
	152	82	234
	1	0	1
	0	1	1
	153	83	236

Right	Thru	Left	X-Walk
5	73	3	1
0	0	0	0
1	0	0	0
5	74	3	1

SR9 6th Street (N378)

Left	Thru	Right	South X-Walk Peds
28	95	15	6
0	3	0	0
1	1	0	0
29	99	15	6

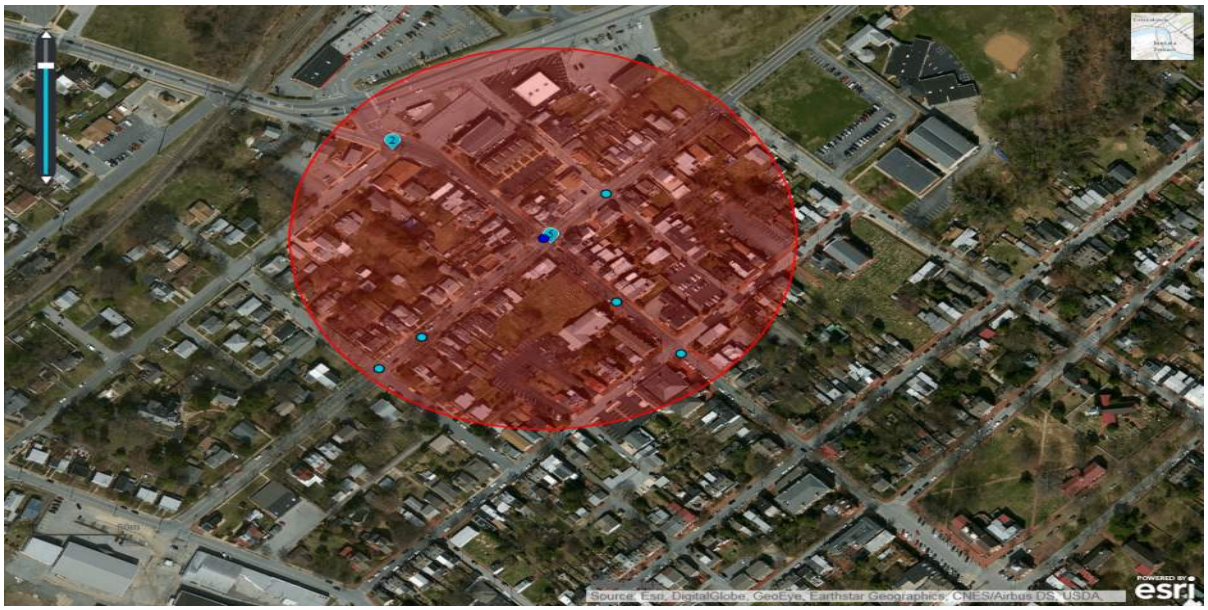
	Out	In	Total
	286	144	430
	3	3	6
	1	2	3
	290	149	439

APPENDIX C – CRASH HISTORY DATA

CRASH HISTORY STATISTICS SUMMARY

Delaware Crash Analysis Reporting System

Crash Study Time Period:	1/1/2013 - 9/28/2016
Query Type:	CrashBufferTool
Description:	Point Buffer - DE Rt. 9, 6th Street (N378) and Delaware Street 38027 @ 0.10 mi radius
Study Requested By:	Christopher Sylvester, Century Engineering, INC.
Study Generated By:	TDTSLXP
Number of Crashes:	12
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	
	# of Crashes
Total Crashes	12
Fatal Crashes	0
Total Alcohol-Related Crashes	0
Total Non Alcohol-Related Crashes	12
Total Fatalities	0
Total Pedestrian Fatalities	0
Total Pedestrian Injuries	1
Total Pedestrian Crashes	1
Total Motorcycle Crashes	0
Total Pedalcyclist Crashes	1

Classification		
	# of Crashes	% of Total Crashes
Non-Reportable	0	0.00%
Reportable	8	66.67%
Personal Injury	4	33.33%
Fatality	0	0.00%
Total	**12**	

Manner of Impact		
	# of Crashes	% of Total Crashes
Front to rear	1	8.33%
Front to front	0	0.00%
Angle	0	0.00%
Sideswipe, same direction	7	58.33%
Sideswipe, opposite direction	0	0.00%
Rear to side	0	0.00%
Rear to rear	0	0.00%
Other	0	0.00%
Unknown	2	16.67%
Not a collision between two vehicles	2	16.67%
Total	**12**	

Alcohol Related Crashes By Classification					
	Non-reportable	Reportable	Personal Injury	Fatality	**Total**
Alcohol Related	0	0	0	0	**0**
Non-Alcohol Related	0	8	4	0	**12**
Total	**0**	**8**	**4**	**0**	**12**

Manner of Impact By Classification					
	Non-Reportable	Reportable	Personal Injury	Fatality	**Total**
Front to rear	0	1	0	0	**1**
Front to front	0	0	0	0	**0**
Angle	0	0	0	0	**0**
Sideswipe, same direction	0	5	2	0	**7**
Sideswipe, opposite direction	0	0	0	0	**0**
Rear to side	0	0	0	0	**0**
Rear to rear	0	0	0	0	**0**
Other	0	0	0	0	**0**
Unknown	0	2	0	0	**2**
Not a collision between two vehicles	0	0	2	0	**2**
Total	**0**	**8**	**4**	**0**	**12**

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Day Of Week		
	# of Crashes	% of Total Crashes
Sunday	0	0.00%
Monday	5	41.67%
Tuesday	0	0.00%
Wednesday	1	8.33%
Thursday	0	0.00%
Friday	4	33.33%
Saturday	2	16.67%
Total	**12**	

Time Of Day (AM)		
	# of Crashes	% of Total Crashes
00:00 - 00:59	0	0.00%
01:00 - 01:59	0	0.00%
02:00 - 02:59	0	0.00%
03:00 - 03:59	0	0.00%
04:00 - 04:59	0	0.00%
05:00 - 05:59	1	8.33%
06:00 - 06:59	0	0.00%
07:00 - 07:59	0	0.00%
08:00 - 08:59	1	8.33%
09:00 - 09:59	0	0.00%
10:00 - 10:59	0	0.00%
11:00 - 11:59	1	8.33%
Total	**3**	

Time Of Day (PM)		
	# of Crashes	% of Total Crashes
12:00 - 12:59	1	8.33%
13:00 - 13:59	0	0.00%
14:00 - 14:59	2	16.67%
15:00 - 15:59	1	8.33%
16:00 - 16:59	1	8.33%
17:00 - 17:59	0	0.00%
18:00 - 18:59	1	8.33%
19:00 - 19:59	0	0.00%
20:00 - 20:59	0	0.00%
21:00 - 21:59	2	16.67%
22:00 - 22:59	1	8.33%
23:00 - 23:59	0	0.00%
Total	**9**	
Unknown Time	0	

