



MEMORANDUM

Date: October 12, 2016

Project: North Claymont Area Master Plan

Subject: Transportation Technical Report



Whitman, Requardt & Associates, LLP provided transportation analysis throughout the planning process for the North Claymont Area Master Plan to develop the recommended street network and facilities for people walking and bicycling. In the same timeframe Delaware Transit Corporation (DTC) has been developing alternative concept plans for the relocated Claymont train station (now branded the Claymont Regional Transportation Center, or CRTC), which lies within the study area. The train station is a key component for Transit Oriented Development (TOD) envisioned in the North Claymont Area Master Plan. The opportunity for TOD was a benefit of relocating the CRTC cited in DTC's successful application for federal TIGER grant funding.

The lead project planner for the North Claymont Area Master Plan, Rhodeside & Harwell, Inc. (RHI), developed the land use plans with a grid of smaller streets to create a denser development that encourages walking, rather than recommending wider roadways in a suburban context.

This memo documents the process for future scenario traffic forecasts and resulting street and intersection requirements for the North Claymont Area Master Plan.

The traffic analysis divides the Master Plan study area into four subareas:

- Area 1: north of SR 92 (Naamans Road), i.e. the current Tri-State Mall
- Area 2: between SR 92 and US 13 (Philadelphia Pike), or the northern portion of the former Claymont Steel site
- Area 3: between US 13 and the Northeast Corridor rail line
- Area 4: between the Northeast Corridor rail line and the Delaware River

The types and amounts of different land uses in each area were provided by RHI for each of three initial development scenarios (Scenario 2, Scenario 3, Scenario 4). These development scenarios all have the same basic street configuration:

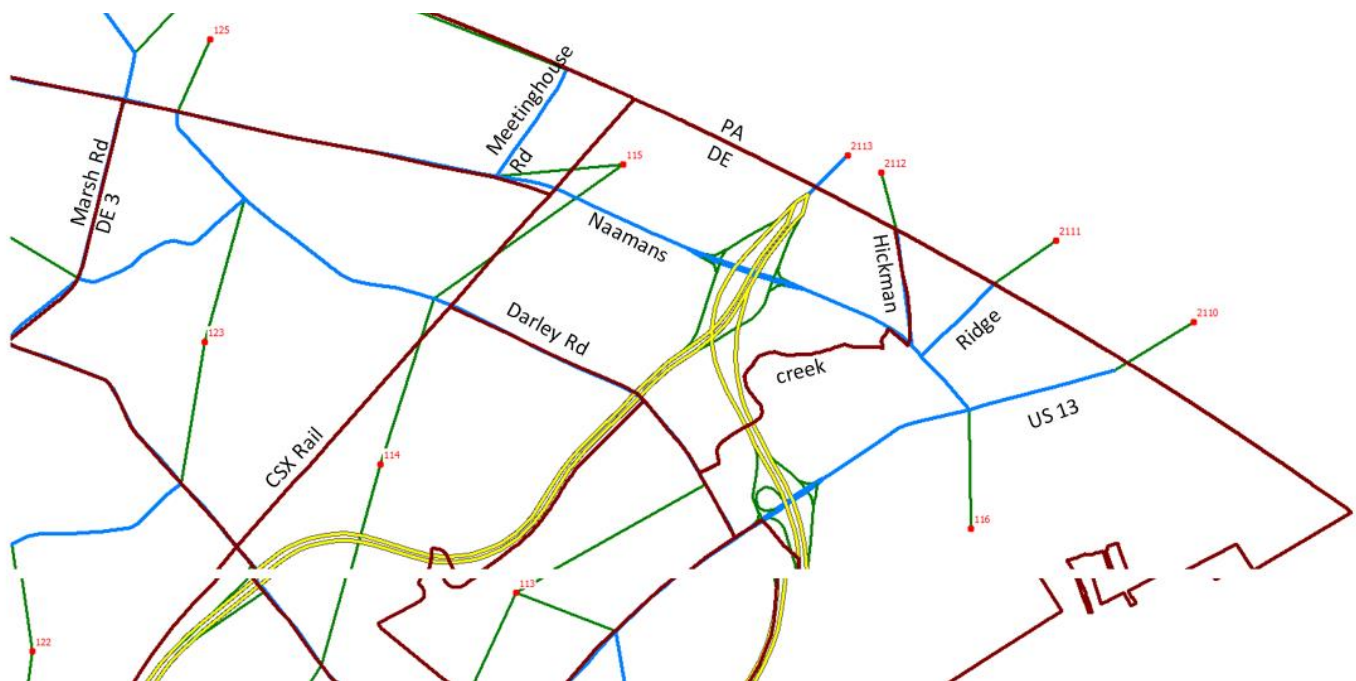
- A new spine road connecting SR 92 with US 13. The spine road continues into Area 1 north of SR 92 and into Area 3 east of US 13. The spine road would be signalized at its intersections with SR 92 and with US 13.
- Conversion of the Alcott Avenue intersection with US 13 to right-in, right-out operation. This is needed to address a safety concern at the existing signal location, and for acceptable spacing of traffic signals along US 13. A new street connecting the Knollwood community to the spine road would provide left-turn entry and exit access to Knollwood via the spine road signal at US 13.
- Additional right in-right out access points for Areas 1, 2, and 3.
- A potential new signal on US 13 for access from the industrial portion of Area 3, to separate industrial traffic from the TOD portion of Area 3 and to provide safe crosswalk opportunities at reasonable intervals.