Surface Conditions		
	# of Crashes	% of Total Crashes
Dry	8	66.67%
Wet	1	8.33%
Snow	1	8.33%
Ice/Frost	0	0.00%
Sand	0	0.00%
Water (standing, moving)	0	0.00%
Slush	1	8.33%
Oil	0	0.00%
Mud, Dirt, Gravel	0	0.00%
Other	0	0.00%
Unknown	1	8.33%
Total	**12**	

Lighting Conditions		
	# of Crashes	% of Total Crashes
Daylight	6	50.00%
Dawn	0	0.00%
Dusk	0	0.00%
Dark-Lighted	4	33.33%
Dark-Not Lighted	0	0.00%
Dark-Unknown Lighting	0	0.00%
Other	0	0.00%
Unknown	2	16.67%
Total	**12**	

Weather Conditions		
	# of Crashes	% of Total Crashes
Clear	7	58.33%
Cloudy	3	25.00%
Fog, Smog, Smoke	0	0.00%
Rain	0	0.00%
Sleet, Hail (freezing rain or drizzle)	1	8.33%
Snow	0	0.00%
Blowing Snow	0	0.00%
Severe Crosswinds	0	0.00%
Blowing Sand, Soil, Dirt	0	0.00%
Other	0	0.00%
Unknown	1	8.33%
Total	**12**	

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.

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	1	8.33%
Pedalcycle, Collision With Person, Motor Vehicle, or Non-Fixed	0	0.00%
Railway Vehicle (train, engine), Collision With Person, Motor Vehicle, or Non-Fixed	0	0.00%
Animal, Collision With Person, Motor Vehicle, or Non-Fixed	0	0.00%
Motor Vehicle in Transport, Collision With Person, Motor Vehicle, or Non-Fixed	8	66.67%
Legally Parked Motor Vehicle, Collision With Person, Motor Vehicle, or Non-Fixed	3	25.00%
Struck by Anything Set in Motion by Vehicle, Collision With Person, Motor Vehicle, or Non-Fixed	0	0.00%
Work Zone / Maintenance Equipment, Collision With Person, Motor Vehicle, or Non-Fixed	0	0.00%
Other Non-Fixed Object, Collision With Person, Motor Vehicle, or Non-Fixed	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	0	0.00%
Ditch, Collision With Fixed Object	0	0.00%
Embankment, Collision With Fixed Object	0	0.00%
Guardrail Face, Collision With Fixed Object	0	0.00%
Guardrail End, Collision With Fixed Object	0	0.00%
	0	0.00%

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Concrete Traffic Barrier, Collision With Fixed Object		
Other Traffic Barrier, Collision With Fixed Object	0	0.00%
Tree (standing), Collision With Fixed Object	0	0.00%
Utility Pole, Collision With Fixed Object	0	0.00%
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	0	0.00%
Other Fixed Object (wall, building, tunnel, etc.), Collision With Fixed Object	0	0.00%
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	**12**	

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Primary Contributing Circumstance		
	# of Crashes	**% of Total Crashes**
Speeding	0	0.00%
Failed to yield right of way	4	33.33%
Passed Stop Sign	0	0.00%
Disregard Traffic Signal	0	0.00%
Wrong side or wrong way	0	0.00%
Improper passing	0	0.00%
Improper lane change	0	0.00%
Following too close	0	0.00%
Made improper turn	0	0.00%
Driving under the influence	0	0.00%
Driver inattention, distraction, or fatigue	1	8.33%
Driving in a careless or reckless manner	0	0.00%
Driving in an aggressive manner	1	8.33%
Improper backing	0	0.00%
Other improper driving	0	0.00%
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	0	0.00%
Roadway circumstances - debris, holes, work zone,	0	0.00%
Other	2	16.67%
Unknown	3	25.00%
Total	**11**	

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Driver Action		
	# of Drivers	**% of Total Crashes**
No Contributing Action	6	37.50%
Failed to yield right of way	3	18.75%
Ran Red Light	0	0.00%
Ran Stop Sign	0	0.00%
Disregard other traffic sign	0	0.00%
Disregard other road markings	0	0.00%
Exceeded authorized speed limit	0	0.00%
Driving too fast for conditions	0	0.00%
Made an improper turn	0	0.00%
Improper backing	0	0.00%
Wrong side or wrong way	0	0.00%
Followed to closely	0	0.00%
Failure to keep in proper lane	0	0.00%
Ran off roadway	0	0.00%
Operating vehicle in erratic, reckless, careless, negligent or aggressive manner	1	6.25%
Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.	0	0.00%
Over-correcting/over-steering	0	0.00%
Improper Passing	1	6.25%
Other Contributing Action	4	25.00%
Unknown	1	6.25%
Total	**16**	

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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
2013																		
N	38066	0.17	0.17	1	3313000824	02/22/2013	11:49	6	0	0	N	01	02	01	13	02	02	04
N	00378	9.37	9.37	1	3313002949	06/21/2013	21:00	6	0	1	N	04	01	01	09	88	03	00
N	38027	0.14	0.14		3313003515	07/27/2013	12:45	7	0	1	N	01	01	01	14	88	03	04
N	38064	0.95	0.95		3313005822	12/20/2013	22:00	6	0	0	N	99	99	99	14	99	02	99
2014																		
N	38027	0.17	0.17		3314000071	01/06/2014	14:00	2	0	0	N	01	01	02	13	02	02	04
N	38066	0.19	0.19	1	3314000389	01/25/2014	14:45	7	0	0	N	99	02	03	14	99	02	99
N	38066	0.26	0.26	1	3314001239	03/24/2014	05:52	2	0	1	N	04	01	01	13	02	03	04
N	38027	0.2	0.20		3314003740	08/13/2014	15:29	4	0	0	N	01	01	01	13	02	02	04
N	38064	0.95	0.95		3314005924	12/19/2014	18:00	6	0	1	N	04	01	01	13	21	03	00
2015																		
N	38066	0.26	0.26	1	3315003798	08/10/2015	08:55	2	0	0	N	01	02	01	13	11	02	01
N	00378	9.33	9.33	1	3315005305	11/16/2015	16:15	2	0	0	N	01	01	01	13	99	02	04
2016																		
N	38027	0.12	0.12		3316000590	02/15/2016	21:38	2	0	0	N	04	05	07	13	13	02	04

Report generated by TDTSLXP at 2016-09-28 14:42:32.788

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 D – SIGNAL WARRANT ANALYSIS

SIGNAL WARRANT ANALYSIS WORKSHEET

Century Engineering, Inc.

2011 Delaware MUTCD Traffic Control Signal Warrants

Year 2016

Location: DE9/6th St (N378) & Delaware St **Date:** October, 2016

County: New Castle **Analyst:** Christopher N. Sylvester, P.E.