Traffic Forecasting Process

DelDOT's Peninsula Travel Demand Model was used to develop future traffic forecasts for a Year 2040 No Build scenario (which includes relocation of the Claymont train station) and for the three development scenarios. Model results provided average daily traffic (ADT) and three-hour peak period directional traffic on the roadway network. The model's No-Build alternative forecast showed very low background growth, less than 0.5% annually.

The North Claymont study area falls into Peninsula Model traffic analysis zones (TAZs) 115 and 116. New centroids and centroid connectors were created for the four development areas. A new TAZ was created for Area 4 because its access will be totally separate from other development in TAZ 116.

The map that follows shows the existing TAZ boundaries and centroids. External centroids were used for I-95, Hickman Road, Ridge Road, and US 13 in Pennsylvania.



The ADTs for the four development area centroid connectors are equivalent to daily trip generation of the development areas. Development area ADTs from the model are shown below. ITE Trip Generation Manual daily trips are indicated in *italics* for comparison. The results are similar with the exception of Area 1 in Scenario 2, which includes 300,000 square feet of institutional-medical uses, and Area 4 in Scenario 3, which includes a 243-acre marine terminal.

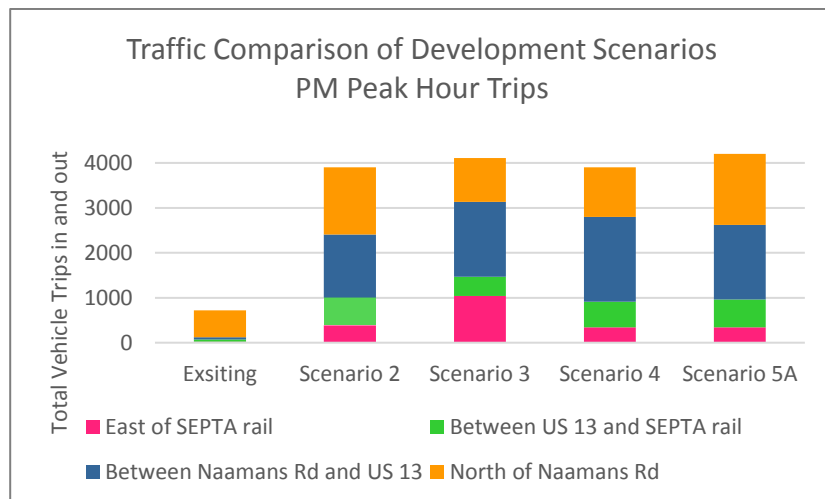
Development Daily Trip Generation

Development Area	Scenario 2	Scenario 3	Scenario 4
Area 1 - North of Naamans Road	23900	11400	13000
	15166	14417	12956
Area 2 - between Naamans & US 13	15500	18700	21400
	13611	21161	25431
Area 3 - between US 13 and railroad	6600	4600	6200
	4920	2371	5329
Area 4 - between railroad and waterfront	4500	11200	3800
	5785	2889	2427
Model Daily Trips Total	50500	45900	44400
<i>ITE Trip Generation Total</i>	39482	40838	46143

In addition to ADTs, the model provided directional peak period traffic for a three-hour AM period and a three-hour PM period. To convert the three-hour period to peak hour traffic, existing intersection traffic counts were examined for the relation of the peak hour to the three-hour total. Many of the counts were conducted for a two-hour peak period, but some counts provided a three-hour period. By examining all the counts it was determined that applying a factor of 38% to the model's three-hour forecasts provides a reasonable estimate of directional peak hour traffic. The directional traffic on the development area centroid connectors represents the peak hour traffic entering and exiting the development areas.

A preferred land use alternative, called Scenario 5A, was reached through a public process after the modelling had been completed. Scenario 5A includes 580 residential units and 2.3 million square feet of commercial, institutional, and industrial space. Scenario 5A is a hybrid in that each area of Scenario 5A is similar to that same area in one of the other scenarios. A manual adjustment was made to the model output to reflect this change.

The PM peak hour is the highest hour of weekday traffic. A comparison of the PM peak hour traffic generated by the scenarios is illustrated in the following chart. All of the scenarios generate approximately 4,000 motor vehicle trips in the PM peak hour.



For informational purposes, peak hour entering and exiting volumes for each development area from the model were compared to trips calculated from the Institute of Transportation Engineers *Trip Generation Manual* (9th Edition). For the ITE trip calculation, pass-by reduction was applied to retail and a 10% reduction was applied to account for internal trips and transit use. The comparison of ITE trip generation and trips provided using the adjusted model is shown below for Scenario 5A. These model results were used for the traffic analysis.

Scenario 5A: Peak Hour Trips by Area

Development Area	Peak	ITE Trip Generation		Model Trips	
		Enter	Exit	Enter	Exit
1	AM	479	335	685	363
	PM	666	688	704	873
2	AM	1068	279	866	477
	PM	671	1156	707	954
3	AM	530	86	376	163
	PM	133	522	247	372
4	AM	93	172	156	122
	PM	183	150	163	179

Assignment of development traffic to the road network

Direction of approach for development traffic was determined by comparing the three-hour peak period directional volume of road links in the model's No-Build condition with the three-hour peak period volume of the development scenario. The difference is traffic generated by scenario development. The model did not show any increase on local roads leading into Pennsylvania: US 13, Ridge Road, or Hickman Road. However WRA assigned a small number to Ridge Road for the traffic analysis.

Approach	Trip Assignment
Naamans Road west	20%
I-95 to-from the north	25%
I-95 to-from the south	15%
I-495 to-from the south	30%
US 13 south of I-495	8%
US 13 north of Naamans Road	0%
Ridge Road	2%
Hickman Road	0%

A spreadsheet model using this assignment was created to distribute development traffic to the road network and calculate turn movements at study area intersections. The analysis assumed that the spine road would primarily serve the development areas and would not divert through traffic off Philadelphia Pike and Naamans Road.

The spine road could provide an attractive route for cut-through traffic between the south on Philadelphia Pike and the west on Naamans Road if it were designed with capacity for through traffic. This is not desirable from a traffic operations viewpoint for several reasons:

- The cut-through would involve northbound Philadelphia Pike left turns to the spine road and spine road left turns to Naamans Road. By staying on the main roads, this movement would travel straight on northbound Philadelphia Pike at the spine road and straight on westbound Naamans Road at the spine road. Through movements are preferred to left turn movements from a traffic operations perspective.
- Northbound traffic on Philadelphia Pike that does not cut-through the spine road will make their left turn at Naamans Road. This is a T intersection with low opposing traffic on southbound Philadelphia Pike. There is a much greater capacity for left turns at Naamans Road.
- The spine road left turn volume from the development to westbound Naamans Road will be very high even without the addition of cut-through traffic.