INTERSECTION CHARACTERISTICS

Choose the number of travel lanes on the MAJOR road and MINOR road, respectivel (Major, Minor): 1 Lane, 1 Lane

Does the 85th percentile speed of major street traffic exceed 40 mph (70 km / h) in either an urban or rural area? NO

Does the intersection lie within the built up area of an isolated community, having a population of less than 10,000? NO

INPUT HOURLY AND PED VOLUMES

Hours	Major Road			Minor Road	
	Northbound	Southbound	Peds	Westbound	Eastbound
6 - 7AM	81	65	5	33	16
7 - 8AM	117	265	5	69	71
8 - 9AM	75	147	3	48	50
9 - 10AM	62	95	7	54	98
10 - 11AM	83	99	7	78	89
11 - 12PM	79	73	14	80	132
12 - 1PM	87	116	7	95	136
1 - 2PM	88	122	19	121	142
2 - 3PM	125	117	17	110	134
3 - 4PM	133	212	11	100	125
4 - 5PM	150	246	19	86	140
5 - 6PM	136	275	14	79	164

WARRANT 1 - EIGHT HOUR VEHICULAR VOLUME

The need for a traffic signal shall be considered if an engineering study finds that Condition A or Condition B exist for each of any 8 hours of an average day.

Condition A:	A minimum of	500	vehicles per hour required on the major road and a minimum of
	150	vehicles per hour required on the higher volume minor road approach.	
	A total of	**0**	hours meet Condition A.
Condition B:	A minimum of	750	vehicles per hour required on the major road and a minimum of
	75	vehicles per hour required on the higher volume minor road approach.	
	A total of	**0**	hours meet Condition B.

WARRANT 1 IS NOT SATISFIED BY CONDITION A OR CONDITION B.

Combination of Condition A & B

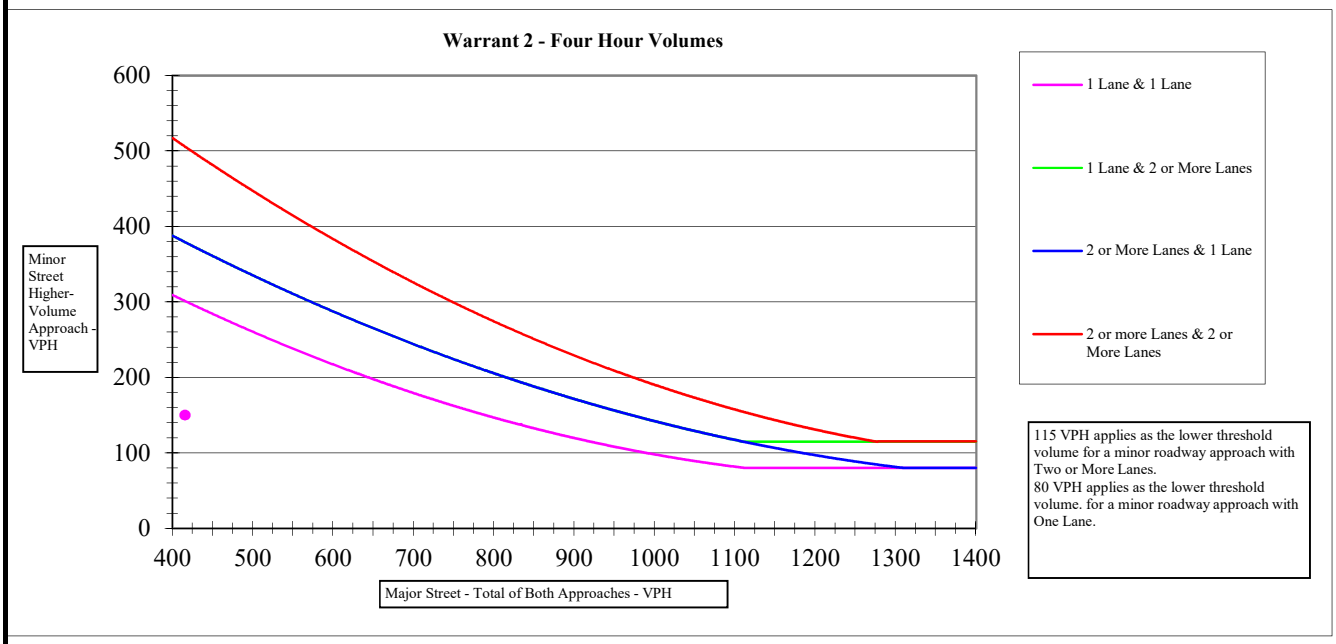
Condition A:	A minimum of	400	vehicles per hour required on the major road and a minimum of
	120	vehicles per hour required on the higher volume minor road approach.	
	A total of	**1**	
Condition B:	A minimum of	600	vehicles per hour required on the major road and a minimum of
	60	vehicles per hour required on the higher volume minor road approach.	
	A total of	**0**	hours meet Condition A.

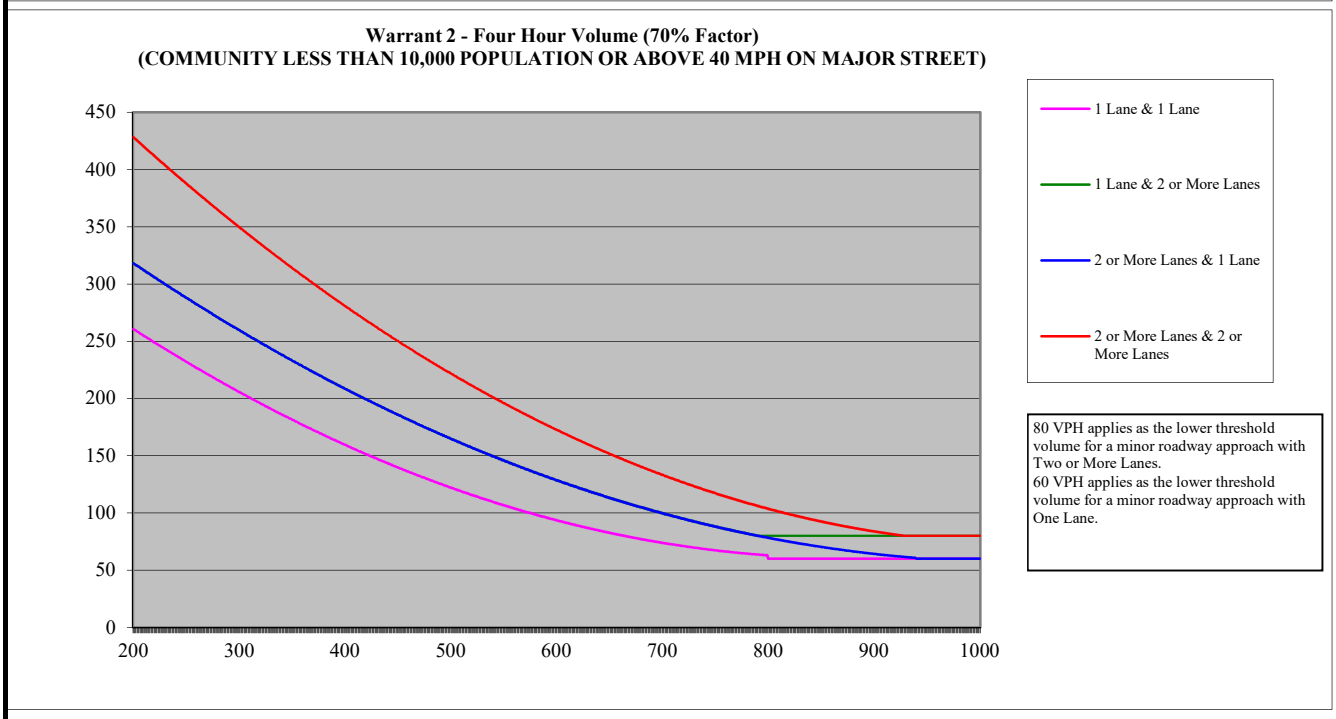
WARRANT 1 IS NOT SATISFIED BY THE COMBINATION OF CONDITION A & CONDITION B.