By designing the spine road to primarily serve the development areas and limiting capacity with one through lane in each direction with turn lanes or roundabouts at major internal intersections, through traffic will find it just as convenient to remain on the main roadways.

Future Road Network Volumes with Full Development of Scenario 5A

The existing ADTs and the projected future ADTs on road segments in the study area with full development of Scenario 5A are illustrated in Figure 1 at the end of this memo.

The AM and PM peak hour signalized intersection volumes under existing conditions are illustrated in Figure 2. Future AM and PM intersection volumes with full development are shown in Figure 3.

Analysis of Future Traffic Operations

The weekday commuter peak hours were analyzed using Synchro version 9 software. Existing conditions analysis used current signal phasing and timing from DelDOT records. Scenario 5A AM peak hour and PM peak hour volumes were analyzed to determine road and signal improvements that would be needed to achieve overall intersection level of service (LOS) D (overall average delay per vehicle less than 55 seconds) under full development



conditions. In order to promote a walkable environment, motor vehicle lanes were not added unless clearly necessary.

A SimTraffic analysis of Philadelphia Pike was run for the PM peak hour in order to check progression and queuing. The SimTraffic showed excessive queuing on the southbound spine road right turn to go south on Philadelphia Pike. Adding a second right turn lane to the southbound approach solved this issue. The SimTraffic analysis also resulted in the addition of a second left turn lane on the northbound I-495 off ramp to Philadelphia Pike, in order to allow more green time for the northbound Philadelphia Pike left turn to the on-ramp and for the southbound Philadelphia Pike through movement.

The Synchro and SimTraffic reports for Alternative 5A are attached to this memo.

Some conclusions apply to all development scenarios examined, including preferred Scenario 5A.

- A road diet was examined for Philadelphia Pike, but the analysis determined this will not be feasible given the future traffic projections. The only intersection that might be reduced in footprint is the intersection of Philadelphia Pike and Naamans Road. The turn radii could be reduced, the four northbound Philadelphia Pike lanes could be reduced to three, and/or the three eastbound lanes on Naamans Road could be reduced to two.
- A second signal for development access may be desirable on Philadelphia Pike for reasons other than capacity – i.e. to separate the industrial traffic from the TOD in Area 3, and to provide reasonable intervals for crosswalks and left turns for people bicycling. The minimum signal spacing would be 800 feet.
- At the request of the Project Management Committee, study area intersections were examined to see whether any are candidates for roundabouts. Single-lane roundabouts could be provided within development areas either on the spine road or other internal development roads. No roundabouts are proposed on the main roadways. The only intersection that could be a candidate for a roundabout (based on volume alone) is the intersection of Philadelphia Pike and Naamans Road. However given the amount of truck traffic here, especially as the industrial area redevelops, a roundabout is not proposed.
- The I-495 southbound off ramp to Naamans Road will need to be widened to provide two left turn lanes and longer storage for the left turn to Naamans Road east. The left turn queue should not be allowed to block the ramp right turn to Naamans Road west; that ramp will have a volume in excess of 1,200 vehicles in the PM peak.
- At some point the I-495 southbound off ramp right turn to Naamans Road west will need to be signalized because of its very high volume and weaving conflicts with westbound Naamans Road traffic. At that time the ramp should be widened for a second right turn lane.
- The intersection of Naamans Road and the I-95 northbound on and off ramps will operate at an extreme LOS F. With the existing diamond interchange configuration, it would be necessary to widen the bridge from five to eight lanes to accommodate future peak hour traffic.
- The radius of the ramp right turn yield lane from northbound I-95 to eastbound Naamans Road should be tightened significantly for traffic operations approaching the spine road. In general, the very large right turn radii of all the ramps should be tightened to slow traffic and provide safer crossings for people walking.

- At Philadelphia Pike and Naamans Road, consider changing northbound Philadelphia Pike from a single left turn lane and two through lanes to one of the following configurations:
 - A double left turn lane and single through lane, or
 - A left turn only lane, a shared left-through lane, and a through-only lane similar to the existing configuration of eastbound Naamans Road at the I-95 northbound ramps. Under this option a split phase operation would be used for Philadelphia Pike.
- The I-495 northbound off-ramp to Philadelphia Pike will need to be widened to provide adequate separate storage lanes for left turns and right turns from the ramp. The radius of the ramp right turn should be reduced significantly and a double right turn lane provided.
- The I-495 southbound off ramp to Philadelphia Pike cannot be signalized due to signal spacing and queuing issues. Today fewer than 10 vehicles per hour turn left from the ramp to go north on Philadelphia Pike but this could increase in the future when there are destinations to the north. Interchange signing for I-495 Exit 6 Naamans Road should be modified to direct motorists on southbound I-495 to exit there to reach the development areas rather than continuing on I-495. This routing was assumed in the traffic analysis.

Implications for Development of Preferred Alternative 5A

Development that is proposed in areas east of Philadelphia Pike can be accommodated with existing roadways, assuming that intersection improvements are made at the site access points. This includes Area 3 between Philadelphia Pike and the Northeast Corridor rail (including the CRTC) and Area 4 between the Northeast Corridor rail line and the Delaware River.

With improvements to the interstate ramps but no widening of the Naamans Road bridge over I-95/I-495, only about one-third of the master plan development in Areas 1 and 2 could be achieved while maintaining LOS D.

Accommodating all of the master plan development while retaining the current traditional diamond interchange design at Naamans Road and I-95 will require widening the Naamans Road bridge from five to eight lanes to provide three through lanes each direction and double left turn lanes at the on-ramps to I-95. Additional widening would be needed for facilities for walking and bicycling.

Alternatively, the master plan development traffic could be accommodated by converting the interchange to a diverging diamond interchange (DDI), keeping the existing bridge width along with ramp widening. People walking and bicycling would cross the bridge in a protected space in the median. The DDI design for the I-95/Naamans Road interchange was examined for general physical feasibility and appears to be feasible. A SimTraffic analysis was run for the diverging diamond concept. The Synchro network layout was conceptual, but the analysis demonstrated the ability of a DDI to handle the future PM peak hour, which is the critical time period. Because the 600-foot long bridges over the interstates would not need to be widened, the cost of interchange improvements for future development might be on the order of half of the cost of improving the traditional diamond interchange with wider bridges.



Initial DDI concept

Implementation

A monitoring and triggering process is recommended for implementation of road improvements. For example, where a double turn lane is envisioned at spine road intersections, initial construction could provide a single turn lane with signal equipment set back far enough for ultimate conditions.

The responsibility for construction and funding source for construction of each transportation recommendation must be determined. Costly improvements such as conversion of the I-95/Naamans Road interchange to a DDI will require state and federal funding and must therefore be programmed in DelDOT's Capital Transportation Plan.

Any development in the area between the Northeast Corridor rail line and the Delaware River will require a totally new road to gain access to Philadelphia Pike, potentially including a bridge over Naamans Creek. The access road will pass through existing industrial properties and will require agreements with property owners. Such access roads are expected to be the responsibility of the developer.

DTC will construct a new access road to the CRTC in the area between Philadelphia Pike and the Northeast Corridor rail. The spine road of the North Claymont Master Plan has been located to serve as a direct access for the station with high visibility from Philadelphia Pike. For the initial phase of implementation, the access road to the train station could be constructed to intersect Philadelphia Pike further north in order to avoid the costs of converting Alcott Avenue to right-in, right out operation, constructing the spine road west of Philadelphia Pike and constructing alternate access for the Knollwood community. The Master Plan provides a location for the initial phase station access road that can be signalized and that fits in with ultimate envisioned TOD and industrial road network.