WARRANT 2 - FOUR HOUR VEHICULAR VOLUME

View Comment for Definition.

The need for a traffic control signal shall be considered if an engineering study finds that for each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor street approach (one direction only) all fall above the applicable curve for the existing condition of approach lanes.





IS WARRANT 2 SATISFIED? NO

A total of 0 hours meet the criteria for Four Hour Vehicular Volume.

The Four Hour 70% Factor criteria is not applicable in this case.

WARRANT 3 - PEAK HOUR

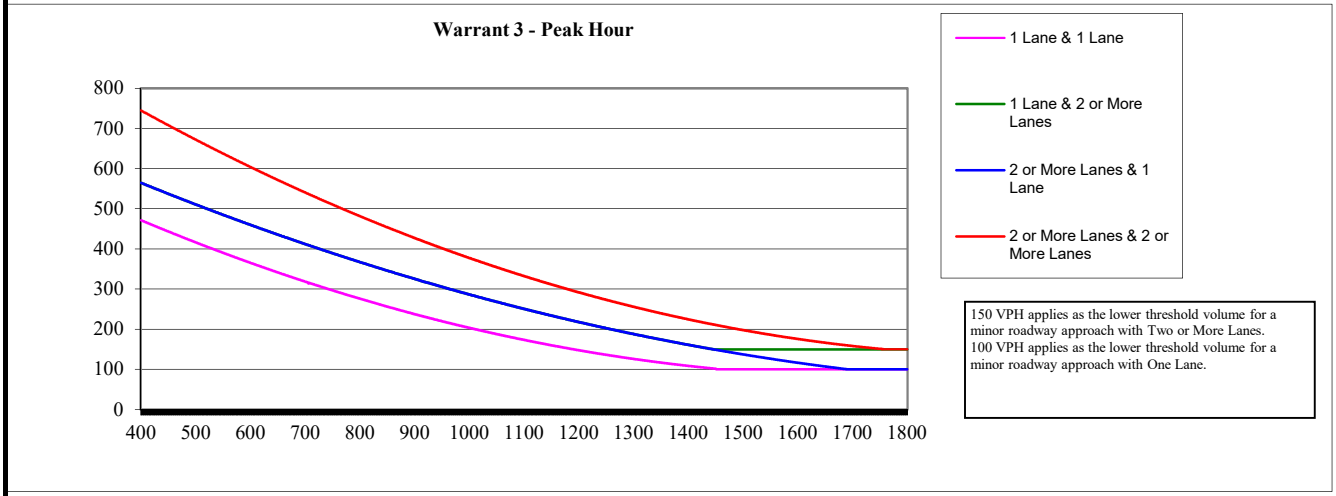
View Comment for Definition. | Warrant 3 is not applicable according to the definition.

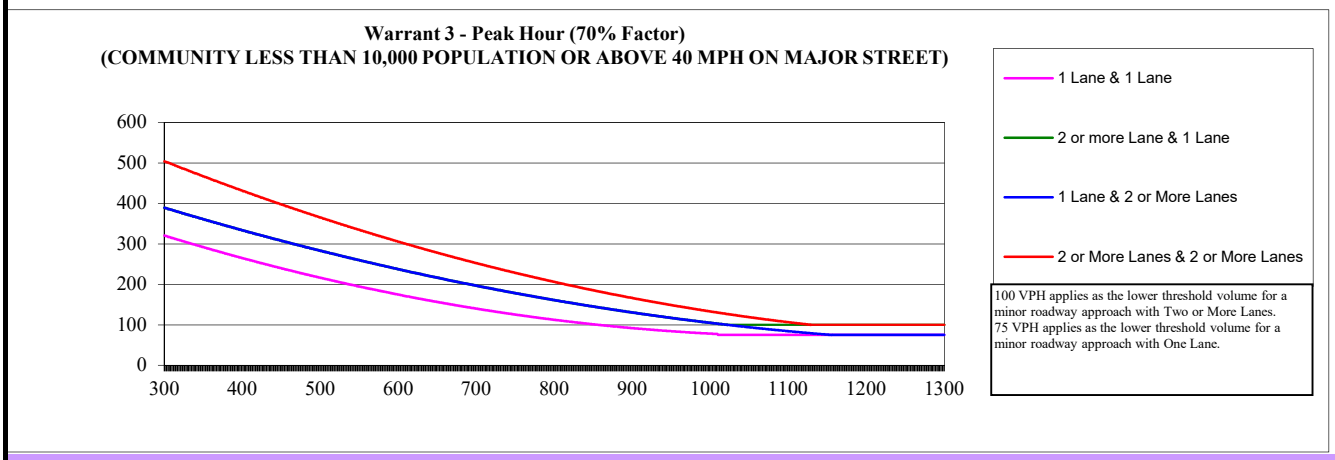
The need for a traffic control signal shall be considered if an engineering study finds that the criteria in either of the following two categories are met:

Category A: If all three of the following conditions exist for the same 1 hour (any four consecutive 15 minute periods) of an average day:

Does the total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equals or exceeds: 4 vehicle hours for a one-lane approach; or 5 vehicle-hours for a two-lane approach?	NO
Does the volume on the same minor-street approach (one direction only) equal or exceed 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes?	YES
Does the total entering volume serviced during the hour equal or exceed 650 vehicles per hour for intersections with three approaches or 800 vehicles per hour for intersections with four or more approaches?	NO

Category B: Does the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) for 1 hour (any four consecutive 15-minute periods) of an average day fall above the applicable curve for the existing combination of approach lanes? NO





WARRANT 3 IS NOT SATISFIED.

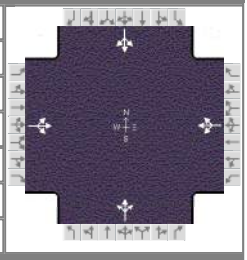
Volume on the minor-street approach = 133 veh/hr & total entering volume serviced for the hour = 892 veh. Stop delay experienced on the minor street approach controlled by a STOP sign = 1.2 Veh/Hour & Category B volumes are not met.

APPENDIX E – TRAFFIC OPERATIONAL ANALYSIS

HIGHWAY CAPACITY SOFTWARE (HCS) REPORTS

HCS 2010 Signalized Intersection Results Summary

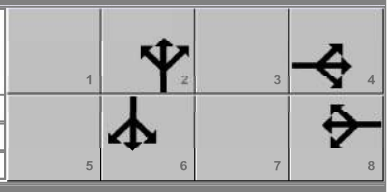
General Information				Intersection Information	
Agency	Century Engineering			Duration, h	0.25
Analyst	Christopher N. Sylvester	Analysis Date	Sep 27, 2016	Area Type	Other
Jurisdiction	State of Delaware	Time Period	AM Peak Hour	PHF	0.87
Urban Street	6th Street (DE Route 9)	Analysis Year	2015	Analysis Period	1> 7:00
Intersection	Delaware Street & 6th S…	File Name	Signal - AM Peak Hour.xus		
Project Description	DE Route 9 / 6th Street (N378) & Delaware Street				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	40	28	3	0	64	5	23	239	3	5	71	41

Signal Information			
Cycle, s	77.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	35.0	30.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		36.0		36.0		41.0		41.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (MAH), s		4.2		4.2		4.2		4.2
Queue Clearance Time (g_s), s		4.9		4.1		10.1		5.6
Green Extension Time (g_e), s		0.5		0.5		1.7		1.7
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		0.00		0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h		82			0			305			134	
Adjusted Saturation Flow Rate (s), veh/h/ln		1487			1440			1838			1702	
Queue Service Time (g_s), s		0.8			0.0			0.0			0.0	
Cycle Queue Clearance Time (g_c), s		2.9			0.0			8.1			3.6	
Green Ratio (g/C)		0.39						0.45			0.45	
Capacity (c), veh/h		652						886			822	
Volume-to-Capacity Ratio (X)		0.125			0.000			0.344			0.164	
Back of Queue (Q), ft/ln (50 th percentile)		24.2			0			88.2			35.2	
Back of Queue (Q), veh/ln (50 th percentile)		1.0			0.0			3.5			1.4	
Queue Storage Ratio (RQ) (50 th percentile)		0.07			0.00			0.20			0.25	
Uniform Delay (d_1), s/veh		15.1						13.7			12.4	
Incremental Delay (d_2), s/veh		0.4			0.0			1.1			0.4	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (d), s/veh		15.5						14.7			12.9	
Level of Service (LOS)		B						B			B	
Approach Delay, s/veh / LOS	15.5	B		15.3	B		14.7	B		12.9	B	
Intersection Delay, s/veh / LOS	14.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.6	A	0.6	A	1.0	A	0.7	A

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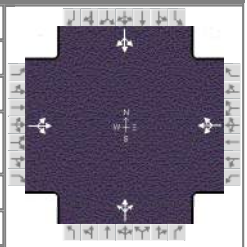
HCS 2010 Signalized Intersection Results Summary

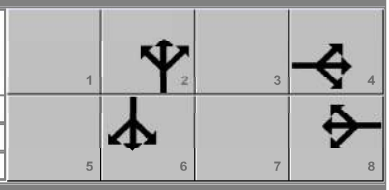
General Information				Intersection Information	
Agency	Century Engineering			Duration, h	0.25
Analyst	Christopher N. Sylvester	Analysis Date	Sep 27, 2016	Area Type	Other
Jurisdiction	State of Delaware	Time Period	Midday Peak Hour	PHF	0.97
Urban Street	6th Street (DE Route 9)	Analysis Year	2015	Analysis Period	1> 7:00
Intersection	Delaware Street & 6th S…	File Name	Signal - Midday Peak Hour.xus		
Project Description	DE Route 9 / 6th Street (N378) & Delaware Street				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	21	111	10	7	102	12	17	57	14	15	87	20

Signal Information			
Cycle, s	77.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	35.0	30.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		36.0		36.0		41.0		41.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (MAH), s		4.2		4.2		4.3		4.3
Queue Clearance Time (g_s), s		6.0		5.4		4.2		5.1
Green Extension Time (g_e), s		0.9		1.0		0.8		0.8
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		0.00		0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h		146			125			91			126	
Adjusted Saturation Flow Rate (s), veh/h/ln		1780			1849			1695			1752	
Queue Service Time (g_s), s		0.0			0.0			0.0			0.0	
Cycle Queue Clearance Time (g_c), s		4.0			3.4			2.2			3.1	
Green Ratio (g/C)		0.39			0.39			0.45			0.45	
Capacity (c), veh/h		747			770			826			849	
Volume-to-Capacity Ratio (X)		0.196			0.162			0.110			0.148	
Back of Queue (Q), ft/ln (50 th percentile)		44.3			37.1			23			32.6	
Back of Queue (Q), veh/ln (50 th percentile)		1.8			1.5			0.9			1.3	
Queue Storage Ratio (RQ) (50 th percentile)		0.13			0.11			0.05			0.23	
Uniform Delay (d_1), s/veh		15.6			15.4			12.1			12.3	
Incremental Delay (d_2), s/veh		0.6			0.5			0.3			0.4	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (d), s/veh		16.2			15.8			12.3			12.7	
Level of Service (LOS)		B			B			B			B	
Approach Delay, s/veh / LOS	16.2	B		15.8	B		12.3	B		12.7	B	
Intersection Delay, s/veh / LOS	14.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.7	A	0.7	A	0.6	A	0.7	A

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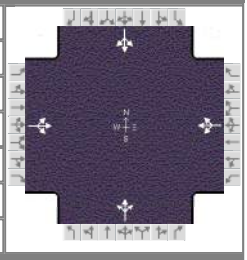
HCS 2010 Signalized Intersection Results Summary

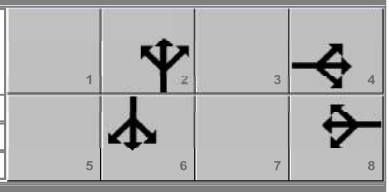
General Information				Intersection Information	
Agency	Century Engineering			Duration, h	0.25
Analyst	Christopher N. Sylvester	Analysis Date	Sep 27, 2016	Area Type	Other
Jurisdiction	State of Delaware	Time Period	PM Peak Hour	PHF	0.93
Urban Street	6th Street (DE Route 9)	Analysis Year	2015	Analysis Period	1> 7:00
Intersection	Delaware Street & 6th S…	File Name	Signal - PM Peak Hour.xus		
Project Description	DE Route 9 / 6th Street (N378) & Delaware Street				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	34	119	8	3	74	5	29	99	15	19	279	22