IMPROVEMENTS TO OTHER LOCATIONS

Two roads, Ridge Road and Society Drive, were cited by the Advisory Committee as having existing traffic problems. These roads were examined for potential improvements. Recommendations for Ridge Road and for Society Drive are not driven by master plan development.

Ridge Road

Ridge Road in Pennsylvania is PennDOT SR 3006.

The Average Daily Traffic (ADT) on Ridge Road is 6,800 vehicles in Pennsylvania (Lower Chichester Township, Delaware County). North of the Delaware state line Ridge Road carries more traffic than US 13 (ADT of 5,100 vehicles).

Ridge Road is 42 feet wide. The road is striped for four lanes (two lanes in each direction) north of the Lawn Croft Cemetery driveway and is striped for two lanes in the vicinity of the Analine Village neighborhood. Ridge Road again becomes four lanes further south approaching Naamans Road.

Curb parking is provided on the west side of Ridge Road between National Avenue and Parkway Avenue and on both sides from Parkway Avenue to Virginia Avenue. The west side is lined with attached single family residences, most of them without driveways. On-street parking ends south of Virginia Avenue where properties on both sides are commercial with off-street parking lots.

Traveling southbound on Ridge Road, after the cemetery the right lane merges left into one lane using a white edge line. The taper distance is 450 feet from the south side of the cemetery driveway to National Avenue. Curb parking begins at National Avenue. The entire merge is in Pennsylvania. In the northbound direction, there is one travel lane on Ridge Road in vicinity of the residential neighborhood. The northbound direction becomes two lanes north of National Avenue, just by adding the dashed lane line.

The truck entrance to a FedEx distribution center is located 1,200 feet north of the cemetery driveway. Large tractor trailers enter and exit this unsignalized driveway travelling to/from the south on Ridge Road to access Naamans Road and the interstate highways. The FedEx facility main entrance is located on Blue Ball Avenue. The signalized intersection of Ridge Road and Blue Ball Avenue is 1,000 feet north of the FedEx truck entrance. Ridge Road remains four lanes through this area.

The speed limit is 40 mph in this segment according to administrative data in PennDOT's video log for SR 3006. There is no speed limit sign in the southbound direction, though a 40 mph speed limit sign is posted in the northbound direction. The speed limit changes to 35 mph north of Blue Ball Avenue.

The ADT of 6,800 does not require a four-lane roadway. Two lanes are required on southbound Ridge Road only for capacity at the Naamans Road traffic signal.

Problem identification

There are no advance signs warning southbound traffic of the lane drop. The 450-foot taper marking meets requirements for the 40 mph speed limit but the speed limit is not posted and some vehicles may be travelling faster. The dashed lane line ends 150 feet in advance of the taper, which technically meets marking requirements. However, the distinction appears to be lost on drivers and does not serve as advance warning.



Advance visibility of the southbound lane merge is not good due to a vertical curve in Ridge Road which crests near the cemetery. The road then descends toward Naamans Road. A vehicle in the right lane that fails to merge encounters the parking lane. If a car is parked north of National Avenue the merge is more abrupt.

For traffic entering Ridge Road from Naamans Road, the section with two northbound lanes is very short, more like a short northbound acceleration lane for the westbound Naamans Road right turn. There is no yield sign for the right turn. This may be for the benefit of trucks, particularly tractor trailers destined to FedEx. The taper length at the lane drop is less than 200 feet. There is no signing and markings are poor. Again the vertical alignment does not provide a good view of the lane drop ahead. This section is in Delaware.



Looking east and north at the entrance to Ridge Road. The westbound right turn currently has its own lane on Ridge Road which then merges left.



Looking north on Ridge Road. In 2007 (left photo) a lane merge warning sign was present, but no sign is there today (right photo).

Ridge Road Recommendations

DelDOT should work with PennDOT on the recommended improvements because they extend into Pennsylvania.