Signal Information			
Cycle, s	77.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	35.0	30.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		36.0		36.0		41.0		41.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		4.2		4.2		4.3		4.3
Queue Clearance Time (g_s), s		6.8		4.3		5.9		11.5
Green Extension Time (g_e), s		0.9		0.9		2.0		1.9
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		0.00		0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		173			88			154			344	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1749			1871			1628			1834	
Queue Service Time (g_s), s		0.0			0.0			0.0			0.0	
Cycle Queue Clearance Time (g_c), s		4.8			2.3			3.9			9.5	
Green Ratio (*g/C*)		0.39			0.39			0.45			0.45	
Capacity (*c*), veh/h		738			777			796			883	
Volume-to-Capacity Ratio (*X*)		0.235			0.113			0.193			0.390	
Back of Queue (*Q*), ft/ln (50 th percentile)		53.4			25.6			40.8			102.8	
Back of Queue (*Q*), veh/ln (50 th percentile)		2.1			1.0			1.6			4.1	
Queue Storage Ratio (*RQ*) (50 th percentile)		0.15			0.07			0.09			0.71	
Uniform Delay (d_1), s/veh		15.8			15.1			12.5			14.1	
Incremental Delay (d_2), s/veh		0.7			0.3			0.5			1.3	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		16.6			15.3			13.0			15.4	
Level of Service (LOS)		B			B			B			B	
Approach Delay, s/veh / LOS	16.6	B		15.3	B		13.0	B		15.4	B	
Intersection Delay, s/veh / LOS	15.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.1	B	2.1	B
Bicycle LOS Score / LOS	0.8	A	0.6	A	0.7	A	1.1	A

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ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*Christopher N. Sylvester*
Agency/Co.	*Century Engineering, Inc.*
Date Performed	*9/26/2016*
Analysis Time Period	*AM Peak Hour*

Site Information

Intersection	*Delaware Street & 6th Street*
Jurisdiction	*State of Delaware*
Analysis Year	*2015*

Project ID *DE Route 9 / 6th Street (N378 & Delaware Street*

East/West Street: *Delaware Street* North/South Street: *6th Street (DE Route 9 / N378)*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	40	28	3	0	64	5
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	23	239	3	5	71	41
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	0.87		0.87		0.87		0.87	
Flow Rate (veh/h)	80		78		303		133	
% Heavy Vehicles	0		0		1		4	
No. Lanes	1		1		1		1	
Geometry Group	1		1		1		1	
Duration, T	0.25							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	0.6		0.0		0.1		0.0	
Prop. Right-Turns	0.0		0.1		0.0		0.4	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
hLT-adj	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
hRT-adj	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
hadj, computed	0.1		-0.0		0.0		-0.1	

Departure Headway and Service Time

hd, initial value (s)	3.20		3.20		3.20		3.20	
x, initial	0.07		0.07		0.27		0.12	
hd, final value (s)	5.13		5.01		4.51		4.54	
x, final value	0.114		0.108		0.379		0.168	
Move-up time, m (s)	2.0		2.0		2.0		2.0	
Service Time, t_s (s)	3.1		3.0		2.5		2.5	

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	727		709		797		782	
Delay (s/veh)	8.8		8.6		10.2		8.5	
LOS	A		A		B		A	
Approach: Delay (s/veh)	8.8		8.6		10.2		8.5	
LOS	A		A		B		A	
Intersection Delay (s/veh)	9.4							
Intersection LOS	A							

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ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*Christopher N. Sylvester*
Agency/Co.	*Century Engineering, Inc.*
Date Performed	*9/26/2016*
Analysis Time Period	*Midday Peak Hour*

Site Information

Intersection	*Delaware Street & 6th Street*
Jurisdiction	*State of Delaware*
Analysis Year	*2015*

Project ID *DE Route 9 / 6th Street (N378 & Delaware Street*

East/West Street: *Delaware Street*

North/South Street: *6th Street (DE Route 9 / N378)*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	21	111	10	7	102	12
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	17	57	14	15	87	20
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	0.97		0.97		0.97		0.97	
Flow Rate (veh/h)	145		124		89		124	
% Heavy Vehicles	0		0		2		2	
No. Lanes	1		1		1		1	
Geometry Group	1		1		1		1	
Duration, T	0.25							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	0.1		0.1		0.2		0.1	
Prop. Right-Turns	0.1		0.1		0.2		0.2	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
hLT-adj	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
hRT-adj	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
hadj, computed	-0.0		-0.0		-0.0		-0.0	

Departure Headway and Service Time

hd, initial value (s)	3.20		3.20		3.20		3.20	
x, initial	0.13		0.11		0.08		0.11	
hd, final value (s)	4.56		4.55		4.68		4.62	
x, final value	0.184		0.157		0.116		0.159	
Move-up time, m (s)	2.0		2.0		2.0		2.0	
Service Time, t_s (s)	2.6		2.5		2.7		2.6	

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	806		775		742		775	
Delay (s/veh)	8.6		8.4		8.3		8.5	
LOS	A		A		A		A	
Approach: Delay (s/veh)	8.6		8.4		8.3		8.5	
LOS	A		A		A		A	
Intersection Delay (s/veh)	8.5							
Intersection LOS	A							

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ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*Christopher N. Sylvester*
Agency/Co.	*Century Engineering, Inc.*
Date Performed	*9/26/2016*
Analysis Time Period	*PM Peak Hour*

Site Information

Intersection	*Delaware Street & 6th Street*
Jurisdiction	*State of Delaware*
Analysis Year	*2015*

Project ID *DE Route 9 / 6th Street (N378 & Delaware Street*

East/West Street: *Delaware Street* North/South Street: *6th Street (DE Route 9 / N378)*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	34	119	8	3	74	5
%Thrus Left Lane						

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume (veh/h)	29	99	15	19	279	22
%Thrus Left Lane						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	0.93		0.93		0.93		0.93	
Flow Rate (veh/h)	172		87		153		342	
% Heavy Vehicles	1		0		2		1	
No. Lanes	1		1		1		1	
Geometry Group	1		1		1		1	
Duration, T	0.25							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	0.2		0.0		0.2		0.1	
Prop. Right-Turns	0.0		0.1		0.1		0.1	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
hLT-adj	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
hRT-adj	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
hadj, computed	0.0		-0.0		0.0		-0.0	

Departure Headway and Service Time

hd, initial value (s)	3.20		3.20		3.20		3.20	
x, initial	0.15		0.08		0.14		0.30	
hd, final value (s)	5.34		5.43		5.11		4.84	
x, final value	0.255		0.131		0.217		0.460	
Move-up time, m (s)	2.0		2.0		2.0		2.0	
Service Time, t_s (s)	3.3		3.4		3.1		2.8	

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity (veh/h)	688		669		695		743	
Delay (s/veh)	10.2		9.2		9.5		11.9	
LOS	B		A		A		B	
Approach: Delay (s/veh)	10.2		9.2		9.5		11.9	
LOS	B		A		A		B	
Intersection Delay (s/veh)	10.7							
Intersection LOS	B							

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HCS 2010 Two-Way Stop Control Summary Report

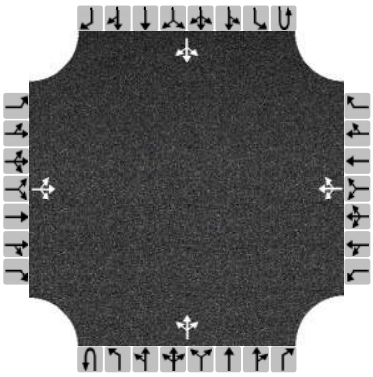
General Information

Analyst	Christopher N. Sylvester
Agency/Co.	Century Engineering, Inc.
Date Performed	9/26/2016
Analysis Year	2015
Time Analyzed	AM Peak Hour
Intersection Orientation	North-South
Project Description	DE Route 9 / 6th Street (N378 & Delaware Street

Site Information

Intersection	Delaware Street & 6th Str
Jurisdiction	State of Delaware
East/West Street	Delaware Street
North/South Street	6th Street (DE Route 9)
Peak Hour Factor	0.87
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		40	28	3		0	64	5		23	239	3		5	71	41
Percent Heavy Vehicles		0	0	0		0	0	0		0				0		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)			81				80			26				6		
Capacity			457				491			1469				1288		
v/c Ratio			0.18				0.16			0.02				0.00		
95% Queue Length			0.6				0.6			0.1				0.0		
Control Delay (s/veh)			14.6				13.8			7.5				7.8		
Level of Service (LOS)			B				B			A				A		
Approach Delay (s/veh)	14.6				13.8				0.8				0.4			
Approach LOS	B				B											

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HCS 2010 Two-Way Stop Control Summary Report

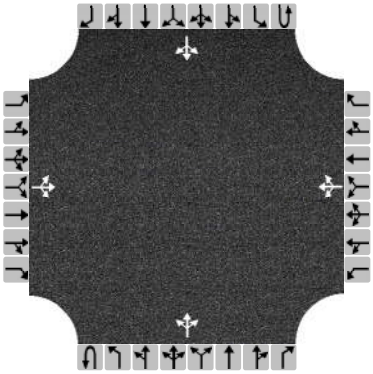
General Information

Analyst	Christopher N. Sylvester
Agency/Co.	Century Engineering, Inc.
Date Performed	9/26/2016
Analysis Year	2015
Time Analyzed	Midday Peak Hour
Intersection Orientation	North-South
Project Description	DE Route 9 / 6th Street (N378 & Delaware Street

Site Information

Intersection	Delaware Street & 6th Str
Jurisdiction	State of Delaware
East/West Street	Delaware Street
North/South Street	6th Street (DE Route 9)
Peak Hour Factor	0.97
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		21	111	10		7	102	12		17	57	14		15	87	20
Percent Heavy Vehicles		0	0	0		0	0	0		0				0		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)			146				124			18				15		
Capacity			645				659			1489				1534		
v/c Ratio			0.23				0.19			0.01				0.01		
95% Queue Length			0.9				0.7			0.0				0.0		
Control Delay (s/veh)			12.2				11.7			7.4				7.4		
Level of Service (LOS)			B				B			A				A		
Approach Delay (s/veh)	12.2				11.7				1.5				0.9			
Approach LOS	B				B											

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HCS 2010 Two-Way Stop Control Summary Report

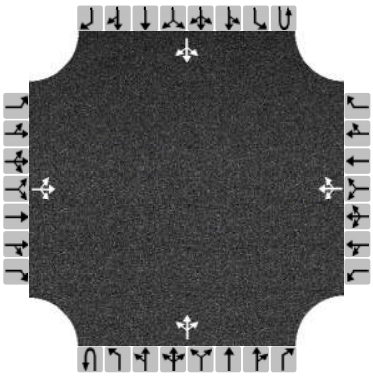
General Information

Analyst	Christopher N. Sylvester
Agency/Co.	Century Engineering, Inc.
Date Performed	9/26/2016
Analysis Year	2015
Time Analyzed	PM Peak Hour
Intersection Orientation	North-South
Project Description	DE Route 9 / 6th Street (N378 & Delaware Street

Site Information

Intersection	Delaware Street & 6th Str
Jurisdiction	State of Delaware
East/West Street	Delaware Street
North/South Street	6th Street (DE Route 9)
Peak Hour Factor	0.93
Analysis Time Period (hrs)	1.00

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		34	119	8		3	74	5		29	99	15		19	279	22
Percent Heavy Vehicles		0	1	0		0	0	0		0				0		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)			174				88			31				20		
Capacity			420				437			1247				1472		
v/c Ratio			0.41				0.20			0.02				0.01		
95% Queue Length			2.1				0.8			0.1				0.0		
Control Delay (s/veh)			19.6				15.3			8.0				7.5		
Level of Service (LOS)			C				C			A				A		
Approach Delay (s/veh)	19.6				15.3				1.8				0.6			
Approach LOS	C				C											

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APPENDIX F – NCHRP GUIDELINES FOR PEDESTRAIN CROSSING TREATMENT

NCHRP REPORT 562 WORKSHEET

NCHRP REPORT 562 GUIDELINES FOR PEDESTRIAN CROSSING TREATMENT
WORKSHEET FOR 35 MPH OR LESS ROADWAY

Fill in the green shaded cells with the required values where applicable.

PROJECT: SR9/6th St (N378) & Delaware St - Signal Removal		**LOCATION:** 6th St & Delaware St	
Analyst:	Christopher N. Sylvester, P.E.	**Major Street:**	SR9/6th St (N378)
Analysis Date:	November 14, 2016	**Minor Street or Location:**	Delaware Street
Data Collection Date:	October 20, 2015	**Peak Hour:**	4:30 - 5:30 PM

Step 1	**Minimum Pedestrian Volume to be considred for TCD type Treatment**		
Peak Hour Ped Volume (Ped/hr) V_p		1a	18
Next Step	**STOP: MIN VOLUME NOT MET, Consider MRI, CE, TC, etc. as Feasible**		
Step 2	**Check Pedestrian Volume Warrant for Signal**		
Major Road Peak Hour Volume (Veh/hr),total for both approaches, V_{maj-s}		2a	463
Minimum Signal Warrant Volume for Peak Hour, SC		2b	582
15th Percentile Pedestrian Crossing Speed (ft/s)		2c	3.5
Pedestrian Speed Adjusted SC		2d	582
PEDESTRIAN SIGNAL WARRANT MET	**NO, Go to Step 3**		
Step 3	**Estimate Pedestrian Delay**		
Pedestrian Crossing Distance, Curb to Curb, L		3a	35
Pedestrian Walking Speed (ft/s) S_p		3b	3.5
Pedestrian Startup Time and End Clearance Time (s), t_s		3c	3.0
Critical Gap Required for Crossing Pedestrian (s) t_c		3d	13.00
Peak Hour Major Road Volume (veh/hr), V_{maj-d}		3e	463
Major Road Flow Rate (veh/s), v		3f	0.1286111
Average Pedestrian Delay (Seconds/Person)		3g	20.609126
Total Pedestrian Delay (hours), D_p		3h	0.1030456
Step 4	**Select Treatment based on Total Pedestrian Delay and Expected Motorist Compliance**		
Expected Motorist Compliance at Pedestrian Crossings in Area		4a	**High** **Choose One**
RED 1: Devices Displaying Circular Red Indication Recommended ($D_P \geq 21.3$ Hrs)		4b	**NO**
RED 2: Devices Displaying Circular Red Indication Recommended (5.3 hr $\leq D_P < 21.3$		4c	**NO**
ACTIVE or ENHANCED 1 Devices Recommended (5.3 hr $\leq D_P < 21.3$ hr & Comp=High		4d	**NO**
ACTIVE or ENHANCED 2 Devices Recommended (1.3 hr $\leq D_P < 5.3$ hr)		4e	**NO**
ONLY CROSSWALK Recommended ($D_P < 1.3$ h hr)		4f	**YES**