1. At a minimum, PennDOT should install warning signs for the southbound lane drop on Ridge Road in accordance with the MUTCD Guidelines for Advance Placement of Warning Signs, 670 feet in advance of beginning the taper for a 40 mph speed. However, it is also recommended that the lane drop be moved north of the cemetery driveway, where sight distance and merge distance are ample. The lane drop can be located between the FedEx truck driveway and the cemetery driveway. Pavement arrows can be used in the right lane to give further warning of the merge ahead. The northbound direction in this area can remain two lanes as it is today.

2. Post the speed limit in the southbound direction. PennDOT should confer with DelDOT to post an appropriate speed limit approaching National Avenue where the land use changes character. The Delaware state line is one block south of National Avenue.
3. For the northbound traffic entering Ridge Road from Naamans Road, it is recommended that the westbound Naamans Road right turn be controlled with yield signs. Northbound Ridge Road can be restriped to provide one lane with a shoulder. This would eliminate the merge problem. The shoulder would enable bypass of a northbound vehicle stopped to make a left turn into one of the commercial sites north of the Wawa convenience store.

Society Drive at Northtowne Plaza Shopping Center

The right turn acceleration lane from the I-95 south off ramp to westbound SR 92 becomes the right turn only lane into Society Drive. Before Society Drive and within that right turn lane on Naamans Road is a right turn entry-only driveway signed for Home Depot deliveries that leads to the Northtowne Shopping Center parking lot. That driveway is also used by shopping center patrons.

The shopping center parking lot driveway to Society Drive is often at or over capacity. The changes made for the new Wawa revised northbound Society Drive approaching the shopping center driveway. Previously there were two more or less unmarked lanes that stopped being wide enough for two cars just south of the shopping center entrance. There was an awkward merge right before the decision point to go straight or turn right into the shopping center. Drivers exiting the shopping center had to decide whether a northbound car on Society Drive was turning right (which was most of the time) or going straight (less likely, but the exiting driver had to be sure). The movement exiting the parking lot is an extremely heavy movement during peak times. Prior to the Wawa construction, this caused backups back to Home Depot and occasional gridlock in the parking lots.



Before – looking south on Society Drive at the driveway. In this view the new Wawa was added at the upper left. Bus stop is seen at right.



Before – looking north from Naamans Road. In this view the new Wawa was added at right.

With the modification, two northbound lanes are provided on Society Drive the entire distance to the driveway, and the right lane drops as a channelized right turn lane into the shopping center. The Wawa entrance is immediately after that turn, and it is entry only, no exit. Cars exit the Wawa to the shopping center driveway at another location further away from Society Drive.



After – looking north from Naamans Road. The right turn from Naamans Road yields, the right lane on Society Drive is channelized with an island to turn right into the shopping center.

The double left turn on eastbound Naamans Road channels the outer left lane into the right turn lane for Wawa and the shopping center. Traffic in the inner left lane is channeled into the Society Hill Drive straight through lane and is often merging right to enter the shopping center/Wawa.



There is a crosswalk across Society Drive to the bus stop at the driveway intersection. Wawa is at the lower right.

Society Drive Recommendations:

1. An all-way stop is proposed at the T intersection of Society Drive through movements and the shopping center driveway. The high volume northbound Society Drive right turn has been removed from the intersection. Now, the heaviest movement, the westbound driveway left turn exit, is forced to stop for two much lighter movements (through movements on Society Drive). By stopping all movements, traffic on the driveway exit would be guaranteed to “get its turn” and the queue within the parking lot would likely be shorter. The stop sign would also reinforce stopping for the crosswalk.
2. In the PM peak hour the very high volume free right turn from the southbound I-495 off ramp to Naamans Road makes it difficult for Naamans Road westbound traffic to merge right to enter the Home Depot driveway or Society Drive. At some point in the future, the conflict will increase to the point where the ramp should be signalized. If signalized, the ramp right turn will require two lanes. Signalization and widening of the ramp is consistent with the proposed Diverging Diamond Interchange improvement. Signalization will also provide for safe crossing of the ramp for people walking along Naamans Road.