Comments:

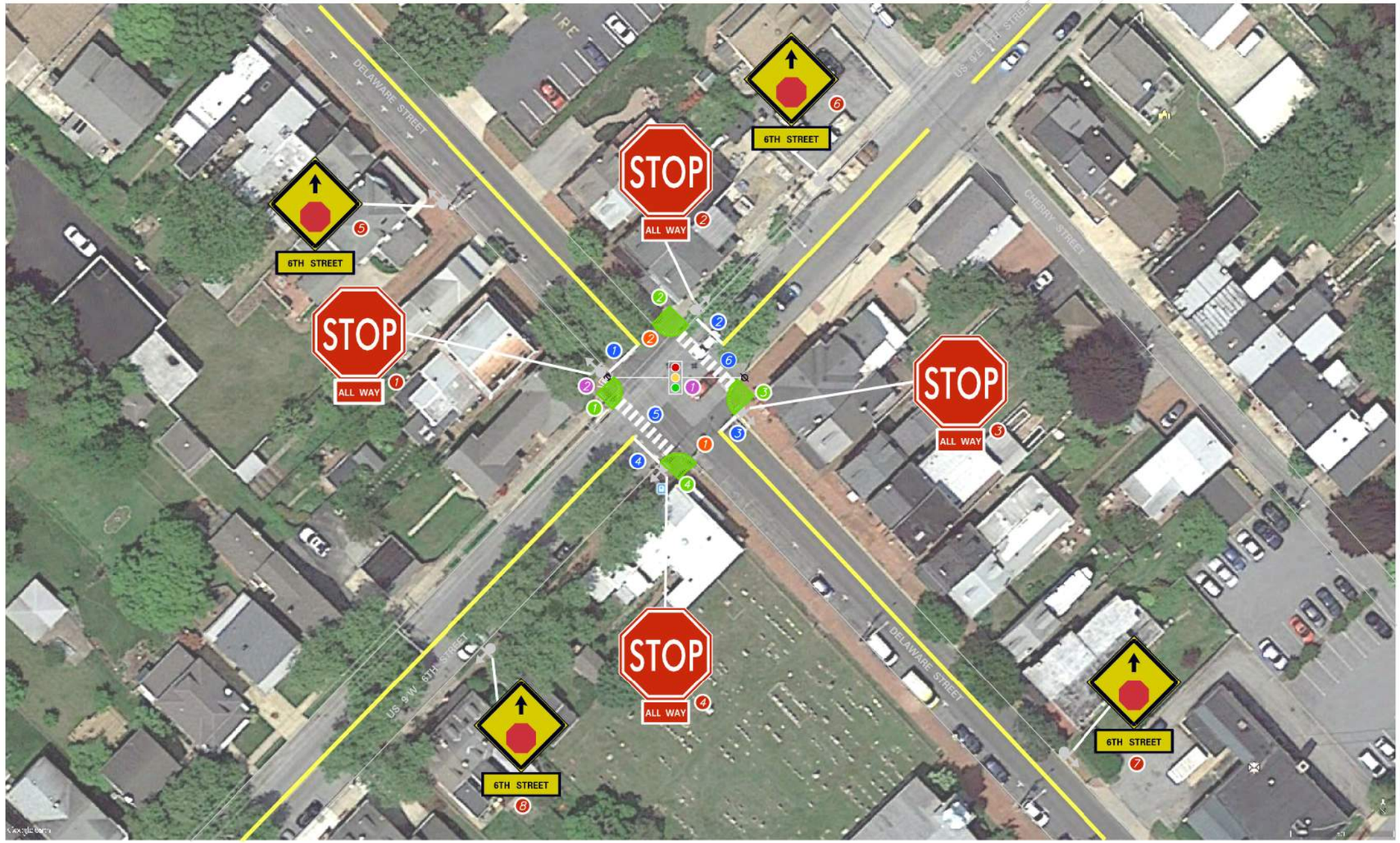
The Peak Hour Pedestrian Volume (Ped/hr) did not met the minimum volume requirement for a roadway with a speed limit of 35MPH or Less.

MRI = Median Refuge Islands
CE = Curb Extensions
TC = Traffic Calming

CENTURY ENGINEERING

APPENDIX G – TRAFFIC STUDY PLAN

TRAFFIC STUDY RECOMMENDATION PLAN



INTERSECTION CONSTRUCTION RECOMMENDATIONS

1. REMOVE EXISTING SPAN WIRE AND ALL EXISTING SIGNAL HEADS
2. REMOVE EXISTING SIGNAL CABINET

INTERSECTION SIGNING RECOMMENDATIONS

1 2 3 4 INSTALL 36"X36" STOP (R1-1) SIGN WITH SUPPLEMENTAL ALL WAY (R1-3P) PLAQUE

5 6 7 8 INSTALL 30"X30" STOP AHEAD (W3-1) SIGN WITH SUPPLEMENTAL ADVANCED STREET NAME (W16-8P) PLAQUE

INTERSECTION STRIPING RECOMMENDATIONS

1 2 3 4 INSTALL 16" STOP LINE MARKING

5 6 INSTALL CROSSWALK MARKINGS (2' WIDE X 2' GAP) REPLACEMENT FOR FADED TRANSVERSE LINES

POTENTIAL CONSTRUCTION IMPROVEMENTS

1 2 3 4 RECONSTRUCT CURB RAMPS TO MEET ADA COMPLIANCE

POTENTIAL STRIPING IMPROVEMENTS

1 2 INSTALL CROSSWALK MARKINGS ACROSS DELAWARE STREET ONCE CURBRAMPS ARE ADA COMPLIAN

12/14/2016
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DELAWARE DEPARTMENT OF TRANSPORTATION	ADDENDUMS / REVISIONS	SCALE 0 30 60 90 FEET	TRAFFIC CONTROL SIGNAL REMOVAL STUDY	CONTRACT --	PERMIT NO. N459T	SIGNAL REMOVAL PLAN DELAWARE AVE & 6TH ST	SHEET NO. --
				COUNTY NEW CASTLE	DESIGNED BY: ES/MP- (CEI)		TOTAL SHTS. --
					CHECKED BY: CS (CEI)		